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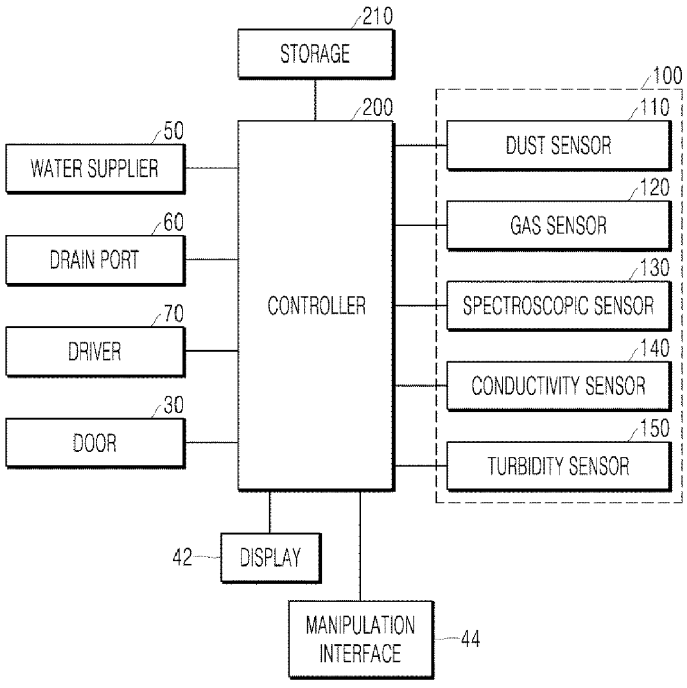
(54) LAUNDRY TREATING APPARATUS AND CONTROL METHOD THEREOF

(57) A laundry treating apparatus (10) according to the present disclosure includes a main body (20), a washing tub, a door (30), a driver (70), a water supply unit (50), a drain unit (60), a sensor unit (100) and a controller (200). The sensor unit (100) includes a dust sensor (110) for measuring a dust concentration inside a washing tub, a gas sensor (120) for measuring gas components inside the washing tub, a turbidity sensor (150) for detecting a water quality of the washing water contained in the washing tub, a conductivity sensor (140), and a spectroscopic sensor (130). The controller (200) controls the driver (70), the water supply unit (50), the drain unit (60) and the sensor unit (100) and calculates an expected washing time based on data measured through the sensor unit (100) and the driver (70).

FIG. 3



EP 3 798 345 A1

Description

[0001] This present application claims benefit of priority to Korean Patent Application No. 10-2019-0119785, entitled "LAUNDRY TREATING APPARATUS AND CONTROL METHOD THEREOF," filed on September 27, 2019, in the Korean Intellectual Property Office.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a laundry treating apparatus and a control method thereof, and more specifically, to a laundry treating apparatus and a control method thereof capable of preventing a washing time from being set too long or too short, by performing washing by calculating the washing time according to a contamination level of laundry.

Background

[0003] In general, clothing requires several forms of care, such as washing, drying, storing, and ironing. To this end, laundry treating apparatuses capable of performing washing, drying, storing, and ironing, respectively, have been implemented. Alternatively, laundry treating apparatuses capable of performing washing, drying, storing, and ironing together have also been implemented.

[0004] In particular, laundry treating apparatuses for performing washing are largely classified into two types according to a washing method.

[0005] Specifically, the types of the laundry treating apparatuses may be classified according to whether a rotating cylindrical washing tub is vertically or horizontally disposed. The laundry treating apparatus in which the washing tub is horizontally disposed is called a drum-type, and the laundry treating apparatus in which the washing tub is vertically disposed is called a vortex-type (pulsator-type) or an agitator-type.

[0006] In the case of the vortex-type, a pulsator provided in a disk shape on the bottom surface of the washing tub rotates to generate a change in water flow, and washing is performed through the change in the water flow.

[0007] In the case of the agitator-type, a rod-shaped agitator is provided inside the washing tub, and a water flow is generated by rotation of the agitator.

[0008] The time for washing, rinsing, and spin-drying in both the vortex-type and the agitator-type is based on the weight of laundry. The time for performing the washing, rinsing, and spin-drying process may be set to be longer or shorter according to the user's manipulation, but the user's manipulation is also based on the amount of the laundry (i.e., laundry amount) detected in the laundry treating apparatus.

[0009] When the operating time is set based on the weight of the laundry, in the case of washing, a difference may occur between the washing time required for the laundry and the actual washing time.

[0010] Specifically, even with a small amount of laundry, the contamination may be so severe that a long washing time is required. Or, even for a large amount of laundry, when the contamination thereof is not severe, sufficient washing may be performed even with a short washing time.

[0011] However, existing methods for calculating the washing time are faced with limitations in that they are unable to distinguish these differences. Therefore, it is often the case that washing is performed for an unnecessarily long time, or washing is performed shorter than necessary such that the laundry is not sufficiently washed.

[0012] As related art, Korean Patent Registration No. 10-1724165 (hereinafter referred to as 'Related Art 1') discloses a 'Turbidity sensor'. According to Related Art 1, a light whose radiation intensity changes is emitted from a light source, and a photosensitive element for receiving the emitted light is further included. Related Art 1 discloses the technical feature of measuring the water quality of the washing water in the washing machine and performing a series of operations of the washing machine according to the measured water quality. However, the process in which the washing is performed and the washing water is contaminated shows various aspects depending on the condition of the laundry. Therefore, the reliability of determining whether the laundry is sufficiently washed by simply inspecting the water quality of the washing water is low.

[0013] Korean Patent Registration No. 10-1462178 (hereinafter referred to as 'Related Art 2') discloses a 'Washing machine and method of controlling the same.' Related Art 2 is directed to increasing washing efficiency by adjusting a soaking cycle time and an amount of detergent according to a contamination level of laundry detected by a contamination detector. Specifically, Related Art 2 measures the turbidity of water in which the laundry is immersed, by a contamination level detector including a light emitting element and a light receiving element. However, in Related Art 2, because the data collected to measure the turbidity of the washing water is limited and there is a structural limitation in that it is difficult to detect the exact turbidity of the washing water, it is often case that the washing is performed longer than necessary or shorter than necessary.

[0014] The above-described related technology is technical information that the inventors hold for the derivation of the present disclosure or that the inventors acquired in the process of deriving the present disclosure. Thus, the above-described related technology cannot be regarded as known technology disclosed to the general public prior to the filing of the present application.

SUMMARY

[0015] It is an object of the present disclosure to address the limitations associated with some related art described above in which it is not possible to accurately measure a contamination level of laundry.

[0016] A further object of the present disclosure is directed to addressing the limitations associated with some related art described above in which washing is performed for a longer time than an appropriate washing time or washing is performed for a shorter time than the appropriate washing time, by determining the washing time based on an amount of the laundry.

[0017] A further object of the present disclosure is directed to addressing the limitations associated with some related art described above in which it is not possible to accurately predict a washing completion time.

[0018] A further object of the present disclosure is directed to addressing the limitations associated with some related art described above in which it is not possible to determine the type of contamination contaminating the laundry, and thus proper washing cannot be performed.

[0019] One or more of the objects are solved by the features of the independent claims. Aspects of the present disclosure are not limited to those mentioned above, and other aspects not mentioned above may be clearly understood from the following description.

[0020] A laundry treating apparatus according to one aspect of the present disclosure includes a main body, a door, a driver, a water supplier (or water supply unit), a drain port (or drain unit), a sensor unit, and a controller. The main body includes a washing tub therein. The door is coupled to the main body and opens or closes an inlet formed in the washing tub. The driver is installed in the main body to operate the washing tub. The water supplier is installed in the main body to supply washing water to the washing tub. The drain port is installed in the main body to discharge the washing water contained in the washing tub. The sensor unit includes at least one of a dust sensor for measuring a dust concentration inside the washing tub, a gas sensor for measuring gas components inside the washing tub, a turbidity sensor for detecting a water quality of the washing water contained in the washing tub, a conductivity sensor, and a spectroscopic sensor. The controller is configured to control at least one of the driver, the water supplier, the drain port, and the sensor unit, and to calculate an expected washing time based on data measured through the sensor unit and/or the driver. The controller may be configured to perform a method according to any one of the embodiments or aspects of the present disclosure.

[0021] A laundry treating apparatus according to another aspect comprises: a main body including a washing tub therein; a door coupled to the main body and configured to open or close an inlet formed in the washing tub; a driver installed in the main body and configured to operate the washing tub; a sensor unit comprising at least one of a dust sensor configured to measure a dust concentration inside the washing tub, a gas sensor configured to measure gas components inside the washing tub, a turbidity sensor configured to measure a water quality of washing water contained in the washing tub, a conductivity sensor, and/or a spectroscopic sensor; and a controller configured to control the driver and the sensor unit, and calculate an expected washing time based on data measured through the sensor unit and/or the driver. The laundry treating apparatus may further include a water supplier (or water supply unit), and a drain port (or drain unit). The water supplier may be configured to supply washing water to the washing tub. The drain port may be configured to discharge the washing water contained in the washing tub. The controller may be configured to control the water supplier and/or the drain port. The controller may be configured to perform a method according to any one of the embodiments or aspects of the present disclosure.

[0022] A laundry treating apparatus according to another aspect comprises: a washing tub for accommodating laundry; a driver configured to operate the washing tub; a water supply unit (or water supplier) configured to supply washing water to the washing tub; a drain unit (or drain port) configured to discharge the washing water contained in the washing tub; a sensor unit configured to sense a contamination level of air and/or of washing water of the washing tub; and a controller configured to control the driver, the water supply unit, the drain unit and the sensor unit, to determine an expected washing time based on data sensed through the sensor unit and to perform washing according to the water supply amount and the expected washing time. The controller may be configured to perform a method according to any one of the embodiments or aspects of the present disclosure. The sensor unit may comprise at least one of a dust sensor configured to measure a dust concentration in air of the washing tub, a gas sensor configured to measure gas components in air of the washing tub, a turbidity sensor configured to measure a turbidity of washing water in the washing tub, a conductivity sensor configured to measure a conductivity of washing water in the washing tub, and a spectroscopic sensor configured to measure a type and/or a concentration of contaminants in the washing water in the washing tub.

[0023] Operating the washing tub within this disclosure may refer to moving the washing water and/or laundry in the washing tub. For instance, operating the washing tub within this disclosure may include rotating the washing tub, a drum provided in the washing tub, a pulsator and/or an agitator.

[0024] The laundry treating apparatus according to aspects of the present disclosure may comprise one or more of the following features:

The controller may include a storage. The storage may store first comparison data to which a predetermined expected washing time is assigned based on the sensed contamination level of the air, in particular first comparison data to which a predetermined expected washing

time is assigned according to the dust concentration and gas components inside the washing tub. The controller may be configured to calculate the expected washing time based on the data stored in the storage.

[0025] The controller may include a storage. The storage may store second comparison data to which a predetermined expected washing time is assigned based on the sensed contamination level of the water, in particular second comparison data to which a predetermined expected washing time is assigned according to the water quality of the washing water contained the washing tub. The controller may be configured to calculate the expected washing time based on the data stored in the storage.

[0026] The controller may be configured to determine the expected washing time based on the first and/or second comparison data stored in the storage.

[0027] A measurement cycle of the sensor unit may be adjustable by a user. that is, the sensor unit may be configured to adjust the operating interval of at least one of the dust sensor, the gas sensor, the spectroscopic sensor, the conductivity sensor, or the turbidity sensor based on a user's selection. That is, a measurement cycle of the dust sensor, the gas sensor, the spectroscopic sensor, the conductivity sensor, or the turbidity sensor may be adjusted based on a user's selection.

[0028] The dust sensor and/or the gas sensor may be installed at an upper portion in the washing tub or in a vent communicating an inside of the washing tub with an outside thereof. At least one of the turbidity sensor, the conductivity sensor, and the spectroscopic sensor may be installed at a lower portion in the washing tub. The dust sensor and/or the gas sensor may be installed in a vent communicating with an outside of the washing tub. At least one of the turbidity sensor, the conductivity sensor and the spectroscopic sensor may be installed in the washing tub, in particular at an internal lower portion of the washing tub.

[0029] Further, a control method according to an aspect of the present disclosure includes steps of: (a) detecting an amount of laundry contained in a washing tub; (b) determining a water supply amount based on the amount of laundry; (c) collecting first contamination data by detecting a dust concentration and gas components inside the washing tub; (d) calculating an expected washing time based on the amount of laundry and the first contamination data; (e) performing washing according to the water supply amount and the expected washing time; (f) collecting second contamination data indicating a contamination level of the washing water, based on at least one of conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing process; and (g) continuing or stopping the washing based on a comparison of the second contamination data with a threshold contamination level, wherein the threshold contamination level is a predetermined set value of contamination level. The laundry treating apparatus may be a laundry treating apparatus according to any one of the embodiments or aspects described in this disclosure.

A control method of a laundry treating apparatus having a washing tub according to another aspect of the present disclosure, comprising steps of: detecting an amount of laundry contained in a washing tub; determining a water supply amount based on the amount of laundry; collecting first contamination data by sensing a contamination level of air of the washing tub and/or second contamination data by sensing a contamination level of washing water in the washing tub; calculating an expected washing time based on the first contamination data and/or the second contamination data; and washing according to the water supply amount and the expected washing time. Second contamination data indicating a contamination level of washing water may be collected based on at least one of conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing. The method may further comprise: continuing or stopping washing based on a comparison of the second contamination data with a threshold contamination level, wherein the threshold contamination level is a predetermined value.

[0030] The laundry treating apparatus may be a laundry treating apparatus according to any one of the embodiments or aspects described in this disclosure.

[0031] The control method according to aspects of the present disclosure may comprise one or more of the following features:

Step (e) may include a water supplying step and/or a driver driving step. In the water supplying step, the washing water may be supplied to the washing tub according to the water supply amount. In the driver driving step, the washing tub may be operated by driving the driver through the controller.

[0032] The method may further include: draining the washing water from the washing tub and performing the step of washing again, in response to the comparison when a contamination level of the second contamination data exceeds the threshold contamination level; and stopping washing and draining the washing water from the washing tub, when a time of the step of washing exceeds the expected washing time. In particular, step (g) may include at least one of: (g-1) draining the washing water contained in the washing tub and performing the water supplying step, in response to the contamination level in the second contamination data exceeding the threshold contamination level; and (g-2) performing drainage and stopping washing, in response to the performed time of the driver driving step exceeding the expected washing time.

[0033] Stopping washing and draining the washing water may be performed in response to the comparison when a contamination level of the second contamination data is less than or equal to the threshold contamination level. In particular, in step (g), the step (g-2) may be performed in response to the contamination level in the second contamination data being less than or equal to the threshold contamination level in the step (g-1).

[0034] The step of washing may comprise a water supplying step in which washing water is supplied to the washing tub according to the determined water supply amount, and a driving step in which the washing tub is operated.

[0035] At least one of the sensed contamination level of air, the expected washing time and a remaining washing time for which the expected washing time has been corrected based on the second contamination data may be displayed to the user through a display. In particular, in the step (c), a detected state of the dust concentration and gas inside the washing tub may be displayed to the user through a display.

[0036] In the step (d), the expected washing time may be displayed to the user through the display.

[0037] In the step (g), a remaining washing time in which the expected washing time has been corrected based on the second contamination data may be displayed to the user through the display.

[0038] The step of determining the water supply amount may be performed after the step of collecting first contamination data and is based on the amount of laundry as well as on the first contamination data.

[0039] The method may further comprise: continuing or stopping washing based on the first contamination data sensed at predetermined times during the step of washing.

[0040] The amount of laundry contained in the washing tub may be detected by a weight sensor and/or by a driver for operating the washing tub.

[0041] The water supply amount may be determined also based on a washing course selected by a user.

[0042] The first contamination data may be indicating a contamination level of air. The contamination level of air of the washing tub may be sensed based on a dust concentration and/or gas components in the air.

[0043] A control method according to another aspect of the present disclosure includes steps of: (a) detecting an amount of laundry contained in a washing tub; (c) collecting first contamination data by detecting a dust concentration and gas components inside the washing tub; (c-1) determining a water supply amount based on the amount of laundry and the first contamination data; (d) calculating an expected washing time based on at least one of the amount of laundry, the water supply amount, or the first contamination data; (e) performing washing according to the water supply amount and the expected washing time; (f) collecting second contamination data indicating a contamination level of washing water, based on at least one of conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing process; and (g) continuing or stopping the washing based on a comparison of the second contamination data with a threshold contamination level, wherein the threshold contamination level is a predetermined set value of contamination level. The laundry treating apparatus may be a laundry treating apparatus according to any one of the embodiments or aspects described in this disclosure.

[0044] A control method of a laundry treating apparatus according to another aspect of the present disclosure comprises steps of: (a) detecting an amount of laundry contained in a washing tub; (b) determining a water supply amount based on the amount of laundry; (c) collecting first contamination data by detecting a dust concentration and gas components inside the washing tub; (d) calculating an expected washing time based on the amount of laundry and the first contamination data; (e) performing washing according to the water supply amount and the expected washing time; and (e-1) continuing or stopping washing based on the first contamination data measured at predetermined times during the washing process. The laundry treating apparatus may be a laundry treating apparatus according to any one of the embodiments or aspects described in this disclosure.

[0045] A control method of a laundry treating apparatus according to another aspect of the present disclosure comprises steps of: (a) detecting an amount of laundry contained in a washing tub; (b) determining a water supply amount based on the amount of laundry; (f) collecting second contamination data indicating a contamination level of washing water, based on conductivity, turbidity, and spectroscopy information of the washing water, wherein the collecting comprises (f-1) performing a preliminary operation by supplying the washing water to the washing tub based on the water supply amount determined in the step (b) and operating a driver; (f-2) calculating an expected washing time based on the second contamination data; (e) performing washing according to the water supply amount and the expected washing time; and (g) continuing or stopping washing based on a comparison with a threshold contamination level, wherein the threshold contamination level is a predetermined set value of contamination level, based on the conductivity, turbidity, and spectroscopy information of the washing water. The laundry treating apparatus may be a laundry treating apparatus according to any one of the embodiments or aspects described in this disclosure.

[0046] According to embodiments of the present disclosure, the accuracy of determining the contamination level of the laundry can be improved by measuring the dust concentration and gas components inside the washing tub.

[0047] According to embodiments of the present disclosure, washing can be performed for an appropriate time by calculating the washing time based on the amount of the laundry and the contamination level of the laundry.

[0048] According to embodiments of the present disclosure, by measuring the amount of the laundry, the dust concentration and gas components inside the washing tub, and the like, and then calculating a washing time and displaying the washing time to the user, the user can predict an exact washing end time.

[0049] According to embodiments of the present disclosure, by measuring the conductivity, turbidity, and spectroscopy information of the washing water in real-

time during washing in order to adjust the expected washing time, washing can be performed for a time optimized for the laundry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0050]

FIG. 1 is a perspective view illustrating a vortex-type laundry treating apparatus.

FIG. 2 is a perspective view illustrating a drum-type laundry treating apparatus.

FIG. 3 is a block diagram illustrating a laundry treating apparatus according to one embodiment of the present disclosure.

FIG. 4 is a diagram illustrating a control panel of the laundry treating apparatus according to one embodiment of the present disclosure.

FIGS. 5 and 6 are flowcharts illustrating control methods of the laundry treating apparatus according to embodiments of the present disclosure.

FIGS. 7 to 9 are diagrams illustrating a display of the laundry treating apparatus according to one embodiment of the present disclosure.

FIG. 10 is a graph illustrating a state in which dirt is desorbed from laundry as washing is performed in the laundry treating apparatus according to one embodiment of the present disclosure.

FIG. 11 is a block diagram illustrating the operation of a controller in the laundry treating apparatus according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0051] Hereinafter, embodiments of the present disclosure for explanation will be described in more detail with reference to the accompanying drawings. Like reference numerals will be given to like parts throughout the detailed description of the embodiments.

[0052] FIG. 1 is a perspective view illustrating a vortex-type laundry treating apparatus 10, and FIG. 2 is a perspective view illustrating a drum-type laundry treating apparatus 10.

[0053] The laundry treating apparatus 10 according to one embodiment of the present disclosure may be a vortex-type laundry treating apparatus 10 in which a washing tub is installed to be vertically disposed and rotates, as illustrated in FIG. 1. Alternatively, the laundry treating apparatus 10 may also be an agitator-type laundry treating apparatus 10 in which a washing tub is installed to be vertically disposed and an agitator provided inside the washing tub rotates.

[0054] Alternatively, the laundry treating apparatus 10 according to one embodiment of the present disclosure may also be a drum-type laundry treating apparatus in which the washing tub is horizontally disposed and an inlet through which the laundry is loaded faces the side, as illustrated in FIG. 2.

[0055] As illustrated in FIGS. 1 and 2, the laundry treating apparatus 10 according to one embodiment of the present disclosure includes a main body 20, a door 30, and a control panel 40. The main body 20 is provided with an accommodation space therein. A washing tub is installed in the accommodation space inside the main body 20. The door 30 is coupled to the main body 20, and is formed on one side or on the top surface of the main body 20.

[0056] The door 30 opens or closes the inlet of the washing tub accommodated inside the main body 20. The inlet of the washing tub is an opening provided such that the laundry can be loaded into and withdrawn from the interior space of the washing tub.

[0057] In addition, the control panel 40 is installed on the outer surface of the main body 20 or the door 30.

[0058] The control panel 40 includes a manipulation interface 44 capable of receiving a predetermined signal from a user. The manipulation interface 44 may be formed of buttons that can be pressed by the user, and may be implemented in various forms such as a touch-type or a dial-type, or the like.

[0059] In addition, the control panel 40 includes a display 42. Information related to the laundry treating apparatus 10 is displayed on the display 42.

[0060] FIG. 3 is a block diagram illustrating a laundry treating apparatus 10 according to one embodiment of the present disclosure.

[0061] As illustrated in FIG. 3, the laundry treating apparatus 10 according to one embodiment of the present disclosure further includes a water supplier 50, a drain port 60, a driver 70, a sensor unitsensor unit 100, and a controller 200.

[0062] The water supplier 50 is connected to an external water supply, and supplies washing water flowing from the water supply to the inside of the washing tub. The water supplier 50 performs or stops water supply under the control of the controller 200.

[0063] The drain port 60 discharges the washing water inside the washing tub to the outside. The drain port 60 is connected to the lower portion of the washing tub, and moves the washing water to the outside of the main body 20. The drain port 60 may further include a drain pump to facilitate drainage. The drain port 60 performs or stops drainage under the control of the controller 200.

[0064] The driver 70 is installed inside the main body 20. The driver 70 may be disposed at the lower portion of the washing tub or on one side of the washing tub, and receives electric power to convert electrical energy into kinetic energy. The converted kinetic energy may be a rotational force which may rotate the washing tub in at least one direction. The driver 70 generates a rotational force and rotates or stops the washing tub under the control of the controller 200.

[0065] The sensor unit 100 includes a dust sensor 110, a gas sensor 120, a spectroscopic sensor 130, a conductivity sensor 140, and a turbidity sensor 150. The gas

sensor 120, the spectroscopic sensor 130, the conductivity sensor 140, and the turbidity sensor 150 may be installed at the washing tub or a location adjacent to the washing tub, respectively. Alternatively, these sensors may be installed in a vent provided to allow the interior space of the washing tub to communicate with the outside.

[0066] In the laundry treating apparatus 10 according to one embodiment of the present disclosure, the sensor unit 100 is installed in the washing tub, wherein the dust sensor 110 and the gas sensor 120 may be installed on an upper portion of the washing tub that the washing water does not reach when washing is performed. The spectroscopic sensor 130, the conductivity sensor 140, and the turbidity sensor 150 may be installed at a position lower than the minimum height at which the washing water is contained in the washing tub when washing is performed. Specifically, the spectroscopic sensor 130, the conductivity sensor 140, and the turbidity sensor 150 may be installed at a lower portion of the interior space of the washing tub.

[0067] The dust sensor 110 detects the dust concentration in the washing tub. Specifically, the dust sensor 110 may measure the dust concentration inside the washing tub by irradiating light into the washing tub and detecting light reflected from the dust. Here, the irradiated light may be infrared LED light, and the infrared LED light reflected from the dust may be detected through an infrared receiver. Here, data detected through the infrared receiver is transmitted to the controller 200. The controller 200 calculates the dust concentration inside the washing tub through the data received from the dust sensor 110.

[0068] The gas sensor 120 detects gas components inside the washing tub. The gas sensor 120 may be provided to detect the concentration of a gas of a predetermined component, and measure the concentration of the gas remaining inside the washing tub and transmit the same to the controller 200. The controller 200 may calculate the concentration of a specific gas component remaining inside the washing tub through the data received from the gas sensor 120.

[0069] The gas sensor 120 may detect whether oil is included in a contaminant in the laundry, or whether there is a specific contaminant impacting the washing speed, or the like, by detecting at least one predetermined gas component.

[0070] The spectroscopic sensor 130 may detect the component and concentration of a composition (e.g., dirt or contaminant) desorbed (separated) from the laundry and remaining in the washing water.

[0071] The spectroscopic sensor 130 may include an output device, a spectrometer, and a detector, wherein the spectrum of a washing water sample collected by the detector is measured through the spectrometer to detect the type or concentration of the composition contained in the washing water.

[0072] A plurality of detectors may be provided according to types of predetermined compositions, and each detector may detect a predetermined composition and the spectrometer may measure the concentration thereof. However, this is merely exemplary, and the type and concentration of contaminant remaining in the washing water may be measured in various ways according to embodiments of the present disclosure.

[0073] The conductivity sensor 140 measures the conductivity of the washing water contained in the washing tub. The conductivity sensor 140 detects the conductivity due to a conductive material (e.g., dirt or contaminant) included in the washing water to detect a contamination level of the washing water, and may be implemented using the 'Conductivity sensor of washer' disclosed in Korean Patent Registration No. 10-0457578.

[0074] The turbidity sensor 150 detects the turbidity of the washing water. Specifically, light emitted from a light emitting element passes through the washing water and is received by a light receiving element, and the turbidity of the washing water is measured by comparing the emitted light amount with the received light amount. Accordingly, the higher the measured turbidity of the washing water, the higher the contamination level of the washing water may be determined to be, and the lower the measured turbidity of the washing water, the lower the contamination level of the washing water may be determined to be.

[0075] The above-described dust sensor 110, gas sensor 120, spectroscopic sensor 130, conductivity sensor 140, and turbidity sensor 150 all detect the contamination level of air or washing water contained in the washing tub.

[0076] The respective pieces of contamination data detected by the sensor unit 100 are transmitted to the controller 200.

[0077] The controller 200 is a kind of central processing unit, and downloads data or programs from a storage 210 included in the controller 200 to operate the laundry treating apparatus. The controller 200 may include any types of devices which are capable of processing data, such as a processor.

[0078] Here, 'processor' may, for example, refer to a data processing device embedded in hardware, which has physically structured circuitry in order to perform a function represented by codes or instructions contained in a program. Examples of the data processing device embedded in hardware include, a microprocessor, a central processing unit (CPU), a processor core, a multiprocessor, an application-specific integrated circuit (ASIC), and a field programmable gate array (FPGA), but the scope of the present disclosure is not limited thereto.

[0079] In one embodiment of the present disclosure, the controller 200 controls the operation of the water supplier 50, the drain port 60, and the driver 70, as described above. In addition, the controller 200 may be involved in opening and closing the door 30.

[0080] The storage 210 is included in the controller 200, and stores programs and data for operating the laundry treating apparatus 10 according to one embodiment

of the present disclosure. Programs and data stored in the storage 210 may be executed or used for calculation through the controller 200.

[0081] The storage 210 may store a reference data table for calculating the dust concentration, gas component and concentration, turbidity of washing water, and contamination level based on data measured from each of the dust sensor 110, gas sensor 120, spectroscopic sensor 130, conductivity sensor 140, and turbidity sensor 150. The reference data table may serve as reference data for calculating an expected washing time through the respective pieces of data measured through the sensor unit 100. The reference data table may also serve as a threshold contamination level, which is a value at which washing water is contaminated and thus further washing may cause re-contamination of the laundry.

[0082] For example, the contamination level and the contamination type may be calculated from the air quality data inside the washing tub measured through the dust sensor 110 and the gas sensor 120, and an expected washing time may be calculated by comparing the data with the reference data table stored in advance in the storage 210.

[0083] The controller 200 may calculate the expected washing time by comparing the data with first comparison data, which is predetermined reference data according to the dust concentration and gas component. The first comparison data may be stored in the storage 210, and the first comparison data may include values predetermined by experiment or by calculation.

[0084] In addition, the calculation of the remaining washing time through the controller 200 may use second comparison data, which is reference data to which a predetermined expected washing time is assigned according to the water quality of the washing water.

[0085] The second comparison data may be stored in advance in the storage 210, and may include values predetermined by experiment or by calculation.

[0086] The air quality data inside the washing tub measured through the dust sensor 110 and the gas sensor 120 is referred to as first contamination data in the present disclosure.

[0087] In addition, the degree of washing progress of the laundry may be calculated from the contamination level data of the washing water measured through the spectroscopic sensor 130, the conductivity sensor 140, and the turbidity sensor 150, and the remaining washing time may be calculated by comparing the data with the reference data table stored in advance in the storage 210.

[0088] The contamination level data of the washing water measured through the spectroscopic sensor 130, the conductivity sensor 140, and the turbidity sensor 150 is referred to as second contamination data in the present disclosure, and may be detected at predetermined time intervals during washing.

[0089] FIG. 4 is a diagram illustrating a control panel 40 of the laundry treating apparatus 10 according to one embodiment of the present disclosure.

[0090] As illustrated in FIG. 4, a display 42 is provided outside the main body 20, and may be disposed on the control panel 40 together with a manipulation interface 44.

[0091] The display 42 displays washing information of the laundry treating apparatus 10 to the user through visual information and/or auditory information that can be recognized by the user.

[0092] The display 42 may display the type of contamination detected by the sensor unit 100, a washing course, and an expected washing time.

[0093] A control method of the laundry treating apparatus 10 according to one embodiment of the present disclosure as described above will hereinafter be described.

[0094] The control method according to one embodiment of the present disclosure may be implemented as a process in which a first expected washing time is calculated after laundry is loaded in a washing tub, and washing is performed according to the calculated expected washing time.

[0095] FIGS. 5 and 6 are flowcharts illustrating control methods of the laundry treating apparatus 10 according to embodiments of the present disclosure.

[0096] As illustrated in FIGS. 5 and 6, the control methods according to embodiments of the present disclosure are as follows.

[0097] In a step (a) (S10), an amount of laundry contained in a washing tub is detected. The amount of laundry may be detected through a weight sensor connected to the washing tub. Alternatively, the amount of laundry may be detected by driving the driver 70 and measuring torque applied to the driver 70.

[0098] In a step (b) (S20), the water supply amount is determined based on the amount of laundry measured in the step (a) (S10). The water supply amount may vary depending on the washing course selected by the user, but the water supply amount may be determined in advance according to the amount of laundry for each washing course selectable by the user.

[0099] In a step (c) (S30), first contamination data is collected by detecting a dust concentration and gas components inside the washing tub.

[0100] In a step (d) (S40), an expected washing time is calculated based on the amount of laundry measured in the step (a) (S 10) and the first contamination data collected in the step (c) (S30).

[0101] In a step (e) (S50), washing is performed by driving the driver 70 according to the water supply amount and the expected washing time.

[0102] In addition, the step (e) (S50) may include a water supplying step (S52) in which the washing water is supplied to the washing tub according to the water supply amount, and a driver driving step (S54) in which the washing tub is operated by driving the driver 70 through the controller 200.

[0103] In addition, the step (e) (S50) may include a step (e-1). In the step (e-1), washing is continued or

stopped based on the first contamination data measured at predetermined times (at a predetermined cycle) during the washing process. That is, the first contamination data is measured at predetermined time intervals through the dust sensor 110 and the gas sensor 120 while washing is in progress, and the controller 200 may determine whether to further continue washing or whether to stop washing by comparing the measured first contamination data with data stored in advance in the storage 210.

[0104] In a step (f) (S60), second contamination data, indicating the contamination level of the washing water based on the conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing process, is collected.

[0105] The step (f) (S60) may include a step (f-1) and a step (f-2). In a step (f-1), a preliminary operation is performed by supplying the washing water corresponding to the water supply amount determined through the step (b) (S20) to the washing tub and operating the driver 70 for a predetermined time. The step (f-1) is a preliminary step in which the laundry is immersed in the washing water and the second contamination data may be collected through the contamination level of the washing water contaminated by the laundry. The step (f-1) may correspond to step (S52) and be included in step (e) (S50). The step (f-2) calculates a corrected expected washing time based on the second contamination data. That is, a remaining washing time may be calculated based on the second contamination data collected through the step (f) (S60), and the expected washing time calculated through the step (d) (S40) may be corrected by reflecting the calculated remaining wash time. Specifically, by adding the calculated remaining washing time to the expected washing time minus the time for which washing has already been performed, the expected washing time from the time when the second contamination data is collected to the end of washing is calculated.

[0106] In a step (g) (S70), washing is continued or stopped based on a comparison of the second contamination data with a threshold contamination level in a reference data table stored in advance in the storage 210. That is, in response to the contamination level in the second contamination data exceeding the threshold contamination level, washing is stopped, and in response to the contamination level in the second contamination data being less than the threshold contamination level, washing is continued.

[0107] The step (g) (S70) may further include a step (g-1) and a step (g-2).

[0108] In the step (g-1), in response to the contamination level in the second contamination data exceeding the threshold contamination level, the washing water contained in the washing tub is drained by performing a drainage step (S80), and the water supplying step (S52) is then performed. In the step (g-2), in response to the performed time of the driver driving step (S54) exceeding the expected washing time, drainage is performed and washing is stopped.

[0109] The step (g-2) may be performed in response to the contamination level in the second contamination data being less than or equal to the threshold contamination level in the step (g-1).

[0110] FIGS. 7 to 9 are diagrams illustrating the display 42 of the laundry treating apparatus 10 according to one embodiment of the present disclosure.

[0111] As illustrated in FIG. 7, in the control method according to one embodiment of the present disclosure, a state of the dust concentration and gas components inside the washing tub detected in the step (c) (S30) may be displayed to the user through the display 42.

[0112] As illustrated in FIG. 8, when the water supplying step (S52) and the driver driving step (S54) are performed again through the step (g-1), the display 42 may display information indicating second washing or third washing, according to the number of times of performance of the water supplying step (S52) and the driver driving step (S54) through the step (g-1).

[0113] As illustrated in FIG. 9, in the step (d) (S40), the display 42 may display the expected washing time to the user. In addition, the display 42 may display the remaining washing time in which the expected washing time has been corrected based on the second contamination data in the step (g) (S70).

[0114] Alternatively, a control method according to another embodiment of the present disclosure may include, as described above, steps of: (a) (S10) detecting the amount of laundry contained in a washing tub; (c) (S30) collecting first contamination data by detecting the dust concentration and gas components inside the washing tub; (c-1) determining the water supply amount based on the amount of laundry and the first contamination data; (d) (S40) calculating an expected washing time based on at least one of the amount of laundry, the water supply amount, or the first contamination data; (e) (S50) performing washing according to the water supply amount and the expected washing time; (f) (S60) collecting second contamination data indicating the contamination level of the washing water, based on conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing process; and (g) (S70) continuing or stopping the washing based on a comparison of the second contamination data with a threshold contamination level, which is a predetermined set value of contamination level.

[0115] FIG. 10 is a graph illustrating a state in which dirt is desorbed from laundry as washing is performed in the laundry treating apparatus 10 according to one embodiment of the present disclosure.

[0116] Referring to FIG. 10, the horizontal axis represents the elapse of the washing time, and the vertical axis represents the amount of contaminant (dirt) in the laundry. When washing is performed, the desorption phenomenon of contaminants occurs at a gradual slope while the washing water penetrates into the fibers of the laundry (0 to ti).

[0117] When the laundry is sufficiently immersed in the washing water, and the laundry receives a physical force by driving of the driver 70 (t_1 to t_2), the phenomenon of the contaminants being desorbed from the laundry becomes active.

[0118] However, when the washing water becomes saturated with the contaminants (t_2~), the phenomenon of the contaminants being desorbed from the laundry stops, and re-contamination of the laundry, in which the contaminants contained in the washing water are again bound to the laundry, occurs.

[0119] Therefore, in order to prevent recontamination of the laundry, the threshold contamination level in the step (g) (S70) may be formed at a point adjacent to t_2.

[0120] FIG. 11 is a block diagram illustrating the operation of the controller 200 in the laundry treating apparatus 10 according to one embodiment of the present disclosure.

[0121] As illustrated in FIG. 11, in the laundry treating apparatus 10 and the control method thereof according to one embodiment of the present disclosure, the controller 200 receives first contamination data and second contamination data to calculate an expected washing time and a remaining washing time. The controller 200 compares the second contamination data with the threshold contamination level and compares the elapsed washing time with the expected washing time and the remaining washing time, and according to the results thereof, controls the water supplier 50, the driver 70, and drainage.

[0122] In the above, the embodiments of the present disclosure have been described with reference to the drawings, but this is illustrative and the present disclosure is not limited to the above-described embodiments and drawings. It is apparent that those skilled in the art can modify the embodiments of the present disclosure within the technical scope of the present disclosure. In addition, although an operation or effect according to the configuration is not explicitly described while describing one embodiment of the present disclosure, it is natural that the effects predictable by the configuration should be recognized.

[List of Reference Symbols in Drawings]

[0123]

10: laundry treating apparatus
20: main body
30: door
40: control panel
42: display
44: manipulation interface
50: water supplier
60: drain port
70: driver
100: sensor
110: dust sensor
120: gas sensor
130: spectroscopic sensor
140: conductivity sensor
150: turbidity sensor
200: controller
210: storage

Claims

1. A laundry treating apparatus (10), comprising:

a washing tub for accommodating laundry;
a driver (70) configured to operate the washing tub;
a water supply unit (50) configured to supply washing water to the wasshing tub;
a drain unit (60) configured to discharge the washing water contained in the washing tub;
a sensor unit (100) configured to sense a contamination level of air and/or of washing water of the washing tub; and
a controller (200) configured to control the driver (70), the water supply unit (50), the drain unit (60) and the sensor unit (100), to determine an expected washing time based on data sensed through the sensor unit (100) and to perform washing according to the water supply amount and the expected washing time.

2. The apparatus of claim 1, further comprising a storage (210) storing first comparison data to which a predetermined expected washing time is assigned based on the sensed contamination level of the air, and/or second comparison data to which a predetermined expected washing time is assigned based on the sensed contamination level of the water, and wherein the controller (200) is configured to determine the expected washing time based on the first and/or second comparison data stored in the storage (210).

3. The apparatus of claim 1 or 2, wherein a measurement cycle of the sensor unit (110) is adjustable by a user.

4. The apparatus according to any one of the preceding claims, wherein the sensor unit (100) comprises at least one of a dust sensor (110) configured to measure a dust concentration in air of the washing tub, a gas sensor (120) configured to measure gas components in air of the washing tub, a turbidity sensor (150) configured to measure a turbidity of washing water in the washing tub, a conductivity sensor (140) configured to measure a conductivity of washing water in the washing tub, and a spectroscopic sensor (130) configured to measure a type and/or a concentration of contaminants in the washing water in the

washing tub

5. The apparatus of claim 4, wherein the dust sensor (110) and/or the gas sensor (120) are installed at an upper portion in the washing tub or in a vent communicating an inside of the washing tub with an outside thereof, and/or wherein at least one of the turbidity sensor (150), the conductivity sensor (140), and the spectroscopic sensor (130) is installed at a lower portion in the washing tub.

6. A control method of a laundry treating apparatus (10) having a washing tub, comprising steps of:

detecting (S10) an amount of laundry contained in a washing tub;
determining (S20) a water supply amount based on the amount of laundry;
collecting (S30, S70) first contamination data by sensing a contamination level of air of the washing tub and/or second contamination data by sensing a contamination level of washing water in the washing tub;
calculating (S40) an expected washing time based on the first contamination data and/or the second contamination data; and
washing (S50) according to the water supply amount and the expected washing time.

7. The control method of claim 6, wherein second contamination data indicating a contamination level of washing water are collected (S70), based on at least one of conductivity, turbidity, and spectroscopy information of the washing water measured at predetermined times during the washing (S50); and further comprising:
continuing or stopping washing based on a comparison (S70) of the second contamination data with a threshold contamination level, wherein the threshold contamination level is a predetermined value.

8. The control method of claim 7, further comprising steps of:

draining (S80) the washing water from the washing tub and performing the step of washing (S50) again, in response to the comparison (S70) when a contamination level of the second contamination data exceeds the threshold contamination level; and
stopping washing and draining (S80) the washing water from the washing tub, when a time of the step of washing (S50) exceeds the expected washing time.

9. The control method of claim 8, wherein stopping washing and draining (S80) the washing water is performed in response to the comparison (S70) when a contamination level of the second contamination data is less than or equal to the threshold contamination level.

10. The control method according to any one of claims 6 to 9, wherein the washing (S50) comprises:

a water supplying step (S52) in which washing water is supplied to the washing tub according to the determined water supply amount; and
a driving step (S54) in which the washing tub is operated.

11. The control method according to any one of claims 6 to 10, wherein at least one of the sensed contamination level of air, the expected washing time and a remaining washing time for which the expected washing time has been corrected based on the second contamination data is displayed to the user through a display (42).

12. The control method according to any one of claims 6 to 11, wherein the step of determining (S20) the water supply amount is performed after the step of collecting (S20, S60) first contamination data and is based on the amount of laundry as well as on the first contamination data.

13. The control method according to any one of claims 6 to 12, further comprising the step of:
continuing or stopping washing based on the first contamination data sensed at predetermined times during the step of washing (S50).

14. The control method according to any one of claims 6 to 13, wherein the amount of laundry contained in the washing tub is detected by a weight sensor and/or by a driver for operating the washing tub, and/or wherein the water supply amount is determined also based on a washing course selected by a user.

15. The control method according to any one of claims 6 to 14, wherein the first contamination data are indicating a contamination level of air and/or wherein the contamination level of air of the washing tub is sensed based on a dust concentration and/or gas components in the air.

FIG. 1

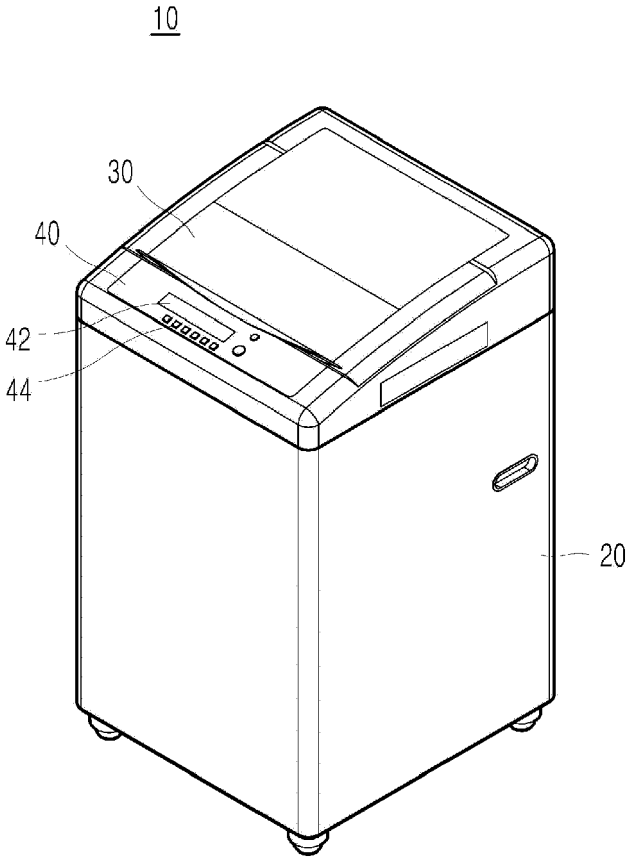


FIG. 2

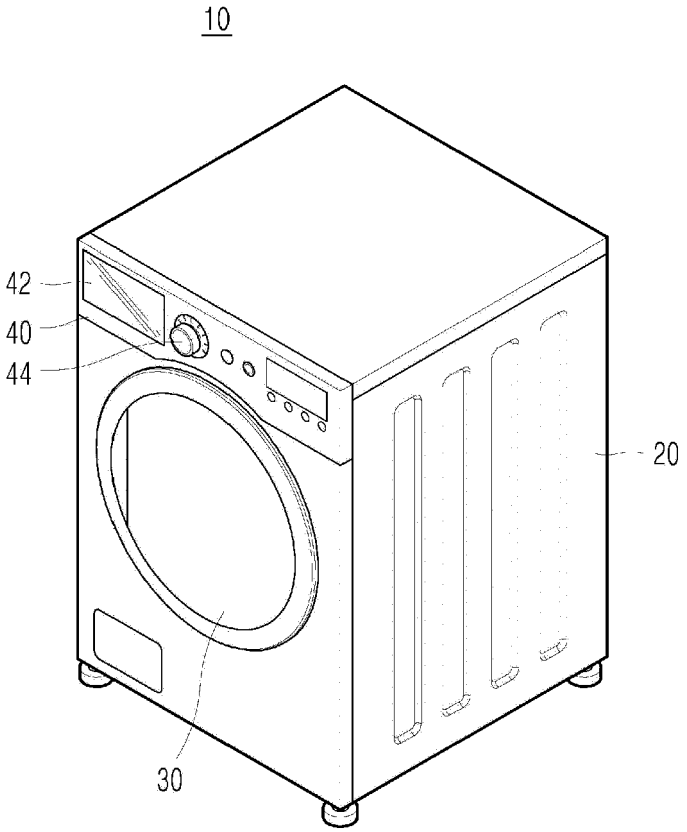


FIG. 3

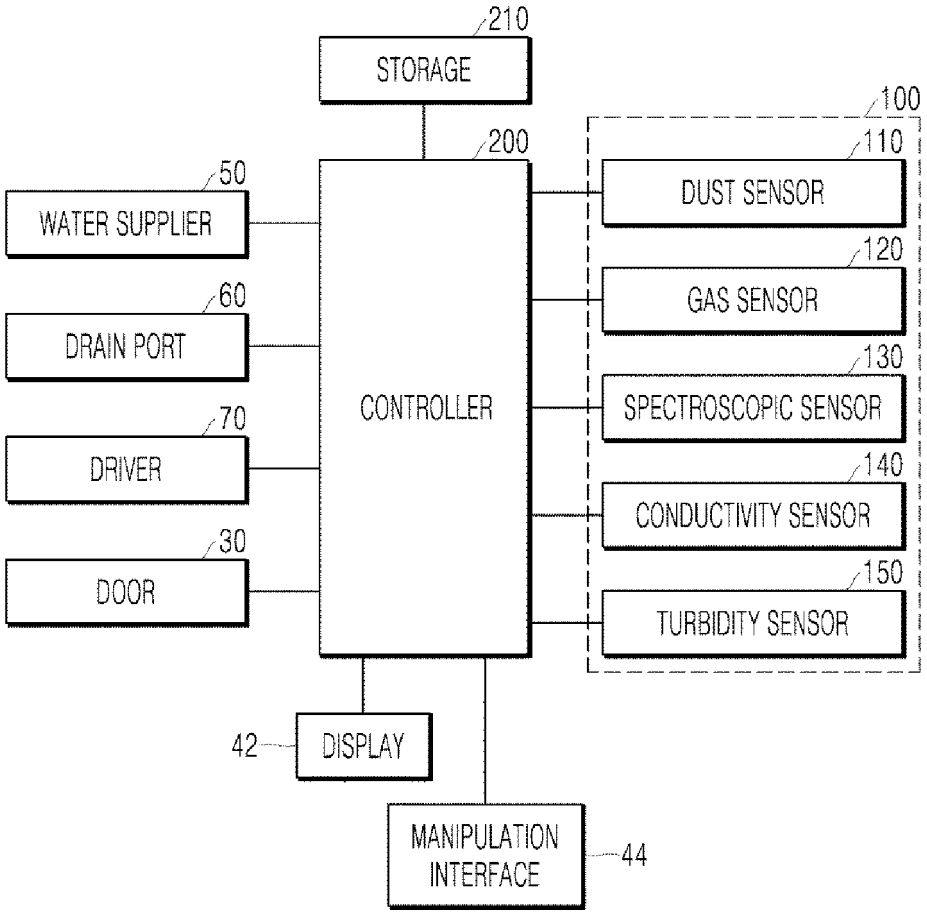

210
STORAGE
100
200
110
50
WATER SUPPLIER
DUST SENSOR
120
60
DRAIN PORT
GAS SENSOR
130
CONTROLLER
SPECTROSCOPIC SENSOR
70
DRIVER
140
CONDUCTIVITY SENSOR
30
DOOR
150
TURBIDITY SENSOR
42
DISPLAY
MANIPULATION INTERFACE
44

FIG. 4

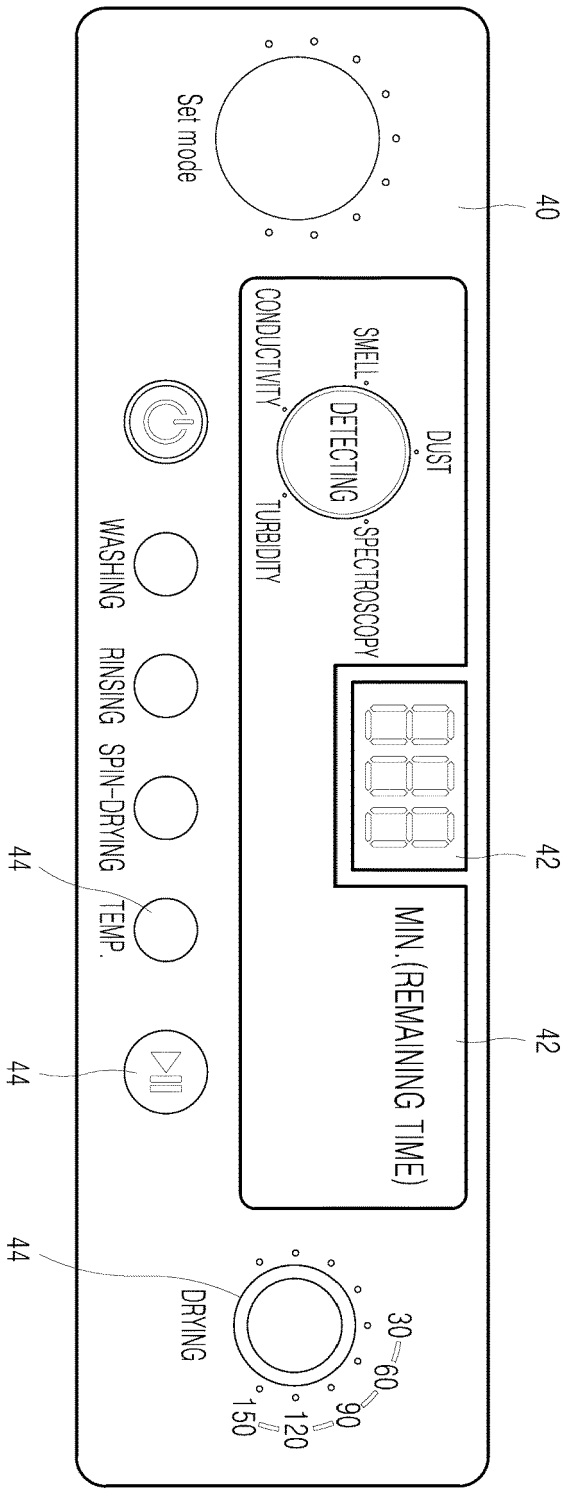

Set mode
40
CONDUCTIVITY
SMELL
DETECTING
DUST
TURBIDITY
SPECTROSCOPY
WASHING
RINSING
SPIN-DRYING
TEMP.
42
MIN.(REMAINING TIME)
42
44
44
44
DRYING
30
60
90
120
150

FIG. 5

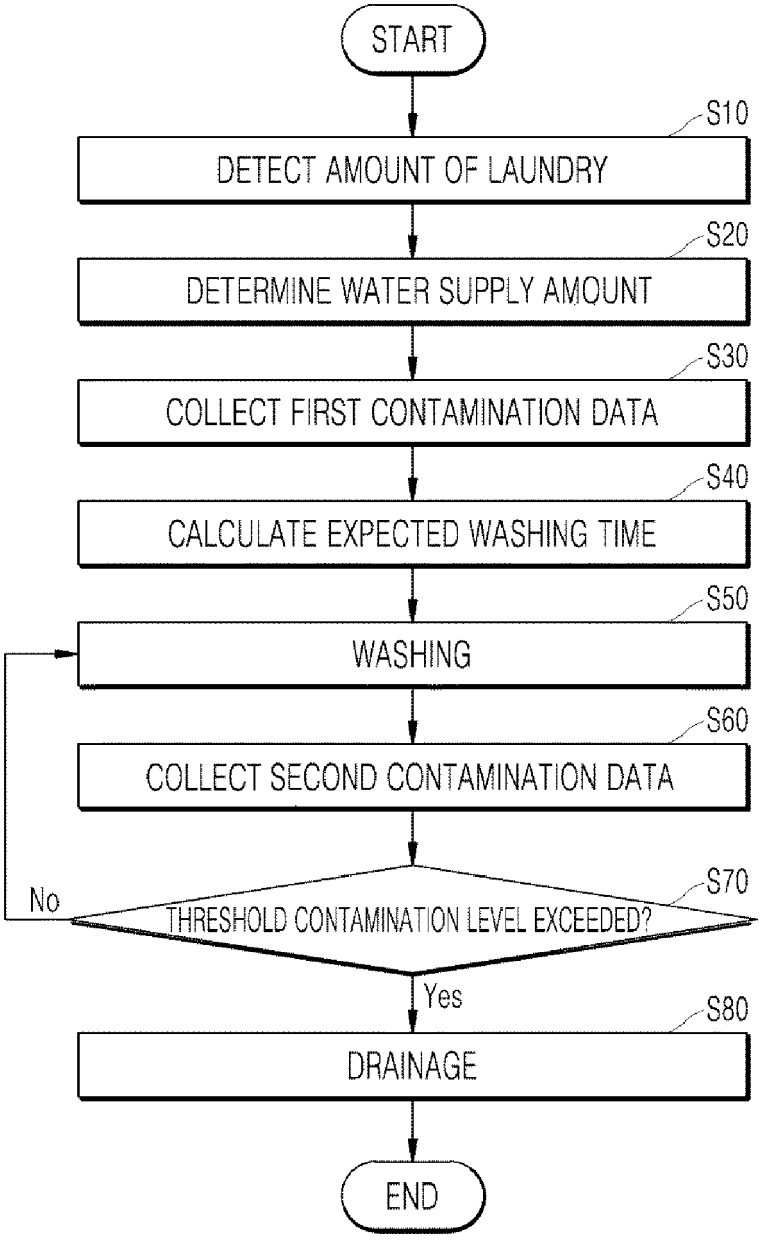

START
S10
DETECT AMOUNT OF LAUNDRY
S20
DETERMINE WATER SUPPLY AMOUNT
S30
COLLECT FIRST CONTAMINATION DATA
S40
CALCULATE EXPECTED WASHING TIME
S50
WASHING
S60
COLLECT SECOND CONTAMINATION DATA
S70
THRESHOLD CONTAMINATION LEVEL EXCEEDED?
No
Yes
S80
DRAINAGE
END

FIG. 6

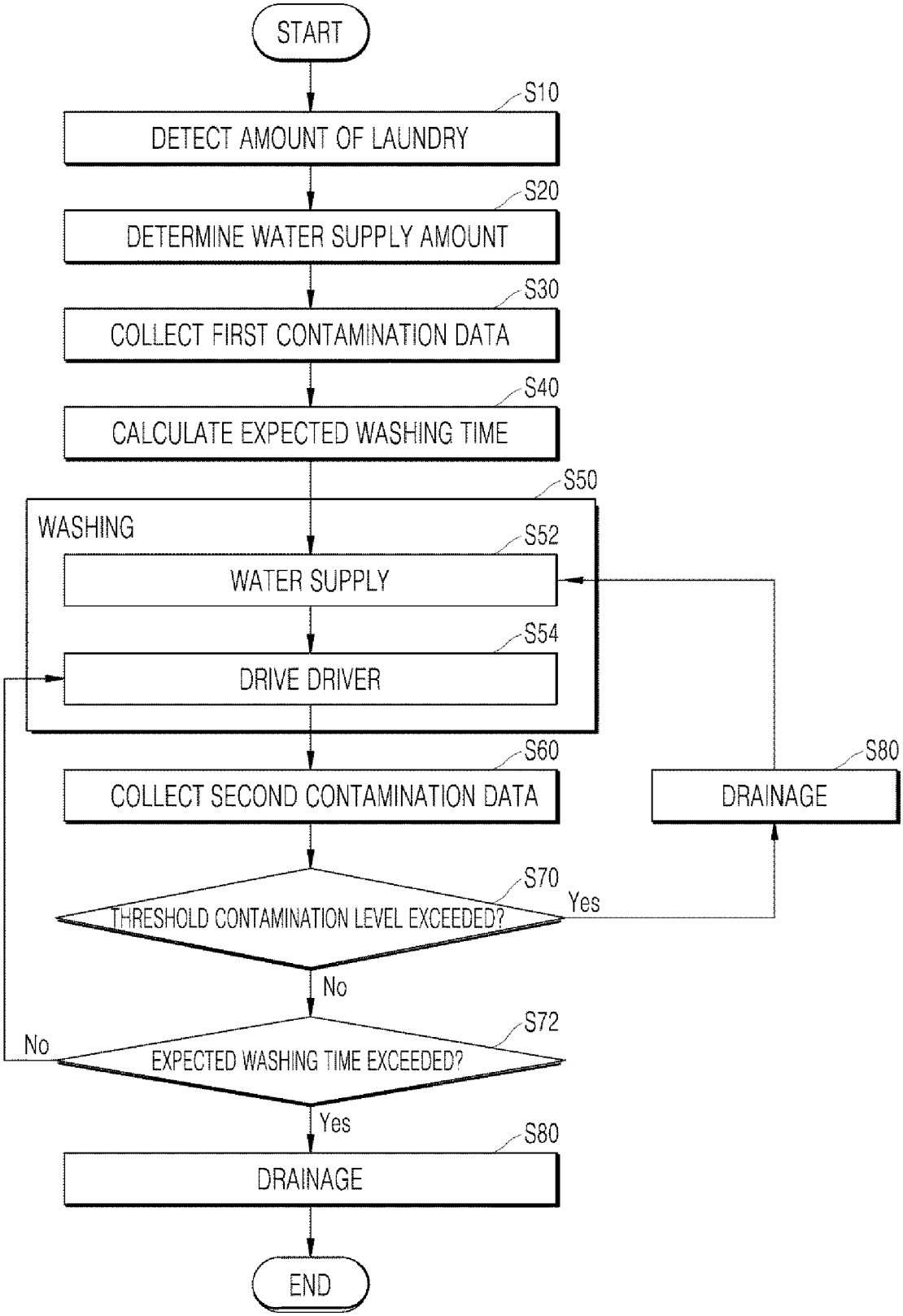

START
S10
DETECT AMOUNT OF LAUNDRY
S20
DETERMINE WATER SUPPLY AMOUNT
S30
COLLECT FIRST CONTAMINATION DATA
S40
CALCULATE EXPECTED WASHING TIME
S50
WASHING
S52
WATER SUPPLY
S54
DRIVE DRIVER
S60
COLLECT SECOND CONTAMINATION DATA
S70
THRESHOLD CONTAMINATION LEVEL EXCEEDED?
Yes
No
S72
EXPECTED WASHING TIME EXCEEDED?
No
Yes
S80
DRAINAGE
S80
DRAINAGE
END

FIG. 7

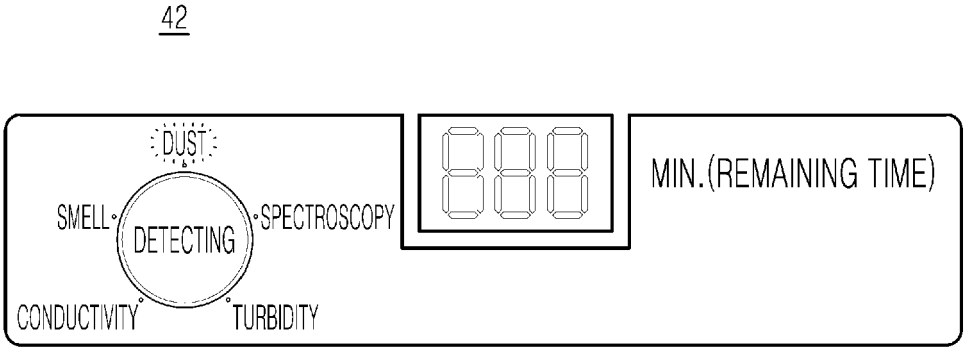


FIG. 8

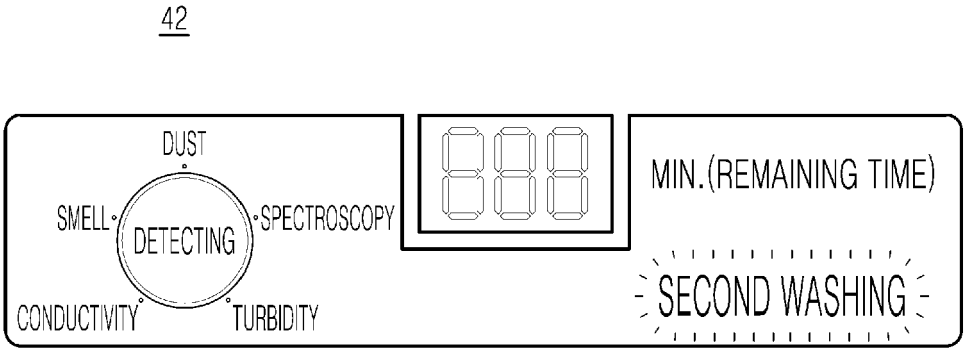


FIG. 9

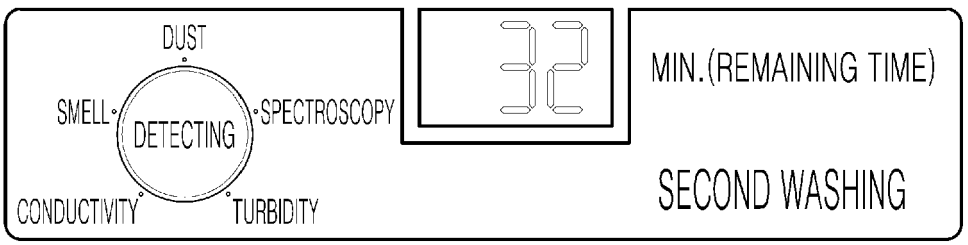


FIG. 10

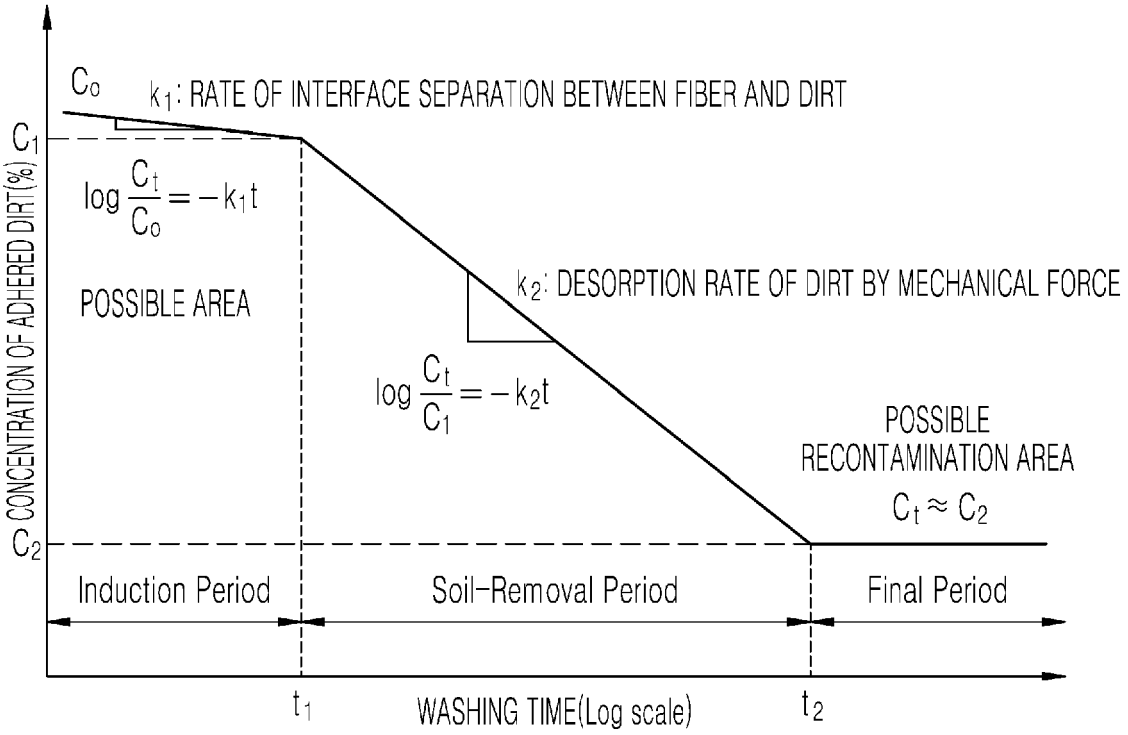
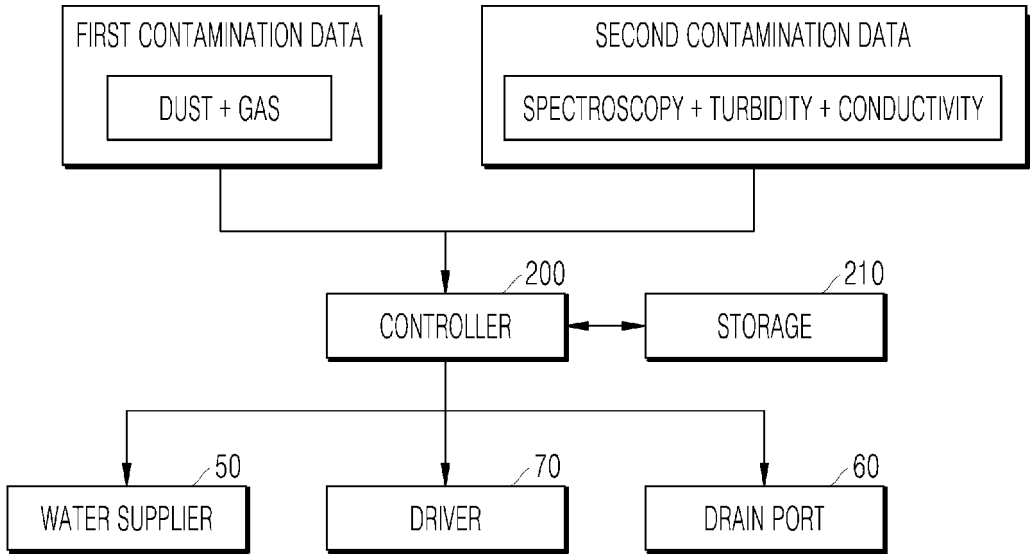

C0
k1: RATE OF INTERFACE SEPARATION BETWEEN FIBER AND DIRT
C1
log Ct/C0 = −k1t
POSSIBLE AREA
k2: DESORPTION RATE OF DIRT BY MECHANICAL FORCE
log Ct/C1 = −k2t
POSSIBLE
RECONTAMINATION AREA
Ct ≈ C2
C CONCENTRATION OF ADHERED DIRT(%)
C2
Induction Period
Soil-Removal Period
Final Period
t1
WASHING TIME(Log scale)
t2

FIG. 11


FIRST CONTAMINATION DATA
DUST + GAS
SECOND CONTAMINATION DATA
SPECTROSCOPY + TURBIDITY + CONDUCTIVITY
200
CONTROLLER
210
STORAGE
50
WATER SUPPLIER
70
DRIVER
60
DRAIN PORT

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 8030

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Y	* human translation;	14	
A	paragraph [0002] *	3,11	ADD. D06F33/70 D06F34/14
	* machine translation; paragraphs [0008], [0015], [0020], [0033], [0035], [0040], [0053], [0054] *		
	* machine translation; claims; figures *		

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Y	* paragraphs [0037], [0054], [0059],	14	
A	[0063], [0082], [0097], [0110], [0112] *	3,5,8,9, 12	
	* paragraph [0118] - paragraph [0119] *		
	* paragraph [0129] - paragraph [0133] *		
	* paragraphs [0146], [0160] *		TECHNICAL FIELDS SEARCHED (IPC)
	* paragraphs [0271], [0275] *		
	* claims; figures *		D06F

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A	* paragraphs [0015], [0017], [0023] *	6-15	
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A	DE 10 2015 204540 A1 (BSH HAUSGERÄTE GMBH [DE]) 15 September 2016 (2016-09-15) * paragraphs [0027], [0043] * * claims; figures *	1-15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 November 2020	Popara, Velimir

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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		WO 2016146313 A1	22-09-2016

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

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- KR 100457578 **[0073]**