



(11)

EP 4 566 507 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.06.2025 Bulletin 2025/24

(51) International Patent Classification (IPC):
A47L 15/42^(2006.01) A47L 15/00^(2006.01)

(21) Application number: **23855055.2**

(52) Cooperative Patent Classification (CPC):
A47L 15/00; A47L 15/42

(22) Date of filing: **18.07.2023**

(86) International application number:
PCT/KR2023/010330

(87) International publication number:
WO 2024/039084 (22.02.2024 Gazette 2024/08)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **KWON, Soon Yong**
Seoul 08592 (KR)
• **KIM, Dongjeong**
Seoul 08592 (KR)
• **HAN, Shinwoo**
Seoul 08592 (KR)

(30) Priority: **16.08.2022 KR 20220101902**

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

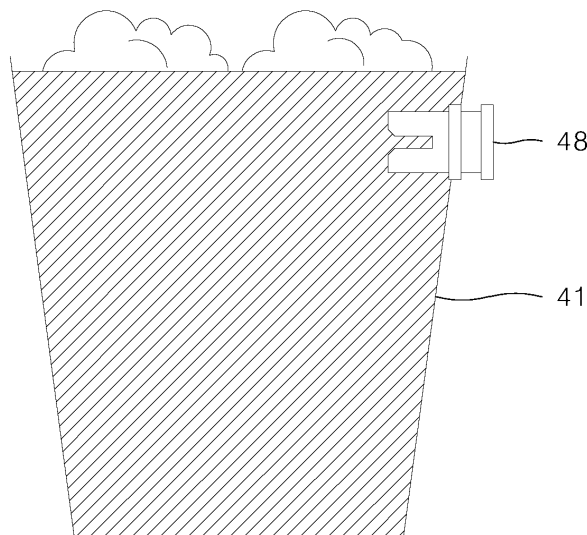
(71) Applicant: **LG Electronics Inc.**
Yeongdeungpo-gu
Seoul 07336 (KR)

(54) **DISHWASHER**

(57) The present invention relates to a dishwasher which can sense the turbidity of washing water in real time regardless of specific measurement conditions, and

thus can effectively identify the progress of an operation, and which can identify the progress of the operation in real time through a turbidity sensor.

【Figure 3】



EP 4 566 507 A1

Description**[Technical Field]**

5 **[0001]** The present disclosure relates to a dishwasher, and more specifically, to a dishwasher that may sense turbidity of washing water in real time regardless of specific measurement conditions, thereby effectively identifying a progress of a cycle and identifying the progress of the cycle in real time via a turbidity sensor.

[Background Art]

10 **[0002]** A dishwasher is an apparatus that washes dishes, cooking utensils, and the like, which are washing targets, stored therein by spraying washing water like water. In this regard, washing water used for the washing may contain detergent.

15 **[0003]** The dishwasher is generally composed of a washing tub that defines a washing space, a dish rack that accommodates the washing targets inside the washing tub, a spraying arm that sprays washing water to the dish rack, and a sump that stores water therein and supplies washing water to the spraying arm.

[0004] Using such a dishwasher, time and effort required to wash the washing targets such as the dishes after a meal may be reduced, contributing to convenience of a user.

20 **[0005]** Recently, a technology for detecting turbidity of washing water using a turbidity sensor and determining a progress of a cycle based on the detected turbidity has been developed.

[0006] In this regard, European Patent No. 2175766 (Prior Document 001) describes a configuration for measuring the turbidity via the turbidity sensor during the cycle of the dishwasher.

25 **[0007]** More specifically, Prior Document 001 describes a configuration for measuring the turbidity at a specific washing water motor speed during the cycle, a configuration for measuring the turbidity when a specific spraying arm of an upper spraying arm and a lower spraying arm rotates, and a configuration for measuring the turbidity when all of the spraying arms rotate, to reduce noise included in a turbidity value sensed via the turbidity sensor and minimize a deviation of the sensed turbidity values.

[0008] However, in Prior Document 001, to minimize the noise and the deviation as such, the turbidity may be sensed only under specific conditions during the cycle and the dishwasher may be controlled via the sensed turbidity.

30 **[0009]** Therefore, even when a washing cycle or a rinsing cycle using the dishwasher is completed to a satisfactory level, a situation in which the turbidity is not sensed may occur when the conditions for detecting the turbidity are not met.

[0010] In this case, the washing cycle or the rinsing cycle may proceed regardless of a contamination level and a degree of rinsing of the washing target, which causes unnecessary power loss and a high possibility of cycle time delay.

[Disclosure]**[Technical Problem]**

40 **[0011]** The present disclosure is designed to solve the problems of the prior art described above, and has a first purpose of providing a dishwasher that may sense turbidity of washing water in real time regardless of specific measurement conditions, and thus, may effectively identify a progress of a cycle.

[0012] In addition, the present disclosure has a second purpose of providing a dishwasher that may identify a progress of a cycle in real time via a turbidity sensor, and thus, may automatically increase or decrease a cycle time effectively.

45 **[0013]** In addition, the present disclosure has a third purpose of providing a dishwasher that may complete a cycle before a planned cycle time elapses when it is identified, via detected turbidity, that washing or rinsing has progressed to a satisfactory level, and thus, minimize power loss and effectively prevent time delay.

50 **[0014]** Purposes of the present disclosure are not limited to the above-mentioned purpose. Other purposes and advantages of the present disclosure that are not mentioned may be understood based on following descriptions, and may be more clearly understood based on embodiments of the present disclosure. Further, it will be easily understood that the purposes and advantages of the present disclosure may be realized using means shown in the claims and combinations thereof.

[Technical Solution]

55 **[0015]** A dishwasher according to the present disclosure includes a tub defining a washing space therein, a sump disposed under the tub and constructed to store washing water to be supplied to the tub therein, a washing water pump that pressurizes the washing water and supplies the pressurized washing water to the washing space, a turbidity sensor that senses turbidity values of the washing water, and a controller electrically connected to the turbidity sensor and the washing

water pump, and the controller detects the turbidity values of the washing water via the turbidity sensor during a cycle and determines whether to continue the cycle based on the detected turbidity values.

[0016] In addition, the controller that determines whether to continue the cycle may further calculate a rate of change of turbidity values during a washing cycle and determine whether to continue the washing cycle based on the calculated rate of change.

[0017] In addition, the controller that determines whether to continue the washing cycle may further receive an output signal from the turbidity sensor and detect turbidity values of the washing water after operation of the washing water pump is initiated, sample the detected turbidity values of the washing water at a first interval and store the sampled turbidity values, calculate an average value of the turbidity values sampled for a first time period and stored to calculate a first turbidity average value, sample turbidity values of the washing water detected after calculating the first turbidity average value at a second interval and store the sampled turbidity values, calculate an average value of the turbidity values sampled for a second time period after calculating the first turbidity average value to calculate a second turbidity average value, and calculate a rate of change of the second turbidity average value compared to the first turbidity average value and determine whether the calculated rate of change exceeds a reference rate of change.

[0018] In addition, the controller may further determine to stop the washing cycle when the calculated rate of change is determined to be smaller than or equal to the reference rate of change.

[0019] In addition, the controller may further stop the operation of the washing water pump when the stopping of the washing cycle is determined.

[0020] In addition, the first interval and the second interval may be equal to each other.

[0021] In addition, the first interval and the second interval may be 1 second.

[0022] In addition, in Claim 3, the first time period and the second time period may be equal to each other.

[0023] In addition, the reference rate of change may be 10%.

[0024] In addition, the controller that determines whether to continue the cycle may further determine whether to continue a rinsing cycle based on turbidity values measured during the rinsing cycle.

[0025] In addition, the controller that determines whether to continue the rinsing cycle may further receive an output signal from the turbidity sensor and detect turbidity values of the washing water, sample the detected turbidity values of the washing water at a third interval and store the sampled turbidity values, and determine whether the sampled turbidity values exceed a reference turbidity value.

[0026] In addition, the controller may further determine to stop the rinsing cycle when the sampled turbidity values are determined to be smaller than the reference turbidity value.

[0027] In addition, the controller may further stop operation of the washing water pump when the stopping of the rinsing cycle is determined.

[0028] In addition, the third interval may be 1 second.

[0029] In addition, the reference turbidity value may be 100 NTU.

[Advantageous Effects]

[0030] The dishwasher according to the present disclosure may sense the turbidity of washing water in real time regardless of the specific measurement conditions, and thus, may effectively identify the progress of the cycle.

[0031] In addition, the dishwasher according to the present disclosure may identify the progress of the cycle in real time via the turbidity sensor, and thus, may automatically increase or decrease the cycle time effectively.

[0032] In addition, the dishwasher according to the present disclosure may complete the cycle before the planned cycle time elapses when it is identified, via the detected turbidity, that the washing or the rinsing has progressed to the satisfactory level, and thus, minimize the power loss and effectively prevent the time delay.

[0033] In addition to the above-mentioned effects, the specific effects of the present disclosure as not mentioned will be described below along with the descriptions of the specific details for carrying out the present disclosure.

[Description of Drawings]

[0034]

FIG. 1 is a front perspective view showing a dishwasher according to an embodiment of the present disclosure.

FIG. 2 is a simplified cross-sectional view of a dishwasher shown in FIG. 1.

FIG. 3 is a schematic diagram for illustrating a state in which a turbidity sensor is installed at a sump and a function of the turbidity sensor.

FIG. 4 is a perspective view of a turbidity sensor shown in FIG. 3.

FIG. 5 is a functional block diagram showing a configuration of a controller according to an embodiment of the present disclosure.

FIGS. 6 and 7 are graphs showing turbidity values detected during a washing cycle.

FIG. 8 is a graph showing turbidity values detected during a rinsing cycle.

FIGS. 9 to 11 are flowcharts for illustrating a method for controlling a dishwasher according to an embodiment of the present disclosure.

[Best Mode]

[0035] The above-mentioned purpose, features and advantages are described in detail below with reference to the attached drawings. Accordingly, a person skilled in the art in the technical field to which the present disclosure belongs will be able to easily implement the technical idea of the present disclosure. In describing the present disclosure, when it is determined that a detailed description of the known technology related to the present disclosure may unnecessarily obscure the gist of the present disclosure, the detailed description thereof is omitted. Hereinafter, preferred embodiments according to the present disclosure will be described in detail with reference to the attached drawings. In the drawings, identical reference numerals are used to indicate identical or similar components.

[0036] It will be understood that, although the terms "first", "second", "third", and so on may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section described below could be termed a second element, component, region, layer or section, without departing from the spirit and scope of the present disclosure.

[0037] The terminology used herein is directed to the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular constitutes "a" and "an" are intended to include the plural constitutes as well, unless the context clearly indicates otherwise.

[0038] It will also be understood that when a first element or layer is referred to as being present "on" a second element or layer, the first element may be disposed directly on the second element or may be disposed indirectly on the second element with a third element or layer being disposed between the first and second elements or layers. It will also be understood that when a first element or layer is referred to as being present "under" a second element or layer, the first element may be disposed directly under the second element or may be disposed indirectly under the second element with a third element or layer being disposed between the first and second elements or layers.

[0039] It will be understood that when an element or layer is referred to as being "connected to", or "coupled to" another element or layer, it may be directly connected to or coupled to another element or layer, or one or more intervening elements or layers therebetween may be present. In addition, it will also be understood that when an element or layer is referred to as being "between" two elements or layers, it may be the only element or layer between the two elements or layers, or one or more intervening elements or layers therebetween may also be present.

[0040] It will be further understood that the terms "comprise", "comprising", "include", and "including" when used in this specification, specify the presence of the stated features, integers, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, operations, elements, components, and/or portions thereof. As used herein, the term "and/or" includes any and all combinations of one or more of associated listed items. Expression such as "at least one of" when preceding a list of elements may modify the entire list of elements and may not modify the individual elements of the list. In interpretation of numerical values, an error or tolerance therein may occur even when there is no explicit description thereof.

[0041] Spatially relative terms, such as "beneath," "below," "lower," "under," "above," "upper," and the like, may be used herein for ease of explanation to describe one element or feature's relationship to another element or feature as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or in operation, in addition to the orientation depicted in the figures. For example, when the device in the drawings may be turned over, elements described as "below" or "beneath" or "under" other elements or features would then be oriented "above" the other elements or features. Thus, the example terms "below" and "under" may encompass both an orientation of above and below. The device may be otherwise oriented for example, rotated 90 degrees or at other orientations, and the spatially relative descriptors used herein should be interpreted accordingly.

[0042] As used herein, "A and/or B" means A, B or A and B, unless specifically stated otherwise. Expression such as "at least one of" when preceding a list of elements may modify the entirety of list of elements and may not modify the individual

elements of the list. As used herein, "C to D" means C inclusive to D inclusive unless otherwise specified.

[0043] Hereinafter, the present disclosure will be described with reference to drawings showing a configuration of a dishwasher 1 according to an embodiment of the present disclosure.

5 [Overall structure of dishwasher]

[0044] Hereinafter, an overall structure of the dishwasher 1 according to an embodiment of the present disclosure will be described in detail with reference to the attached drawings.

10 **[0045]** FIG. 1 is a front perspective view showing a dishwasher according to the present disclosure, and FIG. 2 is a simplified cross-sectional view briefly showing an internal structure of a dishwasher according to the present disclosure.

[0046] As shown in FIGS. 1 to 2, the dishwasher 1 according to an embodiment of the present disclosure may include a casing 10 that constitutes an exterior appearance, a tub 20 installed in the casing 10 and having a washing space 21 defined therein where a washing target is washed, wherein a front surface of the tub is open, a door 30 that opens/closes the open front surface of the tub 20, a driver 40 located under the tub 20 to supply, collect, circulate, and discharge washing water for washing the washing target, a dish rack 50 removably provided in the inner washing space 21 of the tub 20 to receive therein the washing target, and a water sprayer 60 installed adjacent to the dish rack 50 to spray washing water for washing the washing target thereto.

15 **[0047]** In this regard, the washing target received in the dish rack 50 may be, for example, dishes such as bowls, plates, spoons, and chopsticks, and other cooking utensils. Hereinafter, unless otherwise specified, the washing target will be referred to as a dish.

[0048] The tub 20 may be formed in a box shape with an entirely open front surface, and have a configuration of a so-referred to as washing tub disposed on a base 90.

[0049] The washing space 21 may be defined inside the tub 20. The open front surface of the tub 20 may be opened/closing by the door 30.

25 **[0050]** The tub 20 may be formed via pressing of a metal plate resistant to high temperature and moisture, for example, a stainless steel plate.

[0051] Moreover, on an inner surface of the tub 20, a plurality of brackets may be disposed for the purpose of supporting and installing functional components such as the dish rack 50 and the water sprayer 60 which will be described later thereon within the tub 20.

30 **[0052]** In one example, the driver 40 may include a sump 41 that stores therein washing water, a sump cover 42 that distinguishes the sump 41 from the tub 20, a water supply 43 that supplies washing water from an external source to the sump 41, a water discharger 44 that discharges washing water of the sump 41 to an outside, a washing water pump 45 and a supply flow path 46 that supply washing water of the sump 41 to the water sprayer 60, and a filter 47 that is disposed inside the sump 41 and filters washing water.

35 **[0053]** The water supply 43 may include a water supply pipe 431 that receives washing water from an external water source, and a water supply valve 432 that opens and closes the water supply pipe 431.

[0054] The water discharger 44 may include a water discharge pipe 441 that has one end fluidly connected to the sump and the other end extending to the outside of the dishwasher 1, and a water discharge valve 442 that opens and closes the water discharge pipe. In this regard, the water discharger 44 may further include a water discharge pump (not shown) for forcibly draining washing water to the outside during a washing cycle or a rinsing cycle.

40 **[0055]** The sump cover 42 may be disposed at a top of the sump 41 and may serve to distinguish the tub 20 and the sump 41 from each other. Moreover, the sump cover 42 may have a plurality of collecting holes defined therein for collecting washing water sprayed into the washing space 21 through the water sprayer 60 into the sump 41.

[0056] That is, washing water sprayed from the water sprayer 60 toward the dish may fall down to a bottom of the washing space 21, and may be collected again through the sump cover 42 and into the sump 41.

45 **[0057]** The washing water pump 45 may be disposed at a side or a lower side of the sump 41 and may serve to pressurize collected washing water and re-supply pressurized washing water to the water sprayer 60.

[0058] One end of the washing water pump 45 may be connected to the sump 41 and the other end thereof may be connected to the supply flow path 46. The washing water pump 45 may be equipped with an impeller 451, a motor 453, and the like. When power is supplied to the motor 453, the impeller 451 may rotate, and thus washing water in the sump 41 may be pressurized, and then may be supplied to the water sprayer 60 through the supply flow path 46.

[0059] In one example, the supply flow path 46 may serve to selectively supply washing water supplied from the washing water pump 45 to the water sprayer 60.

50 **[0060]** For example, the supply flow path 46 may include a first supply flow path 461 connected to a lower spraying arm 61, and a second supply flow path 463 connected to an upper spraying arm 62 and a top nozzle 63. The supply flow path 46 may be provided with a supply flow path switching valve 465 that selectively opens/closes the supply flow paths 461 and 463.

[0061] In this regard, the supply flow path switching valve 465 may be controlled so that the supply flow paths 461 and

463 are opened sequentially or simultaneously.

[0062] In addition, the sump 41 may be equipped with a turbidity sensor 48 as a means for sensing turbidity of washing water stored inside the sump, as will be described later.

[0063] In one example, the water sprayer 60 may be constructed to spray washing water to the dishes stored in the dish rack 50.

[0064] More specifically, the water sprayer 60 may include the lower spraying arm 61 located at a bottom of the tub 20 to spray washing water to a lower rack 51, the upper spraying arm 62 located between the lower rack 51 and an upper rack 52 to spray washing water to the lower rack 51 and the upper rack 52, and the top nozzle 63 located at a top of the tub 20 to spray washing water to a top rack 53 or the upper rack 52.

[0065] In particular, the lower spraying arm 61 and the upper spraying arm 62 may be rotatably disposed in the washing space 21 of the tub 20 and may spray washing water toward the dish of the dish rack 50 while being rotating.

[0066] The lower spraying arm 61 may be rotatably supported above the sump cover 42 so as to spray washing water toward the lower rack 51 while being rotating and being disposed under the lower rack 51.

[0067] As shown, a hub 613 to which washing water is supplied from the first supply flow path 461 may be disposed under the lower spraying arm. The hub 613 may be rotatably supported by a lower spraying arm holder 640 connected to the sump 41.

[0068] In addition, the upper spraying arm 62 may be rotatably supported by an upper spraying arm holder so as to spray washing water while rotating between the lower rack 51 and the upper rack 52.

[0069] In one example, a means to divert washing water sprayed from the lower spraying arm 61 in an upward direction (U-direction) may be further disposed on a bottom surface 25 of the tub 20 to increase a washing efficiency. A detailed configuration of the lower spraying arm 61 of a configuration of the water sprayer 60 will be described later with reference to FIG. 3 and below.

[0070] In one example, the dish rack 50 for storing the dish therein may be disposed in the washing space 21.

[0071] The dish rack 50 may be constructed to extend or retract from or into the inner space of the tub 20 through the open front surface of the tub 20.

[0072] For example, in FIG. 2, an embodiment is shown in which the dish rack includes the lower rack 51 located at a lower portion of the tub 20 to accommodate therein relatively large dishes, the upper rack 52 located above the lower rack 51 to accommodate therein medium-sized dishes, and the top rack 53 located at a top level of the tub 20 and capable of storing therein small dishes, etc. However, the present disclosure is not limited thereto. However, hereinafter, a description will be made based on the embodiment of the dishwasher with the three dish racks 50 as shown.

[0073] Each of the lower rack 51, the upper rack 53, and the top rack 53 may be constructed to extend or retract from or into the inner space of the tub 20 through the open front surface of the tub 20.

[0074] To this end, guide rails (not shown) may be respectively disposed on both opposing inner side surfaces constituting an inner surface of the tub 20. By way of example, the guide rails may include an upper rail, a lower rail, a top rail, and the like.

[0075] Wheels may be disposed on a bottom of each of the lower rack 51, the upper rack 52, and the top rack 53. The user may extend the lower rack 51, the upper rack 53, and the top rack 53 from the inner space of the tub 20 through the open front surface of the tub 20 and may place the dishes thereon, or easily withdraw the dishes that have been washed out thereof.

[0076] The guide rail 54 may be embodied as a simple rail-type fixed guide rail to guide the extending or the retracting of the water sprayer 60, or a telescopic guide rail capable of guiding the extending or the retracting of the water sprayer 60 and at the same time, increasing an extension distance thereof based on the extending of the water sprayer 60.

[0077] In one example, the door 30 is configured for opening/closing the open front surface of the tub 20 as described above.

[0078] A hinge (not shown) around which the door 30 is closed or opened is generally disposed at a bottom of the open front surface. Thus, the door 30 pivots around the hinge as a pivot axis and opens.

[0079] In this regard, a handle 31 for opening the door 30 and a control panel 32 for controlling the dishwasher 1 may be disposed on an outer side surface of the door 30.

[0080] As shown, the control panel 32 may include a display 33 that visually displays information regarding a current operating status of the dishwasher 1, etc., and a button unit 34 including a selection button through which a user's course selection manipulation is input and a power button through which a user's manipulation for turning the dishwasher on and off is input.

[0081] In one example, an inner side surface of the door 30 may form one surface of the tub 20 when the door 30 is closed, and at the same time, may form a seating surface on which the lower rack 51 of the dish rack 50 may be supported when the door 30 is fully opened.

[0082] To this end, it is preferable that, when the door 30 is fully opened, the inner side surface of the door 30 forms a horizontal plane in the same direction as the extension direction of the guide rail 54 that guides the lower rack 51.

[0083] In one example, although not shown, the door may further include a detergent supply for storing therein detergent

to be used in a washing cycle and a rinsing agent to be used in a rinsing cycle, and automatically discharging them into the washing space 21.

[0084] As shown in FIG. 2, an automatic door opening module 352 for automatically opening the door may be disposed at an outer side of a top surface of the tub 20.

[0085] The automatic door opening module 352 serves to move the door 30 to a predetermined opening position and partially open a front surface 22 of the tub 20 when a drying air supply 80 to be described later is operated and drying air is supplied into the tub 20.

[0086] Accordingly, air that has become moist while drying the dishes may be discharged via an upper side of the opened front surface 22 of the tub 20.

[0087] For example, the automatic door opening module 352 may be equipped with a push rod 3524 that pivots and moves an upper end of a rear surface of the door 30 to the opening position.

[0088] In one example, the drying air supply 80 for generating and supplying high-temperature or low-temperature drying air to the washing space inside the tub 20 may be disposed under the tub 20.

[0089] As illustrated, the drying air supply 80 may include a filter member 883 that filters outside air, a blower fan 825 that generates a drying air flow, a heater 84 that heats the drying air flow, and an air flow guide 83 that is disposed inside the tub and guides the drying air flow.

[0090] A drying air supply hole may be defined in a bottom surface of the tub 20 such that high-temperature drying air generated by the drying air supply may be introduced into the tub 20.

[Configuration of turbidity sensor]

[0091] FIG. 3 is a schematic diagram showing a state in which the turbidity sensor 48 of the dishwasher 1 according to an embodiment of the present disclosure is disposed at the sump 41, and FIG. 4 is a perspective view showing an example of the turbidity sensor 48 shown in FIG. 3.

[0092] The turbidity sensor 48 senses the turbidity of washing water stored in the sump 41.

[0093] To this end, as shown in FIG. 3, the turbidity sensor 48 may be installed through the sump 41.

[0094] The dishwasher 1 according to an embodiment of the present disclosure may be equipped to proceed with the washing cycle of spraying washing water onto the dishes to wash the dishes, a rinsing cycle of spraying newly supplied washing water onto the dishes to rinse the dishes, and a drying cycle of drying the dishes using the drying air flow generated by the drying air supply 80.

[0095] In this regard, when the dishwasher 1 proceeds with a plastic course, a controller 100 to be described below may receive a command on whether to continue the drying cycle.

[0096] In this regard, the washing cycle may include a preliminary washing cycle of spraying washing water not containing the detergent onto the dishes, and a detergent washing cycle of adding the detergent to washing water and spraying washing water onto the dishes.

[0097] The rinsing cycle may include a preliminary rinsing cycle of spraying washing water not containing the rinsing agent onto the dishes, and a rinsing agent rinsing cycle of adding the rinsing agent to washing water and spraying washing water onto the dishes.

[0098] In addition, the rinsing cycle may further include a heating rinsing cycle. When washing water is heated and used for the rinsing, the dishes may be heated, and in the drying cycle that follows, residual heat of the dishes may facilitate evaporation of water remaining on surfaces of the dishes.

[0099] For the turbidity of washing water to be sensed while a sufficient amount of washing water to proceed with the washing cycle or the rinsing cycle is stored in the sump 41, the turbidity sensor 48 may be disposed close to an upper end of the sump 41. As illustrated in FIG. 4, the turbidity sensor 48 may include a sensing area 481 through which washing water flows, a light emitter 482 that is disposed opposite to the sensing area 481 and emits light such that light passes through the sensing area 481, and a light receiver 483 that receives light that passes through the sensing area 481.

[0100] Washing water supplied into the sump 41 may flow along the sensing area 481 of the turbidity sensor 48.

[0101] Light emitted from the light emitter 482 may pass through washing water flowing through the sensing area 481 and be received by the light receiver 483.

[0102] When light is received by the light receiver 483, light may be converted into a predetermined voltage value and output, and as will be described below, an output signal of the light receiver 483 may be transmitted to the controller 100. The controller 100 may convert the voltage value included in the output signal into a turbidity value corresponding thereto using a pre-stored conversion table to calculate a current turbidity value of washing water.

[0103] The conversion table may be separately converted into data and stored in advance in a memory.

[0104] The controller 100 may separately store the calculated turbidity value as data in the memory. In this regard, as will be described later, the turbidity values may be sampled at a predetermined interval, i.e., a 1-second interval, and stored in the memory.

[0105] In one example, the turbidity sensor 48 may sense not only the turbidity of washing water, but also an amount of

foam present in the washing space 21.

[0106] That is, excessive foam may be generated inside the washing space 21 because of misuse of the detergent or the like. The generated foam may be located on a surface of washing water stored in the sump 41. Accordingly, light output from the light emitter 482 is reflected from a surface of the foam, and only a portion of light output from the light emitter 482 is transmitted to the light receiver 483. Accordingly, when the voltage value is low, the amount of foam is determined to be great, and when the voltage value is high, the amount of foam is determined to be small. That is, the turbidity value is proportional to the amount of foam.

[Configuration of controller and method for controlling dishwasher]

[0107] Hereinafter, referring to FIG. 5, a configuration of the controller 100 of the dishwasher 1 according to an embodiment of the present disclosure will be described.

[0108] As illustrated in FIG. 5, the dishwasher 1 according to an embodiment of the present disclosure may include the controller 100 for controlling each functional component.

[0109] The controller 100 may be in various forms such as a microcontroller, a microcomputer, or a microprocessor, as is known in the art.

[0110] First, the controller 100 may be electrically connected to a power converter (not shown). Power input from an external power source that is not shown may be converted through the power converter and supplied to the controller 100, the motor 453 of the washing water pump 45, the water supply valve 432, the water discharge valve 442, the turbidity sensor 48, the supply flow path switching valve 465, and the like.

[0111] In addition, the controller 100 may be electrically connected to the water supply valve 432 that opens and closes the water supply pipe 431 receiving washing water from an external water source, and the motor 453 of the washing water pump 45 that pressurizes washing water supplied via the water supply pipe 431 and supplies pressurized washing water to the washing space 21 of the tub 20.

[0112] As will be described below, when the washing cycle or the rinsing cycle is initiated, the controller 100 may open the water supply valve 432 such that washing water is supplied to the sump 41 via the water supply pipe 431, and supply the power to the motor 453 of the washing water pump 45 to operate the washing water pump 45 for pressurizing washing water stored in the sump 41 and providing pressurized washing water to the water sprayer 60.

[0113] In addition, the controller 100 may be electrically connected to the supply flow path switching valve 465, which switches the flow path such that washing water pressurized via the washing water pump 45 may be distributed and supplied to the lower spraying arm 61, the upper spraying arm 62, or the top nozzle 63 constituting the water sprayer 60.

[0114] Therefore, the controller 100 may transmit a control signal to the supply flow path switching valve 465 to control an entirety or a portion of pressurized washing water to be supplied to the lower spraying arm 61 via the first supply flow path 461 or supplied to the upper spraying arm 62 and the top nozzle 63 via the second supply flow path 463.

[0115] In addition, the controller 100 may be electrically connected to the water discharge valve 442 that opens and closes the water discharge pipe 441 for discharging washing water that has completed washing or rinsing the washing target to the outside.

[0116] The controller 100 may control the water discharge valve 442 to close the water discharge pipe 441 while the washing cycle or the rinsing cycle is in progress and to open the water discharge pipe 441 when the washing cycle or the rinsing cycle is completed.

[0117] In addition, the controller 100 may be electrically connected to the turbidity sensor 48 for sensing the turbidity of washing water in real time during the washing cycle or the rinsing cycle.

[0118] As described above, the turbidity sensor 48 may generate the voltage value that varies based on the turbidity or the contamination level of washing water as the output signal and transmit the out signal to the controller 100 in real time.

[0119] The controller 100 electrically connected to the turbidity sensor 48 may receive the output signal of the turbidity sensor 48, and convert the received output signal into the turbidity value to detect the current turbidity of washing water.

[0120] Therefore, the controller 100 may indirectly estimate a current washed state or rinsed state of the washing target in real time based on the detected turbidity value of washing water.

[0121] In addition, the controller 100 may determine whether to continue, i.e., whether to stop, the washing cycle or the rinsing cycle, based on the washed state or the rinsed state of the washing target estimated via the turbidity value.

[0122] However, basis for determining the washed state of the washing target during the washing cycle and the rinsed state of the washing target during the rinsing cycle may be different from each other.

[0123] First, criteria for determining the washed state of the washing target during the washing cycle are as follows.

[0124] FIGS. 6 and 7 show graphs that record turbidity values of washing water detected during a washing cycle over time.

[0125] As shown in FIG. 6, it may be seen that the turbidity value of washing water gradually increases over time as the washing cycle progresses while the contamination level of the washing target is considerably high.

[0126] On the other hand, as shown in FIG. 7, it may be seen that an amount of change in the turbidity value detected over

time is relatively small when the washing cycle is performed while the contamination level of the washing target is relatively low, and the turbidity value converges to a specific turbidity value over time.

[0127] Judging from such detection results, the contamination level or a degree of washing of the washing target may be estimated based on a rate of change RM of the turbidity value of washing water.

[0128] That is, when the rate of change RM of the turbidity value detected via the turbidity sensor 48 exceeds a predetermined level, it may be determined that decontamination of the washing target is not completed, that is, the washing is not completed, and when the rate of change RM of the turbidity value is equal to or lower than the predetermined level, it may be determined that the decontamination of the washing target is sufficiently completed, that is, the washing is completed.

[0129] Such rate of change RM of the turbidity value may be calculated via a following process as an example.

[0130] First, a first turbidity average value M1 of the turbidity values sampled at a first interval for a predetermined first time period after the washing cycle is initiated and the operation of the washing water pump 45 is initiated is calculated.

[0131] Next, a second turbidity average value M2 of the turbidity values sampled at a second interval for a second time period after the first time period has elapsed is calculated.

[0132] When the first turbidity average value M1 and the second turbidity average value M2 are calculated as such, a rate of change RM of the second turbidity average value M2 with respect to the first turbidity average value is calculated, and the calculated rate of change RM is compared with a predetermined reference rate of change RMth.

[0133] In this regard, the rate of change RM may be calculated with a following Mathematical Formula.

【Mathematical Formula 1】

$$RM = (M2 - M1) / M2 \times 100$$

[0134] In this regard, when the calculated rate of change RM is determined to be smaller than or equal to the reference rate of change RMth, the washing is assumed to be completed and the washing cycle is ended. When the calculated rate of change RM is determined to be greater than the reference rate of change RMth, the washing is assumed to be incomplete and thus the washing cycle is continued, and the above process is repeated.

[0135] In this regard, for example, each of the first interval and the second interval may be 1 second, and each of the first time period and the second time period may be 5 minutes.

[0136] Therefore, detection of the rate of change RM of the turbidity value and determination of the reference rate of change RMth may be performed in units of 5 minutes, and whether to stop the washing cycle may be determined in units of 5 minutes.

[0137] In addition, for example, the reference rate of change RMth may be 10%.

[0138] In one example, criteria for determining the washed state of the washing target in the rinsing cycle are as follows.

[0139] The rinsing cycle is a process for removing the detergent remaining on the washing target after the completion of the washing cycle.

[0140] Therefore, the rinsed state of the washing target may be determined by an amount of residual detergent or an amount of rinsing agent injected during the rinsing cycle, and this may be estimated via the turbidity value of washing water sensed by the turbidity sensor 48.

[0141] Further, as shown in FIG. 8, it may be seen that, when a draining process and a rinsing process (washing water spraying) are repeated during the rinsing cycle, the turbidity value of washing water tends to gradually decrease.

[0142] Whether to stop the rinsing cycle may be determined by comparing turbidity values measured by the turbidity sensor 48 and sampled at a third interval with a reference turbidity value.

[0143] For example, the reference turbidity value may be 100 nephelometry turbidity unit (NTU).

[0144] 100 NTU is a turbidity numeric value that is measured when the draining and rinsing processes are repeated approximately 4 times and is recognized by safety standards and.

[0145] The process of determining whether to stop the washing cycle based on the rate of change RM of the turbidity value of washing water and the process of determining whether to stop the rinsing cycle based on the turbidity value of washing water as such will be described below with reference to FIG. 10 and below.

[0146] In one example, the controller 100 is electrically connected to the memory and a timer. The controller 100 calls an operating condition and a time condition for each cycle that are stored in advance in the memory and uses them to generate a control signal for controlling progress and end of the cycle. In this regard, as described above, the conversion table for converting the output signal received from the turbidity sensor 48 into the turbidity value may be stored in advance in the memory, and the converted turbidity value may be separately converted into the data and stored in the memory.

[0147] In addition, the controller 100 may calculate an elapsed time or the like of each cycle using the timer, and compare

the elapsed time with the time condition for each cycle that is stored in advance to determine whether to complete each cycle. In addition, as will be described below, the timer may be used for time measurement of the first interval to the third interval for sampling the turbidity values and for measurement of the first time period and the second time period for calculating the turbidity average values M1 and M2.

[0148] In addition, although not shown, the controller 100 is electrically connected to the display and a sound output unit. The controller 100 may visually display information regarding the operating status, an operating time, whether the cycle is completed, and the like of the dishwasher 1 via the display, and may control a message regarding the operating status or the completion of the cycle of the dishwasher 1 to be output as a voice or sound via the sound output unit such as a buzzer or a speaker described above.

[0149] Hereinafter, a method for controlling the dishwasher 1 according to the present disclosure will be described with reference to FIGS. 9 to 11.

[0150] As described above, the dishwasher 1 according to the present disclosure may be controlled to detect the turbidity value of washing water during the cycle (S10), and identify the progress of the cycle in real time based on the detected turbidity value and determine whether to complete the cycle based on the identified progress (S20).

[0151] This will be described as follows by distinguishing steps in the washing cycle and steps in the rinsing cycle from each other.

[0152] FIG. 10 shows a process of calculating a rate of change of a turbidity value during a washing cycle and determining whether to continue the washing cycle based on the calculated rate of change.

[0153] Referring to FIG. 10, to initiate a washing cycle (S100), the controller 100 opens the water supply valve 432 such that washing water is supplied to the sump 41 via the water supply pipe 431 (S101).

[0154] When the water supply valve 432 is opened, the controller 100 initiates measuring a washing time T_w from the time when the water supply valve 432 is opened, via the timer (S102).

[0155] Next, when a predetermined amount of washing water is supplied to the sump 41 via the water supply valve 432, the controller 100 supplies the power to the motor 453 of the washing water pump 45 to initiate the operation of the washing water pump 45, to supply washing water to the water sprayer 60 (S103).

[0156] When the operation of the washing water pump 45 is initiated, the controller 100 operates the detergent supply to supply the detergent to the washing space 21 of the tub 20 (S104).

[0157] In this regard, in a case of a type in which the detergent is supplied manually, step S104 may be omitted.

[0158] In one example, after the detergent is supplied, the controller 100 receives the output signal from the turbidity sensor 48, calls the data for the conversion table from the memory to convert the received output signal into the turbidity value, and converts the output signal into the turbidity value using the conversion table to detect the current turbidity value of washing water (S105).

[0159] Next, the controller 100 samples the detected turbidity values at the first interval, and stores the sampled turbidity values in the memory (S106).

[0160] In this regard, the first interval may be 1 second, for example.

[0161] Next, the controller 100 calls the turbidity values sampled for the first time period from the memory, and calculates the called turbidity values to calculate the first turbidity average value M1 (S107).

[0162] The first turbidity average value M1 calculated here may be stored in the memory, and the first time period may be 5 minutes, for example.

[0163] When the first turbidity average value M1 is calculated and stored, the controller 100 samples the turbidity values of washing water detected after calculating the first turbidity average value M1 at the second interval, and stores the sampled turbidity values in the memory (S108).

[0164] In this regard, the second interval may be 1 second, the same as the first interval.

[0165] Next, the controller 100 calls, from the memory, the turbidity values sampled during the second time period after the first turbidity average value is calculated, and calculates the called turbidity values to calculate the second turbidity average value M2 (S109).

[0166] The second turbidity average value M2 calculated here may be stored in the memory, and the second time period may be 5 minutes, the same as the first time period.

[0167] When the second turbidity average value M2 is calculated, the controller 100 calculates the rate of change RM of the second turbidity average value M2 compared to the first turbidity average value M1, and determines whether the calculated rate of change RM exceeds the reference rate of change RMth (S110).

[0168] In this regard, the rate of change RM may be calculated using the above-mentioned Mathematical Formula.

[0169] In this regard, when the calculated rate of change RM is determined to be smaller than or equal to the reference rate of change RMth, the controller 100 determines to stop the washing cycle by assuming that the washing of the washing target has been completed, and stops the washing water pump 45 by stopping the power supply to the motor of the washing water pump 45 (S112). Accordingly, the washing cycle (S100) may be ended.

[0170] In one example, when the rate of change RM calculated in step S110 is determined to exceed the reference rate of change RMth, the controller 100 determines to continue the washing cycle by assuming that the washing of the washing

target has not been completed, and determines, via the timer, whether the washing time T_w that has elapsed so far exceeds a planned washing time T_{w_th} (S111).

[0171] Comparing the washing time T_w with the planned washing time T_{w_th} as above may have a purpose of preventing the washing cycle from being excessively delayed in case of an error or a malfunction in the turbidity sensor 48 or the like.

[0172] Therefore, when the washing time T_w reaches the planned washing time T_{w_th} , the controller 100 may proceed to the aforementioned step S112 to end the washing cycle (S100).

[0173] However, when it is determined that the washing time T_w has not reached the planned washing time T_{w_th} , the controller 100 may return to the aforementioned step S105 and repeat the subsequent steps to continue the washing cycle (S100).

[0174] FIG. 11 shows a process of detecting the turbidity value during a unit rinsing cycle (S200) and determining whether to continue the unit rinsing cycle (S200) based on the detected turbidity value. The unit rinsing cycle (S200) in the illustrated embodiment may be preset to be performed only once or performed a plurality of times, or an operation mode thereof may be selected by the user. Hereinafter, steps performed during the unit rinsing cycle (S200) will be mainly described, and in the operation mode in which the rinsing cycle (S200) is performed a plurality of times, the process illustrated in FIG. 11 may be repeatedly performed.

[0175] Referring to FIG. 11, to initiate the rinsing cycle (S200), the controller 100 opens the water discharge valve 442 such that washing water that has completed the washing cycle may be drained (S201).

[0176] When the water discharge valve 442 is opened and washing water inside the sump 41 is discharged to the outside, the controller 100 opens the water supply valve 432 to replenish washing water such that new washing water is supplied to the sump 41 via the water supply pipe 431 (S202).

[0177] When the water supply valve 432 is opened, the controller 100 initiates measuring a rinsing time T_r from the time the water supply valve 432 is opened, via the timer (S203).

[0178] Next, when a predetermined amount of washing water is supplied to the sump 41 via the water supply valve 432, the controller 100 supplies the power to the motor 453 of the washing water pump 45 to initiate the operation of the washing water pump 45, to supply washing water to the water sprayer 60 (S204).

[0179] Although not shown, when the operation of the washing water pump 45 is initiated, the controller 100 may also proceed with a step of supplying the rinsing agent to the washing space 21 of the tub 20 by operating the detergent supply.

[0180] In one example, after the operation of the washing water pump 45 is initiated, the controller 100 receives the output signal from the turbidity sensor 48, calls the data for the conversion table from the memory to convert the received output signal into the turbidity value, and converts the output signal into the turbidity value using the conversion table to detect the current turbidity value of washing water (S205).

[0181] Next, the controller 100 samples the detected turbidity values at the third interval, and stores the sampled turbidity values in the memory (S206).

[0182] In this regard, the third interval may be 1 second, for example.

[0183] Next, the controller 100 determines whether the sampled turbidity value exceeds the reference turbidity value (S207).

[0184] In this regard, the reference turbidity value may be 100 NTU as described above.

[0185] In this regard, when the sampled turbidity value is determined to be smaller than or equal to the reference turbidity value, the controller 100 determines to stop the rinsing cycle by assuming that the rinsing of the washing target is completed, and stops the washing water pump by stopping the power supply to the motor of the washing water pump 45 (S209). Accordingly, the rinsing cycle (S200) may be ended.

[0186] In one example, when the turbidity value sampled in step S207 is determined to exceed the reference turbidity value, the controller 100 determines to continue the rinsing cycle by assuming that the rinsing of the washing target is not completed, and determines, via the timer, whether the rinsing time T_r that has elapsed so far exceeds a planned rinsing time T_{r_th} (S208).

[0187] Comparing the rinsing time T_r with the planned rinsing time T_{r_th} as above may have a purpose of preventing the rinsing cycle from being excessively delayed in case of the error or the malfunction in the turbidity sensor 48 or the like, in the same manner as in the washing cycle (S100).

[0188] Therefore, when the rinsing time T_r reaches the planned rinsing time T_{r_th} , the controller 100 may proceed to the aforementioned step S209 to end the rinsing cycle (S200).

[0189] However, when it is determined that the rinsing time T_r has not reached the planned rinsing time T_{r_th} , the controller 100 may return to the aforementioned step S204 and repeat the subsequent steps to continue the rinsing cycle (S200).

[0190] Although the embodiments of the present disclosure have been described in more detail with reference to the accompanying drawings, the present disclosure is not necessarily limited to these embodiments, and may be modified in a various manner within the scope of the technical spirit of the present disclosure. Accordingly, the embodiments as disclosed in the present disclosure are intended to describe rather than limit the technical idea of the present disclosure,

and the scope of the technical idea of the present disclosure is not limited by these embodiments. Therefore, it should be understood that the embodiments described above are not restrictive but illustrative in all respects. In addition, even though an effect of a configuration of the present disclosure is not explicitly described in describing the embodiment of the present disclosure above, it is obvious that the predictable effect from the configuration should be recognized.

Claims

1. A dishwasher comprising:

a tub defining a washing space therein;
 a sump disposed under the tub and constructed to store washing water to be supplied to the tub therein;
 a washing water pump configured to pressurize the washing water and supply the pressurized washing water to the washing space;
 a turbidity sensor configured to sense turbidity values of the washing water; and
 a controller electrically connected to the turbidity sensor and the washing water pump, wherein the controller is configured to detect the turbidity values of the washing water via the turbidity sensor during a cycle and determine whether to continue the cycle based on the detected turbidity values.

2. The dishwasher of claim 1, wherein the controller configured to determine whether to continue the cycle is further configured to calculate a rate of change of turbidity values during a washing cycle and determine whether to continue the washing cycle based on the calculated rate of change.

3. The dishwasher of claim 2, wherein the controller configured to determine whether to continue the washing cycle is further configured to:

receive an output signal from the turbidity sensor and detect turbidity values of the washing water after operation of the washing water pump is initiated;
 sample the detected turbidity values of the washing water at a first interval and store the sampled turbidity values;
 calculate an average value of the turbidity values sampled for a first time period and stored to calculate a first turbidity average value;
 sample turbidity values of the washing water detected after calculating the first turbidity average value at a second interval and store the sampled turbidity values;
 calculate an average value of the turbidity values sampled for a second time period after calculating the first turbidity average value to calculate a second turbidity average value; and
 calculate a rate of change of the second turbidity average value compared to the first turbidity average value and determine whether the calculated rate of change exceeds a reference rate of change.

4. The dishwasher of claim 3, wherein the controller is further configured to determine to stop the washing cycle when the calculated rate of change is determined to be smaller than or equal to the reference rate of change.

5. The dishwasher of claim 4, wherein the controller is further configured to stop the operation of the washing water pump when the stopping of the washing cycle is determined.

6. The dishwasher of claim 3, wherein the first interval and the second interval are equal to each other.

7. The dishwasher of claim 6, wherein the first interval and the second interval are 1 second.

8. The dishwasher of claim 3, wherein the first time period and the second time period are equal to each other.

9. The dishwasher of claim 3, wherein the reference rate of change is 10%.

10. The dishwasher of claim 1, wherein the controller configured to determine whether to continue the cycle is further configured to determine whether to continue a rinsing cycle based on turbidity values measured during the rinsing cycle.

11. The dishwasher of claim 10, wherein the controller configured to determine whether to continue the rinsing cycle is further configured to:

receive an output signal from the turbidity sensor and detect turbidity values of the washing water;
sample the detected turbidity values of the washing water at a third interval and store the sampled turbidity values;
and
determine whether the sampled turbidity values exceed a reference turbidity value.

5

12. The dishwasher of claim 11, wherein the controller is further configured to determine to stop the rinsing cycle when the sampled turbidity values are determined to be smaller than the reference turbidity value.

10

13. The dishwasher of claim 12, wherein the controller is further configured to stop operation of the washing water pump when the stopping of the rinsing cycle is determined.

14. The dishwasher of claim 11, wherein the third interval is 1 second.

15

15. The dishwasher of claim 11, wherein the reference turbidity value is 100 NTU.

20

25

30

35

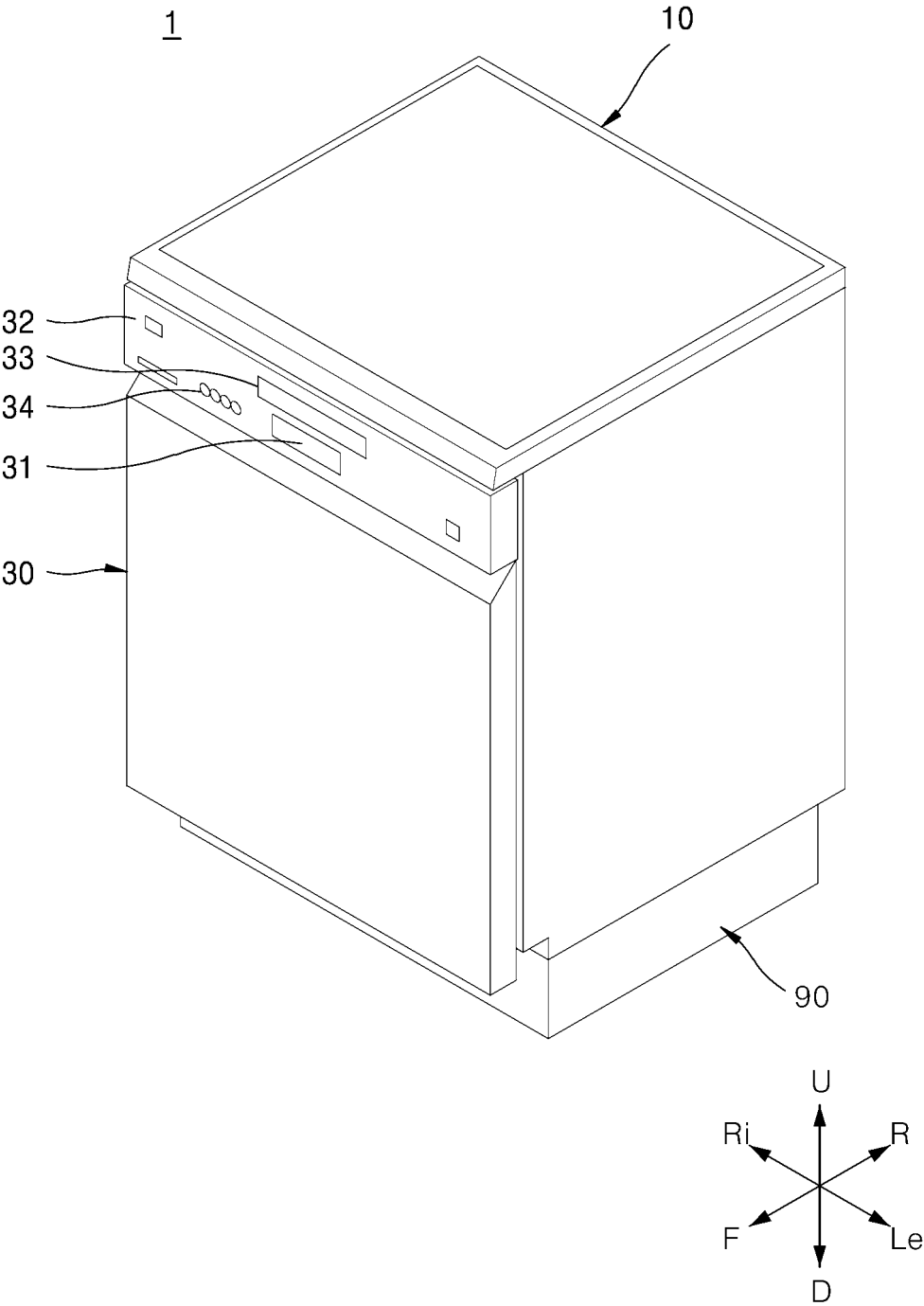
40

45

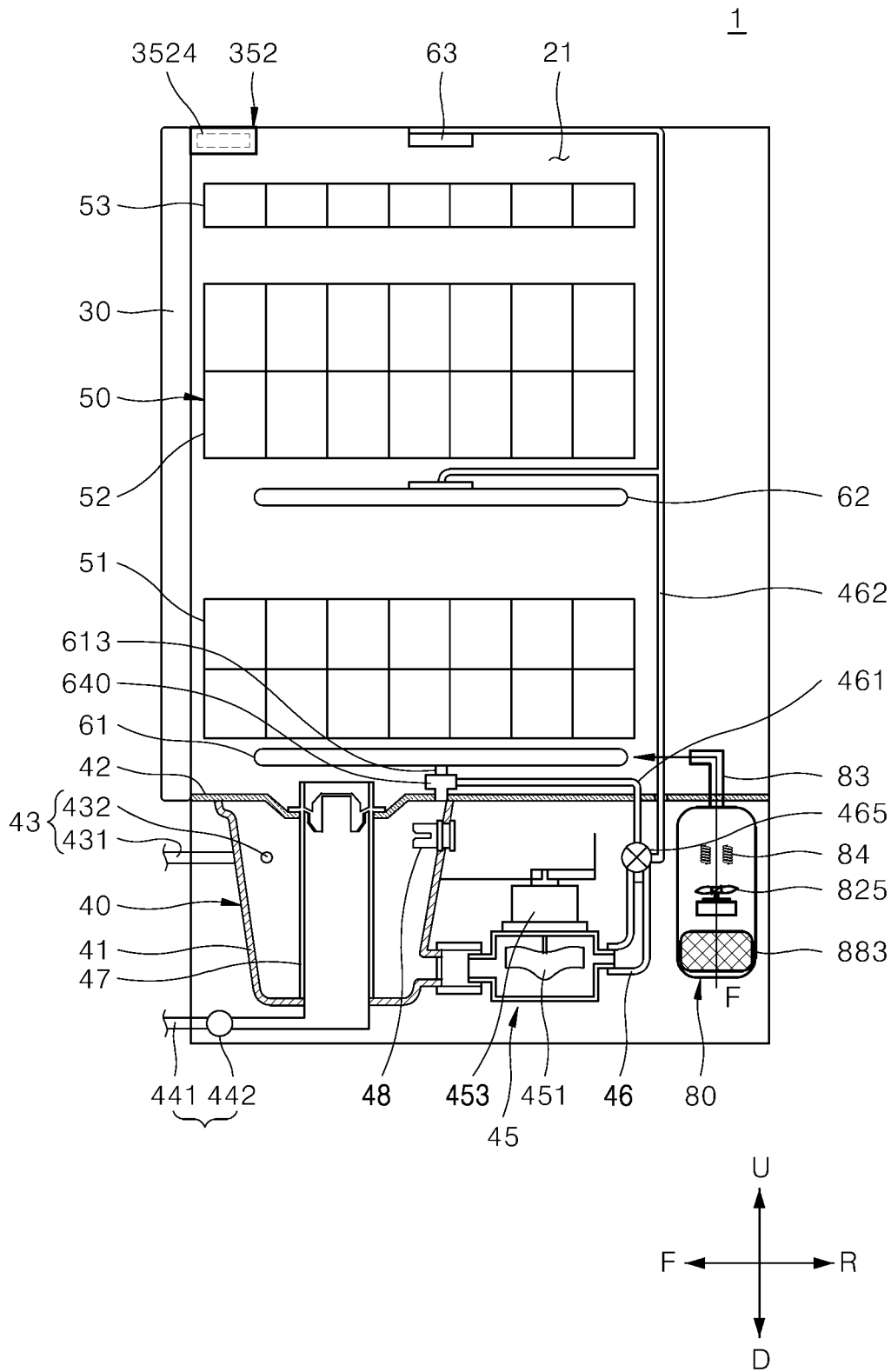
50

55

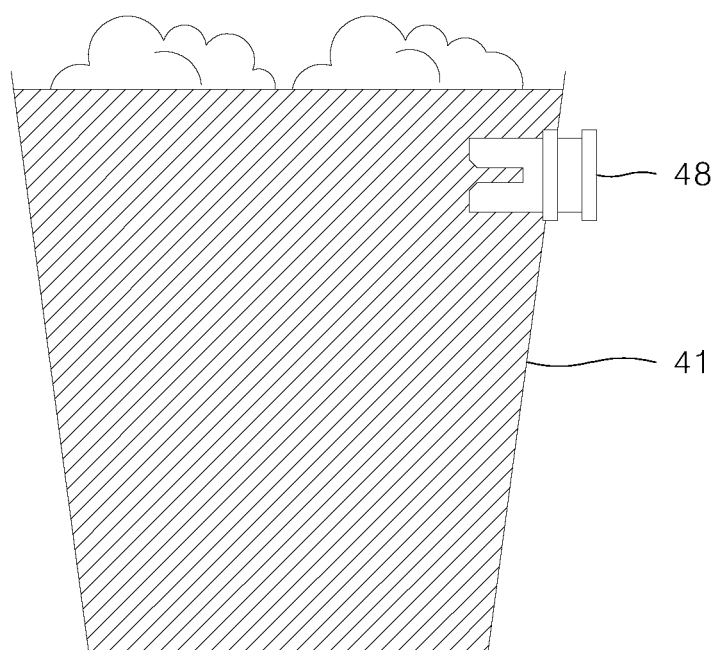
【Figure 1】



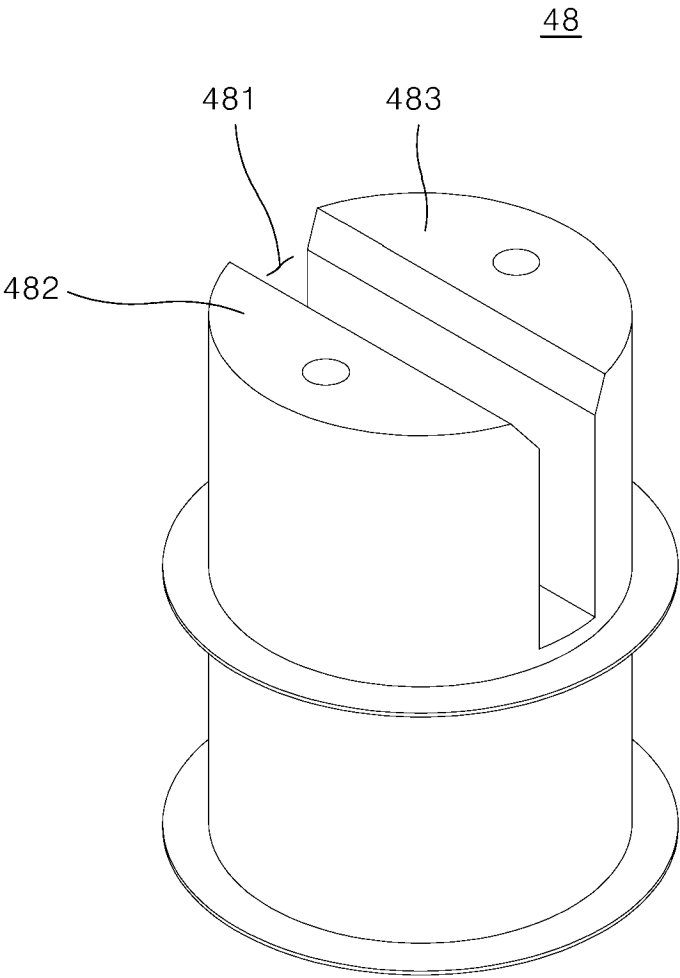
【Figure 2】



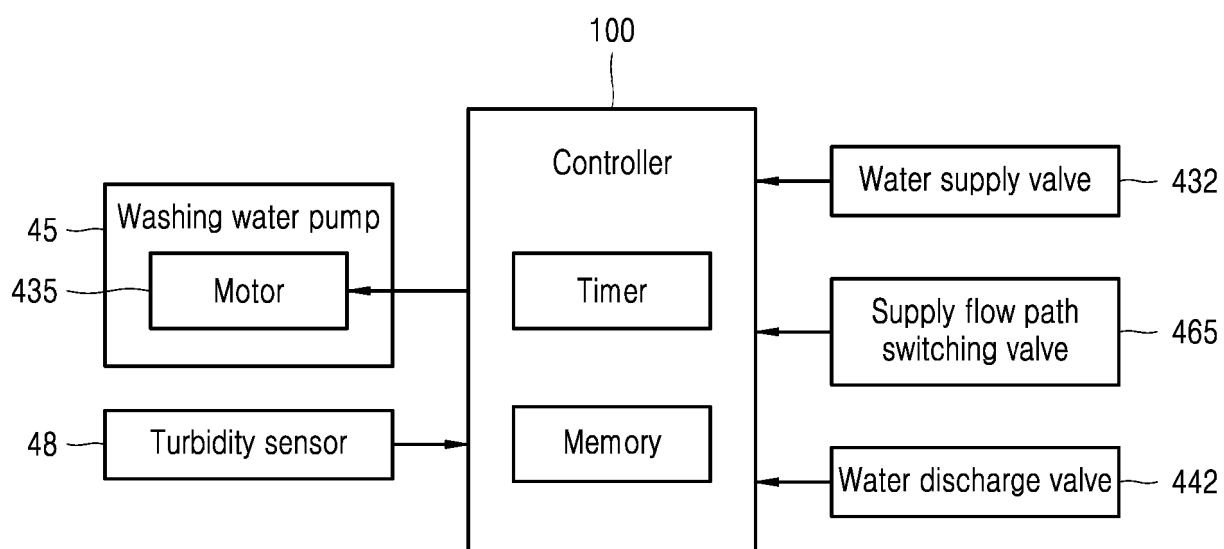
【Figure 3】

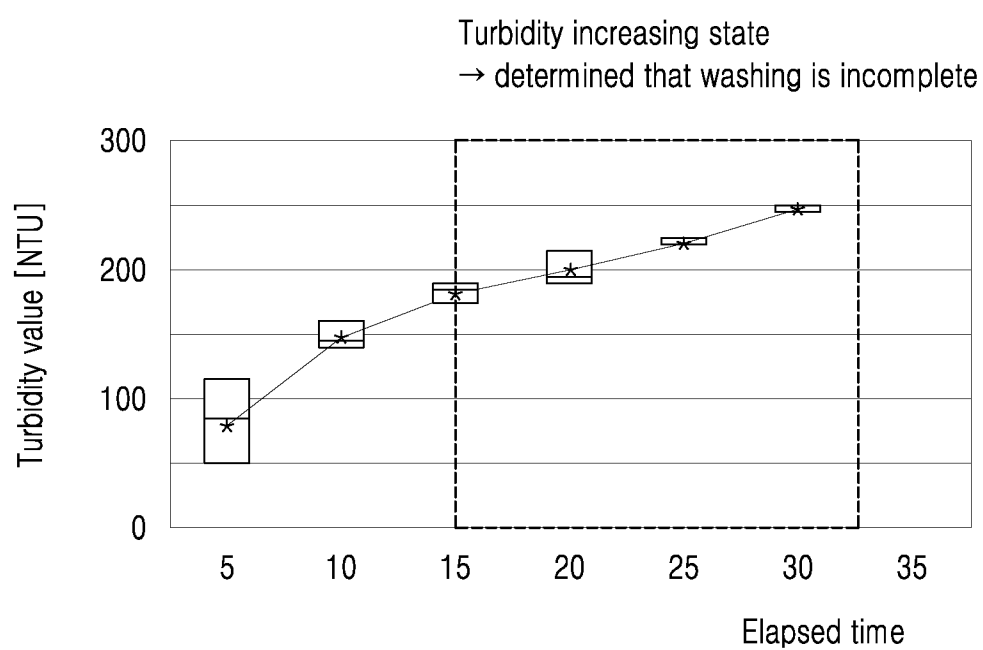


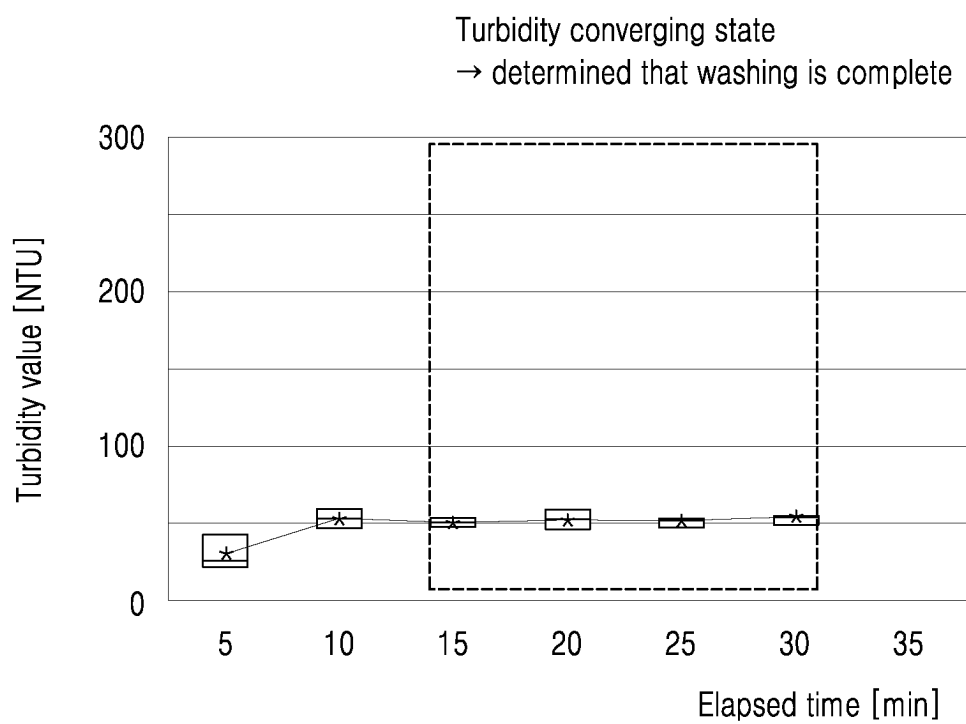
【Figure 4】



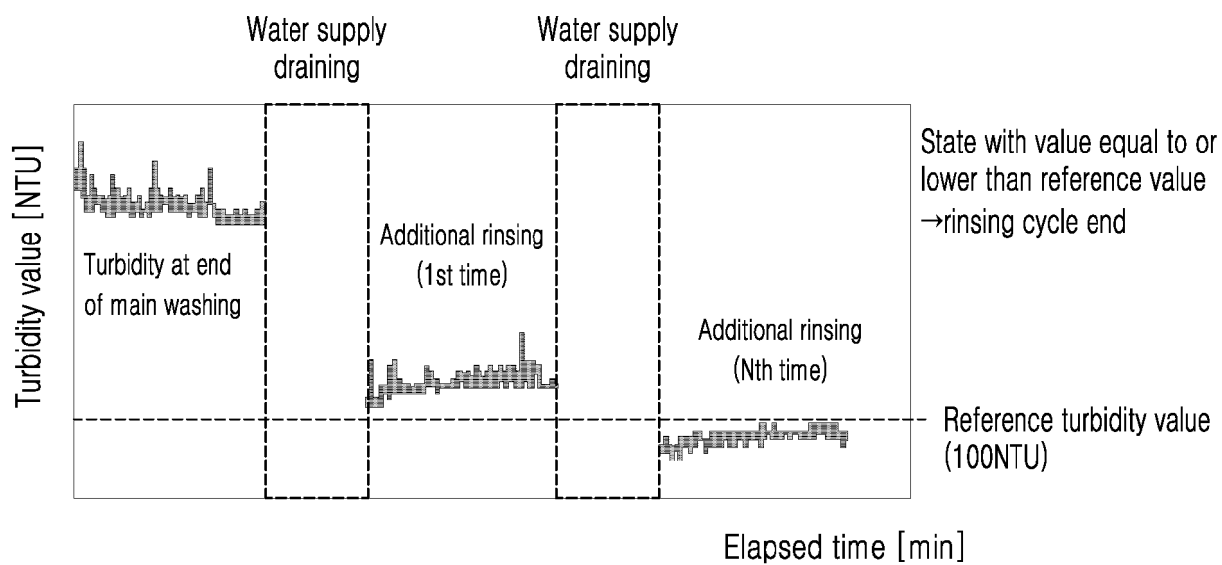
【Figure 5】



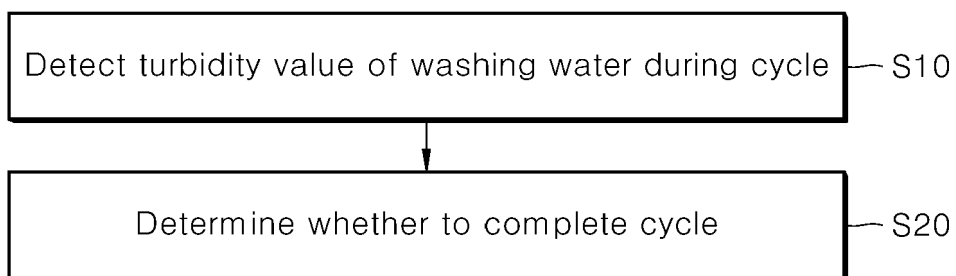
【Figure 6】

【Figure 7】

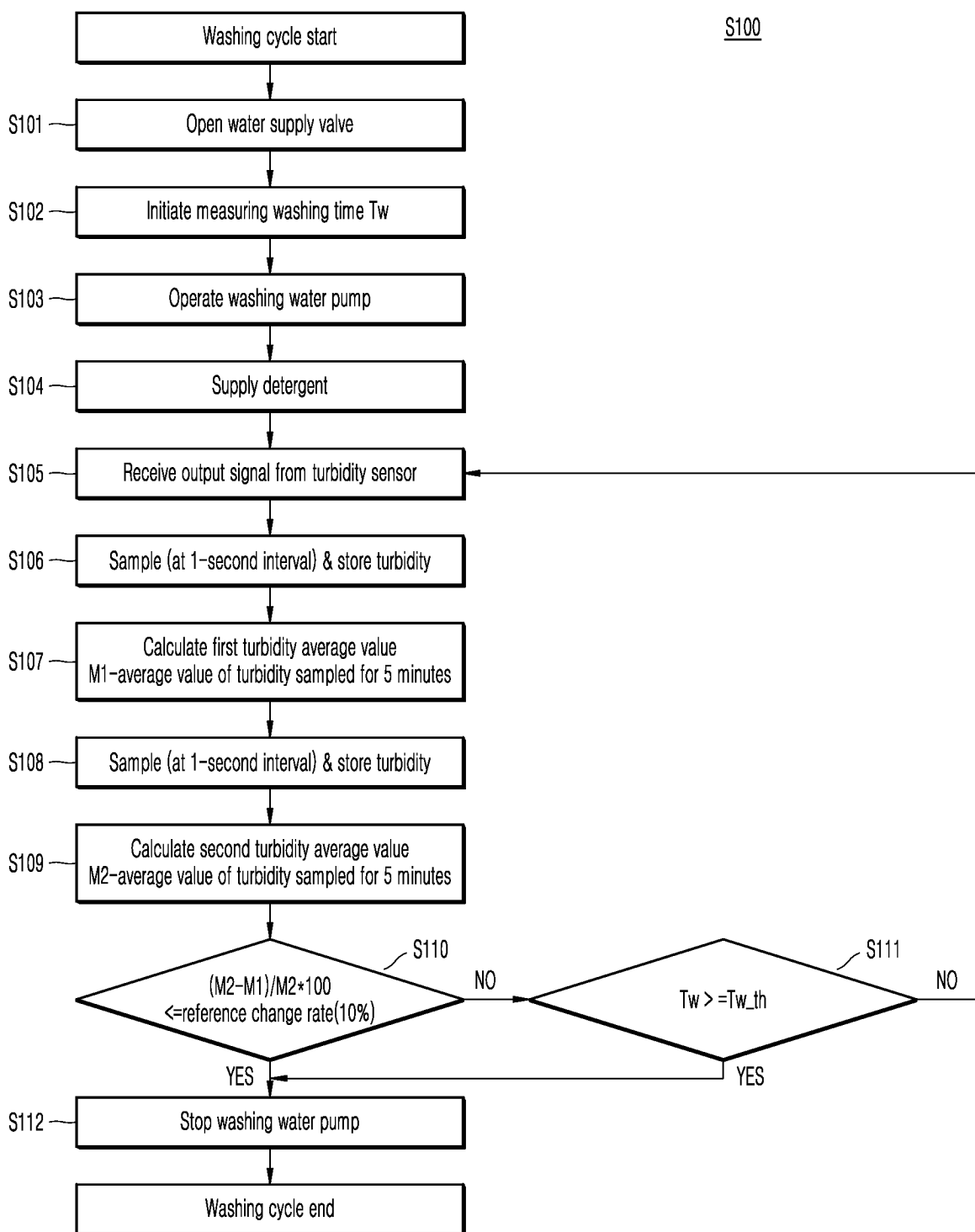
【Figure 8】



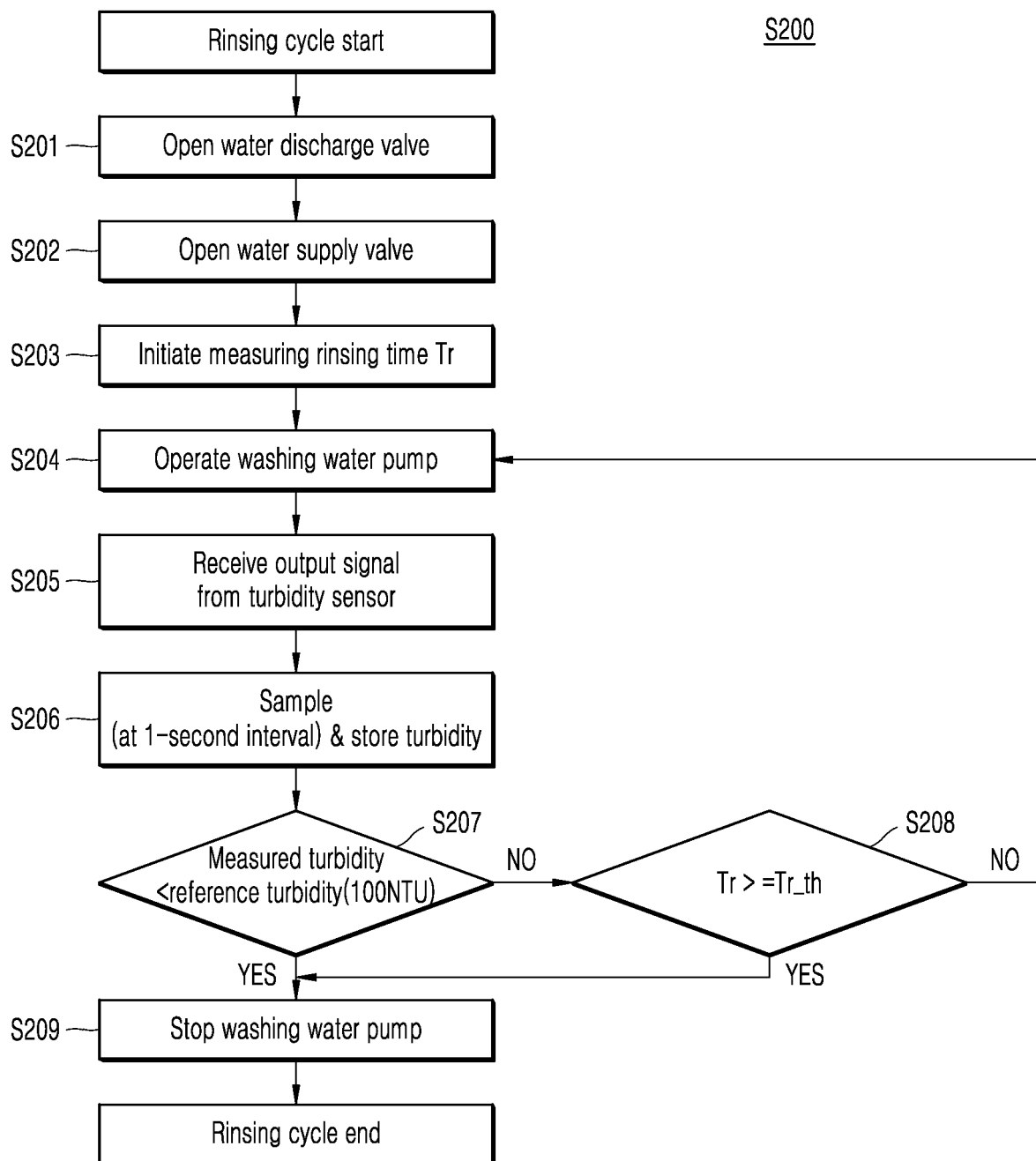
【Figure 9】



【Figure 10】



【Figure 11】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2023/010330

A. CLASSIFICATION OF SUBJECT MATTER

A47L 15/42(2006.01)i; A47L 15/00(2006.01)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)

A47L 15/42(2006.01); A47L 15/00(2006.01); A47L 15/46(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: 탁도(turbidity), 식기세척기(dishwasher), 주기(cycle), 샘플링(sampling) 및 평균(average)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 10-2008-0051369 A (SAMSUNG ELECTRONICS CO., LTD.) 11 June 2008 (2008-06-11) See paragraphs [0033]-[0069] and figures 1-3b.	1,10
Y		2-9,11-15
Y	CN 209331974 U (VATTI CO., LTD.) 03 September 2019 (2019-09-03) See paragraphs [0037]-[0049].	2-9,11-15
A	KR 10-1174533 B1 (LG ELECTRONICS INC.) 17 April 2007 (2007-04-17) See paragraphs [0027]-[0058] and figures 2-4.	1-15
A	KR 10-2008-0050838 A (SAMSUNG ELECTRONICS CO., LTD.) 10 June 2008 (2008-06-10) See paragraphs [0022]-[0048] and figures 1-3.	1-15
A	JP 2011-010798 A (PANASONIC CORP.) 20 January 2011 (2011-01-20) See paragraphs [0020]-[0133] and figures 1-12.	1-15

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“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

“&” document member of the same patent family

Date of the actual completion of the international search

31 October 2023

Date of mailing of the international search report

31 October 2023

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2023/010330

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
KR 10-2008-0051369 A	11 June 2008	CN 101194820 A	11 June 2008
		EP 1929919 A2	11 June 2008
		EP 1929919 A3	22 April 2009
		US 2008-0128001 A1	05 June 2008
CN 209331974 U	03 September 2019	None	
KR 10-1174533 B1	17 April 2007	KR 10-2007-0040469 A	17 April 2007
KR 10-2008-0050838 A	10 June 2008	None	
JP 2011-010798 A	20 January 2011	JP 5278201 B2	04 September 2013

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2175766 A [0006]