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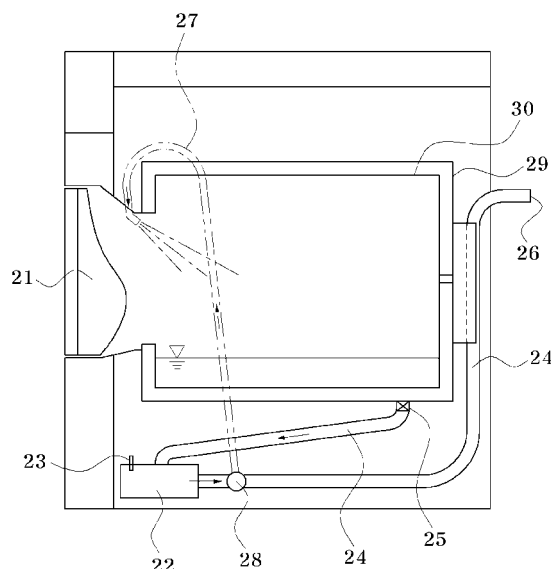
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(54) **APPARATUS AND METHOD FOR CIRCULATING CLEANING WATER FOR DRUM WASHING MACHINE**

(57) An apparatus and method for circulating cleaning water for drum washing machine is disclosed. The apparatus for circulating cleaning water includes a tub, a drain hose connected to the tub, a muddiness detecting sensor detecting a degree of muddiness of wash water being discharged through the drain hose after being used for rinsing laundry, a drain pump located in the drain hose to pump the wash water being discharged through the drain hose, a circulation hose connected to the drain hose at a discharge side of the drain pump to supply the wash water into a drum, a supply valve located at a connecting portion between the drain hose and the circulation hose to selectively supply the wash water pumped by the drain pump to the drain hose of a drain port side or to the circulation hose, and a controller controlling operations of the drain pump and the supply valve.

【Figure 2】



Description

[Technical Field]

[0001] The present invention relates to drum washing machines and, more particularly, to an apparatus and method for circulating cleaning water for drum washing machine that can reduce the amount of wash water for use in a washing operation and can enhance washing efficiency of the drum washing machine.

[Background Art]

[0002] A drum washing machine is a machine that washes laundry using detergent and water in a drum by rotating the drum using a drive force from a motor. The drum washing machine has many advantages such as little damage of laundry, less entanglement, and laundry pounding and rubbing effects in a washing operation.

[0003] A drum washing machine of the related art will be described with reference to a drawing.

[0004] Fig. 1 is a schematic diagram showing a drainage device of a drum washing machine in the related art.

[0005] Referring to Fig. 1, the washing machine includes a cabinet (not shown) having a laundry entrance opening defined in a front side thereof, a door 11 hingably attached to the cabinet to open and close the opening, a tub 16 disposed inside the cabinet to receive wash water, a drive unit (not shown) mounted on the tub 16 to generate a drive force, a drum 17 connected to the drive unit to wash the laundry, a water supply device (not shown) to supply the wash water into the drum 17, and a drainage device. The drum 17 is formed with a plurality of through-holes through which the wash water enters or is discharged from the drum 17.

[0006] The drainage device includes a drain pump 12, a drain hose 13, and a drain valve 14. As the drain valve 14 is open and the drain pump 12 is actuated, the wash water is discharged through the drain hose 13.

[0007] With this configuration, the drum washing machine washes laundry while sequentially or optionally performing a washing cycle, a rinsing cycle, a spin-drying cycle and a drying cycle.

[0008] It should be noted that the the aforementioned technique is described for understanding the related art of the invention and is not a well-known conventional technique in the art.

[Disclosure]

[Technical Problem]

[0009] When the rinsing cycle is completed, a conventional drum washing machine supplies fresh water to the drum to perform the rinsing cycle again after discharging wash water used for the rinsing cycle to the outside. In this case, the wash water, which contains little detergent and can be used again for the rinsing cycle, is also dis-

charged, thereby causing waste of water.

[0010] Further, when a washing cycle is started, the conventional drum washing machine allows the water supply unit to supply wash water into the drum, which in turn is rotated to perform the washing cycle when the wash water reaches a predetermined level in the drum. In the conventional drum washing machine, however, a predetermined amount of detergent is supplied in a non-dissolved state from the tub into the drum in washing cycle. Particularly, when a powdery detergent is used for laundry washing, a small amount of powdery detergent is liable to be trapped between strands of the laundry and is not substantially dissolved, thereby making the washing cycle ineffective. Moreover, since the washing cycle is performed after the wash water is supplied to the predetermined level in the drum, there is a problem in that some of the laundry is not sufficiently soaked with the wash water in the washing cycle. Therefore, there is a need to solve such problems of the conventional drum washing machine.

[0011] The present invention is directed to solving the problems of the related art, and an aspect of the invention is to provide an apparatus and method for circulating cleaning water for drum washing machine, which can use clean wash water, having been used for a rinsing cycle and containing substantially no detergent residue, repetitiously for the rinsing cycle by circulating the wash water being discharged to a drain hose of the washing machine during the rinsing cycle, thereby reducing the amount of water for use in the rinsing cycle.

[0012] Further, another aspect of the invention is to provide an apparatus and method for circulating cleaning water for drum washing machine, which can circulate wash water during a washing cycle, thereby enhancing washing efficiency, reducing washing duration, and lowering the amount of water for use in the washing cycle.

[Technical Solution]

[0013] In accordance with an aspect of the invention, an apparatus for circulating cleaning water for drum washing machine includes: a tub; a drain hose connected to the tub; a muddiness detecting sensor detecting a degree of muddiness of wash water being discharged through the drain hose; a drain pump located in the drain hose to pump the wash water being discharged through the drain hose after being used for rinsing the laundry; a circulation hose connected to the drain hose at a discharge side of the drain pump to supply the wash water into a drum; a supply valve located at a connecting portion between the drain hose and the circulation hose to selectively supply the wash water pumped by the drain pump to the drain hose of a drain port side or to the circulation hose; and a controller controlling operations of the drain pump and the supply valve.

[0014] The apparatus for circulating cleaning water may further include a drain valve located at a connecting portion between the tub and the drain hose to drain the

wash water used for rinsing the laundry.

[0015] The drain hose may be connected to a lower side of the tub.

[0016] The muddiness detecting sensor may be located in the drain pump or the drain hose at the tub side.

[0017] In accordance with another aspect of the invention, a method for circulating cleaning water for drum washing machine includes: draining wash water used for rinsing laundry after a rinsing cycle; measuring a degree of muddiness of the wash water to compare the measured degree of muddiness with a target value; circulating the wash water if the measured degree of muddiness of the wash water is less than or equal to the target value; and draining the wash water if the measured degree of muddiness of the wash water is greater than the target value.

[0018] The circulating the wash water may include actuating a drain pump and opening a port of a supply valve at a circulation hose side.

[0019] The draining the wash water used for rinsing the laundry may include actuating a drain pump and opening a port of a supply valve at a drain hose side of a drain port side.

[0020] In accordance with a further aspect of the invention, an apparatus and method for circulating cleaning water for drum washing machine: a tub; a drain hose connected to the tub; a drain pump located in the drain hose to pump wash water being discharged through the drain hose; a circulation hose connected to the drain hose at a discharge side of the drain pump to supply the wash water into a drum; a supply valve located at a connecting portion between the drain hose and the circulation hose to selectively supply the wash water pumped by the drain pump to the drain hose at a drain side or to the circulation hose; and a controller controlling operation of the drain pump and the supply valve.

[0021] The apparatus for circulating cleaning water may further include a drain valve located at a connecting portion between the tub and the drain hose to drain the wash water.

[0022] The drain hose may be connected to a lower side of the tub.

[Advantageous Effects]

[0023] As such, according to the embodiments of the invention, a degree of muddiness of wash water, that is, rinsing water, being discharged through the drain hose of the drum washing machine after being used for a rinsing cycle, is measured and compared with a target value, and the circulation hose is coupled to the supply valve to circulate the rinsing water into the drum therethrough, so that clean rinsing water containing substantially no detergent residue can be used again for the rinsing cycle, thereby reducing the amount of water for use in the rinsing cycle.

[0024] Further, according to the embodiments, wash water is permitted to be circulated into the drum during

a washing cycle by coupling the circulation hose and the supply valve to a discharge port of the drain pump, so that detergent can be more sufficiently dissolved in the wash water and can be prevented from being trapped between the strands of laundry. Accordingly, it is possible to prevent trace detergent from remaining in the laundry after the washing operation.

[0025] Further, according to the embodiments, the detergent is supplied in a sufficiently dissolved state into the drum through circulation of the wash water, thereby enhancing washing efficiency while reducing washing duration.

[0026] Moreover, according to the embodiments, water for use in operation of the drum washing machine is circulated into the drum, thereby reducing the amount of water for use in the washing operation.

[Description of Drawings]

[0027] The above and other aspects, features, and advantages of the invention will become apparent from the following detailed description of embodiments of the invention in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram of a drainage device of a drum washing machine in the related art;

Fig. 2 is a schematic diagram of an apparatus for circulating cleaning water for drum washing machine in accordance with one embodiment of the present invention;

Fig. 3 is a block diagram of an apparatus and method for circulating cleaning water for drum washing machine in accordance with one embodiment of the present invention;

Fig. 4 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with the embodiment of the invention;

Fig. 5 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with another embodiment of the present invention; and

Fig. 6 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with a further embodiment of the present invention.

[Best Mode]

[0028] Embodiments of the invention will hereinafter be described in detail with reference to the accompanying drawings. It should be noted that the drawings are not to precise scale and may be exaggerated in thickness of lines or sizes of components for descriptive convenience and clarity only. Furthermore, the terms as used herein are defined by taking functions of the invention into account and can be changed according to the custom or intention of users or operators. Therefore, definition of the terms should be made according to the overall dis-

closures set forth herein.

[0029] Fig. 2 schematically shows an apparatus for circulating cleaning water for drum washing machine in accordance with one embodiment of the invention.

[0030] Referring to Fig. 2, an apparatus for circulating cleaning water for drum washing machine according to one embodiment includes a door 21, a drain pump 22, a muddiness detecting sensor 23, a drain hose 24, a drain valve 25, a drain port 26, a circulation hose 27, a supply valve 28, a tub 29, and a drum 30. A three-way valve or various other valves may be used as the supply valve 28.

[0031] If a preset duration has elapsed after starting a washing cycle, wash water is drained through the drain hose 24. In one embodiment, draining of wash water may be started by opening the drain valve 25. The drain hose 24 may be connected to a lower side of the tub 29. When draining of the wash water is started, the drain pump 22 pumps the wash water, which is being drained through the drain hose 24, and a port of the supply valve 28 is open at the circulation hose 28 side while another port of the supply valve 28 is closed at the drain hose 24 side of the drain port 26 side. As a result, the wash water is supplied into the drum 30 through the circulation hose 27. When the washing cycle is completed, the drain pump 22 continues to operate, and the other port of the supply valve 28 is open at the drain hose 24 side of the drain port 26 side while the port of the supply valve 28 is closed at the circulation hose 27 side, so that the wash water can be discharged outside from the drain port 26 through the drain hose 24.

[0032] Then, when a rinsing cycle is completed, the drain valve 25 is open and the drain pump 22 is filled with wash water used for the rinsing cycle (hereinafter, referred to as "rinsing water"), which flows into the drain pump 22 through the drain hose 24.

[0033] The muddiness detecting sensor 23 measures the degree of muddiness of the rinsing water. In one embodiment, the muddiness detecting sensor 23 may be located in the drain pump 22 as shown in Fig. 2, and may be located in the drain hose 24 between the drain valve 25 and the drain pump 22.

[0034] If the measured degree of muddiness of the rinsing water is less than or equal to a target value, the drain pump 22 pumps the rinsing water being discharged through the drain hose 24, and the port of the supply valve 28 is open at the circulation hose 27 side while the other port of the supply valve 28 is closed at the drain hose 24 side of the drain port 26 side. As a result, the rinsing water is supplied into the drum 30 through the circulation hose 27. A series of these operations is controlled by a controller 31 (see Fig. 3), which will be described below.

[0035] If the degree of muddiness of the rinsing water is greater than the target value, the drain pump 22 pumps the rinsing water being discharged through the drain hose 24, and the other port of the supply valve 28 is open at the drain hose 24 side of the drain port 26 side while the port of the supply valve 28 is closed at the circulation

hose 27 side. As a result, the rinsing water is discharged from the drain port 26 through the drain hose 24.

[0036] Fig. 3 is a block diagram of an apparatus and method for circulating cleaning water for drum washing machine in accordance with one embodiment of the invention, and Fig. 4 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with the embodiment of the invention.

[0037] Next, the method for circulating cleaning water for drum washing machine according to this embodiment will be described with reference to Figs. 3 and 4.

[0038] The controller 31 controls operations of respective components of the drum washing machine including the drain pump 34 and the supply valve 28. When a rinsing cycle is completed, the controller 31 opens the drain valve 25 to allow rinsing water to be drained in S210. The rinsing water flows into the drain pump 34 through the drain hose 24 and fills the drain pump 34, where a degree of muddiness (Sd) of the rinsing water is measured and compared with a target value (St) by the muddiness detecting sensor 23 in S220. If the measured degree of muddiness (Sd) is less than or equal to the target value (St), the controller 31 actuates the drain pump 22 and opens the port of the supply valve 28 at the circulation hose 27 side in S230. In one embodiment, if the degree of muddiness (Sd) of the rinsing water is less than or equal to the target value (St), the controller 31 may close the drain valve 25 and allow the rinsing cycle to be performed by complementing an amount of rinsing water that corresponds to the amount of rinsing water discharged to the drain pump 22.

[0039] If the measured degree of muddiness (Sd) is greater than the target value (St), the controller 31 actuates the drain pump 22 and opens the other port of the supply valve 28 at the drain hose 24 side of the drain port 26 side in S240.

[0040] As such, in the apparatus for circulating cleaning water for drum washing machine, the degree of muddiness (Sd) of the rinsing water, being discharged through the drain hose 24 of the drum washing machine, is measured and compared with a target value, and the circulation hose 27 is coupled to the supply valve 28 to circulate the rinsing water into the drum therethrough, so that clean rinsing water containing substantially no detergent residue can be used again for the rinsing cycle, thereby reducing the amount of water used in the rinsing cycle.

[0041] Fig. 5 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with another embodiment of the present invention.

[0042] As shown in Figs. 2, 3 and 5, when a washing cycle is started, the controller 31 determines whether a preset duration has elapsed in S310. If the preset duration has elapsed, the controller 31 actuates the drain pump 22 and opens the port of the supply valve 28 at the circulation hose 27 side to allow wash water to be supplied into the drum 30 through the circulation hose 27 in S320. Then, the controller 31 determines whether the

washing cycle is completed in S330. If the washing cycle is completed, the controller 31 continues to actuate the drain pump 22 and opens the other port of the supply valve 28 at the drain hose 24 side of the drain port 26 side to allow the wash water to be discharged through the drain port 26 via the drain hose 24 in S340. As such, the apparatus for circulating cleaning water for drum washing machine permits the wash water to be circulated into the drum during the washing cycle by coupling the circulation hose and the supply valve to the discharge port of the drain pump, so that detergent can be more sufficiently dissolved in the wash water and can be prevented from being trapped between the strands of laundry. Thus, it is possible to prevent trace detergent from remaining in the laundry after the washing operation. Further, the detergent is supplied in a sufficiently dissolved state through circulation of the wash water, thereby enhancing washing efficiency while reducing washing duration. Moreover, water used for the washing cycle and received in the tub 29 is circulated into the drum, thereby reducing the amount of water for use in the washing operation of the washing machine.

[0043] Fig. 6 is a flowchart of a method for circulating cleaning water for drum washing machine in accordance with a further embodiment of the present invention.

[0044] In this embodiment, the method may be applied to a rinsing cycle. Next, the method of the embodiment applied to the rinsing cycle will be described with reference to Figs. 2, 3 and 6.

[0045] When the rinsing cycle is started, the controller 31 determines whether a preset duration has elapsed in S410. If the preset duration has elapsed, the controller 31 actuates the drain pump 22 and opens the port of the supply valve 28 at the circulation hose 27 side to allow wash water to be supplied into the drum 30 through the circulation hose 27 in S420. Then, the controller 31 determines whether the rinsing cycle is completed in S430. If the rinsing cycle is completed, the controller 31 continues to actuate the drain pump 22 and opens the other port of the supply valve 28 at the drain hose 24 side of the drain port 26 side to allow the wash water to be discharged from the drain port 26 through the drain hose 24 in S440. As such, when the method according to the embodiment is applied to the rising cycle, rinsing efficiency can be enhanced while reducing rising duration, thereby reducing the amount of water for use in the rinsing cycle of the washing machine.

[0046] Although some embodiments have been provided to illustrate the invention in conjunction with the drawings, it will be apparent to those skilled in the art that the embodiments are given by way of illustration only, and that various modifications, changes and substitutions can be made without departing from the spirit and scope of the invention. The scope of the invention should be defined only by the accompanying claims and equivalents thereof.

Claims

1. An apparatus for circulating cleaning water for drum washing machine, comprising:
 - a tub;
 - a drain hose connected to the tub;
 - a muddiness detecting sensor detecting a degree of muddiness of wash water being discharged through the drain hose after being used for rinsing laundry;
 - a drain pump located in the drain hose to pump the wash water being discharged through the drain hose;
 - a circulation hose connected to the drain hose at a discharge side of the drain pump to supply the wash water into a drum;
 - a supply valve located at a connecting portion between the drain hose and the circulation hose to selectively supply the wash water pumped by the drain pump to the drain hose of a drain port side or to the circulation hose; and
 - a controller controlling operations of the drain pump and the supply valve.
2. The apparatus according to claim 1, further comprising: a drain valve located at a connecting portion between the tub and the drain hose to drain the wash water used for rinsing the laundry.
3. The apparatus according to claim 1, wherein the drain hose is connected to a lower side of the tub.
4. The apparatus according to claim 1, wherein the muddiness detecting sensor is located in the drain pump or the drain hose at the tub side.
5. A method for circulating cleaning water for drum washing machine comprising:
 - draining wash water used for rinsing laundry after a rinsing cycle;
 - measuring a degree of muddiness of the wash water to compare the measured degree of muddiness of the wash water with a target value;
 - circulating the wash water if the measured degree of muddiness of the wash water is less than or equal to the target value; and
 - draining the wash water if the measured degree of muddiness of the wash water is greater than the target value.
6. The method according to claim 5, wherein the circulating the wash water comprises actuating a drain pump and opening a port of a supply valve at a circulation hose side.
7. The method according to claim 5, wherein the drain-

ing the wash water comprises actuating a drain pump and opening a port of a supply valve at a drain hose side of a drain port side.

8. An apparatus for circulating cleaning water for drum washing machine comprising: 5

a tub;
 a drain hose connected to the tub;
 a drain pump located in the drain hose to pump wash water being discharged through the drain hose; 10
 a circulation hose connected to the drain hose at a discharge side of the drain pump to supply the wash water into a drum; and 15
 a supply valve located at a connecting portion between the drain hose and the circulation hose to selectively supply the wash water pumped by the drain pump to the drain hose at a drain side or to the circulation hose. 20

9. The apparatus according to claim 8, further comprising: a drain valve located at a connecting portion between the tub and the drain hose to drain the wash water. 25

10. The apparatus according to claim 8, wherein the drain hose is connected to a lower side of the tub.

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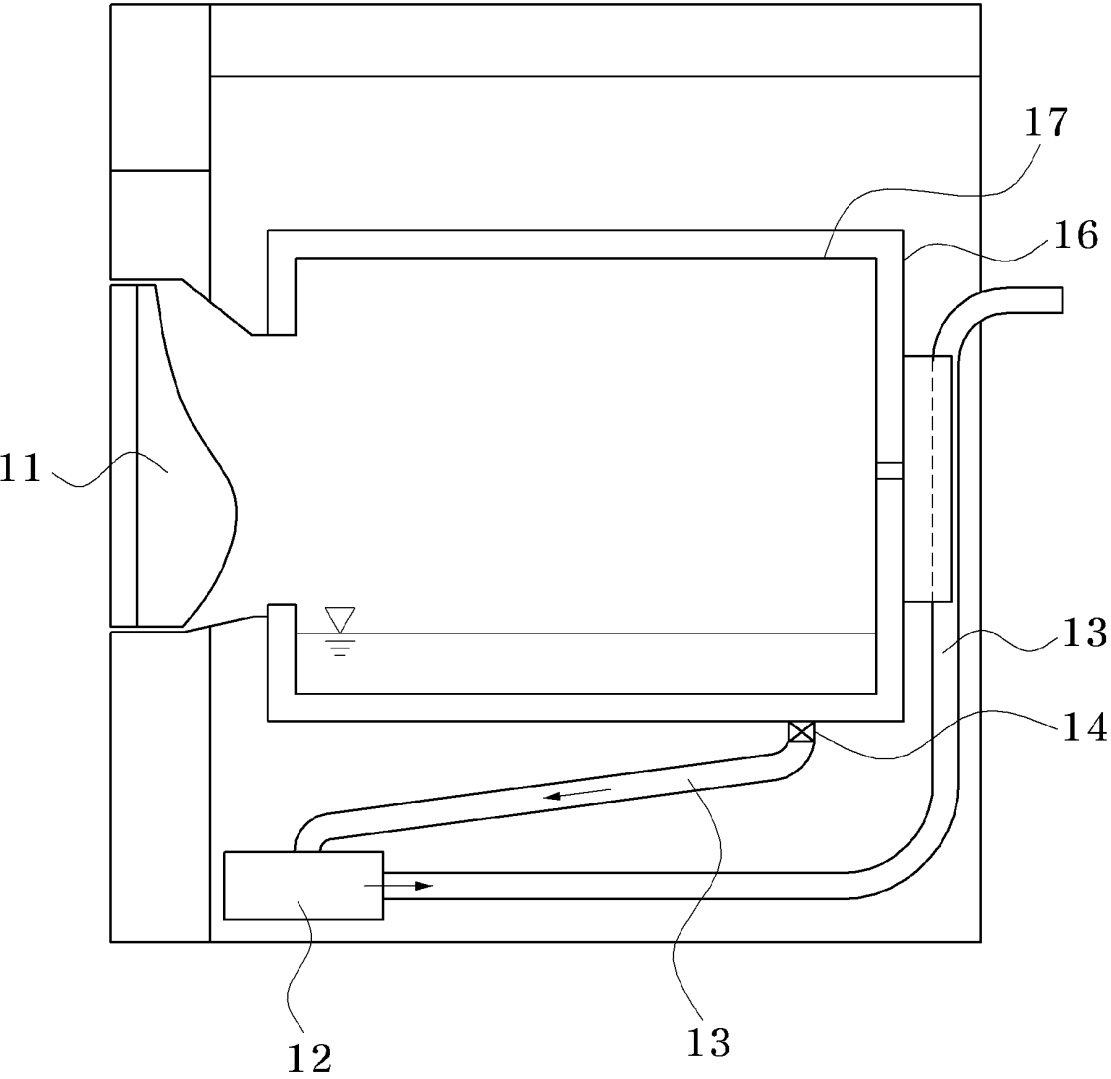
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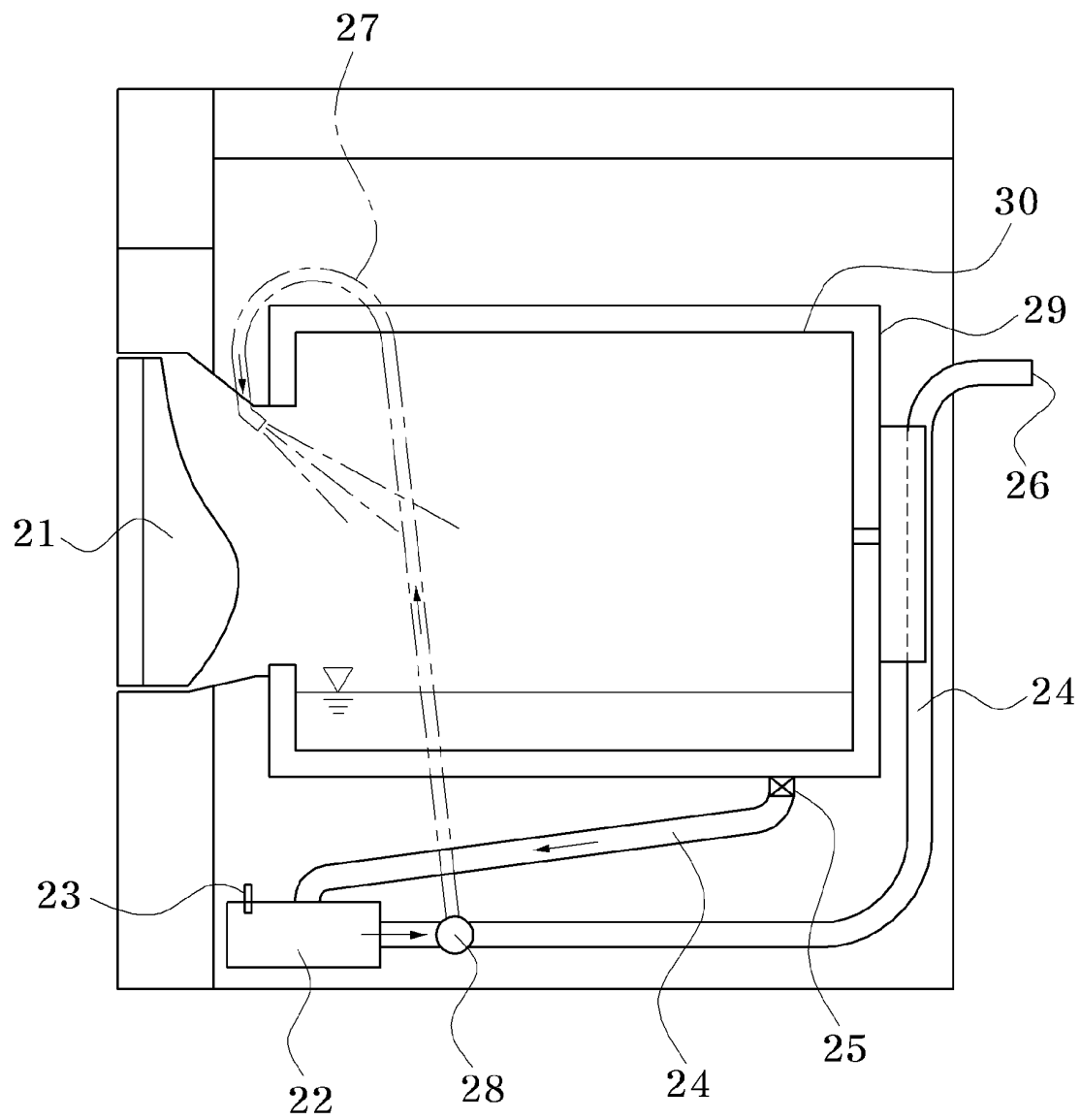
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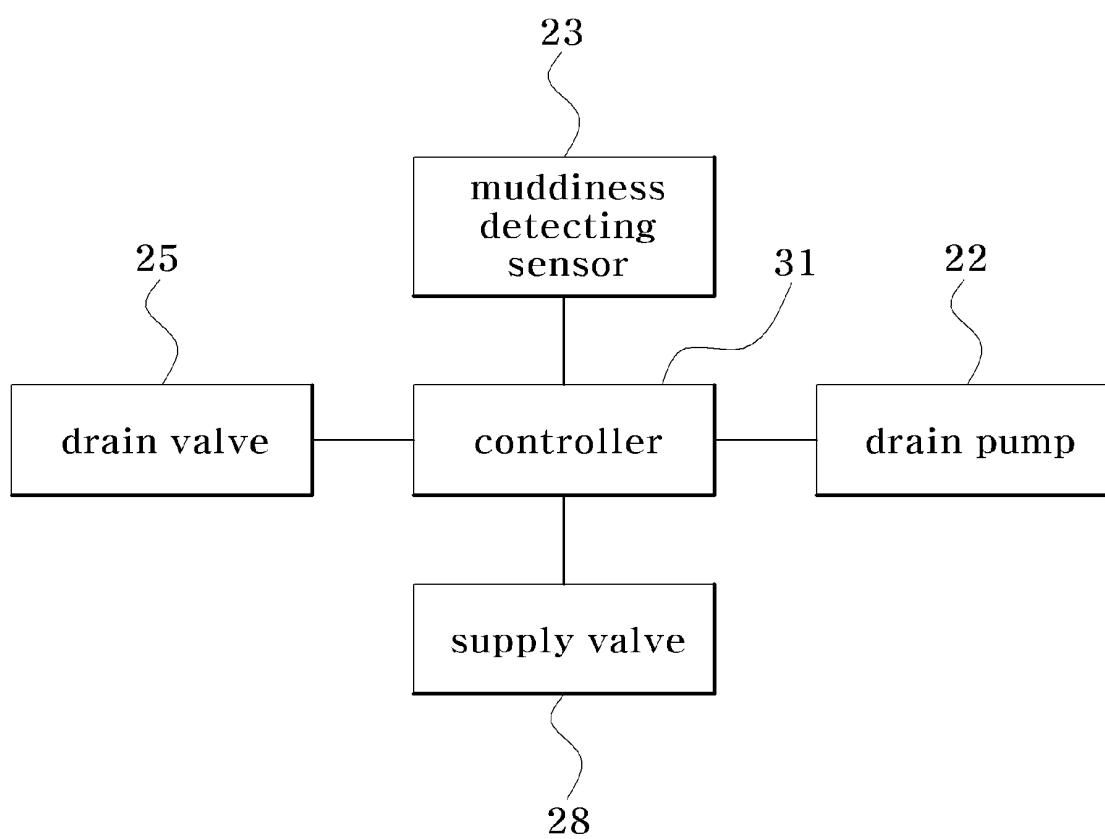
【Figure 1】



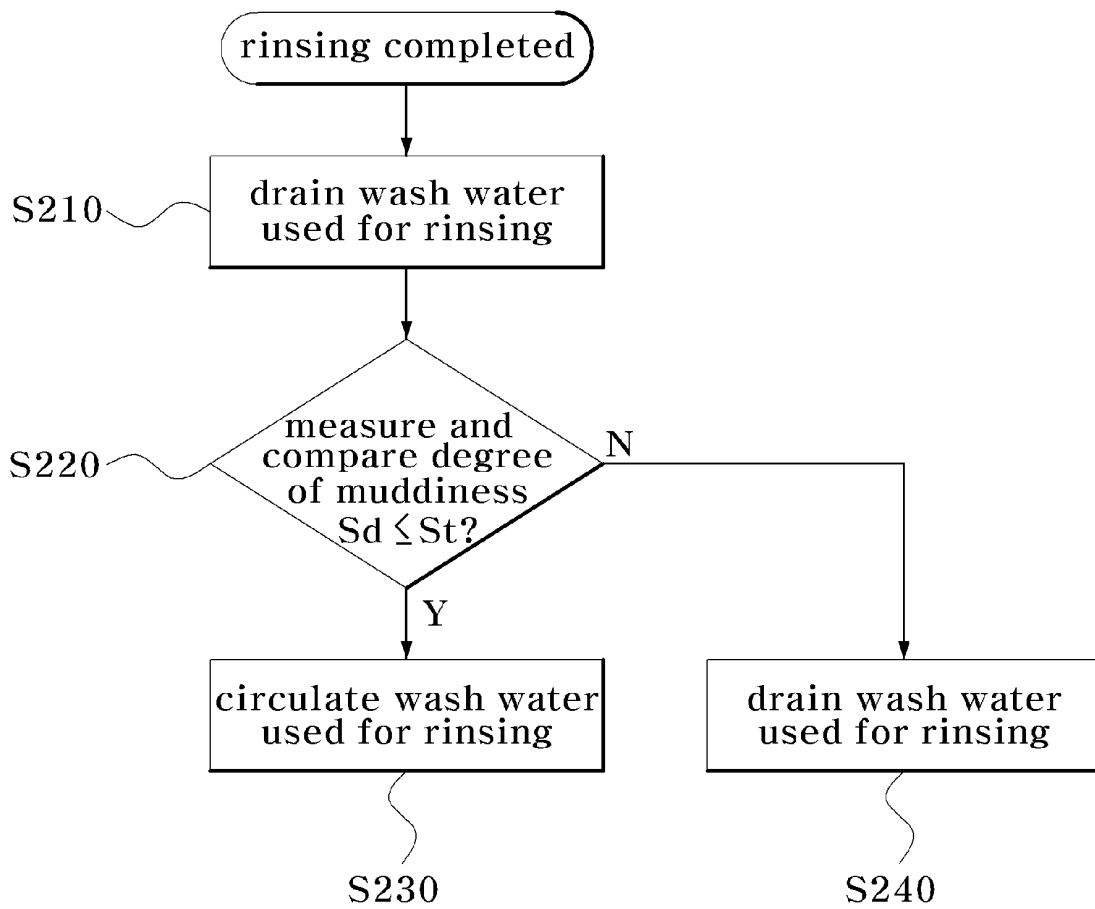
【Figure 2】



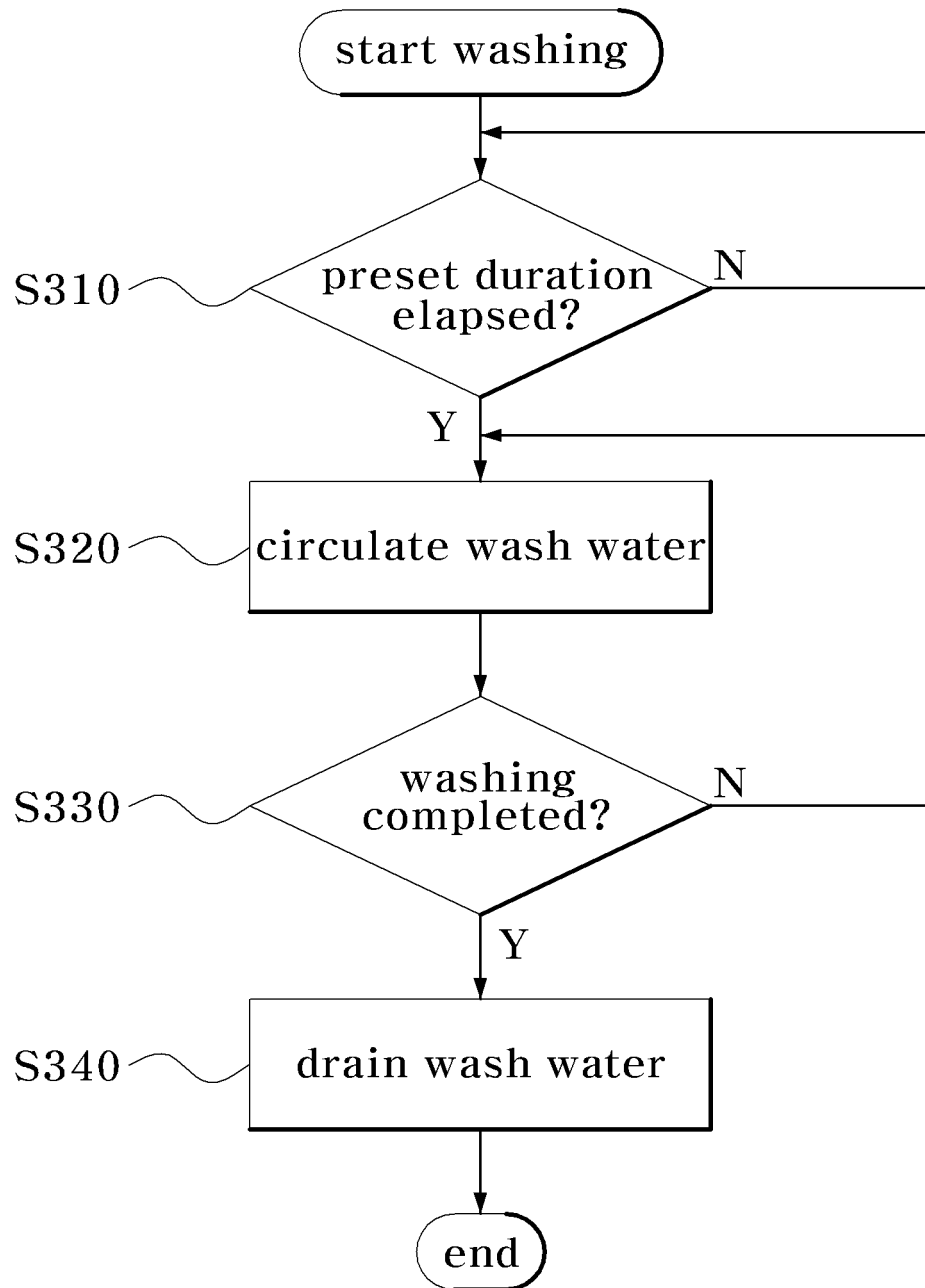
【Figure 3】



【Figure 4】



【Figure 5】



【Figure 6】

