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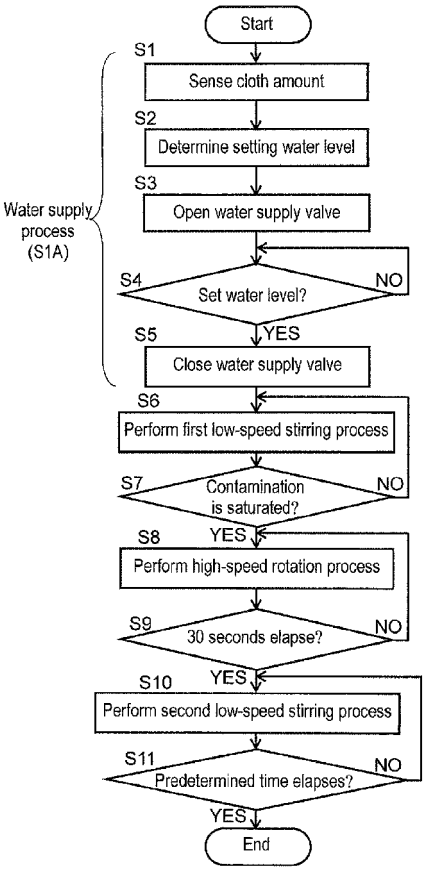
(54) Drum-type washing machine and washing control method performed by the same

(57) A washing process includes a process of rotating a washing tank at low speed at which clothes are not clung to an inner wall of the washing tank and a process of rotating the washing tank at high speed at which the clothes are clung to the inner wall of the washing tank. A controller performs the high-speed rotation process when an output of a contamination sensor becomes a predetermined condition after the low-speed rotation process. Therefore, in a state in which washing water sufficiently spreads into the clothes to cause contamination to sufficiently float from the clothes, the contaminations can be pulled out to quickly perform washing.

FIG. 2



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a drum-type washing machine that includes a washing tank, which is rotatable while accommodating clothes in an elastically-supported outer tank, and washes, rinses, spin-dries, and dries the clothes in the washing tank, and to a washing control method performed by the drum-type washing machine.

2. Description of the Related Art

[0002] In a drum-type washing machine of the related art, after clothes are put in a washing tank, water is supplied from the outside of the washing machine by water supply means. The washing water is poured into the washing tank or an outer tank mounting the washing tank through a detergent storage in which a preset amount of detergent is previously put. After the water is poured, clothes are sufficiently wetted with the washing water while the washing tank is rotated at low speed. Then, the washing tank is rotated for a certain period of time at low speed at which the clothes are not clung to a wall of the washing tank. Contaminations are washed out by an impact that is generated by falling of the wet clothes from an upper portion of the washing tank in association with the rotation. In the drum-type washing machine, particularly in the case of a large amount of clothes, it is difficult to evenly wet the clothes put in the washing tank in a process of wetting the clothes, whereby washing unevenness is generated to significantly degrade washing performance.

[0003] Therefore, after the water supply, beating washing is performed by rotating the washing tank at a predetermined relatively low rotation speed. Additionally, wringing washing is performed by rotating the washing tank at a rotation speed higher than the predetermined rotation speed. The predetermined rotation speed is a rotation speed at which the washing water in the clothes is sufficiently ejected to the outside of the washing tank by a centrifugal force. Therefore, the clothes are stirred so as to be mixed better, thereby evenly wetting the clothes (for example, refer to Unexamined Japanese Patent Publication No. H08-299658).

[0004] However, in the configuration of the related art, the clothes are insufficiently wetted with the water only by the water supply when the washing tank is rotated at high speed at an certain time after the water supply. For this reason, weights of the clothes are not increased too much, which limits an effect of the centrifugal force even if the washing tank is rotated at high speed. When the clothes are insufficiently wetted with the water, large friction is generated between the washing tank and clothes due to high-speed rotation to increase damage of the clothes. Because the washing water in which the detergent is mixed insufficiently reaches the clothes, the contaminations of the clothes hardly float by the washing water. Therefore, because the contaminations of the clothes are not pulled off even if the washing tank is rotated at high speed in this state, the drum-type washing machine of the related art has a problem in that the washing effect is insufficiently obtained.

SUMMARY OF THE INVENTION

[0005] A drum-type washing machine according to the present invention includes a washing tank that rotates while accommodating clothes; an outer tank that mounts the washing tank; a driving unit that drives the washing tank; a contamination sensor that senses contamination of washing water in the outer tank; and a controller that controls the driving unit by determining a degree of a contamination based on an output of the contamination sensor. The controller performs a washing process including a low-speed stirring process of rotating the washing tank at low speed at which the clothes are not clung to an inner wall of the washing tank and a high-speed rotation process of rotating the washing tank at high speed at which the clothes are clung to the inner wall of the washing tank. The controller performs the high-speed rotation process when the output of the contamination sensor becomes a predetermined condition during the low-speed stirring process.

[0006] Therefore, after the water supply, the clothes become wet while including the washing water in which the detergent is sufficiently mixed by performing the low-speed stirring process, and the surfactant of the detergent is attracted to the contaminations of the clothes. The washing tank is rotated at high speed when the output of the contamination sensor becomes the predetermined condition. Therefore, the washing water, which is located near the clothes while the detergent is mixed therein, and the contaminations adhering to the detergent can be pulled out.

BRIEF DESCRIPTION OF DRAWINGS

[0007]

Fig. 1 shows a schematic configuration diagram of a drum-type washing machine according to a first exemplary embodiment of the present invention;

Fig. 2 shows a flowchart of a washing control method performed by the drum-type washing machine according to the first exemplary embodiment of the present invention;

Fig. 3 shows a detected contamination value and a detected contamination value difference in a washing process of the drum-type washing machine according to the first exemplary embodiment of the present invention;

Fig. 4 shows a flowchart of a washing control method

performed by a drum-type washing machine according to a second exemplary embodiment of the present invention;

Fig. 5 shows a flowchart of a washing control method performed by the drum-type washing machine according to a third exemplary embodiment of the present invention; and

Fig. 6 shows the detected contamination value in the washing process of the drum-type washing machine according to the third exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Hereinafter, first to third exemplary embodiments of the present invention will be described below with reference to the drawings. Note that, the present invention is not limited to the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0009] Fig. 1 shows a schematic configuration diagram of a drum-type washing machine according to a first exemplary embodiment of the present invention. As illustrated in Fig. 1, outer tank 2 is disposed in outer casing 1 of the whole washing machine. Drum 3 serving as the washing tank is disposed inside outer tank 2 such that it is rotatable by a rotating shaft slanted downward from a horizontal direction to a backside direction. Motor 4 serving as the driving unit is connected to the backside of drum 3, and drum 3 is rotated by rotation of motor 4. Plural through-holes are formed on a circumferential wall of drum 3, and drum 3 also acts as a washing tank, a spin-drying tank, and a drying tank.

[0010] Water intake port 5 is connected to a lowermost portion of outer tank 2, and circulation route 12 is communicated with water intake port 5. The washing water taken from water intake port 5 is ejected to drum 3 from ejection port 11 through circulation route 12, thereby circulating the washing water in the washing machine. The water is taken in circulation route 12 with circulation pump 13 provided in circulation route 12. Thus, the washing water is circulated through circulation route 12 only by controlling circulation pump 13. Therefore, the washing water can be circulated irrespective of washing control, such as a water flow generated by the rotation of drum 3, in which usually detergency is controlled.

[0011] When the circulation water contains many foreign substances such as fibers of the clothes and hairs during the circulation, there is a risk of clogging circulation pump 13 or drain pipe 7. Therefore, filter 14 is placed between water intake port 5 and circulation pump 13 to remove the foreign substances such as the fibers of the clothes and the hairs.

[0012] Contamination sensor 15 is placed in circulation route 12 to sense a contamination of the washing water. In the first exemplary embodiment of the present invention, contamination sensor 15 is disposed between water intake port 5 and filter 14. At least one of a turbidity sensor, a conductivity sensor, and a color fading sensor is used as contamination sensor 15. Plural sensors may be used, or a sensor may have plural functions of sensing turbidity, electric conductivity, color fading, and the like.

[0013] Drain valve 6 is provided between water intake port 5 and circulation pump 13, and connected to drain pipe 7 located on a downstream side of drain valve 6.

[0014] Water level sensor 8 is placed at water intake port 5 in order to sense a level of the water supplied to outer tank 2 and drum 3. Water level sensor 8 is placed in a position flooded immediately after the water supply. For example, water level sensor 8 senses the water level such that a pressure applied to a diaphragm is detected as a deformation of the diaphragm. For example, a change in electrostatic capacitance and a strain gage are used as a method for detecting the deformation of the diaphragm.

[0015] Water supply inlet 9 is connected to running water, and outer tank 2 and drum 3 are sequentially filled with the washing water or rinse water through water supply valve 10.

[0016] For example, controller 16 is constituted by a microcomputer. Controller 16 determines a degree of the contamination based on a detected contamination value which is an output of contamination sensor 15. The detected contamination value is inputted to controller 16 from contamination sensor 15, and a water level sensing signal is inputted to controller 16 from water level sensor 8, whereby controller 16 opens and closes drain valve 6 and water supply valve 10 and controls motor 4 and circulation pump 13. Therefore, controller 16 controls a washing process, a rinsing process, a spin-drying process, and a drying process. Controller 16 also acts as a cloth amount sensing unit that determines a weight of drum 3, namely, the weight of the clothes by sensing a current signal passed through motor 4.

[0017] An operation of the drum-type washing machine according to the first exemplary embodiment of the present invention will be described below with reference to Fig. 2.

[0018] Fig. 2 shows a flowchart of a washing control method performed by the drum-type washing machine according to the first exemplary embodiment of the present invention. When the clothes are put in the washing machine to start the washing, controller 16 performs cloth amount sensing to sense an amount of the clothes (step S1).

[0019] The cloth amount sensing is performed as follows. First, motor 4 is rotated. At this point, controller 16 once starts up drum 3 to a rotation speed at which the clothes are clung to an inner wall of drum 3, for example, about 100 rpm to about 140 rpm. Controller 16 stops a power distribution of motor 4 after maintaining the rotation of drum 3 for a predetermined time. Then, motor 4 rotates through the inertia rotation of drum 3. At this point, the rotation of drum 3 is gradually decreased by a fric-

tional torque, and drum 3 eventually stops. A time until the rotation of drum 3 is stopped since the power distribution of motor 4 is stopped becomes longer in the case of the large amount of the clothes, and becomes shorter in the case of the small amount of the clothes. The amount of the clothes is sensed by utilizing the fact that a difference of the time necessary to stop the rotation of drum 3 is proportional to the amount of the clothes.

[0020] A basic water supply amount is determined based on the amount of the clothes. For example, when the amount of the clothes is determined to be "small", controller 16 sets the water level to "low" water level WL1. When the amount of the clothes is determined to be "intermediate", controller 16 sets the water level to "intermediate" water level WL2. When the amount of the clothes is determined to be "high", controller 16 sets the water level to "high" water level WL3 (step S2).

[0021] Next, controller 16 opens water supply valve 10 (step S3), and supplies the water to outer tank 2 and drum 3 up to the set water level (step S4).

[0022] During the water supply, controller 16 controls circulation pump 13 to circulate the washing water, which is supplied along with a detergent, from ejection port 11 to outer tank 2 through circulation route 12, thereby promoting the detergent to blend into the water. When the circulation water is ejected from ejection port 11 into drum 3, the clothes absorb the water before the detergent blends into the water. Therefore, the rotation speed of circulation pump 13 is set lower to an extent that the circulation water is not ejected into drum 3 too much but runs into a front end portion of drum 3.

[0023] When controller 16 checks that the water supply amount reaches the set water level (YES in step S4), controller 16 closes water supply valve 10 (step S5). Then, the drum-type washing machine enters a first low-speed stirring process of rotating drum 3 at low speed at which the clothes are not clung to the inner wall of drum 3. In the first low-speed stirring process, stirring of the clothes is started while drum 3 is rotated at low speed (step S6). The rotation speed of drum 3 is one, at which the clothes are lifted to fall from the upper portion of drum 3 by a gravity and kinetic energy is effectively applied to the clothes in the falling of the clothes. Therefore, at this point, the rotation speed of drum 3 is such a rotation speed that the clothes are not clung to the inner wall of drum 3 by the centrifugal force. For example, although depending on the amount of the clothes, preferably the rotation speed of drum 3 is equal to or lower than 50 rpm. A rotating direction of drum 3 may be set to the same direction, or periodically be inverted.

[0024] At this point, controller 16 controls circulation pump 13, whereby the washing water into which the detergent sufficiently blends is circulated in drum 3 from ejection port 11 through circulation route 12. Therefore, the washing water is promoted to sink into the clothes. Accordingly, preferably the rotation speed of circulation pump 13 is set to one at which the circulation water is sufficiently ejected into drum 3 to enable the washing water to easily sink into the clothes.

[0025] Controller 16 periodically reads the detected contamination value from contamination sensor 15 to check a change in detected contamination value. Fig. 3 shows a detected contamination value and a detected contamination value difference in the washing process of the drum-type washing machine according to the first exemplary embodiment of the present invention. When a extent of change of the detected contamination value is equal to or lower than a predetermined value, namely, when a difference with the previously-read value is small, controller 16 determines that the contamination is saturated (YES in step S7). As illustrated in Fig. 3, a time point, at which the difference with the previously-read value becomes a predetermined value or less while rising of the detected contamination value becomes moderate during the first low-speed stirring process of rotating drum 3 at low speed (step S6), is determined as the saturation of the contamination. As to the predetermined value at this time, for example, the difference of the detected contamination value is equal to or lower than about 5 for one minute.

[0026] Because the degree of the contamination is sensed by not the detected contamination value from contamination sensor 15 but the extent of change of the detected contamination value, the control may uniformly be performed irrespective of the cloth amount and the degree of the contamination. Therefore, the contaminations can further be pulled out by rotating drum 3 at high speed when the contaminations are sufficiently dissolved in the washing water from the clothes to saturate the contaminations.

[0027] Controller 16 controls motor 4 to transfer to the high-speed rotation process of rotating drum 3 at high speed (step S8). In the high-speed rotation process, the rotation speed of drum 3 is one at which the centrifugal force is applied to the clothes while the clothes are clung to the inner wall of drum 3. More specifically, the rotation speed of drum 3 is such a rotation speed that moisture contained in the clothes can forcedly be pulled out by the centrifugal force, and preferably the rotation speed of drum 3 is equal to or more than 150 rpm. More preferably, the rotation speed of drum 3 is equal to or more than 300 rpm. Drum 3 is rotated at high speed by a continuous one-time operation. Alternatively, drum 3 may be rotated at high speed by intermittently repeating a operation to start/stop the power distribution of motor 4 for a short time. Sometimes the high-speed rotation of drum 3 generates excess bubbles of the detergent. Therefore, preferably drum 3 is intermittently rotated at high speed when the operation is repeatedly performed.

[0028] The clothes are insufficiently wetted with the water only by the water supply, when the washing tank is rotated at high speed at an appropriate time after the water supply. For this reason, weights of the clothes are not increased too much, which limits an effect of the centrifugal force even if the washing tank is rotated at high speed. When the clothes are insufficiently wetted with

the water, the large friction is generated between the washing tank and clothes due to high-speed rotation to increase the damage of the clothes. Because the washing water in which the detergent is mixed insufficiently reaches the clothes, the contaminations of the clothes hardly float by the washing water. Therefore, the contaminations of the clothes are not pulled off even if the washing tank is rotated at high speed in this state. In the present invention, the detergent containing a surfactant adheres to contamination substances of the clothing fibers through the first low-speed stirring process that is performed until the clothes absorb the washing water and the contaminations in the washing water are saturated. In the high-speed rotation process, because the washing water near the clothing fiber is removed by the centrifugal force, the contamination substances can efficiently be removed from the clothing fibers along with the washing water. In the high-speed rotation of drum 3, when the washing water ejected toward the clothes in drum 3 with circulation pump 13, the washing water to which the contaminations do not adhere yet is effectively absorbed in the clothes that are spin-dried by the high-speed rotation of drum 3. Thus, the replacement of the washing water contained in the clothing fibers is promoted through the spin-drying by the high-speed rotation of drum 3 and the absorption of the ejected washing water.

[0029] A time T drum 3 is rotated at high speed may be a relatively short time because only the washing water included in the clothes can be wrung. For example, the time T may be 30 seconds.

[0030] When the time T of 30 seconds elapses in the high-speed rotation process (YES in step S9), controller 16 performs a second low-speed stirring process of rotating drum 3 at low speed again (step S10). In the second low-speed stirring process, similarly to the first low-speed stirring process, controller 16 starts up circulation pump 13. The washing water in outer tank 2 is circulated from ejection port 11 into drum 3 through circulation route 12. At this point, drum 3 is rotated at a rotation speed at which the clothes are not clung to the inner wall of drum 3 but trundle in drum 3. The operation to put circulation pump 13 in action to eject the washing water from ejection port 11 may be performed by continuous running or intermittent running.

[0031] The second low-speed stirring process is continuously performed after the high-speed rotation process, which allows the contamination substances remaining in the fibers to be picked away again by a chemical action of the detergent and a mechanical action associated with the low-speed rotation of drum 3. In the case that the washing water between the fibers has a high concentration of the contamination substance, possibly the contamination substance adheres to the fiber again. However, the contamination substance, which is surrounded by the surfactant of the detergent while the surfactant adheres thereto, hardly adheres to the fiber again. Therefore, only the surfactant that does not adhere to the contamination substance is attracted to the clothes. This enables a chemical property of the detergent to act on the residual contaminations.

[0032] Because the time necessary for the second low-speed stirring process may be a time the residual detergent sufficiently sinks into the clothes, the time necessary for the second low-speed stirring process is fixed to a predetermined time irrespective of the cloth amount. In the first exemplary embodiment of the present invention, the predetermined time is set to 5.5 minutes, and the washing process is ended when the predetermined time elapses (YES in step S11). Therefore, the number of calculations and the number of constant tables are decreased, so that a load on controller 16 can be reduced.

[0033] As described above, after the water supply, the process of rotating drum 3 at low speed (first low-speed stirring process) is performed until the output of contamination sensor 15 is saturated. Therefore, the clothes become wet while including the washing water in which the detergent is sufficiently mixed. The surfactant of the detergent is attracted to the contaminations of the clothes and dissolved in the washing water. Then, the washing water, which is located near the clothes while the detergent is mixed therein, and the contaminations adhering to the detergent are pulled out by performing the process of rotating drum 3 at high speed (high-speed rotation process). Accordingly, the detergent can sink into the contaminations remaining in the clothes again.

[0034] The control operation of the first exemplary embodiment may be performed in a form of a program that uses hardware resources such as a CPU (or a microcomputer), a RAM, a ROM, a storage/recording device, an electric/information device including an I/O, a computer, and a server in conjunction with one another. In the form of the program, a new function can easily be provided, updated or installed by recording the new function in a recording medium such as a magnetic medium and an optical medium or distributing the new function through a communication line such as the Internet.

[0035] The same effect is obtained not only in the drum-type washing machine but also a drum-type washing/drying machine provided with a drying function.

SECOND EXEMPLARY EMBODIMENT

[0036] A schematic configuration of a drum-type washing machine according to a second exemplary embodiment of the present invention is identical to that of the drum-type washing machine of the first exemplary embodiment. However, the second exemplary embodiment differs from the first exemplary embodiment in an operation performed by controller 16. The description of the first embodiment is incorporated by reference in the detailed description of the configuration of the second exemplary embodiment. In the second exemplary embodiment, controller 16 performs the process of rotating drum 3 at low speed (first low-speed stirring process) for a longer time with increasing contamination sensed by contamination sensor 15.

[0037] The operation of the drum-type washing machine according to the second exemplary embodiment of the present invention, mainly a difference with the first exemplary embodiment of the present invention will be described below with reference to Fig. 4.

[0038] Fig. 4 shows a flowchart of a washing control method of the drum-type washing machine according to the second exemplary embodiment of the present invention. The water supply is identical to that according to the first exemplary embodiment of the present invention.

[0039] When the drum-type washing machine enters the washing process, controller 16 performs the first low-speed stirring process of rotating drum 3 at low speed at which the clothes are not clung to the inner wall of drum 3 (step S6). When a predetermined time (for example, 2 minutes) elapses since the first low-speed stirring process is started (YES in step S12), controller 16 reads a detected contamination value X which is the output of contamination sensor 15.

[0040] When the detected contamination value X which is the output of contamination sensor 15 is equal to or higher than a predetermined value A, for example, 100 (YES in step S13), a time t of the first low-speed stirring process is set to 4 minutes (step S14). When the detected contamination value X is lower than 100 (NO in step S13), and when the detected contamination value X is equal to or higher than a predetermined value B that is lower than the predetermined value A, for example, 50 (YES in step S15), the time t of the first low-speed stirring process is set to 2 minutes (step S16). When the detected contamination value X is lower than 50 (NO in step S15), the time t of the first low-speed stirring process is set to 1 minute (step S17). That is, the time t of the first low-speed stirring process is set to a larger value with increasing detected contamination value X which is the output of contamination sensor 15. The first low-speed stirring process is performed for the set time t (step S18). Thus, controller 16 determines the degree of the contamination based on the detected contamination value X which is the output of the contamination sensor 15, and performs the first low-speed stirring process for a longer time with increase in the degree of the contamination. Therefore, it is possible to secure the time, for which the surfactant contained in the detergent is attracted to the contaminations of the clothes and dissolved in the washing water. As a result, the contamination can be caused to float by exerting a washing effect of the detergent to the contamination of the clothes.

[0041] Then, controller 16 performs the high-speed rotation process of rotating drum 3 at high speed at which the clothes are clung to the inner wall of drum 3 (step S8). Then, similarly to the first exemplary embodiment, the process of performing the stirring while rotating drum 3 at low speed (second low-speed stirring process) is performed (step S10). When the predetermined time elapses (YES in step S11), the washing is ended.

[0042] Thus, the washing water, which is located near the clothes while the detergent is mixed therein, and the contaminations adhering to the detergent are pulled out by performing the process of rotating drum 3 at high speed after the process of rotating drum 3 at low speed. Accordingly, the detergent can sink into the contaminations remaining in the clothes again.

THIRD EXEMPLARY EMBODIMENT

[0043] A schematic configuration of a drum-type washing machine according to a third exemplary embodiment of the present invention is identical to that of the drum-type washing machine of the first exemplary embodiment. However, the third exemplary embodiment differs from the first exemplary embodiment in an operation performed by controller 16. The description of the first embodiment is incorporated by reference in the detailed description of the configuration of the third exemplary embodiment. In the third exemplary embodiment of the present invention, controller 16 performs the process of rotating drum 3 at high speed when the output of contamination sensor 15 becomes the predetermined value or higher.

[0044] The operation of the drum-type washing machine according to the third exemplary embodiment of the present invention, mainly a difference with the first exemplary embodiment will be described below with reference to Fig. 5.

[0045] Fig. 5 shows a flowchart of a washing control method performed by the drum-type washing machine according to the third exemplary embodiment of the present invention. The water supply is identical to that of the first exemplary embodiment.

[0046] When the drum-type washing machine enters the washing process, controller 16 performs the first low-speed stirring process of rotating drum 3 at low speed at which the clothes are not clung to the inner wall of drum 3 (step S6). At this point, controller 16 periodically reads the output of contamination sensor 15 (step S20).

[0047] Fig. 6 shows a view illustrating the detected contamination value in the washing process of the drum-type washing machine according to the third exemplary embodiment of the present invention. When the detected contamination value X which is the output of contamination sensor 15 becomes a predetermined value C or higher, for example, 100 or higher (YES in step S20), controller 16 performs the high-speed rotation process of rotating the drum 3 at high speed at which the clothes are clung to the inner wall of drum 3 (step S8). The high-speed rotation process is performed after the detected contamination value X which is the output of contamination sensor 15 becomes the predetermined value C or higher. Therefore, the contaminations can be pulled out by rotating drum 3 at high speed, when the contaminations start to be dissolved from the clothes after the washing water sufficiently spreads through the clothes.

[0048] When the detected contamination value X which is the output of contamination sensor 15 is lower than 100 (NO in step S20), and when a set time (for ex-

ample, 15 minutes) does not elapse (NO in step S21), the first low-speed stirring process of performing the stirring while rotating drum 3 at low speed is continued (step S6).

[0049] When the set time (for example, 15 minutes) elapses while the detected contamination value X which is the output of contamination sensor 15 is lower than 100 (YES in step S21), the washing process is directly ended.

[0050] After the high-speed rotation process of rotating drum 3 at high speed (step S8), similarly to the first exemplary embodiment, the process of performing the stirring while rotating drum 3 at low speed (second low-speed stirring process) is performed (step S10). When the predetermined time elapses (YES in step S11), the washing is ended.

[0051] As described above, after the water supply, the high-speed rotation process of rotating drum 3 at high speed is performed when the detected contamination value X which is the output of contamination sensor 15 becomes 100 or higher. Therefore, the washing water, which is located near the clothes while the detergent is mixed therein, and the contaminations adhering to the detergent can be pulled out at the stage at which the contaminations start to be sufficiently dissolved. Accordingly, the detergent can sink into the contaminations remaining in the clothes again.

[0052] The drum-type washing machine of the present invention includes the washing tank that rotates while accommodating clothes, the outer tank that mounts the washing tank, the driving unit that drives the washing tank, the contamination sensor that senses the contamination of the washing water in the outer tank; and the controller that controls the driving unit by determining the degree of the contamination based on the output of the contamination sensor. The controller performs the washing process, and the washing process includes the low-speed stirring process of rotating the washing tank at low speed at which the clothes are not clung to the inner wall of the washing tank and the high-speed rotation process of rotating the washing tank at high speed at which the clothes clung to the inner wall of the washing tank. The controller performs the high-speed rotation process when the output of the contamination sensor becomes the predetermined condition during the low-speed stirring process.

[0053] In the above configuration, the washing can quickly be performed by pulling out the contaminations in the state in which the contaminations sufficiently float from the clothes.

[0054] In the drum-type washing machine of the present invention, the controller may perform the high-speed rotation process when the extent of change in the output of the contamination sensor becomes the predetermined value or less. Because the degree of the contamination is sensed by not the output value of the contamination sensor but the extent of change in the output value, the controller may perform the uniform control irrespective of the cloth amount and the degree of the contamination. Therefore, the contaminations can further be pulled out by rotating the washing tank at high speed when the contaminations are sufficiently dissolved in the washing water from the clothes to saturate the contaminations.

[0055] In the drum-type washing machine of the present invention, the controller may perform the low-speed stirring process for a longer time with increase in the degree of the contamination based on the output of the contamination sensor. Therefore, it is possible to secure the time, for which the surfactant contained in the detergent is attracted to the contaminations of the clothes and dissolved in the washing water, and it is possible that the contaminations are caused to float by exerting the washing effect of the detergent to the contaminations of the clothes.

[0056] In the drum-type washing machine of the present invention, the controller may perform the high-speed rotation process when the output of the contamination sensor becomes the predetermined value or higher. Therefore, the contaminations can further be pulled out by rotating the washing tank at high speed, when the contaminations start to be dissolved from the clothes after the washing water sufficiently spreads through the clothes.

[0057] In the drum-type washing machine of the present invention, at least one of the turbidity sensor, the conductivity sensor, and the color fading sensor may be used as the contamination sensor that senses the contamination. Therefore, the drum-type washing machine can deal with the necessary washing of the contaminations based on a contamination component of the clothes.

[0058] The washing control method performed by the drum-type washing machine of the present invention, includes: a step of performing a water supply process of supplying water to the washing tank and the outer tank; a step of performing a low-speed stirring process of rotating the washing tank at low speed at which clothes are not clung to the inner wall of the washing tank; a step of sensing the contamination of the washing water in the outer tank with the contamination sensor; and a step of performing a high-speed rotation process of rotating the washing tank at high speed at which the clothes are clung to the inner wall of the washing tank, wherein the high-speed rotation process is performed when the output of the contamination sensor becomes the predetermined condition during the low-speed stirring process.

[0059] As described above, the washing machine of the present invention can improve the washing performance by controlling the rotation of the washing tank based on the degree of the contamination of the clothes. Therefore, the washing machine can also be applied to applications such as a fiber washing apparatus.

Claims

1. A drum-type washing machine, comprising:

   a washing tank that rotates while accommodating clothes;
   an outer tank that mounts the washing tank;
   a driving unit that drives the washing tank;
   a contamination sensor that senses contamination of washing water in the outer tank; and
   a controller that controls the driving unit by determining a degree of the contamination based on an output of the contamination sensor, wherein
   the controller performs a washing process including a low-speed stirring process of rotating the washing tank at low speed at which the clothes are not clung to an inner wall of the washing tank and a high-speed rotation process of rotating the washing tank at high speed at which the clothes are clung to the inner wall of the washing tank, and the controller performs the high-speed rotation process when the output of the contamination sensor becomes a predetermined condition during the low-speed stirring process.

2. The drum-type washing machine according to claim 1, wherein the controller performs the high-speed rotation process when an extent of change in the output of the contamination sensor becomes a predetermined value or less.

3. The drum-type washing machine according to claim 1, wherein the controller performs the low-speed stirring process for a longer time with increase in the degree of the contamination based on the output of the contamination sensor.

4. The drum-type washing machine according to claim 1, wherein
   the controller performs the high-speed rotation process when the output of the contamination sensor becomes a predetermined value or higher.

5. The drum-type washing machine according to any one of claims 1 to 4, wherein
   the contamination sensor for sensing the contamination comprises at least one of a turbidity sensor, a conductivity sensor and a color fading sensor.

6. A washing control method performed by a drum-type washing machine, comprising:

   a step of performing a water supply process of supplying water to a washing tank and an outer tank;
   a step of performing a low-speed stirring process of rotating the washing tank at low speed at which clothes are not clung to an inner wall of the washing tank;
   a step of sensing contamination of washing water in the outer tank with a contamination sensor; and
   a step of performing a high-speed rotation process of rotating the washing tank at high speed at which the clothes are clung to the inner wall of the washing tank, wherein
   the high-speed rotation process is performed when an output of the contamination sensor becomes a predetermined condition during the low-speed stirring process.

FIG. 1

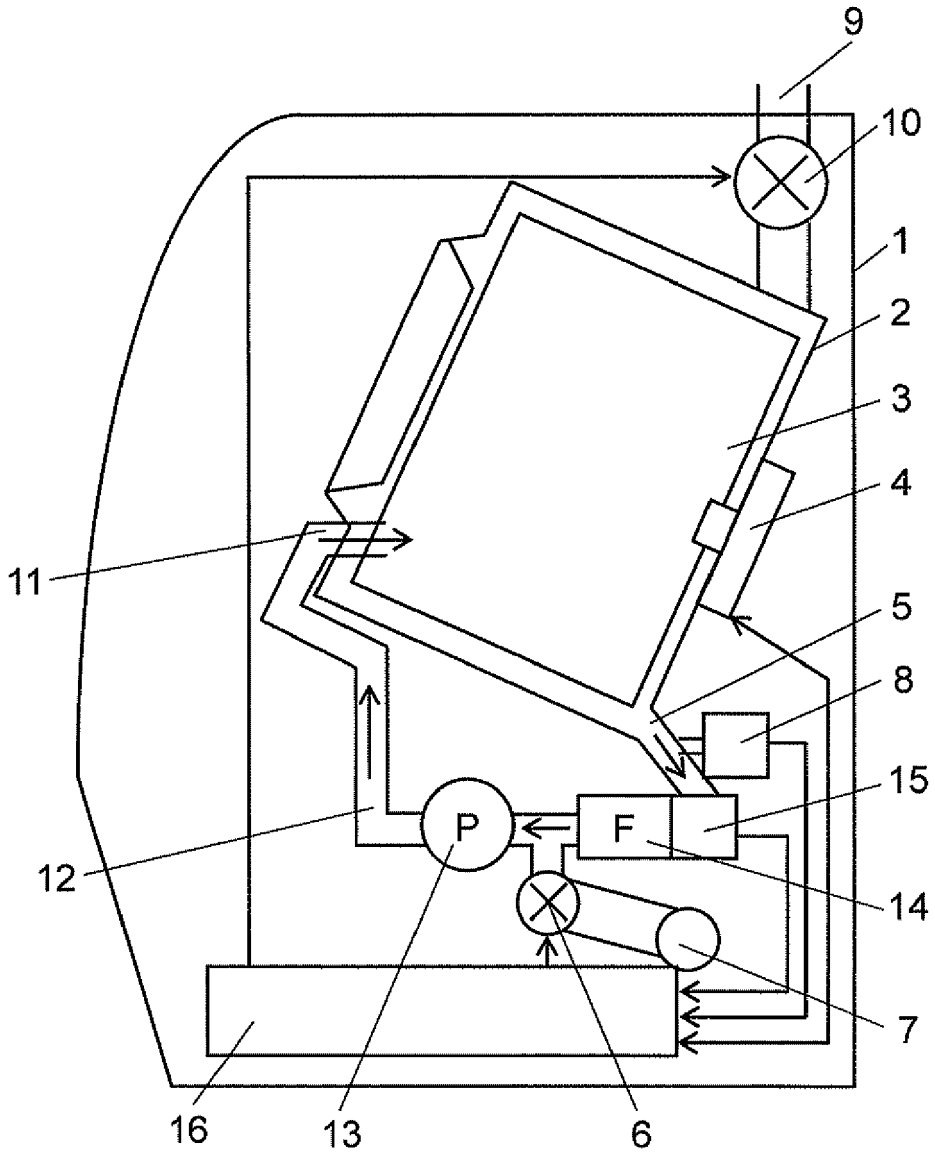


FIG. 2

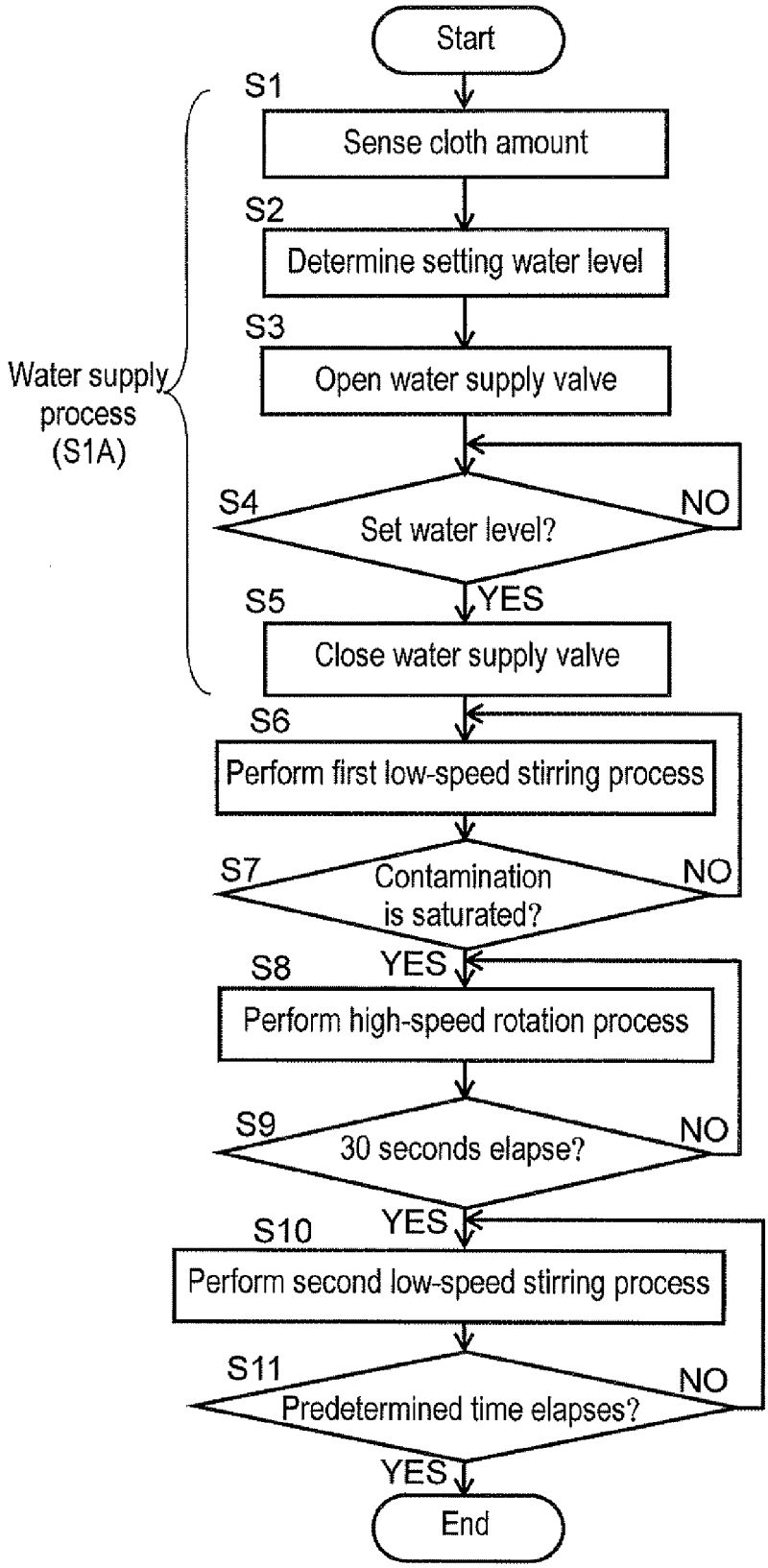

Start
S1
Sense cloth amount
S2
Determine setting water level
S3
Open water supply valve
Water supply process (S1A)
S4
Set water level?
NO
YES
S5
Close water supply valve
S6
Perform first low-speed stirring process
S7
Contamination is saturated?
NO
YES
S8
Perform high-speed rotation process
S9
30 seconds elapse?
NO
YES
S10
Perform second low-speed stirring process
S11
Predetermined time elapses?
NO
YES
End

FIG. 3A

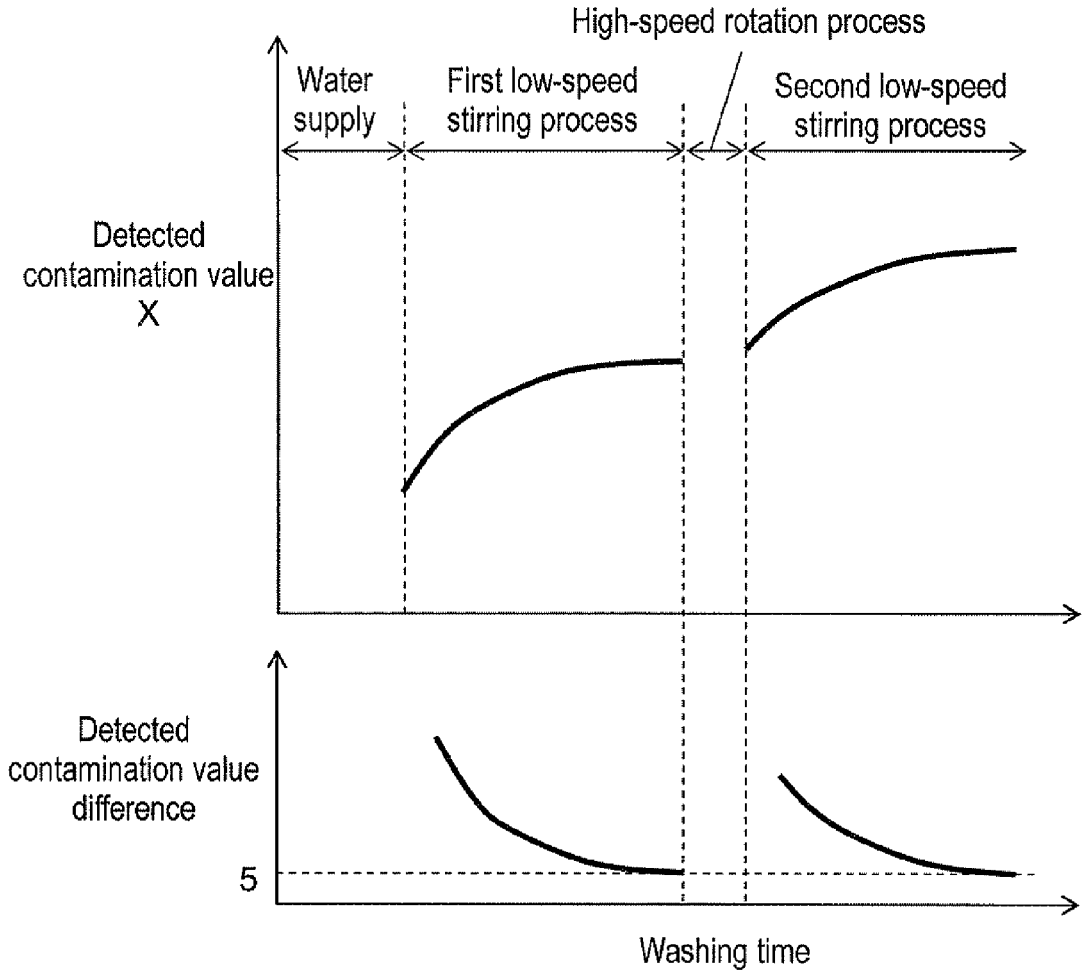

High-speed rotation process
Water supply
First low-speed stirring process
Second low-speed stirring process
Detected contamination value X
Detected contamination value difference
5
Washing time

FIG. 4

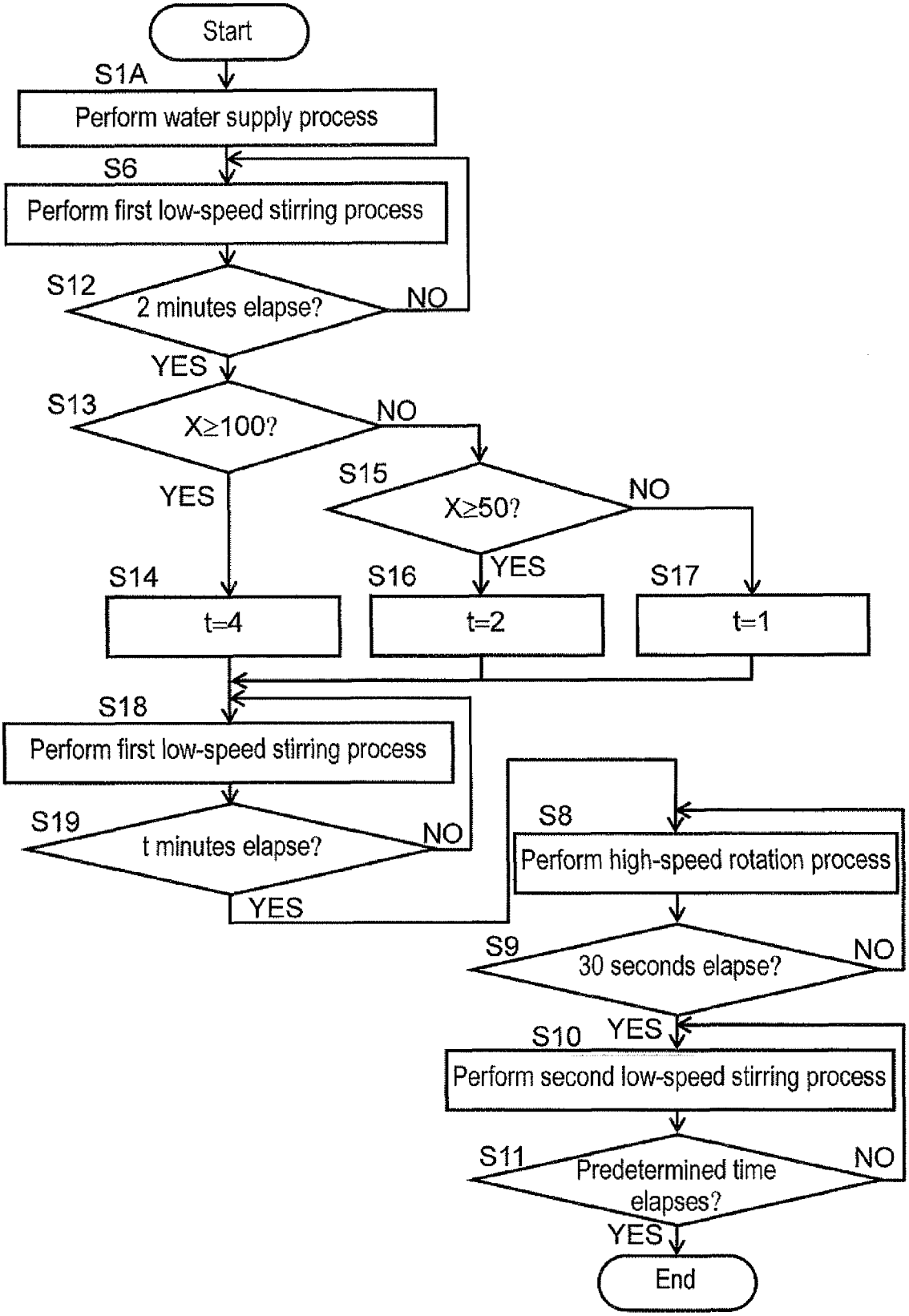

Start
S1A
Perform water supply process
S6
Perform first low-speed stirring process
S12
2 minutes elapse?
NO
YES
S13
X≥100?
NO
YES
S15
X≥50?
NO
YES
S14
t=4
S16
t=2
S17
t=1
S18
Perform first low-speed stirring process
S19
t minutes elapse?
NO
YES
S8
Perform high-speed rotation process
S9
30 seconds elapse?
NO
YES
S10
Perform second low-speed stirring process
S11
Predetermined time elapses?
NO
YES
End

FIG. 5

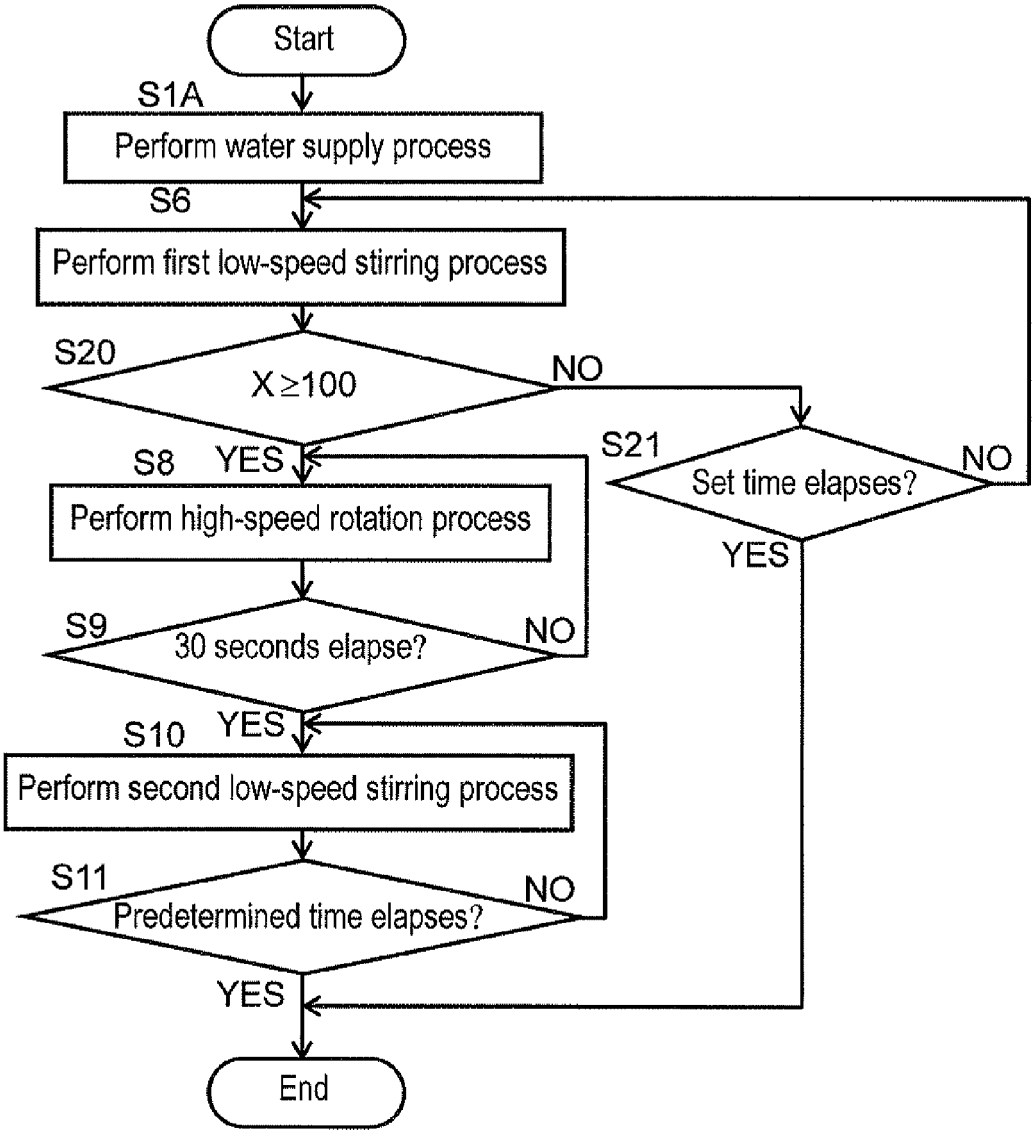
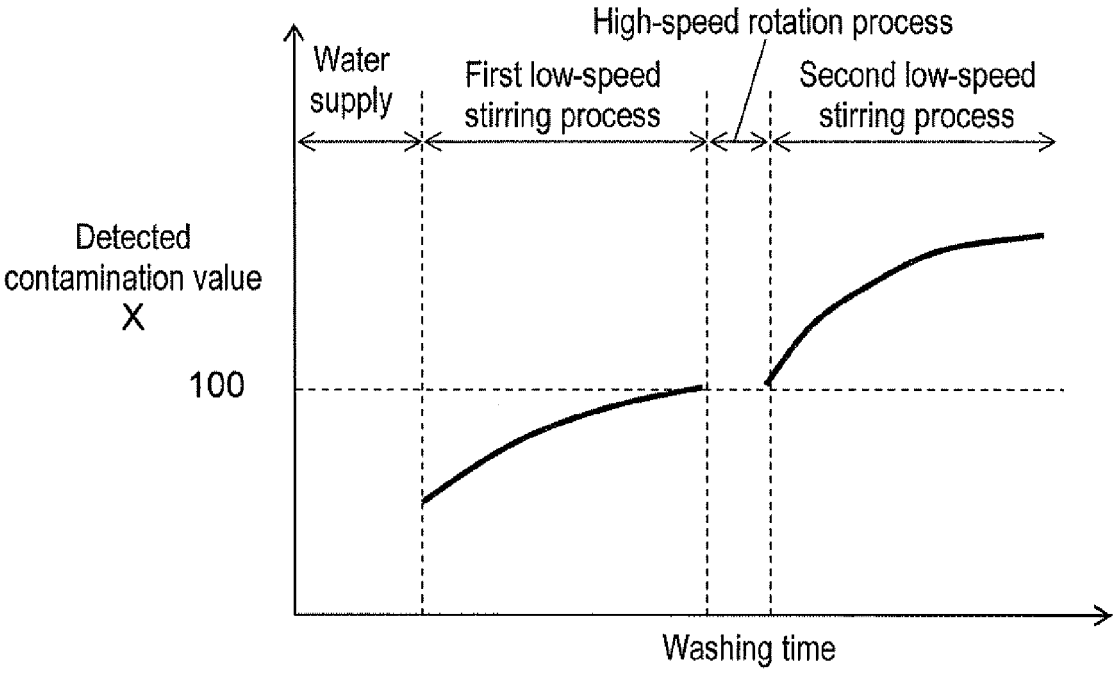

Start
S1A
Perform water supply process
S6
Perform first low-speed stirring process
S20
X≥100
NO
YES
S21
Set time elapses?
NO
YES
S8
Perform high-speed rotation process
S9
30 seconds elapse?
NO
YES
S10
Perform second low-speed stirring process
S11
Predetermined time elapses?
NO
YES
End

FIG. 6


High-speed rotation process
Water supply
First low-speed stirring process
Second low-speed stirring process
Detected contamination value X
100
Washing time

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H08299658 B **[0003]**