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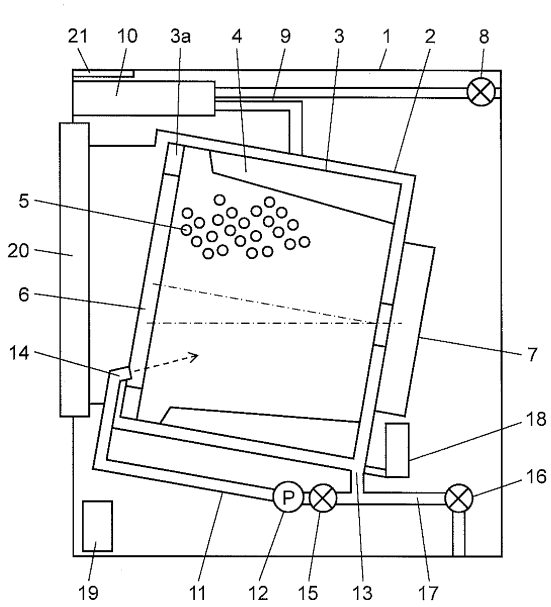
(54) DRUM-TYPE WASHING MACHINE

(57) Front-loading-type washing machine (100) includes water tub (2), washing tub (3), motor (7), water supply valve (8), circulating water channel (11), circulating pump (12), cloth property detector (18), and controller (19). When cloth property detector (18) determines that a washing target loaded in washing tub (3) has low absorbency, controller (19) increases, in the washing process, an amount of the washing water discharged from circulating pump (12) into washing tub (3) so as to be larger than an amount of the washing water discharged when cloth property detector (18) determines that the washing target loaded in washing tub (3) has high absorbency.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a front-loading-type washing machine for washing a washing target such as clothes.

BACKGROUND ART

[0002] A front-loading-type washing machine is capable of washing a washing target with a small amount of water by a tumbling effect of beating and washing. A conventional front-loading-type washing machine has, however, difficulty in evenly wetting a large amount of washing target loaded in a washing tub in a short period of time with washing water, and causes uneven washing. In view of this, it is proposed to cause washing water in a water tub to be circulated and discharged into the washing tub, so as to wet the washing target in the washing tub (see PTL 1, for example).

[0003] FIG. 6 is a sectional view depicting a main portion of conventional front-loading-type washing machine 200.

[0004] As shown in FIG. 6, conventional front-loading-type washing machine 200 has housing 51 that accommodates water tub 52 for keeping washing water therein. Water tub 52 is provided therein with washing tub 53 that has a bottomed cylindrical shape and is rotatable. Rotation of motor 54 mounted outside and below water tub 52 is transmitted to washing tub 53 by way of driving belt 55 so as to drive to rotate washing tub 53. A washing target is loaded into washing tub 53 through door 56 that is openably provided at a front end of housing 51.

[0005] The washing water supplied from water supply valve 57 into water tub 52 is transferred to circulating water channel 59 with use of circulating pump 58. The washing water transferred to circulating water channel 59 is discharged toward the washing target loaded in washing tub 53 through discharge port 60 that is provided at an upper front end of washing tub 53. There are provided a plurality of discharge ports 60 so as to change angles from the front end to the center of washing tub 53. This configuration enables the washing target loaded in washing tub 53 to get wet over a wide range.

[0006] There has been also proposed a washing machine in which, in accordance with strength of a set water flow, a flow rate of a circulating pump is decreased if the water flow is strong, whereas the flow rate of the circulating pump is increased if the water flow is weak (see PTL 2, for example).

[0007] In the conventional configuration described above, although the washing target can get wet with the washing water, the washing target will not be entirely soaked in the washing water if the amount of supplied water is small.

[0008] If a washing target is made of a material having high absorbency, dirt and washing water are kept in contact with each other for a long period of time because the washing target has strong force of keeping the washing water. In contrast, if a washing target is made of a material of low absorbency, washing water hitting the washing target tends not to be kept on fibers of the washing target. In this case, the washing water stays on the fibers for a short period of time and dirt and the washing water are kept in contact with each other for a short period of time. This may lead to insufficient removal of the dirt and uneven washing.

[0009] In view of these problems, in order to increase as much as possible the time of contact between the washing water and the dirt in limited washing time, the circulated washing water can be discharged for a longer period of time or the circulated washing water can be increased in amount in a washing process. However, these cases cause another problem of increase in power consumption.

Citation List

Patent Literature

[0010]

PTL 1: Unexamined Japanese Patent Publication No. H10-127978
PTL 2: Unexamined Japanese Patent Publication No. H09-28987

SUMMARY OF THE INVENTION

[0011] The present invention has been achieved in view of the problems mentioned above, and provides a front-loading-type washing machine that is excellent in energy conservation properties and washing performance.

[0012] A front-loading-type washing machine according to the present invention includes: a water tub supported in a housing; a washing tub rotatably provided in the water tub; a motor for driving the washing tub; a water supplier for supplying the water tub with washing water; and a circulating water channel for sucking the washing water in the water tub and discharging the sucked washing water into the washing tub. The front-loading-type washing machine also includes: a circulating pump for transferring the washing water in the washing tub to the circulating water channel; a cloth property detector for detecting absorbency of a washing target loaded in the washing tub to determine a cloth property; and a controller for controlling at least a washing process. When the cloth property detector determines that the washing target loaded in the washing tub has low absorbency, the controller increases, in the washing process, an amount of the washing water discharged from the circulating pump into the washing tub so as to be larger than an amount of the washing water discharged when the cloth property detector determines that the washing target

loaded in the washing tub has high absorbency.

BRIEF DESCRIPTION OF DRAWINGS

[0013]

FIG. 1 is a sectional view depicting a main portion of a front-loading-type washing machine according to a first exemplary embodiment of the present invention.

FIG. 2 is a functional block diagram of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 3 is a flowchart of behavior to determine a pump operation rate of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 4 is a graph indicating the relationship between water supply time and water level of the front-loading-type washing machine according to the first exemplary embodiment of the present invention.

FIG. 5 is a flowchart of behavior to determine a pump rotational speed of a front-loading-type washing machine according to a second exemplary embodiment of the present invention.

FIG. 6 is a sectional view depicting a main portion of a conventional front-loading-type washing machine.

DESCRIPTION OF EMBODIMENTS

[0014] Exemplary embodiments of the present invention are described below with reference to the drawings. It is noted that the present invention should not be limited to the exemplary embodiments.

(FIRST EXEMPLARY EMBODIMENT)

[0015] FIG. 1 is a sectional view depicting a main portion of front-loading-type washing machine 100 according to the first exemplary embodiment of the present invention. FIG. 2 is a functional block diagram of front-loading-type washing machine 100. FIG. 3 is a flowchart of behavior to determine a pump operation rate of front-loading-type washing machine 100. FIG. 4 is a graph indicating the relationship between water supply time and water level of front-loading-type washing machine 100.

[0016] Front-loading-type washing machine 100 has housing 1 accommodating water tub 2 that is elastically supported by a damper (not shown) or the like. Water tub 2 is provided therein with washing tub 3 that has a bottomed cylindrical shape and is rotatable. Washing tub 3 has a rotation axis inclined upward toward the front (the front end is positioned higher than the rear end). Washing tub 3 is provided, on an inner peripheral surface, with a plurality of baffles 4 and a large number of small holes 5. Baffles 4 project inward toward the rotation axis. Small holes 5 are in communication with the inside of water tub 2.

[0017] Washing tub 3 is provided, at a front end, with opening 6 that allows a washing target to be loaded and unloaded therethrough. Opening 6 is provided, on its periphery, with balancer 3a that reduces vibration generated due to uneven placement or the like of a washing target while washing tub 3 is rotating. Balancer 3a has an annular shape so as to surround opening 6.

[0018] Water tub 2 has a rear end provided with motor 7 for driving to rotate washing tub 3. Motor 7 can be a brushless DC motor, for example, and its rotational speed can be freely varied by inverter control. Water supply valve 8 is a water supplier for supplying water tub 2 with washing water. Water supply valve 8 supplies water tub 2 with washing water by way of detergent feed case 10 that is provided on water supply channel 9 to feed detergent. The washing water supplied into water tub 2 flows into washing tub 3 through small holes 5.

[0019] The washing water in water tub 2 can be circulated into washing tub 3 by circulating pump 12 that is provided on circulating water channel 11. Circulating water channel 11 sucks the washing water in water tub 2 and discharges the sucked washing water into washing tub 3. Circulating pump 12 also transfers the washing water in water tub 2 to circulating water channel 11.

[0020] Water tub 2 is provided, at a bottom, with suction part 13 that is in communication with circulating water channel 11 and sucks washing water. Below opening 6 located at the front end of washing tub 3, there is provided discharge part 14 that allows washing water to be discharged into washing tub 3.

[0021] Circulating water channel 11 is provided with switch valve 15, upstream of circulating pump 12, more particularly, between suction part 13 and circulating pump 12. Connected between suction part 13 and switch valve 15 is exhaust water channel 17. Exhaust water channel 17 is provided with exhaust valve 16 so as to exhaust washing water in water tub 2 to the outside of the machine.

[0022] Exhaust valve 16 is closed and switch valve 15 is opened upon driving circulating pump 12 to discharge washing water in water tub 2 through discharge part 14 into washing tub 3. The washing water in water tub 2 is thus sucked through suction part 13 into circulating water channel 11 and is circulated into washing tub 3 through discharge part 14.

[0023] Cloth property detector 18 has a water level detector that is provided near the rear lower end of water tub 2. Cloth property detector 18 detects, using the water level detector, absorbency of a washing target loaded in washing tub 3 to determine cloth properties.

[0024] In the water supply step during the washing process, cloth property detector 18 causes water tub 2 to be supplied with a predetermined amount of washing water, causes washing tub 3 to rotate so as to keep tumbling the washing target, and determines cloth properties on the basis of water level after predetermined time. It is accordingly possible to determine absorbency of the

washing target upon the start of the washing process, on the basis of water level variation of the washing water. It is thus possible to set an optimum amount of washing water to be discharged onto a washing target in the washing process and optimize time of contact between the washing water and dirt of the washing target in accordance with the absorbency of the washing target, so as to improve washing performance.

[0025] Housing 1 is provided therein with controller 19 that drives motor 7, water supply valve 8, circulating pump 12, switch valve 15, exhaust valve 16, and the like, so as to sequentially control each of the processes of washing, rinsing, spin-drying, and the like. It is noted that controller 19 has only to control at least the washing process.

[0026] Weight detector 22 (see FIG. 2) detects the amount of washing target loaded in washing tub 3.

[0027] As shown in FIG. 2, controller 19 controls motor 7, circulating pump 12, water supply valve 8, and the like, in accordance with inputs from cloth property detector 18 and weight detector 22.

[0028] Housing 1 is provided, at the front end, with openable door 20, so that a user can load and unload a washing target through opening 6 located at the front end of washing tub 3.

[0029] Described below is behavior and functions of front-loading-type washing machine 100 thus configured. Washing typically includes the washing process, the rinsing process, and the spin-drying process in this order. Part of the washing process is described herein with reference to the flowchart in FIG. 3. The rinsing process and the spin-drying process are not described herein.

[0030] A user opens door 20, loads a washing target into washing tub 3 through opening 6, and turns on a power switch in operation unit 21 that is provided at the upper front end of housing 1. When the user operates a start switch to start the machine (S1), weight detector 22 detects the amount of the washing target loaded in washing tub 3 (cloth amount detection step).

[0031] More specifically, controller 19 causes washing tub 3 to rotate for a short period of time. Weight detector 22 determines the amount of the loaded washing target on the basis of information on a torque amount of the motor in this period, on time necessary for washing tub 3 to stop rotation after controlling to stop washing tub 3 that has been rotated at a certain rotational speed, and the like. Controller 19 fixes the amount of washing water to be supplied and washing time in accordance with the amount of the washing target (S2). Once the amount of water to be supplied is fixed, front-loading-type washing machine 100 starts the water supply step.

[0032] In the water supply step, controller 19 opens water supply valve 8 so that tap water serving as washing water is supplied through service water piping. The tap water is guided through water supply channel 9 into water tub 2, while dissolving detergent that has been fed in detergent feed case 10 or the like (S3). If cloth property detector 18 determines that the water in water tub 2 has reached predetermined water level H that is set in accordance with the amount of the washing target loaded in washing tub 3, controller 19 closes water supply valve 8 to stop supply of water (YES in S4). In contrast, if cloth property detector 18 determines that the water in water tub 2 has not yet reached predetermined water level H, supply of water is continued and step S4 is repeated (NO in S4). The time from the start of water supply to the stop thereof is denoted by reference sign t.

[0033] Typical examples of fibers having low absorbency include synthetic fibers such as polyester and acryl, whereas typical examples of fibers having high absorbency include natural fibers such as cotton and hemp. It is noted that the present invention should not be particularly limited to these specific examples. According to the present description, a washing target such as clothes including a large rate of fibers having high absorbency is regarded as clothes having high absorbency, whereas a washing target such as clothes including a large rate of fibers having low absorbency is regarded as clothes having low absorbency.

[0034] Preliminarily set is time T1 required from the start of water supply to the stop thereof in a case where a washing target includes clothes having high absorbency (many of clothes have high absorbency). Also set is time T2 required from the start of water supply to the stop thereof in a case where a washing target includes clothes having low absorbency (many of clothes have low absorbency; $T1 < T2$).

[0035] For example, time T1 can be set to time of a case where about 75% of clothes of predetermined weight have high absorbency. Furthermore, time T2 can be set to time of a case where about 25% of clothes have high absorbency. It is noted that the setting method should not be limited to these examples.

[0036] Cloth property detector 18 compares actually measured time t and time T1, as well as time t and time T2. Cloth property detector 18 detects cloth properties on the basis of these results. Controller 19 varies a ratio between ON time and OFF time (operation rate) of circulating pump 12 in accordance with the cloth properties of the washing target detected by cloth property detector 18. It is thus possible to set an optimum amount of washing water to be discharged onto the washing target and optimize time of contact between the washing water and dirt of the washing target in accordance with the absorbency of the washing target, so as to improve washing performance.

[0037] More particularly, cloth property detector 18 initially compares time t and time T1 (S5). If $t \leq T1$ is established (YES in S5), cloth property detector 18 determines that the washing target has high absorbency, and controller 19 sets the operation rate of circulating pump 12 to value D1 in the subsequent washing process (S7).

[0038] If time t is longer than time T1 (NO in S5), cloth property detector 18 compares time t and time T2 (S6). If $T2 \leq t$ is established (YES in S6), cloth property detector 18 determines that the washing target has low absorb-

ency, and controller 19 sets the operation rate of circulating pump 12 to value D3 in the subsequent washing process (S9). If time t is between time T1 and time T2 (T1 < t < T2, NO in S6), controller 19 sets the operation rate of circulating pump 12 to value D2 (S8). The order of comparison between time t and time T1 and comparison between time t and time T2 is not limited to the example described above, but can be reversed.

[0039] It is desired to set values D1 to D3 so as to have operation rates of about 50%, 80%, and 100%, respectively. However, the values should not be particularly limited to this example as long as value D1 is not more than value D2 and value D2 is not more than value D3. It is noted that all values D1 to D3 do not have identical operation rates.

[0040] Described next is the reason why the operation rates are set as described above.

[0041] If clothes include fibers of low absorbency, the fibers are unlikely to absorb washing water and the water absorbed between the fibers is raised due to the capillary phenomenon with the influence of the structure of the woven fibers or the like. There is thus a small amount of water staying at the bottom, and a water level sensor of the water level detector estimates a smaller value at the initial stage of absorption. In this case, absorption time tends to be longer.

[0042] In contrast, if fibers have high absorbency, water is absorbed between the fibers and a small amount of water is raised to the upper portion of the clothes due to the capillary phenomenon so that a large amount of water stays at the bottom. The water level sensor thus functions with high accuracy, and water reaches the set level in absorption time shorter than that of clothes having low absorbency.

[0043] If clothes include fibers of low absorbency, the fibers do not absorb washing water and the washing water stays in contact with the fibers for a short period of time and flows away soon. This leads to a low washing effect, and improvement in washing performance requires increase in operation rate of circulating pump 12 so as to increase the amount of washing water to be discharged and increase the time of contact between the washing target and the washing water.

[0044] In contrast, if clothes include fibers of high absorbency, the fibers are likely to absorb washing water. The fibers and the washing water are thus in contact with each other for a long period of time. The washing effect can be thus exerted effectively even if the clothes receive circulating water for a shorter period of time, in other words, even if the amount of washing water to be discharged is smaller, as compared with clothes including fibers of low absorbency.

[0045] More specifically, in the present exemplary embodiment, if cloth property detector 18 determines that a washing target loaded in washing tub 3 has low absorbency, controller 19 increases the amount of washing water to be discharged from circulating pump 12 into washing tub 3 in the washing process, as compared with a case where cloth property detector 18 determines that the washing target loaded in washing tub 3 has high absorbency.

[0046] It is thus possible to increase the amount of washing water to be discharged and cause the washing water and dirt to be in contact with each other for a longer period of time, even if the washing target loaded in washing tub 3 is made of a material of low absorbency or is mostly made of a material of low absorbency. This enables effective washing within limited washing time, and improves energy conservation properties and washing performance.

[0047] Furthermore, in the present exemplary embodiment, controller 19 varies the amount of washing water to be discharged from circulating pump 12 into washing tub 3 in accordance with the ratio between fibers of high absorbency and fibers of low absorbency as cloth properties of the washing target detected by cloth property detector 18. It is thus possible to optimize time of contact between the washing water and dirt of the washing target in accordance with the absorbency of the washing target, so as to improve washing performance.

[0048] Further described is a specific example of setting an operation rate.

[0049] FIG. 4 indicates the relationship between water level and elapsed time for each of clothes set A (mainly including underwear and towels) and clothes set B (mainly including sports sweat shirts and jersey wear) each including a plurality of types of clothes.

[0050] Time T0 is a period required for water from the start of water supply to reach set water level in order to start the stirring step for clothes set A. Time T3 is a corresponding period for clothes set B. Time T1 and time T2 are set for fixing operation rates of circulating pump 12 by determining the properties of the clothes sets, as described earlier.

[0051] As apparent from FIG. 4, T0 < T1 is established for the time elapsed until the water supplied to clothes set A reaches the set water level, and clothes set A is determined as including clothes of high absorbency. In this case, the operation rate of circulating pump 12 is fixed to lowest value D1 among the set operation rates, and the washing process is started.

[0052] In contrast, T2 < T3 is established for the time elapsed until the water supplied to clothes set B reaches the set water level, and clothes set B is determined as including clothes of low absorbency. In this case, the operation rate of circulating pump 12 is fixed to highest value D3, and the washing process is started.

[0053] In this manner, in the present exemplary embodiment, an amount of a loaded washing target is detected, and then whether a loaded clothes set includes clothes of high absorbency or clothes of low absorbency is determined on the basis of time elapsed from start of water supply until the water reaches set water level.

[0054] In accordance with the result, the operation rate of circulating pump 12 is varied to optimum time of contact between the clothes and washing water. It is thus possi-

ble to provide a front-loading-type washing machine that improves washing performance as well as suppresses circulating pump 12 from being excessively driven so as to achieve excellent energy conservation properties.

(SECOND EXEMPLARY EMBODIMENT)

[0055] FIG. 5 is a flowchart of behavior to determine a pump rotational speed of front-loading-type washing machine 150 according to the second exemplary embodiment of the present invention.

[0056] The present exemplary embodiment is different from the first exemplary embodiment in that the rotational speed of circulating pump 12 is varied in accordance with cloth properties, more particularly, absorbency of a washing target. Other configurations are similar to those of the first exemplary embodiment. Such same configurations are denoted by same reference signs and description in the first exemplary embodiment is to be referenced without repeating detailed description thereof.

[0057] Steps S1 to S6 in FIG. 5 are similar to those in FIG. 3. Weight detector 22 detects an amount of a washing target loaded in washing tub 3 (S2), and controller 19 fixes an amount of washing water to be supplied and washing time (S2). The water supply step is subsequently started.

[0058] In the water supply step, controller 19 opens water supply valve 8 so that tap water serving as washing water is supplied through service water piping. The tap water is guided through water supply channel 9 into water tub 2, while dissolving detergent that has been fed in detergent feed case 10 or the like (S3). If cloth property detector 18 determines that the water in water tub 2 has reached predetermined water level H that is set in accordance with the amount of the washing target loaded in washing tub 3, controller 19 closes water supply valve 8 to stop supply of water (YES in S4). In contrast, if cloth property detector 18 determines that the water in water tub 2 has not yet reached predetermined water level H, supply of water is continued and step S4 is repeated (NO in S4). The time from the start of water supply to the stop thereof is denoted by reference sign t.

[0059] Preliminarily set is time T1 required from the start of water supply to the stop thereof in a case where a washing target includes clothes having high absorbency (many of clothes have high absorbency). Also set is time T2 required from the start of water supply to the stop thereof in a case where a washing target includes clothes having low absorbency (many of clothes have low absorbency; $T1 < T2$).

[0060] For example, time T1 can be set to time of a case where about 75% of clothes of predetermined weight have high absorbency. Furthermore, time T2 can be set to time of a case where about 25% of clothes have high absorbency. It is noted that the setting method should not be limited to these examples.

[0061] Cloth property detector 18 compares actually measured time t and time T1 or time T2. Cloth property detector 18 detects cloth properties in this manner. Controller 19 varies the rotational speed of circulating pump 12 in accordance with the cloth properties of the washing target detected by cloth property detector 18.

[0062] More particularly, cloth property detector 18 initially compares time t and time T1 (S5). If $t \leq T1$ is established (YES in S5), cloth property detector 18 determines that the washing target has high absorbency, and controller 19 sets the rotational speed of circulating pump 12 to value R1 in the subsequent washing process (S107).

[0063] If time t is longer than time T1 (NO in S5), cloth property detector 18 compares time t and time T2 (S6). If $T2 \leq t$ is established (YES in S6), cloth property detector 18 determines that the washing target has low absorbency, and controller 19 sets the rotational speed of circulating pump 12 to value R3 in the subsequent washing process (S109). If time t is between time T1 and time T2 ($T1 < t < T2$, NO in S6), controller 19 sets the rotational speed of circulating pump 12 to value R2 (S108). The order of comparison between time t and time T1 and comparison between time t and time T2 is not limited to the example described above, but can be reversed.

[0064] It is desired to set values R1 to R3 so as to have rotational speeds of about 3000 rpm, 3500 rpm, and 3800 rpm, respectively. However, the values should not be particularly limited to this example as long as value R1 is not more than value R2 and value R2 is not more than value R3. However, such rotational speeds are excluded if circulating washing water is not discharged at an extremely low rotational speed or if air entrainment is caused at an extremely high rotational speed. It is noted that all values R1 to R3 do not have identical rotational speeds.

[0065] According to the present exemplary embodiment, controller 19 increases the rotational speed of circulating pump 12 if a washing target includes a high ratio of fibers of low absorbency as cloth properties of the washing target detected by cloth property detector 18. It is accordingly possible to set optimum time or frequency of contact with washing water discharged onto the washing target. It is thus possible to optimize time of contact between the washing water and dirt of the washing target in accordance with the absorbency of the washing target, so as to improve washing performance.

[0066] Described next is the reason why the rotational speeds are set as described above.

[0067] If clothes include fibers of low absorbency, the fibers are unlikely to absorb washing water and the washing water stays in contact with the fibers for a short period of time and flows away soon. This leads to a low washing effect. If the rotational speed of circulating pump 12 is increased so as to increase the amount of washing water to be in contact with the clothes, the washing effect can be improved.

[0068] In contrast, if clothes include fibers of high absorbency, the fibers are likely to absorb washing water. Even in a state where no washing water is discharged,

the clothes and the absorbed washing water are in contact with each other. The washing effect can be thus improved even if the rotational speed of circulating pump 12 is decreased to reduce the amount of washing water to be in contact with the clothes.

[0069] According to the present exemplary embodiment, by decreasing the rotational speed of circulating pump 12, it is possible to improve washing performance as well as reduce unnecessary noise generated by driven circulating pump 12 in the washing process.

[0070] The respective exemplary embodiments have been described by exemplifying the front-loading-type washing machine. Similar effects can be achieved with a front-loading-type washing and drying machine that has a drying function. The expression of a front-loading-type washing machine includes such a front-loading-type washing and drying machine.

[0071] In the respective exemplary embodiments, if cloth property detector 18 determines that a washing target loaded in washing tub 3 has low absorbency, controller 19 increases the amount of washing water to be discharged from circulating pump 12 into washing tub 3 in the washing process, as compared with the case where cloth property detector 18 determines that the washing target loaded in washing tub 3 has high absorbency. More specifically, the first exemplary embodiment exemplifies the case where the operation rate of circulating pump 12 is varied, whereas the second exemplary embodiment exemplifies the case where the rotational speed of circulating pump 12 is varied. However, the present invention is not limited to these examples. It is possible to take various measures other than the above, e.g. varying the amount of washing water to be discharged from circulating pump 12.

INDUSTRIAL APPLICABILITY

[0072] As described above, the present invention achieves the significant effects of excellent energy conservation properties and washing performance, and is thus useful in a front-loading-type washing machine or the like for washing a washing target such as clothes.

REFERENCE MARKS IN THE DRAWINGS

[0073]

1	housing
2	water tub
3	washing tub
3a	balancer
4	baffle
5	small hole
6	opening
7	motor
8	water supply valve (water supplier)
9	water supply channel
10	detergent feed case
11	circulating water channel
12	circulating pump
13	suction part
14	discharge part
15	switch valve
16	exhaust valve
17	exhaust water channel
18	cloth property detector
19	controller
20	door
21	operation unit
22	weight detector
100, 150	front-loading-type washing machine

Claims

1. A front-loading-type washing machine comprising:

a water tub supported in a housing;
a washing tub rotatably provided in the water tub;
a motor for driving the washing tub;
a water supplier for supplying the water tub with the washing water;
a circulating water channel for sucking the washing water in the water tub and discharging the washing water into the washing tub;
a circulating pump for transferring the washing water in the washing tub to the circulating water channel;
a cloth property detector for detecting absorbency of a washing target loaded in the washing tub to determine a cloth property; and
a controller for controlling at least a washing process; wherein
when the cloth property detector determines that the washing target loaded in the washing tub has low absorbency, the controller increases, in the washing process, an amount of the washing water discharged from the circulating pump into the washing tub so as to be larger than an amount of the washing water discharged when the cloth property detector determines that the washing target loaded in the washing tub has high absorbency.

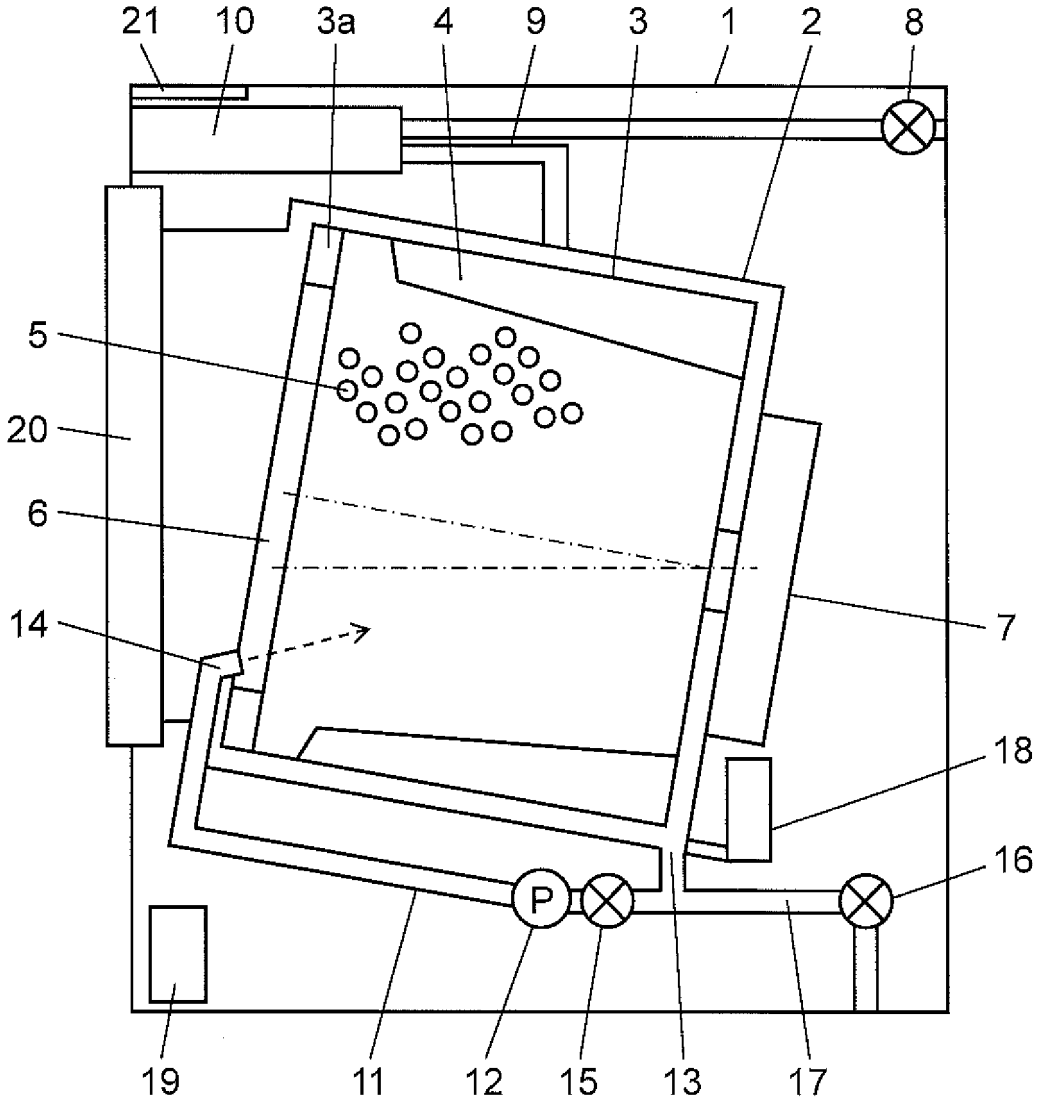
2. The front-loading-type washing machine according to claim 1, wherein
the controller varies an operation rate of the circulating pump in accordance with the cloth property of the washing target detected by the cloth property detector.

3. The front-loading-type washing machine according to claim 1, wherein
the controller varies a rotational speed of the circulating pump in accordance with the cloth property of

the washing target detected by the cloth property detector.

4. The front-loading-type washing machine according to any one of claims 1 to 3, wherein
in a water supply step in the washing process, the cloth property detector causes the water tub to be supplied with a predetermined amount of the washing water, causes the washing tub to be rotated so as to keep tumbling the washing target, and determines the cloth property of the washing target based on water level of the washing water after predetermined time.

FIG. 1



100,150

FIG. 2

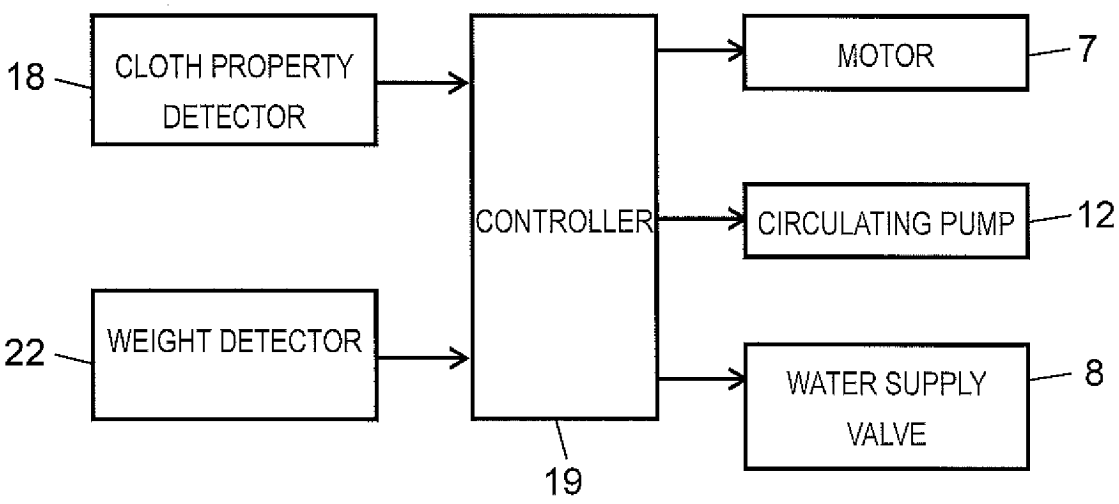

18
CLOTH PROPERTY DETECTOR
22
WEIGHT DETECTOR
CONTROLLER
19
MOTOR
7
CIRCULATING PUMP
12
WATER SUPPLY VALVE
8

FIG. 3

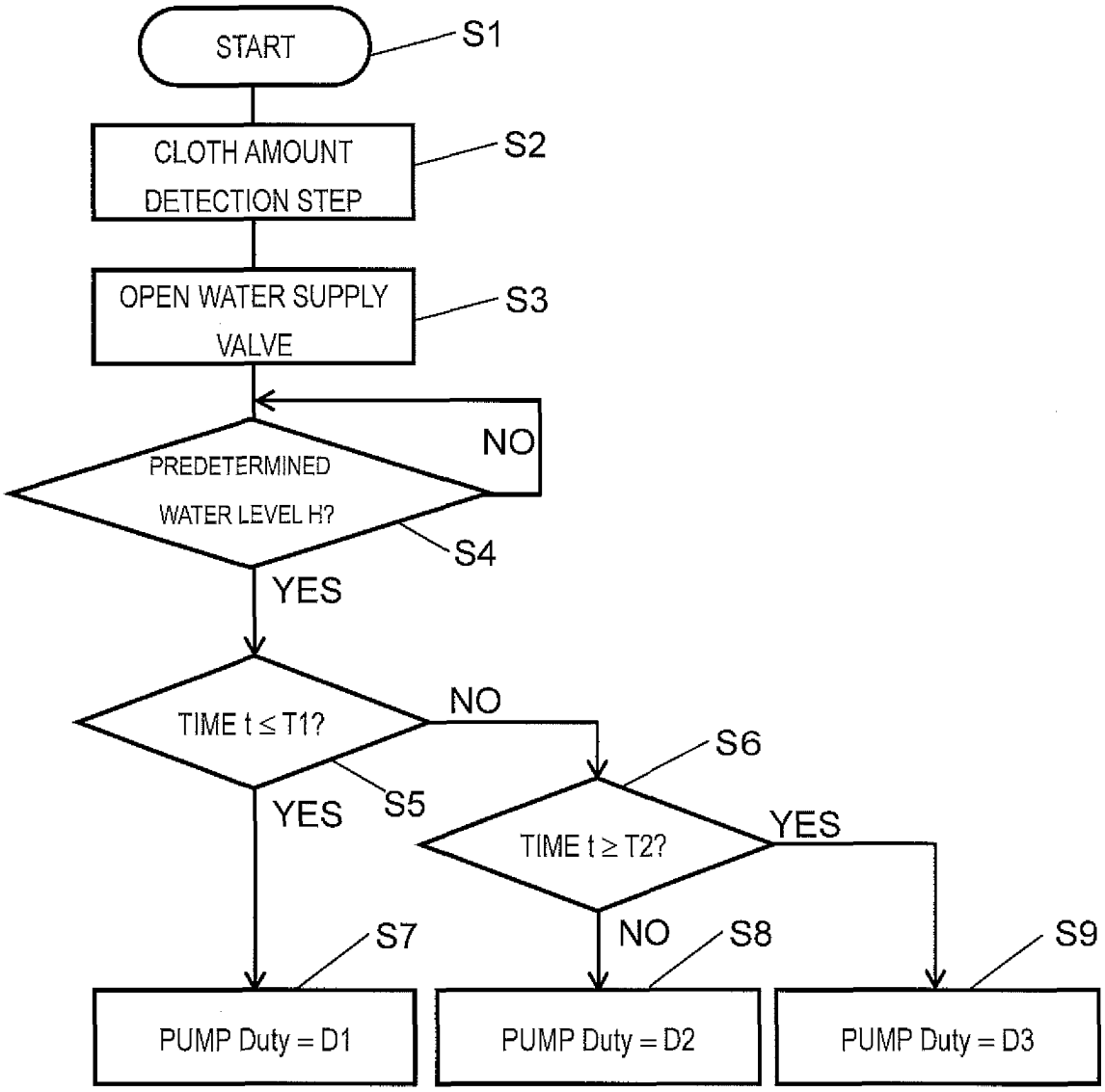

START
S1
CLOTH AMOUNT DETECTION STEP
S2
OPEN WATER SUPPLY VALVE
S3
PREDETERMINED WATER LEVEL H?
NO
S4
YES
TIME t ≤ T1?
NO
S6
YES
S5
TIME t ≥ T2?
YES
S7
NO
S8
S9
PUMP Duty = D1
PUMP Duty = D2
PUMP Duty = D3

FIG. 4

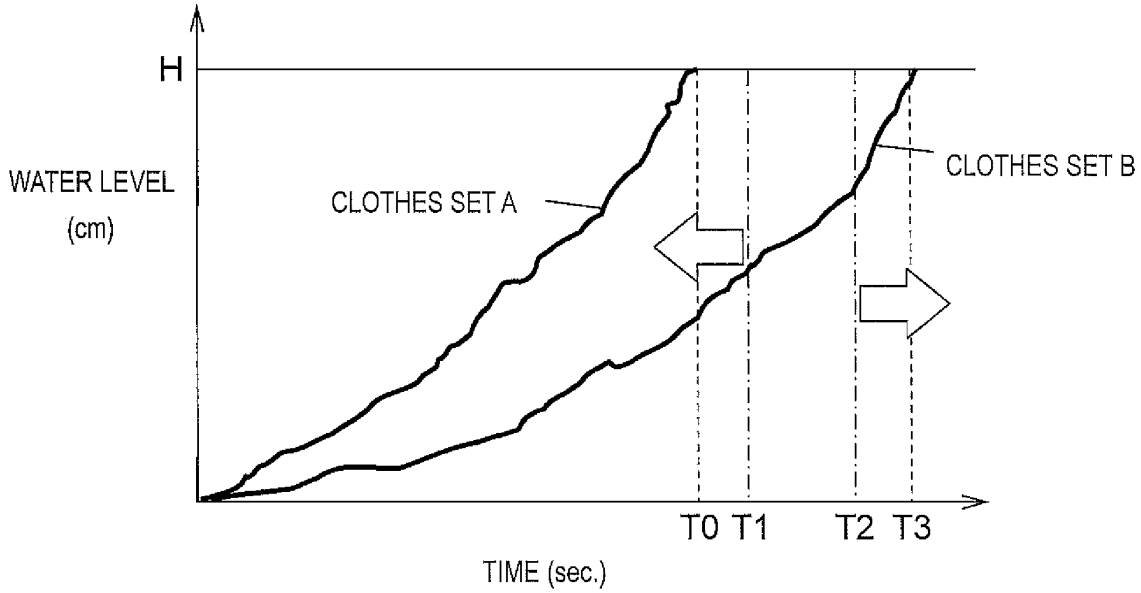

H
WATER LEVEL
(cm)
CLOTHES SET A
CLOTHES SET B
T0 T1
T2 T3
TIME (sec.)

FIG. 5

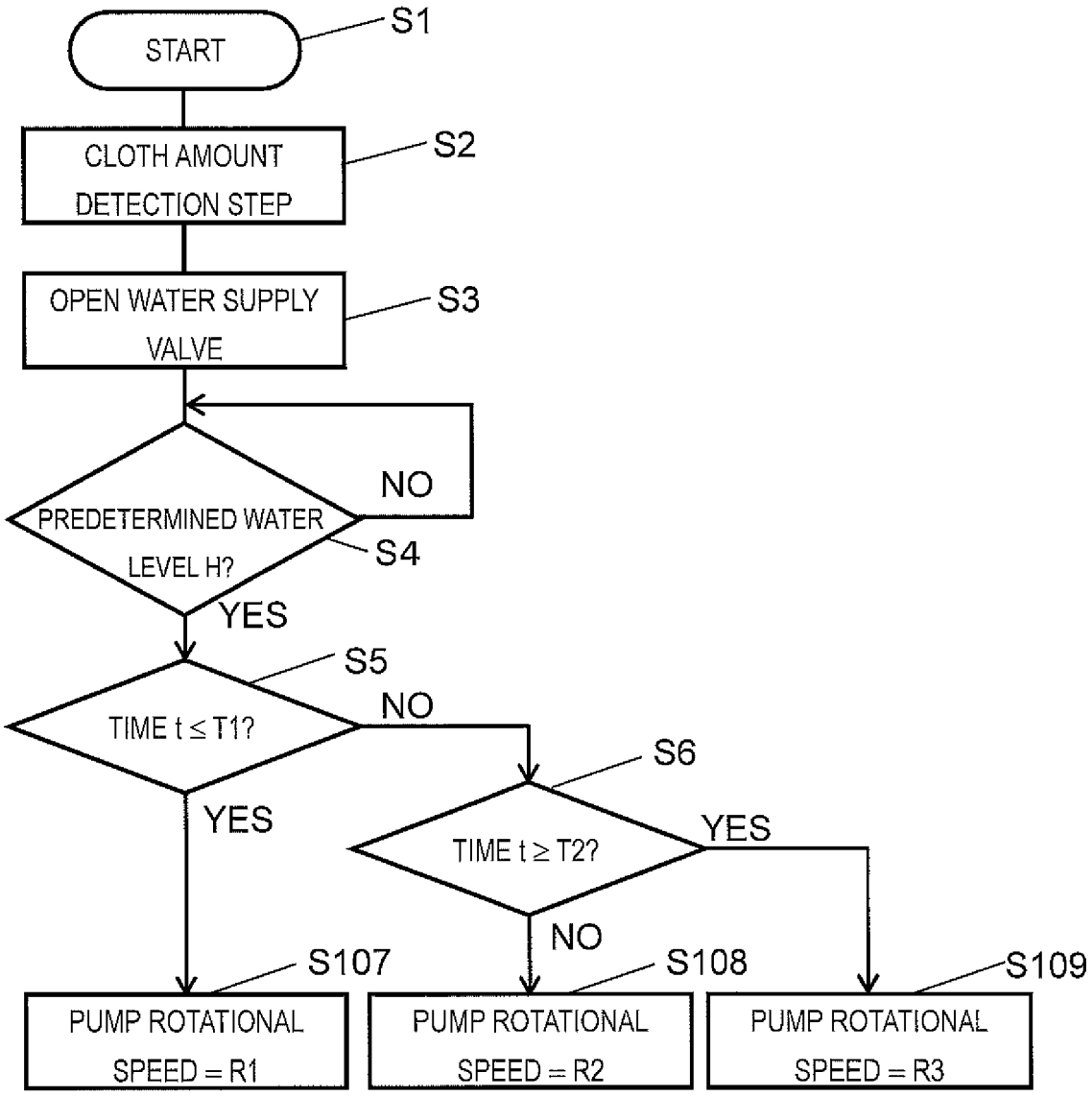
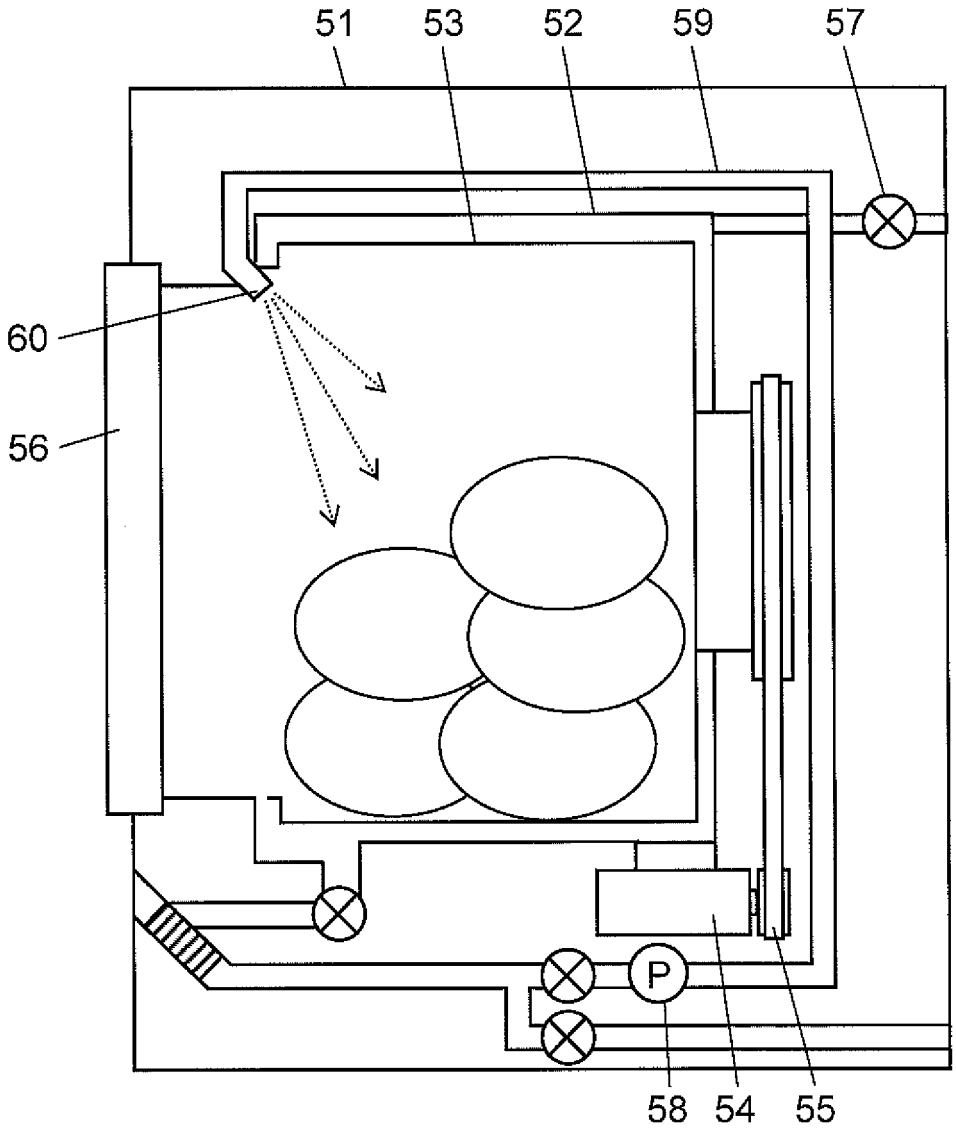

START
S1
CLOTH AMOUNT DETECTION STEP
S2
OPEN WATER SUPPLY VALVE
S3
PREDETERMINED WATER LEVEL H?
NO
S4
YES
TIME t ≤ T1?
S5
NO
YES
TIME t ≥ T2?
S6
YES
NO
PUMP ROTATIONAL SPEED = R1
S107
PUMP ROTATIONAL SPEED = R2
S108
PUMP ROTATIONAL SPEED = R3
S109

FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/001373

A. CLASSIFICATION OF SUBJECT MATTER
D06F33/02(2006.01)i, *D06F23/06*(2006.01)i, *D06F39/08*(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)
D06F33/02, D06F23/06, D06F39/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2-140197 A (Sanyo Electric Co., Ltd.), 29 May 1990 (29.05.1990), column 9, lines 3 to 13; fig. 1 (Family: none)	1-4
A	JP 4-17898 A (Hitachi, Ltd.), 22 January 1992 (22.01.1992), entire text; all drawings (Family: none)	1-4
A	JP 5-3989 A (Hitachi, Ltd.), 14 January 1993 (14.01.1993), paragraph [0033] (Family: none)	1-4

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 April, 2012 (26.04.12)	15 May, 2012 (15.05.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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Patent documents cited in the description

- JP H10127978 B **[0010]**
- JP H0928987 B **[0010]**