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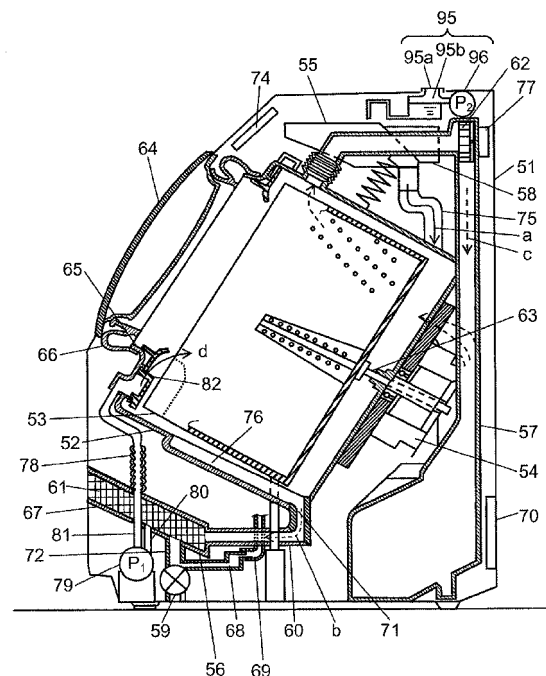
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(54) **Drum-Type Washing Machine**

(57) A drum-type washing machine of the present invention includes a water tank supported in a main cabinet of a washing machine, a rotary drum housed in the water tank (52), a motor (54) rotating the rotary drum (53), a supply valve (85) supplying water to the water tank, an automated detergent dispenser (95) for automatically feeding detergent to the water tank, an operation display unit (74) including an input setting unit (83) and a display (84), a drain outlet provided in an inner bottom part of the water tank, a drain valve (59) connected to the drain outlet, a clothes quantity detector (91) for detecting a quantity of clothes, and a controller for controlling a series of cycles including wash, rinse, and spin-dry cycles. The controller (88) includes a mode for feeding the detergent by the automated detergent dispenser (95) based on a result of the clothes quantity detector, supplying water using the supply valve, driving the motor to execute a prewash cycle, then draining the water inside the water tank by operating the drain valve, feeding the detergent of an amount less than that in the prewash cycle by the automated detergent dispenser, supplying water using the supply valve, and then executing a main wash cycle.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to drum-type washing machines that prevent darkening of clothes by increasing washing performance.

2. Background Art

[0002] A conventional washing machine typically disclosed in the Japanese Patent Unexamined Publication No. 2000-342887 (hereafter referred to as PTL 1) proposes a control system of executing a wash cycle in high detergent levels so as to improve washing performance.

[0003] The operation of the conventional washing machine disclosed in PTL 1 is described below with reference to drawings.

[0004] Fig. 6 is an operational flow chart of the conventional washing machine. Fig. 7 is a front view of a water level setting key of the washing machine. Figs 8A and 8B are examples of lamps for indicating an amount of detergent to be added to in the washing machine.

[0005] As shown in Fig. 6, the washing machine starts when the user turns on power.

[0006] Then, whether or not the user has selected a high-concentration course is determined using an operation course button (Step S101).

[0007] If the user selects the high-concentration course (Yes in Step S101), water consumption is indicated on display lamp 35a in Fig. 7, and rough detergent dosage is indicated on display lamps 40a in Fig. 8A or 40b in Fig. 8B (Step S102). The user puts detergent in an inner tank according to the displayed detergent dosage. The water level may be further reduced by using water level setting key 35 in Fig. 7. In PTL 1, indicated detergent dosage is more than that required in the standard operation course. In addition, a water level is less than that in the standard operation course. For example, if the water supply level is 30 liters, displayed detergent dosage is, for example 60 g. In the high-concentration course, the detergent level is about triple a set value for 3 kg of laundry in the standard operation course, i.e., 27 g of detergent against 39 liters of water.

[0008] Next, the user puts detergent in the inner tank based on the displayed detergent dosage, and starts washing. Water is supplied up to a set level (Step S103). When water supply is completed, a wash cycle starts (Step S111).

[0009] Then, whether or not a predetermined wash time has passed is determined (Step S112). If the predetermined time has passed and the wash cycle is completed (Yes in Step S112), for example the operation moves onto a rinse cycle that is the next cycle. On the other hand, if the wash time has not yet passed (No in Step S112), the wash cycle (step S111) is repeated.

[0010] If the user does not select the high-concentration course (No in Step S101), whether or not the soaking and high-concentration course is selected is determined (Step S104). At this point, if the soaking and high-concentration course is not selected (No in Step S104), the operation after the wash cycle (Step S113) is executed under a separate control.

[0011] If the soaking and high-concentration course is selected (Yes in Step S104), the water level is displayed first, same as the high-concentration course, and also detergent dosage is displayed (Step S105).

[0012] Next, the user puts detergent in the inner tank based on a displayed detergent dosage, and washing starts. Water is supplied up to the set level (Step S106), and a soaking period starts. When water supply is completed, laundry agitation A is executed (Step S107).

[0013] When agitation A (Step S107) is completed, the operation moves onto soaking operation as described below. During the soaking operation, the rotation of water tank is stopped (Step S108) and agitation B (Step S109) is executed. Then, whether or not soaking operation is completed is determined (Step S110). If the soaking operation is not yet completed (No in Step S110), the operation repeats the rotation of water tank stop (Step S108) and agitation B (Step S109).

[0014] When the soaking operation is completed (Yes in Step S110), the operation on and after the wash cycle (Step S111) is executed, same as when the high-concentration course is selected.

[0015] More specifically, in the conventional washing machine, detergent dosage becomes greater than that in the standard operation course by selecting the high-concentration course in the above control system. At the same time, the water level is reduced for washing. This improves the washing performance to prevent darkening of clothes. Laundry can be washed with a high-quality finish.

[0016] However, if the high-concentration course is selected for washing in order to prevent darkening of clothes, the laundry is forcibly agitated in the wash tank (inner tank) because the laundry is washed in the water level less than the specified level. Since a water tank (outer tank) containing the inner tank is oscillatably supported in a cabinet, the entire outer tank greatly shakes if the laundry is forcibly agitated in the inner tank. This generates heavy vibration, causing noise. Furthermore, in the worst case, the outer tank comes into collision with the cabinet. PTL 1 refers to a top-loading fully-automated washing machine in its embodiment. However, the same problem also occurs with a drum-type washing machine.

[0017] To avoid the above problem, a method is disclosed to increase the concentration of detergent by supplying a specified level of water against a specified amount of laundry and making the user put a double dose of detergent. However, reattachment of stains to clothes cannot be completely prevented by doubling the dose of detergent. In addition, a large detergent dosage increases economic burden.

[0018] Recent years, a washing machine equipped with an automated detergent dispenser for automatically feeding detergent into the water tank of the washing machine has been commercialized. Now the automated detergent dispenser is becoming the main stream with respect to its easy-handling. Japanese Patent Unexamined Publication No. 2002-315995 (hereafter referred to as PTL 2) discloses a washing machine equipped with an automated detergent dispenser that feeds air by an air pump into a tank where the liquid detergent is stored so as to increase the pressure inside the tank and pushes out liquid detergent into the water tank.

SUMMARY OF THE INVENTION

[0019] A drum-type washing machine of the present invention includes a water tank supported inside a main cabinet of the washing machine, a rotary drum in the water tank, a motor for rotating the rotary drum, a supply valve for supplying water into the water tank, an automated detergent dispenser for automatically feeding detergent into the water tank, an operation display unit that includes an input setting unit and display, a drain outlet provided in an inner bottom part of the water tank, a drain valve connected to the drain outlet, a clothes quantity detector for detecting a quantity of clothes, and a controller for controlling a series of cycles including wash, rinse, and spin-dry cycles. The controller includes a mode for feeding the detergent by the automated detergent dispenser based on a result of the clothes quantity detector, supplying water using the supply valve, driving the motor to execute a prewash cycle, then draining the water inside the water tank by operating the drain valve, feeding the detergent of an amount less than that in the prewash cycle by the automated detergent dispenser, supplying water using the supply valve, and then executing a main wash cycle.

[0020] This mode enables drainage of stains once removed from clothes in the prewash cycle to prevent reattachment of stains to the clothes. In addition, the laundry is washed in a high detergent level (high detergent concentration) at a water level appropriate for the clothes quantity. The washing performance can thus be improved and also darkening of clothes can be prevented. As a result, the present invention can offer a drum-type washing machine that achieves a high-quality finish by operating a mode of, for example, a so-called high-quality finish course (darkening preventive course).

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a vertical sectional view of a drum-type washing machine in accordance with a first exemplary embodiment of the present invention.

Fig. 2 is a block diagram of the drum-type washing machine.

Fig. 3 is an example of an operation display unit of the drum-type washing machine.

Fig. 4A is a flow chart illustrating control from a wash cycle to spin-dry cycle in a mode of a high-quality finish course in the drum-type washing machine.

Fig. 4B is a flow chart illustrating control from the wash cycle to spin-dry cycle in the mode of the high-quality finish course in the drum-type washing machine.

Fig. 5A is a flow chart illustrating control from a wash cycle to spin-dry cycle in a mode of a high-quality finish course in the drum-type washing machine in accordance with a second exemplary embodiment of the present invention.

Fig. 5B is a flow chart illustrating control from the wash cycle to spin-dry cycle in the mode of the high-quality finish course in the drum-type washing machine.

Fig. 6 is a flow chart illustrates the operation of a conventional washing machine.

Fig. 7 is a front view of a water level setting key in the conventional washing machine.

Fig. 8A is an example of a display lamp for indicating detergent dosage in the conventional washing machine.

Fig. 8B is an example of a display lamp for indicating detergent dosage in the conventional washing machine.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Exemplary embodiments of the present invention are described below with reference to drawings. However, it is apparent that the present invention is not limited to the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0023] Fig. 1 is a vertical sectional view of a drum-type washing machine in the first exemplary embodiment of the present invention. As shown in Fig. 1, the drum-type washing machine in the exemplary embodiment at least includes oscillatably-disposed water tank 52, cylindrical rotary drum 52 with bottom that is rotatably disposed inside water tank 52, and motor 54 attached to an outer rear face of water tank 52 in main cabinet 51 of the washing machine. Motor 54 rotates rotary drum 53. Drain outlet 71 is provided at an inner lower part of a side wall of water tank 52 in a direction of rotating axis 63 of rotary drum 53. For example, concave drain ditch 76 is provided.

[0024] The drum-type washing machine in the exemplary embodiment controls motor 54, water supply system 55, drain system 56, and drying system 57 shown in Fig. 1, using a control unit, according to mode settings and control programs. The drum-type washing machine has functions for executing at least a wash cycle, rinse cycle, spin-dry cycle, and dry cycle. Since the drum-type washing machine may also be configured without drying

system 57, description on details of drying system 57 is omitted in the following description.

[0025] As shown in Fig. 1, water supply system 55 supplies water, such as tap water, into water tank 52 as required by opening and closing supply valve 85 (described later using Fig. 2) through water supply channel 75 shown by solid arrow a provided on the side (such as to the left) with respect to the vertical direction at the center of water tank 52 when seen from the front. Here, detergent in detergent container 58 is fed into water tank 52 together with tap water at the same time as water supply. A view from the front means the case of looking inside water tank 52 from door 64 in Fig. 1.

[0026] The drum-type washing machine in the exemplary embodiment is equipped with automated detergent dispenser 95 at an inner upper part of main cabinet 51 of the washing machine. Automated detergent dispenser 95 at least includes detergent tank 95b, detergent tank cap 95a, and air pump 96. Detergent is poured into detergent tank 95b through detergent tank cap 95a protruding outside of main cabinet 51 of the washing machine. Liquid detergent is stored in detergent tank 95b. Air pressure inside detergent tank 95b that is tightly sealed by detergent tank cap 95a increases by operating air pump 96 connected to detergent tank 95b. The liquid detergent in detergent tank 95b is then pushed out into detergent container 58 by this increased air pressure, and the liquid detergent is dispensed to detergent container 58.

[0027] Drain system 56 drains wash or rinse water, by opening and closing drain valve 59, out of the drum-type washing machine through a drain channel indicated by dotted arrow b in Fig. 1 as required, such as after the wash cycle and rinse cycle. The drain channel includes drain pipe 60 connected to drain outlet 71 formed at the lower part of the inner bottom of water tank 52, drain filter 61 provided in filter case 67, connecting hose 72, and drain valve 59. Drain filter 61 catches lint, and is removable from outside. Wash and rinse water are easily drained through drain outlet 71 of drain ditch 76 provided at the inner lower part of the side wall of water tank 52.

[0028] Air trap 68 is provided at an upstream side of drain valve 59. Water level detector 94 (described later using Fig. 2) configured typically with a pressure sensor is connected to air trap 68 via air pipe 69 connected to air trap 68. Water level detector 94 detects, for example, multiple water levels by the change in water pressure of the wash water supplied to water tank 52.

[0029] Rotary drum 53 is directly connected to motor 54 fixed on an outer bottom part of water tank 52 by rotating shaft 63 provided in a manner tilted upward to the front with respect to a substantially horizontal direction or horizontal direction. Rotary drum 53 rotates by driving motor 54, and laundry loaded to rotary drum 53 through door 64 at the front is agitated and beat-washed. When door 64 is closed, water tank 52 is tightly sealed by sealant 66 attached to rim 65 of opening of water tank 52. Door 64 can be opened for loading laundry.

[0030] Drying system 57 circulates air in water tank 52

and rotary drum 53 through circulating channel shown by dotted arrow c in Fig. 1 by air blower 62 driven by fan motor 77 for feeding air. A filter (not illustrated) for collecting lint and removing dust, a dehumidifier (not illustrated) for dehumidifying incoming air after removing dust, and heat pump device 86 (illustrated later using Fig. 2) configured with a heater for heating dehumidified air to generate hot dry air are provided inside the circulating channel of drying system 57.

[0031] The drum-type washing machine in the exemplary embodiment also has a function of circulating tap water in water tank 52 via circulating water channel 78 typically in a wash preparing cycle, wash cycle, and rinse cycle, as required, in addition to water supply system 55, drain system 56, and drying system 57. This enables quick (short period) dissolution of detergent, prevention of non-uniform detergent in the tap water, and improvement of performance in the wash cycle and rinse cycle.

[0032] In other words, for example, water inside water tank 52 is circulated via circulating water channel 78 by driving circulating pump 79 configured typically with the motor changing the rotation speed during the wash cycle. More specifically, circulating water channel 78 passes water through water tank 52 via drain pipe 60 at the bottom connected to drain outlet 71 of drain ditch 76 in water tank 52, drain filter 61, inflow channel 80 to circulating pump 79, circulating pump 79, and outflow channel 81 from circulating pump 79. Water in water tank 52 that passes through is sprayed into rotary drum 53 as circulating water, as shown by arrow d in Fig. 1, through multiple spray holes 82 formed at the front (front face side) of water tank 52.

[0033] Courses including washing courses are selected and functions including water level are selected by inputting to operation display unit 74 that includes input setting unit 83 (described later using Figs. 2 and 3) provided on the front top face of main cabinet 51 of the washing machine and display unit 74 (described later using Figs. 2 and 3). Here, control unit 70 notifies the user of information input using input setting unit 83 by displaying it on display 84 of operation display unit 74. When the operation start of the washing operation is set using input setting unit 83 of operation display unit 74, data such as from water level detector 94 that detects the water level inside water tank 52 is input to control unit 70. Control unit 70 then controls the operation of motor 54, drain valve 59, and supply valve 85 based on input data, so as to sequentially control a series of cycles including wash, rinse, spin-dry, and dry cycles.

[0034] The control of the drum-type washing machine in this exemplary embodiment is described below with reference to Fig. 2.

[0035] Fig. 2 is a block diagram illustrating the control of the drum-type washing machine in the exemplary embodiment.

[0036] As shown in Fig. 2, controller 88 of control unit 70 is typically configured with a microcomputer. Power connected to mains supply 89 is supplied by turning on

power switch 90 to start the operation. Controller 88 receives outputs from clothes quantity detector 91, temperature detector A 92, temperature detector B 93, and water level detector 94. Operation display unit 74 includes input setting unit 83 and display 84. Setting value is displayed on display 84 of operation display unit 74 based on what the user has set via input setting unit 83 of operation display unit 74.

[0037] Controller 88 of control unit 70 controls the operation of motor 54, fan motor 77 for feeding air, heat pump device 86, drain valve 59, supply valve 85, circulating pump 79, and automated detergent dispenser 95 via load driver 87 of control unit 70 that is typically configured with bidirectional thyristor or relay. In this way, the wash, rinse, spin-dry, and dry cycles are controlled.

[0038] The above configuration achieves the drum-type washing machine in this exemplary embodiment.

[0039] Below is described the operation of a series of wash, rinse, and spin-dry cycles when a mode that this exemplary embodiment focuses on, such as a high-quality finish course (darkening preventive course), is selected. The operation is described using Figs. 3, 4A, and 4B with reference to Figs. 1 and 2. Here, the high-quality finish course is the mode that increases the washing performance to prevent darkening of clothes by washing laundry in a high detergent level (high detergent concentration). In this exemplary embodiment, the above operation mode is named "high-quality finish course." However, the mode is not limited to this name. Any mode that executes similar operation is applicable without being limited to naming.

[0040] Fig. 3 shows an example of the operation display unit of the drum-type washing machine in the first exemplary embodiment of the present invention.

[0041] First, the user opens door 64 shown in Fig. 1, and loads laundry into rotary drum 53. Then, the user pushes power ON button 83a in input setting unit 83 of operation display unit 74 shown in Fig. 3 to turn on power. Next, the user selects the mode of high-quality finish course 84a indicated on display 84 by using course button 83c in input setting unit 83. The user pushes start button 83b in input setting unit 83 to start the operation of the drum-type washing machine. Other than the above buttons, input setting unit 83 of operation display unit 74 includes, as shown in Fig. 3, button 83d for setting wash or dry, cycle button 83e for setting from wash to dry cycles, water level button 83f for setting water level, and button 83g for automated liquid detergent feeding. The user can freely set the water level of tap water to be supplied corresponding to the clothes quantity by using water level button 83f while confirming indication on water level display 84b in display 84.

[0042] On the other hand, if the user does not set the water level, the water level is automatically set based on the clothes quantity detected by clothes quantity detector 91 shown in Fig. 2. For example, the water level from Low to Hi2 levels indicated on water level display 84b is automatically set.

[0043] In the mode of the high-quality finish course (darkening preventive course) for preventing darkening of clothes in this exemplary embodiment, the low or medium water level is automatically set and this water level is indicated on water level display 84b.

[0044] Next is described the control when the mode of the high-quality finish course for preventing darkening of clothes is selected, with reference to Figs. 4A and 4B.

[0045] Figs. 4A and 4B are flow charts illustrating the control from wash cycle to spin-dry cycle in the mode of the high-quality finish course in the drum-type washing machine.

[0046] As shown in Fig. 4A, the first step is to determine whether or not automated liquid detergent feeding is selected by using automated liquid detergent feeding button 83g in input setting unit 83 of operation display unit 74 (Step S1).

[0047] If the automated liquid detergent feeding is selected (Yes in Step S1), the next step is to determine whether or not the mode of high-quality finish course 84a is selected by course button 83c in input setting unit 83 of operation display unit 74 (Step S2).

[0048] If the mode of high-quality finish course 84a is selected (Yes in Step S2), washing starts in the mode of high-quality finish course.

[0049] Next, clothes quantity detector 91 shown in Fig. 2 detects quantity of loaded laundry (Step 3), such as clothes, and controller 88 displays the water level corresponding to the detected clothes quantity (low or medium water level in case of the high-quality finish course) on water level display 84b (Step S4). At the same time, detergent dosage for a normal detergent level against the detected water level is displayed on digital display 84c in typically the form of an amount in detergent cup (cupful) (Step S4). For example, if the clothes quantity is 4.5 kg, and the predetermined water level that is automatically set is the medium water level, the standard detergent dosage is normally 0.8 cupful of detergent cup.

[0050] Next, by air pump 96 of automated detergent dispenser 95, specified liquid detergent equivalent to 0.8 cupful of detergent cup indicated on digital display 84c is dispensed from detergent tank 95b (Step S5).

[0051] Next, controller 88 controls supply valve 85 via load driver 87, and starts supplying water into water tank 52 (Step S6). When the water is supplied to a predetermined water level that is automatically set, water supply and agitation start (Step S7). In water supply and agitation, controller 88 drives circulating pump 79 via load driver 87, and sprays the wash water in water tank 52 as circulating water into rotary drum 53 through spray hole 82 provided at the front (front face side) of water tank 52. This encourages dissolution of dispensed detergent in the wash water. At the same time as spraying of circulating water, controller 88 drives motor 54 via load driver 87, and rotates rotary drum 53. The prewash cycle starts to agitate the laundry loaded in rotary drum 53.

[0052] Next, when the prewash cycle is completed and stains on clothes are removed to some extent, controller

88 opens drain valve 59 via load driver 87 to drain the wash water in water tank 52 via drain system 56 (Step S8). In the above drainage, water inside water tank 5 is completely drained. After water level detector 94 in Fig. 2 detects that there is no water inside, controller 88 closes drain valve 59. By this drainage, stains that are removed from laundry to some extent are discharged outside the drum-type washing machine.

[0053] Next, air pump 96 of automated detergent dispenser 95 automatically feeds a specified amount of liquid detergent from detergent tank 95b again (Step S9).

[0054] In other words, after the prewash cycle, water to be drained and amount of detergent are set (assumed) so as to achieve a specified concentration by detergent in Step S9 in Fig. 4A and water supply in Step S10 in Fig. 4B.

[0055] Then, as shown in Fig. 4B, water is supplied to the same level as in Step S6 (Step S10). Subsequent steps are described with reference to Fig. 4B.

[0056] Then, agitation washing in the main wash cycle starts (Steps S11).

[0057] After agitation washing in the main wash cycle, a subsequent rinse (1) cycle is executed. In the rinse (1) cycle, controller 88 opens drain valve 59 via load driver 87 to drain the wash inside water tank 52 (Step S12). Then, a centrifugal force is applied to the laundry to remove moisture from the laundry as intermediate spin-dry (Step S13). Controller 88 then controls supply valve 85 via load driver 87 to supply water to the level for wash cycle. Controller 88 then drives motor 54 via load driver 87 to rotate rotary drum 53. Agitation rinsing to remove detergent from the laundry starts (Step S14).

[0058] Next, after the rinse (1) cycle, a rinse (2) cycle that is the final rinse is executed. In the rinse (2) cycle, controller 88 opens drain valve 59 via load driver 87, same as in the rinse (1) cycle, to drain the rinse water in water tank 52 (Step S15). Then, by applying the centrifugal force to the laundry, intermediate spin-dry is executed to remove moisture from the laundry (Step S16). Then, controller 88 controls supply valve 85 via load driver 87 to supply water to the level of the wash cycle. Controller 88 then drives motor 54 via load driver 87 to rotate rotary drum 53 to start agitation rinsing for removing detergent from the laundry (Step S17).

[0059] After completing the rise (2) cycle, the spin-dry cycle is executed (Step S18). In the spin-dry cycle, drain valve 59 is first opened, and water inside water tank 52 is drained. Then, motor 54 is driven to spin rotary drum 53 at high speed. By applying the centrifugal force to the laundry, moisture is removed from the laundry.

[0060] Next is described the control when the automated liquid detergent feeding is not selected in Step S1.

[0061] More specifically, as shown in Fig. 4A, when automated liquid detergent feeding is not selected (No in Step S1), the washing machine is operated using a selected course other than the mode of the high-quality finish course (Step S23). (Normally, the washing machine is pre-programmed to disable selection of the

mode of the high-quality finish course.)

[0062] Here, clothes quantity detector 91 shown in Fig. 2 first detects quantity of loaded laundry (Step S24), and controller 88 displays a water level appropriate for the detected clothes quantity on water level display 84b (Step S25). At the same time, detergent dosage for the normal detergent level against detected water level is displayed on digital display 84c in typically the form of detergent cup (cupful) (Step S25). The user puts detergent for the dosage displayed on digital display 84c (Step S26).

[0063] Then, controller 88 controls supply valve 85 via load driver 87, and starts supplying water into water tank 52, as shown in Fig. 4B (Step S10). The aforementioned operation from Step S11 to Step S18 is then implemented to execute the main wash cycle.

[0064] In the same way, the control is described when the mode of the high-quality finish course is not selected in Step S2.

[0065] In other words, as shown in Fig. 4A, if the mode of the high-quality finish course is not selected (No in Step S2), a course other than the mode of the high-quality finish course is selected (Step S19) to operate the washing machine. Here, clothes quantity detector 91 shown in Fig. 2 first detects quantity of laundry loaded (Step S20), and controller 88 displays the water level appropriate for the detected quantity of laundry on water level display 84b (Step S21). At the same time, detergent dosage for normal detergent level against the detected water level is displayed on digital display 84c in typically the form of detergent cup (cupful) (Step S21). Then, the liquid detergent for an amount equivalent to that displayed in the form of detergent cup on digital display 84c is automatically dispensed into water tank 52 by air pump 96 of the automated detergent dispenser (Step S22).

[0066] Then, controller 88 controls supply valve 85 via load driver 87 to start supplying water into water tank 52 as shown in Fig. 4B (Step S10). The aforementioned operation from Step S11 to Step S18 is implemented to execute the main wash cycle.

[0067] As described above, the exemplary embodiment first drains the wash water containing stains removed from clothes by prewash in the mode of the high-quality finish course for preventing darkening of clothes. Then, the liquid detergent is automatically fed into water tank 52 by air pump 96 again. The main wash cycle is executed using detergent contained in the laundry and detergent newly dispensed, which make about 1-fold of a specified detergent level. This prevents darkening of clothes, and achieves a drum-type washing machine that enables washing with a high-quality finish. In addition, the prewash cycle and main wash cycle at the normal water level suppresses increase of vibration and generation of noise in the water tank due to eccentric rotation of the rotary drum. Accordingly, the drum-type washing machine without degradation in vibration performance is achievable.

[0068] In the exemplary embodiment, stains removed from the laundry is discharged outside the washing ma-

chine by drainage in Step S8 in Fig. 4A, but remaining stains and detergent absorbed in the laundry stay with the laundry in the rotary drum. Therefore, an amount of liquid detergent automatically dispensed in Step S9 can be an amount less than that dispensed in the prewash cycle. For example, if 0.8 detergent cup of liquid detergent is needed for the normal detergent level (detergent concentration) against the clothes quantity of 4.5 kg, an amount less than 0.8 cup, such as 0.7 or 0.6 cup, is sufficient, taking into account the detergent content absorbed and remained in the above laundry. In other words, the detergent level can be increased compared to the normal detergent level just by feeding the amount of liquid detergent less than that needed for normal detergent level. This eliminates the need of feeding excessive detergent for washing. As a result, an impact of drained excessive detergent on the environment can be reduced. In addition, the drum-type washing machine that can prevent darkening of clothes and achieve washing with a high-quality finish is made feasible by increasing the washing performance.

[0069] In the exemplary embodiment, stains once removed in the prewash cycle are drained to prevent reattachment of stains that have been removed in the prewash cycle to clothes. This enables washing in a high detergent level at the water level appropriate for the clothes quantity.

[0070] Furthermore, the exemplary embodiments can reduce the amount of detergent dispensed in the main wash cycle compared to that in the prewash cycle by draining stains that have been once removed in the prewash cycle. As a result, washing in high washing performance can be achieved using less dosage of detergent. An environmentally-friendly drum-type washing machine can also be achieved by not using wasteful detergent.

SECOND EXEMPLARY EMBODIMENT

[0071] A drum-type washing machine in a second exemplary embodiment is described with reference to drawings.

[0072] Figs. 5A and 5B are flow charts illustrating the control from a wash cycle to spin-dry cycle in a mode of a high-quality finish course of the drum-type washing machine in the second exemplary embodiment of the present invention.

[0073] The drum-type washing machine in this exemplary embodiment differs from the first exemplary embodiment with respect to a point that the spin-dry cycle (Step S101) is provided after draining in Step S8 in wash to spin-dry cycles in the mode of the high-quality finish course. Other control and operation are the same as the first exemplary embodiment, and thus their description is omitted here. The spin-dry cycle (Step S101) is detailed below, and other cycles same as the first exemplary embodiment are briefly described.

[0074] As shown in Fig. 5A, if automated liquid deter-

gent feeding is selected (Yes in Step S1), and the mode of the high-quality finish course is selected (Yes in Step S2), washing in the high-quality finish course starts.

[0075] Then, clothes quantity detector 91 shown in Fig. 2 detects quantity of loaded laundry (Step S3), and displays a water level appropriate for the detected clothes quantity on water level display 84b (Step S4). At the same time, detergent dosage for normal detergent level (detergent concentration) against the detected water level is displayed on digital display 84c (Step S4).

[0076] Next, automated detergent dispenser 95 automatically dispenses liquid detergent for a specified amount displayed on digital display 84c (Step S5).

[0077] Controller 88 then controls supply valve 85 to start supplying water into water tank 52 (Step S6), and water supply and agitation start (Step S7). This encourages dissolution of dispensed detergent in the wash water. At the same time, the prewash cycle starts by agitating the laundry.

[0078] When stains on the laundry are removed to some extent in the prewash cycle, controller 88 opens drain valve 59, and drains the wash water in water tank 52 (Step S8).

[0079] Next, the spin-dry cycle is executed by spinning rotary drum 53 at high speed (Step S101). This forcibly removes stains remaining in clothes and enables discharge of removed stains outside the drum-type washing machine.

[0080] Next, automated detergent dispenser 95 automatically dispenses a specified amount of liquid detergent again (Step S9). Then, as shown in Fig. 5B water is supplied to the level same as that in Step S6 (Step S10).

[0081] Agitation washing in the main wash cycle starts (Step S11).

[0082] After agitation washing in the main wash cycle, drainage (Step S12), intermediate spin-dry (Step S13), and agitation rinsing (Step S14) are sequentially executed in the rinse (1) cycle.

[0083] After the rinse (1) cycle, the rinse (2) cycle that is the final rinse cycle including drainage (Step S15), intermediate spin-dry (Step S16), and agitation rinsing (Step S17) is executed.

[0084] After completing the rinse (2) cycle, the spin-dry cycle is executed (Step S18).

[0085] The control when automated liquid detergent feeding is not selected in Step S1 and the control when the mode of the high-quality finish course is not selected in Step S2 are the same as that in the first exemplary embodiment. Accordingly, their description is omitted.

[0086] As described above, the exemplary embodiment first drains almost all wash water containing stains removed from the laundry, and also forcibly removes stains remaining in the laundry. They are discharged outside the drum-type washing machine in the prewash cycle in the mode of the high-quality finish course for preventing darkening of clothes. Then, liquid detergent is automatically dispensed again. Detergent slightly remaining in the laundry and detergent newly dispensed

that make about one-fold of specified detergent level are used in the main wash cycle. This further prevents darkening of clothes, and can achieve the drum-type washing machine that can wash with a high-quality finish. In addition, the prewash cycle and main wash cycle at a normal water level suppress increase of vibration and generation of noise in the water tank due to eccentric rotation of the rotary drum. Accordingly, a drum-type washing machine without degrading vibration performance is achievable.

[0087] The exemplary embodiment almost entirely drains the wash containing stains removed from clothes in the prewash cycle, and also forcibly removes stains remaining inside the clothes by executing the spin-dry cycle in Step S101 in Fig. 5A. These stains are discharged outside the drum-type washing machine. At this point, since major stains in the clothes are already removed, an amount of detergent needed for the main wash cycle can be reduced. For example, 0.4 cup to 0.5 cup of detergent, which is less than 0.8 cup dispensed in the prewash cycle, is sufficient together with a faint detergent content remaining in spin-dried clothes. In other words, a small dosage of detergent can demonstrate sufficient washing performance for washing. This eliminates the need of feeding excessive detergent for washing. As a result, an impact on the environment due to discharge of excessive detergent can be further reduced. A drum-type washing machine that can prevent darkening of clothes by increasing the washing performance for further high-quality finish is achievable.

[0088] In this exemplary embodiment, reattachment of stains to clothes can be suppressed as much as possible by forcibly spin-drying and discharging stains once removed in the prewash cycle.

Claims

1. A drum-type washing machine comprising:

a water tank supported inside a main cabinet of the washing machine;
 a rotary drum housed inside the water tank;
 a motor for rotating the rotary drum;
 a supply valve for supplying water into the water tank;
 an automated detergent dispenser for automatically feeding detergent into the water tank;
 an operation display unit including an input setting unit and a display;
 a drain outlet provided in an inner bottom part of the water tank;
 a drain valve connected to the drain outlet;
 a clothes quantity detector for detecting quantity of clothes; and
 a controller for controlling a series of cycles including wash, rinse, and spin-dry cycles, wherein the controller includes a mode for feeding the

detergent by the automated detergent dispenser based on a result of the clothes quantity detector, supplying water using the supply valve, driving the motor to execute a prewash cycle, draining the water inside the water tank by operating the drain valve, feeding the detergent of an amount less than that in the prewash cycle by the automated detergent dispenser, supplying water using the supply valve, and then executing a main wash cycle.

2. The drum-type washing machine of claim 1, wherein the controller drains the water in the water tank after the prewash cycle by operating the drain valve, executes spin-dry for a specified time, feeds the detergent again by the automated detergent dispenser, supplies water by the supply valve, and then executes the main wash cycle.
3. The drum-type washing machine of claim 1, wherein the controller executes the mode when a high-quality finish course is selected in the operation display unit.

FIG. 1

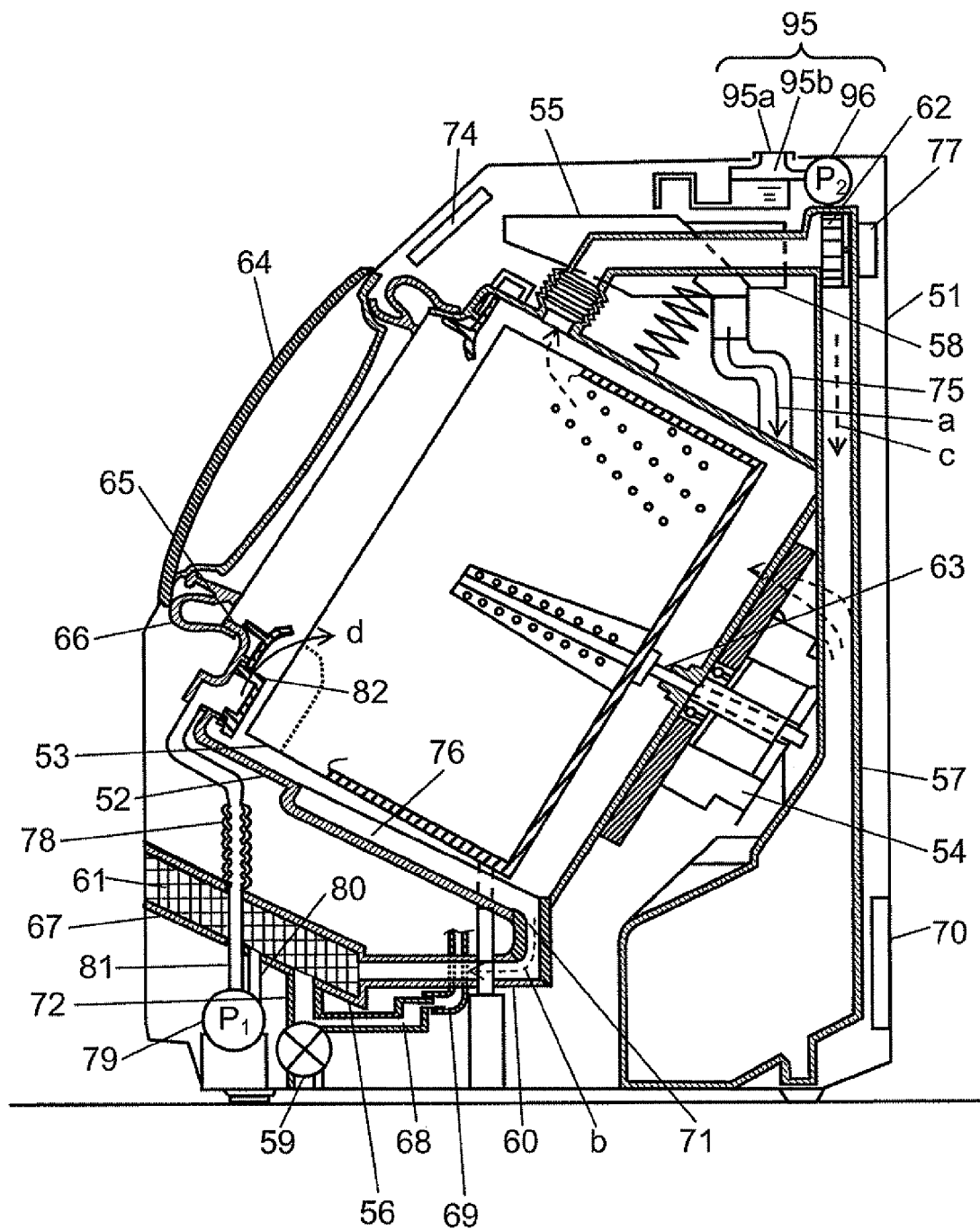


FIG. 2

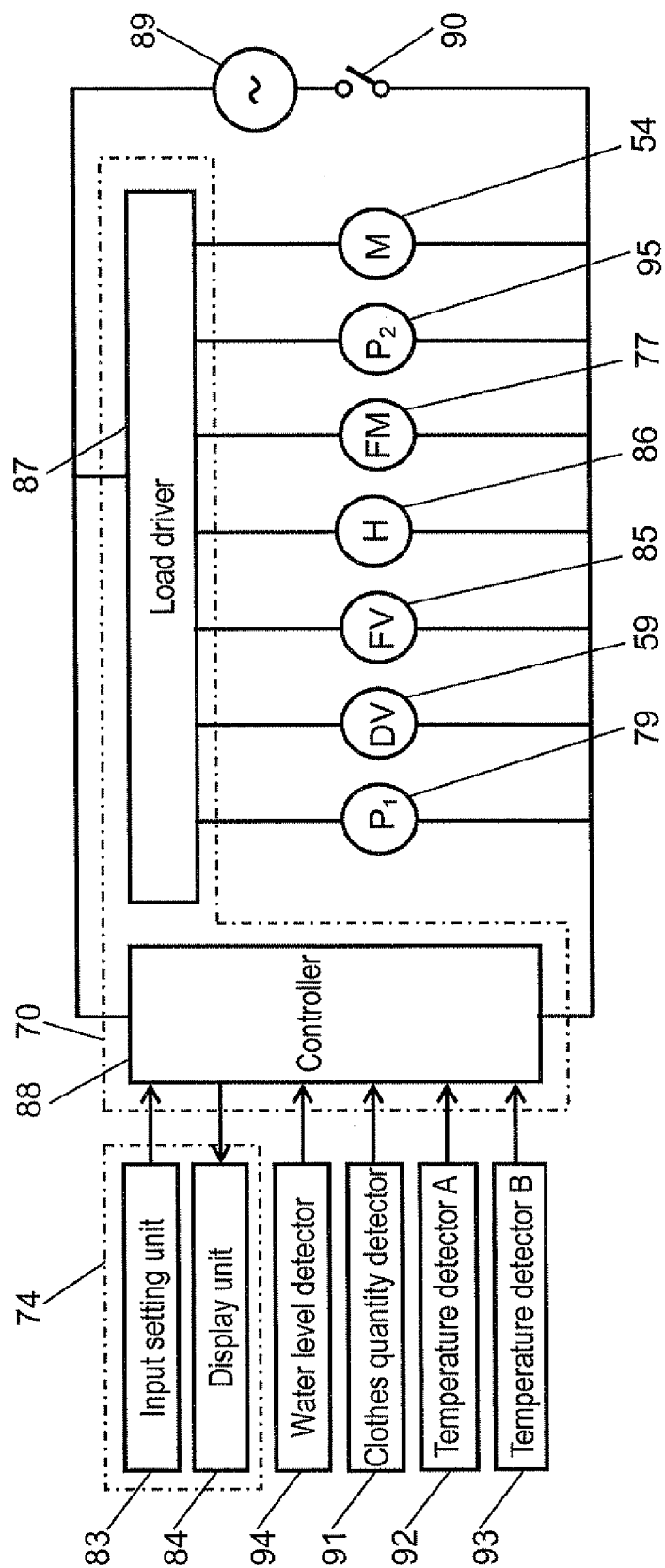


FIG. 3

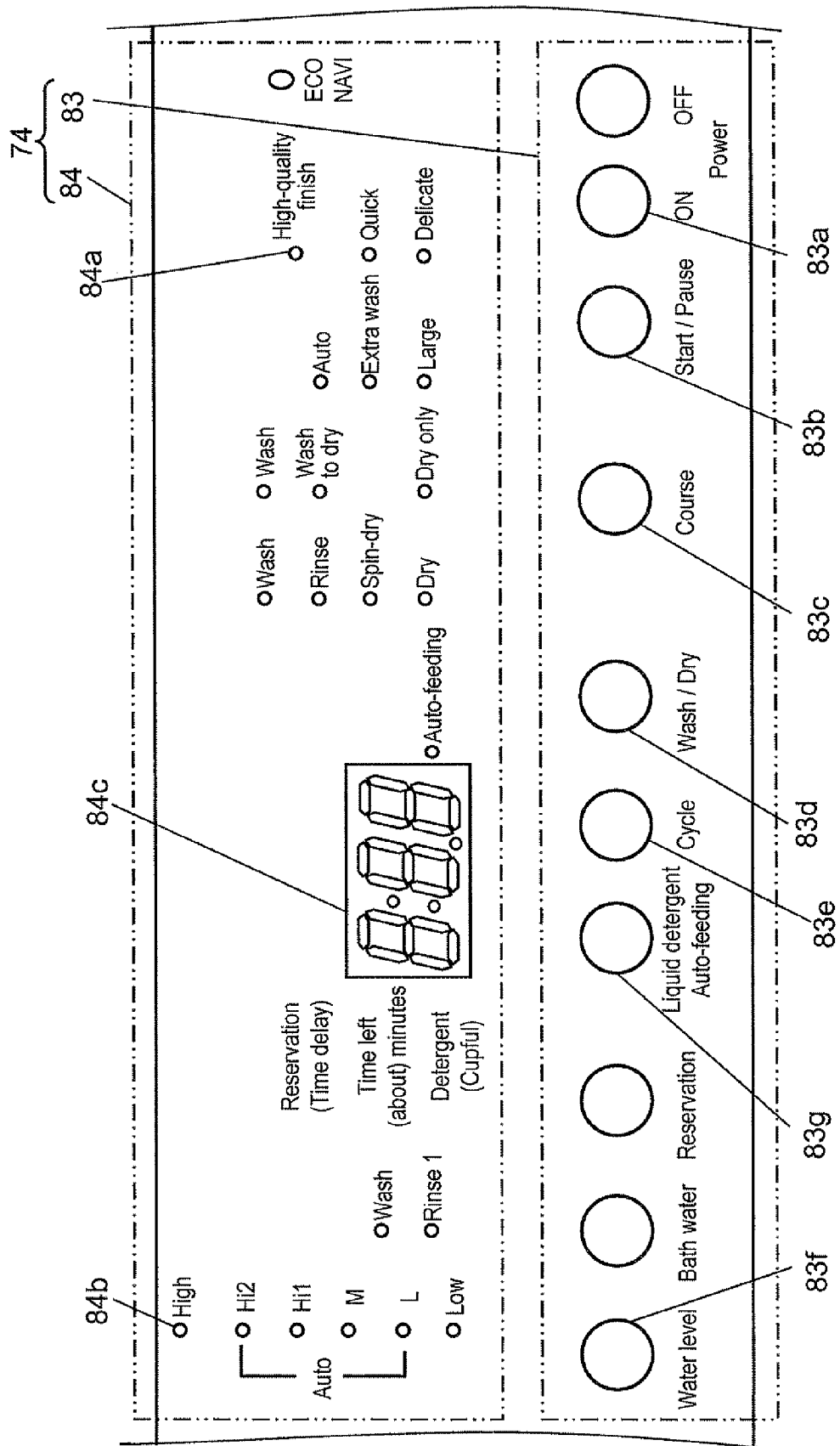


FIG. 4A

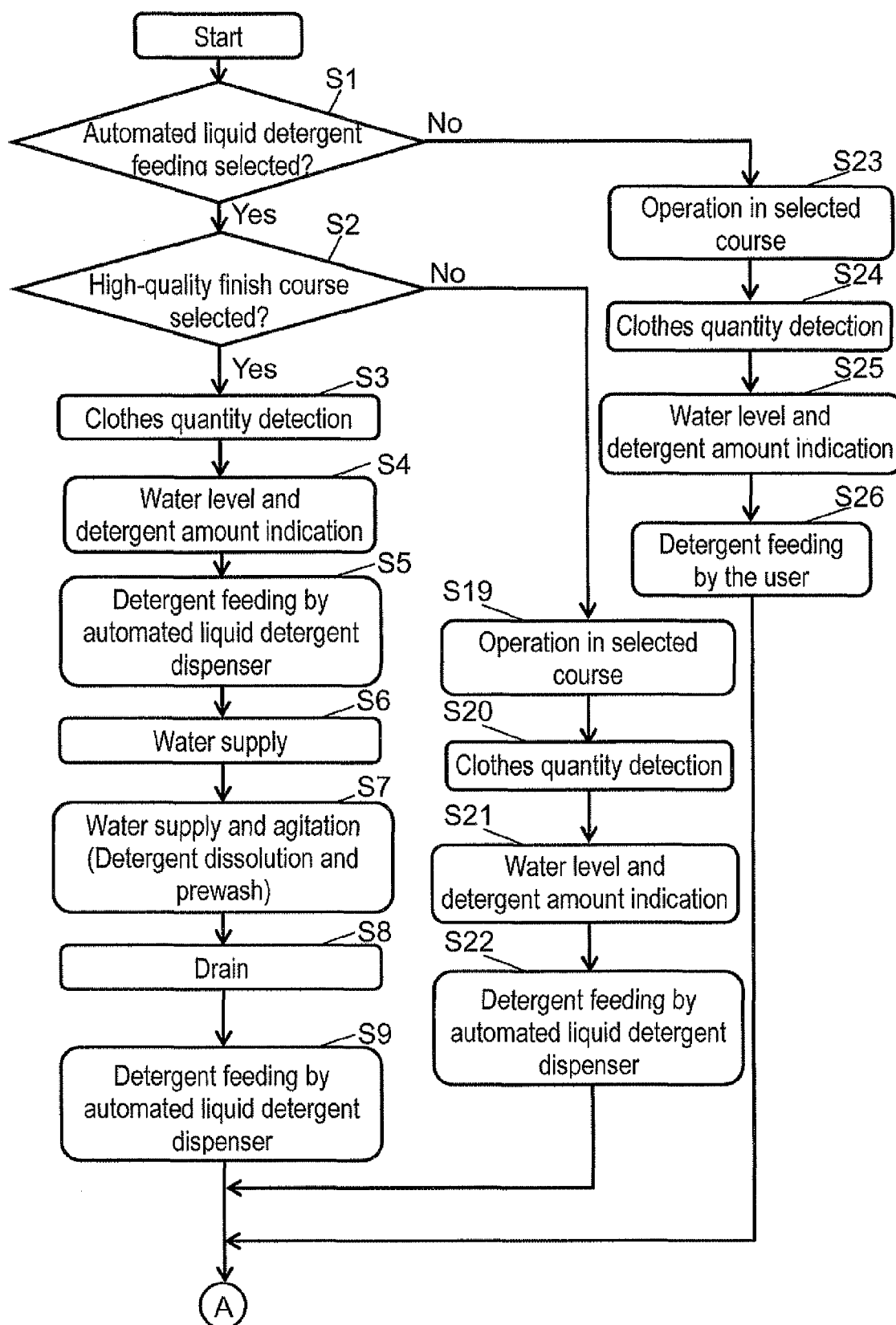


FIG. 4B

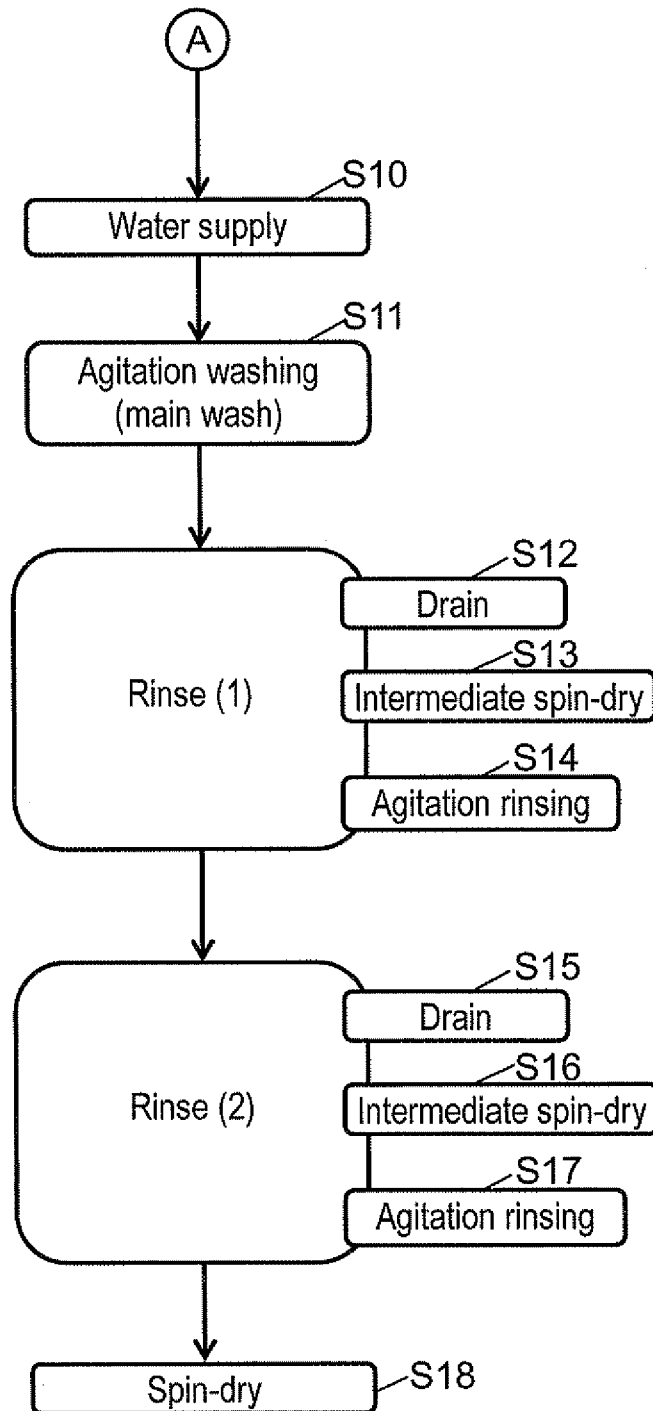


FIG. 5A

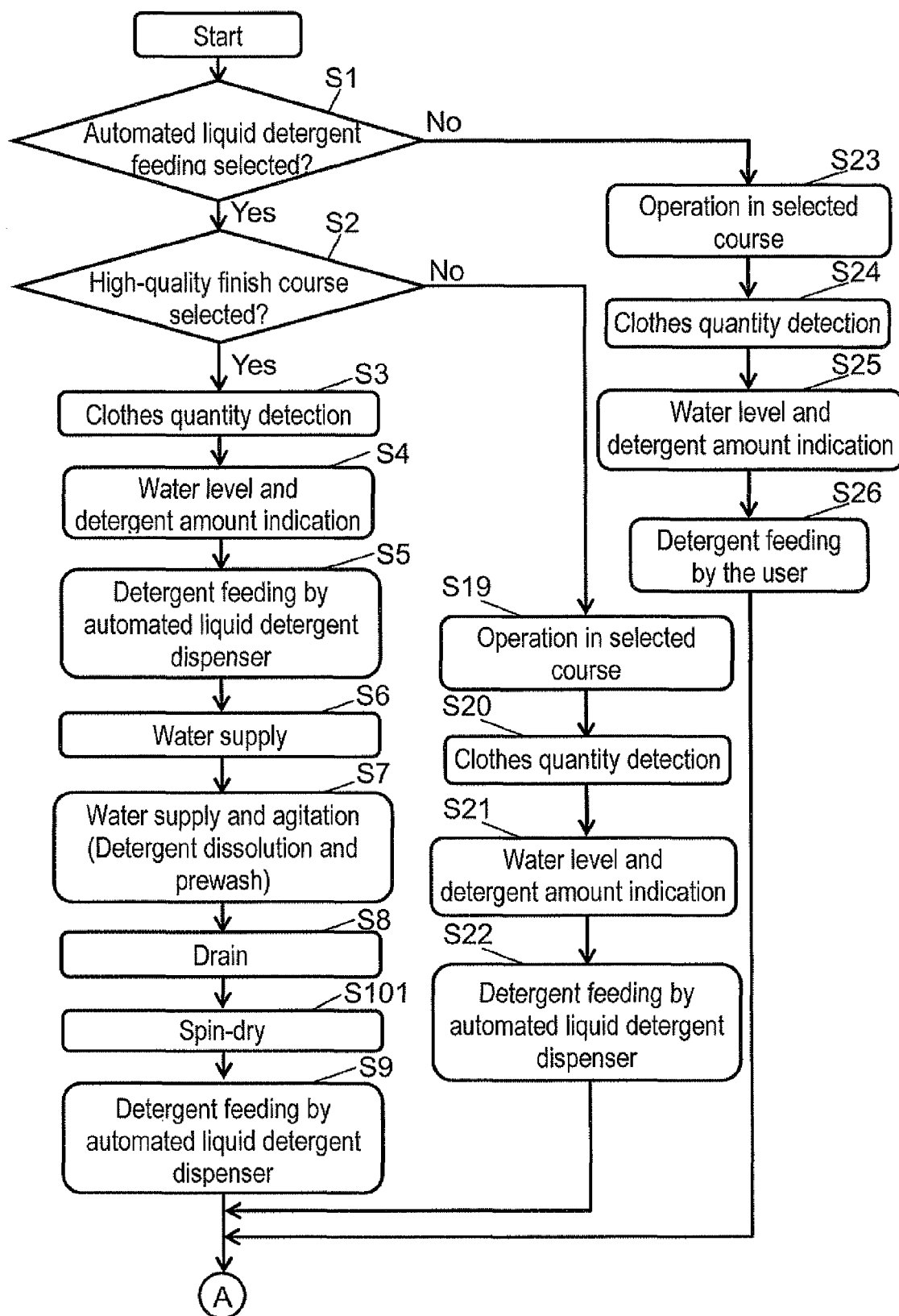


FIG. 5B

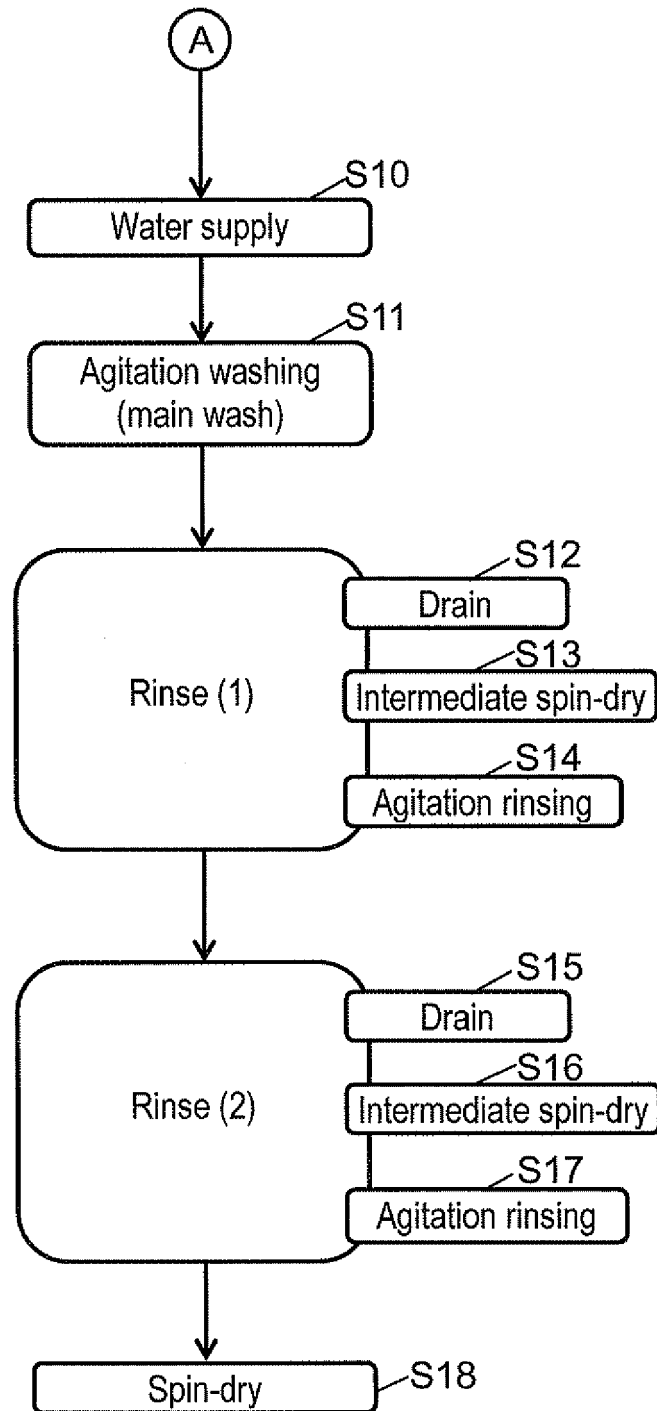


FIG. 6

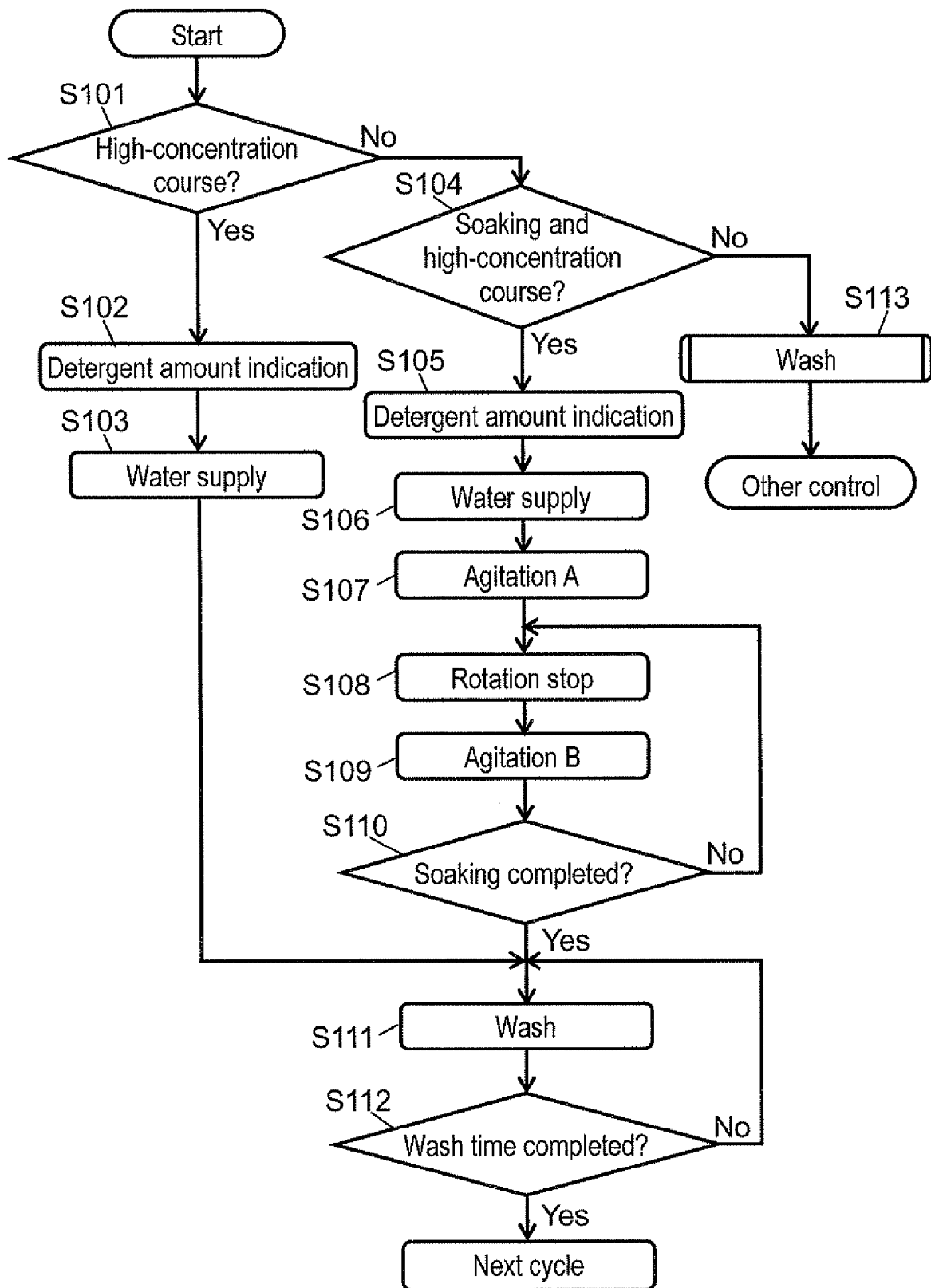


FIG. 7

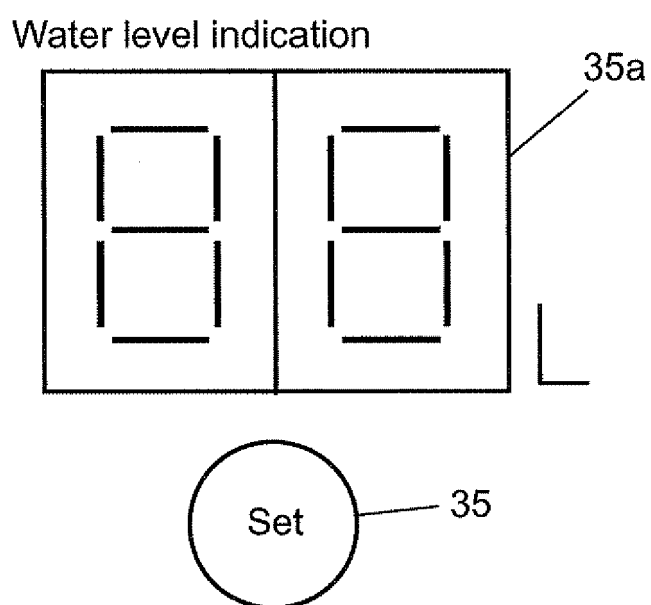


FIG. 8A

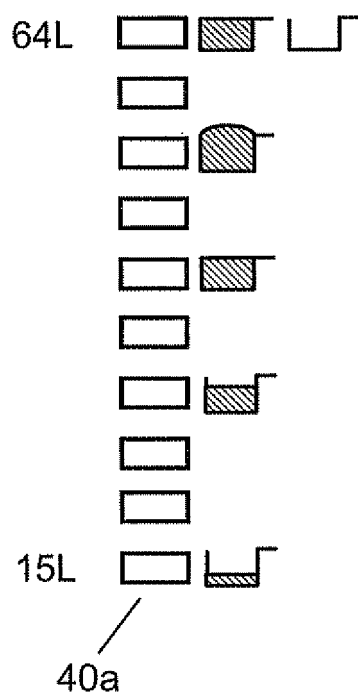
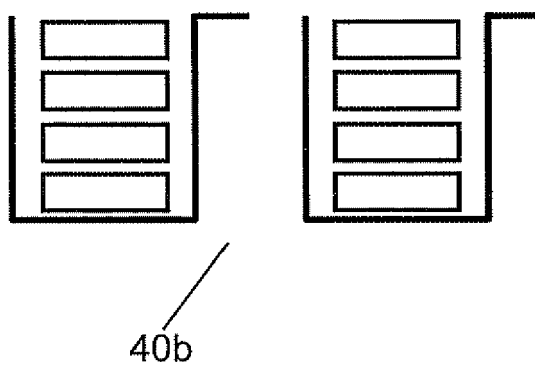


FIG. 8B



REFERENCES CITED IN THE DESCRIPTION

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