

DESCRIPTION

TITLE OF INVENTION: WASHING MACHINE

BACKGROUND

1. Technical Field

5 [0001] The present disclosure relates to a washing machine.

2. Description of the Related Art

[0002] Patent Literature 1 discloses a washing machine including a liquid agent automatic feeding device.

10 [0003] The washing machine in Patent Literature 1 includes: a liquid agent tank configured to store a liquid agent; a liquid agent automatic feeding device configured to automatically supply the liquid agent stored in the liquid agent tank to a washing tub; and a water supply valve configured to communicate with the liquid agent automatic feeding device via a water path. The washing machine drives the liquid agent automatic feeding
15 device to supply the liquid agent to the washing tub, and then opens the water supply valve to supply water to the liquid agent automatic feeding device.

Citation List

[0004] Patent Literature 1: WO 2019/039140

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SUMMARY

[0005] The present disclosure provides a washing machine including a liquid agent automatic feeding device, the washing machine being capable of efficiently performing a water supply operation involved in washing operation.

25 [0006] The washing machine in the present disclosure includes a casing, a washing tub, a water conveyance path, a liquid agent tank, the liquid agent automatic feeding device, and a control unit. The washing tub is disposed inside the casing and configured to accommodate the laundry. The water conveyance path supplies water to the washing tub via a water supply valve. The liquid agent tank is configured to store a liquid agent. The
30 liquid agent automatic feeding device is configured to feed the liquid agent stored in the liquid agent tank into the washing tub. The water conveyance path includes a first water path through which the water is supplied to the washing tub without passing through the liquid agent automatic feeding device. The water supply valve includes a first valve configured to allow the water to flow through the first water path. The control unit is

configured to drive the liquid agent automatic feeding device to open the first valve.
[0007] The washing machine in the present disclosure is capable of performing an automatic feeding operation with the liquid agent automatic feeding device and also efficiently performing the water supply operation involved in the washing operation.

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BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is an external perspective view of the configuration of a washing machine in Embodiment 1 in a state in which a lid of the washing machine is closed.

FIG. 2 is an external perspective view of the configuration of the washing
10 machine in Embodiment 1 in a state in which the lid of the washing machine is opened.

FIG. 3 is an external perspective view of the configuration of a water supply unit of the washing machine and its surroundings in Embodiment 1 in a state in which a detergent case, a detergent tank, and a softening agent tank are drawn out.

FIG. 4 is a back view of the configuration of the water supply unit of the washing
15 machine and its surroundings in Embodiment 1.

FIG. 5 is an exploded perspective view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 1.

FIG. 6 is a top view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 1, except a flow-path lid unit.

FIG. 7 is a cross-sectional top view of the water supply unit of the washing
20 machine and its surroundings in Embodiment 1, except the flow-path lid unit, in a state in which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 8 is a cross-sectional view of the water supply unit and its surroundings, taken along line F-F in FIG. 7.

FIG. 9 is a top view of the water supply unit of the washing machine and its
25 surroundings in Embodiment 1, except the flow-path lid unit, in a state in which the detergent case, the detergent tank, and the softening agent tank are drawn out.

FIG. 10 is a cross-sectional view of the water supply unit and its surroundings, taken along line B-B in FIG. 7.

FIG. 11 is a cross-sectional view of the water supply unit and its surroundings,
30 taken along line E-E in FIG. 7.

FIG. 12 is a cross-sectional view of the water supply unit and its surroundings, taken along line C-C in FIG. 7.

FIG. 13 is a cross-sectional view of the water supply unit and its surroundings,

taken along line A-A in FIG. 7.

FIG. 14 is a cross-sectional view of the water supply unit and its surroundings, taken along line D-D in FIG. 7.

FIG. 15 is an external front view of the water supply unit of the washing machine in Embodiment 1 in a state in which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 16 is a timing chart illustrating washing operation of the washing machine in Embodiment 1.

FIG. 17 is an external perspective view of the configuration of a washing machine in Embodiment 2 in a state in which a lid of the washing machine is closed.

FIG. 18 is an external perspective view of the configuration of the washing machine in Embodiment 2 in a state in which the lid of the washing machine is opened.

FIG. 19 is an external perspective view of the configuration of a water supply unit of the washing machine and its surroundings in Embodiment 2 in a state in which a detergent case, a detergent tank, and a softening agent tank are drawn out.

FIG. 20 is a back view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 2.

FIG. 21 is an exploded perspective view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 2.

FIG. 22 is a top view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 2, except a flow-path lid unit.

FIG. 23 is a cross-sectional top view of the water supply unit of the washing machine and its surroundings in Embodiment 2, except the flow-path lid unit, in a state in which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 24 is a cross-sectional view of the water supply unit and its surroundings, taken along line M-M in FIG. 23.

FIG. 25 is a top view of the water supply unit of the washing machine and its surroundings in Embodiment 2, except the flow-path lid unit, in a state in which the detergent case, the detergent tank, and the softening agent tank are drawn out.

FIG. 26 is a cross-sectional view of the water supply unit and its surroundings, taken along line H-H in FIG. 23.

FIG. 27 is a cross-sectional view of the water supply unit and its surroundings, taken along line L-L in FIG. 23.

FIG. 28 is a cross-sectional view of the water supply unit and its surroundings,

taken along line J-J in FIG. 23.

FIG. 29 is a cross-sectional view of the water supply unit and its surroundings, taken along line G-G in FIG. 23.

FIG. 30 is a cross-sectional view of the water supply unit and its surroundings,
5 taken along line K-K in FIG. 23.

FIG. 31 is an external front view of the water supply unit of the washing machine in Embodiment 2 in a state in which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 32 is a timing chart illustrating washing operation of the washing machine in
10 Embodiment 2.

FIG. 33 is an external perspective view of the configuration of a washing machine in Embodiment 3 in a state in which a lid of the washing machine is closed.

FIG. 34 is an external perspective view of the configuration of the washing machine in Embodiment 3 in a state in which the lid of the washing machine is opened.

FIG. 35 is an external perspective view of the configuration of a water supply unit of the washing machine and its surroundings in Embodiment 3 in a state in which a
15 detergent case, a detergent tank, and a softening agent tank are drawn out.

FIG. 36 is a back view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 3.

FIG. 37 is an exploded perspective view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 3.
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FIG. 38 is a top view of the configuration of the water supply unit of the washing machine and its surroundings in Embodiment 3, except a flow-path lid unit.

FIG. 39 is a cross-sectional top view of the water supply unit of the washing machine and its surroundings in Embodiment 3, except the flow-path lid unit, in a state in
25 which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 40 is a cross-sectional view of the water supply unit and its surroundings, taken along line S-S in FIG. 39.

FIG. 41 is a top view of the water supply unit of the washing machine and its surroundings in Embodiment 3, except the flow-path lid unit, in a state in which the
30 detergent case, the detergent tank, and the softening agent tank are drawn out.

FIG. 42 is a cross-sectional view of the water supply unit and its surroundings, taken along line O-O in FIG. 39.

FIG. 43 is a cross-sectional view of the water supply unit and its surroundings,

taken along line R-R in FIG. 39.

FIG. 44 is a cross-sectional view of the water supply unit and its surroundings, taken along line P-P in FIG. 39.

5 FIG. 45 is a cross-sectional view of the water supply unit and its surroundings, taken along line N-N in FIG. 39.

FIG. 46 is a cross-sectional view of the water supply unit and its surroundings, taken along line Q-Q in FIG. 39.

10 FIG. 47 is an external front view of the water supply unit of the washing machine in Embodiment 3 in a state in which the detergent case, the detergent tank, and the softening agent tank are removed.

FIG. 48 is an external perspective view of the configuration of the detergent tank of the washing machine in Embodiment 3.

15 FIG. 49A is a cross-sectional top view of the water supply unit of the washing machine and its surroundings in Embodiment 3, except the flow-path lid unit, in a state in which the detergent tank is accommodated.

FIG. 49B is a cross-sectional top view of the water supply unit of the washing machine and its surroundings in Embodiment 3, except the flow-path lid unit, in a state in which the detergent tank is drawn out.

20 FIG. 50 is a cross-sectional view of the water supply unit and its surroundings, taken along line T-T in FIG. 49A.

FIG. 51 is a cross-sectional view of the water supply unit and its surroundings, taken along line W-W in FIG. 49B.

FIG. 52 is a cross-sectional view of the water supply unit and its surroundings, taken along line U-U in FIG. 49A.

25 FIG. 53 is a cross-sectional view of the water supply unit and its surroundings, taken along line V-V in FIG. 49B.

FIG. 54 is a top view of the configuration of a flow-path lower unit of the washing machine in Embodiment 3.

30 FIG. 55 is a timing chart illustrating washing operation of the washing machine in Embodiment 3.

DETAILED DESCRIPTIONS

[0009] Hereinafter, embodiments will be described in detail with reference to the drawings. The accompanying drawings and the following descriptions are provided to

help those skilled in the art fully understand the present disclosure, and do not intend to thereby restrict the subject matter recited in the claims.

[0010] (Embodiment 1)

Hereinafter, washing machine 100 in Embodiment 1 will be described using FIG. 1 to FIG. 16.

[0011] [1-1. Configuration]

[1-1-1. Configuration of Washing Machine]

FIG. 1 is an external perspective view of the configuration of washing machine 100 in Embodiment 1 in a state in which lid 700 is closed. FIG. 2 is an external perspective view of the configuration of washing machine 100 in a state in which lid 700 is opened. Note that, in Embodiment 1, the vertical direction in a state in which washing machine 100 is installed as illustrated in FIG. 1 and FIG. 2 is sometimes referred to as a top-and-bottom direction. Furthermore, in Embodiment 1, a side on which operation unit 800 of washing machine 100 is present in FIG. 1 and FIG. 2 is sometimes referred to as a rear side, meanwhile a side opposing the rear side is sometimes referred to as a front side. That is, typically, a user stands in front of washing machine 100 and puts the laundry, such as clothes, into washing machine 100, and performs various types of operations for operating washing machine 100. Note that the laundry in the present disclosure is not limited to clothes, but may be, for example, fabrics and leather products, such as bedclothes, curtains, carpeting, and shoes, and other various known washing-machine washables.

[0012] As illustrated in FIG. 1 and FIG. 2, washing machine 100 includes casing 600, lid 700, operation unit 800, and control unit 900. Washing machine 100 is what is called a top-loading washing machine that allows the laundry to be put into casing 600 from above when washing machine 100 is in the installed state. Casing 600 includes lower casing 610 and upper casing 620. Lower casing 610 is configured to accommodate washing tub 500. Washing tub 500 is in the shape of an open-top cylinder and configured to accommodate the laundry and perform a washing operation for washing the laundry. In other words, washing tub 500 is disposed inside casing 600 and is configured to accommodate the laundry. The washing operation may be an operation performed by a washing tub of any type of various known washing machines. The principle of Embodiment 1 is not limited to a specific washing operation performed by washing tub 500.

[0013] Upper casing 620 is disposed above lower casing 610. In upper casing 620, loading opening 621 for the laundry is formed to communicate with washing tub 500. Lid

700 is attached to a rear portion of upper casing 620 and configured to cover loading opening 621 in an openable and closable manner. When the user rotates lid 700 upward, washing tub 500 is exposed through loading opening 621. The user can put the laundry into washing tub 500 from loading opening 621.

5 [0014] In a rear portion of upper casing 620, operation unit 800 is disposed at a position behind loading opening 621. The user can operate operation unit 800 to set various types of operations of washing tub 500.

[0015] Water supply port 200 is provided behind operation unit 800. Water supply hose 210 is connected to water supply port 200 so as to introduce tap water from a tap.

10 [0016] Control unit 900 is disposed in casing 600. Control unit 900 is configured to control the operation of the whole of washing machine 100 in response to the operation of operation unit 800 by the user. For example, control unit 900 is configured to control water supply valve 310 (see FIG. 3) and liquid agent automatic feeding device 301 (see FIG. 3). Control unit 900 includes a computer system including a processor and a memory.

15 When the processor executes a program stored in the memory, the computer system functions as a controller. Here, there was described that the program to be performed by the processor is beforehand recorded in the memory of the computer system, but the program may be recorded in a non-transitory recording medium, such as a memory card, and provided, or may be provided via a telecommunication line, such as the Internet.

20 [0017] As illustrated in FIG. 2, detergent tank 450, softening agent tank 460, and detergent case 400 are disposed so that, when detergent tank 450, softening agent tank 460, and detergent case 400 are accommodated in water supply unit 300, their front faces are flush with each other.

[0018] FIG. 3 is an external perspective view of the configuration of water supply unit 25 300 and its surroundings in a state in which detergent case 400, detergent tank 450, and softening agent tank 460 are drawn out. As illustrated in FIG. 3, detergent tank 450 and softening agent tank 460 are configured to be capable of storing a liquid in amounts allowing two or more operations. Specifically, detergent tank 450 and softening agent tank 460 store a liquid detergent and a softening agent, respectively. In other words, detergent 30 tank 450 and softening agent tank 460 are examples of the liquid agent tank in the present disclosure configured to store a liquid agent. Detergent tank 450 includes detergent tank feeding unit 451 through which the liquid detergent to be stored is fed, meanwhile softening agent tank 460 includes softening agent tank feeding unit 461 through which the softening agent to be stored is fed. The top faced of detergent tank feeding unit 451 and

softening agent tank feeding unit 461 are open so as to allow their respective liquid agents to be fed.

[0019] Detergent tank 450 and softening agent tank 460 include detergent tank residual amount scale 450a and softening agent tank residual amount scale 460a, respectively.

5 Detergent tank residual amount scale 450a and softening agent tank residual amount scale 460a are each formed of a transparent material, so that the user can visually check the residual amount of a liquid agent.

[0020] In contrast, detergent case 400 is to be used in order that the user feeds an agent in amounts necessary for one operation. Detergent case 400 includes: powder detergent
10 manual feeding unit 410 into which a powder detergent is fed; liquid detergent manual feeding unit 420 into which a liquid detergent is fed; and softening agent manual feeding unit 430 into which a softening agent is fed.

[0021] Lid 700 is configured to be partially transparent. With this configuration, even when lid 700 is in the closed state, the user can visually read detergent tank residual
15 amount scale 450a and softening agent tank residual amount scale 460a to check the residual amount of a liquid agent stored in detergent tank 450 and the residual amount of a liquid agent stored in softening agent tank 460.

[0022] [1-1-2. Water Supply Unit]

FIG. 4 is a back view of the configuration of water supply unit 300 and its
20 surroundings. FIG. 5 is an exploded perspective view of the configuration of water supply unit 300 and its surroundings. As illustrated in FIG. 5, water supply unit 300 mainly includes: water supply unit casing 320 being approximately box-shaped; flow-path lid unit 340 configured to cover the top face of water supply unit casing 320; and flow-path lower unit 370 attached to the bottom of water supply unit casing 320.

25 [0023] As illustrated in FIG. 3 and FIG. 4, water supply valve 310 configured to be openable and closable to allow the passage of water introduced from water supply port 200 is attached to the left side of water supply unit casing 320 when seen from the back face thereof. With water supply valve 310 open, water introduced via water supply valve 310 is introduced into water supply unit casing 320.

30 [0024] At the center of the back face of water supply unit casing 320, bath pump 314 configured to suck water via a hose (not illustrated) from the outside of washing machine 100 is provided. Bath pump 314 is fixed to flow-path lid unit 340 with a screw, and directly connected to the later-described first water conveyance path 321 via bath pump-specific water feed port 333. When water is supplied from first water conveyance path 321,

bath pump 314 can start suction and discharge operations.

[0025] As illustrated in FIG. 5 and FIG. 6, water supply unit casing 320 is formed in an approximately box shape that is open forward. Water supply unit casing 320 includes tank accommodation unit 360 and detergent case accommodation unit 350, each serving as an interior space. Tank accommodation unit 360 independently drawably accommodates detergent tank 450 and softening agent tank 460, meanwhile detergent case accommodation unit 350 independently drawably accommodates detergent case 400.

[0026] Detergent case flow-path unit 330 is provided to serve as the top face of detergent case accommodation unit 350. In detergent case flow-path unit 330, the later-described first water conveyance path 321 and the later-described second water conveyance path 322 are formed.

[0027] As illustrated in FIG. 3 and FIG. 4, liquid agent automatic feeding device 301 is attached to the right side of water supply unit casing 320 when seen from the back face thereof. Liquid agent automatic feeding device 301 is configured to feed liquid agents stored in detergent tank 450 and softening agent tank 460 into washing tub 500. Liquid agent automatic feeding device 301 will be described later.

[0028] [1-1-3. Water Conveyance Path]

As illustrated in FIG. 4 and FIG. 5, water supply valve 310 includes three opening-and-closing valves, namely, first water conveyance pipe 311, second water conveyance pipe 312, and third water conveyance pipe 313, and is capable of independently opening and closing these three opening-and-closing valves.

[0029] FIG. 6 is a top view of the configuration of water supply unit 300 and its surroundings, except flow-path lid unit 340. FIG. 7 is a top view of water supply unit 300 and its surroundings, except flow-path lid unit 340, in a state in which detergent case 400, detergent tank 450, and softening agent tank 460 are removed. FIG. 8 is a cross-sectional view of water supply unit 300 and its surroundings, taken along line F-F in FIG. 7. FIG. 9 is a top view of water supply unit 300 and its surroundings, except flow-path lid unit 340, in a state in which detergent case 400, detergent tank 450, and softening agent tank 460 are drawn out. FIG. 10 is a cross-sectional view of water supply unit 300 and its surroundings, taken along line B-B in FIG. 7.

[0030] As illustrated in FIG. 6 to FIG. 10, first water conveyance path 321, second water conveyance path 322, and third water conveyance path 323, each supplies water to washing tub 500 via water supply valve 310, are formed in water supply unit casing 320. First water conveyance path 321, second water conveyance path 322, and third water

conveyance path 323 are directly connected to water supply valve 310. First water conveyance path 321, second water conveyance path 322, and third water conveyance path 323 are formed by branching to independently communicate with first water conveyance pipe 311, second water conveyance pipe 312, and third water conveyance pipe 313,

5 respectively. In other words, first water conveyance pipe 311 communicates with first water conveyance path 321, second water conveyance pipe 312 communicates with second water conveyance path 322, and third water conveyance pipe 313 communicates with third water conveyance path 323.

[0031] [1-1-4. Detergent Case, First Water Conveyance Path, Second Water Conveyance
10 Path]

As illustrated in FIG. 3 and FIG. 6 to FIG. 9, first water conveyance path 321 and second water conveyance path 322 are configured to guide water supplied from first water conveyance pipe 311 and second water conveyance pipe 312 to detergent case flow-path unit 330 and feed the water into detergent case 400 positioned below.

15 [0032] As described above, powder detergent manual feeding unit 410, liquid detergent manual feeding unit 420, and softening agent manual feeding unit 430 are provided inside detergent case 400 and configured to allow the user to feed a powder detergent, a liquid detergent, and a softening agent, respectively.

[0033] First water conveyance path 321 includes: powder detergent-specific water feed
20 port 331 formed in order to make the upper and lower sides communicate with each other above powder detergent manual feeding unit 410; and liquid detergent-specific water feed port 332 formed in order to make the upper and lower sides communicate with each other above liquid detergent manual feeding unit 420. Second water conveyance path 322 includes softening agent-specific water feed port 334 formed in order to make the upper
25 and lower sides communicate with each other above softening agent manual feeding unit 430.

[0034] Each of powder detergent manual feeding unit 410, liquid detergent manual feeding unit 420, and softening agent manual feeding unit 430 includes a discharge port (not illustrated) configured to discharge a liquid having gathered inside. The liquid
30 discharged from the discharge port falls down to flow-path lower unit 370. Flow-path lower unit 370 is configured as a discharge unit to discharge the liquid to washing tub 500.

[0035] [1-1-5. Detergent Tank, Automatic Feeding Device, Third Water Conveyance Path]

FIG. 11 is a cross-sectional view of water supply unit 300 and its surroundings,

taken along line E-E in FIG. 7. FIG. 12 is a cross-sectional view of water supply unit 300 and its surroundings, taken along line C-C in FIG. 7. FIG. 13 is a cross-sectional view of water supply unit 300 and its surroundings, taken along line A-A in FIG. 7. FIG. 14 is a cross-sectional view of water supply unit 300 and its surroundings, taken along line D-D in FIG. 7. FIG. 15 is an external front view of the configuration of water supply unit 300 in a state in which detergent case 400, detergent tank 450, and softening agent tank 460 are removed.

[0036] As illustrated in FIG. 6 and FIG. 10 to FIG. 15, third water conveyance path 323 is formed along the back face of water supply unit casing 320 in the approximately horizontal direction, and is open toward the back face side at washing path water port 324. Washing path water port 324 is connected to the later-described in-automatic-feeding-device path 325, and causes third water conveyance path 323 to communicate with liquid agent automatic feeding device 301. Liquid agent automatic feeding device 301 is disposed on the back face side of tank accommodation unit 360. Furthermore, as described later, liquid agent automatic feeding device 301 is connected to detergent tank 450 and softening agent tank 460, each being accommodated in tank accommodation unit 360.

[0037] As illustrated in FIG. 9, detergent tank entry 302 is provided on the back face side of detergent tank 450, and a detergent tank check valve (not illustrated) configured to be opened when pushed is provided inside detergent tank entry 302. Similarly, softening agent tank entry 303 and a softening agent tank check valve (not illustrated) configured to be opened when pushed are provided on the back face side of softening agent tank 460. Detergent tank 450 is configured such that, in a state in which detergent tank 450 is installed in tank accommodation unit 360, the later-described detergent automatic feed entry 452 is inserted into detergent tank entry 302 and thereby the detergent tank check valve is opened to allow the supply of a liquid detergent. Similarly, softening agent tank 460 is configured such that, in a state in which softening agent tank 460 is installed in tank accommodation unit 360, the later-described softening agent automatic feed entry 462 is inserted into softening agent tank entry 303 and thereby the softening agent tank check valve is opened to allow the supply of a softening agent.

[0038] Detergent automatic feeding-specific connection unit 360a and softening agent automatic feeding-specific connection unit 360b are provided in the inner back face of tank accommodation unit 360. Detergent automatic feeding-specific connection unit 360a and softening agent automatic feeding-specific connection unit 360b are configured to surround detergent automatic feed entry 452 and softening agent automatic feed entry 462 of liquid

agent automatic feeding device 301, respectively.

[0039] Liquid agent automatic feeding device 301 includes detergent automatic feed entry 452, softening agent automatic feed entry 462, three-way valve 380, pump unit 390, and in-automatic-feeding-device path 325. Three-way valve 380 is configured to switch
5 between paths for a liquid detergent, a softening agent, and water. Pump unit 390 is configured to suck in and discharge a liquid agent. In-automatic-feeding-device path 325 connects three-way valve 380 to pump unit 390.

[0040] As illustrated in FIG. 9, detergent automatic feed entry 452 and softening agent automatic feed entry 462 are formed to project forward. In a state in which detergent tank
10 450 and softening agent tank 460 are accommodated in tank accommodation unit 360, detergent automatic feed entry 452 and softening agent automatic feed entry 462 are connected to detergent tank 450 and softening agent tank 460, respectively.

[0041] Three-way valve 380 includes detergent three-way valve 381 and softening agent three-way valve 382, each being configured to be independently openable and closable.

15 Detergent three-way valve 381 is disposed to communicate with detergent automatic feed entry 452. Softening agent three-way valve 382 is disposed to communicate with softening agent automatic feed entry 462. As illustrated in FIG. 13, a portion on the downstream side of three-way valve 380 is connected to pump unit 390 via in-automatic-feeding-device path 325. Thus, three-way valve 380 is connected to in-automatic-feeding-device path 325,
20 detergent automatic feed entry 452, softening agent automatic feed entry 462, and pump unit 390. Washing machine 100 can control the flow of a detergent, a softening agent, and water by opening and closing detergent three-way valve 381 and softening agent three-way valve 382.

[0042] Pump unit 390 includes in-pump flow path 391, cylinder 397, and piston 395. In-
25 pump flow path 391 is disposed between pump unit inlet 392a and pump unit outlet 392b. Cylinder 397 is disposed in the middle of in-pump flow path 391. Piston 395 is configured to move up and down with a rotational driving force of a motor (not illustrated).

[0043] Inlet check valve 393 is provided in pump unit inlet 392a, meanwhile outlet check valve 394 is provided in pump unit outlet 392b.

30 [0044] Inlet check valve 393 is configured to be opened by a negative-pressure operation of piston 395, meanwhile outlet check valve 394 is configured to be opened by a positive-pressure operation of piston 395.

[0045] On the downstream side of pump unit 390, in-automatic-feeding-device path 325 is connected to flow-path lower unit 370 via washing path outlet 326.

[0046] [1-2. Operation]

The operation of washing machine 100 configured as described above will be explained below.

[0047] [1-2-1. Water Flow in Washing Operation during Use of Automatic Feeding Function]

In FIG. 6, FIG. 8 and FIG. 10 to FIG. 15, the flow of water supplied from first water conveyance pipe 311 is defined as X, the flow of water supplied from second water conveyance pipe 312 is defined as Y, and the flow of water supplied from third water conveyance pipe 313 is defined as Z.

[0048] FIG. 16 is a timing chart illustrating washing operation of washing machine 100. As illustrated in FIG. 16, at the start of a washing step, liquid agent automatic feeding device 301 is driven to automatically feed a liquid agent. Specifically, first, in a state in which third water conveyance pipe 313 is closed, detergent three-way valve 381, which is a part of three-way valve 380, is opened, whereby detergent tank 450 communicates with pump unit 390 by means of a path. By rotating a motor, pump unit 390 causes piston 395 to move up and down, and thereby sucks in the liquid detergent from pump unit inlet 392a and discharges the liquid detergent from pump unit outlet 392b. The discharged detergent reaches flow-path lower unit 370.

[0049] During the driving of piston 395, first water conveyance pipe 311 is opened to start water supply to first water conveyance path 321. In like manner with water flow X, water having been introduced into first water conveyance path 321 passes through powder detergent-specific water feed port 331, liquid detergent-specific water feed port 332, and bath pump-specific water feed port 333, and is then fed into powder detergent manual feeding unit 410, liquid detergent manual feeding unit 420, and bath pump 314. Water having been fed into powder detergent manual feeding unit 410 and liquid detergent manual feeding unit 420 flows down into flow-path lower unit 370 through the discharge port, whereby the liquid detergent in flow-path lower unit 370 is dissolved in the water and fed into washing tub 500. The water supply to first water conveyance path 321 continues until the later-described path washing is started. Thus, the water supply to washing tub 500 can be performed while the automatic feeding of the detergent is performed, and therefore, time required for the water supply operation at the washing step can be made shorter. Note that the water supply to first water conveyance path 321 may be intermittently performed.

[0050] The suction and discharge of a liquid agent by pump unit 390 are intermittently

performed. While piston 395 stops driving, a detergent sending operation is performed.

[0051] At the start of the detergent sending operation, detergent three-way valve 381 is closed, whereby the path between detergent tank 450 and pump unit 390 is blocked and third water conveyance pipe 313 communicates with liquid agent automatic feeding device 301 by means of a path. Subsequently, third water conveyance pipe 313 of water supply valve 310 is opened. In like manner with water flow Z, water introduced from third water conveyance pipe 313 passes through third water conveyance path 323, reaches in-automatic-feeding-device path 325 via washing path water port 324, and passes through in-pump flow path 391. Thus, in the detergent sending operation, water is supplied to three-way valve 380 and pump unit 390 to send a detergent remaining in three-way valve 380 and pump unit 390 to flow-path lower unit 370.

[0052] As illustrated in FIG. 16, the driving of piston 395 and the detergent sending operation, that is, the opening of third water conveyance pipe 313 are alternately performed. Thus, washing machine 100 can dilute a detergent to a dilution concentration within a predetermined range and supply the resulting diluted detergent solution to the laundry in washing tub 500.

[0053] After the driving of piston 395 and the detergent sending operation are performed a predetermined number of times, single-valve water supply is performed only by first water conveyance pipe 311. In the single-valve water supply, detergent three-way valve 381 is closed and third water conveyance pipe 313 is closed. Water having been introduced into first water conveyance path 321 flows down to flow-path lower unit 370 through the discharge port of detergent case 400, and is fed into washing tub 500. When the predetermined water supply is completed, first water conveyance pipe 311 is closed.

[0054] The amount of water flowing through liquid agent automatic feeding device 301 has an upper limit, and therefore the amount of water flowing through third water conveyance path 323 or in-automatic-feeding-device path 325 is set to be smaller than that through first water conveyance path 321. Hence, when the single-valve water supply is performed by first water conveyance pipe 311 only, a predetermined amount of water can be supplied in a shorter time than in the case of performing single-valve water supply by third water conveyance pipe 313 only. Note that, in place of the single-valve water supply by first water conveyance pipe 311 only, first water conveyance pipe 311 may be opened and furthermore third water conveyance pipe 313 may be opened.

[0055] Subsequently, path washing is performed. In the path washing, water is supplied using third water conveyance pipe 313 only. Thus, water introduced via water supply

valve 310 is not diverted into first water conveyance path 321 and third water conveyance path 323, but is supplied to third water conveyance path 323 only. Hence, the amount of water passing through third water conveyance path 323 in the path washing is larger than the amount of water passing through third water conveyance path 323 in the detergent sending operation. The water having passed through in-automatic-feeding device path 325 flows down into flow-path lower unit 370 via washing path outflow port 326, and is fed into washing tub 500 from flow-path lower unit 370.

[0056] With the path washing, a detergent remaining in liquid agent automatic feeding device 301 and flow-path lower unit 370 is surely washed away and sent to washing tub 500. Thus, the path washing can substantially prevent the mixing of the remaining detergent and a softening agent to be fed at a final rinsing step and thereby substantially prevent the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent. Furthermore, even when a foreign substance is present, the path washing can remove the foreign substance with a strong water stream.

[0057] At the final rinsing step, softening agent three-way valve 382 as a part of three-way valve 380 is opened, whereby softening agent tank 460 communicates with pump unit 390 by means of a path. By rotating the motor, pump unit 390 causes piston 395 to move up and down, and thereby sucks in an appropriate amount of the softening agent from pump unit inlet 392a and discharges the softening agent from pump unit outlet 392b. The softening agent discharged from pump unit outlet 392b reaches flow-path lower unit 370.

[0058] Before or during the driving of piston 395, second water conveyance pipe 312 is opened and water supply to second water conveyance path 322 is started. In like manner with water flow Y, water having been introduced into second water conveyance path 322 passes through softening agent-specific water feed port 334 and is fed into softening agent manual feeding unit 430. Then, the water flows down into flow-path lower unit 370 from the discharge port of softening agent manual feeding unit 430, whereby the softening agent having gathered in flow-path lower unit 370 is dissolved in the water and the resultant solution is fed into washing tub 500.

[0059] Next, softening agent three-way valve 382 is closed, whereby the path between softening agent tank 460 and pump unit 390 is blocked, and third water conveyance pipe 313 communicates with liquid agent automatic feeding device 301 by means of a path. After that, third water conveyance pipe 313 is opened, whereby path washing is performed to wash away the detergent remaining in three-way valve 380 and pump unit 390. This path washing substantially prevents the mixing of the remaining softening agent and a

detergent to be fed in the next washing operation and thereby substantially prevents the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent.

[0060] [1-3. Effects]

5 As described above, washing machine 100 in Embodiment 1 includes casing 600, washing tub 500, the water conveyance path, detergent tank 450 and softening agent tank 460, liquid agent automatic feeding device 301, and control unit 900. Washing tub 500 is disposed inside casing 600 and configured to accommodate the laundry. The water conveyance path is configured to supply washing tub 500 with water introduced via water supply valve 310. Detergent tank 450 and softening agent tank 460 are examples of the liquid agent tank in the present disclosure, and is configured to store a liquid agent. Liquid agent automatic feeding device 301 is configured to feed the liquid agents stored in detergent tank 450 and softening agent tank 460 into washing tub 500. The water conveyance path includes a first water path. The first water path is first water conveyance path 321 or second water conveyance path 322 configured to provide water supply to washing tub 501 without passing through liquid agent automatic feeding device 301. Water supply valve 310 includes a first valve. The first valve is first water conveyance pipe 311 or second water conveyance pipe 312 configured to provide water supply to first water conveyance path 321 or second water conveyance path 322. Control unit 900 is configured to drive liquid agent automatic feeding device 301 and also open first water conveyance pipe 311.

[0061] Thus, an operation for supplying water to washing tub 500 and an operation for automatically feeding a liquid detergent or a softening agent can be performed at the same time.

25 [0062] The water supply operation involved in the washing operation using the automatic feeding function can be efficiently performed.

[0063] As in the case of washing machine 100 in Embodiment 1, the water conveyance path may further include a second water path, and water supply valve 310 may further include a second valve. The second water path is third water conveyance path 323 configured to provide water supply to washing tub 500 with passing through liquid agent automatic feeding device 301. The second valve is third water conveyance pipe 313 configured to provide water supply to third water conveyance path 323. Control unit 900 may cause liquid agent automatic feeding device 301 to stop driving, and open third water conveyance pipe 313 while liquid agent automatic feeding device 301 stops driving.

[0064] Thus, while a detergent is sent from in-automatic-feeding device path 325 or third water conveyance path 323, the water supply operation can be continued, so that time required for the washing step can be made shorter.

[0065] (Modification of Embodiment 1)

5 Embodiment 1 was described above to illustrate the technology of the present disclosure. However, the technology of the present disclosure is not limited by Embodiment 1.

[0066] Then, a modification of Embodiment 1 will be illustrated below.

[0067] In Embodiment 1, washing machine 100, which was a top-loading washing
10 machine, was described as an example of the washing machine in the present disclosure. The washing machine in the present disclosure is not limited to the top-loading washing machine, but may be a front-loading washing machine or a twin-tub washing machine.

[0068] In Embodiment 1, first water conveyance pipe 311 was described as an example
15 of the first valve in the present disclosure. The first valve in the present disclosure is beneficially a valve configured to open and close the first water path configured to provide water supply to the washing tub without passing through the liquid agent automatic feeding device, and therefore is not limited to first water conveyance pipe 311. The first valve in the present disclosure may include only second water conveyance pipe 312 or may include both first water conveyance pipe 311 and second water conveyance pipe 312.

20 [0069] (Embodiment 2)

 The present disclosure relates to a washing machine.

[0070] Patent Literature 1 discloses the washing machine including the liquid agent automatic feeding device.

[0071] The washing machine in Patent Literature 1 includes: the liquid agent tank
25 configured to store a liquid agent; the liquid agent automatic feeding device configured to automatically supply the liquid agent stored in the liquid agent tank to the washing tub; and the water supply valve configured to communicate with the liquid agent automatic feeding device via the water path. The washing machine drives the liquid agent automatic feeding device to supply the liquid agent to the washing tub, and then opens the water supply valve
30 to supply water to the liquid agent automatic feeding device.

[0072] The present disclosure provides a washing machine capable of substantially preventing the occurrence of a trouble associated with the supply of water to the liquid agent automatic feeding device.

[0073] The washing machine in the present disclosure includes a casing, a washing tub, a

water conveyance path, a liquid agent tank, the liquid agent automatic feeding device, and a controller. The washing tub is disposed inside the casing and configured to accommodate the laundry. The water conveyance path is configured to supply the washing tub with water introduced via a water supply valve. The liquid agent tank is configured to store a liquid agent. The liquid agent automatic feeding device is configured to feed the liquid agent stored in the liquid agent tank into the washing tub. The water conveyance path includes: a third water path configured to provide water supply to the washing tub or an external tub without passing through the liquid agent automatic feeding device; and a fourth water path configured to provide water supply to the washing tub or the external tub with passing through the liquid agent automatic feeding device. The water supply valve includes: a third valve configured to provide water supply to the third water path; and a fourth valve configured to provide water supply to the fourth water path. The control unit is configured to open the third valve, and then open the fourth valve after a lapse of a predetermined time.

[0074] The washing machine in the present disclosure is capable of substantially preventing the occurrence of a trouble associated with the water supply to the liquid agent automatic feeding device.

[0075] Hereinafter, Embodiment 2 will be described in detail with reference to the drawings. The accompanying drawings and the following descriptions are provided to help those skilled in the art fully understand the present disclosure, and do not intend to thereby restrict the subject matter recited in the claims.

[0076] Hereinafter, washing machine 1100 in Embodiment 2 will be described using FIG. 17 to FIG. 32.

[0077] [2-1. Configuration]

[2-1-1. Configuration of Washing Machine]

FIG. 17 is an external perspective view of the configuration of washing machine 1100 in Embodiment 2 in a state in which lid 1700 is closed. FIG. 18 is an external perspective view of the configuration of washing machine 1100 in a state in which lid 1700 is opened. Note that, in Embodiment 2, the vertical direction in a state in which washing machine 1100 is installed as illustrated in FIG. 17 and FIG. 18 is sometimes referred to as a top-and-bottom direction. Furthermore, in Embodiment 2, a side on which operation unit 1800 of washing machine 1100 is present in FIG. 17 and FIG. 18 is sometimes referred to as a rear side, meanwhile a side opposing the rear side is sometimes referred to as a front side. That is, typically, a user stands in front of washing machine 1100 and puts the

laundry, such as clothes, into washing machine 1100, and performs various types of operations for operating washing machine 1100. Note that the laundry in the present disclosure is not limited to clothes, but may be, for example, fabrics and leather products, such as bedclothes, curtains, carpeting, and shoes, and other various known washing-machine washables.

[0078] As illustrated in FIG. 17 and FIG. 18, washing machine 1100 includes casing 1600, lid 1700, operation unit 1800, and control unit 1900. Washing machine 1100 is what is called a top-loading washing machine that allows the laundry to be put into casing 1600 from above when washing machine 1100 is in the installed state. Casing 1600 includes lower casing 1610 and upper casing 1620. Lower casing 1610 is configured to accommodate washing tub 1500. Washing tub 1500 is in the shape of an open-top cylinder and configured to accommodate the laundry and perform a washing operation for washing the laundry. In other words, washing machine 1100 is disposed inside casing 1600 and configured to accommodate the laundry. The washing operation may be an operation performed by a washing tub of any type of various known washing machines. The principle of Embodiment 2 is not limited to a specific washing operation performed by washing tub 1500.

[0079] Upper casing 1620 is disposed above lower casing 1610. In upper casing 1620, loading opening 1621 for the laundry is formed to communicate with washing tub 1500.

Lid 1700 is attached to a rear portion of upper casing 1620 and configured to cover loading opening 1621 in an openable and closable manner. When the user rotates lid 1700 upward, washing tub 1500 is exposed through loading opening 1621. The user can put the laundry into washing tub 1500 from loading opening 1621.

[0080] In a rear portion of upper casing 1620, operation unit 1800 is disposed at a position behind loading opening 1621. The user can operate operation unit 1800 to set various types of operations of washing tub 1500.

[0081] Water supply port 1200 is provided behind operation unit 1800. Water supply hose 1210 is connected to water supply port 1200 so as to introduce tap water from a tap.

[0082] Control unit 1900 is provided in casing 1600. Control unit 1900 is configured to control the operation of the whole of washing machine 1100 in response to the operation of operation unit 1800 by the user. For example, control unit 1900 is configured to control water supply valve 1310 (see FIG. 19) and liquid agent automatic feeding device 1301 (see FIG. 19). Control unit 1900 includes a computer system including a processor and a memory. When the processor executes a program stored in the memory, the computer

system functions as a controller. Here, there was described that the program to be performed by the processor is beforehand recorded in the memory of the computer system, but the program may be recorded in a non-transitory recording medium, such as a memory card, and provided, or may be provided via a telecommunication line, such as the Internet.

5 [0083] As illustrated in FIG. 18, detergent tank 1450, softening agent tank 1460, and detergent case 1400 are disposed so that, when detergent tank 1450, softening agent tank 1460, and detergent case 1400 are accommodated in water supply unit 1300, their front faces are flush with each other.

[0084] FIG. 19 is an external perspective view of the configuration of water supply unit
10 1300 and its surroundings in a state in which detergent case 1400, detergent tank 1450, and softening agent tank 1460 are drawn out. As illustrated in FIG. 19, detergent tank 1450 and softening agent tank 1460 are configured to be capable of storing a liquid in amounts allowing two or more operations. Specifically, detergent tank 1450 and softening agent tank 1460 store a liquid detergent and a softening agent, respectively. In other words,
15 detergent tank 1450 and softening agent tank 1460 are examples of the liquid agent tank in the present disclosure configured to store a liquid agent. Detergent tank 1450 includes detergent tank feeding unit 1451 through which the liquid detergent to be stored is fed, meanwhile softening agent tank 1460 includes softening agent tank feeding unit 1461 through which the softening agent to be stored is fed. The top faces of detergent tank
20 feeding unit 1451 and softening agent tank feeding unit 1461 are open so as to allow their liquid agents to be poured.

[0085] Detergent tank 1450 and softening agent tank 1460 include detergent tank residual amount scale 1450a and softening agent tank residual amount scale 1460a, respectively. Detergent tank residual amount scale 1450a and softening agent tank residual amount scale
25 1460a are each formed of a transparent material, so that the user can visually check the residual amount of a liquid agent.

[0086] In contrast, detergent case 1400 is to be used in order that the user feeds an agent in amounts necessary for one operation. Detergent case 1400 includes: powder detergent manual feeding unit 1410 into which a powder detergent is fed; liquid detergent manual
30 feeding unit 1420 into which a liquid detergent is fed; and softening agent manual feeding unit 1430 into which a softening agent is fed.

[0087] Lid 1700 is configured to be partially transparent. With this configuration, even when lid 1700 is in the closed state, the user can visually read detergent tank residual amount scale 1450a and softening agent tank residual amount scale 1460a to check the

residual amount of a liquid agent stored in detergent tank 1450 and the residual amount of a liquid agent stored in softening agent tank feeding unit 1461.

[0088] [2-1-2. Water Supply Unit]

FIG. 20 is a back view of the configuration of water supply unit 1300 and its surroundings. FIG. 21 is an exploded perspective view of the configuration of water supply unit 1300 and its surroundings. As illustrated in FIG. 21, water supply unit 1300 mainly includes: water supply unit casing 1320 being approximately box-shaped; flow-path lid unit 1340 configured to cover the top face of water supply unit casing 1320; and flow-path lower unit 1370 attached to the bottom of water supply unit casing 1320.

[0089] As illustrated in FIG. 19 and FIG. 20, water supply valve 1310 configured to be openable and closable to allow the passage of water introduced from water supply port 1200 is attached to the left side of water supply unit casing 1320 when seen from the back face thereof. With water supply valve 1310 open, water introduced via water supply valve 1310 is introduced into water supply unit casing 1320.

[0090] At the center of the back face of water supply unit casing 1320, bath pump 1314 configured to suck water via a hose (not illustrated) from the outside of washing machine 1100 is provided. Bath pump 1314 is fixed to flow-path lid unit 1340 with a screw, and directly connected to the later-described first water conveyance path 1321 via bath pump-specific water feed port 1333. When water is supplied from first water conveyance path 1321, bath pump 1314 can start suction and discharge operations.

[0091] As illustrated in FIG. 21, water supply unit casing 1320 is formed in an approximately box shape that is open forward. Water supply unit casing 1320 includes tank accommodation unit 1360 and detergent case accommodation unit 1350, each serving as an interior space. Tank accommodation unit 1360 independently drawably accommodates detergent tank 1450 and softening agent tank 1460, meanwhile detergent case accommodation unit 1350 independently drawably accommodates detergent case 1400.

[0092] Detergent case flow-path unit 1330 is provided to serve as the top face of detergent case accommodation unit 1350. In detergent case flow-path unit 1330, the later-described first water conveyance path 1321 and the later-described second water conveyance path 1322 are formed.

[0093] As illustrated in FIG. 3 and FIG. 4, liquid agent automatic feeding device 1301 is attached to the right side of water supply unit casing 1320 when seen from the back face thereof. Liquid agent automatic feeding device 1301 is configured to feed liquid agents

stored in detergent tank 1450 and softening agent tank 1460 into washing tub 1500. Liquid agent automatic feeding device 1301 will be described later.

[0094] [2-1-3. Water Conveyance Path]

As illustrated in FIG. 20 and FIG. 21, water supply valve 1310 includes three opening-and-closing valves, namely, first water conveyance pipe 1311, second water conveyance pipe 1312, and third water conveyance pipe 1313, and is capable of independently opening and closing these three opening-and-closing valves.

[0095] FIG. 22 is a top view of the configuration of water supply unit 1300 and its surroundings, except flow-path lid unit 1340. FIG. 23 is a top view of water supply unit 1300 and its surroundings, except flow-path lid unit 1340, in a state in which detergent case 1400, detergent tank 1450, and softening agent tank 1460 are removed. FIG. 24 is a cross-sectional view of water supply unit 1300 and its surroundings, taken along line M-M in FIG. 23. FIG. 25 is a top view of water supply unit 1300 and its surroundings, except flow-path lid unit 1340, in a state in which detergent case 1400, detergent tank 1450, and softening agent tank 1460 are drawn out. FIG. 26 is a cross-sectional view of water supply unit 1300 and its surroundings, taken along line H-H in FIG. 23.

[0096] As illustrated in FIG. 22 to FIG. 26, first water conveyance path 1321, second water conveyance path 1322, and third water conveyance path 1323, each being configured to supply washing tub 1500 with water introduced via water supply valve 1310, are formed in water supply unit casing 1320. First water conveyance path 1321, second water conveyance path 1322, and third water conveyance path 1323 are directly connected to water supply valve 1310. First water conveyance path 1321, second water conveyance path 1322, and third water conveyance path 1323 are formed by branching to independently communicate with first water conveyance pipe 1311, second water conveyance pipe 1312, and third water conveyance pipe 1313, respectively. In other words, first water conveyance pipe 1311 communicates with first water conveyance path 1321, second water conveyance pipe 1312 communicates with second water conveyance path 1322, and third water conveyance pipe 1313 communicates with third water conveyance path 1323.

[0097] [2-1-4. Detergent Case, First Water Conveyance Path, Second Water Conveyance Path]

As illustrated in FIG. 19 and FIG. 22 to FIG. 25, first water conveyance path 1321 and second water conveyance path 1322 are configured to guide water supplied from first water conveyance pipe 1311 and second water conveyance pipe 1312 to detergent case

flow-path unit 1330 and feed the water into detergent case 1400 positioned below.

[0098] As described above, powder detergent manual feeding unit 1410, liquid detergent manual feeding unit 1420, and softening agent manual feeding unit 1430 are provided inside detergent case 1400 and configured to allow the user to feed a powder detergent, a

5 liquid detergent, and a softening agent, respectively.

[0099] First water conveyance path 1321 includes: powder detergent-specific water feed port 1331 formed in order to make the upper and lower sides communicate with each other above powder detergent manual feeding unit 1410; and liquid detergent-specific water feed port 1332 formed in order to make the upper and lower sides communicate with each other
10 above liquid detergent manual feeding unit 1420. Second water conveyance path 1322 includes softening agent-specific water feed port 1334 formed in order to make the upper and lower sides communicate with each other above softening agent manual feeding unit 1430.

[0100] Each of powder detergent manual feeding unit 1410, liquid detergent manual
15 feeding unit 1420, and softening agent manual feeding unit 1430 includes a discharge port (not illustrated) configured to discharge a liquid having gathered inside. The liquid discharged from the discharge port falls down to flow-path lower unit 1370. Flow-path lower unit 1370 is configured as a discharge unit to discharge the liquid to washing tub 1500.

20 [0101] [2-1-5. Detergent Tank, Automatic Feeding Device, Third Water Conveyance Path]

FIG. 27 is a cross-sectional view of water supply unit 1300 and its surroundings, taken along line L-L in FIG. 23. FIG. 28 is a cross-sectional view of water supply unit 1300 and its surroundings, taken along line J-J in FIG. 23. FIG. 29 is a cross-sectional
25 view of water supply unit 1300 and its surroundings, taken along line G-G in FIG. 23. FIG. 30 is a cross-sectional view of water supply unit 1300 and its surroundings, taken along line K-K in FIG. 23. FIG. 31 is an external front view of the configuration of water supply unit 1300 in a state in which detergent case 1400, detergent tank 1450, and softening agent tank 1460 are removed.

30 [0102] As illustrated in FIG. 22 and FIG. 26 to FIG. 31, third water conveyance path 1323 is formed along the back face of water supply unit casing 1320 in the approximately horizontal direction, and is open toward the back face side at washing path water port 1324. Washing path water port 1324 is connected to the later-described in-automatic-feeding-device path 1325, and causes third water conveyance path 1323 to communicate with

liquid agent automatic feeding device 1301. Liquid agent automatic feeding device 1301 is disposed on the back face side of tank accommodation unit 1360. Furthermore, as described later, liquid agent automatic feeding device 1301 is connected to detergent tank 1450 and softening agent tank 1460, each being accommodated in tank accommodation unit 1360.

[0103] As illustrated in FIG. 25, detergent tank entry 1302 is provided on the back face side of detergent tank 1450, and a detergent tank check valve (not illustrated) configured to be opened when pushed is provided inside detergent tank entry 1302. Similarly, softening agent tank entry 1303 and a softening agent tank check valve (not illustrated) configured to be opened when pushed are provided on the back face side of softening agent tank 1460. Detergent tank 1450 is configured such that, in a state in which detergent tank 1450 is installed in tank accommodation unit 1360, the later-described detergent automatic feed entry 1452 is inserted into detergent tank entry 1302 and thereby the detergent tank check valve is opened to allow the supply of a liquid detergent. Similarly, softening agent tank 1460 is configured such that, in a state in which softening agent tank 1460 is installed in tank accommodation unit 1360, the later-described softening agent automatic feed entry 1462 is inserted into softening agent tank entry 1303 and thereby the softening agent tank check valve is opened to allow the supply of a softening agent.

[0104] Detergent automatic feeding-specific connection unit 1360a and softening agent automatic feeding-specific connection unit 1360b are provided in the inner back face of tank accommodation unit 1360. Detergent automatic feeding-specific connection unit 1360a and softening agent automatic feeding-specific connection unit 1360b are configured to surround detergent automatic feed entry 1452 and softening agent automatic feed entry 1462 of liquid agent automatic feeding device 1301, respectively.

[0105] Liquid agent automatic feeding device 1301 includes detergent automatic feed entry 1452, softening agent automatic feed entry 1462, three-way valve 1380, pump unit 1390, and in-automatic-feeding-device path 1325. Three-way valve 1380 is configured to switch between paths for a liquid detergent, a softening agent, and water. Pump unit 1390 is configured to suck in and discharge a liquid agent. In-automatic-feeding-device path 1325 connects three-way valve 1380 to pump unit 1390.

[0106] As illustrated in FIG. 25, detergent automatic feed entry 1452 and softening agent automatic feed entry 1462 are formed to project forward. In a state in which detergent tank 1450 and softening agent tank 1460 are accommodated in tank accommodation unit 1360, detergent automatic feed entry 1452 and softening agent automatic feed entry 1462 are

connected to detergent tank 1450 and softening agent tank 1460, respectively.

[0107] Three-way valve 1380 includes detergent three-way valve 1381 and softening agent three-way valve 1382, each being configured to be independently openable and closable. Detergent three-way valve 1381 is disposed to communicate with detergent automatic feed entry 1452. Softening agent three-way valve 1382 is disposed to communicate with softening agent automatic feed entry 1462. As illustrated in FIG. 29, a portion on the downstream side of three-way valve 1380 is connected to pump unit 1390 via in-automatic-feeding-device path 1325. Thus, three-way valve 1380 is connected to in-automatic-feeding-device path 1325, detergent automatic feed entry 1452, softening agent automatic feed entry 1462, and pump unit 1390. Washing machine 1100 can control the flow of a detergent, a softening agent, and water by opening and closing detergent three-way valve 1381 and softening agent three-way valve 1382.

[0108] Pump unit 1390 includes in-pump flow path 1391, cylinder 1397, and piston 1395. In-pump flow path 1391 is disposed between pump unit inlet 1392a and pump unit outlet 1392b. Cylinder 397 is disposed in the middle of in-pump flow path 1391. Piston 1395 is configured to move up and down with a rotational driving force of a motor (not illustrated).

[0109] Inlet check valve 393 is provided in pump unit inlet 1392a, meanwhile outlet check valve 1394 is provided in pump unit outlet 1392b.

[0110] Inlet check valve 1393 is configured to be opened by a negative-pressure operation of piston 1395, meanwhile outlet check valve 1394 is configured to be opened by a positive-pressure operation of piston 1395.

[0111] On the downstream side of pump unit 1390, in-automatic-feeding-device path 1325 is connected to flow-path lower unit 1370 via washing path outlet 1326.

[0112] [2-2. Operation]

The operation of washing machine 1100 configured as described above will be explained below.

[0113] [2-2-1. Water Flow in Washing Operation during Use of Automatic Feeding Function]

In FIG. 22, FIG. 24 and FIG. 26 to FIG. 31, the flow of water supplied from first water conveyance pipe 1311 is defined as X1, the flow of water supplied from second water conveyance pipe 1312 is defined as Y1, and the flow of water supplied from third water conveyance pipe 1313 is defined as Z1.

[0114] FIG. 32 is a timing chart illustrating washing operation of washing machine 1100. As illustrated in FIG. 32, at the start of a washing step, liquid agent automatic feeding

device 1301 is driven to automatically feed a liquid agent. Specifically, first, in a state in which third water conveyance pipe 1313 is closed, detergent three-way valve 1381, which is a part of three-way valve 1380, is opened, whereby detergent tank 1450 communicates with pump unit 1390 by means of a path. By rotating motor 1396, pump unit 1390 causes piston 1395 to move up and down, and thereby sucks in the liquid detergent from pump unit inlet 1392a and discharges the liquid detergent from pump unit outlet 1392b. The discharged detergent reaches flow-path lower unit 1370.

[0115] During the driving of piston 1395, first water conveyance pipe 1311 is opened to start water supply to first water conveyance path 1321. In like manner with water flow X1, water having been introduced into first water conveyance path 1321 passes through powder detergent-specific water feed port 1331, liquid detergent-specific water feed port 1332, and bath pump-specific water feed port 1333, and is then fed into powder detergent manual feeding unit 1410, liquid detergent manual feeding unit 1420, and bath pump 1314. Water having been fed into powder detergent manual feeding unit 1410 and liquid detergent manual feeding unit 1420 flows down into flow-path lower unit 1370 through the discharge port, whereby the liquid detergent in flow-path lower unit 1370 is dissolved in the water and fed into washing tub 1500. The water supply to first water conveyance path 1321 continues until the later-described path washing is started. Thus, the water supply to washing tub 1500 can be performed while the automatic feeding of the detergent is performed, and therefore, time required for the water supply operation at the washing step can be made shorter. Note that the water supply to first water conveyance path 1321 may be intermittently performed.

[0116] The suction and discharge of a liquid agent by pump unit 1390 are intermittently performed. While piston 1395 stops driving, a detergent sending operation is performed.

[0117] At the start of the detergent sending operation, detergent three-way valve 1381 is closed, whereby the path between detergent tank 1450 and pump unit 1390 is blocked and third water conveyance pipe 1313 communicates with liquid agent automatic feeding device 1301 by means of a path. Subsequently, third water conveyance pipe 1313 of water supply valve 1310 is opened. In like manner with water flow Z1, water introduced from third water conveyance pipe 1313 passes through third water conveyance path 1323, reaches in-automatic-feeding-device path 1325 via washing path water port 1324, and passes through in-pump flow path 1391. Thus, in the detergent sending operation, water is supplied to three-way valve 1380 and pump unit 1390 to send a detergent remaining in three-way valve 1380 and pump unit 1390 to flow-path lower unit 1370.

[0118] As illustrated in FIG. 32, the driving of piston 395 and the detergent sending operation are alternately performed. Thus, washing machine 1100 can dilute a detergent to a dilution concentration within a predetermined range and supply the resulting diluted detergent solution to the laundry in washing tub 1500.

5 [0119] As illustrated in FIG. 32, after the driving of piston 1395 and the detergent sending operation are performed a predetermined number of times, single-valve water supply is performed only by first water conveyance pipe 1311. In the single-valve water supply, detergent three-way valve 1381 is closed and third water conveyance pipe 1313 is closed. Water having been introduced into first water conveyance path 1321 flows down
10 to flow-path lower unit 1370 through the discharge port of detergent case 1400, and is fed into washing tub 1500. When the predetermined water supply is completed, first water conveyance pipe 1311 is closed. Note that, in Embodiment 2, third water conveyance pipe 1313 is opened and subsequently first water conveyance pipe 1311 is closed, as described later.

15 [0120] Subsequently, path washing is performed. In the path washing, water is supplied using third water conveyance pipe 1313 only. Thus, water introduced via water supply valve 1310 is not diverted into first water conveyance path 1321 and third water conveyance path 1323, but is supplied to third water conveyance path 1323 only. Hence, the amount of water passing through third water conveyance path 1323 in the path washing
20 is larger than the amount of water passing through third water conveyance path 1323 in the detergent sending operation. The water having passed through in-automatic-feeding device path 1325 flows down into flow-path lower unit 1370 via washing path outflow port 1326, and is fed into washing tub 1500 from flow-path lower unit 1370.

[0121] With the path washing, a detergent remaining in liquid agent automatic feeding
25 device 1301 and flow-path lower unit 1370 is surely washed away and sent to washing tub 1500. Thus, the path washing can substantially prevent the mixing of the remaining detergent and a softening agent to be fed at a final rinsing step and thereby substantially prevent the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent. Furthermore, even when a foreign substance is present, the path
30 washing can remove the foreign substance with a strong water stream.

[0122] At the final rinsing step, softening agent three-way valve 1382 as a part of three-way valve 1380 is opened, whereby softening agent tank 1460 communicates with pump unit 1390 by means of a path. By rotating the motor, pump unit 1390 causes to move up and down, and thereby sucks in an appropriate amount of the softening agent from pump

unit inlet 1392a and discharges the softening agent from pump unit outlet 1392b. The softening agent discharged from pump unit outlet 1392b reaches flow-path lower unit 1370.

[0123] Before or during the driving of piston 1395, second water conveyance pipe 1312 is opened and water supply to second water conveyance path 1322 is started. In like

5 manner with water flow Y1, water having been introduced into second water conveyance path 1322 passes through softening agent-specific water feed port 1334 and is fed into softening agent manual feeding unit 1430. Then, the water flows down into flow-path lower unit 1370 from the discharge port of softening agent manual feeding unit 1430, whereby the softening agent having gathered in flow-path lower unit 1370 is dissolved in
10 the water and the resultant solution is fed into washing tub 1500.

[0124] Next, softening agent three-way valve 1382 is closed, whereby the path between softening agent tank 1460 and pump unit 1390 is blocked, and third water conveyance pipe 1313 communicates with liquid agent automatic feeding device 1301 by means of a path. After that, third water conveyance pipe 1313 is opened, whereby path washing is

15 performed to wash away the detergent remaining in three-way valve 1380 and pump unit 1390. This path washing substantially prevents the mixing of the remaining softening agent and a detergent to be fed in the next washing operation and thereby substantially prevents the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent.

20 [0125] [2-2-2. Load Reduction Operation]

The water conveyance path is branched into first water conveyance path 1321 configured to be opened and closed by first water conveyance pipe 1311, second water conveyance path 1322 configured to be opened and closed by second water conveyance pipe 1312, and third water conveyance path 1323 configured to be opened and closed by
25 third water conveyance pipe 1313. Hence, when all the opening-and-closing valves of water supply valve 1310 are closed and then one or more of them are opened, a high water pressure is temporarily applied to the opened opening-and-closing valves, and accordingly a heavy load is applied to a portion of the water conveyance path at which the opened opening-and-closing valves are positioned.

30 [0126] In order to reduce loads on third water conveyance path 1323 and liquid agent automatic feeding device 1301, the loads being associated with the opening and closing of third water conveyance pipe 1313, washing machine 1100 in Embodiment 2 performs a load reduction operation.

[0127] As illustrated in FIG. 32, in a detergent sending operation, control unit 1900 opens

third water conveyance pipe 1313 in a state in which first water conveyance pipe 1311 is opened. When first water conveyance pipe 1311 is opened in advance, a heavy load can be substantially prevented from being applied to third water conveyance path 1323. Thus, also for liquid agent automatic feeding device 1301 communicating with third water conveyance path 1323, a heavy load can be substantially prevented from being applied to in-automatic-feeding-device path 1325. Therefore, components of liquid agent automatic feeding device 1301 can be substantially prevented from being damaged and thereby causing water leakage or operation failures.

[0128] Furthermore, in a state in which first water conveyance pipe 1311 is kept open, control unit 1900 blocks third water conveyance pipe 1313 after a lapse of a predetermined time. Thus, water contaminated in third water conveyance path 1323 or in-automatic-feeding-device path 1325 due to a negative pressure temporarily generated when third water conveyance pipe 1313 is blocked can be substantially prevented from flowing backwards to water supply port 1200.

[0129] In the path washing, control unit 1900 closes first water conveyance pipe 1311 after a predetermined time has elapsed from the opening of third water conveyance pipe 1313. Thus, in the path washing, a heavy load can be substantially prevented from being applied to third water conveyance path 1323 and in-automatic-feeding-device path 1325.

[0130] Furthermore, in the path washing, control unit 1900 closes third water conveyance pipe 1313 after a predetermined time has elapsed from the opening of first water conveyance pipe 1311. Thus, water can be substantially prevented from flowing backward to water supply port 1200 due to a negative pressure temporarily generated when third water conveyance pipe 1313 is blocked, and water contaminated in liquid agent automatic feeding device 1301 can be substantially prevented from flowing into water upward of water supply port 1200.

[0131] [2-3. Effects]

As described above, washing machine 1100 in Embodiment 2 includes casing 1600, washing tub 1500, the water conveyance path, detergent tank 1450 and softening agent tank 1460, liquid agent automatic feeding device 1301, and control unit 1900.

Washing tub 1500 is disposed inside casing 1600 and configured to accommodate the laundry. The water conveyance path is configured to supply washing tub 1500 with water introduced via water supply valve 1310. Detergent tank 1450 and softening agent tank 1460 are examples of the liquid agent tank in the present disclosure, and is configured to store a liquid agent. Liquid agent automatic feeding device 1301 is configured to feed the

liquid agents stored in detergent tank 1450 and softening agent tank 1460 into washing tub 1500. Control unit 1900 is configured to control water supply valve 1310 and liquid agent automatic feeding device 1301. The water conveyance path includes the third water path and the fourth water path. The third water path includes first water conveyance path 1321 and second water conveyance path 1322 configured to provide water supply to washing tub 1500 without passing through liquid agent automatic feeding device 1301. The fourth water path is third water conveyance path 1323 configured to provide water supply to washing tub 1500 with passing through liquid agent automatic feeding device 1301. Water supply valve 1301 includes the third valve and the fourth valve. The third valve is first water conveyance pipe 1311 configured to provide water supply to first water conveyance path 1321 or is second water conveyance pipe 1312 configured to provide water supply to second water conveyance path 1322. The fourth valve is third water conveyance pipe 1313 configured to provide water supply to third water conveyance path 1323. Control unit 1900 is configured to open first water conveyance pipe 1311, and then open third water conveyance pipe 1313 after a lapse of a predetermined time.

[0132] Thus, when first water conveyance pipe 1311 is opened in advance, a heavy load can be substantially prevented from being applied to third water conveyance path 1323.

[0133] Thus, the occurrence of a trouble associated with the water supply to liquid agent automatic feeding device 1301 can be substantially prevented.

[0134] As in the case of washing machine 1100 in Embodiment 2, control unit 1900 may close first water conveyance pipe 1311 after a predetermined time has elapsed from the opening of third water conveyance pipe 1313.

[0135] As in the case of washing machine 1100 in Embodiment 2, control unit 1900 may close third water conveyance pipe 1313 after a predetermined time has elapsed from the opening of first water conveyance pipe 1311.

[0136] (Modification of Embodiment 2)

Embodiment 2 was described above to illustrate the technology of the present disclosure. However, the technology of the present disclosure is not limited by Embodiment 2.

[0137] Then, a modification of Embodiment 2 will be illustrated below.

[0138] In Embodiment 2, washing machine 1100, which was a top-loading washing machine, was described as an example of the washing machine in the present disclosure. The washing machine in the present disclosure is not limited to the top-loading washing machine, but may be a front-loading washing machine or a twin-tub washing machine.

[0139] In Embodiment 2, first water conveyance pipe 311 was described as an example of the third valve in the present disclosure. The third valve in the present disclosure is beneficially a valve configured to open and close the third water path configured to provide water supply to the washing tub without passing through the liquid agent automatic feeding device, and therefore is not limited to first water conveyance pipe 1311. The third valve in the present disclosure may include only second water conveyance pipe 1312 or may include both first water conveyance pipe 1311 and second water conveyance pipe 1312.

[0140] (Embodiment 3)

The present disclosure relates to a washing machine.

[0141] Patent Literature 1 discloses the washing machine including the liquid agent automatic feeding device.

[0142] The washing machine in Patent Literature 1 includes: the liquid agent tank configured to store a liquid agent; the liquid agent automatic feeding device configured to automatically supply the liquid agent stored in the liquid agent tank to the washing tub; and the water supply valve configured to communicate with the liquid agent automatic feeding device via the water path. The washing machine drives the liquid agent automatic feeding device to supply the liquid agent to the washing tub, and then opens the water supply valve to supply water to the liquid agent automatic feeding device.

[0143] The present disclosure provides a washing machine capable of enhancing performance for supplying a detergent solution during the use of an automatic feeding device.

[0144] The washing machine in the present disclosure includes a casing, a washing tub, a water conveyance path, a liquid agent tank, the liquid agent automatic feeding device, and a controller. The washing tub is disposed inside the casing and configured to accommodate the laundry. The water conveyance path is configured to supply the washing tub with water introduced via a water supply valve. The liquid agent tank is configured to store a liquid agent. The liquid agent automatic feeding device is configured to feed the liquid agent stored in the liquid agent tank into the washing tub. The water conveyance path includes a fifth water path, a sixth water path, and a junction water path. The fifth water path is configured to provide water supply to the washing tub without passing through the liquid agent automatic feeding device. The sixth water path is configured to provide water supply to the washing tub with passing through the liquid agent automatic feeding device. The fifth water path and the sixth water path join into the junction water path. The control unit is configured to drive the water supply valve to provide water

supply to the fifth water path and configured to drive the liquid agent automatic feeding device to feed a liquid agent into the washing tub.

[0145] The washing machine in the present disclosure enhances performance for supplying a detergent-solution during the use of the automatic feeding device.

5 [0146] Hereinafter, an embodiment will be described in detail with reference to the drawings. The accompanying drawings and the following descriptions are provided to help those skilled in the art fully understand the present disclosure, and do not intend to thereby restrict the subject matter recited in the claims.

[0147] Hereinafter, washing machine 2100 in Embodiment 3 will be described using FIG.
10 33 to FIG. 55.

[0148] [3-1. Configuration]

[3-1-1. Configuration of Washing Machine]

FIG. 33 is an external perspective view of the configuration of washing machine 2100 in Embodiment 3 in a state in which lid 2700 is closed. FIG. 34 is an external
15 perspective view of the configuration of washing machine 2100 in a state in which lid 2700 is opened. Note that, in Embodiment 3, the vertical direction in a state in which washing machine 2100 is installed as illustrated in FIG. 33 and FIG. 34 is sometimes referred to as a top-and-bottom direction. Furthermore, in Embodiment 3, a side on which operation unit 2800 of washing machine 2100 is present in FIG. 33 and FIG. 34 is sometimes referred to
20 as a rear side, meanwhile a side opposing the rear side is sometimes referred to as a front side. That is, typically, a user stands in front of washing machine 2100 and puts the laundry, such as clothes, into washing machine 2100, and performs various types of operations for operating washing machine 2100. Note that the laundry in the present disclosure is not limited to clothes, but may be, for example, fabrics and leather products,
25 such as bedclothes, curtains, carpeting, and shoes, and other various known washing-machine washables.

[0149] As illustrated in FIG. 33 and FIG. 34, washing machine 2100 includes casing 2600, lid 2700, operation unit 2800, and control unit 2900. Washing machine 2100 is what
30 is called a top-loading washing machine that allows the laundry to be put into casing 2600 from above when washing machine 2100 is in the installed state. Casing 2600 includes lower casing 2610 and upper casing 2620. Lower casing 2610 is configured to accommodate washing tub 2500. Washing tub 2500 is in the shape of an open-top cylinder and configured to accommodate the laundry and perform a washing operation for washing the laundry. In other words, washing tub 2500 is disposed inside casing 2600 and

configured to accommodate the laundry. The washing operation may be an operation performed by a washing tub of any type of various known washing machines. The principle of Embodiment 3 is not limited to a specific washing operation performed by washing tub 2500.

5 [0150] Upper casing 2620 is disposed above lower casing 2610. In upper casing 2620, loading opening 2621 for the laundry is formed to communicate with washing tub 2500. Lid 2700 is attached to a rear portion of upper casing 2620 and configured to cover loading opening 2621 in an openable and closable manner. When the user rotates lid 2700 upward, washing tub 2500 is exposed through loading opening 2621. The user can put the laundry
10 into washing tub 2500 from loading opening 2621.

[0151] In a rear portion of upper casing 2620, operation unit 2800 is disposed at a position behind loading opening 2621. The user can operate operation unit 2800 to set various types of operations of washing tub 2500.

[0152] Water supply port 2200 is provided behind operation unit 2800. Water supply
15 hose 2210 is connected to water supply port 2200 so as to introduce tap water from a tap.

[0153] Control unit 2900 is disposed in casing 2600. Control unit 2900 is configured to control the operation of the whole of washing machine 2100 in response to the operation of operation unit 2800 by the user. For example, control unit 2900 is configured to control water supply valve 2310 (see FIG. 35) and liquid agent automatic feeding device 2301 (see
20 FIG. 35). Control unit 2900 includes a computer system including a processor and a memory. When the processor executes a program stored in the memory, the computer system functions as a controller. Here, there was described that the program to be performed by the processor is beforehand recorded in the memory of the computer system, but the program may be recorded in a non-transitory recording medium, such as a memory
25 card, and provided, or may be provided via a telecommunication line, such as the Internet.

[0154] As illustrated in FIG. 34, detergent tank 2450, softening agent tank 2460, and detergent case 2400 are disposed so that, when detergent tank 2450, softening agent tank 2460, and detergent case 2400 are accommodated in water supply unit 2300, their front faces are flush with each other.

30 [0155] FIG. 35 is an external perspective view of the configuration of water supply unit 2300 and its surroundings in a state in which detergent case 2400, detergent tank 2450, and softening agent tank 2460 are drawn out. As illustrated in FIG. 35, detergent tank 2450 and softening agent tank 2460 are configured to be capable of storing a liquid in amounts allowing two or more operations. Specifically, detergent tank 2450 and softening agent

tank 2460 store a liquid detergent and a softening agent, respectively. In other words, detergent tank 2450 and softening agent tank 2460 are examples of the liquid agent tank in the present disclosure configured to store a liquid agent. Detergent tank 2450 includes detergent tank feeding unit 2451 through which the liquid detergent to be stored is fed, 5 meanwhile softening agent tank 2460 includes softening agent tank feeding unit 2461 through which the softening agent to be stored is fed. The top faces of detergent tank feeding unit 2451 and softening agent tank feeding unit 2461 are open so as to allow their liquid agents to be poured.

[0156] Detergent tank 2450 and softening agent tank 2460 include detergent tank residual 10 amount scale 2450a and softening agent tank residual amount scale 2460a, respectively. Detergent tank residual amount scale 2450a and softening agent tank residual amount scale 2460a are each formed of a transparent material, so that the user can visually check the residual amount of a liquid agent.

[0157] In contrast, detergent case 2400 is to be used in order that the user feeds an agent 15 in amounts necessary for one operation. Detergent case 2400 includes: powder detergent manual feeding unit 2410 into which a powder detergent is fed; liquid detergent manual feeding unit 2420 into which a liquid detergent is fed; and softening agent manual feeding unit 2430 into which a softening agent is fed.

[0158] Lid 2700 is configured to be partially transparent. With this configuration, even 20 when lid 2700 is in the closed state, the user can visually read detergent tank residual amount scale 2450a and softening agent tank residual amount scale 2460a to check the residual amount of a liquid agent stored in detergent tank 2450 and the residual amount of a liquid agent stored in softening agent tank 2460.

[0159] [3-1-2. Water Supply Unit]

25 FIG. 36 is a back view of the configuration of water supply unit 2300 and its surroundings. FIG. 37 is an exploded perspective view of the configuration of water supply unit 2300 and its surroundings. As illustrated in FIG. 37, water supply unit 2300 mainly includes: water supply unit casing 2320 being approximately box-shaped; flow-path lid unit 2340 configured to cover the top face of water supply unit casing 2320; and 30 flow-path lower unit 2370 attached to the bottom of water supply unit casing 2320.

[0160] As illustrated in FIG. 35 and FIG. 36, water supply valve 2310 configured to be openable and closable to allow the passage of water introduced from water supply port 2200 is attached to the left side of water supply unit casing 2320 when seen from the back face thereof. With water supply valve 2310 open, water introduced via water supply valve

2310 is introduced into water supply unit casing 2320.

[0161] At the center of the back face of water supply unit casing 2320, bath pump 2314 configured to suck water via a hose (not illustrated) from the outside of washing machine 2100 is provided. Bath pump 2314 is fixed to flow-path lid unit 2340 with a screw, and
5 directly connected to the later-described first water conveyance path 2321 via bath pump-specific water feed port 2333. When water is supplied from first water conveyance path 2321, bath pump 2314 can start suction and discharge operations.

[0162] As illustrated in FIG. 37 and FIG. 38, water supply unit casing 2320 is formed in an approximately box shape that is open forward. Water supply unit casing 2320 includes
10 detergent tank accommodation unit 2360, softening agent tank accommodation unit 2365, and detergent case accommodation unit 2350, each serving as an interior space. Detergent tank accommodation unit 2360 independently drawably accommodates detergent tank 2450, and softening agent tank accommodation unit 2365 independently drawably accommodates softening agent tank 2460, and detergent case accommodation unit 2350
15 independently drawably accommodates detergent case 2400.

[0163] Detergent case flow-path unit 2330 is provided to serve as the top face of detergent case accommodation unit 2350. In detergent case flow-path unit 2330, the later-described first water conveyance path 2321 and the later-described second water conveyance path 2322 are formed.

[0164] As illustrated in FIG. 35 and FIG. 36, liquid agent automatic feeding device 2301
20 is attached to the right side of water supply unit casing 2320 when seen from the back face thereof. Liquid agent automatic feeding device 2301 is configured to feed liquid agents stored in detergent tank 2450 and softening agent tank 2460 into washing tub 2500. Liquid agent automatic feeding device 2301 will be described later.

[0165] [3-1-3. Water Conveyance Path]

As illustrated in FIG. 36 and FIG. 37, water supply valve 2310 includes three opening-and-closing valves, namely, first water conveyance pipe 2311, second water conveyance pipe 2312, and third water conveyance pipe 2313, and is capable of independently opening and closing these three opening-and-closing valves.

[0166] FIG. 38 is a top view of the configuration of water supply unit 2300 and its surroundings, except flow-path lid unit 2340. FIG. 39 is a top view of water supply unit 2300 and its surroundings, except flow-path lid unit 2340, in a state in which detergent case 2400, detergent tank 2450, and softening agent tank 2460 are removed. FIG. 40 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line S-S

in FIG. 40. FIG. 41 is a top view of water supply unit 2300 and its surroundings, except flow-path lid unit 2340, in a state in which detergent case 2400, detergent tank 2450, and softening agent tank 2460 are drawn out. FIG. 42 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line O-O in FIG. 39.

[0167] As illustrated in FIG. 38 to FIG. 42, first water conveyance path 2321, second water conveyance path 2322, and third water conveyance path 2323, each being configured to supply washing tub 2500 with water introduced via water supply valve 2310, are formed in water supply unit casing 2320. In other words, flow-path lower unit 2370 is disposed below first water conveyance path 2321 and second water conveyance path 2322. First water conveyance path 2321, second water conveyance path 2322, and third water conveyance path 2323 are directly connected to water supply valve 2310. First water conveyance path 2321, second water conveyance path 2322, and third water conveyance path 2323 are formed by branching to independently communicate with first water conveyance pipe 2311, second water conveyance pipe 2312, and third water conveyance pipe 2313, respectively. In other words, first water conveyance pipe 2311 communicates with first water conveyance path 2321, and second water conveyance pipe 2312 communicates with second water conveyance path 2322, and third water conveyance pipe 2313 communicates with third water conveyance path 2323.

[0168] [3-1-4. Detergent Case, First Water Conveyance Path, Second Water Conveyance Path]

As illustrated in FIG. 35 and FIG. 38 to FIG. 41, first water conveyance path 2321 and second water conveyance path 2322 are configured to guide water supplied from first water conveyance pipe 2311 and second water conveyance pipe 2312 to detergent case flow-path unit 2330 and feed the water into detergent case 2400 positioned below.

[0169] As described above, powder detergent manual feeding unit 2410, liquid detergent manual feeding unit 2420, and softening agent manual feeding unit 2430 are provided inside detergent case 2400 and configured to allow the user to feed a powder detergent, a liquid detergent, and a softening agent, respectively.

[0170] First water conveyance path 2321 includes: powder detergent-specific water feed port 2331 formed in order to make the upper and lower sides communicate with each other above powder detergent manual feeding unit 2410; and liquid detergent-specific water feed port 2332 formed in order to make the upper and lower sides communicate with each other above liquid detergent manual feeding unit 2420. Second water conveyance path 2322 includes softening agent-specific water feed port 2334 formed in order to make the upper

and lower sides communicate with each other above softening agent manual feeding unit 2430.

[0171] Each of powder detergent manual feeding unit 2410, liquid detergent manual feeding unit 2420, and softening agent manual feeding unit 2430 includes a discharge port (not illustrated) configured to discharge a liquid having gathered inside. The liquid having been discharged from the discharge port is discharged to flow-path lower unit 2370.

[0172] As illustrated in FIG. 38, foaming-specific water feed port 2335 is provided in first water conveyance path 2321. Foaming-specific water feed port 2335 is disposed behind detergent case 2400 stored in detergent case accommodation unit 2350. Thus, water having been fed downward from detergent case accommodation unit 2350 falls down into flow-path lower unit 2370 without passing through detergent case 2400. Note that foaming-specific water feed port 2335 may be provided in second water conveyance path 2322 or may be provided in both first water conveyance path 2321 and second water conveyance path 2322.

[0173] [3-1-5. Detergent Tank, Automatic Feeding Device, Third Water Conveyance Path]

FIG. 43 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line R-R in FIG. 39. FIG. 44 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line P-P in FIG. 39. FIG. 45 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line N-N in FIG. 39. FIG. 46 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line Q-Q in FIG. 39. FIG. 47 is an external front view of the configuration of water supply unit 2300 in a state in which detergent case 2400, detergent tank 2450, and softening agent tank 2460 are removed.

[0174] As illustrated in FIG. 38 and FIG. 42 to FIG. 47, third water conveyance path 2323 is formed along the back face of water supply unit casing 2320 in the approximately horizontal direction, and is open toward the back face side at washing path water port 2324. Washing path water port 2324 is connected to the later-described in-automatic-feeding-device path 2325, and causes third water conveyance path 2323 to communicate with liquid agent automatic feeding device 2301. Liquid agent automatic feeding device 2301 is disposed on the back face side of detergent tank accommodation unit 2360 and softening agent tank accommodation unit 2365. Furthermore, as described later, liquid agent automatic feeding device 2301 is connected to detergent tank 2450 and softening agent tank 2460 accommodated in detergent tank accommodation unit 2360 and softening agent

tank accommodation unit 2365, respectively.

[0175] As illustrated in FIG. 41, detergent tank entry 2302 is provided on the back face side of detergent tank 2450, and a detergent tank check valve configured to be opened when pushed is provided inside detergent tank entry 2302. Similarly, softening agent tank entry 2303 and a softening agent tank check valve configured to be opened when pushed are provided on the back face side of softening agent tank 2460. Detergent tank 2450 is configured such that, in a state in which detergent tank 2450 is installed in detergent tank accommodation unit 2360, the later-described detergent automatic feed entry 2452 is inserted in detergent tank entry 2302 and thereby the detergent tank check valve is opened to allow the supply of a liquid detergent. Similarly, softening agent tank 2460 is configured such that, in a state in which softening agent tank 2460 is installed in softening agent tank accommodation unit 2365, the later-described softening agent automatic feed entry 2462 is inserted into softening agent tank entry 2303 and thereby the softening agent tank check valve is opened to allow the supply of a softening agent.

[0176] Detergent automatic feeding-specific connection unit 2360a and softening agent automatic feeding-specific connection unit 2365a are provided in the inner back face of detergent tank accommodation unit 2360 and softening agent tank accommodation unit 2365, respectively. Detergent automatic feeding-specific connection unit 2360a and softening agent automatic feeding-specific connection unit 2365a are configured to surround detergent automatic feed entry 2452 and softening agent automatic feed entry 2462 of liquid agent automatic feeding device 2301, respectively.

[0177] Liquid agent automatic feeding device 2301 includes detergent automatic feed entry 2452, softening agent automatic feed entry 2462, three-way valve 2380, pump unit 2390, and in-automatic-feeding-device path 2325. Three-way valve 2380 is configured to switch between paths for a liquid detergent, a softening agent, and water. Pump unit 2390 is configured to suck in and discharge a liquid agent. In-automatic-feeding-device path 2325 connects three-way valve 2380 to pump unit 2390.

[0178] As illustrated in FIG. 41, detergent automatic feed entry 2452 and softening agent automatic feed entry 2462 are formed to project forward. In a state in which detergent tank 2450 and softening agent tank 2460 are accommodated in detergent tank accommodation unit 2360 and softening agent tank accommodation unit 2365, respectively, detergent automatic feed entry 2452 and softening agent automatic feed entry 2462 are connected to detergent tank 2450 and softening agent tank 2460, respectively.

[0179] Three-way valve 2380 includes detergent three-way valve 2381 and softening

agent three-way valve 2382, each being configured to be independently openable and closable. Detergent three-way valve 2381 is disposed to communicate with washing path water port 2324, detergent automatic feed entry 2452, and softening agent three-way valve 2382. Softening agent three-way valve 2382 is disposed to communicate with detergent three-way valve 2381, softening agent automatic feed entry 2462, and in-automatic-feeding-device path 2325. A portion on the downstream side of three-way valve 2380 is connected to pump unit 2390 via in-automatic-feeding-device path 2325. Thus, three-way valve 2380 is connected to in-automatic-feeding-device path 2325, detergent automatic feed entry 2452, softening agent automatic feed entry 2462, and pump unit 2390. Washing machine 2100 can control the flow of a detergent, a softening agent, and water by opening and closing detergent three-way valve 2381 and softening agent three-way valve 2382.

[0180] Pump unit 2390 includes in-pump flow path 2391, cylinder 2397, and piston 2395. In-pump flow path 2391 is disposed between pump unit inlet 2392a and pump unit outlet 2392b. Cylinder 2397 is disposed in the middle of in-pump flow path 2391. Piston 2395 is configured to move up and down with a rotational driving force of a motor (not illustrated).

[0181] Inlet check valve 2393 is provided in pump unit inlet 2392a, meanwhile outlet check valve 2394 is provided in pump unit outlet 2392b.

[0182] Inlet check valve 2393 is configured to be opened by a negative-pressure operation of piston 2395, meanwhile outlet check valve 2394 is configured to be opened by a positive-pressure operation of piston 2395.

[0183] On the downstream side of pump unit 2390, in-automatic-feeding-device path 2325 is connected to flow-path lower unit 2370 via washing path outlet 2326.

[0184] [3-1-6. Detergent Tank, Tank Accommodation Unit]

Hereinafter, detergent tank 2450 will be described as an example of the liquid agent tank. Softening agent tank 2460 is configured in like manner with in detergent tank 2450.

[0185] FIG. 48 is an external perspective view of the configuration of detergent tank 2450. As illustrated in FIG. 48, detergent tank 2450 includes: detergent tank casing 2456 being approximately box-shaped; and detergent tank feeding unit 2451 disposed in an upper portion of detergent tank casing 2456.

[0186] Detergent tank feeding unit 2451 has an opening at the approximate center thereof. Feeding incline unit 2464 is provided in the front portion, the right-and-left side portion, and the rear portion of detergent tank feeding unit 2451. Feeding incline unit 2464 is

inclined downward toward the opening of detergent tank feeding unit 2451, and is configured to guide a liquid agent to detergent tank feeding unit 2451 and cause the liquid agent to flow downward into detergent tank casing 2456.

[0187] FIG. 49A is a cross-sectional top view of water supply unit 2300 and its

5 surroundings, except flow-path lid unit 2340, in a state in which detergent tank 2450 is accommodated. FIG. 49B is a cross-sectional top view of water supply unit 2300 and its surroundings, except flow-path lid unit 2340, in a state in which detergent tank 2450 is drawn out. FIG. 50 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line T-T in FIG. 49A. FIG. 51 is a cross-sectional view of water
10 supply unit 2300 and its surroundings, taken along line W-W in FIG. 49B. FIG. 52 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line U-U in FIG. 49A. FIG. 53 is a cross-sectional view of water supply unit 2300 and its surroundings, taken along line V-V in FIG. 49B.

[0188] As illustrated in FIG. 50, lock lever 2454 is provided on the bottom of detergent
15 tank casing 2456. In a state in which detergent tank 2450 is accommodated in detergent tank accommodation unit 2360, lock lever 2454 is engaged with detergent tank accommodation unit hook 2361 provided in the inner bottom face of detergent tank accommodation unit 2360. Lock lever grip unit 2454a is provided at a front-side end of lock lever 2454. Lock lever grip unit 2454a is disposed in the vicinity of detergent tank
20 casing grip unit 2456a formed by extending a front lower portion of detergent tank casing 2456.

[0189] As illustrated in FIG. 50 to FIG. 53, filter 2470 configured to filter a liquid is provided inside detergent tank casing 2456 on the back face side of detergent tank casing 2456. Filter 2470 is approximately rectangular-shaped to come into contact with an inner
25 side wall of detergent tank casing 2456 and is inclined downward from the back face to the front.

[0190] Spring mechanism 2455 is provided at the approximate center of a lower portion in the back face of detergent tank casing 2456. Spring mechanism 2455 includes spring 2455a disposed at a position below filter 2470. Spring 2455a is configured to bias
30 detergent tank casing 2456 toward the front. Detergent tank accommodation unit contact face 2362 is provided behind spring mechanism 2455. Detergent tank accommodation unit contact face 2362 is configured to come into contact with spring mechanism 2455 to cause spring 2455a to stand still in a compressed state. Note that detergent tank entry 2302 is disposed on the side of spring mechanism 2455.

[0191] Flow-path lid unit 2340 constitutes the top face of detergent tank accommodation unit 2360. Flow-path lid unit 2340 is configured to cover the upper portion of detergent tank feeding unit 2451 and functions as a lid to substantially prevent contamination with a foreign substance from detergent tank feeding unit 2451.

5 [0192] As illustrated in FIG. 50 and FIG. 51, stopper 2368 is provided in a front portion in the inner top face of detergent tank accommodation unit 2360. Stopper 2368 is configured to be engageable with tank projection 2457 provided in the top face of detergent tank 2450.

[0193] As illustrated in FIG. 52 and FIG. 53, drop port 2364 communicating with flow-
10 path lower unit 2370 is formed in the inner bottom face of detergent tank accommodation unit 2360. Drop port 2364 is disposed at a position below detergent tank entry 2302 in a state in which detergent tank 2450 is accommodated in detergent tank accommodation unit 2360. Drop port 2364 causes a liquid detergent leaking from detergent tank entry 2302 or detergent automatic feed entry 2452 to flow down into washing path 2319.

15 [0194] Storage unit 2363 is provided in the inner bottom face of detergent tank accommodation unit 2360. Storage unit 2363 is configured to serve as a recess capable of storing a liquid and also as a gap that separates the bottom face of detergent tank 2450 from the inner bottom face of detergent tank accommodation unit 2360.

[0195] [3-1-7. Flow-Path Lower Unit]

20 FIG. 54 is a top view of the configuration of flow-path lower unit 2370. As illustrated in FIG. 53 and FIG. 54, flow-path lower unit 2370 includes first flow-path lower unit path 2372, washing path 2319, second flow-path lower unit path 2373, and flow-path lower unit discharge port 2371. First flow-path lower unit path 2372 communicates with washing path outflow port 2326. Washing path 2319 is disposed below drop port 2364.
25 Second flow-path lower unit path 2373 allows a liquid discharged from detergent case 2400 to pass therethrough.

[0196] Washing path 2319 includes: washing path inlet 2318 configured to introduce a liquid from first flow-path lower unit path 2372; and washing path outlet 2374 configured to allow the liquid to flow out to first flow-path lower unit path 2372. Washing path inlet
30 2318 is disposed at a position upstream of a drop point of a liquid dropping from drop port 2364, meanwhile washing path outlet 2374 is disposed at a position downstream of the drop point of the liquid dropping from drop port 2364. Washing path inlet 2318 is configured to have an area smaller than the flow path cross-sectional area of first flow-path lower unit path 2372, and therefore the amount of water passing through washing path

2319 is comparatively small. Thus, washing machine 2100 can substantially prevent water passing through washing path 2319 from overflowing upward from drop port 2364 and then entering detergent tank accommodation unit 2360.

[0197] A plurality of pins 2377 is provided on the downstream side of first flow-path lower unit path 2372. Pins 2377 vertically extend below foaming-specific water feed port 2335. In other words, flow-path lower unit 2370 includes pins 2377 vertically extending below foaming-specific water feed port 2335. That is, pins 2377 are disposed in a location in which a liquid passing through first flow-path lower unit path 2372 collides with water fed from foaming-specific water feed port 2335. Thus, foaming unit 2376 configured to produce foam owing to the collision is formed.

[0198] First flow-path lower unit path 2372 communicates with second flow-path lower unit path 2373 at junction 2375. Flow-path lower unit discharge port 2371 is disposed downstream of junction 2375, and is open downward so as to drop a liquid into washing tub 2500.

[0199] [3-2. Operation]

The operation of washing machine 2100 configured as described above will be explained below.

[0200] [3-2-1. Water Flow in Washing Operation during Use of Automatic Feeding Function]

In FIG. 38, FIG. 40 and FIG. 42 to FIG. 47, the flow of water supplied from first water conveyance pipe 2311 is defined as X2, the flow of water supplied from second water conveyance pipe 2312 is defined as Y2, and the flow of water supplied from third water conveyance pipe 2313 is defined as Z2.

[0201] FIG. 55 is a timing chart illustrating washing operation of washing machine 2100.

As illustrated in FIG. 55, before the start of a washing step, liquid agent automatic feeding device 2301 is driven to automatically feed a liquid agent. Specifically, first, in a state in which third water conveyance pipe 2313 is closed, detergent three-way valve 2381, which is a part of three-way valve 2380, is opened, whereby detergent tank 2450 communicates with pump unit 2390 by means of a path. By rotating a motor, pump unit 2390 causes piston 2395 to move up and down, and thereby sucks in the liquid detergent from pump unit inlet 2392a and discharges the liquid detergent from pump unit outlet 2392b. The discharged detergent reaches flow-path lower unit 2370.

[0202] Before, during, or after the driving of piston 2395, first water conveyance pipe 2311 is opened to start water supply to first water conveyance path 2321. In like manner

with water flow X2, water having been introduced into first water conveyance path 2321 passes through powder detergent-specific water feed port 2331, liquid detergent-specific water feed port 2332, bath pump-specific water feed port 2333, and foaming-specific water feed port 2335, and is then fed into powder detergent manual feeding unit 2410, liquid
5 detergent manual feeding unit 2420, bath pump 2314, and pins 2377. Water having been fed into powder detergent manual feeding unit 2410 and liquid detergent manual feeding unit 2420 flows down into flow-path lower unit 2370 through the discharge port, whereby the liquid detergent in flow-path lower unit 2370 is dissolved in the water and the resultant solution is fed into washing tub 2500. The water supply to first water conveyance path
10 2321 continues until the later-described path washing is started. Thus, the water supply to washing tub 2500 can be performed while the automatic feeding of the detergent is performed, and therefore time required for water supply operation at the initial stage of the washing step can be made shorter.

[0203] The suction and discharge of a liquid agent by pump unit 2390 are intermittently
15 performed. While piston 2395 stops driving, a detergent sending operation is performed.

[0204] At the start of the detergent sending operation, detergent three-way valve 2381 is closed, whereby the path between detergent tank 2450 and pump unit 2390 is blocked and third water conveyance pipe 2313 communicates with liquid agent automatic feeding
device 2301 by means of a path. Subsequently, third water conveyance pipe 2313 of water
20 supply valve 2310 is opened. In like manner with water flow Z2, water introduced from third water conveyance pipe 2313 passes through third water conveyance path 2323, reaches in-automatic-feeding-device path 2325 via washing path water port 2324, and passes through in-pump flow path 2391. Thus, in the detergent sending operation, water is supplied to three-way valve 2380 and pump unit 2390 to send a detergent remaining in
25 three-way valve 2380 and pump unit 2390 to flow-path lower unit 2370.

[0205] The driving of piston 2395 and the detergent sending operation are alternately performed. Thus, washing machine 2100 can produce a detergent solution diluted to a dilution concentration within a predetermined range in flow-path lower unit 2370.

[0206] The detergent solution having passed through in-pump flow path 2391 flows into
30 first flow-path lower unit path 2372 via washing path outflow port 2326. A part of the detergent solution having flown into first flow-path lower unit path 2372 flows into washing path 2319 from washing path inlet 2318. The detergent solution having flown into washing path 2319 washes away the liquid detergent adhering to washing path 2319, and passes through washing path outlet 2374 and joins first flow-path lower unit path 2372.

The detergent solution passing through first flow-path lower unit path 2372 reaches pins 2377 downstream of washing path outlet 2374. Pins 2377 are configured to delay the flow of the detergent solution and spread the flow thereof.

[0207] During the driving of piston 2395 and the detergent sending operation, the water supply by first water conveyance pipe 2311 continues, so that water is poured from foaming-specific water feed port 2335 toward pins 2377 of foaming unit 2376. The poured water collides with the detergent solution around pins 2377 to produce detergent foam.

The produced detergent foam and the detergent solution enter second flow-path lower unit path 2373 and are fed into washing tub 2500 from flow-path lower unit discharge port 2371.

[0208] The driving of piston 2395 and the detergent sending operation are alternately performed. Thus, washing machine 2100 can cause the detergent solution diluted to the dilution concentration within the predetermined range to continuously reach pins 2377. Thus, the detergent solution and the detergent foam are fed into washing tub 2500 for many hours, so that the detergent solution and the detergent foam can be thoroughly supplied to clothes. Furthermore, in flow-path lower unit 2370 in Embodiment 3, the detergent solution produced by diluting a liquid detergent is fed into washing tub 2500, so that an undiluted liquid detergent can be substantially prevented from adhering to clothes accommodated in washing tub 2500. Thus, the clothes can be substantially prevented from being damaged due to the adhesion of the undiluted liquid detergent.

[0209] The driving of piston 2395 and the detergent sending operation are alternately performed. Thus, washing machine 2100 can dilute a detergent to the dilution concentration within the predetermined range and supply the resulting diluted detergent solution to the clothes in washing tub 2500.

[0210] After the driving of piston 2395 and the detergent sending operation are performed a predetermined number of times, single-valve water supply is performed by first water conveyance pipe 2311 only. In the single-valve water supply, detergent three-way valve 2381 is closed and third water conveyance pipe 2313 is closed. Water having been introduced into first water conveyance path 2321 flows down to flow-path lower unit 2370 through the discharge port of detergent case 2400 and is fed into washing tub 2500. When the predetermined water supply is completed, first water conveyance pipe 2311 is closed. Note that, in Embodiment 3, third water conveyance pipe 2313 is opened and subsequently first water conveyance pipe 2311 is closed, as described later.

[0211] Subsequently, path washing is performed. In the path washing, water is supplied

using third water conveyance pipe 2313 only. Thus, water introduced via water supply valve 2310 is not diverted into first water conveyance path 2321 and third water conveyance path 2323, but is supplied to third water conveyance path 2323 only. Hence, the amount of water passing through third water conveyance path 2323 in the path washing is larger than the amount of water passing through third water conveyance path 2323 in the detergent sending operation. The water having passed through in-automatic-feeding device path 2325 flows down into flow-path lower unit 2370 via washing path outflow port 2326 and is fed into washing tub 2500 from flow-path lower unit 2370.

[0212] With the path washing, a detergent remaining in liquid agent automatic feeding device 2301 and flow-path lower unit 2370 is surely washed away and sent to washing tub 2500. Thus, the path washing can substantially prevent the mixing of the remaining detergent and a softening agent to be fed at a final rinsing step and thereby substantially prevent the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent. Furthermore, even when a foreign substance is present, the path washing can remove the foreign substance with a strong water stream.

[0213] At the final rinsing step, softening agent three-way valve 2382 as a part of three-way valve 2380 is opened, whereby softening agent tank 2460 communicates with pump unit 2390 by means of a path. By rotating the motor, pump unit 2390 causes piston 2395 to move up and down, and thereby sucks in an appropriate amount of the softening agent from pump unit inlet 2392a and discharges the softening agent from pump unit outlet 2392b. The softening agent discharged from pump unit outlet 2392b reaches flow-path lower unit 2370.

[0214] Before or during the driving of piston 2395, second water conveyance pipe 2312 is opened and water supply to second water conveyance path 2322 is started. In like manner with water flow Y2, water having been introduced into second water conveyance path 2322 passes through softening agent-specific water feed port 2334 and is fed into softening agent manual feeding unit 2430. Then, the water flows down into flow-path lower unit 2370 from the discharge port of softening agent manual feeding unit 2430, whereby the softening agent having gathered in flow-path lower unit 2370 is dissolved in the water and the resultant solution is fed into washing tub 2500.

[0215] Next, softening agent three-way valve 2382 is closed, whereby the path between softening agent tank 2460 and pump unit 2390 is blocked, and third water conveyance pipe 2313 communicates with liquid agent automatic feeding device 2301 by means of a path. After that, third water conveyance pipe 2313 is opened, whereby path washing is

performed to wash away the detergent remaining in three-way valve 2380 and pump unit 2390. This path washing substantially prevents the mixing of the remaining softening agent and a detergent to be fed in the next washing operation and thereby substantially prevents the precipitation of a foreign substance caused by the mixing of the detergent and the softening agent. Furthermore, even when the foreign substance is present, the path washing can remove the foreign substance with a strong water stream.

[0216] [3-3. Effects]

As described above, washing machine 2100 in Embodiment 3 includes casing 2600, washing tub 2500, the water conveyance path, detergent tank 2450 and softening agent tank 2460, liquid agent automatic feeding device 2301, and control unit 2900. Washing tub 2500 is disposed inside casing 2600 and configured to accommodate the laundry. The water conveyance path is configured to supply washing tub 2500 with water introduced via water supply valve 2310. Detergent tank 2450 and softening agent tank 2460 are examples of the liquid agent tank in the present disclosure and are configured to store a liquid agent. Liquid agent automatic feeding device 2301 is configured to feed the liquid agents stored in detergent tank 2450 and softening agent tank 2460 into washing tub 2500. The water conveyance path includes the fifth water path, the sixth water path, and the junction water path. The fifth water path includes first water conveyance path 2321 and second water conveyance path 2322, each being configured to provide water supply to washing tub 2500 without passing through liquid agent automatic feeding device 2301. The sixth water path is third water conveyance path 2323 configured to provide water supply to washing tub 2500 with passing through liquid agent automatic feeding device 2301. The junction water path is flow-path lower unit 2370 into which first water conveyance path 2321, second water conveyance path 2322, and third water conveyance path 2323 join. Control unit 2900 is configured to drive water supply valve 2310 to provide water supply to first water conveyance path 2321 and configured to drive liquid agent automatic feeding device 2301 to feed a liquid agent into washing tub 2500.

[0217] Thus, a detergent to be supplied to washing tub 2500 can be diluted in junction 2375, whereby an undiluted liquid detergent can be substantially prevented from adhering to the laundry.

[0218] As in the case of washing machine 2100 in Embodiment 3, control unit 2900 may drive liquid agent automatic feeding device 2301 intermittently, and, while liquid agent automatic feeding device 2301 stops driving, control unit 2900 may drive water supply valve 2310 to provide water supply to third water conveyance path 2323.

[0219] Thus, while the concentration of the detergent solution to be fed is kept within a predetermined range, the detergent solution can be fed into washing tub 2500 for many hours.

[0220] Thus, the detergent solution can be thoroughly sprinkled on the clothes in washing tub 2500.

[0221] As in the case of washing machine 2100 in Embodiment 3, flow-path lower unit 2370 is disposed below first water conveyance path 2321 and second water conveyance path 2322, and first water conveyance path 2321 and second water conveyance path 2322 may be provided with foaming-specific water feed port 2335 configured to allow water to be poured toward flow-path lower unit 2370.

[0222] Thus, the detergent solution is foamed with water vigorously poured from foaming-specific water feed port 2335.

[0223] As in the case of washing machine 2100 in Embodiment 3, flow-path lower unit 2370 may include pins 2377 vertically extending below foaming-specific water feed port 2335.

[0224] Thus, water is poured from foaming-specific water feed port 2335 into the detergent solution staying around the pins, whereby the detergent solution is foamed.

[0225] (Modification of Embodiment 3)

Embodiment 3 was described above to illustrate the technology of the present disclosure. However, the technology of the present disclosure is not limited by Embodiment 3.

[0226] Then, a modification of Embodiment 3 will be illustrated below.

[0227] In Embodiment 3, washing machine 2100, which was a top-loading washing machine, was described as an example of the washing machine in the present disclosure.

The washing machine in the present disclosure is not limited to the top-loading washing machine, but may be a front-loading washing machine or a twin-tub washing machine.

[0228] In Embodiment 3, as an example of configuration for driving a water supply unit to provide water supply to the fifth water path and driving the liquid agent automatic feeding device to feed a liquid agent, an operation for providing water supply to first water conveyance path 2321 and driving liquid agent automatic feeding device 2301 to feed a liquid agent was described. The fifth water path is beneficially a water path configured to provide water supply to the washing tub without passing through the liquid agent automatic feeding device, and therefore is not limited to first water conveyance path 2321, but may be second water conveyance path 2322, for example. Furthermore, in

Embodiment 3, as an example of configuration for driving the liquid agent automatic feeding device to feed a liquid agent, an operation for feeding a liquid detergent was described. The liquid agent is not limited to the liquid detergent, but may be a softening agent, for example.

5 [0229] In Embodiment 3, as an example of the foaming-specific water feed port in the present disclosure, foaming-specific water feed port 2335 configured to pour water into flow-path lower unit 2370 not via detergent case 2400 was described. The foaming-specific water feed port in the present disclosure is beneficially configured to allow water to be poured toward the junction water path, and therefore is not limited to foaming-specific water feed port 2335. The foaming-specific water feed port may be configured to
10 pour water into the flow-path lower unit via the detergent case, for example, or may be configured to also serve as a powder detergent-specific water feed port, a liquid detergent-specific water feed port, or a softening agent-specific water feed port.

15 INDUSTRIAL APPLICABILITY

[0230] The present disclosure is applicable to a device including a liquid agent automatic feeding device. Specifically, the present disclosure is applicable to, for example, top-loading washing machines, front-loading washing machines, twin-tub washing machines, and dish washers.

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REFERENCE MARKS IN THE DRAWINGS

[0231] 100, 1100, 2100...washing machine
200, 1200, 2200...water supply port
210, 1210, 2210...water supply hose
25 300, 1300, 2300...water supply unit
301, 1301, 2301...liquid agent automatic feeding device
302, 1302, 2302...detergent tank entry
303, 1303, 2303...softening agent tank entry
310, 1310, 2310...water supply valve
30 311, 1311, 2311...first water conveyance pipe
312, 1312, 2312...second water conveyance pipe
313, 1313, 2313...third water conveyance pipe
314, 1314, 2314...bath pump
320, 1320, 2320...water supply unit casing unit

	321, 1321, 2321...first water conveyance path
	322, 1322, 2322...second water conveyance path
	323, 1323, 2323...third water conveyance path
	324, 1324, 2324...washing path water port
5	325, 1325, 2325...in-automatic-feeding device path
	326, 1326, 2326...washing path outflow port
	330, 1330, 2330...detergent case flow-path unit
	331, 1331, 2331...powder detergent-specific water feed port
	332, 1332, 2332...liquid detergent-specific water feed port
10	333, 1333, 2333...bath pump-specific water feed port
	334, 1334, 2334...softening agent-specific water feed port
	340, 1340, 2340...flow-path lid unit
	350, 1350, 2350...detergent case accommodation unit
	360, 1360...tank accommodation unit
15	360a, 1360a, 2360a...detergent automatic feeding-specific connection unit
	360b, 1360b...softening agent automatic feeding-specific connection unit
	370, 1370, 2370...flow-path lower unit
	380, 1380, 2380...three-way valve
	381, 1381, 2381...detergent three-way valve
20	382, 1382, 2382...softening agent three-way valve
	390, 1390, 2390...pump unit
	391, 1391, 2391...in-pump flow path
	392a, 1392a, 2392a...pump unit inlet
	392b, 1392b, 2392b...pump unit outlet
25	393, 1393, 2393...inlet-port check valve
	394, 1394, 2394...outlet check valve
	395, 1395, 2395...piston
	397, 1397, 2397...cylinder
	400, 1400, 2400...detergent case
30	410, 1410, 2410...powder detergent manual feeding unit
	420, 1420, 2420...liquid detergent manual feeding unit
	430, 1430, 2430...softening agent manual feeding unit
	450, 1450, 2450...detergent tank
	450a, 1450a, 2450a...detergent tank residual amount scale

	451, 1451, 2451...detergent tank feeding unit
	452, 1452, 2452...detergent automatic feed entry
	460, 1460, 2460...softening agent tank
	460a, 1460a, 2460a...softening agent tank residual amount scale
5	461, 1461, 2461...softening agent tank feeding unit
	462, 1462, 2462...softening agent automatic feed entry
	500, 1500, 2500...washing tub
	600, 1600, 2600...casing
	610, 1610, 2610...lower casing
10	620, 1620, 2620...upper casing
	621, 1621, 2621...loading opening
	700, 1700, 2700...lid
	800, 1800, 2800...operation unit
	900, 1900, 2900...control unit
15	2360...detergent tank accommodation unit
	2318...washing path inlet
	2319...washing path
	2335...foaming-specific water feed port
	2361...detergent tank accommodation unit hook
20	2362...detergent tank accommodation unit contact face
	2363...storage unit
	2364...drop port
	2365...softening agent tank accommodation unit
	2365a...softening agent automatic feeding-specific connection unit
25	2368...stopper
	2371...flow-path lower unit discharge port
	2372...first flow-path lower unit path
	2373...second flow-path lower unit path
	2374...washing path outlet
30	2375...junction
	2376...foaming unit
	2377...pin
	2454...lock lever
	2454a...lock lever grip

2455...spring mechanism
2455a...spring
2456...detergent tank casing
2457...tank projection
5 2464...feeding incline unit
2470...filter

WHAT IS CLAIMED IS:

1. A washing machine, comprising:
 - a casing;
 - 5 a washing tub disposed inside the casing and configured to accommodate laundry;
 - a water conveyance path through which water is supplied to the washing tub via a water supply valve;
 - a liquid agent tank configured to store a liquid agent;
 - a liquid agent automatic feeding device configured to feed the liquid agent into the
 - 10 washing tub, the liquid agent being stored in the liquid agent tank; and
 - a control unit,
 - wherein the water conveyance path includes a first water path through which the water is supplied to the washing tub without passing through the liquid agent automatic feeding device,
 - 15 wherein the water supply valve includes a first valve configured to allow the water to flow through the first water path, and
 - wherein the control unit drives the liquid agent automatic feeding device and opens the first valve.
- 20 2. The washing machine according to claim 1, wherein
 - the water conveyance path further includes a second water path through which the water is supplied to the washing tub with passing through the liquid agent automatic feeding device,
 - the water supply valve further includes a second valve configured to allow the
 - 25 water to flow through the second water path, and
 - the control unit
 - stops driving of the liquid agent automatic feeding device, and
 - opens the second valve while the liquid agent automatic feeding device
 - stops driving.
- 30 3. A washing machine, comprising:
 - a casing;
 - a washing tub disposed inside the casing and configured to accommodate laundry;
 - a water conveyance path through which water is supplied to the washing tub via a

water supply valve;

a liquid agent tank configured to store a liquid agent;

a liquid agent automatic feeding device configured to feed the liquid agent into the washing tub, the liquid agent being stored in the liquid agent tank; and

5 a control unit,

wherein the water conveyance path includes:

a third water path through which the water is supplied to the washing tub without passing through the liquid agent automatic feeding device; and

10 a fourth water path through which the water is supplied to the washing tub with passing through the liquid agent automatic feeding device,

wherein the water supply valve includes:

a third valve configured to allow the water to flow through the first water path; and

15 a fourth valve configured to allow the water to flow through the second water path, and

wherein, after a predetermined time elapses from opening of the third valve, the control unit opens the fourth valve.

4. The washing machine according to claim 3, wherein,

20 after a predetermined time elapses from opening of the fourth valve, the control unit closes the third valve.

5. The washing machine according to claim 3 or 4, wherein,

25 after a predetermined time elapses from opening of the third valve, the control unit closes the fourth valve.

6. A washing machine, comprising:

a casing;

a washing tub disposed inside the casing and configured to accommodate laundry;

30 a water conveyance path through which water is supplied to the washing tub via a water supply valve;

a liquid agent tank configured to store a liquid agent;

a liquid agent automatic feeding device configured to feed the liquid agent into the washing tub, the liquid agent being stored in the liquid agent tank; and

a control unit,

wherein the water conveyance path includes:

a fifth water path through which the water is supplied to the washing tub without passing through the liquid agent automatic feeding device;

5 a sixth water path through which the water is supplied to the washing tub with passing through the liquid agent automatic feeding device; and

a junction water path into which the fifth water path and the sixth water path join, and

10 wherein the control unit drives the water supply valve to allow the water to flow through the fifth water path, and drives the liquid agent automatic feeding device to feed the liquid agent.

7. The washing machine according to claim 6, wherein
the control unit

15 drives the liquid agent automatic feeding device intermittently, and
drives the water supply valve to allow the water to flow through the sixth water path while the liquid agent automatic feeding device stops driving.

20 8. The washing machine according to claim 6 or 7, wherein
the junction water path is disposed below the first water path, and
the fifth water path includes a foaming-specific water feed port configured to
allow water to be poured into the junction water path.

25 9. The washing machine according to claim 8, wherein
the junction water path includes a plurality of pins vertically extending below the
foaming-specific water feed port.