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(71) Applicant: **Panasonic Corporation**
Kadoma-shi
Osaka 571-8501 (JP)

(72) Inventors:
• **UCHIYAMA, Wataru**
Osaka-shi
Osaka 540-6207 (JP)

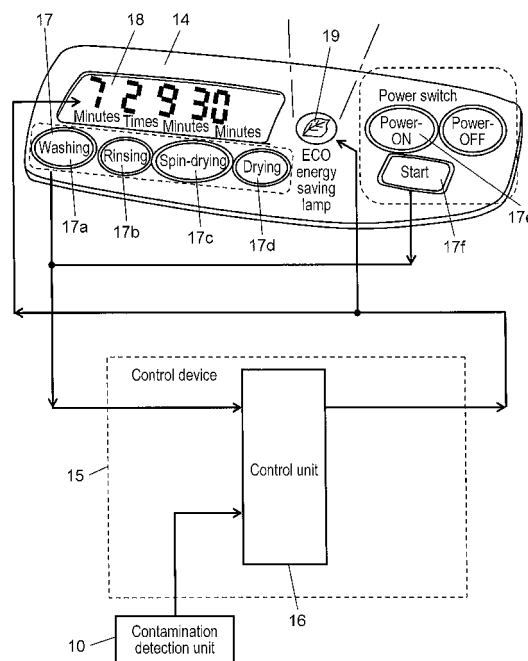
• **YASUI, Toshihiko**
Osaka-shi
Osaka 540-6207 (JP)
• **OYAMA, Makoto**
Osaka-shi
Osaka 540-6207 (JP)
• **KUBO, Koichi**
Osaka-shi
Osaka 540-6207 (JP)

(74) Representative: **Schwabe - Sandmair - Marx**
Patentanwälte
Stuntzstraße 16
81677 München (DE)

(54) **WASHING MACHINE AND PROGRAM THEREFOR**

(57) A washing machine includes a washing tank, a door, an input setting unit, a contamination detection unit, an energy saving display unit, and a control device in which an output of the input setting unit and an output of the contamination detection unit are input to sequentially control a washing step, a rinsing step, and a spin-drying step, wherein the control device lights the energy saving display unit when a first working description that is the working description set by the input setting unit is heavier than a second working description fixed based on the contamination detected by the contamination detection unit.

FIG. 7



Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine that washes laundry and the like and a program thereof.

BACKGROUND ART

[0002] In a conventional washing machine, a door of a main body is opened to take laundry (clothes) and a proper amount of detergent in a washing tank. In a manipulation display unit, working contents such as a washing time and the number of times of rinsing are set by pressing a switch according to the clothes. Then, generally a start button is pressed to start a working.

[0003] On the other hand, recently, contaminations of the laundry are detected by turbidity of a washing solution in a washing step, and the working is performed the small number of times of the rinsing for the shorter washing time (within a range in which basic performance such as washing performance and rinsing performance can sufficiently be ensured) compared with the working contents initially set by the user in the case of a small contamination amount of the laundry. Therefore, an energy saving type washing machine that saves an electric bill and a water bill has been proposed. A configuration of the energy saving type washing machine will be described below (for example, refer to PTL 1).

[0004] FIG. 19 is a system block diagram illustrating a manipulation display unit of a conventional washing machine. Manipulation display unit 51 includes input setting unit 52 and setting content display unit 53 that displays the set working contents. Input setting unit 52 includes washing time setting switch 52a, rinsing frequency setting switch 52b, spin-drying time setting switch 52c, drying time setting switch 52d, power switch 52e, and start button 52f. Washing time setting switch 52a sets the washing time. Rinsing frequency setting switch 52b sets the number of times of the rinsing. Spin-drying time setting switch 52c sets a spin-drying time. Drying time setting switch 52d sets a drying time in the case in which the washing machine has a drying function. Power switch 52e turns on and off the power.

[0005] Contamination detection unit 54 is placed in a bottom portion of the washing tank (not illustrated) (or in a washing-solution circulation tube in the case of the washing machine has a structure in which the washing solution accumulated in the bottom portion is circulated in the washing tank using a small-size pump). In many cases, contamination detection unit 54 measures the turbidity or an electric conductivity of the washing solution to detect the contamination in several stages, thereby outputting the contamination.

[0006] Control device 55 includes control unit 56 including a microcomputer. Control device 55 receives an input signal from input setting unit 52, and performs an

output to setting content display unit 53. After a working course is started, control device 55 operates a water supply valve and a drain valve to perform a sequence of controls such as the passage of water in the washing tank, drive of a motor, and an operation of a heater, thereby performing the washing, the rinsing, and the spin-drying (and drying) of the laundry (such as clothes).

[0007] An operation of the conventional washing machine having the above configuration will be described below. FIG. 20 is a flowchart illustrating the operation of the control unit of the conventional washing machine. The laundry (clothes) and the proper amount of detergent are input to a washing tank in the main body of the washing machine, and power switch 52e of input setting unit 52 in manipulation display unit 51 of FIG. 19 is pressed to establish electric conduction. At this point, the washing machine becomes a state called an initial standby state, and the working content of each step can be set by manipulating washing time setting switch 52a, rinsing frequency setting switch 52b, spin-drying time setting switch 52c, and drying time setting switch 52d until start button 52f is pressed to start the working.

[0008] The working contents set in input setting unit 52, the working contents fixed based on the contaminations of the laundry, which are detected by contamination detection unit 54, and an actually-performed working sequence will be described in detail below. As illustrated in the flowchart of FIG. 20, in the initial standby state, the washing time, the number of times of the rinsing, the spin-drying time, and the drying time are set by washing time setting switch 52a, rinsing frequency setting switch 52b, spin-drying time setting switch 52c, and drying time setting switch 52d in input setting unit 52.

[0009] When start button 52f is pressed to start the working in order to perform the working contents set in input setting unit 52, a washing step is started in S1 (Step 1) of the flowchart. In a water supply step in S2 (Step 2), a predetermined amount of tap water is supplied to the washing tank. Then, in S3 (Step 3), a washing drum is alternately rotated in a normal rotating direction and a reverse rotating direction, whereby the contamination component of the laundry starts to be dissolved in the washing solution. When a predetermined time elapses in S4 (Step 4), contamination detection unit 54 detects the contamination in S5 (Step 5).

[0010] In the case of the small contamination amount of the laundry in S6 (Step 6), the working contents that the user sets using input setting unit 52 in the initial standby state are changed to the working contents (saving course) in which the washing time and the number of times of the rinsing are decreased within the range in which the basic performance such as the washing performance and the rinsing performance can sufficiently be ensured. After the washing step is performed until the newly-set working contents (washing time) are satisfied in S8 (Step 8), the washing step is ended in S9 (Step 9). After the newly-set working contents (the number of times of the rinsing, the spin-drying time, and the drying time)

are performed in S10 (Step 10) to S12 (Step 12), the working is ended.

[0011] However, in the control of the conventional washing machine, it is unknown whether the working contents are changed in the middle of the washing according to the contaminations of the laundry detected by the contamination detection unit. That is, the user has no means for easily learning whether the working is actually performed the smaller number of times of rinsing for the shorter washing time to save an electric bill and a water bill compared with the initially-set working contents. Therefore, unfortunately the user hardly feels how much amount of laundry (clothes) and how much degree of the contamination enables the saving working contributing to the energy saving, and convenience is degraded.

Citation List

Patent Literature

[0012]

PTL 1: Unexamined Japanese Patent Publication No. 61-206494

SUMMARY OF THE INVENTION

[0013] A washing machine of the present invention includes: a washing tank in which laundry are accommodated; a door through which the washing are taken in and out of the washing tank; an input setting unit that sets working contents of a washing time and the number of times of rinsing; a contamination detection unit that detects contaminations of the laundry; an energy saving display unit that indicates a degree of an energy saving working; and a control device in which an output of the input setting unit and an output of the contamination detection unit are input to sequentially control a washing step, a rinsing step, and a spin-drying step, wherein the control device lights the energy saving display unit when a first working description that is the working description set by the input setting unit is heavier than a second working description fixed based on the contamination detected by the contamination detection unit.

[0014] As a result, compared with the initially-set working contents, the user can easily learn whether the working is actually performed the smaller number of times of the rinsing for the shorter washing time to save the electric bill and the water bill. The user easily feels how much amount of laundry and how much degree of the contamination enables the saving working contributing to the energy saving, so that the convenience can be enhanced.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

FIG. 1 is a schematic configuration diagram of a washing machine according to a first exemplary embodiment of the present invention.

FIG. 2 is a vertical sectional view illustrating a contamination detection unit of the washing machine according to the first exemplary embodiment.

FIG. 3 is a sectional view illustrating the contamination detection unit of the washing machine according to the first exemplary embodiment when viewed from above.

FIG. 4 is a vertical sectional view illustrating another example of the contamination detection unit of the washing machine according to the first exemplary embodiment.

FIG. 5 is a sectional view illustrating another example of the contamination detection unit of the washing machine according to the first exemplary embodiment when viewed from above.

FIG. 6 is a sectional view illustrating still another example of the contamination detection unit of the washing machine according to the first exemplary embodiment when viewed from above.

FIG. 7 is a system block diagram illustrating a manipulation display unit of the washing machine according to the first exemplary embodiment.

FIG. 8 is a flowchart illustrating an operation of a control unit of the washing machine according to the first exemplary embodiment.

FIG. 9 is a flowchart illustrating an operation of a control unit of a washing machine according to a second exemplary embodiment of the present invention.

FIG. 10 is a system block diagram illustrating a manipulation display unit of a washing machine according to a third exemplary embodiment of the present invention.

FIG. 11 is a flowchart illustrating an operation of a control unit of the washing machine according to the third exemplary embodiment.

FIG. 12 is a flowchart illustrating the operation of the control unit when a door of the washing machine according to the third exemplary embodiment is opened.

FIG. 13 is a flowchart illustrating an operation of a control unit of a washing machine according to a fourth exemplary embodiment of the present invention.

FIG. 14 is a timing chart illustrating the operation of the control unit of the washing machine according to the fourth exemplary embodiment.

FIG. 15 is a flowchart illustrating an operation of a control unit of a washing machine according to a fifth exemplary embodiment of the present invention.

FIG. 16 is a timing chart illustrating the operation of the control unit of the washing machine according to the fifth exemplary embodiment.

FIG. 17 is a flowchart illustrating an operation of a control unit of a washing machine according to a seventh exemplary embodiment of the present invention.

tion.

FIG. 18 is a flowchart illustrating an operation of a control unit of a washing machine according to an eighth exemplary embodiment of the present invention.

FIG. 19 is a system block diagram illustrating a manipulation display unit of a conventional washing machine.

FIG. 20 is a flowchart illustrating an operation of a control unit of the conventional washing machine.

DESCRIPTION OF EMBODIMENTS

[0016] Hereinafter, exemplary embodiments of the present invention will be described with reference to the drawings. However, the present invention is not limited to the exemplary embodiments.

FIRST EXEMPLARY EMBODIMENT

[0017] FIG. 1 is a schematic configuration diagram of a washing machine according to a first exemplary embodiment of the present invention, FIG. 2 is a vertical sectional view illustrating a contamination detection unit of the washing machine according to the first exemplary embodiment, and FIG. 3 is a sectional view illustrating the contamination detection unit of the washing machine according to the first exemplary embodiment when viewed from above.

[0018] In FIGS. 1 to 3, outer tank 2 is provided in cabinet 1 of the whole washing machine, and drum 3 serving as a washing tank is provided in outer tank 2 while being rotatable by a rotating shaft whose front side is inclined upward from a horizontal direction. Drum 3 is rotated by motor 4 connected to a back surface thereof. The washing tank accommodates laundry therein. The laundry are taken in and out from the washing tank through door 1a. Many passing-water holes (not illustrated) are made in an outer circumferential surface of drum 3, and drum 3 acts as the washing tank, a spin-drying tank, and a drying tank.

[0019] Opening 5 is connected to a lowest level portion on a rear portion side of outer tank 2 whose rear side is inclined downward, and Opening 5 is connected to drain pipe 7 that is opened and closed by drain valve 6. Circulation tube 9 is communicated between Opening 5 and drain valve 6. A washing solution and a rinsing solution in outer tank 2 are circulated through circulation tube 9 by the rotation of drum 3. At this point, circulation tube 9 is connected to ejection port 8 that ejects the washing solution taken in through Opening 5 to drum 3.

[0020] Contamination detection unit 10 that detects a state of the washing solution, namely, contaminations of the laundry is placed in horizontal flow path 9a formed in the horizontal direction of circulation tube 9. More particularly, contamination detection unit 10 is provided downstream at a predetermined distance L from an inlet port through which the washing solution, which enters circu-

lation tube 9 from Opening 5, flows in horizontal flow path 9a. Horizontal flow path 9a may slightly be inclined from the horizontal direction.

[0021] Contamination detection unit 10 is constructed by a transmittance sensor including light emitting element 11 such as an LED (Light Emitting Diode) and light receiving element 12 such as a phototransistor. In contamination detection unit 10, light emitting element 11 and light receiving element 12 may horizontally be placed opposite each other while sandwiching horizontal flow path 9a of circulation tube 9 therebetween from the outside. In a portion sandwiched between light emitting element 11 and light receiving element 12, horizontal flow path 9a is made of a translucent material. Light receiving element 12 receives light emitted from light emitting element 11 through the washing solution in circulation tube 9, and light receiving element 12 converts the light into a voltage and outputs the voltage. Therefore, contamination detection unit 10 has a light-blocking sealed structure such that light receiving element 12 does not receive the light from the outside.

[0022] Contamination detection unit 10 is placed in horizontal flow path 9a in which circulation tube 9 is horizontally disposed. Light emitting element 11 and light receiving element 12 are disposed on the right and the left near a center in a vertical direction in a vertical section of circulation tube 9. That is, contamination detection unit 10 is configured to detect the state of the washing solution in a lower position that avoids an upper layer portion of the flow path section of circulation tube 9.

[0023] Emission control of light emitting element 11 and a load of an output of light receiving element 12 are performed by a control circuit (not illustrated) such as a microcomputer. An output value from light receiving element 12 is processed as transmittance of the washing solution passing through circulation tube 9. A washing step and a rinsing step are controlled based on the transmittance.

[0024] The contamination is dissolved from the laundry by a detergent and agitation, and the washing solution in the washing step becomes gradually cloudy. Therefore, a contamination amount and completion of the washing can be determined by observing a change in transmittance of the washing solution or change in transmittance with time.

[0025] An operation to detect the transmittance of the washing machine of the first exemplary embodiment will be described below. During the washing and the rinsing, the washing solutions in drum 3 and outer tank 2 enter circulation tube 9 through Opening 5 by the rotation of drum 3. The washing solution circulates to drum 3 through horizontal flow path 9a of circulation tube 9 in which contamination detection unit 10 exists. Therefore, the contamination of the water in circulation tube 9 is always substantially equal to the contaminations of the washing solutions in drum 3 and outer tank 2.

[0026] In contamination detection unit 10, it is assumed that the output, in which light emitting element 11 emits

the light every one minute and light receiving element 12 receives the light, is used as the transmittance of the washing solution at that time point, and it is assumed that the output is used for the control in the washing step and the rinsing step.

[0027] Many air bubbles exist in the washing solution because the washing solution is water containing the detergent. Particularly, the air bubbles float and flow easily through the upper layer portion in horizontal flow path 9a in which the contamination detection unit 10 is placed. However, light emitting element 11 and light receiving element 12 perform the detection in the lower position that avoids the upper layer portion of the flow path section in the horizontal flow path 9a, so that the transmittance of the washing solution can accurately be measured without suffering from an effect of the air bubble.

[0028] Contamination detection unit 10 may be placed in a central position that avoids the upper layer portion and the lower layer portion of horizontal flow path 9a. In the case in which contamination materials are included in the washing solution that enters circulation tube 9 from the lower portion of outer tank 2, the contamination material passes through the lower layer when the washing solution flows in horizontal flow path 9a, so that contamination detection unit 10 can detect the washing solution, which flows in the central position while including the small number of contamination materials.

[0029] Contamination detection unit 10 is provided downstream at the predetermined distance from the inlet port of horizontal flow path 9a. Therefore, the air bubble included in the washing solution entering horizontal flow path 9a flows downstream while floating upward, so that the washing solution including the small number of air bubbles flowing the lower portion of horizontal flow path 9a can be detected.

[0030] As described above, light emitting element 11 and light receiving element 12 of contamination detection unit 10 are disposed on the right and the left near the center in the vertical direction in the vertical section of circulation tube 9. Therefore, the transmittance of the washing solution can always be measured without suffering from the effect of the air bubble in circulation tube 9. Accordingly, a risk of generating a measurement variation of the transmittance, which is caused by the number of air bubbles depending on a type and an amount of the detergent, is eliminated.

[0031] FIG. 4 is a vertical sectional view illustrating another example of the contamination detection unit of the washing machine according to the first exemplary embodiment of the present invention. Light emitting element 11 and light receiving element 12 are inserted in horizontal flow path 9a of circulation tube 9, and located in horizontal flow path 9a. According to the configuration of FIG. 4, because the transmittance of the washing solution can be detected in circulation tube 9, it is not necessary that circulation tube 9 be made of the translucent material. Degradation of a light receiving level in light receiving element 12, which is caused by the contamination of a

wall surface of circulation tube 9, is not generated. It is only necessary to insert light emitting element 11 and light receiving element 12 in circulation tube 9 to form a water-resistant structure. Therefore, the need of the light-blocking sealed structure is eliminated.

[0032] Contamination detection unit 10 is disposed in the lower position that avoids the upper layer portion in horizontal flow path 9a or in the central position that avoids the upper layer portion and the lower layer portion in horizontal flow path 9a. Light emitting element 11 and light receiving element 12 of the transmittance sensor are provided outside horizontal flow path 9a or in horizontal flow path 9a.

[0033] Light emitting element 11 and light receiving element 12 of the transmittance sensor are disposed so as to be detectable in the lower position that avoids the upper layer portion in horizontal flow path 9a or in the central position that avoids the upper layer portion and the lower layer portion in horizontal flow path 9a. Therefore, light emitting element 11 and light receiving element 12 are disposed on the right and the left, namely, in the horizontal direction while facing each other, when light emitting element 11 and light receiving element 12 are provided outside horizontal flow path 9a. Light emitting element 11 and light receiving element 12 are disposed one above the other, namely, in the vertical direction in addition to the horizontal direction, when light emitting element 11 and light receiving element 12 are provided inside horizontal flow path 9a.

[0034] FIG. 5 is a sectional view illustrating another example of the contamination detection unit of the washing machine according to the first exemplary embodiment of the present invention when viewed from above. Contamination detection unit 10 is constructed by a conductivity sensor including a pair of electrodes 13a and 13b dipped in circulation tube 9. The pair of electrodes 13a and electrode 13b is horizontally inserted in horizontal flow path 9a of circulation tube 9 to measure an electric conductivity of the washing solution flowing in circulation tube 9. In order to measure the electric conductivity, for example, an RC oscillation circuit is constructed by an impedance of the washing solution between electrode 13a and electrode 13b and a capacitor on a control circuit (not illustrated). A change in impedance of the washing solution is output as a change in frequency, and the change in frequency is converted into a voltage value.

[0035] Therefore, the type of the detergent or the amount of detergent in the washing solution can be determined when the electric conductivity of the washing solution is measured. Because the contamination amount of a conductive component mainly including sweat dissolved from the laundry can be determined, the washing step and the rinsing step can be controlled.

[0036] In the case in which the electric conductivity is detected, electrode 13a and electrode 13b are horizontally placed in horizontal flow path 9a of circulation tube 9 to detect the state of the washing solution flowing in the lower position that avoids the upper layer portion of

horizontal flow path 9a. Therefore, the electric conductivity of the washing solution can correctly be measured without suffering from the effect of the air bubble in circulation tube 9.

[0037] FIG. 6 is a sectional view illustrating still another example of the contamination detection unit of the washing machine according to the first exemplary embodiment of the present invention when viewed from above. Contamination detection unit 10 is constructed by the transmittance sensor that includes light emitting element 11 and light receiving element 12 to detect the transmittance of the washing solution and the conductivity sensor that includes the pair of electrodes 13a and 13b to measure the electric conductivity of the washing solution.

[0038] The transmittance and the electric conductivity of the washing solution are detected. Therefore, when the transmittance is higher than another previously fixed value while the electric conductivity is lower than a previously fixed value, a determination that a liquid detergent is input is made to control the washing step. Even if the transmittance becomes a level equal to that of tap water, when the electric conductivity is higher than a reference value, shortage of the rinsing is determined to lengthen the rinsing. When the electric conductivity becomes lower than the reference value, the rinsing step is ended.

[0039] FIG. 7 is a system block diagram illustrating a manipulation display unit of the washing machine according to the first exemplary embodiment of the present invention. Control device 15 includes control unit 16 including a microcomputer. Control device 15 receives an input signal from input setting unit 17, and performs an output to setting content display unit 18. An output signal of contamination detection unit 10 is input to control unit 16. Working contents of a washing time and the number of times of the rinsing are set to input setting unit 17.

[0040] After a working course is started, control device 15 operates a water supply valve (not illustrated) and drain valve 6 to perform a sequence of controls such as the passage of water in outer tank 2, drive of motor 4, and an operation of a heater, thereby performing the washing, the rinsing, and the spin-drying (and drying) of the laundry (such as clothes). Manipulation display unit 14 is disposed in an upper portion of a front surface of cabinet 1, and is provided in a position in which a user easily performs a manipulation. That is, the output of input setting unit 17 and the output of contamination detection unit 10 are input to control device 15, and control device 15 sequentially controls the washing step, the rinsing step, and the spin-drying step.

[0041] Energy saving lamp 19 that indicates a degree of an energy saving working is an energy saving display unit that indicates that the washing machine is operated more economically than the working contents set to input setting unit 17 by the user, and a green lamp is used as energy saving lamp 19. This facilitates association with an image that the saving working is performed to contribute to the energy saving.

[0042] The operation of the control unit of the washing

machine according to the first exemplary embodiment of the present invention will be described below with reference to a flowchart of FIG. 8. The laundry (clothes) and the proper amount of detergent are input to drum 3 of the washing machine, and power switch 17e of input setting unit 17 in manipulation display unit 14 of FIG. 7 is pressed to establish electric conduction. As a result, the washing machine becomes the state called an initial standby state. Until start button 17f is pressed to start the working, the working content of each step can be set by manipulating washing time setting switch 17a of input setting unit 17, rinsing frequency setting switch 17b, spin-dry time setting switch 17c, and drying time setting switch 17d in the case in which the washing machine has the drying function.

[0043] The working contents set in input setting unit 17, the working contents fixed based on the contaminations of the laundry, which are detected by contamination detection unit 10, and an actually-performed working sequence will be described in detail below. At this point, it is assumed that the working contents set in input setting unit 17 are a first working content, and it is assumed that the working contents fixed based on the contaminations of the laundry, which are detected by contamination detection unit 10, are a second working content.

[0044] As illustrated in the flowchart of in FIG. 8, in the initial standby state, the washing time, the number of times of the rinsing, the spin-drying time, and the drying time are set by manipulating washing time setting switch 17a, rinsing frequency setting switch 17b, spin-drying time setting switch 17c, and drying time setting switch 17d in the case in which the washing machine has a drying function. When start button 17f is pressed to start the working of the washing machine, the washing step is started in S1 (Step 1) of the flowchart.

[0045] In the water supply step in S2 (Step 2), a predetermined amount of tap water is supplied to drum 3. Then, in S3 (Step 3), drum 3 is alternately rotated in a normal rotating direction and a reverse rotating direction, whereby the contamination component of the laundry starts to be dissolved in the washing solution. When the predetermined washing time elapses in S4 (Step 4), contamination detection unit 10 detects the contamination in S5 (Step 5).

[0046] In the case of the small amount of contamination of the laundry in S6 (Step 6), the following operation is performed within a range in which basic performance such as washing performance and rinsing performance can sufficiently be ensured. That is, the working contents that the user sets using input setting unit 17 in the initial standby state (in FIG. 8, the washing time of 20 minutes) are changed to working contents of "saving course" in which the washing time and the number of times of the rinsing are decreased (In the example of FIG. 8, the washing time of 15 minutes). In the case in which the washing time fixed based on the contamination is shorter than the time of working contents set by the user in S7 (Step 7), energy saving lamp 19 is lit on in S13 (Step 13).

That is, control device 15 lights energy saving lamp 19 in the case in which the second working content is smaller than the first working content.

[0047] On the other hand, in the case in which the washing time fixed based on the contamination is longer than the time of working contents set by the user in S7 (Step 7), the setting contents such as the washing time are not changed, and energy saving lamp 19 is not lit on.

[0048] When the washing time fixed based on the contamination elapses, namely, when 15 minutes changed from 20 minutes elapses in S8 (Step 8), the washing step is ended in S9 (Step 9). Then the rinsing step in S10 (Step 10), the spin-drying step in S11 (Step 11), and the drying step in S12 (Step 12) are performed. When the sequence of setting steps is ended, energy saving lamp 19 is turned off in S12a (Step 12a).

[0049] Therefore, compared with the initially-set working contents, the user can easily learn whether the working is actually performed the smaller number of times of rinsing for the shorter washing time to save an electric bill and a water bill. Additionally, the convenience that the user easily feels how much amount of laundry and how much degree of the contamination enables the saving working contributing to the energy saving can be enhanced.

[0050] A program of the washing machine according to the first exemplary embodiment of the present invention causes a computer to execute pieces of software incorporated in input setting unit 17, contamination detection unit 10, and energy saving lamp 19 (energy saving display unit). As a result, a part or a whole of the washing machine of the present invention can easily be constructed using a microcomputer and the like. The program can easily be distributed by recording the program in a recording medium or by delivering the program through a communication line.

[0051] In the first exemplary embodiment, the specific name and the number of times in which the user sets the content of each step using input setting unit 17 and the specific time energy saving lamp 19 is lit on are described. However, the present invention is not limited to the specific name, the number of times, and the specific time.

[0052] In the first exemplary embodiment, the method for comparing the first working content that the user sets using input setting unit 17 during the initial standby state and the second working description fixed based on the contamination detected by contamination detection unit 10 is described by specifically citing the comparison of the shorter and longer washing times. However, the present invention is not limited to the above method, but the numbers of times of the rinsing or the rinsing times may be compared, or spin-drying times and the drying times may be compared. A determination may be made by comparing combinations of the washing times and the numbers of times of the rinsing.

SECOND EXEMPLARY EMBODIMENT

[0053] In a second exemplary embodiment of the present invention, the same components as the first exemplary embodiment are designated by the same reference marks, the description of the components is omitted, and only a difference with the first exemplary embodiment is described. FIG. 9 is a flowchart illustrating an operation of a control unit of a washing machine according to a second exemplary embodiment of the present invention.

[0054] One of the features of the second exemplary embodiment is that energy saving lamp 19 is blinked in S15 (Step 15) after the washing step is started in S1 (Step 1). Energy saving lamp 19 is continuously blinked until the amount of contamination of the laundry is determined in S6 (Step 6). That is, control device 15 blinks energy saving lamp 19 from the start of the working description until contamination detection unit 10 detects the contamination of the laundry.

[0055] In the case in which the washing time fixed based on the contamination is shorter than the time of working contents set by the user in S7 (Step 7), energy saving lamp 19 is changed from blinking to lighting in S13 (Step 13). In the case in which the washing time fixed based on the contamination is longer than the time of working contents set by the user in S7 (Step 7), energy saving lamp 19 is changed from blinking to turning off in S14 (Step 14).

[0056] Therefore, for example, in the case in which it takes several minutes to detect the contamination since the start of the working, the user can be informed that the washing machine currently determines whether the saving working can be performed (the washing machine is in a stage before the determination result is gotten).

THIRD EXEMPLARY EMBODIMENT

[0057] In a third exemplary embodiment of the present invention, the same components as the first and second exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first and second exemplary embodiments is described. FIG. 10 is a system block diagram illustrating a manipulation display unit of a washing machine according to a third exemplary embodiment of the present invention, and FIG. 11 is a flowchart illustrating an operation of a control unit of the washing machine according to the third exemplary embodiment. One of the features of the third exemplary embodiment is that energy saving lamp 19 is lit on when door 1a is opened after the working is ended.

[0058] In the case of the small amount of contamination of the laundry in S6 (Step 6), the following operation is performed within the range in which the basic performance such as the washing performance and the rinsing performance can sufficiently be ensured. That is, the working contents that the user sets using input setting

unit 17 in the initial standby state (in FIG. 11, the washing time of 20 minutes) are changed to the working contents of "saving course" in which the washing time and the number of times of the rinsing are decreased (In FIG. 11, the washing time of 15 minutes). In the case in which the washing time fixed based on the contamination is shorter than the time of working contents set by the user in S7 (Step 7), energy saving lamp 19 is lit on in S13 (Step 13), and information (existence of energy saving) that the saving working is performed is stored in storage unit 20 in S13a (Step 13a).

[0059] On the other hand, in the case in which the washing time fixed based on the contamination is longer than the time of working contents set by the user in S7 (Step 7), the setting contents such as the washing time are not changed. Energy saving lamp 19 is not lit on, and information (non-existence of energy saving) that the saving working is not performed is stored in storage unit 20 in S13b (Step 13b).

[0060] After the washing step is performed until the newly-set working contents (washing time) are satisfied in S8 (Step 8), the washing step is ended in S9 (Step 9). After the newly-set working contents (the number of times of the rinsing, the spin-drying time, and the drying time) are performed in S10 (Step 10) to S12 (Step 12), energy saving lamp 19 is turned off in S12a (Step 12a), and all the working contents are ended.

[0061] The operation during the opening of door 1a will be described below. FIG. 12 is a flowchart illustrating the operation of the control unit when a door of the washing machine according to the third exemplary embodiment of the present invention is opened. When door 1a is opened, information whether the saving working has been performed (existence of energy saving/non-existence of energy saving) is called with respect to the working operation stored in storage unit 20 in S16 (Step 16). In the case in which the saving working exists in S17 (Step 17), energy saving lamp 19 is lit on in S18 (Step 18). That is, control device 15 lights energy saving lamp 19 when door 1a is opened after the end of the working contents.

[0062] Therefore, the following operation is performed in the case in which the second working description fixed based on the contamination detected during the actual washing step is smaller than the first working content that the user sets using input setting unit 17 before the start of the working. The electric bill and the water bill are saved by decreasing the washing time and the number of times of the rinsing within the range in which the basic performance such as the washing performance and the rinsing performance can sufficiently be ensured. The convenience of usage of the washing machine can be enhanced by informing the user whether the saving working of the washing machine can be performed.

FOURTH EXEMPLARY EMBODIMENT

[0063] In a fourth exemplary embodiment of the

present invention, the same components as the first to third exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first to third exemplary embodiments is described. FIG. 13 is a flowchart illustrating an operation of a control unit of a washing machine according to a fourth exemplary embodiment of the present invention, and FIG. 14 is a timing chart illustrating the operation of the control unit of the washing machine according to the fourth exemplary embodiment.

[0064] As illustrated in FIG. 13, one of the features of the fourth exemplary embodiment is that, after the end of the working, energy saving lamp 19 is lit on in S18 (Step 18), and energy saving lamp 19 is turned off in S20 (Step 20) when a predetermined time T1 (for example, 5 minutes) elapses since door 1a is opened in S19 (Step 19). That is, as illustrated in FIG. 14, control device 15 turns off energy saving lamp 19 when the predetermined time T1 elapses since door 1a is opened.

[0065] Therefore, when the user takes out the laundry, the user can be informed of the result whether the saving working can be performed for a proper time.

FIFTH EXEMPLARY EMBODIMENT

[0066] In a fifth exemplary embodiment of the present invention, the same components as the first to fourth exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first to fourth exemplary embodiments is described. FIG. 15 is a flowchart illustrating an operation of a control unit of a washing machine according to a fifth exemplary embodiment of the present invention, and FIG. 16 is a timing chart illustrating the operation of the control unit of the washing machine according to the fifth exemplary embodiment.

[0067] One of the features of the fifth exemplary embodiment is that, after the end of the working, door 1a is opened to light on energy saving lamp 19 in S18 (Step 18), and energy saving lamp 19 is turned off in S20 (Step 20) when door 1a is closed in S21 (Step 21). That is, as illustrated in FIG. 16, control device 15 turns off energy saving lamp 19 when door 1a is closed.

[0068] Therefore, only when the user takes out the laundry, the user can be informed of the result whether the saving working can be performed.

SIXTH EXEMPLARY EMBODIMENT

[0069] In a sixth exemplary embodiment of the present invention, the same components as the first to fifth exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first to fifth exemplary embodiments is described. The washing machine according to the sixth exemplary embodiment of the present invention displays the result of the saving working in

terms of a specific numerical value or index when the working time that is fixed based on the contamination level of the laundry detected during the actual washing step is shorter than the working time that the user sets using input setting unit 17 before the start of the working.

[0070] For example, a power consumption amount or an amount of electric power that can be saved is displayed as the numerical value when the washing time is shortened from 20 minutes to 15 minutes. Alternatively, an amount of tap water used or an amount of water that can be saved is displayed. For example, "the amount of electric power that can be saved is 10%" or "the amount of water that can be saved is 10%" is displayed.

[0071] When the result of the saving working is visually displayed as a graph while the working contents set by input setting unit 17 before the start of the working is set to 100, the result of the saving working is effectively and easily recognized.

[0072] Therefore, the convenience of usage of the washing machine can further be enhanced by specifically informing the user whether the saving working of the washing machine can be performed.

SEVENTH EXEMPLARY EMBODIMENT

[0073] In a seventh exemplary embodiment of the present invention, the same components as the first to sixth exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first to sixth exemplary embodiments is described.

[0074] FIG. 17 is a flowchart illustrating an operation of a control unit of a washing machine according to a seventh exemplary embodiment of the present invention. The laundry (clothes) and the proper amount of detergent are input to drum 3 of the washing machine, and power switch 17e of input setting unit 17 in manipulation display unit 14 of FIG. 7 is pressed to establish electric conduction. As a result, the washing machine becomes the state called the initial standby state. Until start button 17f is pressed to start the working, the working content of each step can be set by manipulating washing time setting switch 17a of input setting unit 17, rinsing frequency setting switch 17b, spin-drying time setting switch 17c, and drying time setting switch 17d in the case in which the washing machine has the drying function.

[0075] The first working contents set in input setting unit 17, the second working contents fixed based on the contaminations of the laundry, which are detected by contamination detection unit 10, and the actually-performed working sequence will be described in detail below. As illustrated in the flowchart of FIG. 17, in the initial standby state, the washing time, the number of times of the rinsing, the spin-drying time, and the drying time are set by manipulating washing time setting switch 17a, rinsing frequency setting switch 17b, spin-drying time setting switch 17c, and drying time setting switch 17d in the case in which the washing machine has a drying function.

When start button 17f is pressed to start the working of the washing machine, the washing step is started in S1 (Step 1) of the flowchart.

[0076] In the water supply step in S2 (Step 2), the predetermined amount of tap water is supplied to drum 3. Then, in S3 (Step 3), drum 3 is alternately rotated in the normal rotating direction and the reverse rotating direction, whereby the contamination component of the laundry starts to be dissolved in the washing solution. When the predetermined washing time elapses in S4 (Step 4), contamination detection unit 10 detects the contamination in S5 (Step 5).

[0077] In the case of the small amount of contamination of the laundry in S6 (Step 6), the following operation is performed within a range in which basic performance such as washing performance and rinsing performance can sufficiently be ensured. That is, the working contents that the user sets using input setting unit 17 in the initial standby state (in FIG. 17, the washing time of 20 minutes) are changed to the working contents of "saving course" in which the washing time and the number of times of the rinsing are decreased (In FIG. 17, the washing time of 15 minutes). In the case in which the washing time fixed based on the contamination is shorter than the time of working contents set by the user in S7 (Step 7), energy saving lamp 19 is lit on in S8 (Step 8). That is, control device 15 lights energy saving lamp 19 in the progression of the working contents. As a result, the user who exists near the washing machine during the working of the washing machine can quickly learn whether the electric bill and the water bill are saved.

[0078] On the other hand, in the case in which the washing time fixed based on the contamination is longer than the time of working contents set by the user in S7 (Step 7), the setting contents such as the washing time are not changed, and energy saving lamp 19 is not lit on in S9 (Step 9).

[0079] When the washing time fixed based on the contamination elapses, namely, when 15 minutes changed from 20 minutes elapses in S10 (Step 10), the washing step is ended in S11 (Step 11). Then the rinsing step in S12 (Step 12), the spin-drying step in S13 (Step 13), and the drying step in S14 (Step 14) are performed. When the sequence of setting steps is ended, an ending buzzer is sounded in order to inform the user that all the workings are ended in S15 (Step 15). At this point, energy saving lamp 19 is not turned off. The state of energy saving lamp 19 is continued (energy saving lamp 19 is continuously lit on) until a predetermined time, for example, 120 minutes elapse after the working is ended in S16 (Step 16), and energy saving lamp 19 is turned off in S17 (Step 17).

[0080] Therefore, the user can learn the following fact, even if the user leaves the washing machine during the working, and returns to the washing machine after hearing the ending buzzer at the end of the working. That is, compared with the initially-set working contents, the user can easily learn whether the working is actually performed the smaller number of times of rinsing for the

shorter washing time to save the electric bill and the water bill. Additionally, the user easily feels how much amount of laundry and how much degree of the contamination enables the saving working contributing to the energy saving.

[0081] In the seventh exemplary embodiment, the specific name and the number of times in which the user sets the content of each step using input setting unit 17 are described. In the seventh exemplary embodiment, the specific time energy saving lamp 19 is lit on is also described. However, the present invention is not limited to the specific name, the number of times, and the specific time.

[0082] In the seventh exemplary embodiment, the method for comparing the first working content that the user sets using input setting unit 17 during the initial standby state and the second working description fixed based on the contamination detected by contamination detection unit 10 is described by specifically citing the comparison of the shorter and longer washing times. Alternatively, the numbers of times of the rinsing or the rinsing times, or the spin-drying times and the drying times may be compared instead of the comparison of the shorter and longer washing times. The combinations of the washing times and the numbers of times of the rinsing may be compared.

EIGHTH EXEMPLARY EMBODIMENT

[0083] FIG. 18 is a flowchart illustrating an operation of a control unit of a washing machine according to an eighth exemplary embodiment of the present invention. In the eighth exemplary embodiment of the present invention, the same components as the first to seventh exemplary embodiments are designated by the same reference marks, the description of the components is omitted, and only a difference with the first to seventh exemplary embodiments is described.

[0084] The ending buzzer is sounded in order to inform the user that all the workings are ended in S15 (Step 15). The state of energy saving lamp 19 is continued until 120 minutes elapse after the working is ended in S16 (Step 16). One of the features of the eighth exemplary embodiment is that energy saving lamp 19 is rapidly turned off in S17 (Step 17) when the opening of door 1a is detected in newly-added S18 (Step 18) while the state of energy saving lamp 19 is continued.

[0085] After the end of the working, the user learns whether the electric bill and the water bill can actually be saved with respect to the initially-set working contents, and energy saving lamp 19 can be turned off without performing the special manipulation. Therefore, not only the convenience can be enhanced, but also the electric bill necessary to light on energy saving lamp 19 can be saved.

INDUSTRIAL APPLICABILITY

[0086] As described above, the present invention is usefully applied to instruments, such as the washing machine and a dishwasher, which have the washing function.

REFERENCE MARKS IN THE DRAWINGS

10 **[0087]**

1	Cabinet
1a	Door
2	Outer tank
3	Drum
4	Motor
5	Opening
6	Drain valve
7	Drain pipe
8	Ejection port
9	Circulation tube
9a	Horizontal flow path
10	Contamination detection unit
11	Light emitting element
12	Light receiving element
13a, 13b	Electrode
14	Manipulation display unit
15	Control device
16	Control unit
17	Input setting unit
17a	Washing time setting switch
17b	Rinsing frequency setting switch
17c	Spin-drying time setting switch
17d	Drying time setting switch
17e	Power switch
17f	Start button
18	Setting content display unit
19	Energy saving lamp (energy saving display unit)
20	Storage unit

Claims

1. A washing machine comprising:

- a washing tank in which washing are accommodated;
- a door through which the washing are taken in and out of the washing tank;
- an input setting unit that sets working description of a washing time and the number of times of rinsing;
- a contamination detection unit that detects contaminations of the washing;
- an energy saving display unit that indicates a degree of an energy saving working; and
- a control device in which an output of the input

setting unit and an output of the contamination detection unit are input to sequentially control a washing step, a rinsing step, and a spin-drying step, wherein

the control device lights the energy saving display unit when a first working description that is the working description set by the input setting unit is heavier than a second working description fixed based on the contamination detected by the contamination detection unit. 5 10

2. The washing machine according to claim 1, wherein the control device blinks the energy saving display unit from the start of the working description until the contamination detection unit detects the contamination of the washing. 15
3. The washing machine according to claim 1 or 2, wherein the control device displays any of a numerical value and an index on the energy saving display unit. 20
4. A washing machine program that causes a computer to execute pieces of software incorporated in the input setting unit, the contamination detection unit, and the energy saving display unit according to claim 1. 25
5. The washing machine according to claim 1, wherein the control device lights the energy saving display unit when the door is opened after the working description is ended. 30
6. The washing machine according to claim 5, wherein the control device turns off the energy saving display unit when a predetermined time elapses after the door is opened. 35
7. The washing machine according to claim 5, wherein the control device turns off the energy saving display unit when the door is closed. 40
8. The washing machine according to claim 1, wherein the control device lights the energy saving display unit lit until a predetermined time elapses after the working description is ended. 45
9. The washing machine according to claim 8, wherein the control device turns off the energy saving display unit when the door is opened. 50
10. The washing machine according to claim 8 or 9, wherein the control device lights the energy saving display unit lit during progression of the working description. 55
11. The washing machine according to claim 1, wherein the energy saving display unit is a green lamp.

FIG. 1

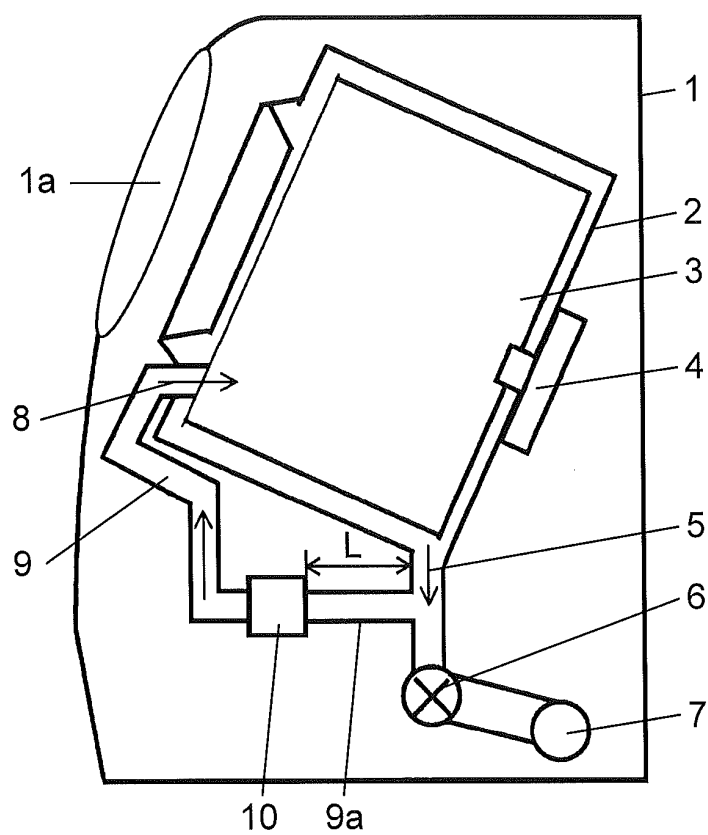


FIG. 2

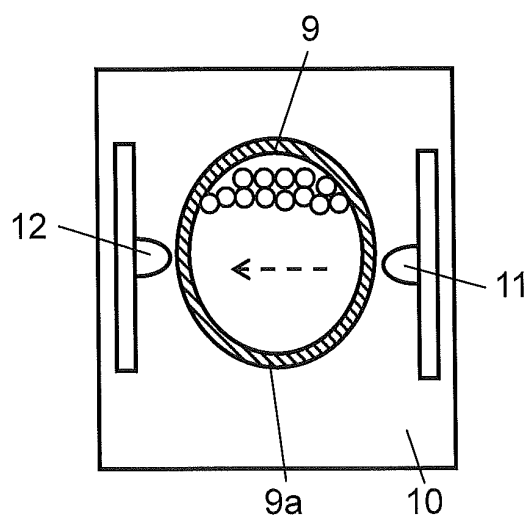


FIG. 3

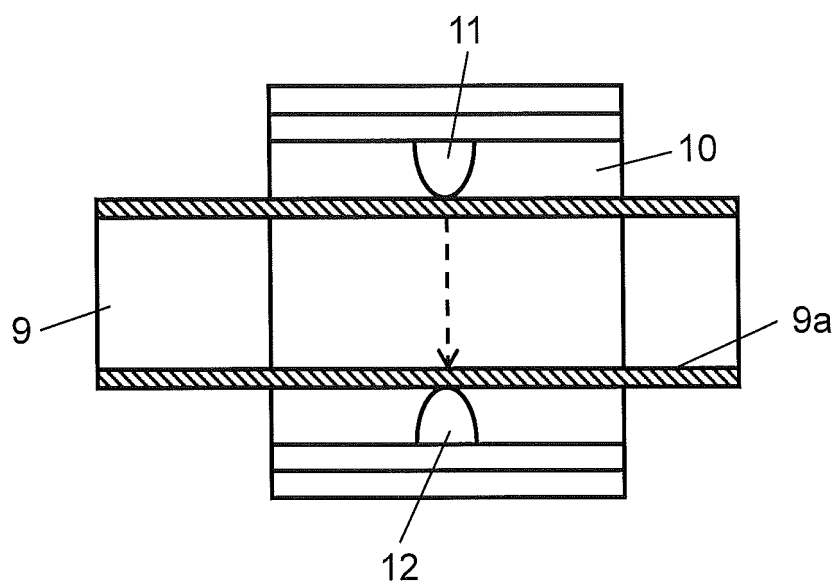


FIG. 4

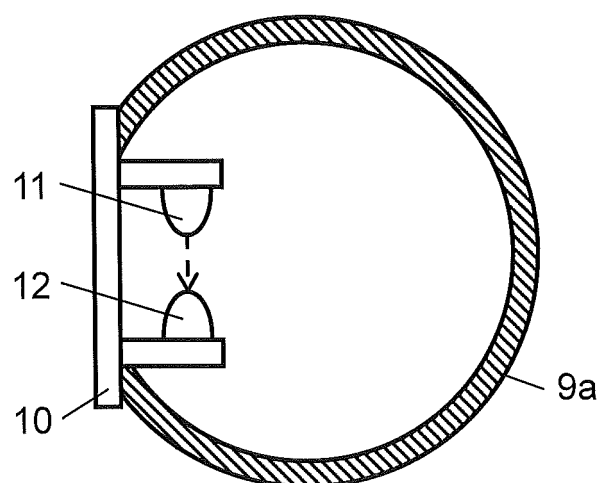


FIG. 5

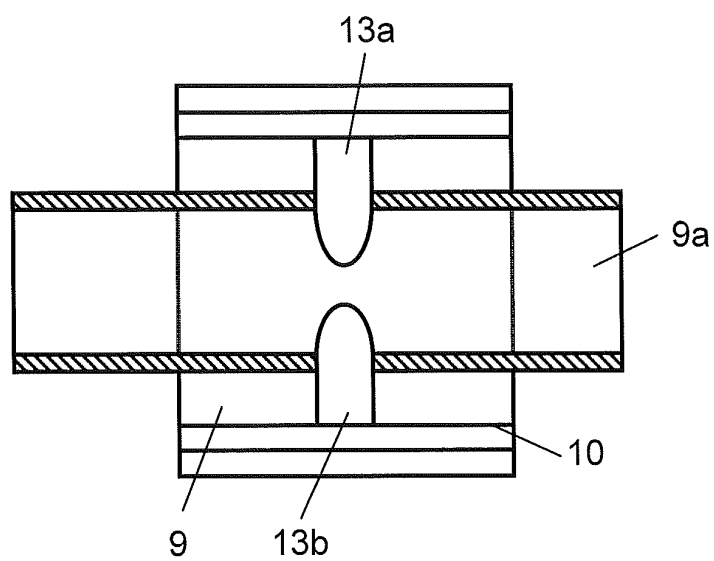


FIG. 6

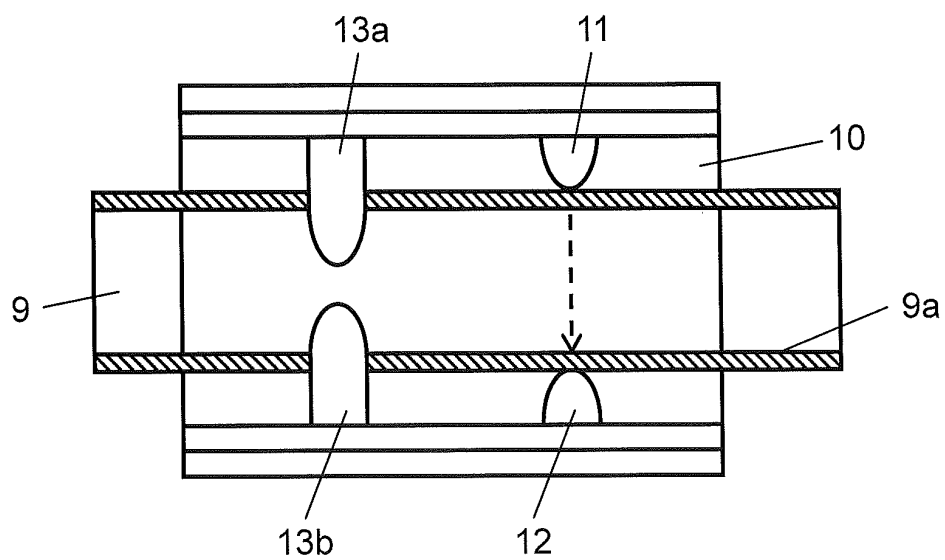


FIG. 7

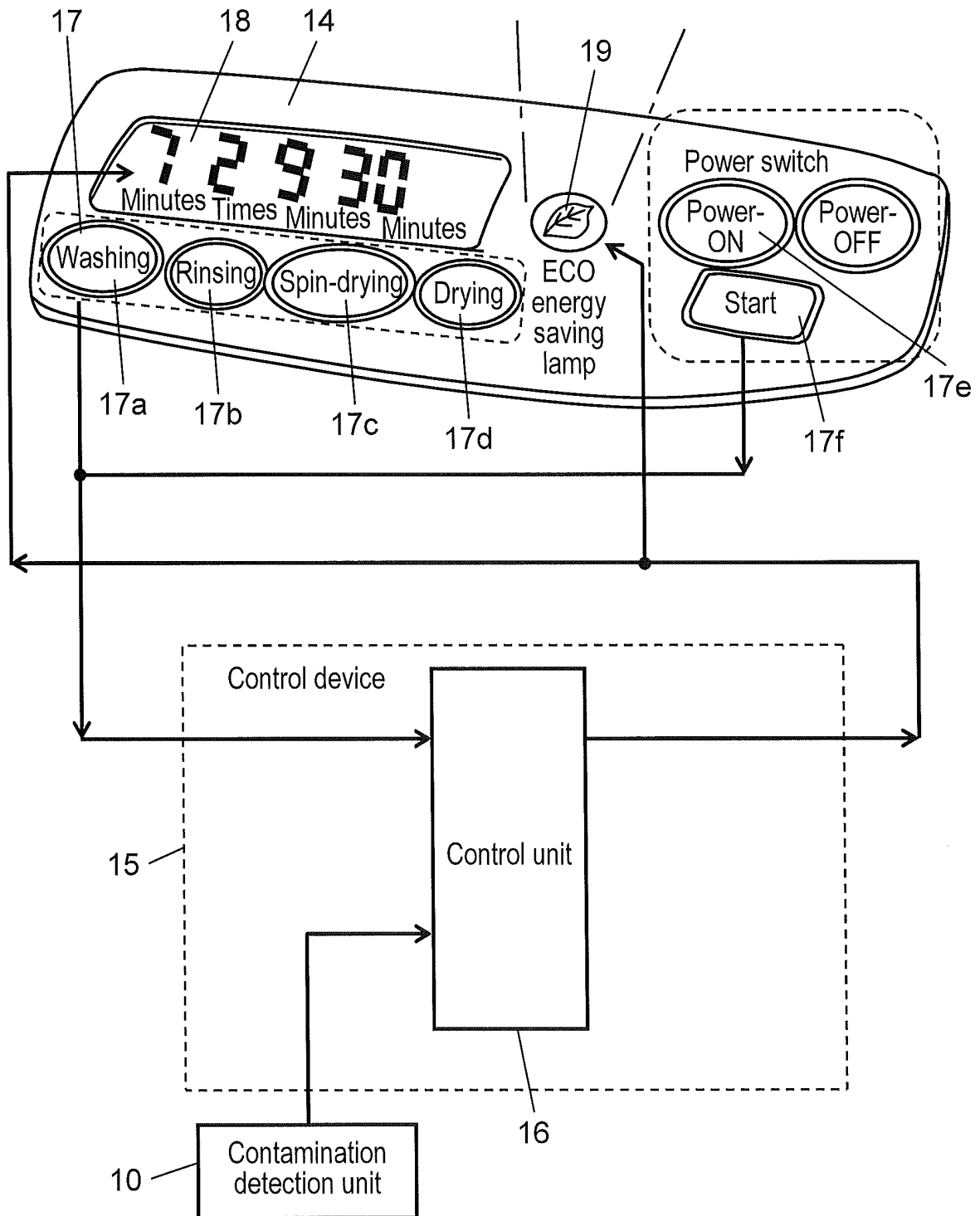


FIG. 8

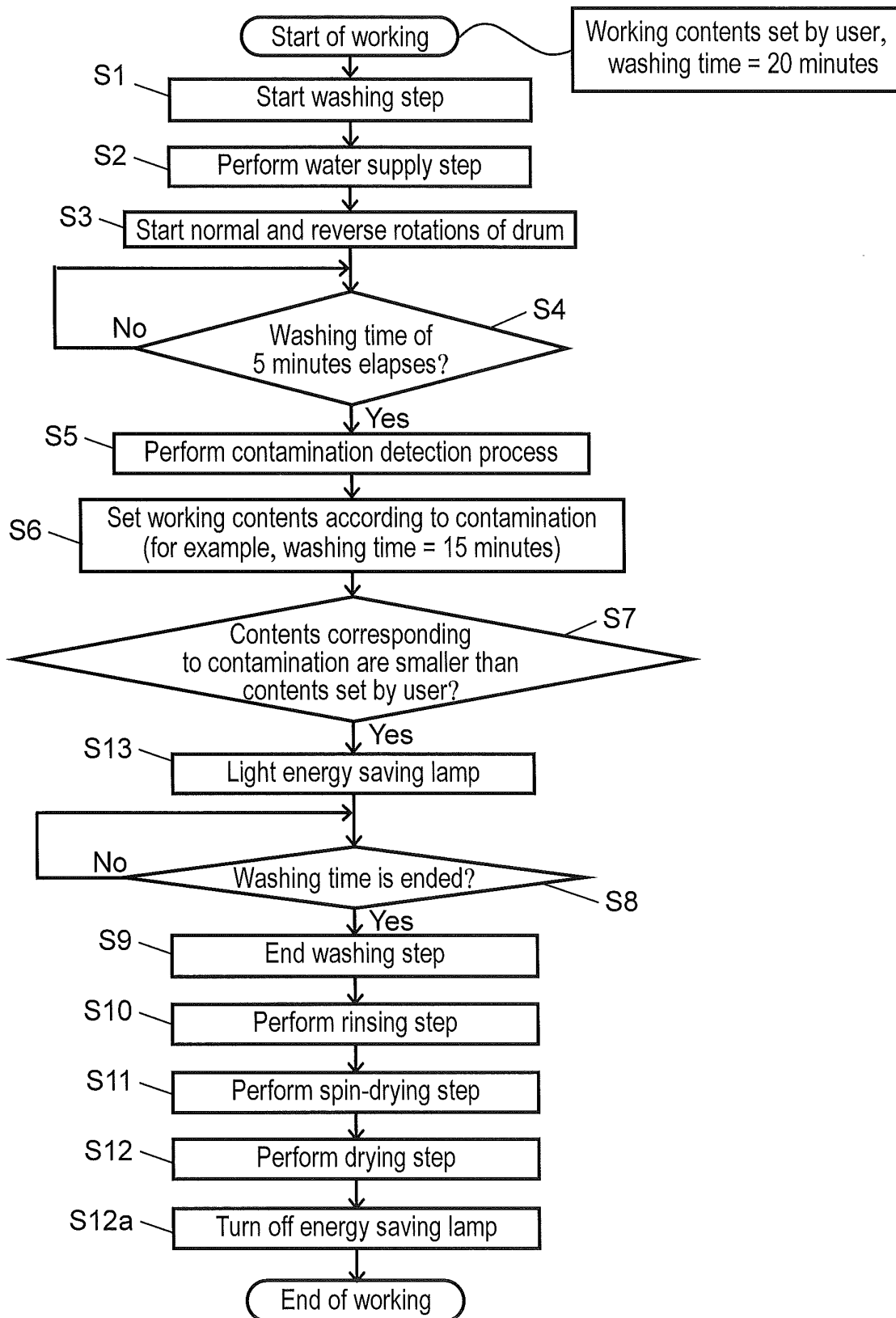


FIG. 9

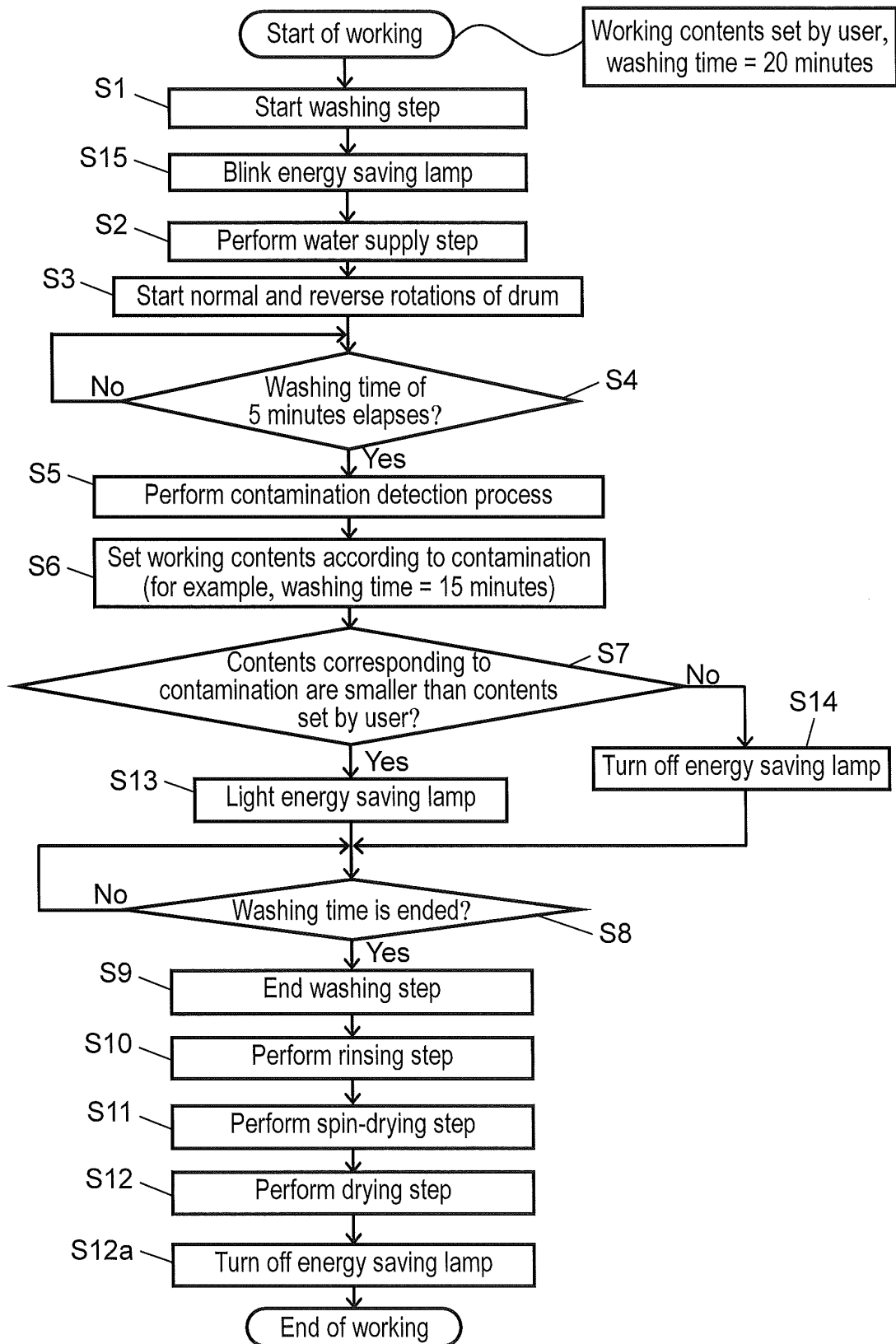


FIG. 10

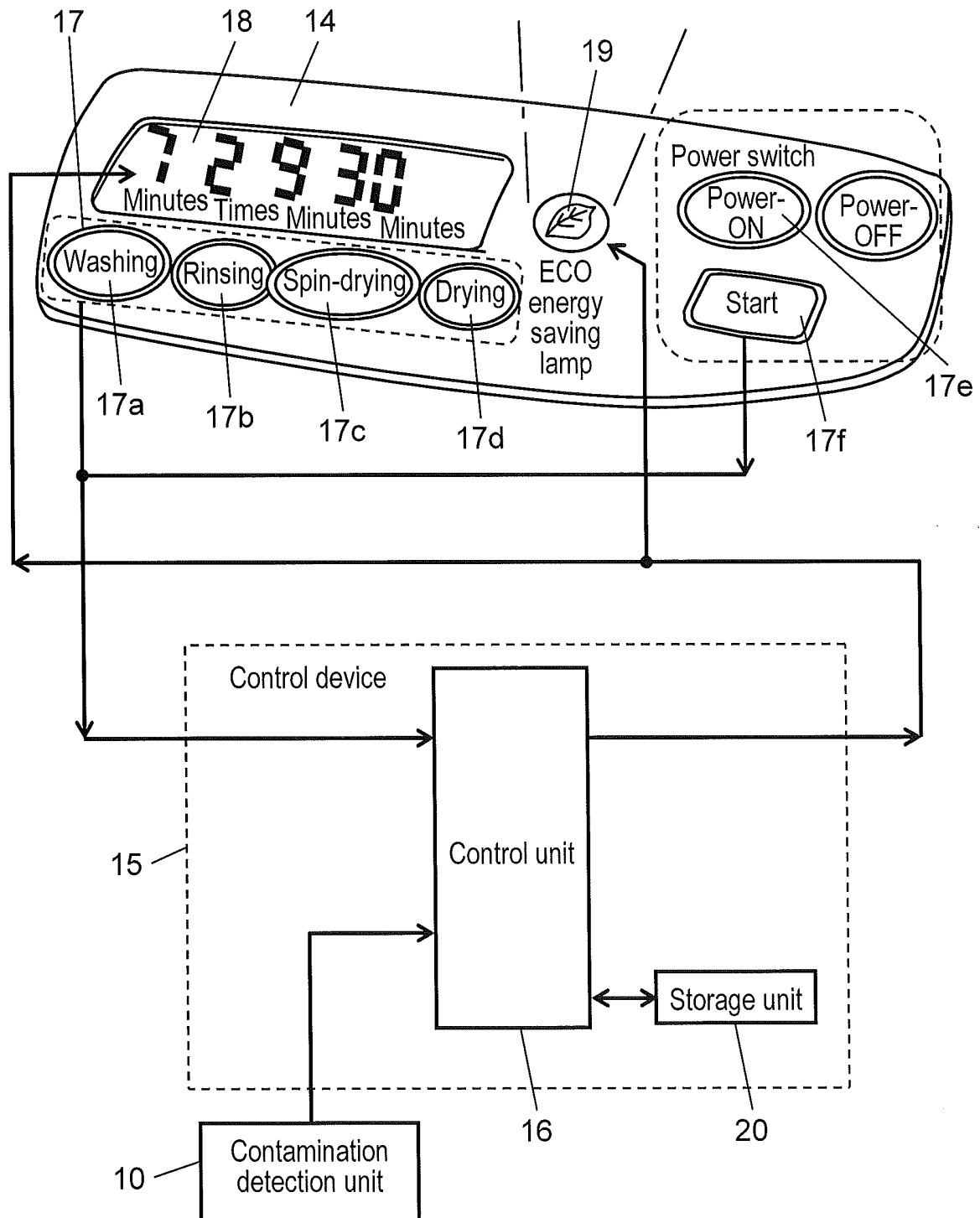


FIG. 11

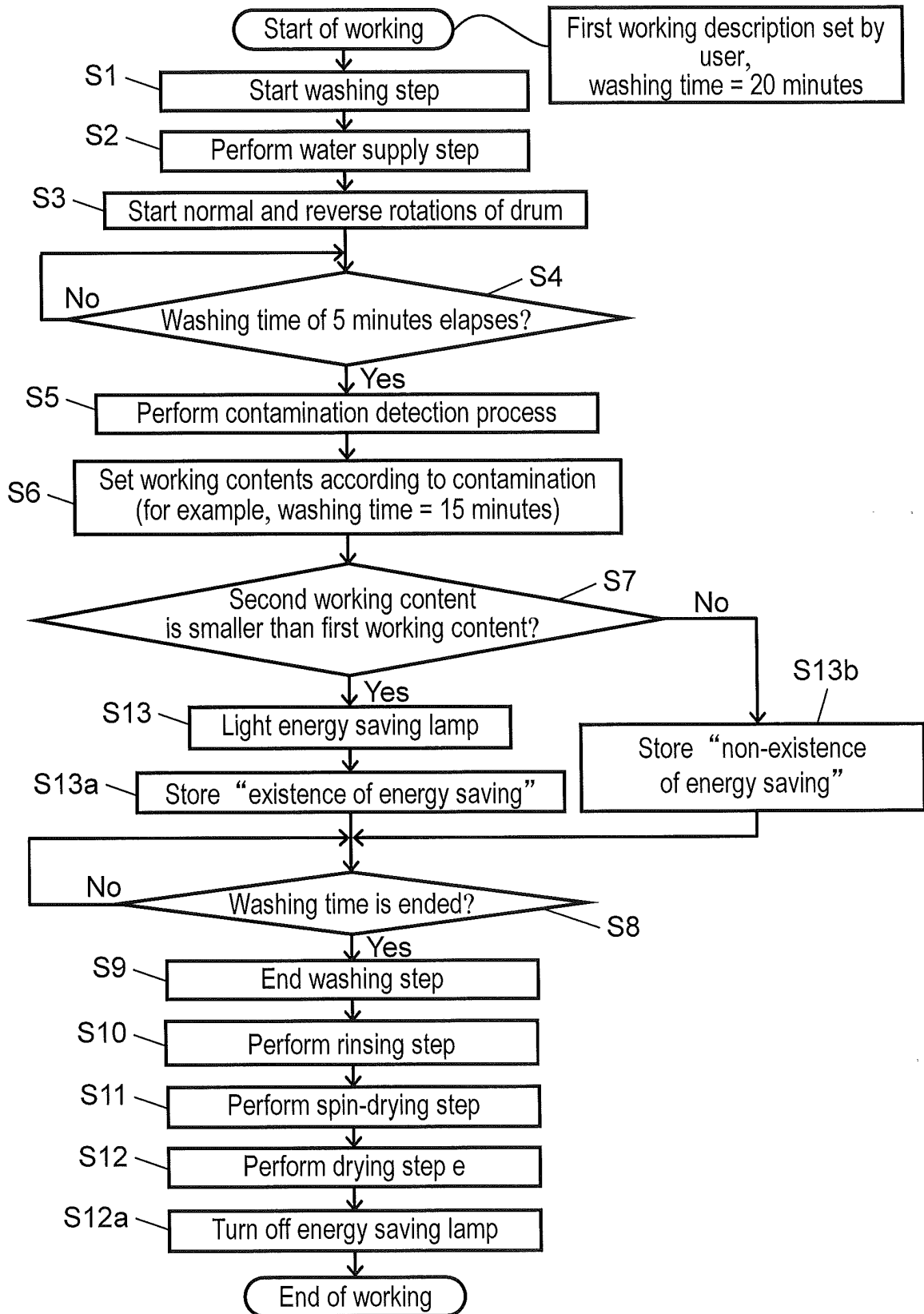


FIG. 12

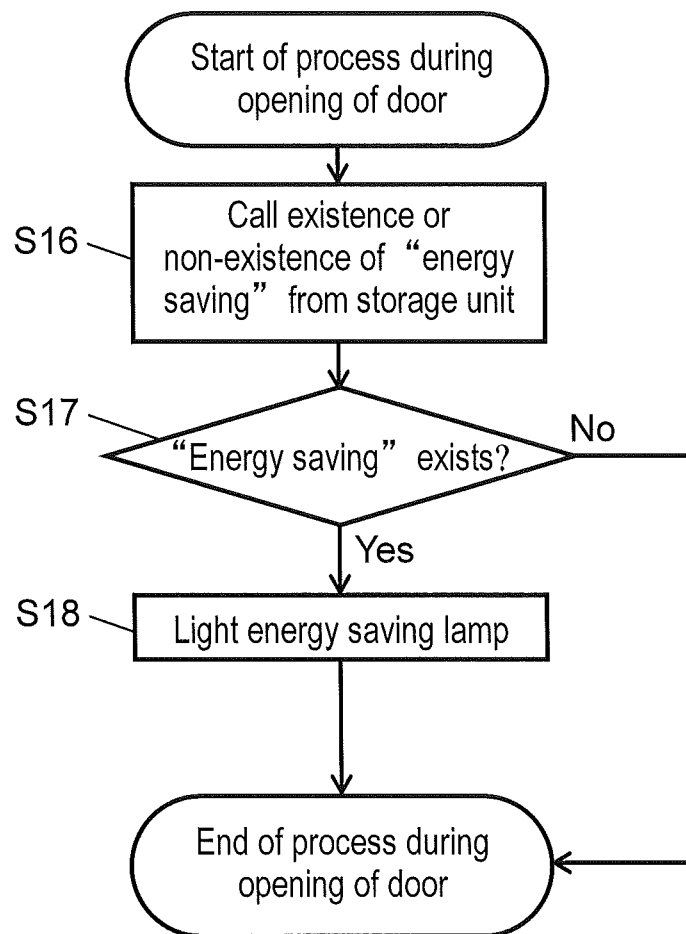


FIG. 13

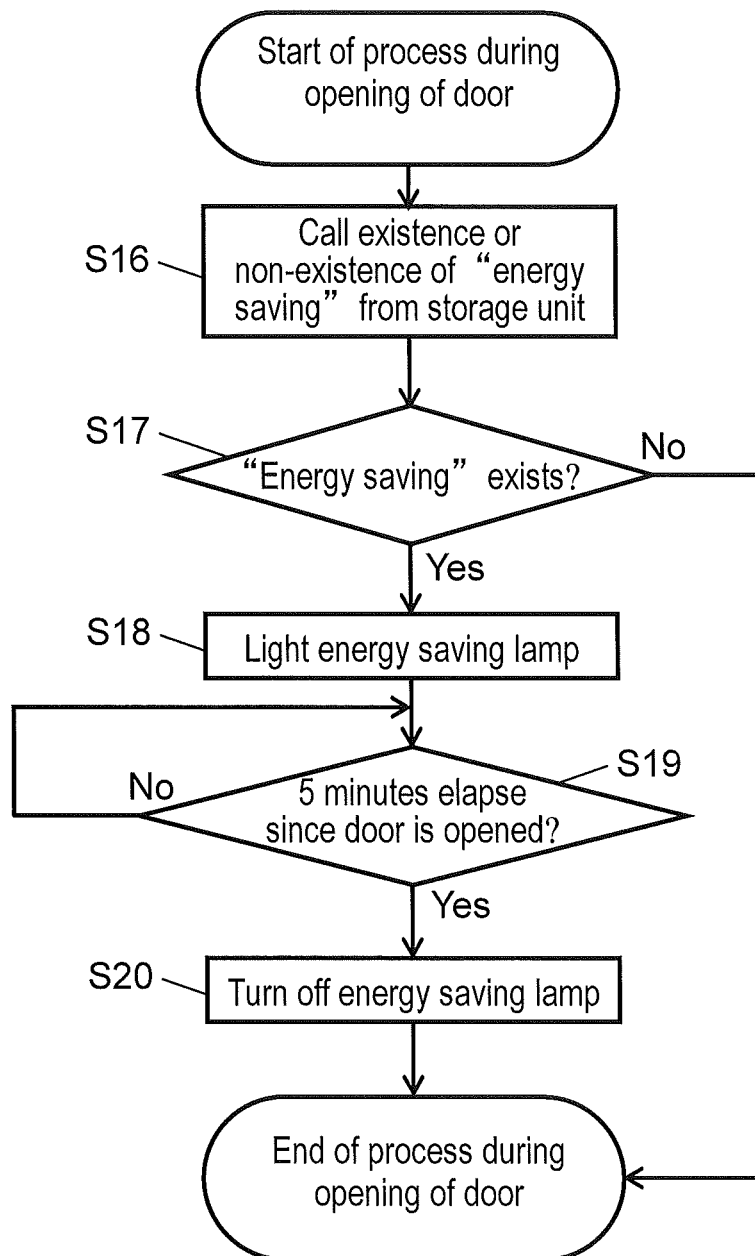


FIG. 14

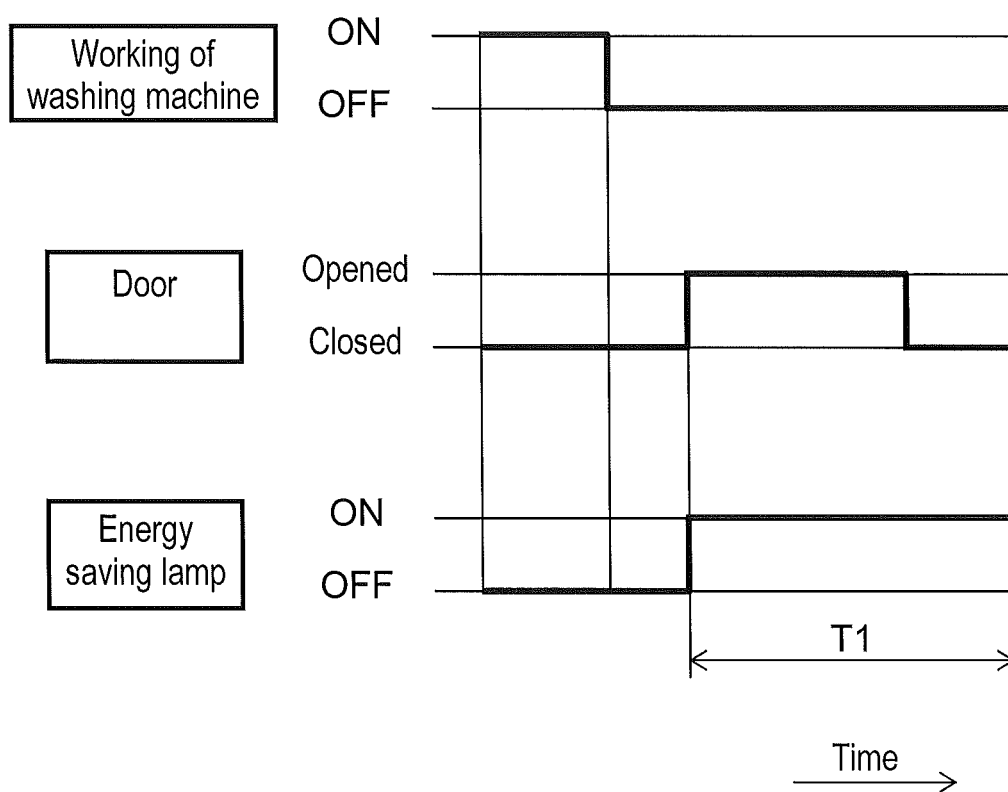


FIG. 15

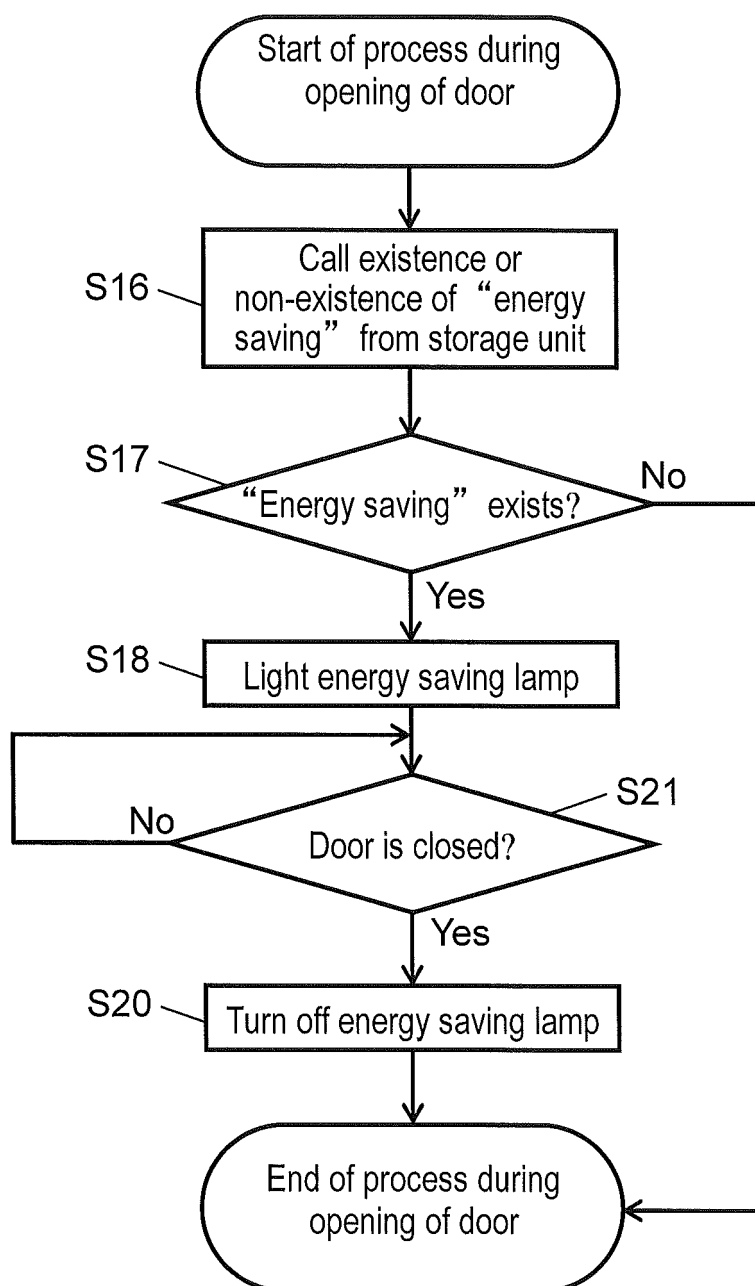


FIG. 16

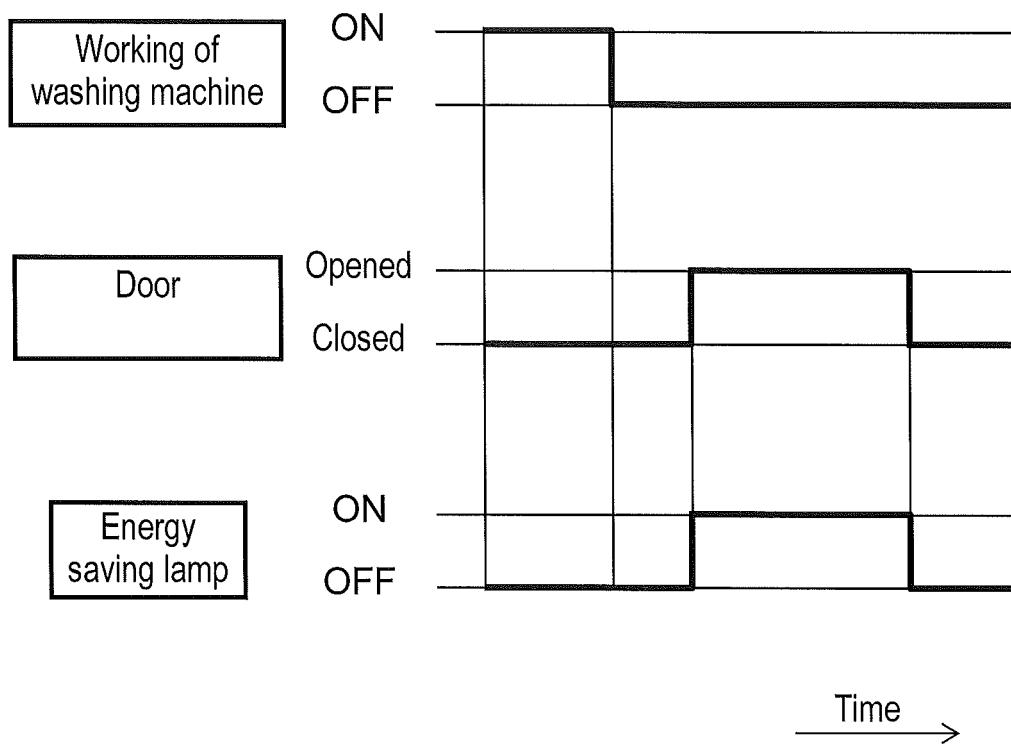


FIG. 17

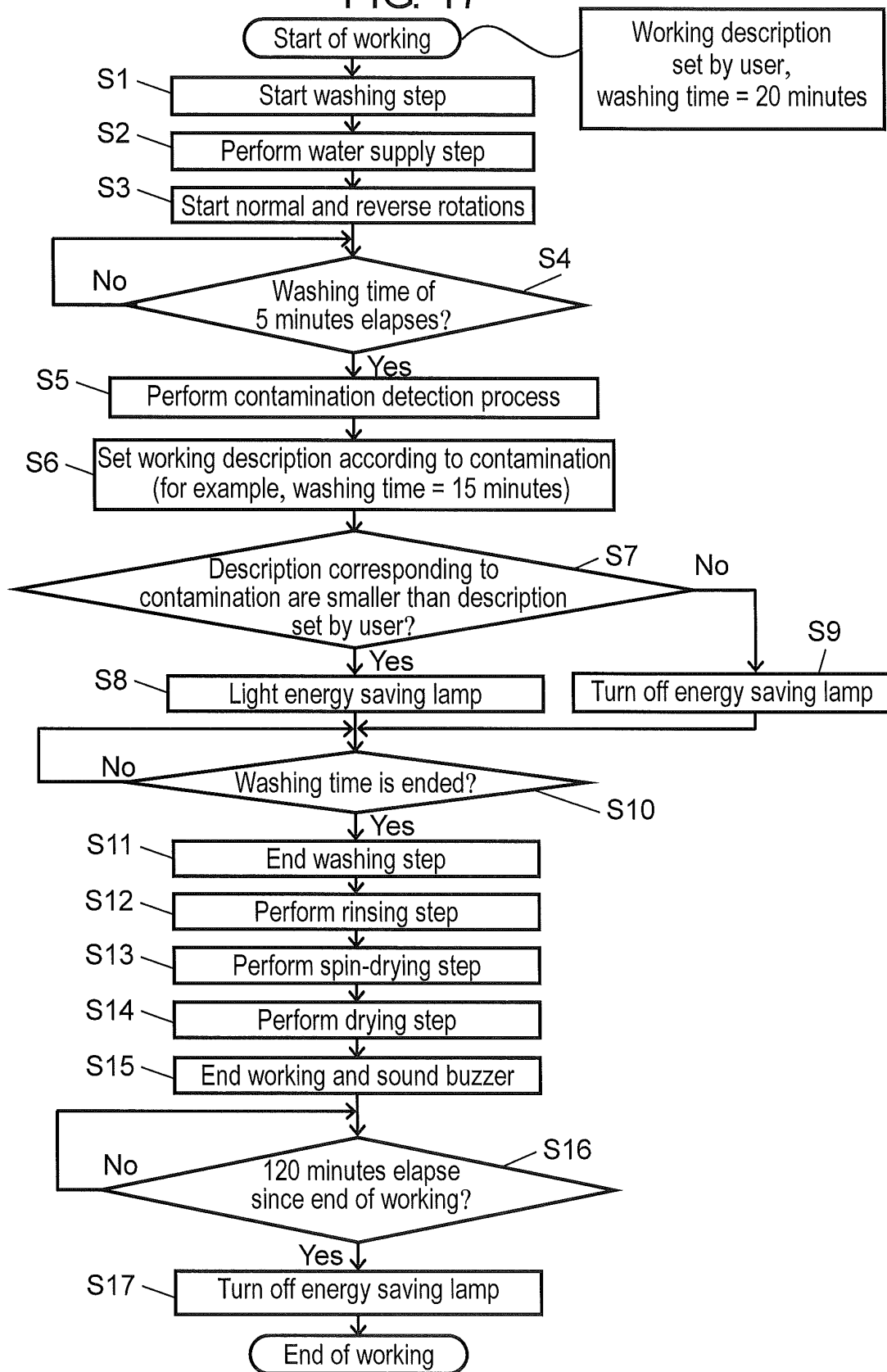


FIG. 18

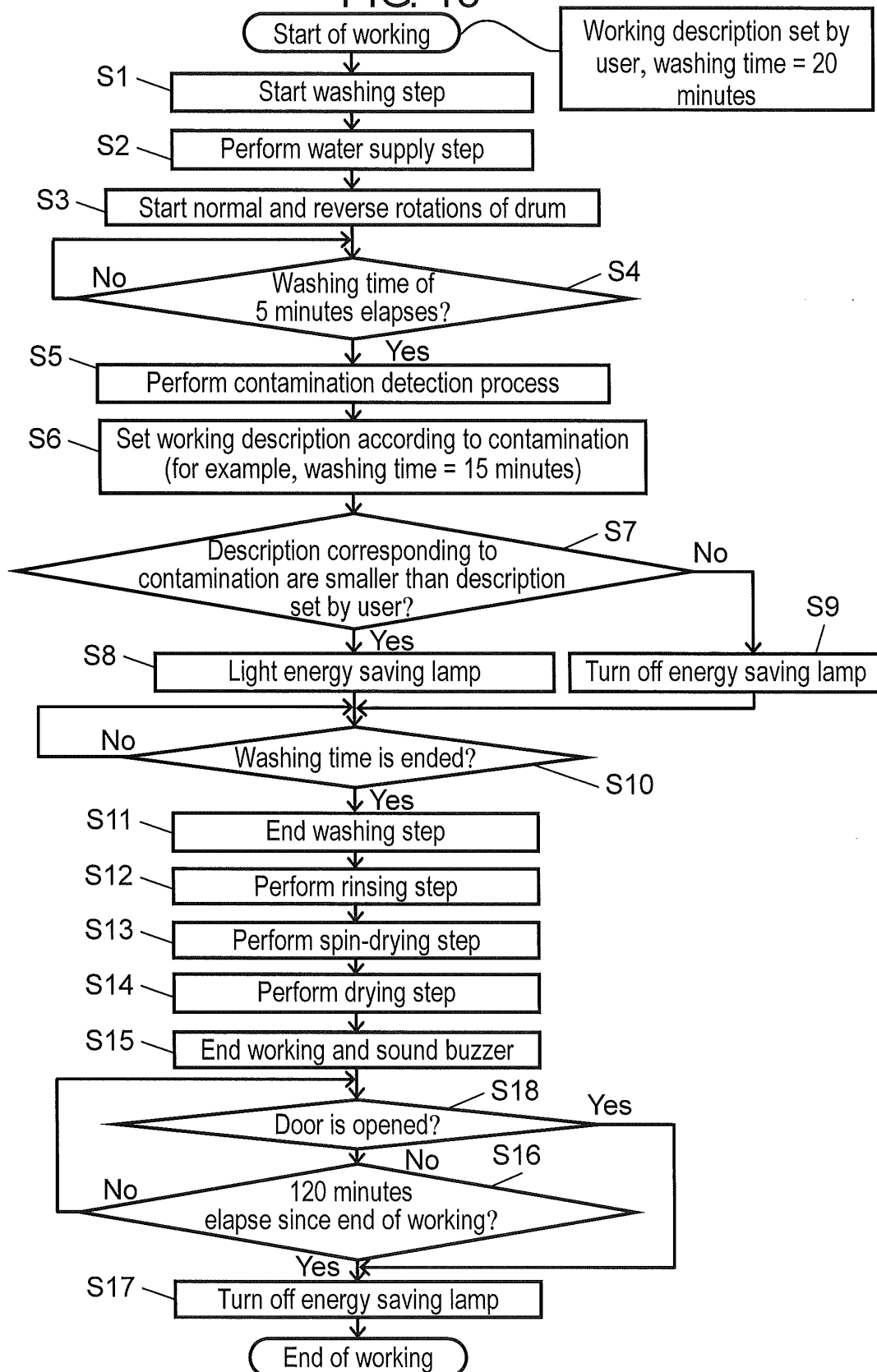


FIG. 19

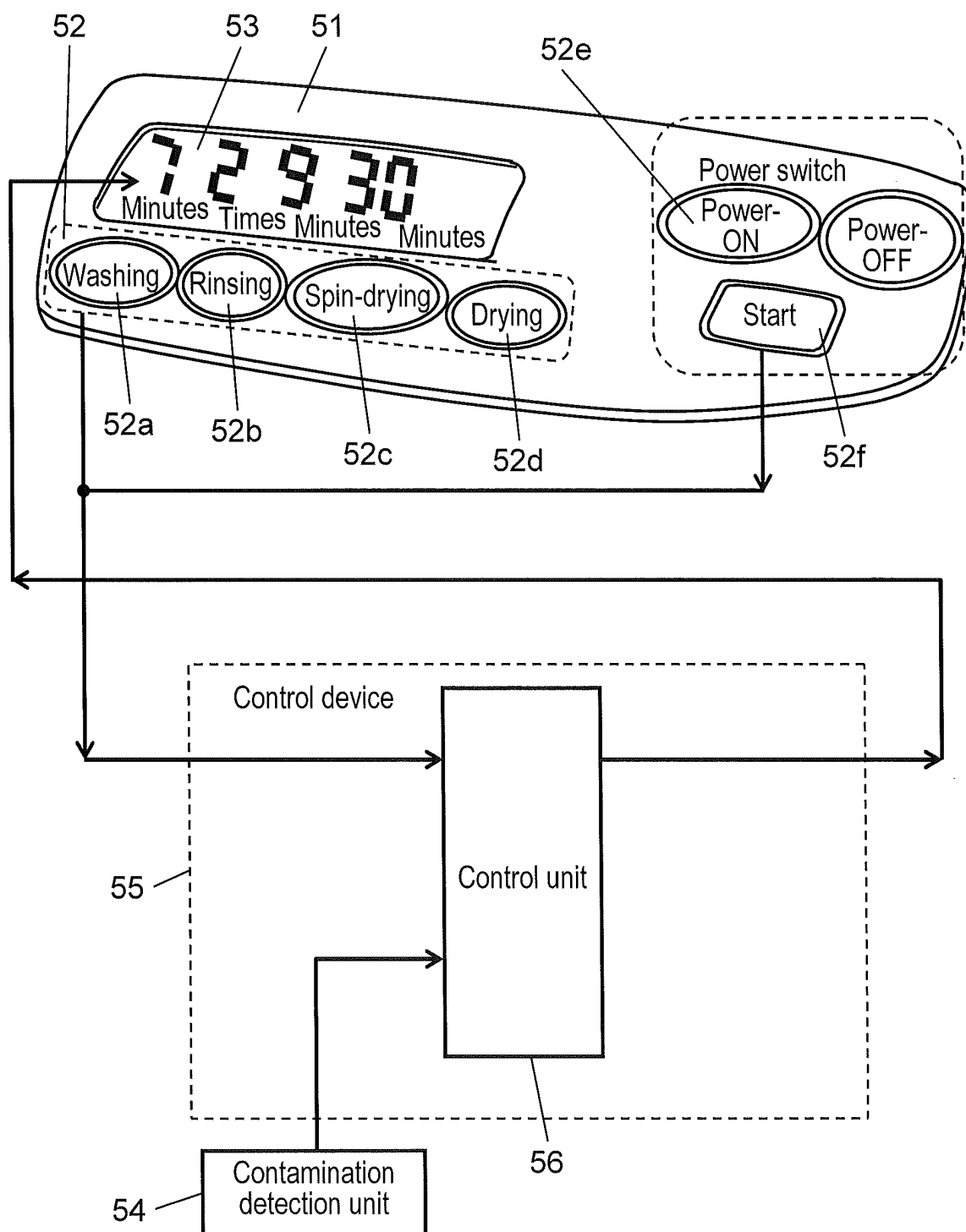
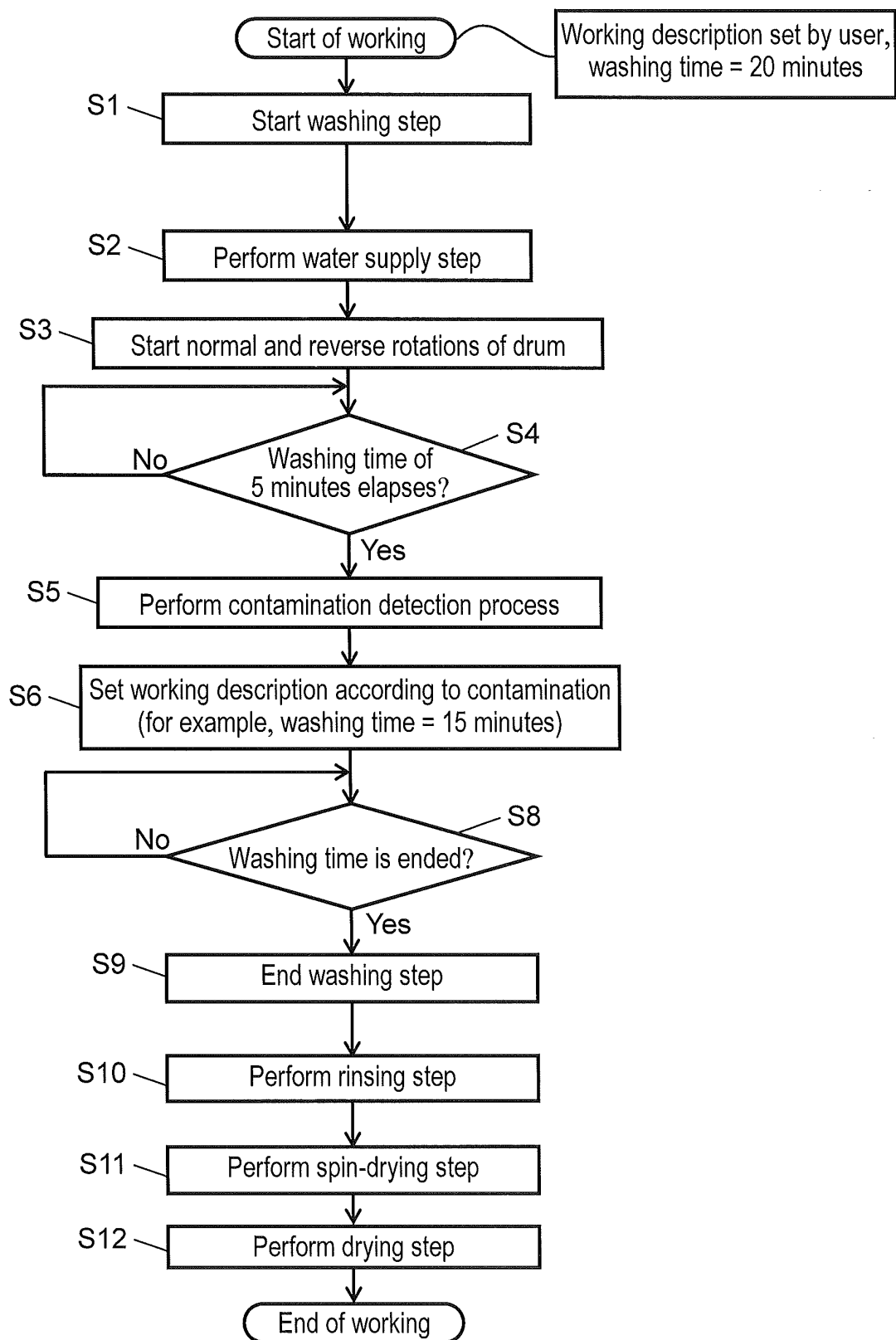


FIG. 20



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/004205

A. CLASSIFICATION OF SUBJECT MATTER

D06F33/02 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F33/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2010

Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-284888 A (Mitsubishi Electric Corp.), 07 October 2003 (07.10.2003), entire text; all drawings (Family: none)	1-11
Y	JP 4-288197 A (Hitachi, Ltd.), 13 October 1992 (13.10.1992), paragraphs [0019], [0020], [0029] (Family: none)	1-11
Y	JP 6-126085 A (Toshiba Corp.), 10 May 1994 (10.05.1994), paragraphs [0027] to [0028] & US 5373714 A & GB 9321264 D0 & KR 10-0130186 B	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

27 July, 2010 (27.07.10)

Date of mailing of the international search report

03 August, 2010 (03.08.10)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/004205

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-61279 A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 26 February 2004 (26.02.2004), paragraphs [0050] to [0051] (Family: none)	3

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 61206494 A [0012]