

SPECIFICATION**WASHING MACHINE****5 Technical field**

The present invention relates to a washing machine that is capable of treating laundry with a treatment substance.

Background art

10 When laundry is washed in a washing machine, it is common to add a treatment substance to water, in particular rinsing water. Typical examples of such treatment substances include softening and starching agents. In addition to these, in recent years, the demand has been increasing for treatment whereby laundry is subjected to antimicrobial treatment.

15 From the hygienic point of view, it is desirable to hang laundry in the sun to dry. However, in recent years, with the increase in the number of women who go to work, and with the increase in the number of nuclear families, there have been an increasing number of households where no one is at home in the daytime. In these households, there is no choice but to hang laundry indoors to dry. Even in households where someone is at home in the
20 daytime, in rainy weather, there is no choice but to hang laundry indoors to dry.

As compared with hanging laundry in the sun to dry, hanging it indoors tends to promote growth of bacteria and mold in laundry. This tendency is marked particularly when it takes time to dry laundry, as when humidity is high, such as in a rainy season, or when temperature is low. As the amount of bacteria and mold increases, laundry may become

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smelly. For this reason, in households where there is usually no choice but to hang laundry indoors to dry, there is a high demand for antimicrobial treatment of textile articles for the purpose of suppressing growth of bacteria and mold.

Nowadays, many clothes are available that have previously been treated with
5 antimicrobial/deodorizing or fungistatic treatment. However, it is difficult to replace all the textile articles in a household with those previously treated with antimicrobial/deodorizing treatment. Moreover, even with such textile articles, as they are washed repeatedly, the efficacy of antimicrobial/deodorizing treatment wears off.

Conceived under these circumstances was the idea of treating laundry with
10 antimicrobial treatment every time it is washed. For example, Japanese Utility Model Laid-Open No. H5-74487 discloses an electric washing machine furnished with an ion generator that generates metal ions, such as silver ions or copper ions, that exert a sterilizing effect. Japanese Patent Application Laid-Open No. 2000-93691 discloses a washing machine that generates an electric field with which to sterilize cleaning fluid. Japanese Patent Application
15 Laid-Open No. 2001-276484 discloses a washing machine furnished with a silver ion adding unit that adds silver ions to cleaning water.

Among various methods of treating laundry with antimicrobial treatment while washing it, using metal ions is the most effective and practical. For example, silver in laundry exists in the form of ions after the laundry is squeezed until it dries off, but thereafter
20 exists in the form of silver salts instead of ions. When the laundry becomes wet with water again, silver ionizes again, and recovers its sterilizing effect. Using metal ions as a treatment substance for antimicrobial treatment, however, poses the following problem.

The problem arises when metal ions are used in combination with another treatment substance, in particular a softening agent. Assuming that the metal ions are silver ions, they

combine with chloride ions contained in the softening agent to form silver chloride. Silver chloride is almost insoluble in water, and thus hardly exist in the form of ions in water. Silver, existing in the form of silver chloride instead of silver ions, does not exert a satisfactory sterilizing effect.

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Disclosure of the invention

An object of the present invention is to provide a washing machine that permits, in a case where metal ions exerting a sterilizing effect are used as a treatment substance with which to treat laundry, use of those metal ions in combination with another treatment
10 substance, for example a softening agent, without unduly diminishing the efficacy of the metal ions.

To achieve the above object, according to the present invention, a washing machine is so configured that, in a rinsing process, first, metal ions as a first treatment substance are added to rinsing water and then, a predetermined period of time thereafter, a laundry
15 treatment agent as a second treatment substance is added to the rinsing water. With this configuration, two treatment substances that, if added to the rinsing water simultaneously, diminish the efficacy of at least one of them are added separately with a time difference. This makes it possible to satisfactorily exploit the efficacy of both the treatment substances.

According to the present invention, in the washing machine configured as described
20 above, the rinsing water is agitated each time that the metal ions as the first treatment substance and the laundry treatment agent as the second treatment substance are added thereto. With this configuration, as the rinsing water is agitated, the metal ions as the first treatment substance and the laundry treatment agent as the second treatment substance can be distributed all over the laundry so as to be evenly attached thereto.

According to the present invention, in the washing machine configured as described above, addition of the metal ions as the first treatment substance is optional and, when the user chooses not to add the metal ions as the first treatment substance, then, at an early stage in the final rinsing process, the laundry treatment agent as the second treatment substance is added. With this configuration, when the metal ions as the first treatment substance is not added, the laundry treatment agent as the second treatment substance is added at an early stage in the final rinsing process. This helps reduce the time required to go through the final rinsing process to equal to the time required to attach the laundry treatment agent as the second treatment substance to the laundry. Thus, it is possible to avoid unnecessarily spending time in the rinsing process and unnecessarily damaging the laundry.

According to the present invention, in the washing machine configured as described above, addition of the metal ions as the first treatment substance is optional and, when the user chooses not to add the metal ions as the first treatment substance, then, at an early stage in the final rinsing process, the laundry treatment agent as the second treatment substance is added and the rinsing water is agitated. With this configuration, when the metal ions as the first treatment substance is not added, the laundry treatment agent as the second treatment substance is added at an early stage in the final rinsing process. This helps reduce the time required to go through the final rinsing process to equal to the time required to attach the laundry treatment agent as the second treatment substance to the laundry. Thus, it is possible to avoid unnecessarily spending time in the rinsing process and unnecessarily damaging the laundry. Moreover, as the rinsing water is agitated, the laundry treatment agent as the second treatment substance can be distributed all over the laundry so as to be evenly attached thereto.

According to the present invention, in the washing machine configured as described

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above, irrespective of whether or not the laundry treatment agent as the second treatment substance is present in the storage space from which to add the laundry treatment agent as the second treatment substance, the action by which to add the laundry treatment agent as the second treatment substance is executed whenever the laundry treatment agent as the second treatment substance is supposed to be added. With this configuration, the user need not necessarily choose whether to add the laundry treatment agent as the second treatment substance or not expressly; that is, when the user chooses not to add the laundry treatment agent as the second treatment substance, the user can simply leave the storage space for the laundry treatment agent as the second treatment substance empty. This eliminates the need for the user to memorize many operation steps, and thus permits easy operation of the washing machine.

According to the present invention, in the washing machine configured as described above, addition of the metal ions as the first treatment substance and addition of the laundry treatment agent as the second treatment substance can both be inhibited so as not to be executed. With this configuration, when neither the metal ions as the first treatment substance nor the laundry treatment agent as the second treatment substance needs to be added, their addition can be inhibited so as not to be executed. This helps prevent the washing machine from performing unnecessary actions, and thus helps save time and energy required for washing.

According to the present invention, in the washing machine configured as described above, before addition of the metal ions as the first treatment substance and/or the laundry treatment agent as the second treatment substance, the resulting rise in the water level in the washing tub is anticipated to adjust the water level in the washing tub accordingly. With this configuration, when the metal ions as the first treatment substance and/or the laundry

treatment agent as the second treatment substance is added, the water level in the washing tub is prevented from rising above the set level. This helps prevent an overflow of water and thus helps prevent water containing the treatment substance from being drained unnecessarily. Moreover, it is possible to avoid annoying the neighborhood with the noise of overflowing
5 water.

According to the present invention, in the washing machine configured as described above, addition of the laundry treatment agent as the second treatment substance is optional and, only when the user chooses to add the laundry treatment agent as the second treatment substance, addition of the metal ions as the first treatment substance is permitted. With this
10 configuration, only when the user chooses to add the laundry treatment agent as the second treatment substance, the user is permitted to add the metal ions as the first treatment substance. This helps promote simultaneous execution of treatment with the metal ions as the first treatment substance and treatment with the laundry treatment agent as the second treatment substance.

15 According to the present invention, in the washing machine configured as described above, addition of the laundry treatment agent as the second treatment substance is optional and, even when the user chooses not to add the laundry treatment agent as the second treatment substance, addition of the metal ions as the first treatment substance is executed. With this configuration, irrespective of whether or not the user chooses to add the laundry
20 treatment agent as the second treatment substance, the metal ions as the first treatment substance is added. This makes it possible to perform treatment with the metal ions as the first treatment substance only.

According to the present invention, in the washing machine configured as described above, the metal ions are generated by an ion elution unit that generates metal ions by

applying a voltage between electrodes. With this configuration, it is possible to generate, whenever and wherever necessary, the metal ions required to treat the laundry with antimicrobial treatment.

According to the present invention, in the washing machine configured as described
5 above, the concentration of the metal ions in the rinsing water is made higher when the treatment agent is used than when the treatment agent is not used. With this configuration, it is possible to increase the concentration of the metal ions and thereby compensate for the loss of the efficacy of the metal ions resulting from the use of the treatment agent.

According to the present invention, in the washing machine configured as described
10 above, the metal ions are silver ions or copper ions generated by an ion elution unit that generates metal ions by applying a voltage between electrodes. With this configuration, it is possible to exploit the profound antimicrobial effect to microbes of the silver or copper ions.

According to the present invention, in the washing machine configured as described
above, the passage through which the metal ions are added to the rinsing water is separate
15 from the passage through which the treatment agent is added to the rinsing water. With this configuration, it is possible to prevent the metal ions from losing their antimicrobial effect as a result of the metal ions, while passing through the passage through which the treatment agent is added to the rinsing water, making contact with and reacting with the treatment agent remaining in that passage.

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Brief description of drawings

Fig. 1 is a vertical sectional view of a washing machine embodying the present invention.

Fig. 2 is a schematic vertical sectional view of a water feed mouth.

Fig. 3 is a flow chart of an entire session of laundry washing.

Fig. 4 is a flow chart of a washing process.

Fig. 5 is a flow chart of a rinsing process.

Fig. 6 is a flow chart of a squeezing process.

5 Fig. 7 is a schematic horizontal sectional view of an ion elution unit.

Fig. 8 is a schematic vertical sectional view of the ion elution unit.

Fig. 9 is a circuit diagram of a drive circuit of the ion elution unit.

Fig. 10 is a first flow chart illustrating a sequence for adding metal ions and a treatment agent.

10 Fig. 11 is a second flow chart illustrating the sequence for adding metal ions and a treatment agent.

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Fig. 12 is a third flow chart illustrating the sequence for adding metal ions and a treatment agent.

Fig. 13 is a fourth flow chart illustrating the sequence for adding metal ions and a treatment agent.

5 Fig. 14 is a table showing the results of experiments of adding metal ions and a treatment agent.

Fig. 15 is a first flow chart showing an adding sequence used in the experiments.

Fig. 16 is a second flow chart showing the adding sequence used in the experiments.

Fig. 17 is a third flow chart showing the adding sequence used in the experiments.

10 Fig. 18 is a flow chart of the sequence for adding metal ions and a treatment agent.

Best mode for carrying out the invention

Hereinafter, an embodiment of the present invention will be described with reference to Figs. 1 to 12.

15 Fig. 1 is a vertical sectional view showing the overall construction of a washing machine 1. The washing machine 1 is of the fully automatic type, and has a cabinet 10. The cabinet 10 is box-shaped, is formed of a metal or synthetic resin, and has openings at its top and bottom. The top opening of the cabinet 10 is covered with a top plate 11, which is formed of a synthetic resin and is fixed to the cabinet 10 with screws. In Fig. 1, the front and
20 rear of the washing machine 1 point leftward and rightward, respectively. A rear portion of the top surface of the top plate 11 is covered with a back panel 12, which is formed of a synthetic resin and is fixed to the cabinet or the top plate 11 with screws. The bottom opening of the cabinet 10 is covered with a base 13, which is formed of a synthetic resin and is fixed to the cabinet 10 with screws. None of the screws mentioned thus far are shown in

the figure.

In four corners of the base 13, there are provided feet 14a and 14b for supporting the cabinet 10 on a floor. The rear feet 14b are fixed feet that are integrally formed with the base 13. The front feet 14a are screw feet of which the supporting level can be adjusted.

5 Turning these permits the washing machine 1 to be leveled.

In the top plate 11, there is formed a laundry inlet opening 15 through which laundry is put in the washing tub described later. The laundry inlet opening 15 is covered with a lid 16 from above. The lid 16 is coupled to the top plate 11 with a hinge 17 so as to be pivotable in a vertical plane.

10 Inside the cabinet 10, there are provided a water tub 20 and a washing tub 30 that serves also as a squeezing tub. The water tub 20 and the washing tub 30 both have the shape of a cylindrical cup open at its top, and the two tubs are arranged concentrically with their axes vertical and with the washing tub 30 placed inside the water tub 20. The water tub 20 is suspended from the cabinet 10 with suspension members 21. The suspension members 21
15 are arranged in four places so as to connect a lower portion of the outer surface of the water tub 20 to corner portions of the inner surface of the cabinet 10, and support the water tub 20 in such a way as to permit it to swing in a horizontal plane.

The washing tub 30 has a circumferential wall that widens upward with a gentle taper. This circumferential wall has a plurality of drain holes 31 formed in a ring-shaped
20 arrangement around its topmost portion, and has, other than these drain holes, no opening that permits passage of liquid. That is, the washing tub 30 is of the so-called "holeless" type. Around the rim of the top opening of the washing tub 30, there is fitted a ring-shaped balancer 32 for suppressing the vibration that the washing tub 30 produces when rotated at high speed for the squeezing of laundry. Inside the washing tub 30, on its bottom surface, there is

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provided a pulsator 33 for producing a current of washing or rinsing water inside the tub 30.

The water tub 20 has a drive unit 40 fitted to its bottom surface from below. The drive unit 40 includes a motor 41, a clutch mechanism 42, and a brake mechanism 43, and has a squeezing spindle 44 and a pulsator spindle 45 protruding from its center upward. The
5 squeezing spindle 44 and the pulsator spindle 45 form a double-spindle structure, with the pulsator spindle 45 placed inside the squeezing spindle 44. The two spindles both penetrate the water tub 20. The squeezing spindle 44 is then connected to the washing tub 30 so as to support it. On the other hand, the pulsator spindle 45 further penetrates the washing tub 30, and is then connected to the pulsator 33 to support it. Between the squeezing spindle 44 and
10 the water tub 20, and between the squeezing spindle 44 and the pulsator spindle 45, there are provided sealing members for preventing leakage of water.

Inside the space below the back panel 12, there is provided a water feed valve 50 that is opened and closed electromagnetically. The water feed valve 50 has a connection pipe 51 that penetrates the back panel 12 to extend upward. To the connection pipe 51 is connected
15 a water feed hose (not shown) through which to supply clean water such as tap water to the washing machine. From the water feed valve 50 extends a water feed pipe 52. The water feed pipe 52 is, at the other end, connected to a water feed mouth 53 that is container-shaped. The water feed mouth 53 is placed above the inside of the water tub 20, and has a structure as shown in Fig. 2.

20 Fig. 2 is a schematic vertical sectional view of the water feed mouth 53, as seen from in front. The water feed mouth 53 is open at its top, and has its interior divided into a left-hand and a right-hand section. The left-hand section is a detergent chamber 54 that serves as a storage space in which to store a detergent. The right-hand section is a treatment agent chamber 55 that serves as a storage space in which to store a treatment agent for laundry

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washing. In a front portion of the bottom of the detergent chamber 54, there is formed a horizontally elongate water outlet 56 through which water is fed out into the washing tub 30. In the treatment agent chamber 55, there is provided a siphon 57.

The siphon 57 is composed of an inner pipe 57a that extends vertically upward from the bottom surface of the treatment agent chamber 55 and a cap-shaped outer pipe 57b with which the inner pipe 57a is capped. Between the inner pipe 57a and the outer pipe 57b is left a gap that permits passage of water. The inner pipe 57a, at its bottom, is open to the bottom of the water feed mouth 53. A predetermined gap is kept between the bottom end of the outer pipe 57b and the bottom surface of the treatment agent chamber 55 so as to serve as a water inlet. When water is poured into the treatment agent chamber 55 up to a level higher than the top end of the inner pipe 57a, the principle of a siphon works to cause the water to flow through the siphon 57 out of the treatment agent chamber 55 and then drop into the washing tub 30.

The water feed valve 50 is composed of a main water feed valve 50a and a sub water feed valve 50b. While the connection pipe 51 is shared between the main and sub water feed valves 50a and 50b, the water feed pipe 52 is composed of a main water feed pipe 52a that is connected to the main water feed valve 50a and a sub water feed pipe 52b that is connected to the sub water feed valve 50b.

The main water feed pipe 52a is connected to the detergent chamber 54, and the sub water feed pipe 52b is connected to the treatment agent chamber 55. That is, the passage that runs from the main water feed pipe 52a through the detergent chamber 54 to the washing tub 30 is separate from the passage that runs from the sub water feed pipe 52b through the treatment agent chamber 55 to the washing tub 30.

The top opening of the detergent chamber 54 and the top opening of the treatment

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agent chamber 55 are respectively covered with unillustrated lids. The user opens these lids as necessary to put a detergent in the detergent chamber 54 and a treatment agent in the treatment agent chamber 55.

Back in Fig. 1, to the bottom of the water tub 20 is fitted a drain hose 60 through which to drain water out of the water tub 20 and the washing tub 30. Water flows into the drain hose 60 from drain pipes 61 and 62. The drain pipe 61 is connected to a rather peripheral portion of the bottom surface of the water tub 20, and the drain pipe 62 is connected to a rather central portion of the bottom surface of the water tub 20.

Inside the water tub 20, on its bottom surface, there is fixed a ring-shaped partition wall 63 in such a way as to enclose the portion of the water tub 20 where the drain pipe 62 is connected to it. The partition wall 63 is fitted with a sealing member 64 at its top. This sealing member 64 is kept in contact with the circumferential surface of a disk 65 fixed to the outer surface of the bottom of the washing tub 30 so as to form a separate drain space 66 between the water tub 20 and the washing tub 30. The drain space 66 communicates with the interior of the washing tub 30 through a drain outlet 67 formed in the bottom of the washing tub 30.

The drain pipe 62 is provided with a drain valve 68 that is opened and closed electromagnetically. In a portion of the drain pipe 62 located on the upstream side of the drain valve 68, there is provided an air trap 69. From the air trap 69 extends a lead pipe 70. The lead pipe 70 is, at its top end, connected to a water level switch 71.

In a front portion of the cabinet 10, there is provided a controller 80. The controller 80 is arranged beneath the top plate 11. The controller 80 receives operation requests from the user via an operation/display panel 81 provided on the top surface of the top plate 11, and sends operation commands to the drive unit 40, the water feed valve 50, and the drain valve

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68. The controller 80 also sends display commands to the operation/display panel 81. The controller 80 includes a drive circuit for driving an ion elution unit described later.

Now, how the washing machine 1 operates will be described. First, the lid 16 is opened, and laundry is put into the washing tub 30 through the laundry inlet opening 15. A
5 detergent is put in the detergent chamber 54 of the water feed mouth 53. As necessary, a treatment agent is put in the treatment agent chamber 55 of the water feed mouth 53. The treatment agent may be put there in the middle of a session of laundry washing.

After the detergent is made ready for addition in this way, the lid 16 is closed, and a desired course of laundry washing is selected by operating a group of operation buttons on the
10 operation/display panel 81. Subsequently, when a start button is pressed, a session of laundry washing is executed according to the flow charts shown in Figs. 3 to 6.

Fig. 3 is a flow chart showing the entire session of laundry washing. In step S201, laundry washing is started at a previously set time. Whether or not a timer-started operation is selected or not is checked. If a timer-started operation is selected, the flow proceeds to
15 step S206; if not, the flow proceeds to step S202.

In step S206, whether or not the operation start time has come is checked. If the operation start time has come, the flow proceeds to step S202.

In step S202, whether or not a washing process is selected is checked. If a washing process is selected, the flow proceeds to S300. How the washing process in step S300
20 proceeds will be described later with reference to Fig. 4. On completion of the washing process, the flow proceeds to step S203. If no washing process is selected, the flow proceeds directly from step S202 to step S203.

In step S203, whether or not a rinsing process is selected is checked. If a rinsing process is selected, the flow proceeds to S400. How the rinsing process in step S400

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proceeds will be described later with reference to Fig. 5. On completion of the rinsing process, the flow proceeds to step S204. If no rinsing process is selected, the flow proceeds directly from step S203 to step S204.

In step S204, whether or not a squeezing process is selected is checked. If a
5 squeezing process is selected, the flow proceeds to S500. How the squeezing process in step S500 proceeds will be described later with reference to Fig. 6. On completion of the squeezing process, the flow proceeds to step S205. If no squeezing process is selected, the flow proceeds directly from step S204 to step S205.

In step S205, a predetermined sequence of operations for terminating the operation of
10 the controller 80, in particular the processor (microcomputer) provided in it, is automatically executed. In addition, the end of the session of laundry washing is indicated by sounding an end-of-operation beep. On completion of all the operations, the washing machine 1 goes back into a stand-by state in preparation for a new session of laundry washing.

Next, with reference to Figs. 4 to 6, the individual processes of washing, rinsing, and
15 squeezing will be described.

Fig. 4 is a flow chart of the washing process. In step S301, the water level inside the washing tub 30 as sensed by the water level switch 71 starts being monitored. In step S302, whether or not laundry amount sensing is selected is checked. If laundry amount sensing is selected, the flow proceeds to step S308; if not, the flow proceeds directly from step S302 to
20 S303.

In step S308, the amount of laundry is measured on the basis of the rotation load of the pulsator 33. On completion of laundry amount sensing, the flow proceeds to step S303.

In step S303, the main water feed valve 50a is opened, and water is poured into the washing tub 30 through the main water feed pipe 52a and the water feed mouth 53. The

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detergent put in the detergent chamber 54 of the water feed mouth 53 mixes with the water and enters the washing tub 30 together with it. The drain valve 68 remains closed. When the water level switch 71 detects the set water level, the main water feed valve 50a is closed. The flow then proceeds to step S304.

5 In step S304, a preparatory operation is performed. The pulsator 33 is rotated repeatedly in the forward and then reverse directions to agitate the laundry and water so that the laundry makes satisfactory contact with water. This permits the laundry to absorb an ample amount of water, and permits air trapped in many parts of the laundry to escape. If, as a result of the preparatory operation, the water level as detected by the water level switch 71
10 becomes lower than at the beginning, then, in step S305, the main water feed valve 50a is opened to supply additional water to recover the set water level.

If a course of laundry washing including "cloth type sensing" is selected, when the preparatory operation is performed, the type of cloth is sensed. On completion of the preparatory operation, the change of the water level from the set water level is detected, and,
15 if the drop in the water level is greater than a predetermined value, the laundry is judged to be of the highly water-absorbent cloth type.

When, in step S305, the set water level is stably obtained, the flow proceeds to step S306. According to the settings made by the user, the motor 41 rotates the pulsator 33 in a predetermined pattern so as to produce, in the washing tub 30, a main current of water for
20 washing. With this main current of water, the laundry is washed. The squeezing spindle 44 remains braked by the brake mechanism 43 so that, even when the washing water and the laundry move, the washing tub 30 does not rotate.

On completion of the period in which the laundry is washed with the main current of water, the flow proceeds to step S307. In step S307, the pulsator 33 is rotated repeatedly in

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the forward and then reverse directions at short time intervals. This permits the laundry to loosen, and thereby permits it to spread evenly in the washing tub 30. This is done in preparation for squeezing rotation of the washing tub 30.

Next, with reference to the flow chart shown in Fig. 5, the rinsing process will be
5 described. First, in step S500, the squeezing process is executed, of which a description will be given later with reference to the flow chart shown in Fig. 6. On completion of squeezing, the flow proceeds to step S401. In step S401, the main water feed valve 50a is opened, and water is supplied up to the set water level.

On completion of the supply of water, the flow proceeds to step S402. In step S402,
10 a first preparatory operation is performed. The preparatory operation performed here is the same as that performed in step S304 in the washing process.

On completion of the first preparatory operation, the flow proceeds to step S403. If,
as a result of the preparatory operation, the water level as detected by the water level switch 71 becomes lower than at the beginning, the main water feed valve 50a is opened to supply
15 additional water to recover the set water level.

After recovering the set water level in step S403, in step S404, a second preparatory operation is performed. The flow then proceeds to step S405. According to the settings made by the user, the motor 41 rotates the pulsator 33 in a predetermined pattern so as to produce, in the washing tub 30, a main current of water for rinsing. With this main current
20 of water, the laundry is rinsed. The squeezing spindle 44 remains braked by the brake mechanism 43 so that, even when the rinsing water and the laundry move, the washing tub 30 does not rotate.

On completion of the period in which the laundry is rinsed with the main current of water, the flow proceeds to step S406. In step S406, the pulsator 33 is rotated repeatedly in

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the forward and then reverse directions at short time intervals. This permits the laundry to loosen, and thereby permits it to spread evenly in the washing tub 30. This is done in preparation for squeezing rotation.

In the above description, rinsing is assumed to be performed with rinsing water stored
5 in the washing tub 30. This is called "stored-water rinsing." It is, however, also possible to perform rinsing with water kept supplied from the water feed mouth 53 while the washing tub 30 is rotated at low speed. This is called "shower rinsing." Which type of rinsing to adopt, or whether to adopt both types of rinsing, is determined by the user's choice.

Next, with reference to the flow chart shown in Fig. 6, the squeezing process will be
10 described. First, in step S501, the drain valve 68 is opened. The washing water in the washing tub 30 is drained through the drain space 66. The drain valve 68 remains open during the squeezing process.

After the lapse of a predetermined period of time, when most of the washing water has exited from the laundry, the clutch mechanism 42 is so switched that the motor 41 now rotates
15 the squeezing spindle 44. This causes the washing tub 30 to start squeezing rotation. The pulsator 33 rotates together with the washing tub 30.

When the washing tub 30 rotates at high speed, the laundry is pressed against the inner circumferential wall of the washing tub 30 by the centrifugal force. The washing water present in the laundry also gathers on the inner surface of the circumferential wall of the
20 washing tub 30, and, since the washing tub 30 widens upward in a tapered shape as described earlier, the washing water acted upon by the centrifugal force rises along the inner surface of the washing tub 30. When the washing water reaches the top end of the washing tub 30, it is drained through the drain holes 31. The washing water that has left the drain holes 31 hits the inner surface of the water tub 20, and then flows down along the inner surface of the water

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tub 20 to the bottom of the water tub 20. The washing water is then drained out of the cabinet 10 through the drain pipe 61 and then through the drain hose 60.

In the flow shown in Fig. 6, after squeezing is performed at relatively low speed in steps S502 and S503, squeezing is performed at high speed in steps S504 and S505. On completion of step S505, the flow proceeds to step S506. In step S506, the supply of electric power to the motor 41 is stopped but the brake mechanism 43 is not operated so that the washing tub 30 is left rotating under its own inertia until it spontaneously stops.

The washing machine 1 is furnished with an ion elution unit 100. The ion elution unit 100 is provided in the middle of the main water feed pipe 52a, specifically between the main water feed valve 50a and the detergent chamber 54. Now, with reference to Figs. 7 to 18, the structure and functions of the ion elution unit 100 and the purpose for which it is incorporated in the washing machine 1 will be described.

Figs. 7 and 8 are schematic horizontal and vertical sectional views, respectively, of the ion elution unit 100. The ion elution unit 100 has a casing 110 formed of an insulating material such as a synthetic resin. The casing 110 has a water inlet 111 at one end and a water outlet 112 at the other end. Inside the casing 110, there are arranged two plate-shaped electrodes 113 and 114 parallel to each other and with a predetermined interval secured in between. The electrodes 113 and 114 are formed of a metal, such as silver, copper, or zinc, from which metal ions that exert an antimicrobial effect are produced.

At one ends of the electrodes 113 and 114, there are provided terminals 115 and 116, respectively. Preferably, the electrode 113 and the terminal 115 are formed integrally, and the electrode 114 and the terminal 116 are formed integrally. In a case where these cannot be formed integrally, the junctions between the electrodes and the terminals and the portions of the terminals located inside the casing 110 need to be coated with a synthetic resin to

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prevent contact with water and thereby prevent electrolytic corrosion. The terminals 115 and 116 protrude out of the casing 110, and are connected to the drive circuit provided in the controller 80.

Inside the casing 110, water flows parallel to the longer sides of the electrodes 113 and 114. When a predetermined voltage is applied between the electrodes 113 and 114 while water is flowing inside the ion elution unit 100, metal ions of the metal of which the electrodes 113 and 114 are formed are eluted from whichever of them is at the anode side at the moment. The electrodes 113 and 114 are, for example, plates of silver each measuring 2 cm × 5 cm and about 1 mm thick, and are arranged 5 mm apart from each other.

Fig. 9 shows the drive circuit 120 for driving the ion elution unit 100. A transformer 122 is connected to commercially distributed electric power 121 so as to step down 100 V to a predetermined voltage. The output voltage of the transformer 122 is rectified by a full-wave rectifier circuit 123, and is then formed into a constant voltage by a constant voltage circuit 124. To the constant voltage circuit 124 is connected a constant current circuit 125. The constant current circuit 125 operates in such a way as to supply a constant current to the electrode drive circuit 150 described later without being influenced by variation in the resistance through the electrode drive circuit 150.

To the commercially distributed electric power 121 is also connected, in parallel with the transformer 122, a rectifying diode 126. The output voltage of the rectifying diode 126 is smoothed by a capacitor 127, is then formed into a constant voltage by a constant voltage circuit 128, and is then supplied to a microcomputer 130. The microcomputer 130 controls the starting of a triac 129 connected between one end of the primary coil of the transformer 122 and the commercially distributed electric power 121.

The electrode drive circuit 150 is composed of NPN-type transistors Q1 to Q4, diodes

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D1 and D2, and resistors R1 to R7. These are interconnected as shown in the figure. The transistor Q1 and the diode D1 form a photocoupler 151, and the transistor Q2 and the diode D2 form a photocoupler 152. That is, the diodes D1 and D2 are photodiodes, and the transistors Q1 and Q2 are phototransistors.

5 Suppose now that the microcomputer 130 feeds a high-level voltage to a line L1 and a low-level voltage to a line L2. Then, the diode D2 turns on, and this causes the transistor Q2 to turn on. When the transistor Q2 turns on, a current flows through the resistors R3, R4, and R7, and this causes a bias to be applied to the base of the transistor Q3. Thus, the transistor Q3 turns on.

10 On the other hand, the diode D1 is off, and thus the transistors Q1 is off, and accordingly the transistor Q4 is off. In this state, a current flows from the anode-side electrode 113 to the cathode-side electrode 114. As a result, in the ion elution unit 100, there are produced metal ions as positively-charged ions together with negatively-charged ions.

15 When a current is passed through the ion elution unit 100 in one direction for a long time, while the electrode 113, which is at the anode side in Fig. 9, wears off, the electrode 114, which is at the cathode side, collects impurities in water in the form of scale deposited on it. This degrades the performance of the ion elution unit 100. To avoid this, the electrode drive circuit 150 can be operated in a forcible electrode cleaning mode.

20 In the forcible electrode cleaning mode, the microcomputer 130 switches modes of control so as to invert the voltage applied between the lines L1 and L2 and thereby reverse the current that flows between the electrodes 113 and 114. In this mode, the transistors Q1 and Q4 are on, and the transistors Q2 and Q3 are off. The microcomputer 130 has a counter capability, and switches modes of control as described above every time a predetermined count is reached.

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When the resistance through the electrode drive circuit 150, in particular the resistance of the electrodes 113 and 114, varies and as a result, for example, the current that flows between the electrodes decreases, the constant current circuit 125 raises its output voltage to compensate for the decrease. However, as the total use time increases, the ion elution unit
5 100 eventually reaches the end of its useful life. When this happens, even if the mode of control is switched to the forcible electrode cleaning mode, or if the output voltage of the constant current circuit 125 is raised, it is no longer possible to compensate for the decrease in the current.

To cope with this, in the circuit under discussion, the current that flows between the
10 electrodes 113 and 114 of the ion elution unit 100 is monitored on the basis of the voltage that it produces across the resistor R7. When the current becomes equal to a predetermined minimum current, a current detection circuit 160 detects it. The fact that the minimum current has been detected is transmitted from a photodiode D3, which is a part of a photocoupler 163, through a phototransistor Q5 to the microcomputer 130. The
15 microcomputer 130 then drives, by way of a line L3, a warning indicator 131 to make it indicate a predetermined warning. The warning indicator 131 is provided in the operation/display panel 81.

Moreover, to cope with a fault such as short-circuiting within the electrode drive circuit 150, there is provided a current detection circuit 161 that detects the current being
20 larger than a predetermined maximum current. On the basis of the output of this current detection circuit 161, the microcomputer 130 drives the warning indicator 131. Furthermore, when the output voltage of the constant current circuit 125 becomes lower than a previously set minimum voltage, a voltage detection circuit 162 detects it, and the microcomputer 130 likewise drives the warning indicator 131.

The principal feature of the present invention is the timing with which metal ions are added. Now, this feature will be described with reference to the flow charts shown in Figs. 10 to 13.

The sequence shown in Fig. 10 is executed in, among the rinsing processes S400
5 executed in the flow shown in Fig. 3, the final rinsing process. That is, when the final rinsing process is started, then, in step S411, whether or not addition of metal ions is selected is checked. If "addition of metal ions" is selected through a selection operation performed via the operation/display panel 81, the flow proceeds to step S412; if not, the flow proceeds to step S414.

10 In step S412, the main water feed valve 50a is opened so that a predetermined amount of water is passed through the ion elution unit 100. Simultaneously, the drive circuit 120 applies a voltage between the electrodes 113 and 114 so that ions of the metal of which they are formed are eluted into the water. The water containing the metal ions is fed via the water feed mouth 53 into the washing tub 30.

15 When a predetermined amount of water containing metal ions has been fed, and the concentration of metal ions in the rising water has reached a predetermined level, the main water feed valve 50a is closed, and the application of the voltage between the electrodes 113 and 114 is stopped.

Next, in step S413, the rinsing water is agitated to promote contact between the
20 laundry and the metal ions. The agitation lasts for a predetermined period of time.

The agitation of the rinsing water after its mixing with water containing metal ions may be achieved by initial agitation, whereby the rinsing water and the laundry are agitated by the pulsator 33 for a predetermined period of time (and with considerable intensity as in ordinary rinsing), followed by complete rest or mild agitation. Through such initial agitation

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of the laundry together with the rinsing water mixed with water containing metal ions, it is possible to permit the metal ions to be distributed all over the laundry. By thereafter keeping the laundry and the rinsing water at rest, or mildly agitating them, it is possible to permit the metal ions to firmly attach to the laundry. Moreover, by first powerfully agitating the laundry together with the rinsing water after its mixing with water containing metal ions so that the metal ions are distributed all over the laundry and then keeping them at rest or mildly agitating them, it is possible to alleviate the load of the motor 41, which performs agitation, and thereby reduce power consumption.

Depending on the type of laundry, the laundry, instead of being subjected to initial agitation, may be left dipped in the rinsing water mixed with water containing metal ions for a longer period of time, for example about 30 minutes to one hour. This helps not only to make the laundry resistant to microbes by letting metal ions attach to it, but also to kill microbes and mold present in the laundry and the water. Such "long-time dipping" may be one of the choices that can be selected in the rinsing process (or washing process). "Long-time dipping" helps even to kill microbes and mold present in laundry contaminated with bacteria (for example, clothes and linens used in hospitals, and those used outside hospitals but soiled with stool or contaminated with colon bacilli) and laundry infested with mold (for example, curtains used in modular baths).

Moreover, "long-time dipping" helps also to kill microbes and mold present in water that is, unlike tap water, not sterilized with hypochlorous acid or the like, for example rain water, stored water, or bath water left overnight, and that is thus likely to be contaminated with bacteria. This permits such water to be used safely in laundry washing.

Next, in step S414, whether or not addition of a treatment agent is selected is checked. This check step may be executed earlier on. For example, the check may be made in step

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S411, i.e., simultaneously with the check of whether or not addition of metal ions is selected or not. If "addition of a treatment agent" is selected through a selection operation performed via the operation/display panel 81, the flow proceeds to step S415; if not, the flow proceeds to step S406. In step S406, the pulsator 33 is rotated repeatedly in the forward and then reverse
5 directions at short time intervals. This permits the laundry to loosen, and thereby permits it to spread evenly in the washing tub 30. This is done in preparation for squeezing rotation.

In step S415, the sub water feed valve 50b is opened, and water is passed through the treatment agent chamber 55 of the water feed mouth 53. If a treatment agent has been put in the treatment agent chamber 55, the treatment agent is fed, together with the water, into the
10 washing tub 30 through the siphon 57. The effect of a siphon does not occur until the water level inside the treatment agent chamber 55 reaches a predetermined level. This permits the liquid treatment agent to be held in the treatment agent chamber 55 until the time comes when water is poured into the treatment agent chamber 55.

When a predetermined amount of water (so much as or more than to cause the effect
15 of a siphon to occur in the siphon 57) is poured into the treatment agent chamber 55, the sub water feed valve 50b is closed. This step of feeding water, i.e., adding a treatment agent, is performed automatically irrespective of whether or not a treatment agent has been put in the treatment agent chamber 55 so long as addition of a treatment agent is selected.

Next, in step S416, the rinsing water is agitated to promote contact between the
20 laundry and the treatment agent. The agitation lasts for a predetermined period of time. The flow then proceeds to step S406.

In the above sequence, it is a predetermined period of time after addition of metal ions to the rinsing water that a treatment agent is added to the rinsing water. If metal ions and a treatment agent (softening agent) are added simultaneously to the rinsing water, the metal ions

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react with ingredients of the softening agent, resulting in a diminished antimicrobial effect. By contrast, according to the above sequence, it is after the metal ions have firmly attached to the laundry that the treatment agent is added. This prevents the metal ions from reacting with ingredients of the treatment agent, and thus permits the metal ions to remain on the
5 laundry while maintaining a satisfactory antimicrobial effect as expected from metal ions.

It is preferable that the electrodes 113 and 114 be formed of silver, copper, or an alloy of silver and copper. Silver ions eluted from a silver electrode offer an excellent sterilizing effect, and copper ions eluted from a copper electrode offer excellent resistance to mold. From an alloy of silver and copper can be eluted silver and copper ions simultaneously.

10 Silver ions are positively-charged ions. Laundry is negatively charged in water, and therefore the silver ions are electrically absorbed by the laundry. Absorbed by the laundry, the silver ions are electrically neutralized. This makes it difficult for the silver ions to react with chloride ions (negatively-charged ions) contained in a treatment agent (softening agent) as its ingredients. Here, it takes time for the silver ions to be absorbed by the laundry, and
15 therefore it is necessary to secure a certain length of time before addition of the treatment agent. For this reason, after addition of silver ions, agitation is performed for 10 minutes. After addition of the treatment agent, it suffices to perform agitation for three minutes.

The metal ions are fed into the washing tub 30 through the main water feed pipe 52a and then through the detergent chamber 54. The treatment agent is fed into the washing tub
20 30 from the treatment agent chamber 55. Thus, the passage through which metal ions are added to the rinsing water is separate from the passage through which a treatment agent is added to the rinsing water. This prevents the metal ions from passing through the passage through which the treatment agent is added to the rinsing water, and thereby prevents the metal ions from making contact and reacting with the treatment agent remaining in that

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passage to form compounds and lose their antimicrobial effect.

Moreover, according to the above sequence, the rinsing water is agitated each time that the metal ions and the treatment agent are added. This permits the metal ions and the treatment agent to attach evenly and firmly to the laundry.

5 Moreover, according to the above sequence, addition of metal ions is optional, and, when addition of metal ions is not selected, a treatment agent is added at an early stage in the final rinsing process. This helps reduce the time required to go through the final rinsing process to equal to the time required to attach the treatment agent to the laundry. Moreover, by agitating the rinsing water, it is possible to attach the treatment agent to the laundry evenly
10 and firmly.

Moreover, according to the above sequence, irrespective of whether a treatment agent is present in the treatment agent chamber 55 or not, the action by which to add the treatment agent is executed whenever the treatment agent is supposed to be added. Thus, the user need not necessarily choose whether to add the treatment agent or not expressly; that is, when the
15 user chooses not to add the treatment agent, the user can simply leave the treatment agent chamber 55 empty.

Moreover, according to the above sequence, addition of metal ions and addition of a treatment agent can both be inhibited so as not to be executed. With this configuration, when neither metal ions nor a treatment agent needs to be added, their addition can be
20 inhibited so as not to be executed. This helps prevent the washing machine 1 from performing unnecessary actions.

As compared with the sequence shown in Fig. 10, the sequence shown in Fig. 11 lacks step S411 (checking of whether or not addition of metal ions is selected). According to this sequence, whether to add a treatment agent or not can be freely chosen, but metal ions are

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always added.

As compared with the sequence shown in Fig. 10, the sequence shown in Fig. 12 is modified in the following respects. Step S421 (adjustment of the water level) is executed before step S412 (feeding of water containing metal ions). Likewise, step S422 (adjustment of the water level) is executed before step S415 (addition of a treatment agent). These modifications are made for the reasons stated below.

Addition of metal ions is achieved by feeding water containing them. Likewise, addition of a treatment agent is achieved by feeding it together with water. This inevitably results in a rise in the water level inside the washing tub 30. When the water level inside the washing tub 30 is already high, adding metal ions or a treatment agent may cause water to overflow the washing tub 30. Such an overflow lets the metal ions or treatment agent be drained unnecessarily, and may even annoy the neighborhood with the noise of the overflowing water.

To prevent these inconveniences, in step S421, the drain valve 68 is opened before addition of metal ions to drain a little water. The amount of water drained here is equal to or smaller than the amount of water containing metal ions that is going to be fed in, and is such as not to cause water to overflow the washing tub 30. In step S422 also, the drain valve 68 is opened before addition of a treatment agent to drain a little water. The amount of water drained here is equal to or smaller than the amount of water containing a treatment agent that is going to be fed in, and is such as not to cause water to overflow the washing tub 30.

As compared with the sequence shown in Fig. 12, the sequence shown in Fig. 13 is modified in the following respects. Step S414 (checking of whether addition of a treatment agent is selected or not) is executed first so that, if addition of a treatment agent is selected, the flow proceeds to step S411 (checking of whether addition of metal ions is selected or not)

If, in step S411, "addition of metal ions" is found to be selected, the flow proceeds from step S421 (adjustment of the water level) to step S412 (feeding of water containing metal ions) to step S413 (agitation) to step S422 (adjustment of the water level) to S415 (addition of a treatment agent) to step S416 (agitation). If, in step S411, "addition of metal
5 ions" is found not to be selected, the flow proceeds from step S422 (adjustment of the water level) to step S415 (addition of a treatment agent) to S416 (agitation).

According to the sequence shown in Fig. 13, addition of metal ions is permitted only when a treatment agent is added.

Fig. 14 shows the results of experiments. Four experiments were conducted. The
10 conditions common to all these experiments are as follows. The amount of cloth washed was 1 kg. The amount of water used was 25 L. The washing session went through the following sequence: "washing, then first-time rinsing (stored-water rinsing for three minutes), then final rinsing (stored-water rinsing), and then squeezing." During the step of final rinsing, addition of water containing metal ions and addition of a treatment agent were
15 executed under varying conditions. The conditions under which the metal ions and the treatment agent were added in the different experiments are shown in the flow charts shown in Figs. 15 to 17. In all the experiments, the metal ions were silver ions, and the treatment agent was a softening agent.

In experiment No. 1, as shown in Fig. 15, water containing silver ions and the
20 softening agent were added simultaneously at the start of the final rinsing. Specifically, at the start of the final rinsing, water was supplied via both the main water feed valve and the sub water feed valve, and simultaneously a voltage was applied between the electrodes of the ion elution unit so that the concentration of silver ions in the rinsing water was 90 ppb. After addition, agitation was performed for 10 minutes, then the water was drained, and then

squeezing was performed.

In experiment No. 2, as shown in Fig. 16, first, at the start of the final rinsing, only water containing silver ions was added. Water was supplied via the main water feed valve, and a voltage was applied between the electrodes of the ion elution unit so that the concentration of silver ions in the rinsing water was 90 ppb. Then, agitation was performed for 10 minutes. Thereafter, in preparation for addition of the softening agent, the drain valve was opened to drain 5L of water out of the washing tub. Thereafter, water was supplied via the sub water feed valve until the predetermined water level (25 L) was recovered, and simultaneously the softener was added. After addition, agitation was performed for two minutes, then the water was drained, and then squeezing was performed.

In experiment No. 3, the same sequence as that used in experiment No. 2 was used, except that the concentration of silver ions in the rinsing water was 180 ppb.

In experiment No. 4, as shown in Fig. 17, only water containing silver ions was added at the start of the final rinsing; that is, no softening agent was added. Water was supplied via the main water feed valve, and a voltage was applied between the electrodes of the ion elution unit so that the concentration of silver ions in the rinsing water was 90 ppb. After addition, agitation was performed for 10 minutes, then the water was drained, and then squeezing was performed.

In the rightmost column of the table shown in Fig. 14 are shown the antimicrobial activity values of the cloths that were washed under the conditions of the above experiments Nos. 1 to 4 and that were then dried indoors at room temperature. The antimicrobial activity values were calculated by the quantitative testing method according to JIS (Japanese Industrial Standards) L1902.

The antimicrobial effect obtained in experiment No. 1, where silver ions were added simultaneously with a softening agent, was strikingly lower than that obtained in experiment No. 4, where no softening agent was added. The antimicrobial effect obtained in experiment No. 2, where a softening agent was added later, was not higher than that obtained in experiment No. 4, but was higher than that obtained in experiment No. 1. The antimicrobial effect obtained in experiment No. 3, where the concentration of silver ions was higher, was higher than that obtained in experiment No. 2, and was roughly equal to that obtained in experiment No. 4.

As these results suggest, in a case where a softening agent is used, by making the concentration of silver ions in the rinsing water higher than in a case where no softening agent is used, it is possible to compensate for the decrease in the antimicrobial effect.

Conducting experiment No. 2 with no softening agent put in the storage space for it resulted in the same result as experiment No. 4. Thus, by executing the sequence shown in Fig. 18 without putting a softening agent but with the action for adding it performed, it is possible to obtain a satisfactory antimicrobial effect..

The washing machine of the present invention can perform rinsing with water containing metal ions by going through any of the sequences shown in Figs. 10 to 13 described above under any of the sets of conditions of experiments Nos. 1 to 4. By adopting the conditions of experiment No.1, it is possible to shorten the rinsing time. By adopting the conditions of experiment No.2, it is possible to obtain a high antimicrobial activity value while using a softening agent. By adopting the conditions of experiment No. 3, it is possible to obtain a higher antimicrobial activity value while using a softening agent. By adopting the conditions of experiment No. 4, while it is not possible to use a softening agent, it is possible to obtain a high antimicrobial activity value.

That is, under the conditions of experiment No. 1, it is possible to give laundry antimicrobial effect in a short period of time and in addition obtain the effect of a softening agent. Under the conditions of experiments Nos. 2 and 3, it is possible to give laundry higher antimicrobial effect while obtaining the effect of a softening agent. The conditions of experiment No. 4 are suitable for laundry that does not require a softening agent but that needs to be given high antimicrobial effect.

Preferably, which of the sets of conditions of experiments Nos. 1 to 4 to adopt when going through the sequences shown in Figs. 10 to 13 is automatically determined by the washing machine, which then performs appropriate control accordingly. The laundry amount sensing and cloth type sensing described earlier can be used for this purpose. Specifically, which set of conditions to adopt is determined according to the amount of laundry as measured by laundry amount sensing and the water absorbency of laundry as detected by cloth type sensing.

For example, thin-cloth, low water-absorbent laundry needs to be made antimicrobial and in addition softened, but needs to be subjected to rinsing for as short a period of time as possible to minimize damage. Thus, the conditions of experiment No.1 are suitable. By contrast, high water-absorbent laundry (thick-cloth clothes such as jeans, and textile products with wide areas such as bed sheets) is not generally considered to require softening. Thus, the conditions of experiment No. 4 are suitable. As the amount of laundry increases, the concentration of metal ions needs to be increased. Thus, the conditions of experiment No. 3 are suitable. With moderately water-absorbent laundry, the conditions of experiment No. 2 are suitable to achieve a balance between the concentration of metal ions and the effect of softening. In this way, by automatically controlling the addition of water containing metal ions according to the type (or amount) of laundry, it is possible to give laundry maximum

antimicrobial effect.

It is to be understood that the present invention may be carried out in any other manner than specifically described above as an embodiment, and many modifications and variations are possible within the scope of the invention. It is also to be understood that the present invention may be applied to any other type of washing machine than the one, of fully automatic type, taken up in the embodiment describe above; that is, the present invention is applicable to all types of washing machine, such as those having horizontal drums (of the tumbler type), those having slanted drums, those which function also as dryers, and those with two separated tubs.

Industrial applicability

As described above, according to the present invention, in a washing machine, two treatment substances that, if added to rinsing water simultaneously, diminish the efficacy of at least one of them are added separately with a time difference. This makes it possible to surely and satisfactorily exploit the efficacy of both the treatment substances. Moreover, metal ions are used as the first treatment substance, and a treatment agent for laundry washing is used as the second treatment substance. This makes it possible to sterilize laundry and make it resistant to microbes with the sterilizing effect of the metal ions, and in addition to treat the laundry with a common treatment agent. Even when the treatment agent is a softening agent, it does not greatly diminish the antimicrobial effect. This permits laundry to be appropriately treated, and helps enhance the hygiene of laundry.

CLAIMS

1. A washing machine that agitates water and laundry in a washing tub,
wherein, in a rinsing process, out of two treatment substances of which at least one has
5 an effect thereof diminished if the two treatment substances are simultaneously added to
rinsing water, first, metal ions as a first treatment substance are added to the rinsing water and
then, a predetermined period of time thereafter, a laundry treatment agent as a second
treatment substance is added to the rinsing water.

10 2. The washing machine according to claim 1,
wherein the rinsing water is agitated each time that the metal ions as the first treatment
substance and the laundry treatment agent as the second treatment substance are added thereto.

 3. The washing machine according to claim 1,
15 wherein addition of the metal ions as the first treatment substance is optional and,
when a user chooses not to add the metal ions as the first treatment substance, then, at an early
stage in a final rinsing process, the laundry treatment agent as the second treatment substance
is added.

20 4. The washing machine according to claim 2,
wherein addition of the metal ions as the first treatment substance is optional and,
when a user chooses not to add the metal ions as the first treatment substance, then, at an early
stage in a final rinsing process, the laundry treatment agent as the second treatment substance
is added and the rinsing water is agitated.

5. The washing machine according to claim 1,
wherein, irrespective of whether or not the laundry treatment agent as the second treatment substance is present in a storage space from which to add the laundry treatment agent as the second treatment substance, an action by which to add the laundry treatment agent as the second treatment substance is executed whenever the laundry treatment agent as the second treatment substance is expected to be added.

6. The washing machine according to claim 1,
10 wherein addition of the metal ions as the first treatment substance and addition of the laundry treatment agent as the second treatment substance can each be inhibited so as not to be executed.

7. The washing machine according to claim 1,
15 wherein, before addition of the metal ions as the first treatment substance and/or the laundry treatment agent as the second treatment substance, a resulting rise in a water level in the washing tub is anticipated to adjust the water level in the washing tub accordingly.

8. The washing machine according to claim 1,
20 wherein addition of the laundry treatment agent as the second treatment substance is optional and, only when a user chooses to add the laundry treatment agent as the second treatment substance, addition of the metal ions as the first treatment substance is permitted.

9. The washing machine according to claim 1,

wherein addition of the laundry treatment agent as the second treatment substance is optional and, even when a user chooses not to add the laundry treatment agent as the second treatment substance, addition of the metal ions as the first treatment substance is executed.

5

10. The washing machine according to claim 1,

wherein the metal ions are generated by an ion elution unit that generates metal ions by applying a voltage between electrodes.

10

11. The washing machine according to claim 1,

wherein a concentration of the metal ions in the rinsing water is made higher when the treatment agent is used than when the treatment agent is not used.

15

12. The washing machine according to claim 1,

wherein the metal ions are silver ions or copper ions generated by an ion elution unit that generates metal ions by applying a voltage between electrodes.

20

13. The washing machine according to claim 1,

wherein a passage through which the metal ions are added to the rinsing water is separate from a passage through which the treatment agent is added to the rinsing water.