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(54) **A WASHING DEVICE AND AN OPERATION METHOD OF THE WASHING DEVICE**

(57) With the present invention, there is provided a washing device, and an operation method for said washing device. The washing device comprises at least one washing compartment (K) adapted to receive at least one item (3) for washing; at least one electrolysis unit (E) for obtaining acidic water and basic water by electrolyzing the water received from at least one water source; at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit (E) and/or acidic water obtained and/or basic water obtained at the electrolysis unit (E); at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit (E), based on an information received from the measure-

ment unit, the control unit being in connection with the measurement unit; and at least a first heating element (S) for adjusting a temperature of water transferred to the electrolysis unit (E), wherein operation of the first heating element (S) is controlled by the control unit. The operation method comprises the steps of: measuring, by the measurement unit, at least one parameter of at least one of the water which is transferred to the electrolysis unit (E), the acidic water obtained at the electrolysis unit (E) and the basic water obtained at the electrolysis unit (E); and controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured.

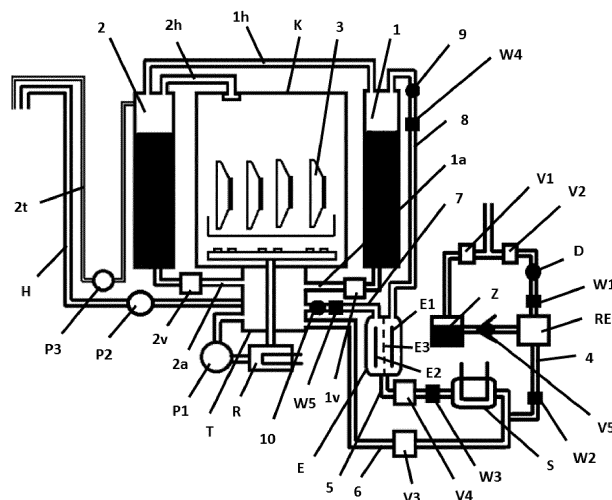


Figure - 1

Description

Technical Field

[0001] The present invention relates to washing devices such as dishwashers and washing machines, and to an operation method for said washing devices.

Background of the Invention

[0002] In washing devices used for cleaning various items by washing, washing liquids are utilised to wash said items. Various chemicals are used to purify said items especially from water-insoluble foreign substances, such as oil. Chemical substances called detergents may both harm users by leaving residues in the washed items and damage the nature as a result of releasing the washing liquid to the nature after the washing process.

[0003] According to the embodiments covered by the known art, additional products like rinse aids or softeners may be used in order to prevent chemicals, such as detergents, from remaining on the washed items. Although the additional products decrease the detergent residue remaining on the items, said additional products may cause an increase in damage to nature since these additional products contain different chemicals, as well.

[0004] Within the known art, as disclosed in the patent document US2006266381A1, there are also washing devices which provide a washing process without using chemical substances such as detergents. In said washing devices, water received from the mains is passed through an electrolysis cell. By conducting an electrolysis process in the electrolysis cell, acidic water and basic water are able to be obtained. The basic water obtained may directly be used as a washing liquid. Therefore, foreign substances present on the items to be washed can be separated by the basic water instead of detergent. In such embodiments, however, the electrolysis process may not be conducted efficiently. For that reason, energy efficiency of the washing device may decrease.

Brief Description of the Invention

[0005] With the present invention, there is provided a washing device, and an operation method for said washing device. The washing device comprises at least one washing compartment adapted to receive at least one item for washing; at least one electrolysis unit for obtaining acidic water and basic water by electrolyzing the water received from at least one water source; at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit and/or acidic water and/or basic water obtained at the electrolysis unit; at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit, based on an information received from the measurement unit, the control unit being in connection with the measurement unit; and at least

a first heating element for adjusting a temperature of water transferred to the electrolysis unit, wherein operation of the first heating element is controlled by the control unit.

[0006] The operation method provided for said washing device comprises the steps of: measuring, by the measurement unit, at least one parameter of at least one of the water which is transferred to the electrolysis unit, the acidic water obtained at the electrolysis unit and the basic water obtained at the electrolysis unit; and controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit based on at least one parameter measured.

Object of the Invention

[0007] An object of the present invention is to provide a washing device which is capable of washing without using a detergent, and an operation method for said washing device.

[0008] Another object of the present invention is to provide a reliable and efficient washing device, and an operation method for said washing device.

Description of the Drawings

[0009] An exemplary embodiment of the washing device according to the invention is illustrated in the attached figure, in which:

Figure 1 is a block diagram of the washing device according to the invention.

[0010] All the parts illustrated in figures are individually assigned a reference numeral and the corresponding terms of these numbers are listed below:

35	Washing compartment	(K)
	Main discharge line	(H)
	Collection reservoir	(T)
	First heating element	(S)
40	Second heating element	(R)
	Resin chamber	(RE)
	Salt chamber	(Z)
	Electrolysis unit	(E)
45	First electrode	(E1)
	Second electrode	(E2)
	Membrane	(E3)
	First valve	(V1)
	Second valve	(V2)
50	Collection reservoir valve	(V3)
	Electrolysis unit valve	(V4)
	Interconnecting valve	(V5)
	Flow rate adjusting element	(D)
55	First pump	(P1)
	Collection reservoir discharge pump	(P2)
	Acidic water discharge pump	(P3)

(continued)

First chamber	(1)
First water line	(1a)
First discharge line	(1h)
First chamber valve	(1v)
Second chamber	(2)
Second water line	(2a)
Second air discharge line	(2h)
Second chamber valve	(2v)
Acidic water discharge line	(2t)
Item	(3)
Resin line	(4)
Electrolysis unit line	(5)
Collection reservoir line	(6)
Basic water line	(7)
Acidic water line	(8)
First chamber flow rate adjuster	(9)
Collection reservoir flow rate adjuster	(10)
First parameter measuring device	(W1)
Second parameter measuring device	(W2)
Third parameter measuring device	(W3)
Fourth parameter measuring device	(W4)
Fifth parameter measuring device	(W5)

Description of the Invention

[0011] In washing devices such as washing machines or dishwashers, items to be cleaned are washed by washing liquids. In case that the detergent water is used as a washing liquid, chemical substances may remain on the washed item, and also the washing liquid may harm the nature. Therefore, with the present invention, there is disclosed a washing device in which the water is electrolyzed to obtain a washing liquid, and an operation method for said washing device.

[0012] The washing device according to the present invention, as illustrated in Figure 1, comprises at least one washing compartment (K) adapted to receive at least one item (3) for washing; at least one electrolysis unit (E) for obtaining acidic water and basic water by electrolyzing the water received from at least one water source (e.g. a water mains); at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit (E) and/or acidic water and/or basic water obtained at the electrolysis unit (E); at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit (E), based on an information received from the measurement unit, the control unit being in connection with the measurement unit; and at least a first heating element (S) for adjusting a temperature of water transferred to the electrolysis unit (E), wherein operation of the first heating element (S) is controlled by the control unit. The electrolysis unit (E) preferably comprises at least a first electrode (E1), at least a second electrode

(E2), and at least one membrane (E3) separating the first electrode (E1) and the second electrode (E2).

[0013] In another preferred embodiment of the invention, the washing device comprises at least one flow rate adjusting element (D) which is preferably located at the inlet of the resin chamber (RE), and adjusts a flow rate of the water to be transferred to the electrolysis unit (E), wherein operation of the flow rate adjusting element (D) is controlled by the control unit.

[0014] In a preferred embodiment of the invention, the washing device comprises at least one resin chamber (RE) for filtering the water, which is to be electrolyzed in the electrolysis unit (E), before entering the electrolysis unit (E) such that the water is purified from elements which cause hardness, such as calcium and magnesium. In this embodiment, the measurement unit comprises at least a first parameter measuring device (W1) located at the inlet of the resin chamber (RE) and/or at least a second parameter measuring device (W2) located at the outlet of the resin chamber (RE). The first parameter measuring device (W1) and/or the second parameter measuring device (W2) measures at least one parameter such as pressure, temperature, pH, saltiness, total dissolved solids (TDS), conductivity, hardness, and flow rate. By means of these parameters measured, the control unit can control the operation (such as operating voltage and current) of the first heating element (S) and/or the electrolysis unit (E). Here, the measurement unit also comprises at least a third parameter measuring device (W3) which is located between the first heating element (S) and the electrolysis unit (E). The third parameter measuring device (W3) can also measure at least one parameter such as pressure, temperature, pH, saltiness, total dissolved solids (TDS), conductivity, hardness, and flow rate. Therefore, e.g. a temperature of the water transferred to the electrolysis unit (E) can be controlled precisely to perform electrolysis process with water that has a desired temperature.

[0015] In a preferred embodiment of the invention, the washing device comprises at least one collection reservoir (T) which is preferably located below the washing compartment (K), wherein the basic water obtained in the electrolysis unit (E) is transferred to the collection reservoir (T). In this embodiment, the washing device comprises at least one basic water line (7) for transferring the basic water obtained in the electrolysis unit (E) to the collection reservoir (T). The washing device further comprises at least a first pump (P1) (e.g. a circulation pump) which is in connection with the collection reservoir (T) from at least one side and in connection with the washing compartment (K) from at least another side, and which allows the fluids in the collection reservoir (T) to be transferred to the washing compartment (K). Here, at least a second heating element (R) (e.g. a resistance) is also provided, which is preferably located between the first pump (P1) and the washing compartment (K). In another preferred embodiment, the washing device comprises at least one main discharge line (H) which is connected to

the collection reservoir (T) from at least one side and is adapted to be connected to a drain from at least another side, and at least one collection reservoir discharge pump (P2) located on the main discharge line (H).

[0016] In another preferred embodiment of the invention, the washing device comprises at least one resin line (4) connecting the resin chamber (RE) and the electrolysis unit (E). Here, the resin line (4) may be directly connected to the electrolysis unit (E). In an alternative embodiment, the washing device comprises at least one electrolysis unit line (5) which is connected from one side to the resin line (4), and from another side to the electrolysis unit (E) and at least one electrolysis unit valve (V4) which is located on the electrolysis unit line (5). In a preferred embodiment, the washing device further comprises at least one collection reservoir line (6) which is connected from one side to the resin line (4), and from another side to the collection reservoir (T), and at least one collection reservoir valve (V3) located on the collection reservoir line (6).

[0017] In a further preferred embodiment of the invention, the washing device comprises at least a first chamber (1) to which the acidic water obtained in the electrolysis unit (E) is transferred. In this embodiment, the washing device comprises at least one acidic water line (8) for transferring the acidic water obtained in the electrolysis unit (E) to the first chamber (1). The washing device may comprise at least a first water line (1a) which connects the first chamber (1) and the collection reservoir (T). At least a first chamber valve (1v) is preferably provided on the first water line (1a). Here, the washing device may also comprise at least a second chamber (2). The second chamber (2) is connected to the first chamber (1) preferably by means of at least a first discharge line (1h). The washing device may comprise at least a second water line (2a) which connects the second chamber (2) and the collection reservoir (T). Preferably, at least a second chamber valve (2v) is provided on the second water line (2a). The washing device also comprises at least a second discharge line (2h) which connects the second chamber (2) and the washing compartment (K). In another preferred embodiment, the washing device comprises at least one acidic water discharge line (2t) which is connected to the second chamber (2) from at least one side and is adapted to be connected to a drain from at least another side, and at least one acidic water discharge pump (P3) located on the acidic water discharge line (2t).

[0018] In a further preferred embodiment, the washing device comprises at least one collection reservoir flow rate adjuster (10) which is located on the basic water line (7). In another preferred embodiment, the washing device comprises at least a first chamber flow rate adjuster (9) located on the acidic water line (8).

[0019] In another preferred embodiment of the invention, the washing device comprises at least one salt chamber (Z). In this embodiment, the washing device also comprises at least a first valve (V1) controlling the water transfer to the salt chamber (Z), at least a second

valve (V2) controlling the water transfer to the resin chamber (RE), and at least one interconnecting valve (V5) located between the salt chamber (Z) and the resin chamber (RE).

[0020] In a preferred embodiment of the invention, the measurement unit preferably comprises at least a fourth parameter measuring device (W4) located on the acidic water line (8) and/or a fifth parameter measuring device (W5) located on the basic water line (7). The fourth parameter measuring device (W4) and/or the fifth parameter measuring device (W5) can measure at least one parameter such as pressure, temperature, pH, saltiness, total dissolved solids (TDS), conductivity, hardness, and flow rate.

[0021] The operation method according to the present invention which is suitable for use in a washing device comprising at least one washing compartment (K) adapted to receive at least one item (3) for washing; at least one electrolysis unit (E) for obtaining acidic water and basic water by electrolyzing the water received from at least one water source (e.g. a water mains); at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit (E) and/or acidic water and/or basic water obtained at the electrolysis unit (E); at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit (E), based on an information received from the measurement unit, the control unit being in connection with the measurement unit; and at least a first heating element (S) for adjusting a temperature of water transferred to the electrolysis unit (E), wherein operation of the heating element is controlled by the control unit, comprises the steps of: measuring, by the measurement unit, at least one parameter of at least one of the water which is transferred to the electrolysis unit (E), the acidic water obtained at the electrolysis unit (E) and the basic water obtained at the electrolysis unit (E); and controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured.

[0022] In a preferred embodiment of the invention, in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured, a current level supplied to the electrolysis unit (E) is controlled. Thus, the current which will be provided for the electrolysis process can be controlled. In this embodiment, the current value is preferably determined according to a hardness level of the water transferred to the electrolysis unit (E) (e.g. according to a hardness level which is measured by the first parameter measuring device (W1), the second parameter measuring device (W2) or the third parameter measuring device (W3)). Here, preferably, at least a first look-up-table is used to determine which current value will be used for which hardness value. In an exemplary embodiment, the current value supplied to the electrolysis unit (E) depending on the

measured water hardness value is determined according to the first exemplary look-up-table given below.

Current (A)	Hardness of Water (df)
8	$0 < X < 2$
10	$2 < X < 4$
12	$4 < X < 6$
14	$6 < X < 8$
16	$8 < X < 10$

[0023] In another preferred embodiment, in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured, voltage level supplied to the first heating element (S) is controlled. Here, the voltage level is preferably determined according to a temperature value which is measured by the first parameter measuring device (W1) and/or the second parameter measuring device (W2). Here, preferably, at least a second look-up-table is used to determine which voltage value will be used for which temperature value. In an exemplary embodiment, the voltage value supplied to the heating element (S) depending on the measured temperature value is determined according to the second exemplary look-up-table given below.

Volt (V)	Temperature Range (°C)
230	$0 < X < 3$
220	$3 < X < 6$
210	$6 < X < 9$
200	$9 < X < 12$
190	$12 < X < 15$
180	$15 < X < 18$
150	$18 < X < 21$
120	$21 < X < 24$
100	$24 < X < 27$
80	$27 < X < 30$
30	$30 < X < 33$

[0024] In another preferred embodiment, in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured, a flow rate of water to be transferred to the electrolysis unit (E) is adjusted by, for example, the flow rate adjusting element (D). Here, the flow rate is preferably determined according to a temperature value which is measured by the first parameter measuring device (W1) and/or the second parameter measuring device (W2). Here, preferably, at

least a third look-up-table is used to determine which flow rate will be used for which temperature value. In an exemplary embodiment, the flow rate of water transferred to the electrolysis unit (E) depending on the measured temperature value is determined according to the third exemplary look-up-table given below.

Flow Rate (l/min)	Temperature Range (°C)
0,45	$0 < X < 3$
0,5	$3 < X < 6$
0,55	$6 < X < 9$
0,6	$9 < X < 12$
0,65	$12 < X < 15$
0,75	$15 < X < 18$
0,85	$18 < X < 21$
0,95	$21 < X < 24$
1,1	$24 < X < 27$
1,2	$27 < X < 30$
1,3	$0 < X < 13$

[0025] Various exemplary operations of the washing device according to the present invention are described below with reference to Figure 1.

[0026] As illustrated in Figure 1, the electrolysis unit (E) is positioned at the outlet of the resin chamber (RE) of the washing device for performing the washing process completely without using a detergent. Washing water to be received in a washing step of the washing device is passed through the resin chamber (RE) by opening the second valve (V2). After the washing water that has passed through the resin chamber (RE) is purified from the elements causing hardness, such as calcium and magnesium, it is sent to the electrolysis unit (E) via the resin line (4) and electrolysis unit valve (V4). Thanks to the fact that the electrolysis unit (E) comprises the first electrode (E1) (e.g. anode), the second electrode (E2) (e.g. cathode), and the membrane (E3) which is ion permeable and located between first electrode (E1) and the second electrode (E2), the washing water is ionised into H^+ and OH^- . By altering the positive and negative currents, the first electrode (E1) and second electrode (E2) can be used as anode or cathode. While the acidic water having H^+ ions is created in the anode portion of the electrolysis unit (E), the basic water having OH^- ions is created in the cathode portion thereof. The acidic water accumulates in the first chamber (1), which is preferably located next to the washing device, through the acidic water line (8) while the basic water is sent to the collection reservoir (T) through the basic water line (7). By this way, after the water softened in the resin chamber (RE) is separated in the electrolysis unit (E), the basic water is sent to the collection reservoir (T) for use in a washing step

of the washing device. The basic water is circulated within the washing compartment (K) by means of the first pump (P) and, if needed, it is heated via the second heating element (R) for being use in a washing program to clean items (3) such as dishes. The acidic water may be accumulated in the first chamber (1) and/or the second chamber (2). The first discharge line (1h) can be used for air and acidic water transfer between the first chamber (1) and the second chamber (2). In order to prevent ionized water accumulated in the second chamber (2) from overflowing into the washing compartment (K), it can be discharged into a waste water drain through the acidic water discharge line (2t) by operating the acidic water discharge pump (P3) in a certain step of the main washing step or when needed. In predetermined points of the washing steps, after a desired number of washing processes with basic water is provided, the first chamber valve (1v) and/or the second chamber valve (2v) is opened at the same time or different times to send the water to the collection reservoir (T) through the first water line (1a) and/or the second water line (2a). The air in the first chamber (1) and/or the second chamber (2) is able to be sent into the washing compartment (K) through the second air discharge line (2h). At the end of the washing step, the washing water is sent to a sewage drain by means of the main discharge line (H) by using the collection reservoir discharge pump (P2). The abovementioned process also applies for switching anodes and cathodes (i.e. reverse bonding of + and - charges to the first electrode (E1) and the second electrode (E2)). In other words, while the basic water is stored at the first chamber (1) and/or the second chamber (2), it is also possible to send acidic water to the collection reservoir (T).

[0027] Operational performance of the electrolysis unit (E) varies according to the temperature of the water from the mains, hardness of the water, flow rate of the water, softening capacity of the resin, pressure of the mains, amount of the solid particles dissolved in water (TDS), pH value of the mains water, voltage of the mains, salt rate of the water, and flow rate of ionized water at the outlet of the electrolysis unit (E).

[0028] According to the present invention, operation of the electrolysis unit (E) and the first heating element (S) is controlled based on an algorithm determined in the control unit by obtaining information such as pressure, temperature, pH, saltiness, TDS, conductivity, hardness, and flow rate by means of the first parameter measuring device (W1), the second parameter measuring device (W2), the third parameter measuring device (W3) and the fourth parameter measuring device (W4) which are located at the inlet and outlet of the resin chamber (RE) and at the inlet and outlet of the electrolysis unit (E) to control washing performance of the washing device.

[0029] Since the electrical current values passing between the first electrode (E1) and the second electrode (E2) in the electrolysis unit (E) will differ if the mains water is received into the washing device at different temper-

ature values, ionic concentrations of the ionized water to be produced will be different, accordingly. As the water temperature changes the conductivity of the water, the first electrode (E1) and the second electrode (E2) material, electrical current passing between the first electrode (E1) and the second electrode (E2) varies. In order to control temperature of water to be received into the electrolysis unit (E), temperature of water is measured by the first parameter measuring device (W1) and/or the second parameter measuring device (W2). If the measured water temperature value is below a predetermined water temperature value, the first heating element (S) is activated. Temperature of the washing water which has passed through the first heating element (S) and heated is measured by the third parameter measuring device (W3); and when the washing water reaches the predetermined temperature, the first heating element (S) is deactivated. When the measured water temperature value decreases below the predetermined water temperature value, the first heating element (S) is re-activated. For example, the first heating element (S) is activated if the predetermined water temperature is below 33°C, and the first heating element (S) is deactivated when the water temperature reaches 33°C. In this case, the first heating element (S) runs at ON and OFF positions at constant voltage value.

[0030] In another embodiment of the present invention, the first heating element (S) is connected to a voltage changeable power source (not shown in the figures) in order to control temperature of water at the inlet of the electrolysis unit (E) in a more precise manner. Power of the first heating element (S) can be adjusted by changing the voltage value. By this way, voltage of the first heating element (S) is able to be changed and controlled by the power source in order to enable the washing water temperature to reach the predetermined temperature value. In case the first heating element (S) is driven by a variable voltage, a quicker heating may be provided by using a first heating element (S) having a more powerful heating value, as well as eliminating the disadvantage that the first heating element (S) runs and stops continuously under constant voltage. For example, when the mains water has a temperature of 5°C, the first heating element (S) is operated at full power, and when the temperature value measured by the third parameter measuring device (W3) approaches the predetermined temperature value (e.g. 25°C), the power of the first heating element (S) is decreased in order to keep the temperature of water at the inlet of the electrolysis unit (E) constant. For example, it can be decreased from 230 Volt to 180 Volt to change resistance power.

[0031] In another embodiment of the present invention, as illustrated in the exemplary second look-up-table given above, the first heating element (S) is fixed at a different voltage value depending on the water temperature range value to be measured by the first parameter measuring device (W1) or the second parameter measuring device (W2). As illustrated in the exemplary second look-up-table, when the inlet water temperature is between

0-3°C, voltage of the first heating element (S) is fixed at 230 Volt while it may be fixed at 180 Volt when the inlet water temperature is between 15-18°C. Thus, by controlling the first heating element (S) via the voltage changeable power source, water temperature can be controlled precisely depending on the variable inlet water temperature and the variable mains flow rate.

[0032] In another embodiment of the present invention, in case that the mains water is cold and the flow rate increases depending on the variable mains pressure, flow rate of the water is able to be decreased to the predetermined value by means of the flow rate adjusting element (D) if the first heating element (S) cannot enable the washing water to reach the determined water temperature value within a given period. Therefore, the amount of heat that passes into the water per unit time from the first heating element (S) can be increased. In an exemplary embodiment, if the water temperature to be measured by the third parameter measuring device (W3) cannot reach the predetermined water temperature 20 seconds after the second valve (V2) is opened, the flow rate adjusting element (D) decreases the flow rate of the washing water. For example, water flow rate adjuster (D) is able to decrease the mains inlet flow rate from 1l/min to 0.5 l/min.

[0033] In another embodiment of the present invention, as illustrated in the exemplary third look-up-table given above, depending on the variable temperature of mains water, the flow rate adjusting element (D) can fix the flow rate of mains water at the predetermined values without changing voltage of the first heating element (S) for the predetermined value range of inlet water temperature, in order to control the amount of heat that will be transferred from the first heating element (S) to the washing water per unit time more precisely.

[0034] In another embodiment of the present invention, if the mains water is harder, it causes the resin chamber (RE) to fill faster, as well as causing the water passing through the resin chamber (RE) to not reach the desired softness at the outlet of the resin chamber (RE). Thus, it will cause a decrease in electrical current value between the first electrode (E1) and the second electrode (E2) and cause the pH values of the water, which will be ionized, to be weaker since the elements remaining in water, such as Mg and Ca, changes conductivity level of water. In order to prevent this, hardness value of water is measured by the second parameter measuring device (W2) at the outlet of the resin chamber (RE) and compared with the predetermined water hardness values. In order for the performance of the electrolysis unit (E) to not change depending on the water hardness values at the outlet of the resin chamber (RE), voltage values and current values of the electrolysis unit (E) are increased a little by means of the voltage adjustable power source, according to the current situation.

[0035] As illustrated in the exemplary first look-up-table given above, for example if the water hardness value at the outlet of the resin chamber (RE) is between 0-2

dF, the electrolysis unit (E) is supplied with 8 Volt while the electrolysis unit is supplied with 16 Volt if the water hardness level increases up to 8-16 dF. Therefore, by increasing the voltage of the electrolysis unit (E), the current values between the first electrode (E1) and the second electrode (E2) are completely increased above the current level obtained with the soft water. For example, when the water hardness value is between 0-2 dF, a desired pH is obtained with 8 Amps between the plates, and when the water hardness value is between 8-10 dF, a desired pH is obtained with 10 Amps between the first electrode (E1) and the second electrode (E2).

[0036] In another embodiment of the present invention, if the water hardness value measured by the second parameter measuring device (W2) is above the predetermined level, the washing process can be maintained by turning off the electrolysis unit (E) and regenerating the resin chamber (RE) with salt water in order to prevent transfer of hard water into the electrolysis unit (E), wherein the hard water may be caused by filling of the resin chamber (RE) as a result of variable water hardness or it may be received as a result of insufficient water softening capacity of the resin chamber (RE).

[0037] In another embodiment of the present invention, in case of missing information about the amount of salt to be taken from at least one sensor (not shown in the figures) provided in the salt chamber (Z) when a user forgets filling the salt chamber (Z), operation of the electrolysis unit (E) is blocked and an alert is provided for the user.

[0038] In another embodiment of the present invention, if the saltness rate of water that is determined by means of the second parameter measuring device (W2) is above the determined value, as a result of the regeneration of the resin chamber (RE), before the electrolysis unit (E) is operated, the electrolysis unit (E) is not operated and water is passed through the resin chamber (RE) until all of the salt remained in the resin chamber (RE) is removed. Here, operation of the electrolysis unit (E) is prevented until the value determined by the second parameter measuring device (W2) reaches the determined value. Therefore, production of chlorine gas that may occur during the electrolysis process of the salt water while the electrolysis unit (E) operates is prevented. For example, electrolysis unit (E) is not operated unless the predetermined value does not decrease to 650 ppm or below while the mains water is 450 ppm.

[0039] In another embodiment of the present invention, if the conductivity and TDS amounts measured by the third parameter measuring device (W3) at the inlet of the electrolysis unit (E) do not fall within the predetermined level range values, operation of the electrolysis unit (E) is blocked to prevent the electrolysis unit (E) from breaking down, and an alert is provided for the user.

[0040] Change in the number of dissolved particles in the washing water coming from the mains causes the conductivity value of the water to change and thus, causes the electrolysis unit (E) to produce ionized water that

has different pH values. In case the mains water is more alkaline, the basic water to be produced will have denser basic properties while the acidic water to be produced will have weaker acidic properties. On the contrary, in case the mains water is less alkaline, the basic water to be produced will have weaker basic properties while the acidic water to be produced will have stronger acidic properties. Since the operational performance of the electrolysis unit (E) will vary in different ambient conditions, the H⁺ and OH⁻ concentrations of the ionized water to be produced by the electrolysis unit (E) will change, and also the flow rates of the acidic and basic water that will be sent to the acidic water line (8) and the basic water line (7) at the outlet of the electrolysis unit (E) will change depending on these concentrations. Accordingly, amount of ionized water that will be sent to the collection reservoir (T) and the first chamber (1) and the second chamber (2) will be different. Variability of the amount of water that will be sent to the collection reservoir (T) will cause the washing performance of the washing device to change in each washing process. According to the present invention, if the conductivity and pH values of the water at the inlet of the electrolysis unit (E) are different, the predetermined pH values can be obtained by measuring the pH value of water by the fifth parameter measuring device (W5) and the fourth parameter measuring device (W4) and changing the flow rates by the first chamber flow rate adjuster (9) and the collection reservoir flow rate adjuster (10). If the acidic or basic water to be sent to the first chamber (1) is desired to be stronger, the first chamber flow rate adjuster (9) decreases the flow rate while the collection reservoir flow rate adjuster (10) increases the flow rate. Therefore, pH value of the ionized water which is to be sent to the first chamber (1) is continuously measured by the fourth parameter measuring device (W4) and the flow rate adjustment process is performed in desired rates via the first chamber flow rate adjuster (9) and the collection reservoir flow rate adjuster (10). When pH value of the ionized water reaches the desired level, the first chamber flow rate adjuster (9) and the collection reservoir flow rate adjuster (10) completes flow rate reducing process. After the pH values reach the desired level, the fifth parameter measuring device (W5) and the fourth parameter measuring device (W4) can continue to read the values of ionized water, so that pH values at the outlet of the electrolysis unit (E) are controlled. In a further embodiment of the present invention, operation algorithms described above can be evaluated together in the control unit for different ambient conditions to determine operation algorithm of the system.

[0041] In another embodiment of the present invention, current value between the first electrode (E1) and the second electrode (E2) can be fixed by changing voltage values of the electrolysis unit (E), regardless of different ambient conditions. For example, changing the voltage of the power source supplying the electrolysis unit (E) during operation period of the electrolysis unit (E) in different ambient conditions ensures that the current value

between the first electrode (E1) and the second electrode (E2) is fixed at 10 Amps continuously. In another embodiment of the present invention, if the current value between the first electrode (E1) and the second electrode (E2) increases above the predetermined current value during operation period of the electrolysis unit (E), the current value is restricted, regardless of different ambient conditions. For example, if the current value between the first electrode (E1) and the second electrode (E2) increases above 15 Amps in different ambient conditions, voltage value of the electrolysis unit (E) is changed to prevent the current value between the first electrode (E1) and the second electrode (E2) from increasing above 15 Amps.

Claims

1. A washing device comprising at least one washing compartment (K) adapted to receive at least one item (3) for washing, **characterized by** comprising:
 - at least one electrolysis unit (E) for obtaining acidic water and basic water by electrolyzing the water received from at least one water source;
 - at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit (E) and/or acidic water and/or basic water obtained at the electrolysis unit (E);
 - at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit (E), based on an information received from the measurement unit, the control unit being in connection with the measurement unit; and
 - at least a first heating element (S) for adjusting a temperature of water transferred to the electrolysis unit (E), wherein operation of the first heating element (S) is controlled by the control unit.
2. A washing device according to Claim 1, **characterized by** comprising at least one flow rate adjusting element (D) which adjusts a flow rate of the water to be transferred to the electrolysis unit (E), wherein operation of the flow rate adjusting element (D) is controlled by the control unit.
3. A washing device according to Claim 1 or 2, **characterized by** comprising at least one resin chamber (RE) for filtering the water, which is to be electrolyzed in the electrolysis unit (E), before entering the electrolysis unit (E) such that the water is purified from elements which cause hardness, such as calcium and magnesium.
4. A washing device according to Claim 3, **character-**

ized in that the measurement unit comprises at least a first parameter measuring device (W1) located at the inlet of the resin chamber (RE) and/or at least a second parameter measuring device (W2) located at the outlet of the resin chamber (RE).

5. A washing device according to any of the preceding claims, **characterized in that** the measurement unit comprises at least a third parameter measuring device (W3) which is located between the first heating element (S) and the electrolysis unit (E). 5
6. A washing device according to any of the preceding claims, **characterized by** comprising at least one collection reservoir (T) to which the basic water obtained in the electrolysis unit (E) is transferred. 10
7. A washing device according to any of the preceding claims, **characterized by** comprising at least a first chamber (1) to which the acidic water obtained in the electrolysis unit (E) is transferred. 15
8. A washing device according to Claim 7, **characterized by** comprising at least a second chamber (2). 20
9. An operation method suitable for use in a washing device which comprises at least one washing compartment (K) adapted to receive at least one item (3) for washing; at least one electrolysis unit (E) for obtaining acidic water and basic water by electrolyzing the water received from at least one water source; at least one measurement unit for measuring at least one parameter of water which is transferred to the electrolysis unit (E) and/or acidic water and/or basic water obtained at the electrolysis unit (E); at least one control unit for controlling at least one parameter of an electrolysis process, which is performed in the electrolysis unit (E), based on an information received from the measurement unit, the control unit being in connection with the measurement unit; and at least a first heating element for adjusting a temperature of water transferred to the electrolysis unit (E), wherein operation of the first heating element (S) is controlled by the control unit, **characterized by** comprising the steps of: 25
 - measuring, by the measurement unit, at least one parameter of at least one of the water which is transferred to the electrolysis unit (E), the acidic water obtained at the electrolysis unit (E) and the basic water obtained at the electrolysis unit (E); and 30
 - controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured. 35

10. An operation method according to Claim 9, **charac-** 40

terized in that in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter measured, a current value supplied to the electrolysis unit (E) is controlled.

11. An operation method according to Claim 10, **characterized in that** the current value is determined according to a hardness level of the water transferred to the electrolysis unit (E). 45
12. An operation method according to Claim 9, **characterized in that** in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter, a voltage level supplied to the first heating element (S) is controlled. 50
13. An operation method according to Claim 12, **characterized in that** the voltage level is determined according to a temperature value which is measured by at least a first parameter measuring device (W1) and/or at least a second parameter measuring device (W2). 55
14. An operation method according to Claim 9, **characterized in that** in the step of controlling, by the control unit, at least one parameter of electrolysis process performed in the electrolysis unit (E) based on at least one parameter, a flow rate of water to be transferred to the electrolysis unit (E) is controlled.
15. An operation method according to Claim 14, **characterized in that** the flow rate is controlled according to a temperature value which is measured by at least a first parameter measuring device (W1) and/or at least a second parameter measuring device (W2).

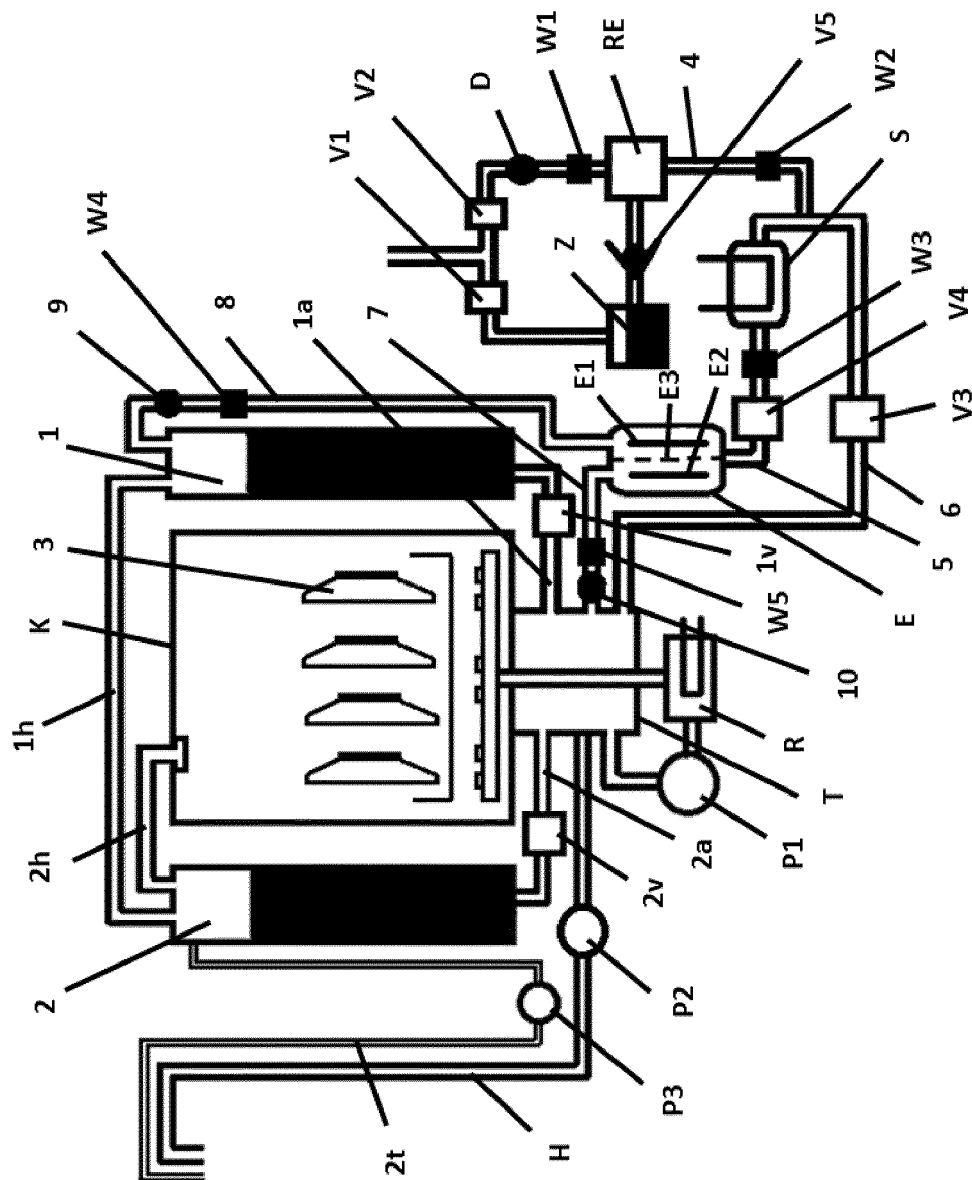


Figure - 1



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EP 20 16 5937

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