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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 570-6207 (JP)

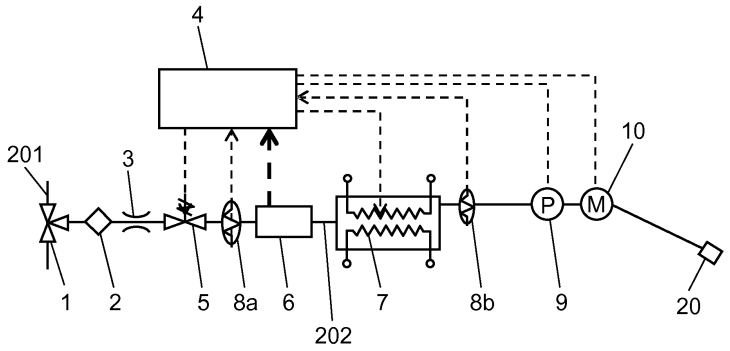
(72) Inventors:
- **FUJII, Yuko**
  Osaka-shi,
  Osaka 540-6207 (JP)
- **NOZAWA, Kohei**
  Osaka-shi,
  Osaka 540-6207 (JP)
- **KATO, Saori**
  Osaka-shi,
  Osaka 540-6207 (JP)

(74) Representative: **Schwabe - Sandmair - Marx**
Patentanwälte Rechtsanwalt Partnerschaft mbB
Joseph-Wild-Straße 20
81829 München (DE)

(54) **SANITARY WASHING DEVICE**

(57) A sanitary washing device includes nozzle (20) that moves to a predetermined washing position and ejects washing water, washing water flow path (202) that guides the washing water to nozzle (20), and positive-displacement pump (9) that causes nozzle (20) to eject the washing water. The sanitary washing device further includes heat exchanger (7) that heats the washing water, sterilizer (6) that is disposed on an upstream side of heat exchanger (7) for sterilizing the washing water, and controller (4) that controls positive-displacement pump (9), heat exchanger (7), and sterilizer (6). In doing so, sterilizer (6) can sterilize bacteria that are present in the washing water or in washing water flow path (202). As a result, it is possible to realize a sanitary washing device that washes a private area with clean washing water.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a sanitary washing device that washes a human body.

BACKGROUND ART

[0002] In the related art, a warm water washing toilet seat includes a sanitary washing device that sprays warm water from a nozzle device toward a private area. The nozzle device is configured such that a nozzle portion approaches the private area of a human body and sprays washing water for washing. However, the sanitary washing device with the aforementioned configuration tends to be exposed to sewage or sewage water at the nozzle portion during the washing. Thus, a sanitary washing device with a configuration of washing the nozzle portion has been proposed (see Patent Literature 1, for example).

[0003] The sanitary washing device described in Patent Literature 1 has a configuration in which a liquid chemical is poured into washing water and is then sprayed when the nozzle portion is washed. Then, the nozzle portion is washed by splashing of the washing water or by exposing the nozzle portion to the washing water. In doing so, contamination at the nozzle portion is removed by a chemical effect of the liquid chemical.

[0004] However, the configuration of the sanitary washing device in the related art cannot sterilize bacteria that has propagated in the washing water or in the washing water flow path up to the nozzle. That is, the private area is washed with the washing water containing the bacteria. Therefore, there are problems in terms of sanitation and the like.

Citation List

Patent Literature

[0005] PTL 1: Japanese Patent Unexamined Publication No. 8-93034

SUMMARY OF THE INVENTION

[0006] The invention provides a sanitary washing device capable of sterilizing washing water and the inside of a washing water flow path up to a nozzle.

[0007] That is, a sanitary washing device according to the invention includes a nozzle that moves to a predetermined washing position and ejects washing water, a washing water flow path that guides the washing water to the nozzle, a pump that causes the nozzle to eject the washing water, and a heater that heats the washing water. The sanitary washing device further includes a sterilizer that is disposed on an upstream side of the heater for sterilizing the washing water and a controller that controls the pump, the heater, and the sterilizer.

[0008] With such a configuration, the sterilizer can sterilize bacteria that are present in the washing water or in the washing water flow path. In doing so, it is possible to implement a sanitary washing device that washes a private area with clean washing water.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1. is a perspective view of a toilet apparatus on which a sanitary washing device according to a first embodiment of the invention is mounted.

FIG. 2. is a diagram schematically illustrating a configuration of a supply system of washing water to a nozzle at a main body of the sanitary washing device according to the embodiment.

Fig. 3 is a sectional view illustrating a configuration of a sterilizer of the sanitary washing device according to the embodiment.

Fig. 4 is a graph illustrating a relationship between a water temperature and ozone concentration at the sterilizer according to the embodiment.

Fig. 5 is a diagram schematically illustrating a configuration of a main body of a sanitary washing device according to a second embodiment of the invention.

Fig. 6 is a diagram schematically illustrating a configuration of a main body of a sanitary washing device according to a third embodiment of the invention.

Fig. 7 is a diagram schematically illustrating a configuration of a sanitary washing device according to a fourth embodiment of the invention.

Fig. 8A is a sectional view illustrating a scale pulverizer according to the embodiment.

Fig. 8B is a sectional view illustrating another example of the scale pulverizer according to the embodiment.

Fig. 9 is a diagram schematically illustrating a configuration of a main body of a sanitary washing device according to a fifth embodiment of the invention.

EMBODIMENTS FOR IMPLEMENTING THE INVENTION

[0010] Hereinafter, description will be given of a sanitary washing device according to embodiments of the invention with reference to drawings. The embodiments are not intended to limit the invention.

(FIRST EMBODIMENT)

[0011] Hereinafter, description will be given of a sanitary washing device according to a first embodiment of the invention and a toilet apparatus provided with the sanitary washing device with reference to Fig. 1.

[0012] Fig. 1 is a perspective view of a toilet apparatus with the sanitary washing device according to the first

embodiment of the invention attached thereto.

[0013] As illustrated in Fig. 1, toilet apparatus 1000 according to the embodiment is configured of at least toilet bowl 600, sanitary washing device 100 attached to toilet bowl 600, and the like. Toilet apparatus 1000 is installed in a toilet room

[0014] Sanitary washing device 100 is configured of at least main body 200, manipulator 300, toilet seat 400, cover 500, and the like. Main body 200 includes a built-in washing water supply mechanism controlled by controller 4 (see Fig. 2). Toilet seat 400 and cover 500 are attached to main body 200 so as to be able to be freely opened and closed.

[0015] The washing water supply mechanism built in main body 200 supplies washing water, which has been supplied from plumbing, to nozzle 20. Nozzle 20 sprays the supplied washing water to a private area of a user. In doing so, the private area is washed.

[0016] Toilet apparatus 1000 according to the embodiment is configured as described above.

[0017] Hereinafter, description will be given of a configuration of a water supply system in a main body of the sanitary washing device according to the embodiment with reference to Fig. 2.

[0018] Fig. 2 is a diagram schematically illustrating a configuration of a system of supplying the washing water to the nozzle at the main body of the sanitary washing device according to the embodiment.

[0019] First, washing water flow path 202 of main body 200 that reaches nozzle 20 via branched faucet 1 is connected to plumbing 201 as a water supply source of the washing water as illustrated in Fig. 2.

[0020] Strainer 2, flow regulating valve 3, electromagnetic valve 5, sterilizer 6, temperature sensor 8a, heat exchanger 7, temperature sensor 8b, and positive-displacement pump 9 are inserted into washing water flow path 202 in this order from branched faucet 1 to nozzle 20. Nozzle 20 includes motor 10 that drives nozzle 20 and takes nozzle 20 into and out of a predetermined position.

[0021] Next, description will be given of a flow of the washing water in main body 200 of sanitary washing device 100 and control of the respective components in main body 200 performed by controller 4.

[0022] First, tap water flowing through plumbing 201 is supplied as washing water to strainer 2 via branched faucet 1. Strainer 2 removes foreign matters, impurities, and the like contained in the washing water.

[0023] At this time, controller 4 controls electromagnetic valve 5 to switch a washing water supply state and supply the washing water to the inside of washing water flow path 202. The washing water flowing inside washing water flow path 202 passes through flow regulating valve 3 and is depressurized. Flow regulating valve 3 is configured of a variable orifice or the like that has an orifice diameter varying due to water pressure acting and is made of rubber, for example.

[0024] Next, controller 4 causes temperature sensor 8a to detect the temperature of the washing water flowing inside washing water flow path 202. Controller 4 controls sterilizer 6 based on the temperature detected by temperature sensor 8a. Sterilizer 6 generates ozone water from the washing water flowing inside washing water flow path 202.

[0025] Next, the washing water after passing through sterilizer 6 is supplied to heat exchanger 7 with a heater provided on the downstream side of sterilizer 6 and on the upstream side of positive-displacement pump 9. The heater of heat exchanger 7 heats the supplied washing water to a predetermined temperature (39°C, for example).

[0026] Next, controller 4 drives positive-displacement pump 9 connected to heat exchanger 7. In doing so, the washing water at a flow rate in accordance with an operating speed of positive-displacement pump 9 is ejected from nozzle 20. Then, the private area of the user is washed. At this time, controller 4 controls the heating operation performed by the heater of heat exchanger 7 based on the temperature of the washing water measured by temperature sensors 8a and 8b and the flow rate of the washing water controlled by positive-displacement pump 9. In the embodiment, a pulsatile pump is used as positive-displacement pump 9.

[0027] The components of the sanitary washing device are controlled and the washing water is made to flow as described above.

[0028] Hereinafter, specific description will be given of a configuration of the sterilizer of the sanitary washing device according to the embodiment with reference to Fig. 3.

[0029] Fig. 3 is a sectional view illustrating a configuration of the sterilizer of the sanitary washing device according to the embodiment.

[0030] As illustrated in Fig. 3, sterilizer 6 is configured of electrolysis tank 6a, anode electrode 6b, and cathode electrode 6c. Anode electrode 6b and cathode electrode 6c are disposed in an axial direction of electrolysis tank 6a. At this time, anode electrode 6b is disposed at the center of electrolysis tank 6a, and cathode electrode 6c is disposed at an inner surface on each of both sides of electrolysis tank 6a. In doing so, washing water electrolysis flow path 6f is formed between anode electrode 6b and cathode electrode 6c. Then, the washing water flows and enters from inlet 6d of electrolysis tank 6a, passes through electrolysis flow path 6f, and flows out from outlet 6e of electrolysis tank 6a.

[0031] That is, sterilizer 6 electrolyzes the washing water in electrolysis flow path 6f and efficiently generates ozone water. Bacteria are brought into contact with the ozone water generated by the electrolysis when passing in electrolysis flow path 6f. In doing so, the bacteria can be sterilized.

[0032] The sterilizer of the sanitary washing device is configured as described above.

[0033] Hereinafter, specific description will be given of anode electrode 6b and cathode electrode 6c configuring

the sterilizer of the sanitary washing device.

[0034] Anode electrode 6b and cathode electrode 6c are formed by causing electrode catalysts to adhere to surfaces of metal boards. Thicker metal boards can further suppress influences of warping or deflection caused during installation on electrolysis tank 6a. Thus, titanium (Ti) with a thickness of 0.5 to 1 mm, for example, is used as the metal boards in the embodiment. Anode electrode 6b is formed by causing an electrode catalyst made of a tantalum oxide (TaOx) layer, for example, with a thickness of about 1000 nm to adhere to the surface of the metal board. In contrast, cathode electrode 6c is formed by causing an electrode catalyst made of a platinum (Pt) layer or an alloy layer of platinum (Pt) and iridium (Ir) with a thickness of 1000 nm, for example, to adhere to the surface of the metal board. In addition to the aforementioned electrode catalysts, noble metal or noble metal oxide, for example, may be contained.

[0035] Hereinafter, specific description will be given of a method of producing anode electrode 6b and cathode electrode 6c.

[0036] For anode electrode 6b, a solvent with a mixture ratio between isopropyl alcohol and ethylene glycol monoethyl ether adjusted to 4:1, for example, is produced first in a case of using platinum as noble metal, for example. Then, hexachloroplatinic acid hexahydrate and tantalum ethoxide are dissolved in the produced solvent such that total concentration of platinum and tantalum is 1.45 mol/l (mol/liter). In such a case, the mixture ratio between platinum and tantalum is adjusted such that the content of tantalum is equal to or greater than 75 mol% and the remainder corresponds to platinum in the composition ratio between tantalum oxide and platinum in the electrode catalyst. In doing so, it is possible to form preferable electrodes for generating ozone.

[0037] Anode electrode 6b is produced by applying an electrode catalyst of tantalum oxide with a thickness of 1 nm to several hundreds of nm to the surface of the metal board a plurality of times and burning the electrode catalyst. In such a case, the thickness of the electrode catalyst for anode electrode 6b is preferably equal to or greater than 500 nm, for example. This enhances film performances of the electrode catalyst and adhesion strength between the films. Furthermore, electrode duration time of anode electrode 6b and ozone generation efficiency are enhanced.

[0038] Thus, anode electrode 6b is formed by applying the electrode catalyst made of tantalum oxide with a thickness of 30 nm to the surface of the metal board twenty five times and burning the electrode catalyst in the embodiment. The burning is preferably performed at a burning temperature from 300 to 700°C. This enhances adhesiveness between the metal board and the electrode catalyst and enables precise formation of the electrode catalyst. It is further preferable that the electrode catalyst is burned at a temperature from 550 to 650°C. This enhances ozone generation efficiency and electrode duration time. In the embodiment, anode electrode 6b is formed by burning the electrode catalyst at a burning temperature of 600°C and forming the electrode catalyst made of tantalum oxide on the metal board.

[0039] In order to further enhance the adhesiveness between the metal board and the electrode catalyst and to enhance the electrode duration time and ozone generation, it is preferable to roughen the surface of the metal board to obtain a rough surface. Specifically, the rough surface is obtained by performing blast processing or etching processing, for example, on the surface of the metal board to rough the surface. In doing so, the electrode catalyst enters the irregularity on the rough surface formed on the surface of the metal surface. As a result, a contact area between the surface of the metal board and the electrode catalyst increases, and a higher anchor effect can be achieved. At this time, the surface roughness Ra of the metal board is preferably equal to or greater than 1.5. If the surface roughness Ra of the metal board is set to 3, in particular, the adhesiveness between the metal board and the electrode catalyst further increases as compared with the case where the surface roughness Ra is 1.5. As a result of studies, it was discovered that time required for the electrode catalyst to peel off from the metal board can increase to about 1.5 times as long as the original time. Thus, the metal board is dipped into hot oxalic acid at 100°C, for example, for 3 hours to etch the surface in the embodiment.

[0040] In order to suppress corrosion of the metal board and to enhance the electrode duration time, it is further preferable to form a metal layer on the metal board.

[0041] Thus, description will be given below of a method of producing anode electrode 6b using platinum as the metal layer according to the embodiment.

[0042] First, titanium (Ti) is used as the metal board, and the rough surface is formed by performing etching processing with hot oxalic acid and roughening the surface.

[0043] Then, the metal layer is formed by applying platinum as the metal layer to the surface of the metal board several times and burning the platinum.

[0044] Then, an electrode catalyst film is formed by similarly applying tantalum oxide as the electrode catalyst to (the surface of) metal layer made of platinum several times and burning tantalum oxide. Anode electrode 6b is produced by the aforementioned method. This enables extension of the time required for the metal board to cause pitting corrosion by about 40%. As the metal layer, iridium (Ir), ruthenium (Ru), or niobium (Nb) may be used instead of platinum, and the same effects can be achieved.

[0045] According to the embodiment, anode electrode 6b is configured by forming tantalum oxide as the electrode catalyst on the surface of the metal board using titanium as described above. In doing so, anode electrode 6b with an area of 1/4 times as large as that of an electrode with another configuration (a platinum electrode, for example) can generate substantially the same

amount of ozone. As a result, it is possible to reduce the sizes and the costs of the electrodes and the electrolysis tank.

[0046] Hereinafter, description will be given of an ozone water generation mechanism of tantalum oxide used for the electrode catalyst in anode electrode 6b according to the embodiment, including conjecture.

[0047] First, a thin depleted layer is formed at a boundary between the surface of tantalum oxide as the electrode catalyst and the washing water.

[0048] Then, electrons generated by a reaction at anode electrode 6b pass through the depleted layer formed on the surface of tantalum oxide by a tunnel effect. In doing so, a potential for exchange of the electrons becomes equal to or greater than an ozone oxidation-reduction potential. It is considered that as a result, the ozone generation reaction is more efficiently performed and ozone water can be generated.

[0049] In the related art, lead dioxide, diamond, or platinum, for example, is used as an electrode catalyst for generating ozone water. However, in the case of lead, there is a concern in influences on an environment and human bodies. In the case of diamond or platinum, there are problems such as high cost and low generation efficiency of ozone water. Therefore, it is difficult to generate ozone water by applying the electrode catalyst in the related art to a wide range of purposes.

[0050] Thus, tantalum oxide is used as the electrode catalyst in the embodiment. Tantalum oxide can generate ozone at lower current density as compared with platinum in the related art. Tantalum oxide has an advantage that ozone generation efficiency is further enhanced at lower current density.

[0051] Furthermore, tantalum oxide exhibits a high oxygen overvoltage. Therefore, it is possible to generate ozone at a voltage over about 1.5 V, for example, without generating oxygen at a low voltage. In doing so, tantalum oxide can generate ozone with power of about 1/4 times as high as that for platinum in the related art. As a result, it is possible to further enhance an energy saving property in a case of applying tantalum oxide to a home appliance.

[0052] As described above, it is possible to efficiently generate ozone water by using tantalum oxide for the electrode catalyst.

[0053] Hereinafter, description will be given of a bacteria elimination effect of the ozone water generated by sterilizer 6.

[0054] A CT value is typically used as one of indexes of a bacteria elimination performance. C represents concentration (ppm), and T represents time (minute). That is, the CT value is a product of concentration C of active species and contact time T with the bacteria necessary for sterilizing or eliminating bacteria. That is, a smaller CT value represents a higher bacterial elimination performance.

[0055] Since the CT value that represents the bacteria elimination performance of the ozone water generated in the embodiment is smaller than that of a hypochlorous acid solution by about one or more orders of magnitude, the ozone water exhibits high reactivity. Therefore, the ozone water can instantaneously (short time) eliminate bacteria at a low concentration, which is difficult for the hypochlorous acid solution. That is, the ozone water can perform sterilization while the washing water where bacteria are present flows into electrolysis tank 6a of sterilizer 6 and is then ejected from nozzle 20. Ozone water can maintain washing water flow path 202 to be clean.

[0056] In contrast, in a case of performing sterilization by generating a high-concentration hypochlorous acid solution, it is necessary to apply a high current or voltage to the electrodes for electrolysis of the washing water. Therefore, durability of the electrodes configuring the sterilizer cannot be secured. Furthermore, there is a problem that the energy saving property deteriorates. However, according to the electrode configuration in the sterilizer of the embodiment, the above problem does not occur when the hypochlorous acid solution is generated.

[0057] In the case of generating the hypochlorous acid solution by electrolysis, it is necessary for the washing water to contain chlorine ions. Furthermore, the amount of hypochlorous acid generated differs depending on the amount of chlorine ions contained in the washing water. That is, sterilizing performances may differ depending on areas. Therefore, it is necessary to supply chlorine ions in a case where the amount of chlorine ions contained in the washing water is excessively small. However, the electrode catalyst made of tantalum oxide is formed on the surface of anode electrode 6b according to the embodiment. The electrode catalyst of anode electrode 6b efficiently generate the ozone water with the aforementioned mechanism. Therefore, the sterilizing performance is not affected by water quality (such as the amount of chorine ions) depending on areas. As a result, it is possible to obtain a constantly stable sterilizing performance by sterilizer 6.

[0058] The sanitary washing device according to the embodiment is configured such that sterilizer 6 with electrolysis tank 6a is installed on the upstream side of heat exchanger 7. This is for preventing the ozone water generation efficiency from differing depending on a water temperature of the washing water.

[0059] Hereinafter, description will be given of a reason that the ozone water generation efficiency differs depending on the water temperature of the washing water with reference to Fig. 4.

[0060] Fig. 4 is a graph illustrating a relationship between the water temperature and the ozone concentration of the sterilizer according to the embodiment.

[0061] As illustrated in Fig. 4, it is possible to understand that the amount of ozone dissolved in the washing water decreases and the concentration of dissolved ozone decreases as the water temperature of the washing water increases.

[0062] In a case of generating the ozone water by electrolyzing warm water at about 39°C that is sprayed from the nozzle after being heated by heat exchanger 7, in

particular, a large part of generated ozone is released as ozone gas without being dissolved in water. Therefore, the ozone concentration in the washing water decreases, and the bacteria elimination performance deteriorates. There is also a concern that ozone gas that does not act for eliminating bacteria in the washing water is diffused in a toilet space, which may cause a disadvantage for the user.

[0063] Thus, sterilizer 6 with electrolysis tank 6a is installed on the upstream side of heat exchanger 7 to electrolyze the washing water at a low temperature before being heated by heat exchanger 7 in the embodiment. In doing so, it is possible to increase ozone concentration in the washing water and to efficiently generate the ozone water. As a result, it is possible to implement the sanitary washing device with the excellent bacteria elimination performance.

[0064] By disposing sterilizer 6 as described above, the heater of heat exchanger 7 can heat the ozone water generated from the washing water at the low temperature. This can enhance activity and reactivity of ozone. As a result, the bacteria elimination performance is significantly enhanced.

[0065] Hereinafter, specific description will be given of the bacteria elimination performance of sterilizer with the configuration according to the embodiment.

[0066] First, water at 20°C containing 10000 CFU (Colony Forming Unit)/ml of coli bacteria is made to flow into electrolysis tank 6a. About 0.1 ppm of ozone water is generated from the flowing water in electrolysis tank 6a of sterilizer 6. Then, a bacteria elimination rate of water ejected from the nozzle is evaluated in a state where a power of the heater of heat exchanger 7 is turned off. As a result, the bacteria elimination rate of coli bacteria is 99%, and 1% of coli bacteria cannot be eliminated.

[0067] In contrast, the power of the heater of heat exchanger 7 is turned on in a state where the above ozone water is generated, the temperature of water exiting electrolysis tank 6a is raised to 39°C, and the bacteria elimination rate in the water ejected from the nozzle is evaluated. As a result, the bacteria elimination rate of coli bacteria is 99.99%, and 0.01% of coli bacteria remains at the most.

[0068] Based on the above evaluation results, the reactivity of ozone is enhanced by heating the generated ozone water by heat exchanger 7. In doing so, the rate of non-eliminated bacteria is enhanced by about two or more orders of magnitude from about 1% to 0.01% or less. As a result, the bacteria elimination performance can be significantly enhanced.

[0069] In the sanitary washing device according to the embodiment, temperature sensor 8a detects the washing water before flowing into electrolysis tank 6a in sterilizer 6. Controller 4 is configured to then control a voltage or a current to be applied to the electrodes at the time of electrolysis of the washing water based on the detected temperature of the washing water. With such a configuration, variations in the ozone concentration due to variations in the water temperature of the washing water entering electrolysis tank 6a are suppressed. As a result, it is possible to generate the washing water with stable ozone concentration without being affected by the water temperature of the washing water.

[0070] Specifically, in a case where the water temperature of the washing water detected by temperature sensor 8a is 5°C, for example, controller 4 reduces the voltage of the electrolysis and reduces the ozone concentration in the washing water. In contrast, in a case where the temperature is 35°C, controller 4 increases the voltage of the electrolysis and raises the ozone concentration in the washing water. In doing so, it is possible to secure the constantly stable ozone concentration without depending on the variations in the water temperature. As a result, it is possible to obtain the stable bacteria elimination performance.

[0071] Furthermore, it is important to increase the electrode duration time of anode electrode 6b and cathode electrode 6c for maintaining the generation at the constantly stable ozone concentration and the bacteria elimination performance for a long period of time.

[0072] Thus, the sanitary washing device according to the embodiment is configured such that ends of anode electrode 6b and cathode electrode 6c is covered by coating processing without being exposed. In doing so, it is attempted to further extend the electrode duration time of anode electrode 6b and cathode electrode 6c.

[0073] That is, concentration of the current on the ends of anode electrodes 6b and cathode electrode 6c during the electrolysis is suppressed by the coating processing. Furthermore, peeling-off of the electrode catalysts, which adhere to the metal boards of anode electrode 6b and cathode electrode 6c, from the metal boards is suppressed.

[0074] Specifically, the current concentrates on the electrode ends of anode electrode 6b and cathode electrode 6c during the electrolysis, in particular. Therefore, pitting corrosion of the metal board occurs from the electrode ends. As a result, the electrode duration time of anode electrode 6b and cathode electrode 6c is shortened.

[0075] The electrode catalysts adhering to the metal boards of anode electrode 6b and cathode electrode 6c easily peel off from the ends of the electrodes due to physical effects such as impact at the time of punching the electrodes and influences of a water flow of the washing water during the electrolysis. Thus, the electrode ends are covered by the coating processing or with sealing or the like and are covered. This can prevent the exposure of the metal board of anode electrode 6b and cathode electrode 6c. At the same time, it is possible to effectively suppress the peeling-off of the electrode catalysts from the metal boards of anode electrode 6b and cathode electrode 6c.

[0076] Specifically, the ends of anode electrode 6b and cathode electrode 6c are coated with UV resin, for example, in the embodiment. In doing so, it is possible to

extend the time required for pitting corrosion being generated in the metal boards of anode electrode 6b and cathode electrode 6c by about 30%.

[0077] Although the aforementioned embodiment was described as the example in which the ends of anode electrode 6b and cathode electrode 6c were coated with the UV resin, the invention is not limited thereto. A configuration of forming anode electrode 6b and cathode electrode 6c by coating and burning glass paste, for example or coating with a tape, resin, or the like is also applicable as long as the metal boards are not exposed with the configuration. In doing so, the same effects can be achieved.

[0078] A configuration is also applicable in which a value of a current to be applied between anode electrode 6b and cathode electrode 6c is controlled, for example, in order to further extend the electrode duration time.

[0079] In general, a control method in which a low current is applied between anode electrode 6b and cathode electrode 6c from an initial stage in which the electrode catalysts are formed is typically employed.

[0080] However, in the case of anode electrode 6b according to the embodiment, the electrode catalyst made of tantalum oxide has high activity in the initial stage of formation. Therefore, the concentration of ozone, which is generated by the electrode catalysts during initial energization, in the washing water is higher than the ozone concentration after the energization for 100 hours.

[0081] Thus, the current to be applied between electrode catalysts of anode electrode 6b and cathode electrode 6c in the initial stage of formation is lowered than a prescribed value in the embodiment. Then, control is performed so as to increase the applied current with elapse of time of the electrolysis. In doing so, it is possible to suppress damage due to the applied current on the electrode catalysts in the initial stage of the formation. Furthermore, it is possible to suppress a decrease in the ozone concentration in the washing water as compared with that in the initial stage and to supply the washing water containing ozone at a stable concentration over a long period of time.

[0082] Specifically, the sanitary washing device according to the embodiment controls applied current density from the initial stage of the formation of the electrode catalysts to 100 hours to 10 mA/cm2, and controls applied current density after 100 hours to 15 Ma/cm2. That is, control is performed such that the applied current increases in a stepwise manner with elapse of time of the electrolysis. In doing so, it is possible to constantly hold the concentration of generated ozone over a long period of time. As a result, it is possible to extend the electrode duration time of anode electrode 6b and cathode electrode 6c by about 20%.

[0083] Although the aforementioned embodiment was described as the example in which the applied current is made to increase in the stepwise manner, the invention is not limited thereto. The control may be performed so as to gradually increase the applied current (applied current density) with the elapse of time. In doing so, it is possible to further uniformly hold the ozone concentration in the washing water.

[0084] Although not particularly described in the aforementioned embodiment, an organic substance remover that removes organic substances and the like may be provided on the upstream side beyond electrolysis tank 6a of sterilizer 6 in the washing water flow path 202. In doing so, the performance of eliminating bacteria and the like contained in the washing water is further enhanced.

[0085] Specifically, an activated carbon filter, for example, is provided as the organic substance remover. The activated carbon filter suctions the organic substances contained in the washing water. Then, the washing water from which the organic substances have been removed are electrolyzed by electrolysis tank 6a of sterilizer 6. In doing so, consumption (decrease) of ozone contained in the washing water due to the organic substances can be suppressed. As a result, it is possible to further stably hold the concentration of ozone contained in the washing water and to maintain the bacteria elimination performance in a predetermined level over a long period of time.

[0086] Although the aforementioned embodiment was described as the case in which ozone was used as the active species, the invention is not limited thereto. For example, chlorine or another active species (such as hydrogen peroxide or OH radical) may be used, and the same effects can be achieved. In the case where the active species is chlorine, the problem of variations in the chlorine ion concentration depending on areas occurs. However, it is possible to reduce the amount of hypochlorite used for other purpose than the bacteria elimination by providing the aforementioned organic substance remover. Since the activated carbon of the organic substance remover does not remove chlorine ions at this time, it is possible to increase the bacteria elimination rate.

[0087] Although the configuration in which a voltage (or a current) was simply applied between anode electrode 6b and cathode electrode 6c from one direction was described as an example in the aforementioned embodiment, the invention is not limited thereto. For example, a configuration is also applicable in which electrolysis is performed while polarities of the voltages (or the currents) applied to anode electrode 6b and cathode electrode 6c are inverted.

[0088] Hereinafter, description will be given of a reason thereof.

[0089] If the washing water is electrolyzed in electrolysis tank 6a of sterilizer 6, scale components such as calcium or magnesium contained in the washing water adhere to the surface of cathode electrode 6c. If the scale components adhere to the surface of cathode electrode 6c, the flow velocity, the flow rate, and the like of water flowing in electrolysis flow path 6f between anode 6b and cathode electrode 6c deteriorate. Furthermore, there is a concern that energization efficiency of cathode elec-

trode 6c deteriorates.

[0090] Thus, the polarities of the currents applied to anode electrode 6b and cathode electrode 6c are inverted, and the washing water is electrolyzed according to the embodiment. In doing so, adhering of the scale components to cathode electrode 6c is suppressed.

[0091] Hereinafter, description will be given of specific operations and effects.

[0092] If a current is applied in one direction, cathode electrode 6c typically electrically attracts cation of calcium, magnesium, or the like contained in the washing water. The surface of cathode electrode 6c is alkalified. Therefore, calcium or magnesium in the washing water are precipitated as calcium hydroxide or calcium hydroxide on the surface of cathode electrode 6c. Alternatively, calcium or magnesium adheres to the surface of cathode electrode 6c as calcium carbonate or magnesium carbonate due to a reaction with carbonate ions.

[0093] Thus, the washing water is electrolyzed while the polarities of the currents applied to anode electrode 6b and cathode electrode 6c are inverted. In doing so, it is possible to suppress generation, adhering, and the like of the scale components such as calcium hydroxide, calcium hydroxide, calcium carbonate, magnesium carbonate, and the like generated on the surface of cathode electrode 6c. It is also possible to remove the scale components adhering to the surface of cathode electrode 6c. Specifically, pH in the vicinity of the electrodes is strongly acidified due to polarity inversion of the electrodes. Therefore, it is possible to dissolve the scale precipitated on the surfaces of the electrodes or to remove the scale by making the scale peel off from interfaces of the electrodes.

(SECOND EMBODIMENT)

[0094] Hereinafter, description will be given of a sanitary washing device according to a second embodiment of the invention and a toilet apparatus provided with the sanitary washing device with reference to Fig. 5. Since the toilet apparatus is the same as that in the first embodiment, description thereof will be omitted.

[0095] Fig. 5 is a diagram schematically illustrating a configuration of a main body of the sanitary washing device according to the second embodiment of the invention.

[0096] As illustrated in Fig. 5, the sanitary washing device according to the embodiment is different from that according to the first embodiment in that reservoir 11 is provided on the downstream side of electrolysis tank 6a forming sterilizer 6 and further on the downstream side of heat exchanger 7. Other configurations and operations are the same as those according to the first embodiment. The same reference numerals will be given to the same components as those in the first embodiment, and descriptions thereof will be omitted.

[0097] Reservoir 11 according to the embodiment is provided to secure the contact time between the active species such as ozone water generated in electrolysis tank 6a and bacteria.

[0098] As described above in the first embodiment, a bacteria elimination performance of ozone water generated by sterilizer 6 can be typically determined by a CT value.

[0099] In a case where a CT value of the ozone water against coli bacteria is 0.02 and the concentration of the ozone water is 0.02 ppm, for example, the time (contact time T) required for sterilizing coli bacteria is one minute. In a case where the concentration of the active species is 0.2 ppm, only 1/10 minutes is enough for the contact time T with the bacteria. That is, this means the sterilization can be done if bacteria are brought into contact with the 0.2 ppm of active species for 6 seconds.

[0100] However, in a case of using washing water containing ozone at a low concentration, it is necessary to secure the sterilizing performance by extending the contact time between bacteria and the active species.

[0101] Thus, reservoir 11 is provided on the downstream side of electrolysis tank 6a in the embodiment. In doing so, the contact time between the active species and bacteria is extended in reservoir 11. As a result, the sterilizing performance is further enhanced.

[0102] It is possible to extend the contact time between the active species and bacteria and to thereby reduce the concentration of ozone generated in the washing water. In doing so, it is possible to extend electrode duration time of anode electrode 6b and cathode electrode 6c. Furthermore, it is possible to reduce a voltage or a current to be applied in electrolysis. As a result, it is possible to maintain a bacteria elimination performance over a long period of time and to enhance an energy saving property.

[0103] Although the configuration in which reservoir 11 was provided on the downstream side of heat exchanger 7, in particular, was described as an example in the aforementioned embodiment, the invention is not limited thereto. For example, reservoir 11 may be disposed at an arbitrary position as long as reservoir 11 is disposed on the downstream side of electrolysis tank 6a. In doing so, it is possible to obtain the same sterilizing performance. However, it is more preferable that reservoir 11 is provided on the downstream side of heat exchanger 7. The reason is that an activity of the ozone water is further enhanced by being heated by heat exchanger 7.

(THIRD EMBODIMENT)

[0104] Hereinafter, description will be given of a sanitary washing device according to a third embodiment of the invention and a toilet apparatus provided with the sanitary washing device with reference to Fig. 6. Since the toilet apparatus is the same as that in the first embodiment, the description thereof will be omitted.

[0105] Fig. 6 is a diagram schematically illustrating a configuration of a main body of the sanitary washing device according to the third embodiment of the invention.

[0106] As illustrated in Fig. 6, the sanitary washing de-

vice according to the embodiment is different from that according to the first embodiment in that active species remover 12 is provided on the downstream side of electrolysis tank 6a configuring sterilizer 6 and on the upstream side of positive-displacement pump 9. Other configurations and operations are the same as those in the first embodiment. The same reference numerals will be given to the same components as those in the first embodiment, and the descriptions thereof will be omitted.

[0107] Active species remover 12 according to the embodiment is provided to remove or decompose active species such as ozone water generated in electrolysis tank 6a.

[0108] Typically, controller 4 of the sanitary washing device controls the amount of generated active species such as ozone by a current or a voltage such that the concentration of active species generated becomes the concentration of active species that is equal to or less than several ppm that does not affect a human body.

[0109] However, there is a case where such a trouble that an excessive current or voltage is applied to the electrode or water at a predetermined flow rate does not flow into electrolysis tank 6a occurs due to disorder or the like of controller 4. In such a case, there is a concern that activity species is generated at a concentration of equal to or greater than a prescribed value. In a case where the activity species is generated at a concentration of equal to or greater than the prescribed value, there is a possibility that an unexpected disadvantage occurs.

[0110] Thus, active species remover 12 configured of an activated carbon filter, for example, is provided on the downstream side of electrolysis tank 6a and on the upstream side of nozzle 20 according to the embodiment. In doing so, the active species at the concentration of equal to or greater than the prescribed value is removed or decomposed.

[0111] Specifically, it is possible to reduce the concentration of the active species ejected from nozzle 20 to about 1/10 or less as high as the concentration of the active species immediately after existing electrolysis tank 6a by providing the activated carbon filter as active species remover 12.

[0112] The washing water is typically subjected to bacteria elimination in electrolysis tank 6a before reaching active species remover 12. Therefore, there is no particular problem even if the concentration of the active species is reduced by active species remover 12 in a state where the voltage is normally applied to sterilizer 6.

[0113] Furthermore, the active species dissolved in the washing water is also diffused in a gas phase (air) when ejected from nozzle 20. However, it is possible to reduce the concentration of the active species in the gas phase by providing active species remover 12. That is, in a case of using ozone as the active species, a small amount of ozone is diffused in the toilet room. However, it is possible to reduce the ozone concentration in the gas phase in the toilet room by providing active species remover 12. As a result it is possible to provide a sanitary washing device with enhanced safety.

[0114] Although the configuration in which active species remover 12 was provided on the downstream side of electrolysis tank 6a and on the upstream side of positive-displacement pump 9 was described as an example in the aforementioned embodiment, the invention is not limited thereto. For example, active species remover 12 may be provided between positive-displacement pump 9 and nozzle 20, for example, and the same effects can be achieved.

[0115] Although the aforementioned embodiment was described as the example in which the activated carbon filter was used as active species remover 12, the invention is not limited thereto. For example, the invention is not particularly limited as long as the active species can be removed or decomposed by the configuration.

(FOURTH EMBODIMENT)

[0116] Hereinafter, description will be given of a sanitary washing device according to a fourth embodiment of the invention and a toilet apparatus provided with the sanitary washing device with reference to Fig. 7. Since the toilet apparatus is the same as that in the first embodiment, the description thereof will be omitted.

[0117] Fig. 7 is a diagram schematically illustrating a configuration of a main body of the sanitary washing device according to the fourth embodiment of the invention.

[0118] As illustrated in Fig. 7, the sanitary washing device according to the embodiment is different from that according to the second embodiment in that scale pulverizer 13 is disposed on the downstream side of electrolysis tank 6a. Other configurations and operations are the same as those in the second embodiment. The same reference numerals will be given to the same components as those in the second embodiment, and descriptions thereof will be omitted.

[0119] That is, scale pulverizer 13 according to the embodiment is configured to suppress scale components, which have been generated by electrolysis in electrolysis tank 6a configuring sterilizer 6, from flowing into washing water flow path 202 in a later stage than electrolysis tank 6a and blocking washing water flow path 202. That is, the embodiment is configured such that the electrolysis is performed while polarities of currents applied to anode electrode 6b and cathode electrode 6c are inverted. In doing so, adhesion of the scale components to cathode electrode 6c is avoided.

[0120] However, it is difficult to completely suppress generation of the scale and adhesion of the scale to the surface of cathode electrode 6c. Therefore, generated scale and scale removed from cathode electrode 6c flow from electrolysis tank 6a. Then, the scale adheres to heat exchanger 7, positive-displacement pump 9, and the like that are installed on the downstream side of electrolysis tank 6a. As a result, there is a possibility that blocking of washing water flow path 202 or an operation failure of positive-displacement pump 9 or the like occur.

[0121] Thus, scale pulverizer 13 is disposed on the downstream side of electrolysis tank 6a in the embodiment.

[0122] Scale pulverizer 13 pulverizes the generated scale or the scale removed from cathode electrode 6c into fine particles. In doing so, it is possible to suppress occurrence of the blocking or the failure of heat exchanger 7, positive-displacement pump 9, or the like in advance.

[0123] Hereinafter, description will be given of a specific configuration and operations of the scale pulverizer with reference to Figs. 8A and 8B.

[0124] Fig. 8A is a sectional view illustrating the scale pulverizer according to the embodiment. Fig. 8B is a sectional view of another scale pulverizer 13 according to the embodiment.

[0125] First, scale pulverizer 13 is configured of at least pulverizer 13a and strainer 13b as illustrated in Fig. 8A.

[0126] Pulverizer 13a is configured to have a propeller shape, for example, and pulverizes scale contained in washing water in scale pulverizer 13. Pulverizer 13a is not limited to the propeller shape and may have any shape as long as pulverizer 13a can pulverize the scale with the shape.

[0127] Specifically, pulverizer 13a is rotated by a water flow of the washing water flowing in scale pulverizer 13. Then, scale is pulverized into fine particles by the rotation of pulverizer 13a.

[0128] Pulverizer 13a of scale pulverizer 13 does not necessarily have a propeller shape. For example, pulverizer 13a may have a ball shape with a larger diameter than the inner diameter of piping as illustrated in Fig. 8B.

[0129] That is, pulverizer 13a according to another example moves in scale pulverizer 13 by the water flow in scale pulverizer 13. Then, scale is pulverized into fine particles by movement of pulverizer 13a.

[0130] The scale pulverized by pulverizer 13a is discharged from scale pulverizer 13 via strainer 13b. The scale which has not been pulverized by pulverizer 13a is trapped by strainer 13b. Therefore, scale is not discharged from scale pulverizer 13.

[0131] That is, the scale trapped by strainer 13b is diffused by turbulence of the washing water occurring in scale pulverizer 13. Then, the diffused scale is repeatedly brought into contact with pulverizer 13a and is then pulverized. In doing so, the scale is reliably pulverized into fine particles. As a result, occurrence of the blocking or the failure of heat exchanger 7, positive-displacement pump 9, or the like can be more reliably suppressed.

[0132] Specifically, strainer 13b according to the embodiment is formed of metal such as stainless steel with a mesh from 10 to 200 or synthesized resin, for example. Strainer 13b is preferably formed of a material such as fluorine resin, Teflon (registered trademark), or polystyrene. The reason is that the aforementioned materials have small surface free energy and scale does not easily adhere. In doing so, the scale is easily diffused in scale pulverizer 13. Therefore, the configuration is further preferable in which the propeller shape is employed as the shape of pulverizer 13a.

[0133] In contrast, in a case where pulverizer 13a is configured to have a ball shape or the like, it is necessary to select a material with strength enough for tolerating impact of the ball as a material of strainer 13b. The mesh shape is selected for strainer 13b to increase the surface free energy of the material in order to increase the contact rate between pulverizer 13a and scale. In doing so, the scale is made to adhere to strainer 13b with the mesh shape. Then, the scale adhering to strainer 13b is pulverized by bringing pulverizer 13a with the ball shape illustrated in Fig. 8B into contact with the scale. That is, in the case of scale pulverizer 13 illustrated in Fig. 8B, it is also effective to increase the contact rate between pulverizer 13a and the scale by making the scale adhere to strainer 13b.

[0134] Therefore, in the case of using pulverizer 13a with the ball shape, the diameter of pulverizer 13a is set to be larger than that of washing water flow path 202 such that washing water flow path 202 is not blocked. Furthermore, the ball as pulverizer 13a is preferably configured of a material with a relatively low specific gravity such as synthesized resin in order that pulverizer 13a can freely move by the water flow. At this time, it is more preferable to form the inside of the ball as pulverizer 13a into a hollow shape to reduce the weight.

[0135] According to the configuration of the embodiment, scale pulverizer 13 is provided on the downstream side of sterilizer 6 and on the upstream side of heat exchanger 7. Then, scale pulverizer 13 pulverizes the scale discharged from electrolysis tank 6a into fine particles. In doing so, it is possible to avoid the blocking or the failure of the flow path of heat exchanger 7, positive-displacement pump 9, or the like installed on the downstream side of electrolysis tank 6a configuring sterilizer 6.

[0136] Although the embodiment was described as the example in which scale pulverizer 13 was configured of pulverizer 13a and strainer 13b, the invention is not limited thereto. That is, any configuration is applicable as long as the scale can be pulverized. For example, an ultrasonic element or the like may be provided as scale pulverizer 13 to pulverize the scale by ultrasonic vibration, and the same effects can be achieved.

(FIFTH EMBODIMENT)

[0137] Hereinafter, description will be given of a sanitary washing device according to a fifth embodiment of the invention and a toilet apparatus provided with the sanitary washing device with reference to Fig. 9. Since the toilet apparatus is the same as that in the first embodiment, the description thereof will be omitted.

[0138] Fig. 9 is a diagram schematically illustrating a configuration of a main body of the sanitary washing device according to the fifth embodiment of the invention.

[0139] As illustrated in Fig. 9, the sanitary washing device according to the embodiment is different from that

according to the second embodiment in that discharge valve 14 is provided on the downstream side of electrolysis tank 6a. Other configurations are the same as those in the second embodiment. The same reference numerals will be given to the same components as those in the second embodiment, and the descriptions thereof will be omitted.

[0140] Discharge valve 14 according to the embodiment operates to discharge washing water flowing into the downstream side of sterilizer 6 and containing washing water to a toilet bowl.

[0141] That is, discharge valve 14 discharge scale removed from cathode electrode 6c, to which the scale has adhered, to the toilet bowl by polarity inversion control of currents applied to electrodes of sterilizer 6. Such a configuration prevents the water containing the scale from flowing into heat exchanger 7, nozzle 20, and the like. As a result, it is possible to suppress the scale components generated in electrolysis tank 6a from flowing through washing water flow path 202 on the downstream side beyond electrolysis tank 6a and blocking washing water flow path 202 in advance.

[0142] That is, the polarity inversion control for inverting polarities is performed between anode electrode 6b and cathode electrode 6c in the embodiment in the same manner as in the second embodiment. In doing so, adhesion of the scale to cathode electrode 6c is suppressed.

[0143] That is, in a case of performing the electrolysis with the polarities inverted, anode electrode 6b that generates the active species such as ozone has a negative potential. Therefore, the active species such as ozone is not generated at anode electrode 6b.

[0144] Thus, in the case of performing the electrolysis with the polarities inverted, the flow path through which the washing water flows is switched by discharge valve 14. In doing so, the washing water is discharged to toilet bowl 600 without causing the washing water to flow through heat exchanger 7 and nozzle 20.

[0145] In a case of performing the electrolysis with the polarities inverted, the washing water may or may not be made to pass through washing water flow path 202. In the case of not stopping the water passing, it is necessary to perform control so as to discharge the water to toilet bowl 600 during the electrolysis. Furthermore, it is preferable to cause the water to pass and discharge the water for about several seconds after the completion of the electrolysis. In doing so, it is possible to flush the scale components adhering to the surfaces of the electrodes of sterilizer 6.

[0146] In contrast, in a case of performing the electrolysis while stopping the water passing, the control is performed so as to discharge the washing water containing removed scale in electrolysis tank 6a after the completion of the electrolysis. It is preferable to further discharge the water while the washing water is further made to pass after the discharging even in the case where the control is performed so as to discharge the water after the completion of the electrolysis. In doing so, it is possible to flush the scale components adhering to the surfaces of the electrodes of sterilizer 6.

[0147] After flushing the surfaces of the electrodes, it is preferable to fill electrolysis tank 6a with the washing water by closing discharge valve 14. In doing so, it is possible to prevent the washing water adhering to the surfaces of the electrodes from being dried when electrolysis tank 6a is not used for a long period of time. As a result, it is possible to suppress the scale components contained in the washing water from adhering to the surfaces of the electrodes of sterilizer 6.

[0148] With the configuration according to the embodiment, it is possible to discharge the scale components to toilet bowl 600 by the control of discharge valve 14. Therefore, it is possible to avoid the occurrence of the blocking, the failure, and the like of heat exchanger 7, positive-displacement pump 9, or the like due to the scale components flowing through the washing water flow path in advance.

[0149] As described above, the sanitary washing device according to the invention may include a nozzle that moves to a predetermined washing position and sprays washing water, a washing water flow path that guides the washing water to the nozzle, a pump that causes the nozzle to eject the washing water, and a heater that heats the washing water. Furthermore, the sanitary washing device may include a sterilizer that is disposed on the upstream side of the heater for sterilizing the washing water and a controller that controls the pump, the heater, and the sterilizer.

[0150] With such a configuration, it is possible to sterilize bacteria that are present in the washing water or in the washing water flow path by the sterilizer. In doing so, it is possible to implement the sanitary washing device that washes a private area with clean washing water.

[0151] The sterilizer is disposed on the upstream side of the heater. In doing so, it is possible to enhance solubility of the active species, such as ozone, generated in the sterilizer in the washing water. As a result, it is possible to further enhance the sterilizing ability. Furthermore, the washing water with the active species such as ozone dissolved at a higher rate is heated by the heater. In doing so, the reactivity of the active species is further enhanced. As a result, it is possible to achieve a higher sterilizing property.

[0152] The sanitary washing device according to the invention may include a water temperature detector that detects a water temperature of the washing water, and the controller may control the sterilizer based on the water temperature detected by the water temperature detector. In doing so, it is possible to stably secure always constant sterilizing ability without being affected by the water temperature.

[0153] The sanitary washing device according to the invention may generate electrolysis water by the sterilizer electrolyzing the washing water. In doing so, it is not necessary to add a necessary chemical to the sterilizer. As

a result, it is possible to realize maintenance free and to thereby enhance usability.

[0154] In the sanitary washing device according to the invention, the electrolysis water generated by the sterilizer may be ozone water. In doing so, it is possible to maintain the high sterilizing property without depending on water quality of the washing water.

[0155] In the sanitary washing device according to the invention, the sterilizer is configured of at least two electrodes, and the electrodes each include an electrode catalyst on a surface of a metal board. The electrode catalyst of at least one of the electrodes may be formed of tantalum oxide or tantalum oxide and platinum.

[0156] In the sanitary washing device according to the invention, at least one of the electrodes may include a metal layer for suppressing corrosion of the metal board on the surface of the metal board and include the electrode catalyst on the metal layer. In doing so, it is possible to extend the electrode duration time of the sterilizer.

[0157] In the sanitary washing device according to the invention, the metal layer may be included at least any of platinum, iridium, ruthenium, and niobium. In doing so, it is possible to further extend the electrode duration time of the sterilizer.

[0158] In the sanitary washing device according to the invention, a reservoir may be provided on the downstream side of the sterilizer. With such a configuration, it is possible to extend the time for the washing water to reach the nozzle. In doing so, it is possible to extend the contact time between bacteria contained in the washing water or bacteria that are present in the washing water flow path and the active species generated by the sterilizer. As a result, it is possible to further enhance the sterilizing property. That is, it is possible to reduce the bacteria contained in the washing water ejected from the nozzle and to thereby implement a clean sanitary washing device with excellent sanitation.

[0159] In the sanitary washing device according to the invention, an active species remover may be provided on a downstream side of the sterilizer. In doing so, it is possible to secure safety of a human body such as a private area and skin even in a case where the active species is generated at a high concentration or in a case where the private area is washed for a long period of time.

[0160] In the sanitary washing device according to the invention, a scale pulverizer that pulverizes scale generated by the sterilizer may be provided on a downstream side of the sterilizer. With such a configuration, the scale generated in the electrolysis tank of the sterilizer is pulverized into fine particles. In doing so, it is possible to prevent the scale from adhering to the washing water flow path, the heat exchanger, the positive-displacement pump, or the like. As a result, it is possible to suppress the occurrence of the failures, such as blocking or an erroneous operation, of the washing water flow path, the heat exchanger, the positive-displacement pump, or the like in advance.

[0161] In the sanitary washing device according to the invention, a discharge valve may be provided on a downstream side of the sterilizer, and a scale generated by the sterilizer may be discharged to the toilet bowl by the discharge valve. In doing so, it is possible to suppress the occurrence of the failures, such as blocking or an erroneous operation, due to the scale adhering to the washing water flow path, the heat exchanger, the positive-displacement pump, or the like in advance.

INDUSTRIAL APPLICABILITY

[0162] The invention enables sterilization of supplied water and stable supply thereof. Therefore, the invention is useful not only for a warm water washing toilet seat but also for purposes such as a sanitary washing device for faces, heads, hands, feet, and the like or a washing device for pets or objects other than living creatures.

REFERENCE MARKS IN THE DRAWINGS

[0163]

1	branched faucet
2	strainer
3	flow regulating valve
4	controller
5	electromagnetic valve
6	sterilizer
6a	electrolysis tank
6b	anode electrode
6c	cathode electrode
6d	inlet
6e	outlet
6f	electrolysis flow path
7	heat exchanger
8a, 8b	temperature sensor
9	positive-displacement pump
10	motor
11	reservoir
12	active species remover
13	scale pulverizer
13a	pulverizer
13b	strainer
14	discharge valve
20	nozzle
100	sanitary washing device
200	main body
201	plumbing
202	washing water flow path
300	manipulator
400	toilet seat
500	cover
600	toilet bowl
1000	toilet apparatus

Claims

1. A sanitary washing device comprising:

   a nozzle that moves to a predetermined washing position and ejects washing water;
   a washing water flow path that guides the washing water to the nozzle;
   a pump that causes the nozzle to eject the washing water;
   a heater that heats the washing water;
   a sterilizer that is disposed on an upstream side of the heater and sterilizes the washing water; and
   a controller that controls the pump, the heater, and the sterilizer.

2. The sanitary washing device of Claim 1, further comprising:

   a water temperature detector that detects a water temperature of the washing water,
   wherein the controller controls the sterilizer based on the water temperature detected by the water temperature detector.

3. The sanitary washing device of Claim 1 or 2,
   wherein the sterilizer generates electrolysis water by electrolyzing the washing water.

4. The sanitary washing device of Claim 3,
   wherein the electrolysis water generated by the sterilizer is ozone water.

5. The sanitary washing device of Claim 3,
   wherein the sterilizer is configured of at least two electrodes, and
   wherein the electrodes each include an electrode catalyst on a surface of a metal board, and the electrode catalyst of at least one of the electrodes is formed of tantalum oxide or tantalum oxide and platinum.

6. The sanitary washing device of Claim 5,
   wherein at least one of the electrodes of the sterilizer includes a metal layer provided on the surface of the metal board for suppressing corrosion of the metal board, and
   wherein the electrode catalyst is provided on the metal layer.

7. The sanitary washing device of Claim 6,
   wherein the metal layer has contains at least any of platinum, iridium, ruthenium, and niobium.

8. The sanitary washing device of Claim 3, further comprising:

   a reservoir that is provided on a downstream side of the sterilizer.

9. The sanitary washing device of Claim 3, further comprising:

   an active species remover that is provided on a downstream side of the sterilizer.

10. The sanitary washing device of Claim 3, further comprising:

    a scale pulverizer that is provided on a downstream side of the sterilizer for pulverizing scale generated by the sterilizer.

11. The sanitary washing device of Claim 3, further comprising:

    a discharge valve that is provided on a downstream side of the sterilizer,
    wherein the discharge valve discharges a scale generated by the sterilizer to a toilet bowl.

FIG. 1

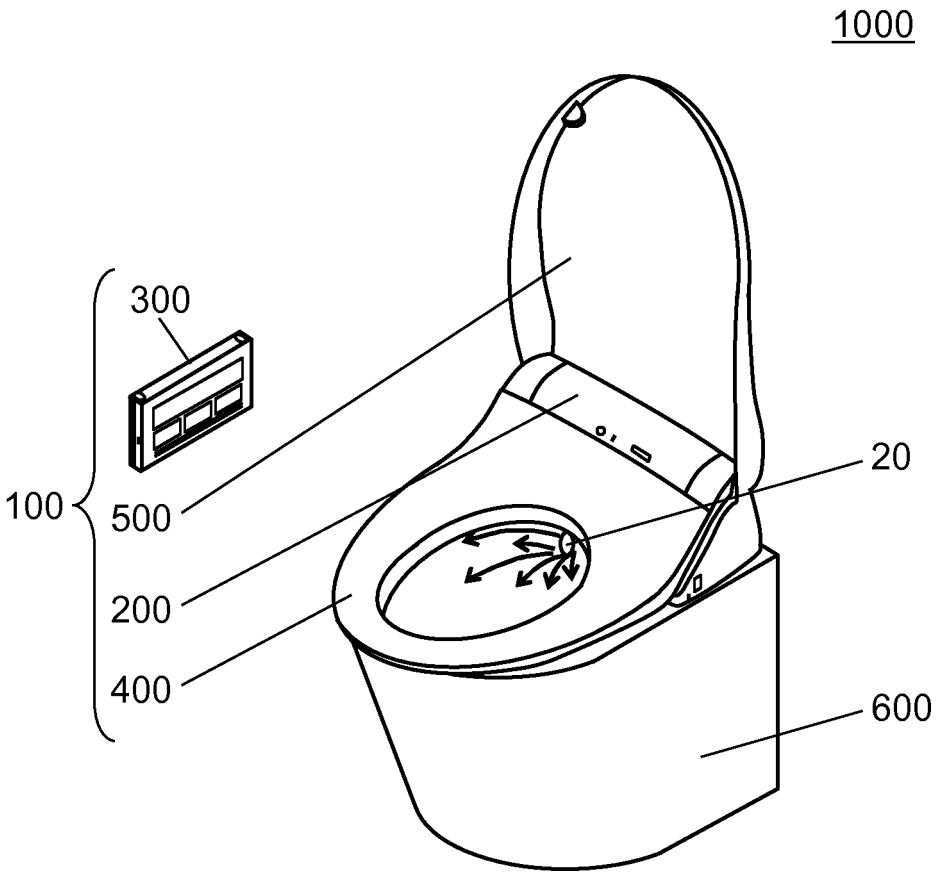


FIG. 2

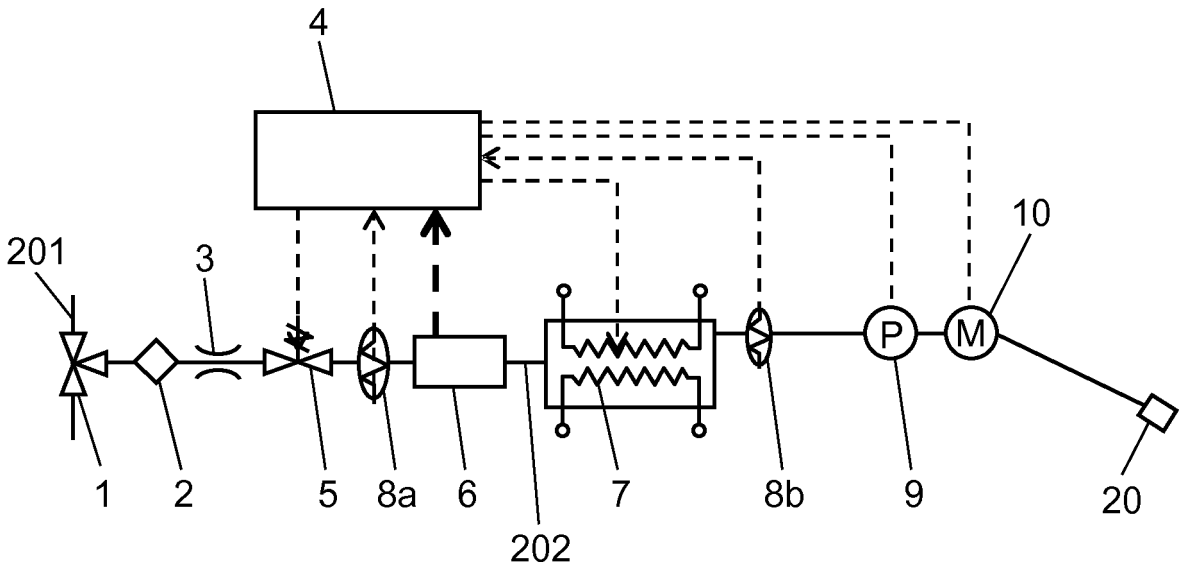


FIG. 3

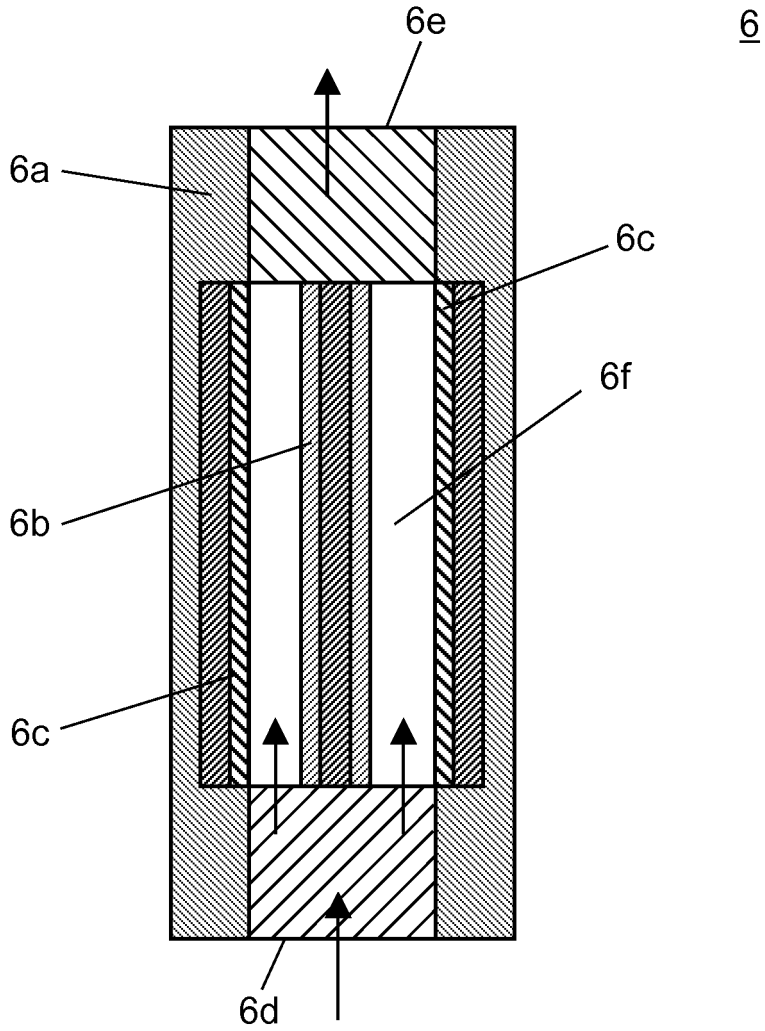


FIG. 4

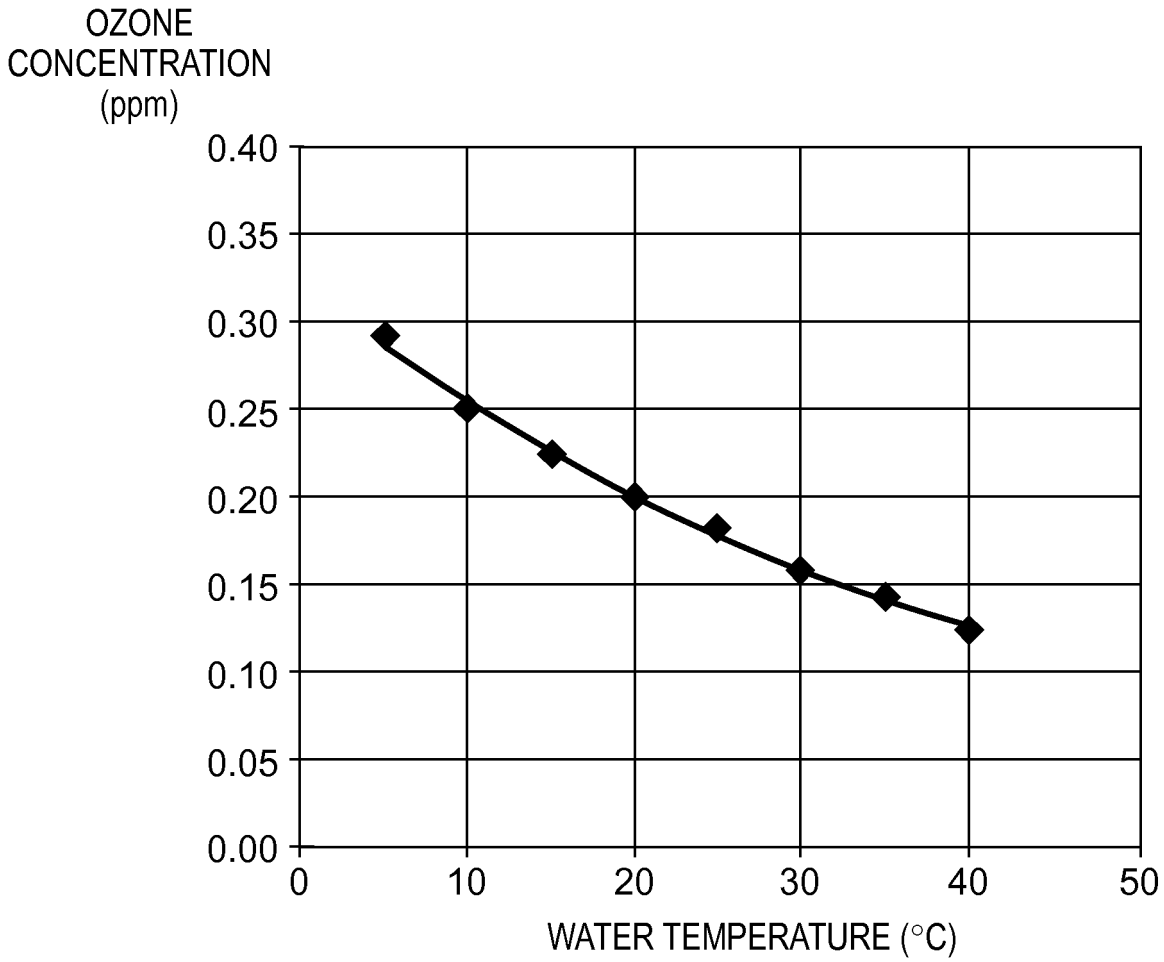
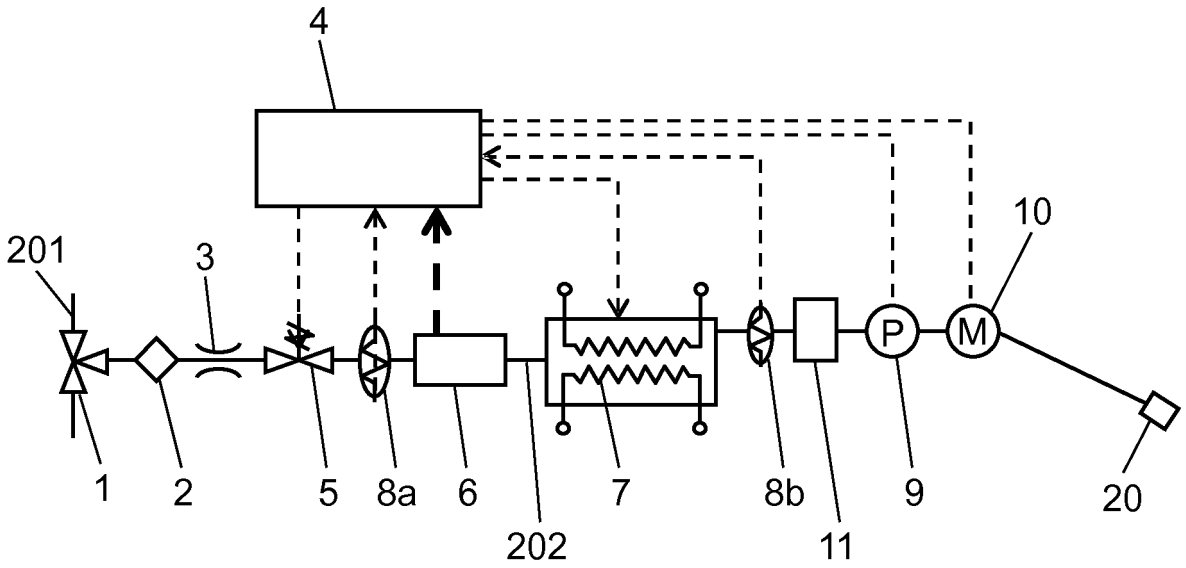

OZONE
CONCENTRATION
(ppm)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50
WATER TEMPERATURE (°C)

FIG. 5


4
201
3
10
P
M
1
2
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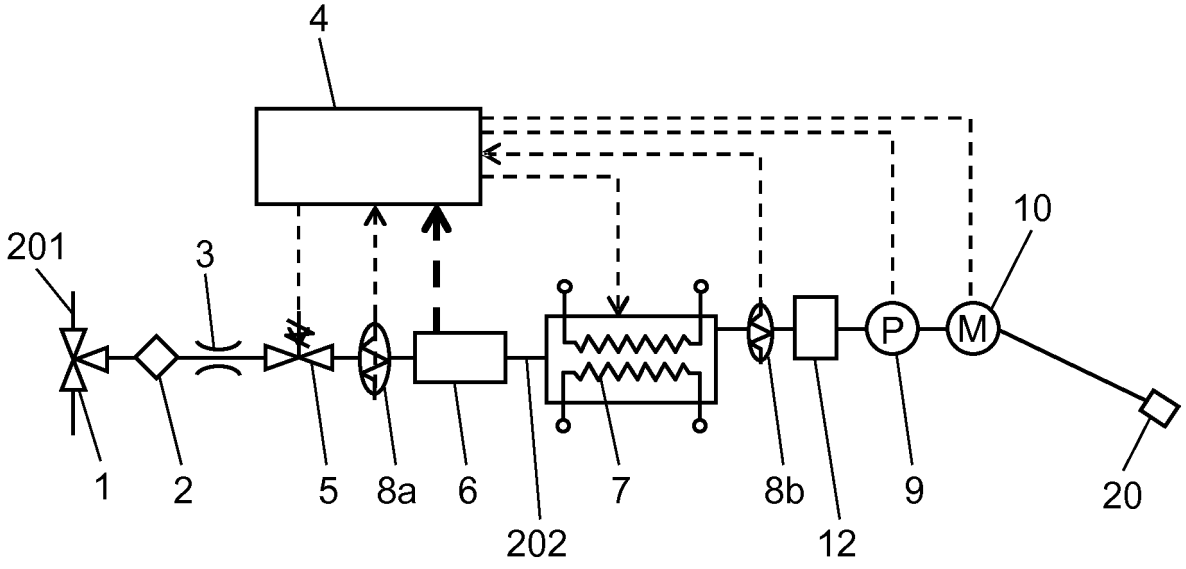
8a
6
202
7
8b
11
9
20

FIG. 6


4
201
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10
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M
1
2
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8a
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202
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8b
12
9
20

FIG. 7

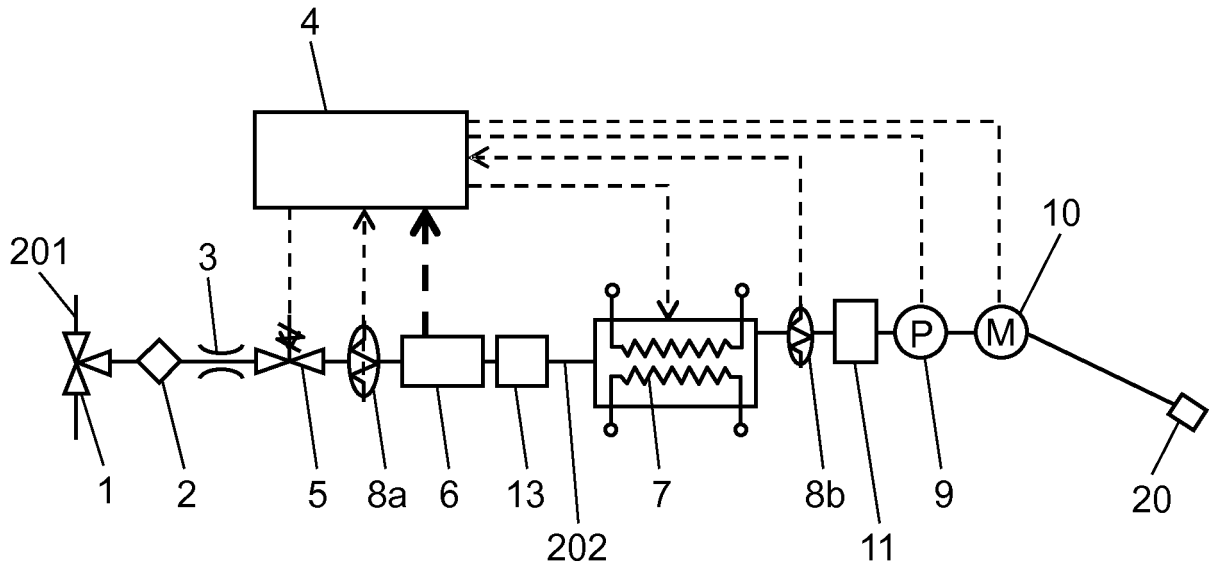


FIG. 8A

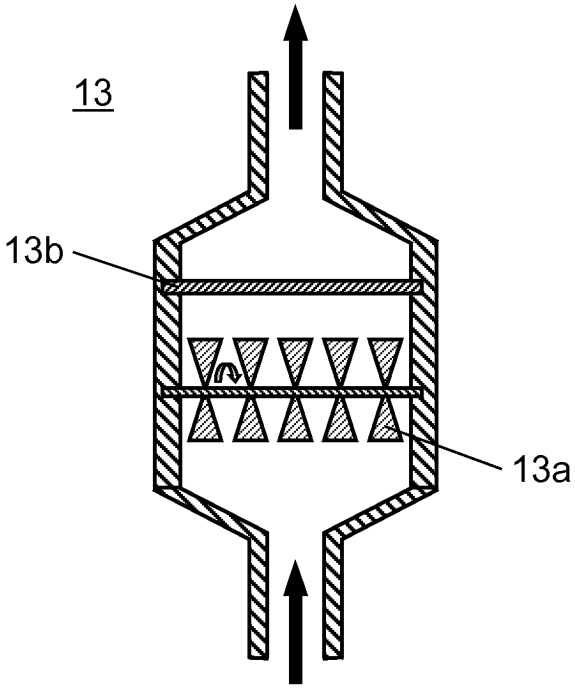


FIG. 8B

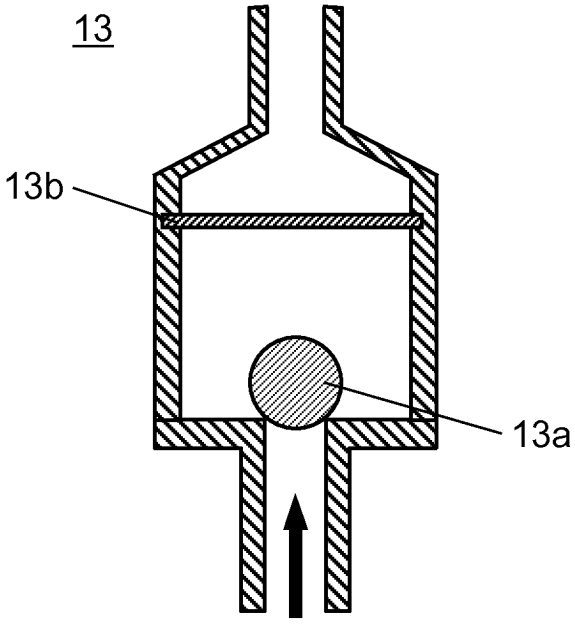
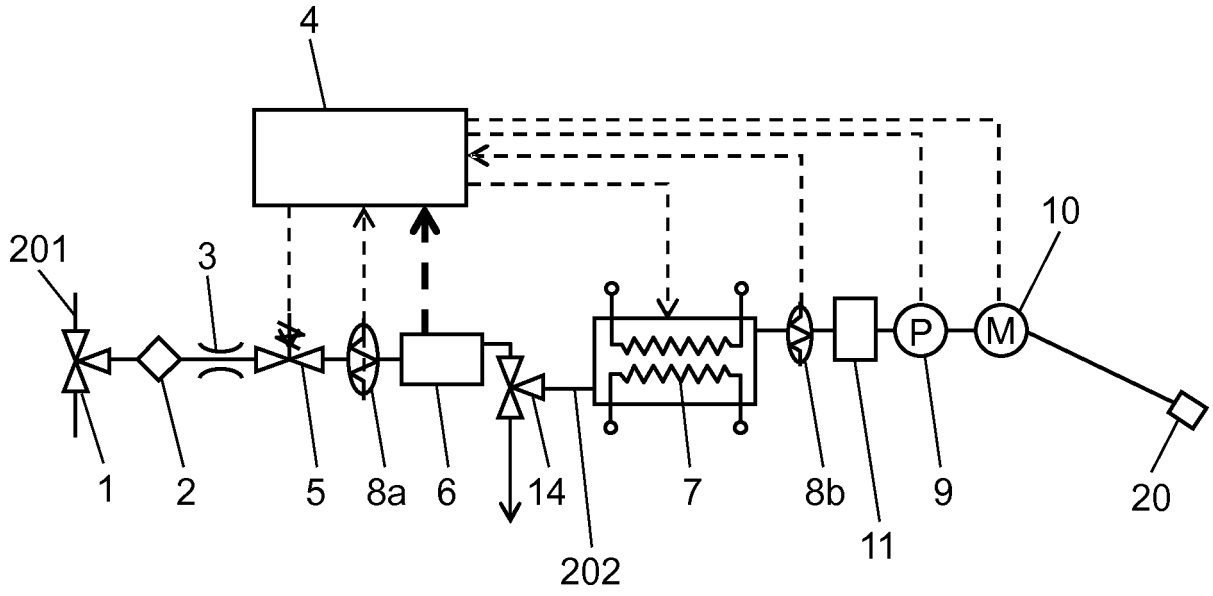


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/002136

A. CLASSIFICATION OF SUBJECT MATTER
E03D9/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E03D9/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015
Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001-279776 A (Toto Ltd.), 10 October 2001 (10.10.2001), paragraphs [0023] to [0025]; fig. 1 (Family: none)	1
X Y	JP 2008-232616 A (Matsushita Electric Industrial Co., Ltd.), 02 October 2008 (02.10.2008), paragraphs [0180] to [0196]; fig. 23 (Family: none)	1 2-11
Y	JP 2012-125715 A (Toto Ltd.), 05 July 2012 (05.07.2012), paragraphs [0067], [0070] to [0080], [0087] to [0089]; fig. 13 (Family: none)	2-11

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
02 June 2015 (02.06.15)	23 June 2015 (23.06.15)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2015/002136

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2007-283180 A (Kabushiki Kaisha Ozotech), 01 November 2007 (01.11.2007), paragraph [0027] (Family: none)	2-11
Y	JP 2014-32136 A (Nikka Micron Co., Ltd.), 20 February 2014 (20.02.2014), paragraph [0014] (Family: none)	2-11
Y	JP 7-313980 A (TDK Corp.), 05 December 1995 (05.12.1995), paragraph [0015] (Family: none)	5-7
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Y	JP 3180399 U (Kabushiki Kaisha Eco Planner), 20 December 2012 (20.12.2012), paragraph [0017] (Family: none)	9
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Y	JP 2012-207456 A (Toto Ltd.), 25 October 2012 (25.10.2012), paragraphs [0029], [0039]; fig. 4 (Family: none)	11

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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