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(54) **Washing method and system**

Waschverfahren und -system

Système et procédé de lavage

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## Description

### Field of the invention

**[0001]** The present invention relates to the field of façade wall washing, and more specifically to façade wall washing using aqueous cleaning liquids.

### Background of the invention

**[0002]** The purposes of façade wall washings are *i)* to improve the esthetical appearance of the façade wall and/or to preserve the façade wall and/or *ii)* to prepare the façade wall for painting or other surface treatments in order to achieve a satisfactory and sustainable result.

**[0003]** Traditionally, façade walls have been washed by applying water under high pressure, by application of water containing chemicals and/or by blasting techniques.

**[0004]** The high-pressure washings entail a number of problems. The high pressure forces water deep into pores and cavities of the façade wall which results in long drying times, e.g. more than two days, modified moisture properties of the façade wall which may accelerate algae growth and accumulation of dirt, and sometimes even damaging of building materials behind the façade wall surface. As an example, the long drying times results in long change-over times and high costs of a façade restoration project including washing and painting. Furthermore, the force of the high-pressure water may mechanically harm the finish of the façade wall, and excess amounts of water is consumed.

**[0005]** Washing with chemicals results in a waste water which is harmful to the environment. Further, the chemicals may also be harmful to the operator(s) performing the washing. Also, the chemicals may retain the applied water in the façade and thereby cause longer drying times.

**[0006]** Blasting techniques also harm the finish of the façade, and the dust resulting from the blasting is a working environment problem.

**[0007]** Some types of dirt on façade walls have required a combination of the above-mentioned techniques. For example, to wash away green algae, water containing environmentally harmful algae-removing chemicals have been applied under high pressure. This specific method is the closest prior art for this application.

**[0008]** In US 5 249 326, a system for washing building windows is disclosed. The washing technique relies on the combination of mechanical treatment with brushes and rinsing with purified water. The system comprises a washing unit with brushes, purifying means for delivery of purified rinsing water and cable arrangements for restraining the washing unit against the building surface. Cleaning of "other exterior surfaces" is also mentioned. However, the system is clearly adapted for window washing. Further, neither specific adaptations of the system for washing façade walls nor the maximum conductivity of the rinsing water for achieving a satisfactory washing result are discussed.

**[0009]** Consequently, there remains a need within the art for a method which effectively washes algae, mould or claudiosporium off a façade wall without: damaging the façade or the building materials; decreasing the resistance to future dirtying; causing harm to the environment or operators performing the washing; or consuming large amounts of water.

### Summary of the invention

**[0010]** Thus, an object of the present invention is to provide a method for effectively washing away algae, mould or claudiosporium from a façade wall.

**[0011]** Another object of the present invention is to provide a façade wall washing method which cause minimal harm to the façade wall and building materials.

**[0012]** Another object of the invention is to provide a façade wall washing method which allows for quick drying of the washed façade wall.

**[0013]** Another object of the present invention is to provide a façade wall washing method which is environmentally friendly.

**[0014]** Another object of the present invention is to provide a façade wall washing method which minimizes the exposure to harmful matter when performing the washing method.

**[0015]** Another object of the present invention is to provide a façade wall washing method which achieves a good washing result using limited amounts of water.

**[0016]** These and other objects of the present invention are achieved by means of a method, a use and a system as characterized by the claims. According to the invention, the method for washing away algae, mould or claudiosporium from a façade wall comprises the following steps: (a) providing a cleaning liquid, wherein said cleaning liquid consists of water having a conductivity of 0,5 μS/cm or less; (b) cleaning said façade wall, wherein said cleaning involves application of said cleaning liquid of step (a) onto said façade wall; and (c) allowing used cleaning liquid from step (b) containing dirt to leave the façade wall.

**[0017]** Preferable embodiments of the invention are characterized by the dependent claims or itemized embodiments.

**[0018]** Throughout the description and the claims, a "façade wall" refers to the part of a façade of a building not being of glass, i.e. not being windows.

**[0019]** Further, throughout the description and the claims, "dirt" refers to materials which are unwanted on a façade wall, e.g. deposits, such as calcium sulfate, soot, dust, organic material, such as rubber particles and biological material, such as, algae and mould, comprising claudiosporium, and heavy metals.

**[0020]** Within the scope of the present invention, it is contemplated that the inventive water destroys the cells of algae, such as green algae, by osmosis: the hypotonic

purified water moves across the cell membranes into the cells to balance the difference in salt concentrations, which results in such a high internal pressure that the cells explodes.

**[0021]** Further, beyond the scope of the present invention, it was found that water having a conductivity of 3 μS/cm or less possesses excellent properties for façade wall washing. Without being bound to any specific theory, the inventive water has very few dissolved ions and consequently, a high capacity of dissolving salts and hydrates. As an example, the inventive water is very reactive towards gypsum, $CaSO_4*2H_2O$, which is often formed on façade walls comprising calcium carbonate, $CaCO_3$, such as façade wall comprising limestone, after exposure to acidic rain comprising sulphate.

**[0022]** According to the invention, the cleaning liquid consists of water having a conductivity of 0.5 μS/cm or less.

**[0023]** In a particularly preferred embodiment of the invention, the cleaning liquid consists of water having a conductivity of 0.1 μS/cm or less, such as 0.08 μS/cm or less. It was noted by the inventors that water having such low conductivity has unexpectedly good washing properties. The washing effect increased significantly when the conductivity of the cleaning liquid was brought down to 0.1 μS/cm or less.

**[0024]** Water can have a theoretical minimum conductivity of about 0.055 uS/cm. Consequently, in one embodiment, the cleaning liquid consists of water having a conductivity of 0.055 - 0.1 μS/cm, such as 0.055 - 0.08 μS/cm.

**[0025]** In one embodiment of the invention, the application of cleaning liquid of step (b) comprises continuous application of the cleaning liquid in the form of a mist for a period of 3 hours or less. Using the cleaning liquid of the invention, a good washing result is obtained already after less than 3 hours when the cleaning liquid is applied in the form of a mist. For example, the period may be as short as 10-60 minutes. For example, the mist may be provided by nozzles, which are well known to the person skilled in the art. Shorter application times are beneficial because they lead to lower costs due to lower water consumption and lower labor and construction costs.

**[0026]** In one embodiment of the invention, step (b) comprises a first application of the cleaning liquid, and, after a predetermined period of time, a second application of the cleaning liquid. For example, the predetermined period of time may be 1-24 hours, such as 1-12 hours. When using two separate applications, the water from the first application is given time to dissolve the dirt on the façade wall, and subsequently, the water from the second application washes away the dirt-containing water from the first application. Two separate applications are beneficial because they require less water than one, corresponding continuous application. As an example, a brushing of the façade wall is performed between the first and the second application of cleaning liquid. Alternatively, or as a complement, brushing may be performed simultaneously with the first or second application. Brushing further facilitates the removal of dirt from the façade wall. Appropriate brushes are well known to the skilled person.

**[0027]** In one embodiment of the invention, the cleaning liquid is applied to the façade wall with a flow of at least 20 liters/minute.

**[0028]** In one embodiment of the invention, the method for washing away algae, mould or claudiosporium from a façade wall further comprises the steps of: (d) collecting the used cleaning liquid of step (c); and (e) purifying the collected, used cleaning liquid of step (d). Collecting and purifying the used cleaning liquid prevents hazardous components comprised in the algae, mould or claudiosporium from the façade wall to be released to the surroundings, such as the surrounding nature or the sewage system. For example, step (d) may involve collecting the used cleaning liquid in a storm drain or street inlet located in the vicinity of the façade wall and step (e) may involve purifying at the washing site. Collecting the used cleaning liquid in a nearby storm drain is very convenient, because the water leaving the façade wall is naturally directed to such storm drain and no extra water directing means are required. By purifying the collected, used cleaning liquid at the washing site, no transportation of used cleaning liquid is needed and the purified liquid may be discharged at the washing site, for example in the same storm drain as in which the used cleaning liquid was collected.

**[0029]** In one embodiment of the invention, step (a) involves providing the cleaning liquid at the washing site by continuous processing of inlet water. Normally, the inlet water is having a conductivity of more than 0,5 μS/cm. By "at the washing site" is meant in the vicinity of the façade wall, such as within 100 meters of the façade wall, such as within 50 meters of the façade wall, such as within 30 meters of the façade wall. By providing the cleaning liquid at the washing site by continuous processing of inlet water, the cleaning liquid does not have to be transported to the washing site. Rather, for example, municipal water available at the washing site may be used as inlet water avoiding all transportations of water. Transportations are costly and inconvenient and further, transportations of the cleaning liquid may impair its quality, i.e., increase the amount of dissolved matter in the cleaning liquid and thus the conductivity.

**[0030]** In one embodiment of the invention, step (a) involves providing the cleaning liquid at the washing site by continuous processing of inlet water and, in a further step (f) recycling at least part of the purified, used cleaning liquid of step (e) such that it constitutes at least part of the inlet water of step (a). By recycling at least part of the purified, used cleaning liquid, the water consumption of a façade wall washing is decreased.

**[0031]** In one embodiment of the invention, the dirt includes one or more of the following: algae and green algae.

**[0032]** As an example, the dirt includes algae. The in-

ventors have found that the washing method of the invention effectively removes algae, which are one of the most frequent types of dirt also, traditionally, being very difficult to wash away.

**[0033]** As another example, beyond the scope of the present invention, the dirt includes calcium sulphate compounds, such as gypsum, $CaSO_4*2H_2O$. The inventors have found that the washing method effectively removes calcium sulphate compounds, which are also one of the most frequent types of dirt on façade walls. Calcium sulphate compounds are mainly formed on the surface of façade walls comprising calcium carbonate, such as façade walls comprising sandstone, limestone, travertine, marble, calcareous sandstone, cement, concrete, and rendering or facing plaster.

**[0034]** In one embodiment which falls beyond the scope of the present invention, the façade wall comprises calcium carbonate, such as at least 5 % calcium carbonate (w/w), such as at least 10 % calcium carbonate (w/w), such as at least 15 % calcium carbonate (w/w), such as at least 20 % calcium carbonate (w/w), such as at least 25 % calcium carbonate (w/w), such as at least 30 % calcium carbonate (w/w), such as at least 35 % calcium carbonate (w/w), such as at least 40 % calcium carbonate (w/w), such as at least 45 % calcium carbonate (w/w), such as at least 50 % calcium carbonate (w/w), such as at least 55 % calcium carbonate (w/w), such as at least 60 % calcium carbonate (w/w), such as at least 65 % calcium carbonate (w/w). Due to above-mentioned reasons, the method which falls beyond the scope of the present invention is particularly suitable for washing façade walls comprising calcium carbonate.

**[0035]** In one embodiment of the invention, the method for washing away algae, mould or claudiosporium from a façade wall further comprises the steps of: (g) determining if after-treatment is needed; and, if after-treatment is needed, (h) applying an after-treatment liquid selected from a silicate liquid, a silicone hydride liquid and a fungicide liquid to the façade wall, wherein step (h) is performed after step (c). A fungicide liquid may be needed if the dirt comprises algae. In one example, the after-treatment liquid is selected from a silicate liquid and a silicone hydride liquid. The silicate liquid may be a liquid comprising potassium silicate. The silicone hydride liquid may be a liquid comprising silane or a combination of silane and siloxane. Such after-treatment liquid is particularly suitable if the façade wall comprises calcium carbonate, such as at least 5 % calcium carbonate (w/w).

**[0036]** Without being bound to any specific theory, the following description of the effect of an after-treatment with a silicate liquid or a silicone hydride is provided. A façade wall comprises pores. Generally, the diameter of such pores should be smaller closer to the surface of the façade wall and larger further into the façade. As long as the pores have such shape, capillary forces "sucks" water from the inner parts of the surface because water is drawn from a larger cavity to a smaller. However, over time, the material surrounding the small-diameter part of the pores close to the surface is transformed. For example, façade wall material comprising calcium carbonate may be transformed to gypsum as described above. Then, when the façade wall is cleaned, the formed gypsum is washed off and the shape of the pores is altered. Also, the shape of the pores may be altered because the material surrounding the small-diameter part of the pores is worn off. With the altered shape of the pores, water is no longer "sucked" out and the water properties of the façade wall is impaired. Applying an after-treatment liquid selected from a silicate liquid and a silicone hydride liquid reforms the original shape of the pores by building up a silicon-containing material, such as $SiO_2$, in the part of the pores closest to the surface. Such silicon-containing materials resist many of the most common stresses on façade walls, such as mechanical and chemical stress from wind and rain.

**[0037]** In one embodiment, step (g) may comprise at least one measurement of the water absorption capacity of the façade wall. For example, the water absorption capacity may be measured by measuring the amount of water absorbed by a limited area of the façade wall during a limited period of time. If the water absorption capacity is high, after-treatment is considered to be needed. A "high" water absorption capacity refers to a water absorption capacity which is higher than desired. The person skilled in the art is aware of desired water absorption capacity levels. Desired water absorption capacity levels may vary with weather conditions, i.e. geographical location. Further, desired water absorption capacity levels vary between different façade wall materials. In an alternate or complementary example, step (g) may comprise measuring the drying time of the façade wall. The drying time may be measured by applying water to a limited area of the façade wall and then measuring the amount of time required for that area to reach a certain degree of dryness. If the drying time is long, after-treatment is considered to be needed. A "long" drying time refers to a drying time which is longer than desired. The person skilled in the art is aware of desired drying times. Further, the person skilled in the art understands how to perform such measurement.

**[0038]** As an example, step (g) may comprise two water absorption capacity measurements, wherein the first measurement is performed before step (b) and the second measurement is performed after step (c). The difference in water absorption capacity between the second and the first measurement may then be used to determine: i) if after-treatment is needed; and/or *ii)* the composition of the after-treatment liquid, such as the components of the after-treatment liquid, e.g. silicate(s) and/or silicone hydride(s), and their concentration(s). For example, if the difference is considered to be large, an after-treatment liquid with a high concentration may be used and/or the period of application according to step (h) may be long. The person skilled in the art understands what, during the circumstances, is considered to be a "high concentration" or a "long period". The first measurement

may be performed during an initial step determining the status of the façade wall. In addition to a water absorption capacity measurement, such status-determining may comprise visual inspection of the façade wall and analysis of the dirt on the façade wall.

**[0039]** In one embodiment of the invention, the method for washing away algae, mould or claudiosporium from a façade wall further comprises the steps of: (i) applying an after-treatment liquid selected from a silicate liquid and a silicone hydride liquid to the façade wall, wherein step (i) is performed after step (c). In such embodiment, the method comprises steps (a), (b), (c) and (i), and step (i) has the same benefits as described above with regard to application of a silicate liquid or a silicone hydride liquid.

**[0040]** In one embodiment of the invention, the after-treatment liquid comprises the cleaning liquid. An after-treatment liquid comprising silicate(s) and/or silicone hydride(s) may, for example, preferably be prepared by mixing a silicate or silicone hydride solution with water with a low or substantially no concentration of calcium carbonate, e.g. deionized water. The calcium carbonate concentration of normal municipal water is, at many locations, too high. Consequently, it is beneficial to mix the silicate or silicone hydride solution with the cleaning liquid having a conductivity of 3 μS/cm or less. For example, the silicate solution may have a water to potassium silicate ratio of about 30:1 (w/w), such as commercially available KEIM Fixativ. As an example, the water to potassium silicate ratio of the after-treatment liquid may be about from 250:1 to 45:1 (w/w), depending on the condition of the façade wall and the desired result. As an example, if the façade wall is very porous, an after-treatment liquid having a high such ratio, such as 180:1, may be applied during a first application, followed by a second application with an after-treatment liquid having a ratio of about 120:1 and a third application with an after-treatment liquid having a ration of about 60:1. The person skilled in the art understands how to adapt the ratio of the after-treatment liquid to the needs of a specific façade wall.

**[0041]** One embodiment which falls beyond the scope of the invention relates to use of a cleaning liquid consisting of water having a conductivity of 0.5 μS/cm or less, such as 0.1 μS/cm or less, such as 0.08 μS/cm or less, for washing away dirt from a façade wall. For above-mentioned reasons, use of such cleaning liquid is particularly suitable for washing a façade wall.

**[0042]** One embodiment which falls beyond the scope of the invention relates to a façade wall washing system comprising: a cleaning liquid apparatus for providing a cleaning liquid, wherein the cleaning liquid consists of water having a conductivity of 3 μS/cm or less, such as 1 μS/cm or less, such as 0.5 μS/cm or less, such as 0.1 μS/cm or less, such as 0.08 μS/cm or less; and cleaning liquid application means. The person skilled in the art understands what appropriate cleaning liquid application means are. In one example, at least part of the cleaning liquid application means are of such materials that do not considerably increase the ion content of the cleaning liquid. Especially, it may be important that the parts of the cleaning liquid application means being in contact with the cleaning liquid during a longer time is made of such materials.

**[0043]** In one embodiment which falls beyond the scope of the invention, at least one of the cleaning liquid apparatus and the cleaning liquid application means contains conductivity measurement means for measuring the conductivity of the cleaning liquid. Such conductivity measurement means may serve to assure the operator that the cleaning liquid has a sufficiently low conductivity to obtain the desired washing result.

**[0044]** In one embodiment which falls beyond the scope of the invention, the system further comprises a waste water apparatus for purifying used cleaning liquid. Traditionally, the waste water resulting from façade wall washings have been let out to the drainage system without purification. However, such waste water commonly contains contaminants which are harmful to humans, such as the to operator(s) performing the washing, and to the environment. For example, the waste water may contain heavy metals, such as heavy metals resulting from the pigments of eroding façade paint, such as linoleum based paint. Examples of pigments comprising heavy metal compounds are cadmium yellow (cadmium sulfide), cadmium red (cadmium selenide) and cadmium orange (an intermediate cadmium sulfoselenide), chrome green, lead white, zinc white, cobalt blue, uranium yellow and copper sulfate. Further, the waste water resulting from façade walls which have been exposed to exhaust gases from vehicular traffic, such as façade walls in urban environments, may contain particularly high levels of lead and lead compounds. Further, the used cleaning liquid may contain organic compounds being harmful to humans and the environment. Accordingly, in one embodiment which falls beyond the scope of the invention, the waste water apparatus comprises a purification device for removing particles, organic compounds and heavy metals from the used cleaning liquid. As an example, the purification device comprises: a prefilter for removing particulate matter; an organic compounds removing device comprising activated carbon; and and an ion exchange filter for removing heavy metals, wherein: the prefilter is arranged upstream the organic compounds removing device and the ion exchange filter; and the organic compounds removing device and the ion exchange filter may be the same or different. As an example, the purification device further comprises a chelating ion exchange filter for removing heavy metals arranged downstream the prefilter. The chelating ion exchange filter further reduces the amount of heavy metal to very low levels, which may be necessary to fulfill environmental policy requirements.

**[0045]** In one embodiment of a system which falls beyond the scope of the invention, the waste water apparatus and the cleaning liquid apparatus are functionally connected so that purified used cleaning liquid from the

waste water apparatus can be recycled and used as input to the cleaning liquid apparatus for providing cleaning liquid. Such recycling reduces the water consumption of a façade washing operation.

**[0046]** In one embodiment which falls beyond the scope of the invention, the waste water apparatus comprises: a collecting device for collecting used cleaning liquid, wherein the collecting device is adapted for being arranged in a storm drain; and a pump device for pumping collected, used cleaning liquid from the collecting device to the purification device. The benefits of arranging a collecting device in a storm drain are mentioned above. As an example, the collecting device comprises a trough and a flange for maintaining the trough in a storm drain.

**[0047]** In one embodiment which falls beyond the scope of the invention, the system according to the invention further comprises means for routing purified, used aqueous cleaning liquid obtainable from the purification device to a storm drain, thereby by-passing the collecting device. Such arrangement is very convenient because the same storm drain may be used for both collecting and drainage purposes.

**[0048]** Further objects and advantages of the present invention will be discussed below by means of exemplifying embodiments.

**[0049]** Even though the embodiments of the invention described above are adapted for a washing of a façade wall, they may also be applicable to a washing of an interior surface, not being glass, or a floor.

**[0050]** In one embodiment which falls beyond the scope of the invention, the cleaning liquid apparatus for providing a cleaning liquid is comprising: a water inlet; a prefilter for removing particulate solids, the prefilter having an inlet and an outlet; means for routing water from the water inlet to the prefilter; a pump having an inlet and an outlet; means for routing water from the prefilter to the pump; a recycling water inlet arranged between the water inlet and the pump; a reverse osmosis device comprising an inlet, a drainage outlet and a deionized water outlet; means for routing water from the pump to the reverse osmosis device; an ion exchange device comprising at least one ion exchange filter, the ion exchange device having an inlet and an outlet; means for routing water from the deionized water outlet to the ion exchange device; a purified water tank comprising an inlet, a purified water outlet and a recycling water outlet, wherein the recycling water outlet is arranged at the top of the purified water tank; means for routing water from the ion exchange device outlet to the purified water tank inlet; and means for routing water from the recycling water outlet to the recycling water inlet; wherein water having a conductivity of 3 μS/cm or less is obtainable from the purified water outlet.

**[0051]** An arrangement "at the top of the purified water tank" refers to an arrangement so as to eliminate substantially all air from the purified water tank when the flow in through the inlet of the purified water tank is bigger than the flow out of the purified water outlet of the purified water tank. In a preferred embodiment, the purified water tank is substantially air-free.

**[0052]** In one embodiment of the invention, step (a) involving providing the cleaning liquid at the washing site by continuous processing of inlet water comprises: (a1) prefiltering inlet water for removal of particulate solids; (b1) pumping water obtained from step (a1) and optionally step (f1); (c1) subjecting water obtained from step (b1) to reverse osmosis, thereby generating a drainage flow and a deionized water flow; (d1) subjecting the deionized water flow from step (c1) to ion exchange treatment; (e1) collecting water resulting from step (d1) in an air-free tank; (f1) recycling water from the tank of step (e1) by subjecting it to at least steps (b1)-(e1); and (g1) obtaining water having a conductivity of 0,5 μS/cm or less from the tank of step (e1).

**[0053]** The cleaning liquid apparatus for providing a cleaning liquid entails a number of advantages. The apparatus requires only one pump. By starting the only pump required, which is arranged upstream the reverse osmosis device, the complete purification process is started. Consequently, only one on/off switch is required on the apparatus, which makes it easy to operate. The pumping action of the pump is also sufficient for maintaining an overpressure in the purified water tank (the air free tank). Consequently, water from the purified water tank can be recycled to the recycling water inlet arranged upstream the pump, without the aid of a second pump. In contrast, recycling of water from the purified water tank to a recycling water inlet arranged downstream the pump would require a second pump which makes the apparatus more complex and expensive. Arranging the recycling water outlet at the top of the pressurized purified water tank results in a tank substantially free from air. Minimizing the amount of air in the purified water tank is essential for maintaining the conductivity of the water at a low level. Further, the continuous recycling of water allows for continuous removal of impurities resulting from the components of the apparatus. The man skilled in the art understands that the same benefits also concerns to the corresponding method.

Brief description of the drawings

**[0054]** In the following detailed description, reference will be made to the accompanying drawings, of which:

Fig 1 schematically shows an embodiment of an apparatus for the provision of water having a conductivity of about 0.08 μS/cm or less;

Fig 2 schematically shows an embodiment of an ion exchange device;

Fig 3 schematically shows another embodiment of an apparatus for the provision of water having a conductivity of 0.08 μS/cm or less;

Fig 4 shows a schematic representation of an embodiment of a waste water apparatus for purifying used cleaning liquid, including a cross-sectional view

of an embodiment of a collecting device;
Fig 5 schematically shows a cross-sectional view of an embodiment of a used cleaning liquid collecting device for arrangement in a storm drain; and
Fig 6 schematically shows a cross-sectional view of another embodiment of a used cleaning liquid collecting device for arrangement in a storm drain.

Example embodiments

**[0055]** The embodiments presented below are provided as examples of apparatuses which are not within the scope of the invention.

*1. Apparatus for the provision of water having a conductivity of about 0.08 μS/cm or less*

**[0056]** To obtain the cleaning liquid of the invention, an apparatus as described below may be used. For example, municipal water may be used as inlet water.

**[0057]** With reference to figures 1 and 2, the apparatus comprises the following components: a water inlet 1; a prefilter 2 for removing particulate solids, the prefilter 2 having an inlet and an outlet; means for routing water from the water inlet 1 to the prefilter 2; a prefiltered water tank 9, the prefiltered water tank containing a recycling water inlet 4 and further containing a prefiltered water inlet, and an outlet; means for routing water from the prefilter 2 to the prefiltered water tank 9; a pump 3 having an inlet and an outlet; means for routing water from the prefiltered water tank 9 to the pump 3; a reverse osmosis device 5 comprising an inlet, a drainage outlet and a deionized water outlet; means for routing water from the pump 3 to the reverse osmosis device 5; an ion exchange device 6 comprising a first and second ion exchange filter 61, 62 arranged parallel to each other and upstream a third ion exchange filter 63, the ion exchange device 6 having an inlet and an outlet; means for routing water from the deionized water outlet to the ion exchange device 6; a purified water tank 7 comprising an inlet, a purified water outlet and a recycling water outlet 8, wherein the recycling water outlet 8 is arranged at the top of the purified water tank 7; means for routing water from the ion exchange device 6 to the purified water tank 7; and means for routing water from the recycling water outlet 8 to the recycling water inlet 4; wherein water having a conductivity of about 0.08 μS/cm or less is obtainable from the purified water outlet.

**[0058]** An arrangement "at the top of the purified water tank" refers to an arrangement so as to eliminate substantially all air from the purified water tank when the flow in through the inlet of the purified water tank is bigger than the flow out of the purified water outlet of the purified water tank.

**[0059]** An "ion exchange filter" refers to any ion exchange means comprising ion exchange material, including ion exchange columns. For example, the ion exchange filters may comprise an anionic exchanger bed, an cationic exchanger bed and/or a mixed bed.

**[0060]** Conductivity measuring means 64 are arranged at two positions: i) downstream the first and second column 61, 62, but upstream the third column 63; and *ii)* downstream the third column 63.

**[0061]** The purification grade of the prefilter 1 is 1 μm with a β-value of 80-90 %. The pump is made of acid-proof stainless steel.

**[0062]** The inlet 1 is adapted for being connected to a fire hydrant. Municipal water provided by a fire hydrant in Stockholm, Sweden has a conductivity of about 200-300 μS/cm. After passing the reverse osmosis device 5, the conductivity of the water is about 1-5 μS/cm. After the first or second ion exchange filter 61, 62, the conductivity is about 0.1 μS/cm, and after the third ion exchange filter, about 0.06 - 0.07 μS/cm. The final conductivity depends e.g. on the temperature of the water.

**[0063]** The purified water outlet of the purified water tank 7 is connected to hose 10. To minimize the hose's 10 contribution of ions to the cleaning liquid, i.e., the purified water, the inside of the hose 10 is made of PVC, which is a beneficial hose material in that aspect. At least one pump 11 is arranged on the hose 10 to pressurize the cleaning liquid for application on a façade wall. For example, additional hoses may be connected to the purified water outlet. Additional pumps may be arranged on these hoses, providing water at different pressures. The hose 10 is connected to application means for application of the cleaning liquid to a façade wall, such as nozzles.

*2. Apparatus for the provision of water having a conductivity of about 0.08 μS/cm or less*

**[0064]** To obtain the cleaning liquid of the invention, an apparatus as described below may be used. For example, municipal water may be used as inlet water.

**[0065]** With reference to figure 3, water is provided at the inlet (not shown) and downstream the inlet are arranged in series: an activated carbon filter 20, such as a filter from Norit; a particle filter 2, such as a 5 μm particle filter, such as a filter from Osmonics; an anti-scalant dosing device 21, such as Nalco 191; a flow regulator; and an open tank 9, such as a tank essentially made of polyethylene. Downstream an outlet of the open tank 9 are arranged in series: a flow regulator; a pump 3, such as a pump made out of stainless steel, such as SS316; a reverse osmosis device 5, such as a RO-filter unit having 99 % rejection, such as DOW BW30; two parallel ion exchange filters 61, 62, such as ion exchange filters comprising a mixed bed, such as Rohm & Haas MB20 filters, each having a flow regulator arranged at their inlet and outlet; a conductivity measuring device 64; an ion exchange filter 63, such as an ion exchange filter comprising a mixed bed, such as a Rohm & Haas MB20 filter; a conductivity measuring device 64; and a closed tank 7, such as a tank made essentially of reinforced polypropylene. Downstream a waste water outlet of the reverse osmosis device 5 is arranged a waste water return. Be-

tween two flow regulators arranged on the waste water return is a connection to a point upstream the pump 3, but downstream the flow regulator downstream the open tank 9. A closed tank outlet arranged at the top of the closed tank 7 is connected to a recycling water inlet 4 of the open tank 9 through a recirculation pipe 24. Downstream an outlet arranged at the lower part of the closed tank 7 are arranged two separate pipes, wherein one is having a flow regulator and downstream of that, a low pressure pump 22, such as a pump from Grundfos, and the other is having a flow regulator and downstream of that, a high pressure pump 23, such as a Cat pump.

**[0066]** Water pipes leading clean water, such as water pipes arranged downstream the reverse osmosis device, are made of polypropylene. Other water pipes are made of PVC.

*3. A waste water apparatus for purifying used cleaning liquid*

**[0067]** With reference to figure 4, an embodiment of a waste water apparatus for purifying used cleaning liquid comprises a collecting device 300 adapted to being arranged in a storm drain 400. As an example, used cleaning liquid leaving a façade wall is naturally directed the storm drain 400 and collected in the collecting device 300 being arranged therein. The apparatus comprises a pumping device 200 comprising a pump 201 which is arranged inside the collecting device 300. A regulator starting the pump 201 when at least the inlet of the pump 201 is covered with water may be arranged at the pump. A purification device 100 is arranged downstream the pumping device 200 such that collected, used cleaning liquid may be pumped from the collecting device 300 to the purification device 100. The purification device 100 comprises, arranged in series: a prefilter 101, such as a particle filter, such as a 10-500 μm particle filter, such as a 50-150 μm particle filter, preferably a 50 μm particle filter, or alternatively, a 100 μm particle filter; an organic compounds removing device, such as a device comprising activated carbon, such as a device comprising activated carbon and ion exchange material 102, such as a device comprising activated carbon and ion exchange material for removal of heavy metals; and an ion exchange filter, such as a chelating ion exchange filter 103 for removing heavy metals. An outlet of the purification device 100 is connected to discharge means 303 arranged on the collecting device 300. The discharge means 303 may route purified, used aqueous cleaning liquid from the purification device 100 through a storm drain 400 to the sewer, thereby by-passing the collecting device 300 arranged in the storm drain 400.

*4. Used cleaning liquid collecting device for arrangement in a storm drain*

**[0068]** With reference to figures 5 and 6, an embodiment of the collecting device 300 comprises a trough 301 and a flange 302 for maintaining the trough 301 in a storm drain 400. When the collecting device 300 is arranged in the storm drain 400, the flange 302 rests upon the same surface (the contact surface) as a storm drain lid or grating does when covering the storm drain 400. The flange has a lower part 305, wherein at least part of the lower part is being in contact with the contact surface when the collecting device 300 is arranged in a storm drain 400. A packing, such as a rubber packing, (not shown) may be provided on the lower part for preventing that water leaks into the storm drain. A pump (not shown) for pumping used cleaning liquid collected in the trough 301 to a purification device (not shown) may be arranged inside the trough 301. At least one pipe 303 is arranged at the flange 302 or trough 301 so that liquids can flow through the collecting device 300 down the storm drain 400 to the sewer. Each pipe 303 has a upper and lower opening, wherein the lower opening, when the collecting device 300 is arranged in a storm drain 400, is facing the inside of the storm drain 400 and the upper opening is opposite to the lower opening facing open air. A connecting means 304 for connecting a pipe 303 to a hose (not shown) is arranged at the upper opening of the pipe(s) 303. For example, the hose(s) may, at its (their) other end, be connected to the purification device (not shown) and/or another apparatus producing discharge water.

**Claims**

1. A method for washing away algae, mould or claudiosporium from a facade wall, comprising the following steps:

   (a) providing a cleaning liquid, wherein said cleaning liquid consists of water having a conductivity of 0.5 μS/cm or less;
   (b) cleaning said facade wall, wherein said cleaning comprises application of said cleaning liquid of step (a) onto said facade wall; and
   (c) allowing used cleaning liquid from step (b) containing algae, mould or claudiosporium to leave the facade wall.

2. A method according to claim 1, wherein said cleaning liquid consists of water having a conductivity of 0.1 μS/cm or less.

3. A method according to any one of the previous claims, further comprising the steps of:

   (d) collecting said used cleaning liquid of step (c); and
   (e) purifying said collected, used cleaning liquid of step (d).

4. A method according to claim 3, wherein step (d) involves collecting said used cleaning liquid in a storm

drain located in the vicinity of said facade wall; and step (e) involves purifying at the washing site.

**5.** A method according to any one of the preceding claims, wherein step (a) involves providing said cleaning liquid at the washing site by continuous processing of inlet water.

**6.** A method according to any one of the previous claims, further comprising the steps of:

(g) determining if after-treatment is needed; and, if after-treatment is needed,
(h) applying an after-treatment liquid selected from a silicate liquid, a silicone hydride liquid and a fungicide liquid to said facade wall, wherein step (h) is performed after step (c).

**7.** A method according to claim 6, wherein said after-treatment liquid is selected from a silicate liquid and a silicone hydride liquid.

**8.** A method according to claim 7, wherein said after-treatment liquid comprises said cleaning liquid.

**Patentansprüche**

**1.** Verfahren zum Abwaschen von Algen, Schimmelpilz oder Claudiosporium von einer Fassadenwand, wobei das Verfahren die folgenden Schritte umfasst:

(a) Bereitstellen einer Reinigungsflüssigkeit, wobei die Reinigungsflüssigkeit aus Wasser einer Leitfähigkeit von höchstens 0,5 μS/cm besteht;
(b) Reinigen der Fassadenwand, wobei das Reinigen das Aufbringen der Reinigungsflüssigkeit aus Schritt (a) auf die Fassadenwand umfasst; und
(c) Ermöglichen, dass verbrauchte Reinigungsflüssigkeit aus Schritt (b), welche Algen, Schimmelpilz oder Claudiosporum enthält, die Fassadenwand verlässt.

**2.** Verfahren nach Anspruch 1, wobei die Reinigungsflüssigkeit aus Wasser einer Leitfähigkeit von höchstens 0,1 μS/cm besteht.

**3.** Verfahren nach einem der vorhergehenden Ansprüche, welches ferner die folgenden Schritte umfasst:

(d) Sammeln der verbrauchten Reinigungsflüssigkeit aus Schritt (c) und
(e) Aufbereiten der gesammelten verbrauchten Reiningungsflüssigkeit aus Schritt (d).

**4.** Verfahren nach Anspruch 3, wobei der Schritt (d) das Sammeln der verbrauchten Reiningungsflüssigkeit in einer Regenwasserleitung umfasst, die in Nachbarschaft der Fassadenwand angeordnet ist; und der Schritt (e) das Aufbereiten am Waschort umfasst.

**5.** Verfahren nach einem der vorhergehenden Ansprüche, wobei der Schritt (a) das Bereitstellen der Reiningungsflüssigkeit am Waschort durch kontinuierliches Verarbeiten von einlaufendem Wasser umfasst.

**6.** Verfahren nach einem der vorhergehenden Ansprüche, welches ferner die folgenden Schritte umfasst:

(g) Ermitteln, ob eine Nachbehandlung erforderlich ist; und, wenn eine Nachbehandlung erforderlich ist,
(h) Aufbringen einer Nachbehandlungsflüssigkeit, die aus einer Silikatflüssigkeit, einer Silikonhydridflüssigkeit und einer Fungizidflüssigkeit ausgewählt ist, auf die Fassadenwand, wobei der Schritt (h) nach dem Schritt (c) durchgeführt wird.

**7.** Verfahren nach Anspruch 6, wobei die Nachbehandlungsflüssigkeit aus einer Silikatflüssigkeit und einer Silikonhydridflüssigkeit ausgewählt ist.

**8.** Verfahren nach Anspruch 7, wobei die Nachbehandlungsflüssigkeit die Reinigungsflüssigkeit umfasst.

**Revendications**

**1.** Procédé d'élimination par lavage d'algues, de moisissure ou de claudiosporium d'une façade, qui comprend les étapes suivantes, consistant à :

(a) fournir un liquide nettoyant, ledit liquide nettoyant étant constitué par de l'eau ayant une conductivité de 0,5 μS/cm ou moins ;
(b) nettoyer ladite façade, ledit nettoyage comprenant l'application dudit liquide nettoyant de l'étape (a) sur ladite façade ; et
(c) laisser le liquide nettoyant usagé de l'étape (b) contenant les algues, la moisissure ou claudiosporium quitter la façade.

**2.** Procédé selon la revendication 1, ledit liquide nettoyant étant constitué par de l'eau ayant une conductivité de 0,1 μS/cm ou moins.

**3.** Procédé selon l'une quelconque des revendications précédentes, comprenant en outre les étapes consistant à :

(d) collecter ledit liquide nettoyant usagé de

l'étape (c) ; et
(e) purifier ledit liquide nettoyant usagé et collecté de l'étape (d).

**4.** Procédé selon la revendication 3, dans lequel l'étape (d) implique la collecte dudit liquide nettoyant usagé dans un collecteur d'eaux pluviales situé à proximité de ladite façade ; et l'étape (e) implique la purification sur le site de lavage.

**5.** Procédé selon l'une quelconque des revendications précédentes, dans lequel l'étape (a) implique la fourniture dudit liquide nettoyant au site de lavage par traitement continu de l'eau d'alimentation.

**6.** Procédé selon l'une quelconque des revendications précédentes, qui comprend en outre les étapes consistant à :

(g) déterminer si un après-traitement est nécessaire ; et, si un après-traitement est nécessaire,
(h) appliquer un liquide après-traitement choisi parmi un liquide à base de silicate, un liquide à base d'hydrure de silicone, et un liquide fongicide à ladite façade, l'étape (h) étant réalisée après l'étape (c).

**7.** Procédé selon la revendication 6, ledit liquide après-traitement étant choisi parmi un liquide à base de silicate et un liquide à base d'hydrure de silicone.

**8.** Procédé selon la revendication 7, ledit liquide après-traitement comprenant ledit liquide nettoyant.

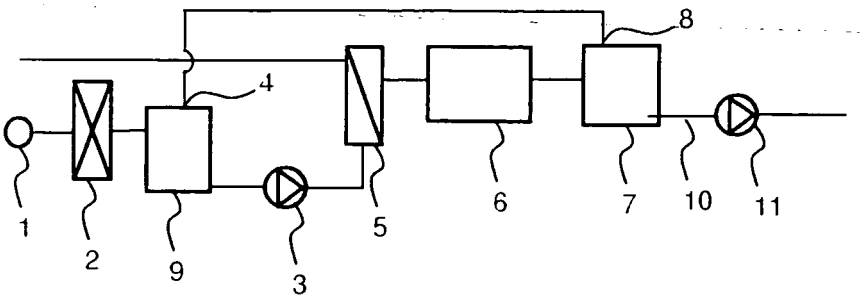


FIG 1

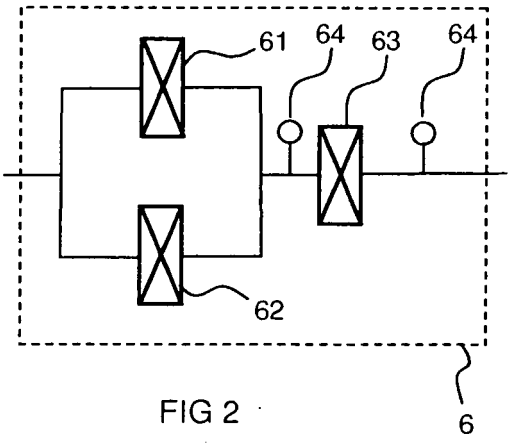


FIG 2

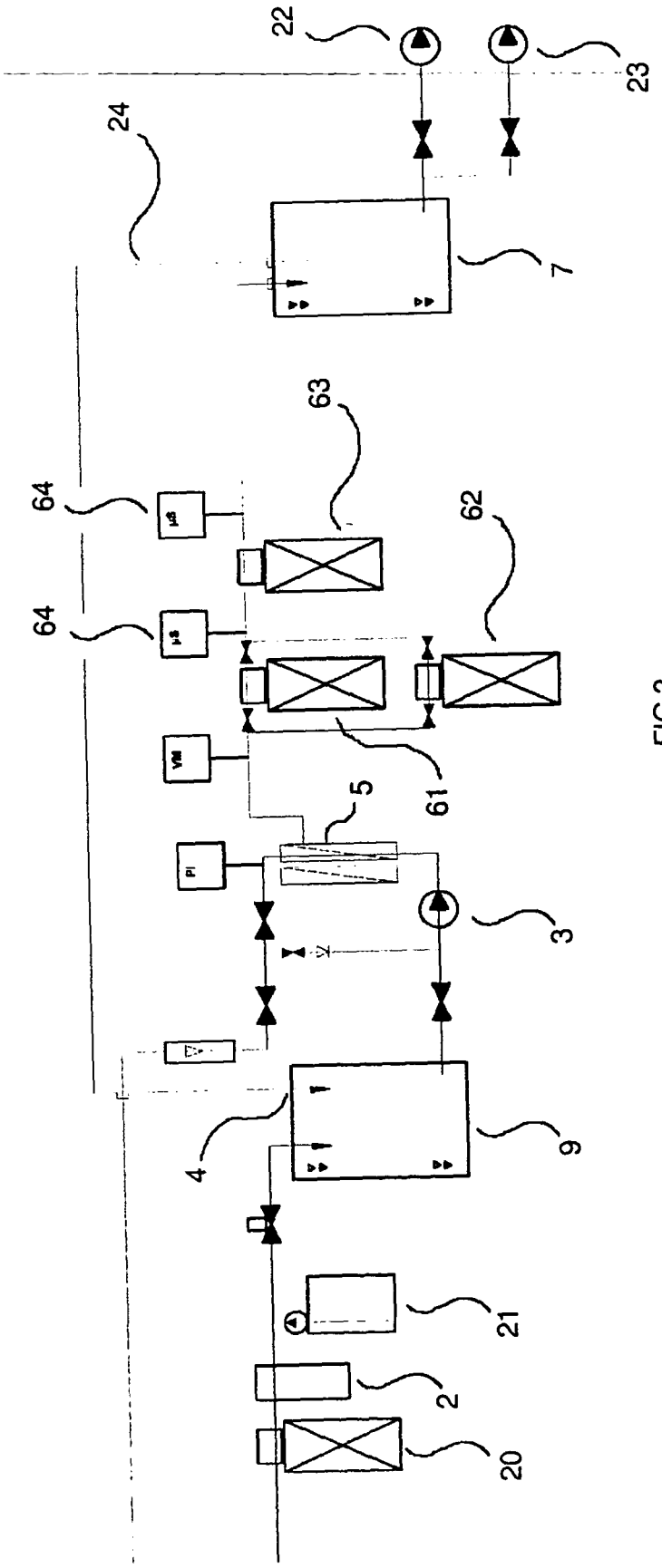


FIG 3

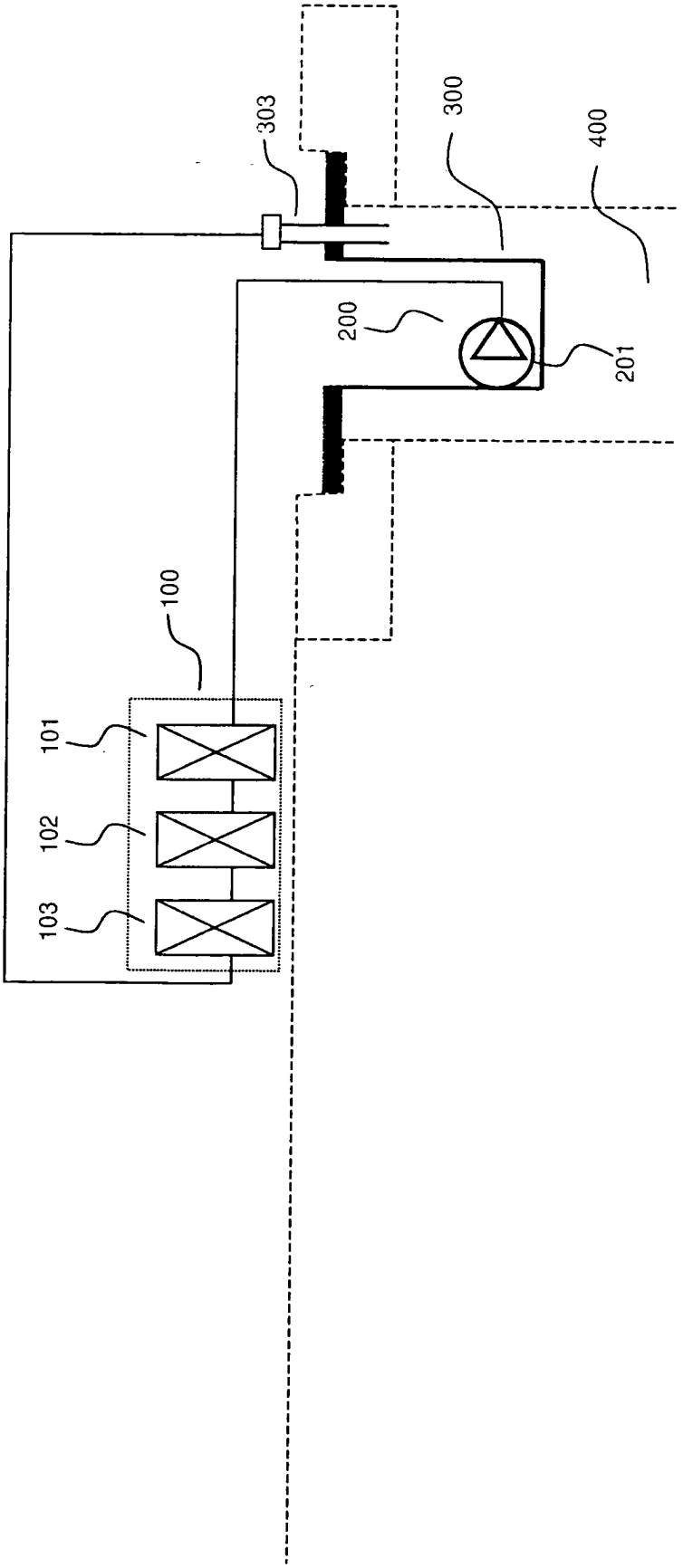


FIG 4

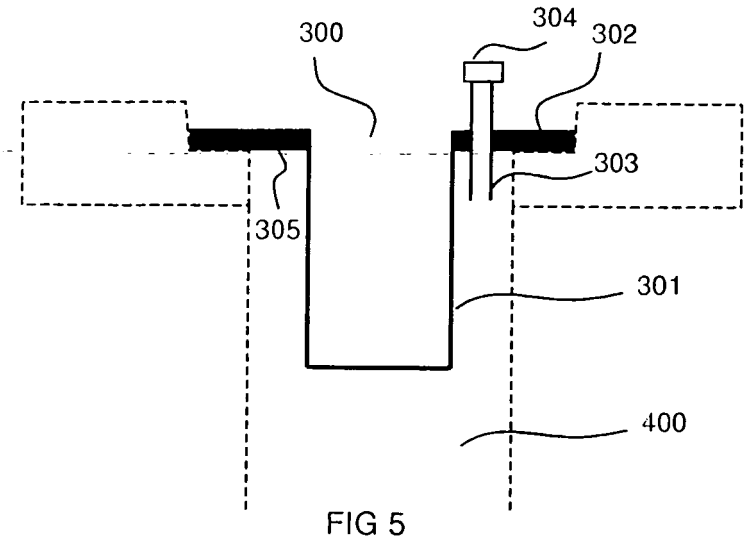


FIG 5

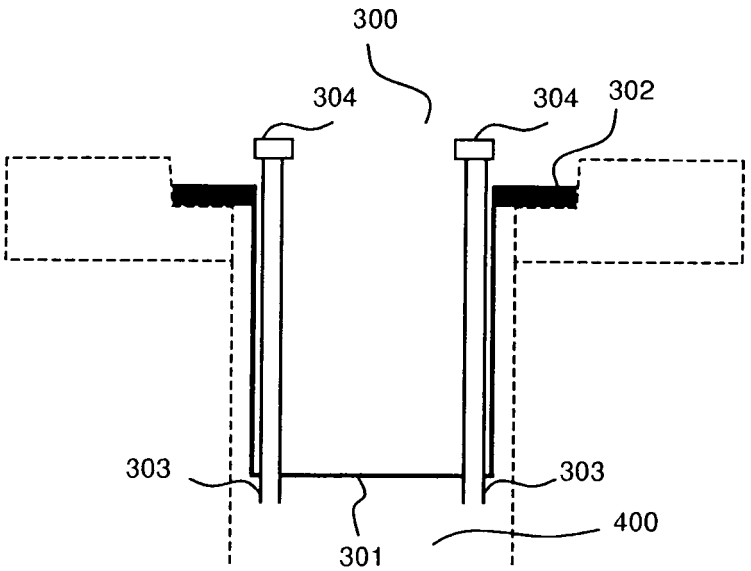


FIG 6

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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