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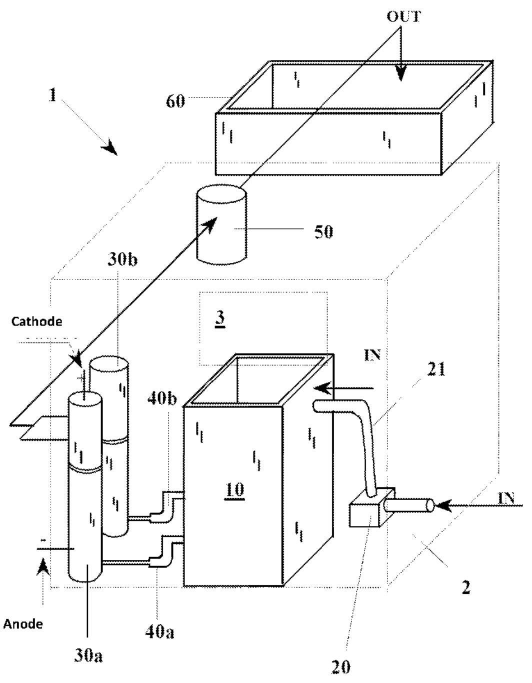
FIG. 2



(57) Abstract: In the field of technology for purifying and disinfecting water, the present invention is directed to the realization of an electrolytic proceeding for the production on-site of the disinfectant sodium hypochlorite (NaClO) for sanitizing any type of water. In particular, the present invention is directed to a dedicated equipment/system which, through the use of salt and electricity only, enables to produce and supply in controlled, variable and automatic way, the desired quantity of disinfectant agent directly in the place of use, thus modulating it depending on the need of use and the environment. Said system enables to supply continuously to the environment the only necessary quantity of disinfectant to obtain the required sanitization, thus avoiding at the same time the production of dangerous collateral products, such as chlorate ions.

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DESCRIPTION

INDUSTRIAL PROCEEDING FOR SANITIZING WATER THROUGH ELECTROLYSIS, APPARATUS FOR THE REALIZATION THEREOF AND USES THEREOF

Technical field of the invention

In the field of technology for purifying and disinfecting water, the present invention is directed to the realization of an electrolytic proceeding for the production on-site of the disinfectant sodium hypochlorite ($NaClO$) for sanitizing any type of water.

In particular, the present invention is directed to a dedicated equipment/system which, through the use of salt and electricity only, enables to produce and supply in controlled, variable and automatic way, the desired quantity of disinfectant agent directly in the place of use, thus modulating it depending on the need of use and the environment. Said system enables to supply continuously to the environment the only necessary quantity of disinfectant to obtain the required sanitization, thus avoiding at the same time the production of dangerous collateral products, such as chlorate ions.

Field of the invention - Brief Description of prior art

The electrolysis of brine (saturated or highly concentrated solution (up to about 26%) substantially of sodium chloride, $NaCl$) is one of the known methods for producing sodium hypochlorite.

Sodium hypochlorite is a chemical compound whose formula is $NaClO$, unstable in anhydrous form (it decomposes explosively), which, however, is widely used (since the 18th century) as a disinfectant or a very efficient bleaching agent, in particular in the form of an aqueous solution. In solution, its strongly oxidizing active ingredient, chlorine, is released after the gradual decomposition of the product. Among the collateral products of sodium hypochlorite decomposition, it is also possible to mention, among others, the formation of chlorate ions which are remarkably harmful to health and the environment. The chlorate ion is an ionic species which is formed in the anodic compartment during the electrolysis phase of the brine, as a result of a parasitic reaction between two chlorite ions (ClO-), present due to the massive concentration of chlorine at high temperatures or in any case in long periods of storage and direct exposure to (UV) solar rays. The chlorate ion is remarkably harmful in many respects. In fact, being a highly stable compound, the chlorate ion tends to accumulate on the anodic side of the electrolytic cell, thus concentrating within the brine itself. In addition, the chlorate ion is also a strong pollutant for the food chain (for example, it is a suspected agent which causes pathologies of thyroid, nervous system and circulatory system) and for everything that becomes part of it, such as, for example, drinking water.

Therefore, the useful use of sodium hypochlorite for water disinfection (such as, for example, drinking water, sanitary water, process water, and waste water) is limited by instability over time of the product itself and the presence of said toxic products.

In the current state of the art, preparations are generally used, for example in the form of tablets, whose reaction causes the generation of sodium hypochlorite. For example, such preparations may be used in the event of sanitization of a swimming pool.

It is clear that these preparations do not enable a production of precise quantities of sodium hypochlorite and therefore in some cases it may be overproduced or underproduced. In the event of overproduction, there might occur the problem of generating the chlorate ion which, as mentioned, is polluting and toxic.

In addition, the machines currently on the market are not so long-lasting (10 years or even less) and not so flexible and they also partially produce an excess of pollutant.

Technical Problem

Consequently, it would be useful the availability of a system/machinery which is capable of producing with a high degree of purity (preferably without the formation of toxic collateral products such as chlorates) and of dosing suitably at the moment and depending on need, the correct quantity of sodium hypochlorite directly on-site or in the immediate vicinity so as to avoid problems of storage and transport thereof.

The aim of the present invention is to provide a satisfying solution to the technical issue described above.

Summary of the invention

Therefore, the aim of the present invention is to provide a machinery which resolves at least in part said technical disadvantages.

In particular, the aim of the present invention is to provide a compact machinery capable of producing in precise and controlled way and modulable over time a predetermined quantity of (NaClO).

The aim of the present invention is also to provide a machinery which can be readily realized in various scales and sizes, which is readily programmable thus enabling to control/monitor and modify real-time all the operative parameters, among which the quantity of final product (NaClO).

The aim of the present invention is also to provide a machinery which is automatic and reduces to a minimum the production of toxic and/or polluting substances such as chlorate ions.

These and other aims are therefore achieved with the present machinery (**1**) for producing sodium hypochlorite (NaClO) intended for the sanitization of water in general, the machinery comprising:

- An inlet (IN) for enabling to feed a liquid within the machinery;
- A collection tank (10) intended for containing in use a brine and arranged in communication with said inlet (IN);
- At least an electrolytic system comprising at least one electrolytic cell (30a, 30b) of cylindrical-coaxial type;
- Feeding means (40a, 40b) configured for enabling to pipe the said brine, contained in use within said collection tank (10), towards said electrolytic system;
- An outlet for piping the product obtained from the electrolytic system towards the outside of the machinery.

By means of this solution, it is possible to produce on-site the suitable quantity of NaClO with low content of dangerous residues. In particular, the use of the cylindrical electrolytic cell, formed by cylindrical cathode and cylindrical anode coaxial to one another, proved to optimize the production and to reduce residues to a minimum.

Advantageously, the machinery comprises an electronic control/management system through which the said machinery can be programmed and managed real-time.

In this way, further technical issues are readily resolved.

By means of its programmability, the machinery can be suitably controlled and programmed thus varying the various parameters, for example through a control panel.

Therefore, by setting up any value of production of the product precisely, it is possible to control and modify the quantity of NaClO produced over time, depending on needs, in addition to the possibility to control other various parameters, such as temperature, intensity of applied current, etc.

By means of this machinery, it is possible to produce on-site the product NaClO which it obtained real-time and supplied where it is needed a precise quantity variable depending on needs.

The machinery can be realized in various sizes and therefore it is compact and transportable, besides producing disinfectant in precise quantities depending on needs.

Therefore, it is not necessary anymore to use tabs and other products to dissolve directly in the place to sanitize.

Therefore, there is advantageously provided a frame, possibly mounted on wheels on which the components of the machine are arranged/assembled.

The machine can be readily moved where it is necessary and in the event of necessity. Otherwise, it can be fixed on-site.

Therefore, this readily transportable and compact machinery integrates in itself all the elements to produce the final product NaClO.

Therefore, it is present at least a reservoir for brine and an electrolytic system, for example constituted by one or more electrolytic cells of cylindrical type, intended for carrying out electrolysis of brine for producing and supplying sodium hypochlorite directly on-site.

The electronic control and/or management system, such as a computerized system PLC (*Programmable Logic Controller*), preferably digital, controls the process, thus enabling to make it automatic if necessary. In this manner, this machinery can give a suitable solution to the technical issue generated by the above-described needs.

Further advantages are illustrated by the remaining dependent claims.

For example, it is described here the use of a machinery according to the description, for producing a predetermined controllable and modulable quantity of sodium hypochlorite (NaClO).

It is also described here a method for producing a predetermined quantity of sodium hypochlorite (NaClO) intended for the sanitization of water in general, the method comprising the arrangement of a machinery according to the description above and the activation thereof according to the following phases:

- Activating the machinery and programming the machinery according to one or more parameters for obtaining a predetermined quantity of sodium hypochlorite (NaClO) controllable by the programming;

- Preparing the brine within the collection tank (10) through the liquid that the machinery charges into the said tank and injecting salt into the said liquid within the collection tank (10);

- Piping the said brine towards the electrolytic system (30a, 30b) controlled by the machinery for obtaining sodium hypochlorite (NaClO);

- Exit of the final product (NaClO) from the machinery.

It is also described here a method for sanitizing water in general through a production directly on-site of a predetermined quantity of sodium hypochlorite (NaClO) which is then poured into said water to purify, the method comprising the arrangement of a machinery according to the description above and the production of a predetermined quantity of sodium hypochlorite by feeding a liquid to the machinery, preferably water, which is treated through a process of electrolysis directly in the said machinery which supplies said quantity of sodium hypochlorite (NaClO).

It is also described here a hydrogen separator, preferably usable in this machinery, which comprises:

- A first cylinder (51);
- A second cylinder (52);
- A first duct (53) which connects the first cylinder to the second cylinder and through which the hydrogen separated from the liquid flows in use;
- A second duct (54) which connects the first cylinder to the second cylinder and through which the liquid separated from the hydrogen flows in use;
- The first cylinder comprising an inlet (55’) for the mixture to separate from the hydrogen and the second cylinder comprising an outlet (57) for the separated hydrogen, and wherein the second cylinder (52) comprises inside a floating element (59) movable through a closing position in which it closes said outlet (57) and an opening position in which it releases said outlet, the said floating element being configured for floating on the liquid contained in use in the second cylinder so as to position itself, due to said floating, in said closing

position thus obstructing the outlet 57 and plunge at least in part when a predetermined pressure acts onto it thus positioning itself in said opening position.

In this way, in use, the hydrogen which flows from the first to the second cylinder through the first duct (53) acts onto said floating element thus plunging it once it reaches a certain pressure value and thus releasing the outlet 5 from which it can flow.

It is also described here an electrolytic cell for a machinery for sanitizing water and wherein said electrolytic cell is cylindrical (30a, 30b) and it is formed by one cathode and one anode, both cylindrical and coaxial to one another.

Preferably said electrolytic cell is composed by graphite and titanium and even more preferably the cathode of said cylindrical electrolytic cell is graphite and the anode is titanium.

It is also disclosed here the use of this electrolytic cell for sanitizing water through a process of electrolysis.

Brief description of the drawings

Additional features and advantages of the present proceeding and relative plant, according to the invention, will become clearer through the following description of preferred embodiments thereof, given only by way of non-limiting example, with reference to the attached drawings, wherein:

- Figure 1 depicts the external part of this machinery according to claim 1;

- Figure 2 depicts a schematization of a preferred embodiment of the apparatus according to the invention for the production through electrolysis of sodium hypochlorite from brine, that is the machinery with the provided internal components;

- Figure 3 is a flowchart of the functioning;
- Figures from 4 to 6 depict structurally some parts of the machinery;
- Figure 7 depicts a preferred constructive solution of the separator 50;
- Figure 8 depicts a schematization of the cylindrical electrolytic cell and thus formed by two coaxial cylinders for the realization of anode and cathode.

Detailed description of the invention

The present invention is directed to a system/machine for producing sodium hypochlorite by means of electrolysis of a brine (saturated or highly concentrated solution of NaCl) at a concentration of NaCl in water up to 26% in weight; preferably up to 20% in weight; more preferably, up to approximately 15% in weight; even more preferably, up to 10% in weight; such as, for example, up to 5% in weight; preferably, from 0% up to 3,5 % in weight.

Therefore, by describing the invention in greater details, with reference to figure 1 and figure 2, it is described the machine subject of the invention.

The machine 1, as per figure 1, is fitted with an external covering 2, which contains inside the necessary components for its functioning and they are described in greater details further with reference to the further figure 2 and from figure 4 to figure 6.

In particular, the external covering 2 is fitted with a movable wicket 3 which is activatable between an opening position and a closing position, so that when it is opened can give access to the inside of the machinery to a containment tank of brine (which is not depicted in figure 1 but outlined in figure 2).

Within the above-mentioned tank, water is mixed with salt as described further in greater details.

The wicket 3 may be removed thus releasing the opening, even if, obviously, the use of a wicket makes the machine safer and prevents the impurities from entering into the inner tank and therefore into the brine.

As per the schematization of figure 2, some components of the invention are described and they envisage:

- The above-mentioned collection tank is the one accessible through the wicket 3.

In fact, figure 2 outlines with dashed line the external covering 2 of the machine within which the components are inserted and the tank 10 among them. The figure depicts clearly the wicket 3 with dashed line.

The external covering 2 is provided with an inlet, indicated in figure 2 with the wording (**IN**) from which the water to treat enters, for example through a connection to any water supply system.

Even if it is not described in the schematization of figure 2, the inlet of water occurs preferably at zero French degrees which are a unit of measurement of hardness of water (generally this value indicates that water is devoid or substantially devoid of calcium and magnesium).

This is obtained through the use of a water softener, such as ion exchange water softener, well known on the market.

The water softener avoids deposits in electrolytic cells and thus it protects them over time.

Therefore, the water softener is arranged upwards to the inlet (**IN**) and it is not depicted in figure 2.

A first pump (outlined in figure with number 20) thrusts water through a duct 21 which pipes water within the containment tank 10.

However, this pump is optional since water may penetrate into the tank 10 simply through the pressure of the water supply system itself.

As explained further in the functioning, a predetermined quantity of salt (sodium chloride) which mixes with water is inserted within the collection tank 10 through the wicket in order to produce the brine. Therefore, the salt is charged manually and it is generally available on the market in the form of bags of tabs of sodium chloride with certified bags which generally weigh 10 or 25 kg.

It is possible to pour into the tank the desired quantity of salt and therefore there is no need of high precision. In fact, it is possible to dissolve in water at most 260 grams per liter of water and then a potential excess of salt poured into the tank 10 will simply result in a deposit of salt on the bottom of the tank 10 which will dissolve subsequently when another liquid (generally water) is fed towards the said tank 10.

A certain quantity of brine is piped through one or more flow switches (40a, 40b) towards the electrolytic cell/s (30a, 30b) so that the required treatment occurs.

Even if it is not depicted in figure 2, it is present a second pump interposed between the flow switches and the tank 10 for thrusting the flow towards the flow switches and from here towards the electrolytic cells. Said pump is a dosing pump which regulates only the quantity of brine to which fresh water is added, but it does not regulate the water flow.

The pump serves for integrating the concentrate of salty water needed by the machinery.

Therefore, the schematization of figure 2 depicts two electrolytic cells showing the negative and positive poles through which the process of electrolysis occurs.

The electrolytic cells, as schematized in figure 2, are cylindrical.

They are preferably composed by graphite and titanium, in which the cathode is made of graphite and the anode is of titanium, preferably with the inside of the cylinder of titanium covered by platinum. Therefore, the electrolytic system comprises a suitable system of electrical feeding for the cells.

The cells are preferably fed at **c.a.** 6.5 V DC. As a function of the continuous current, two or more transformers may be provided for each cell with current from 20 to 300 A, depending on sizes.

As explained above, the electrolytic cells are tubular cells, that is cylindrical and, thus, not with plates. As depicted in figure 2, they have a cylindrical shape and then there is envisaged an external cylindrical ring within which, concentrically, there is provided the internal ring (it is not visible in figure 2 for simplicity purposes). The external ring and the internal ring coaxial to one another are respectively anode and cathode and are made of the above-mentioned materials, i.e. graphite and titanium (cathode of graphite and anode of titanium).

Definitely, the external ring is the anode of titanium and the internal ring concentric to the external one, is the cathode of graphite.

The realization of electrolytic cells of cylindrical size is important since it optimizes the process of production of NaClO thus contributing to reduce the production of chlorate ions. According to this embodiment of electrolytic cell, it is taken advantage to the maximum extent of the salt inserted in the tank 10 to obtain NaClO with the maximum efficiency. The lifespan of this kind of electrolytic cell, unlike commonly used plates, is considerably longer and polluting residues are reduced to a minimum, thus obtaining a perfectly eco-friendly machinery.

Moreover, the use of the above-mentioned constructive material, i.e. graphite and titanium, proved to be optimal, thus enabling to optimize further the production of NaClO and at the same time avoiding the production of toxic residual substances, which are then zeroized.

This embodiment proved to be optimal for producing NaClO with respect to conventional electrolytic cells with plates used for systems belonging to the same technical field.

Therefore, electrolytic cells are fitted with anode and cathode, as schematized in figure 2 with the respective positive sign for the cathode and negative sign for the anode.

The flow of brine which comes from the electrolytic cells is then treated according to the process of electrolysis, well known per se.

The outlet of the treated product, i.e. NaClO, goes into the water to treat.

The component 50, outlined in figure 2, describes a hydrogen separator, since the reaction of electrolysis produces a certain quantity of hydrogen while a minimum part thereof remains dissolved.

The separator 50 is used in order to eliminate the produced hydrogen.

Figure 7 outlines structurally this separator which is described thereinafter.

There is provided a first cylinder 51 connected to a second cylinder 52 through an upper duct 53 and a lower duct 54.

The upper duct 53 connects the upper part of the cylinder 51 with the upper part of the cylinder 52 while the lower duct 54 connects the two lower parts of the two cylinders respectively.

The separated hydrogen moves from the upper duct 53 into the cylinder 52 from which it is expelled outwards.

Water with NaClO enters downwards from the duct 54 into the cylinder 52 thus causing a floating of a float 59 which serves as cut-off.

In greater details, number 55 indicates the arrow of motion of water containing NaClO and hydrogen to purify from hydrogen indeed.

Number 55′ indicates the inlet to said separator, this inlet is connected to a duct which obviously communicates with electrolytic cells.

The separation between hydrogen and water with NaClO occurs in the first cylinder 51.

In fact, the hydrogen leaves the cylinder 51 through the high part and the arrows 56 indicate this passage. This occurs because the gas tends spontaneously to go upwards while the heavier liquid goes downwards.

Therefore, the hydrogen which flows into the upper part of the cylinder 51 moves towards the cylinder 52 to then pour from the inlet 57 (see the arrow of outlet 56′).

On the contrary, water with NaClO is piped towards the second cylinder downwards through the duct 54, for example according to the system of communicating vessels or generating a suitable moving pressure. The arrows 58 depict the path of water with NaClO in inlet to the second cylinder.

As mentioned, the element 59 is a floating element, in particular a plunger float, which can flow within the cylindrical body 52 between an opening position, in which it releases the opening 57 and a closing position in which it obstructs it. As soon as water or liquid in general fills the cylinder 52, it is thrusted towards the upper part of the cylinder 52 thus obstructing the outlet duct 57. When there is sufficient pressure of hydrogen in inlet from the duct 53 into the high part of the cylinder 52, the floating cut-off is thrusted by said pressure which acts onto the surface thereof towards the bottom of the cylinder 52 thus plunging at least in part into the underlying liquid.

In this plunging position, it moves away from the high part of the cylinder 52, thus releasing the opening 57, as depicted in figure 57 and enabling the outlet of the gas.

Therefore, the floating element forms a valvular opening/closing system with the opening with which it cooperates.

The hydrogen flows away freely once the valve is opened.

This is a simple and functional solution which functions in continuous manner with great reliability.

This solution, even described as a component of this machine, could be theoretically produced, sold and used irrespective in or for different machines.

Moreover, it is not an essential element of the present invention, since the formation of hydrogen could be marginal for few quantities of product and it would evaporate anyway.

In other cases, for greater productions, the separator has the advantages not only of cleaning the product from the produced hydrogen but also to enable to provide a recovery section which collects hydrogen for other uses.

Even if it is not depicted in the schematization of figure 2, the machine has an electronic management system, such as a PLC, a control unit or similar systems, such that the machinery is programmable and it is autonomous in functioning, once it is programmed.

In this manner, for example through the electronic control panel, for example conveniently arranged on the upper part of the external covering 2, it is possible to set the processing parameters and read real-time the values produced by the machine.

Therefore, as described thereinafter, the management control system enables to program the machinery precisely such that a precise quantity of brine can be supplied from the tank 10 towards the electrolytic cell/s and then a precise quantity of NaClO is produced at a predetermined time interval.

Therefore, by programming the machine so that it produces a certain quantity of product, the machine will be activated thus producing the programmed quantity.

Therefore, this enables to dose in precise way the necessary quantity of NaClO.

In turn, when it is necessary to vary during the process the quantity of sodium hypochlorite in the water under disinfection, if necessary, a suitable detecting system (which is not depicted here) signals the aforesaid necessity to the above management and control system which intervenes real-time by modifying or activating the machine and/or automatically regulating the parameters of interest to supply the new required quantity of NaClO.

For this purpose, there may be provided one or more external sensors communicating with the machine. The machine connects and communicates with said one or more sensors which measure one or more physical parameters, for example they detect the parameters of water to disinfect. These sensors may be a measuring instrument of chlorine, pH, etc. and they communicate with the machine (wireless, for example). A constant value of chlorine (or other parameter) may be programmed on the machine to maintain in the place where sensors are arranged. The machine receives in input the measurement values carried out by said sensors which operates in the environment to sanitize (for example, the value of chloride). The machine processes automatically through its own control system the received data and produces on-site and pipes a precise quantity of NaClO so that the value measured by the sensor/s remain constant to values set in the machine.

Deviations measured by the sensor and sent to the machine implies an automatic regulation of the machine which may increase the flow and/or act on the electrolytic cells in order to maintain constant the set values.

Therefore, the said electronic management system is programmed according to the description above.

Therefore, for example, if it is necessary to operate on an aqueduct in which it is necessary to maintain a certain value of pH or chloride, the sensors send the value continuously detected to the machine and the machine which receives the value modulates the quantity of NaClO so as to maintain constant the set value.

Deviations from the values measured by sensors imply an automatic modulation of the machine.

Definitely, the machine can communicate with said external sensors which monitors the environment to sanitize and send the measurement parameters so that the machine modulates the production of NaClO as a function of the received parameters.

Moreover, the machine is remotely controllable; know connection systems such as Wi-Fi connection, cable connection or the like enable to render the machine reachable through the Internet and then to be remotely monitorable/manageable/controllable, such as through a PC. An operator may activate/deactivate the machine remotely, control and manage it by varying parameters and functionality.

In addition to automatic manner, the variability may be always carried out through control panel.

Therefore, figure 3 depicts a flowchart which describes the phases of functioning of the present machinery.

As already described, the water to treat is piped towards the tank 10 where the brine is obtained.

The water in inlet is preferably softened.

Immediately on the inlet, upwards to the tank 10, a pre-filter for rough impurities may be provided. The pre-filter per se is a product available on the market and various equivalent types of filters may be used.

Therefore, an electromagnetic valve and a PLC manage the piping through the duct 21 of water to treat towards the tank 10.

The brine forms within the tank through the salt which is charged manually or through automatic systems.

Obviously, automatic systems for charging salt may be provided.

Within the tank a float for regulating the charging of brine may be provided so as to activate the potential pump 20 in order to pipe water towards the tank 10 when the level goes down below a threshold value and stop the filling when the tank reaches a maximum threshold value of filling.

A second pump 23, always managed by the electronic management system, exhausts water from the tank towards the two flow switches which pipes brine under a correct pressure and in a correct quantity towards the two electrolytic cells (or the single cells if the machinery is provided with one cell only).

The electrolytic cells treat water according to the known electrolytic process, which is not described here and pipe the product which has been obtained from chloride towards a potential hydrogen separator so that the treated final product goes towards the tank or the place of collection of the water to treat (if there is no separator, the product is directly supplied into the tank without undergoing the phase of separation of hydrogen).

If the hydrogen is not separated by means of the separator and it is collected in a tank or a container, it is obviously necessary a bleed system.

By describing the invention in greater structural details, figure 4 depicts the apparatus subject of the invention in which the external covering 2 has been removed to highlight the internal components.

Therefore, the external covering 2 may be realized so as to slide with respect to an inner support frame 5 which supports the internal components described thereinafter.

Figure 4 depicts a longitudinal sliding which obviously facilitates the extraction, even if a solution of vertical sliding could be envisaged, thus lifting up the external covering 2.

The double direction of the arrow of figure 4 indicates indeed the possible movement of the external covering 2 to the preferred longitudinal direction.

The external covering is fully made of PP (polypropylene). This high-quality material has not only a high lifespan but also gives an additional protection to the operator since plastic does not conduct electricity. Moreover, when it is closed, the housing gives protection to splashes within the system.

The bearing structure within the machinery, in particular the internal frame, has been engineered so that water and electricity are always separated from one another. This design gives an additional protection to the operator.

The basin of brine has been constructed in the midst of a transparent window so that the operator can control visually the level of brine without opening the system. Moreover, the basin of brine may be readily removed from the housing, for example after cleaning.

The internal frame 5, which is covered by the external covering indeed, supports the previously described components through suitable brackets and/or fastening points.

In fact, figure 4 depicts the tank 10 leaning on a suitable horizontal shelf and facing the previously described opening 3 of the sump 2.

The external covering 2 can be locked in the closing position of the frame in various ways, among which magnetic systems and/or fastening systems, inserts or the like.

The covering can be removed/reapplied by the magnetic system which facilitates this operation.

In a more precise way, figure 5 depicts some previously described components.

For this purpose, the external cover (or external sump in other words) has been removed.

Therefore, the figure depicts a point of inlet of water which, as mentioned, is preferably at zero French degrees. The inlet intercepts a filter 11 which cleans water from the rough sediments (per-filter).

The possible pump (as mentioned, it is sufficient the same pressure of the water source of the aqueduct, thus the pump is not strictly necessary) exhausts water along the duct 21 towards the tank 10 which is filled by water and the addition of salt. Number 22 indicates an electromagnetic valve necessary for the level of water in the basin of brine.

Always with reference to figure 5, a further pump 23 is schematized which exhausts brine from the tank to pipe it, through the duct 24, towards a flow switch 40 which regulates the brine flow fed towards the electrolytic cell.

Other filters (one or more than one) may be provided within the tank or along the outlet path to purify and then filter brine further before it arrives at the electrolytic cells.

Within the tank or along the outlet path, other filters (one or more than one) may be provided to purify and then filter brine further before it arrives at the electrolytic cells. The filter is a special development made of granulated plastic.

The duct 41 pipes brine towards the electrolytic cell with an outlet from the bottom thereof, as outlined in figure 5.

Therefore, the duct 41 is connected to the bottom of the electrolytic cell 30 depicted in the subsequent figure 6.

The electrolytic cells may be one or more than one depending on the sizes of the machinery and the quantity of product to produce.

Electrolytic cells carry out electrolysis.

Figure 6 depict a non-limiting case of one electrolytic cell.

At this point, the treated product goes towards the possible hydrogen separator, if it is present, to end into the liquid to treat.

As mentioned, the part of electronic management envisages a programmable electronic management system.

The machine is also fitted with a suitable voltage generator (direct current) which supplies the electrolytic cell/s.

The tension value to the heads of cells is modulated and therefore it is managed by the electronic management system so as to treat brine adequately according to the programming.

Voltage and the quantity of brine which reaches the electrolytic cells in the unit of time are control parameters. These two parameters enable to regulate the quantity of NaClO which is produced.

By means of this programmability of the machinery, it is possible to control precisely all the operative parameters thereof, among which for example the quantity of product which is needed, even in the unit of time (therefore a certain quantity of product NaClO to supply within a certain time).

By way of example, a further parameter controlled and managed by the system is the temperature within the electrolytic cell/s. In fact, the temperature must not exceed preferably 38°C, since over 38°C the electrolytic system begins to produce chlorate ions which, as already described, are toxic and dangerous for the environment and the system. In this case, if the temperature gets close or exceeds 38°C, the electronic management system acts by modulating (decreasing) the intensity of current and the production of NaClO thus enabling to decrease the temperature within the inside of the cell/s below critical values.

In particular, the system may activate the turn-off of the machine.

For example, the machine may be turn off at temperatures above or below 50°C.

The machine may be realized in various sizes but it is preferably of transportable size so that an operator may move it from a place to another one.

For example, there may be provided possible sizes of height up to one-and-a-half meters with half-meter width.

These sizes may vary but indicate clearly the fact that the device is compact and then readily transportable even by one operator only from a place to another one without the need of particular systems of transport.

It may be transported even manually.

In this manner, it may be arranged where necessary in adaptable and simple manner.

Advantages of the system/device of the invention

The electrolytic system/device of the present invention, as described in the previous description and in the attached figures, proved to be particularly useful in many different fields of treatment of water; drinking water, sanitary water, process water and also refluent water. In particular, said system is advantageously usable for disinfecting water, for example swimming water for private or public pools, hotel pools, covered, uncovered, lap pools, pools in amusement parks, hydromassage pools, pools with salty and sulfurous water. Concerning industrial applications, the utility of the system of the invention applies advantageously to process water, disinfection of containers, glasses, bottles, cooling circuits and cooling towers, papermaking industry, supply of drinking water, supply of municipal and town water, therapeutic pools such as in hospitals and rehabilitation centers.

Industrial applicability

In the field of technology for purification, in particular disinfection/sanitization, of water, the equipment/device of the present invention enabled to obtain and modulate the production of hypochlorite with a high degree of purity, substantially devoid of impurities and harmful degradations, such as chlorate ions; at the same time, it has also enabled to control continuously over time the release/dosage of it in the desired place of application, thus obtaining the desired disinfection of water.

CLAIMS

1. A machinery (**1**) for producing on-site sodium hypochlorite (NaClO) intended for the sanitization of water in general, the machinery comprising:

- An inlet (IN) for enabling to feed a liquid within the machinery;
- A collection tank (10) intended for containing in use a brine and arranged in communication with said inlet (IN);
- An electrolytic system (30) configured for carrying out the electrolysis of the brine to obtain sodium hypochlorite;
- Feeding means (40a, 40b) configured for enabling to pipe the said brine, contained in use within said collection tank (10), towards said electrolytic system;
- An outlet for piping the product obtained from the electrolytic system towards the outside of the machinery;
- And wherein the said electrolytic system comprises at least a cylindrical electrolytic cell (30a, 30b).

2. A machinery (1), according to claim 1, wherein said cylindrical electrolytic cell is formed by one cathode and one anode, both cylindrical and coaxial to one another.

3. A machinery (1), according to claim 1 or 2, wherein said cylindrical electrolytic cell is composed by graphite and titanium.

4. A machinery, according to one or more of the preceding claims, wherein the cathode of said cylindrical electrolytic cell is graphite and the anode is titanium.

5. A machinery, according to one or more of the preceding claims, wherein the anode is covered by platinum.

6. A machinery, according to one or more of the preceding claims, wherein the external cylinder is the anode of titanium and the internal cylinder, concentric to the external one, is the cathode of graphite.

7. The machinery, according to one or more of the preceding claims, wherein there is comprised an electronic control and/or management system.

8. The machinery, according to claim 7, wherein the control and/or management system communicates with one or more external sensors suitable for sending one or more detected parameters and with the said control and/or management system programmed for modulating automatically the production of NaClO as a function of the said parameters received by the said one or more sensors.

9. The machinery, according to one or more of the preceding claims, wherein there is comprised an electronic control and/or management system through which the machine is programmable.

10. The machinery, according to one or more of the preceding claims, wherein said machine is remotely controllable.

11. A machinery (1), according to one or more of the

preceding claims, wherein the machinery is transportable.

12. A machinery (1), according to one or more of the preceding claims, wherein the said machinery is programmable in such a way as to regulate at least the quantity of sodium hypochlorite in outlet from the machinery, preferably a quantity over time.

13. A machinery (1), according to one or more of the preceding claims, wherein there is provided a control panel through which the said machinery is controllable and/or programmable.

14. A machinery (1), according to one or more of the preceding claims, wherein the said electronic control and/or management system comprises a PLC.

15. A machinery (1), according to one or more of the preceding claims, wherein the said electronic control/management system is configured for managing the temperature within the electrolytic cell/s.

16. A machinery (1), according to one or more of the preceding claims, wherein upstream to the inlet (**IN**) there is provided a softening device so that the water in inlet is substantially zero French degrees.

17. A machinery (1), according to one or more of the preceding claims, wherein in outlet from the electrolytic system there is provided a device for separating hydrogen (50).

18. A machinery, according to claim 1, wherein there is provided a device for controlling levels within said collection tank (10).

19. A machinery, according to claim 1, wherein downstream to the inlet (IN) there is provided a first pump (20) for thrusting the liquid in inlet to the machinery towards the collection tank (10).

20. A machinery, according to claim 1, wherein said feeding means (40a, 40b) comprise at least a second pump for thrusting the brine from the collection tank (10) towards the said electrolytic system.

21. A machinery, according to one or more of the preceding claims, wherein one or more flow switches (40a, 40b) are interposed between said collection tank (10) and the said electrolytic system.

22. A machinery, according to one or more of the preceding claims, wherein there is comprised an external covering (2), the external covering (2) covering an internal frame (5) which serves as support for one or more of the internal components of the machinery.

23. A machinery, according to claim 22, wherein the said external covering (2) is extractable with respect to the internal frame (5) and preferably lockable through magnetic systems.

24. A machinery, according to claim 22 or 23, wherein the said external covering (2) is made of polypropylene.

25. A machinery, according to claim 17, wherein the said hydrogen separator comprises:
- A first cylinder (51);
- A second cylinder (52);
- A first duct (53) which connects the first cylinder to the second cylinder and through which the hydrogen separated from the liquid flows in use;
- A second duct (54) which connects the first cylinder to the second cylinder and through which the liquid

separated from the hydrogen flows in use;
- The first cylinder comprising an inlet (55’) for the mixture to separate from the hydrogen and the second cylinder comprising an outlet (57) for the separated hydrogen, and wherein the second cylinder (52) comprises inside a floating element (59) movable through a closing position in which it closes said outlet (57) and an opening position in which it releases said outlet, the said floating element being configured for floating on the liquid contained in use in the second cylinder so as to position itself, due to said floating, in said closing position thus obstructing the outlet 57 and plunge at least in part when a predetermined pressure acts onto it thus positioning itself in said opening position, so that, in use, the hydrogen which flows from the first to the second cylinder through the first duct (53) acts onto said floating element thus plunging it once it reaches a certain pressure value.

26. A machinery, according to claim 1, wherein there is comprised an electric feeding system for feeding electrically the said at least one cylindrical electrolytic cell.

27. The use of a machinery, according to one or more of the preceding claims for producing a predetermined controllable quantity of sodium hypochlorite (NaClO).

28. A method for producing a predetermined quantity of sodium hypochlorite (NaClO) intended for the sanitization of water in general on-site, the method comprising the arrangement of a machinery according to one or more of the preceding claims from 1 to 26 and the following phases:
- Activating the machinery and programming the

machinery according to one or more parameters for obtaining a predetermined quantity of sodium hypochlorite (NaClO);

- Preparing the brine within the collection tank (10) through the liquid that the machinery charges into the said tank and injecting salt into the said liquid within the collection tank (10);

- Piping the said brine towards the electrolytic system (30a, 30b) controlled by the machinery for obtaining sodium hypochlorite (NaClO);

- Exit of the final product (NaClO) from the machinery as a function of the programmed parameters.

29. A method for sanitizing water in general through a production directly on-site of a predetermined quantity of sodium hypochlorite (NaClO) which is then poured into said water to purify, the method comprising the arrangement of a machinery according to one or more of the preceding claims from 1 to 26 and the production of a predetermined quantity of sodium hypochlorite by feeding a liquid to the machinery, preferably water, which is treated through a process of electrolysis directly in the said machinery which supplies said quantity of sodium hypochlorite (NaClO).

FIG. 1

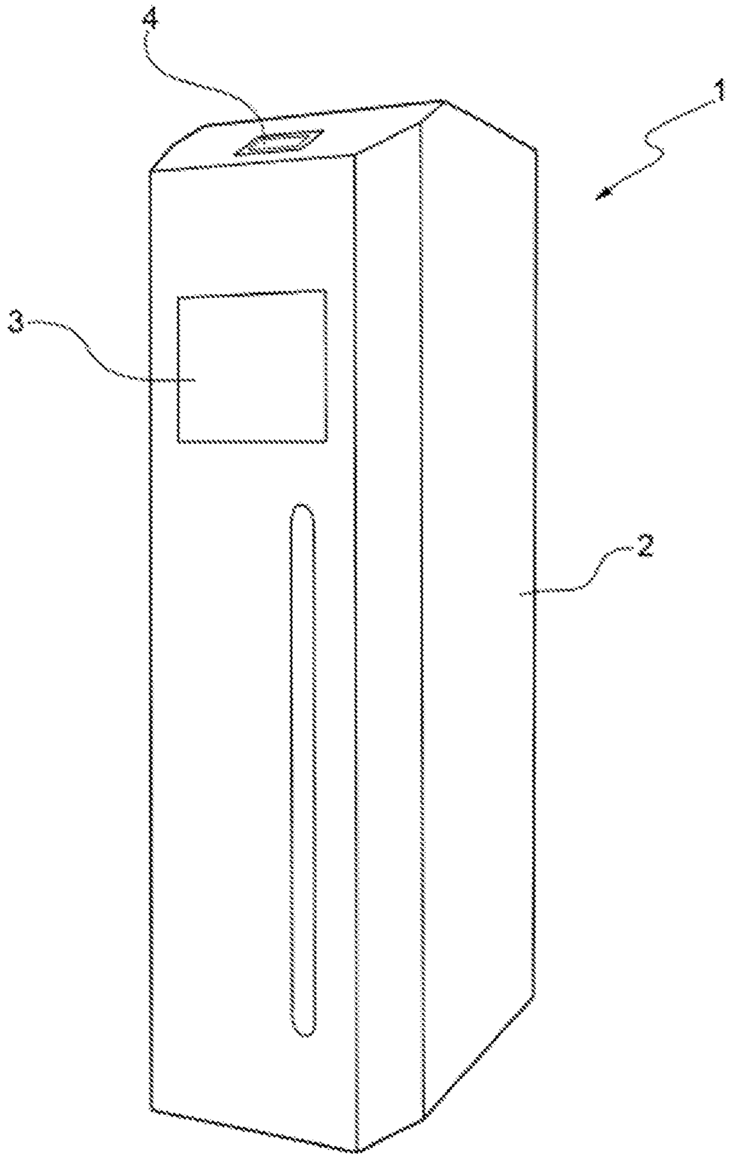


FIG. 2

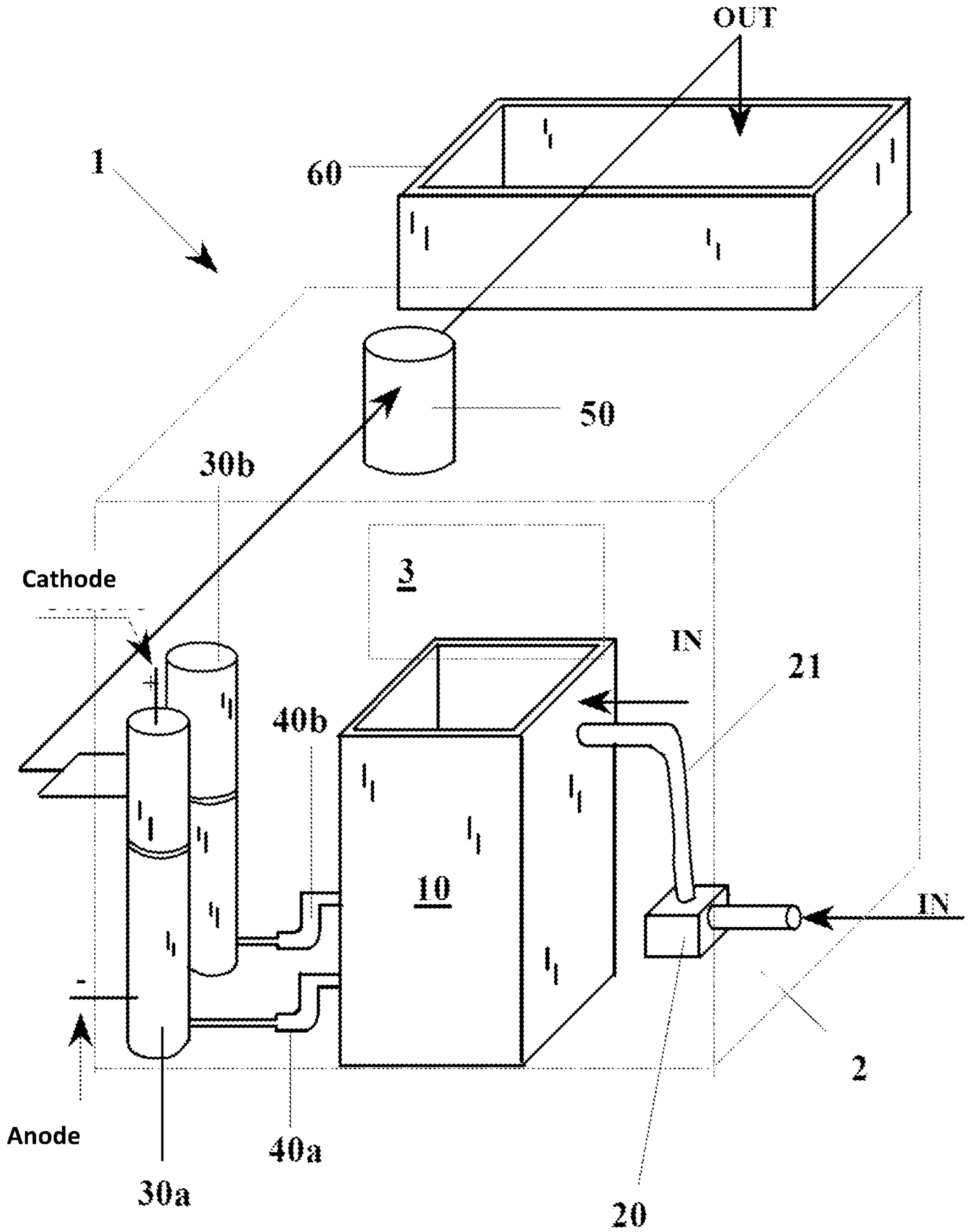


FIG. 3

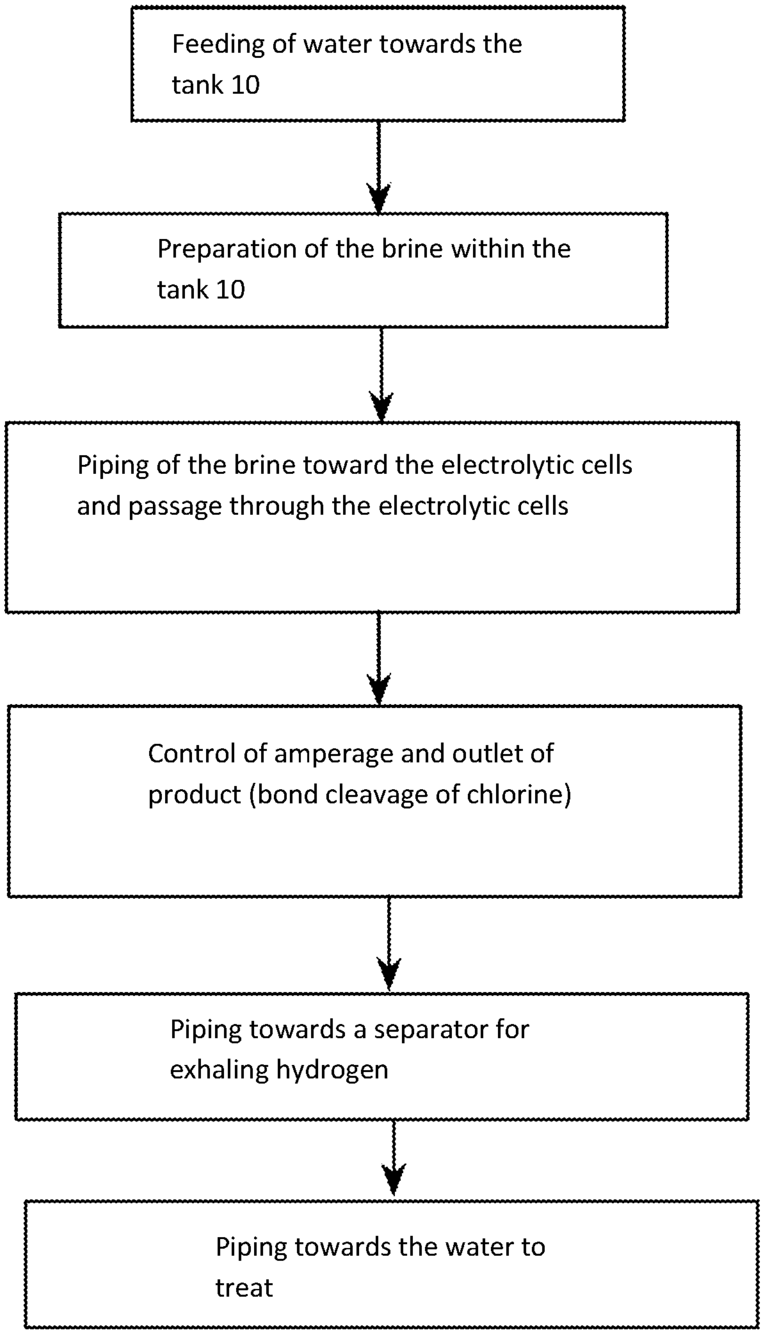

Feeding of water towards the tank 10
Preparation of the brine within the tank 10
Piping of the brine toward the electrolytic cells and passage through the electrolytic cells
Control of amperage and outlet of product (bond cleavage of chlorine)
Piping towards a separator for exhaling hydrogen
Piping towards the water to treat

FIG. 4

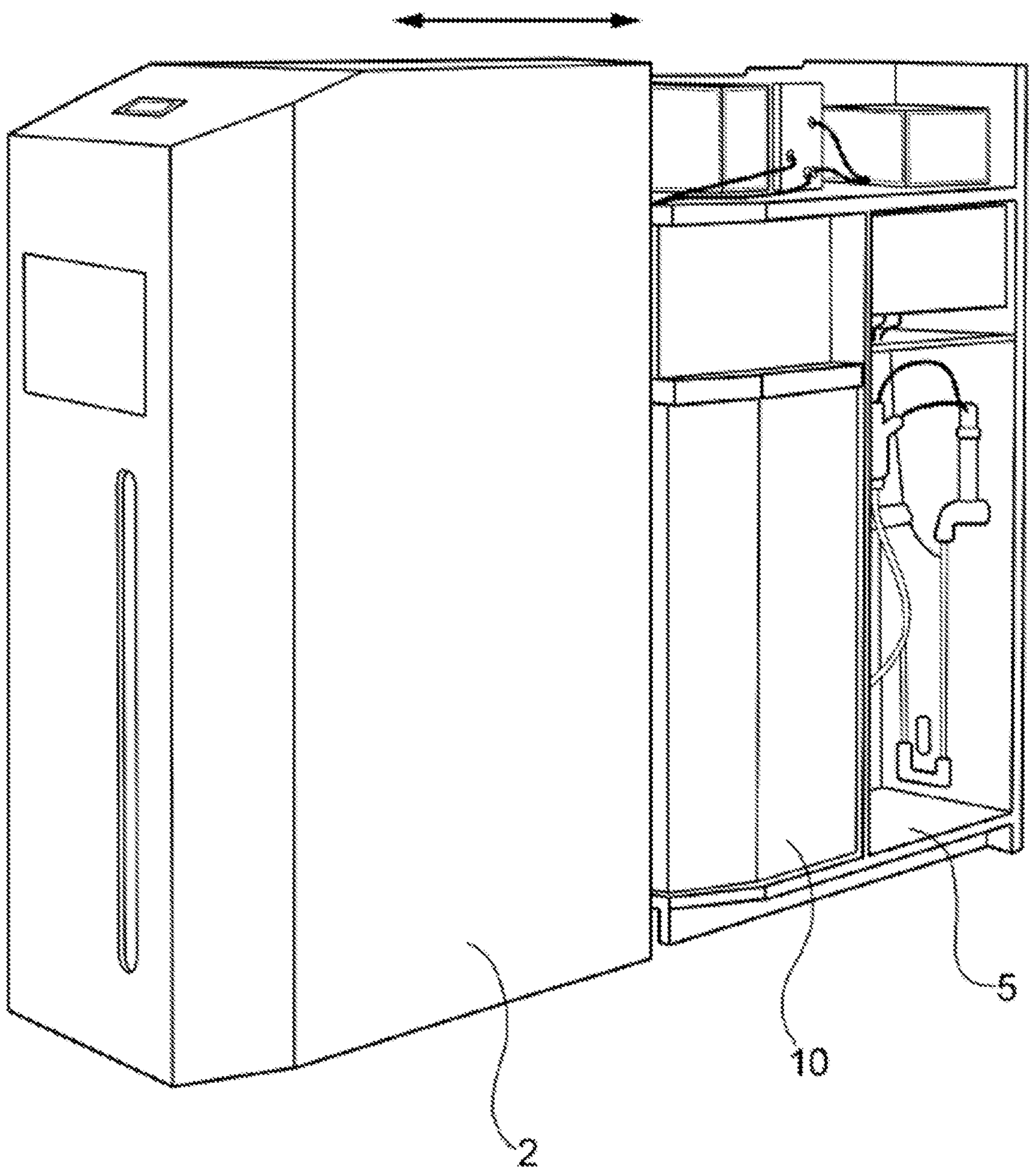


FIG. 5

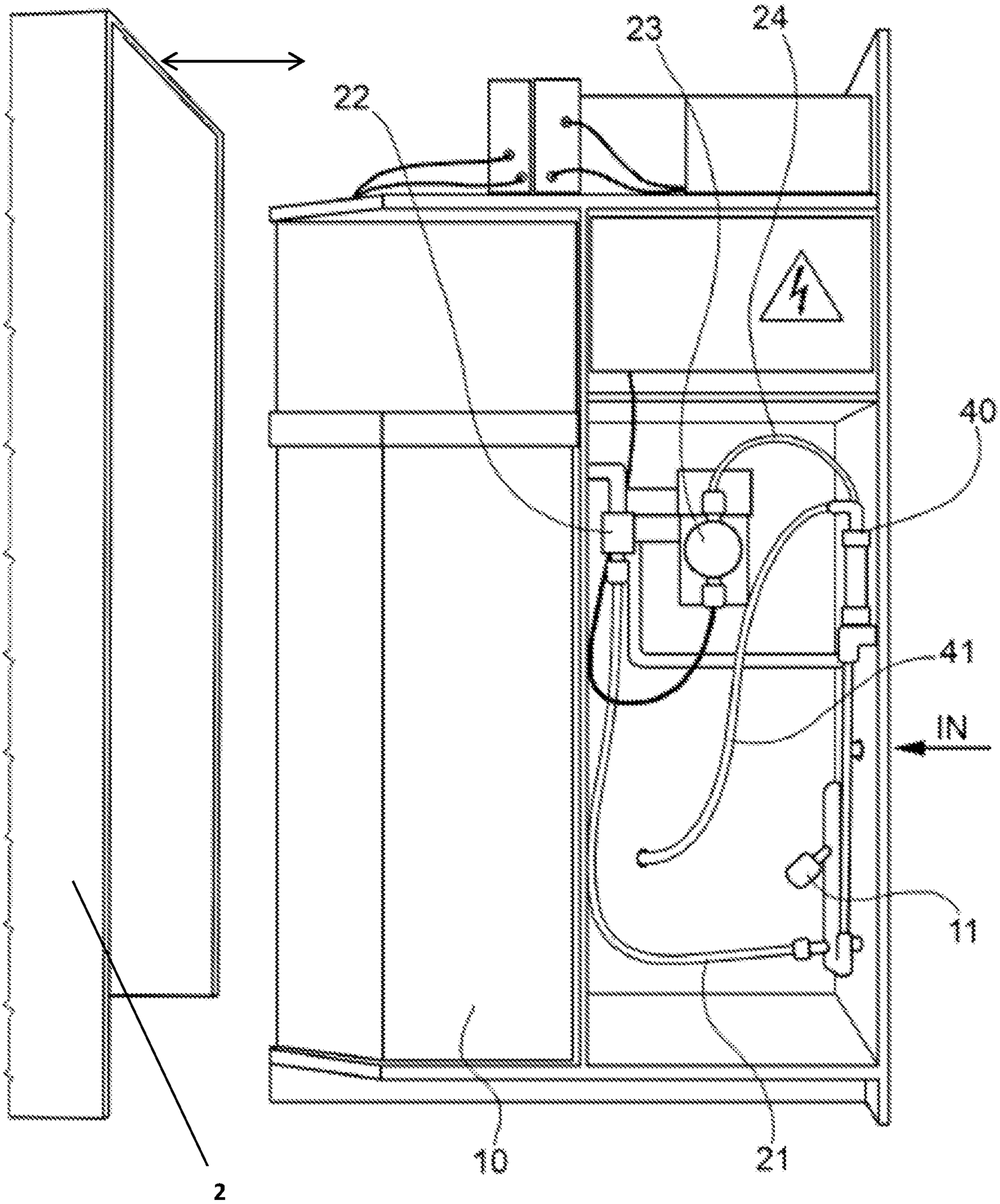


FIG. 6

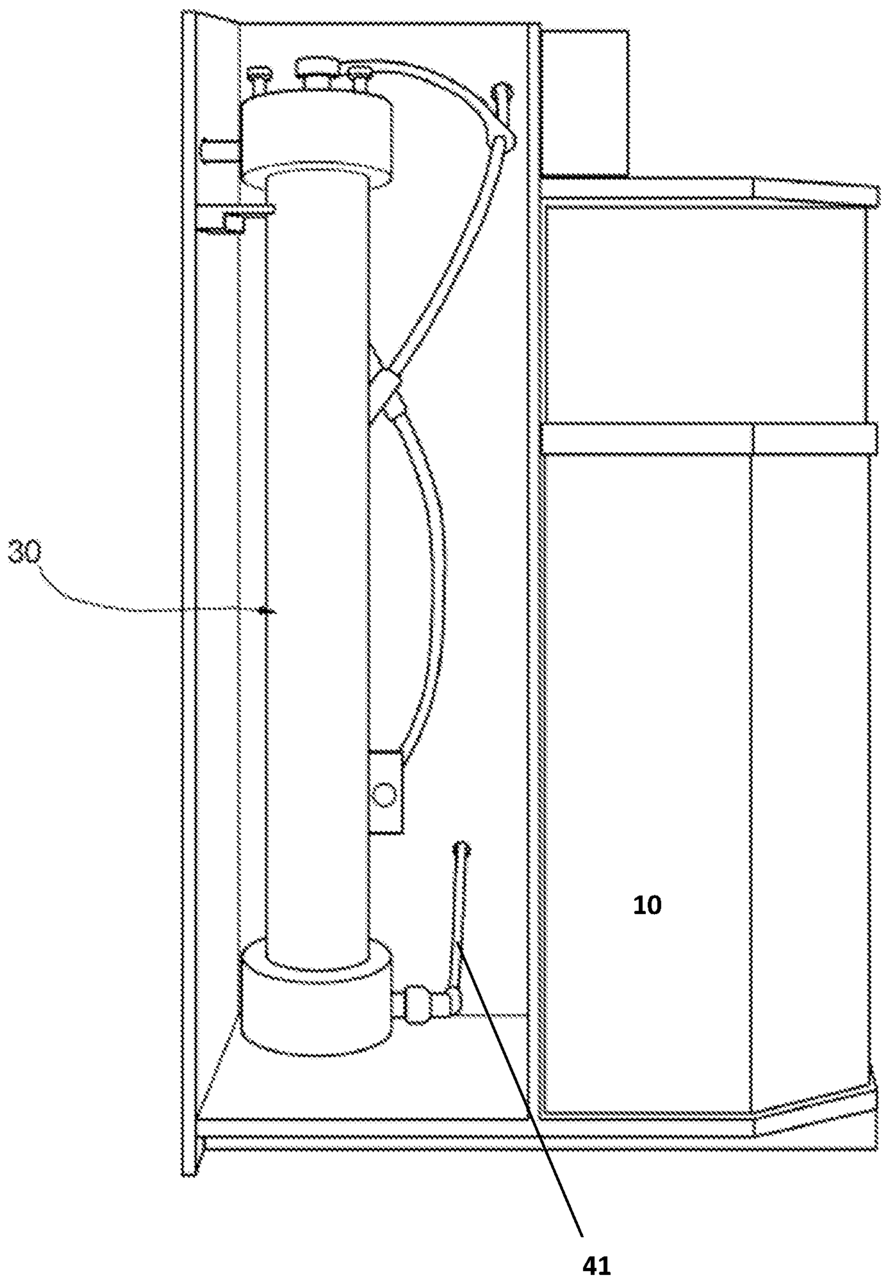


FIG. 7

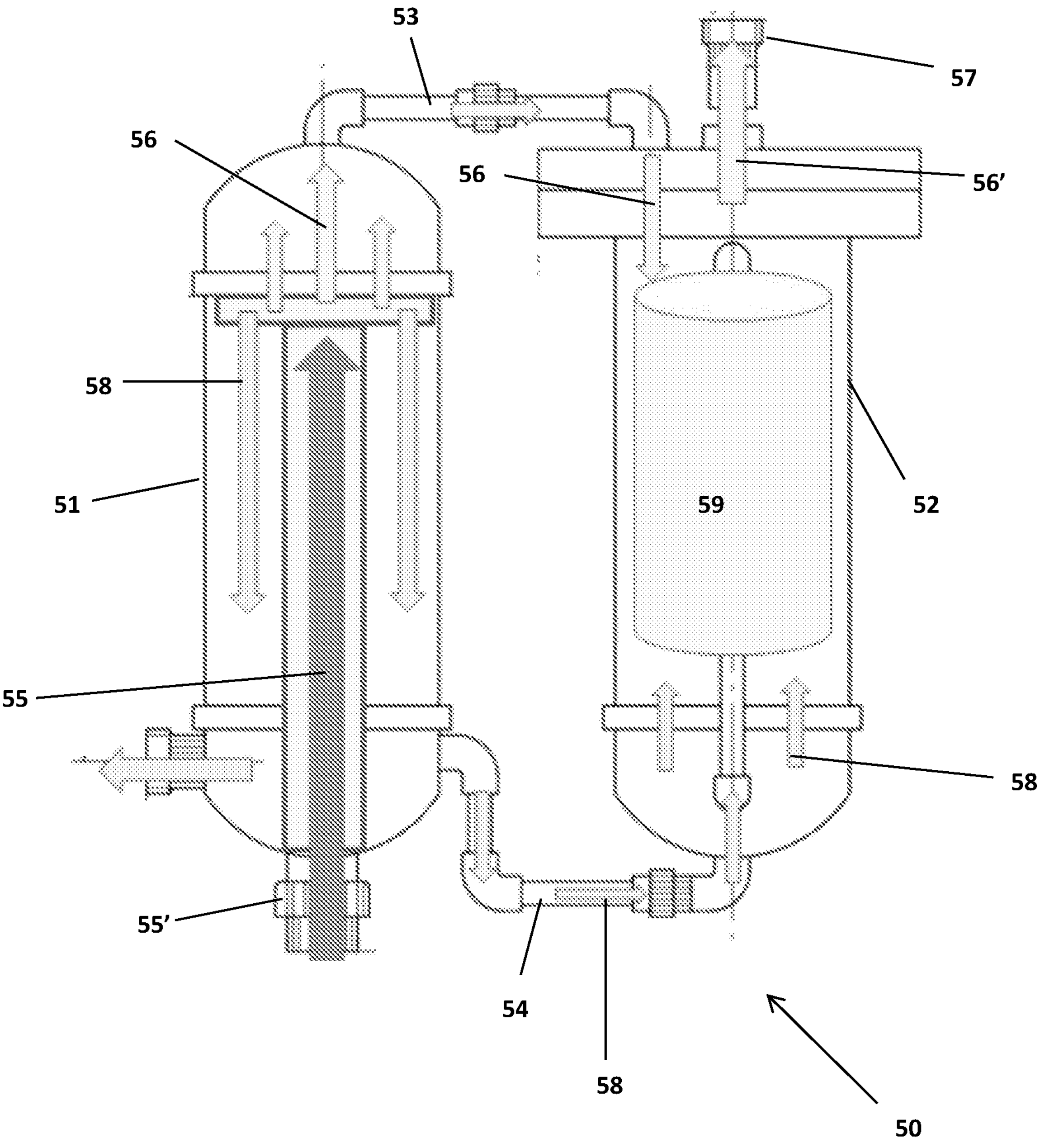
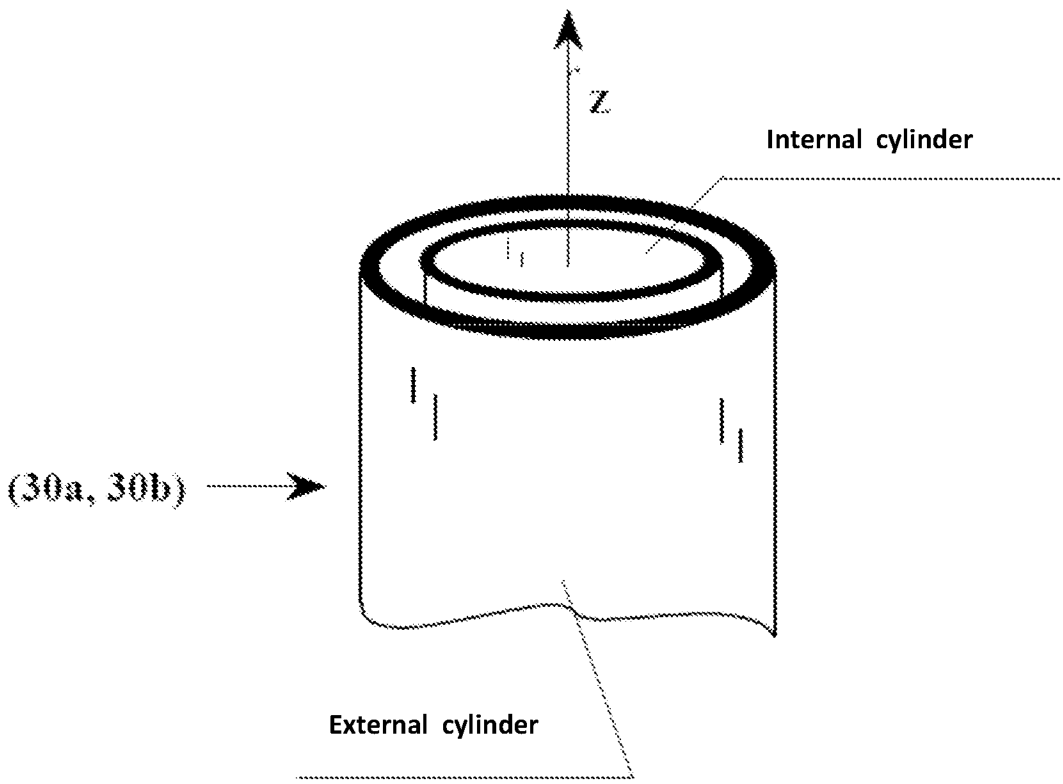


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/051952

A. CLASSIFICATION OF SUBJECT MATTER
INV. C02F1/461 C25B1/26 C25B15/02
ADD. C02F103/42

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)
C02F C25B

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/166997 A2 (CLEAN CHEMISTRY LLC [US]; BUSCHMANN WAYNE [US]) 6 December 2012 (2012-12-06) claims 1, 7; figures 2b, 3a paragraph [0067] - paragraph [0068] paragraph [0150] paragraph [0072] - paragraph [0074] paragraph [0078] paragraph [0008] -----	1-29
X	CN 108 505 061 A (CHINA INST WATER RESOURCES & HYDROPOWER RES) 7 September 2018 (2018-09-07) abstract; figure 1 -----	1,7-13, 16-22, 25-29
	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 September 2020	15/10/2020

Name and mailing address of the ISA/	Authorized officer
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1

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2017/049052 A1 (EVOQUA WATER TECH LLC [US]) 23 March 2017 (2017-03-23) claims 1,25,26; figure 16 page 25, line 25 - page 26, line 29 page 13, line 4 - line 8 -----	1,2,5, 7-26
X	US 2012/168319 A1 (ILTSENKO VALERI [EE] ET AL) 5 July 2012 (2012-07-05) abstract; claims 1,6; figure 1, paragraph [0008] paragraph [0030] -----	1,2,22, 25-27,29

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Information on patent family members

International application No
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