

Description**TECHNICAL FIELD OF THE INVENTION**

[0001] The present invention is encompassed in the field of the generation of oxyhydrogen gas (HHO) or Brown's gas. In particular, it is related to devices and systems used to generate Oxygen (O₂) and Hydrogen (H₂) from water electrolysis.

BACKGROUND OF THE INVENTION

[0002] As we know, our society is largely dependent on highly polluting fuels, which have led us to the current environmental problems. For this reason, non-polluting fuels that are being used to replace the current polluting fuels include oxyhydrogen gas (HHO) or Brown's gas, which can be produced simply from the electrolysis of water, an abundant resource found in nature.

[0003] Therefore, various devices and systems for generating oxyhydrogen gas (HHO) are known, that is, gaseous Oxygen (O₂) and Hydrogen (H₂). These devices are fundamentally based on an electrolytic cell made formed by a cavity, which contains a quantity of electrolyte, and the respective electrode means acting as a cathode and as an anode, respectively, which are spaced apart, arranged in contact with the electrolyte contained in the cavity. The electrolyte is usually sulphuric acid, sodium hydroxide, or potassium hydroxide diluted in water. By means of a continuous electric current, supplied either by a power supply or a battery, which is connected through the electrodes (anode and cathode) to the water, the decomposition of the water into Oxygen (O₂) and Hydrogen (H₂) gases is achieved. The gases produced by the electrolysis are collected in the upper part of the cavity, and are then passed through condensation means that allow the gases to be separated from the water vapour that accompanies them.

[0004] Current devices pose problems in terms of their ability to withstand pressure and their reduced airtightness. In addition, during use thereof, the temperature rises in an uncontrolled manner, thus preventing the possibility of their continued use.

[0005] On the other hand, current devices, in a humid atmosphere with high temperatures and high basicity levels, exhibit a high degradation of the materials that form them, generating a high risk of leaks to the outside.

[0006] The present invention seeks to propose an alternative solution to known oxyhydrogen gas (HHO) generation devices and systems. In addition to very low power consumption for the various functions, it is effective, efficient, safe and sustainable.

DESCRIPTION OF THE INVENTION

[0007] The present invention is defined and characterised by the independent claims, while the dependent claims describe other characteristics thereof.

[0008] An object of the invention is a device for generating oxyhydrogen gas (HHO), comprising:

- a shell, which forms a cavity adapted to contain a quantity of electrolyte,
- a gas outlet duct, arranged at the top of the shell,
- an electrolyte inlet duct, which runs into a lateral wall of the shell, between the gas outlet duct and a level of electrolyte contained in the cavity, and
- respective electrode means that act as cathode and as anode respectively, which are spaced apart and arranged in contact with the electrolyte contained in the cavity.

[0009] Where, the shell is made from steel and its lateral wall constitutes the cathode of the electrode means, and said lateral wall surrounds a steel plate that constitutes the anode of said electrode means.

[0010] Additionally, respective bases of the shell and of the plate are fastened on a centring plate made of insulating material and, in addition, said bases are covered with an insulating layer made of an inert material not taking part in an electrolysis reaction, forming a bottom of the cavity.

[0011] Likewise, a system for generating oxyhydrogen gas (HHO) is also an object of the invention, comprising:

- at least one device as that described above,
- a direct current source, with respective positive and negative terminals connected to the anode and cathode of the electrode means of the device, and
- condensation means, which are arranged downstream of the gas outlet duct of the device.

[0012] Where, the condensation means comprise a coil section, a condensate chamber and a silica filter. The condensate chamber is connected to an outlet of the coil section and arranged above said coil section. For its part, the silica filter is connected to an outlet of the condensate chamber and arranged above said condensate chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present specification is complemented by a set of figures which illustrate a preferred embodiment, and which in no way limit the invention.

Figure 1 depicts a schematic side view of the device for generating oxyhydrogen gas (HHO).

Figure 2 depicts an enlarged schematic front view of the device of Figure 1.

Figure 3 depicts a schematic view of a system for generating oxyhydrogen gas (HHO) that includes a set of devices like the one in the previous figures arranged in series.

Figure 4 depicts an enlarged schematic view of the condensation means of the system for generating oxyhydrogen gas (HHO).

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present invention is a device for generating oxyhydrogen gas (HHO).

[0015] As shown in figure 1, the device (1) comprises a shell (1.1), which forms a cavity (1.11) adapted to contain a quantity of electrolyte. The electrolyte could be a mixture of water and sulphuric acid, sodium hydroxide, or potassium hydroxide. In a preferred embodiment, the electrolyte is a mixture of additivated distilled water, above 10 % and below 50 % of the total volume of electrolyte, with sodium hydroxide (caustic soda).

[0016] Additionally, the device (1) comprises respective electrode means (1.4) that act as cathode (1.41) and as anode (1.42) respectively, spaced apart and arranged in contact with the electrolyte contained in the cavity (1.11).

[0017] For its part, the shell (1.1) is made from steel, for example, ANSI 316 steel, and its lateral wall (1.12) constitutes the cathode (1.41) of the electrode means (1.4). For example, the lateral wall (1.12) could consist of a tubular casing arranged in a vertical position, which could be closed at its upper part by a steel disc (1.14) welded at the top of said lateral wall (1.12). For its part, the base (1.13) of the shell (1.1) could be formed by a washer (disk-shaped piece) also made of steel, which is welded at the bottom of the lateral wall (1.12).

[0018] Likewise, the lateral wall (1.12) surrounds a steel plate (1.6), for example, ANSI 316 steel, which constitutes the anode (1.42) of said electrode means (1.4). The plate (1.6) can be inserted through the washer that forms the base (1.13) of the shell (1.1), with a view to arranging said plate (1.6) inside the cavity (1.11), for example, positioned in a longitudinal centre of the shell (1.1).

[0019] On the other hand, the anode (1.42) (plate (1.6)) and the cathode (1.41) (lateral wall (1.12)) could be connected to respective positive (2.1) and negative (2.2) terminals, respectively, of a direct current source (2), with a view to achieving water electrolysis, in such a way that the oxyhydrogen gas (HHO) is generated inside the cavity (1.11) formed in the shell (1.1).

[0020] Preferably, the thickness of the plate (1.6) is equal to or less than the thickness of the lateral wall (1.12) of the shell (1.1), providing greater wear of the anode (1.42) compared to the wear of the casing that forms the cathode (1.41) in the same period of time of operation of the device (1). Thus, in extreme wear conditions due to corrosion of the anode (1.42) (plate (1.6)), which is positioned inside the cathode (1.41) (lateral wall (1.12)), there is still sufficient lateral wall thickness (1.12) to contain the electrolyte inside the cavity (1.11) of the shell (1.1); thus guaranteeing the full operating capabilities of the lateral wall (1.12) at the end of the service life of the

device (1). For example, the plate (1.6) could have a thickness of 4 mm arranged inside the casing formed by the lateral wall (1.12), which could have a thickness of 3.5 mm. Thus, when the exposed sides of the plate (1.6) deteriorate, 2 mm on each side that make up the total 4 mm thickness of said plate (1.6), the lateral wall (1.12) still maintains 1.5 mm of thickness intact, keeping the electrolyte retained inside the cavity (1.11) of the shell (1.1).

[0021] With a view to detecting a low work intensity of a worn anode (1.42), devices for its control (not shown in the figures) could be installed inside the cavity (1.11) of the shell (1.1), such as anemometric clamps, pressure sensors, timers, or other types of devices suitable for controlling the intensity of electrical consumption within the established parameters, which are taken as indicative values of the actual state of wear inside the device (1) and are interpreted to take automatic actions already programmed in a computer (not shown in the figures) that controls the operation of the device (1), such as stopping its operation. Thus, it is possible to replace the device (1) many cycles before the end of its service life, with a view to avoiding unnecessary risks.

[0022] Additionally, the device (1) comprises a gas outlet duct (1.2), which is arranged at the top of the shell (1.1). Preferably, said gas outlet duct (1.2) is arranged in the lateral wall (1.12) of the shell (1.1), in such a way that it protrudes from the lateral wall (1.12) towards the cavity (1.11).

[0023] Likewise, the device (1) additionally comprises an electrolyte inlet duct (1.3), which also runs into the lateral wall (1.12) of the shell (1.1), between the gas outlet duct (1.2) and a level of electrolyte contained in the cavity (1.11).

[0024] Preferably, the electrolyte inlet duct (1.3) could be adapted to limit the level of electrolyte contained in the cavity (1.11), in other words, the lower edge of the electrolyte inlet duct (1.3) defines a maximum electrolyte level in the cavity (1.11). The electrolyte inlet duct (1.3) prevents said maximum electrolyte level from being exceeded when filling the cavity (1.11) with electrolyte. Likewise, the electrolyte inlet duct (1.3) additionally prevents electrolyte splashes from reaching the gas outlet duct (1.2), which are produced with the bubbling exit of the gas from within the electrolyte during the water electrolysis reaction.

[0025] With this, a primary condensation chamber (1.112) is also formed between the electrolyte inlet duct (1.3) and the gas outlet duct (1.2), which is not involved in the electrolysis. The primary condensation chamber (1.112) is an empty space filled with air where the first condensation of the water vapour that accompanies the generated gases takes place, gases which, being in contact with the steel disc (1.14), or with the portion of the lateral wall (1.12) corresponding to the primary condensation chamber (1.112) formed, part of the water vapour that accompanies the gases condenses and drains down said portion of the lateral wall (1.12) towards the electro-

lyte, while the rest of its composition leaves the cavity (1.11) through the gas outlet duct (1.2).

[0026] Like the gas outlet duct (1.2), it is preferred that the electrolyte inlet duct (1.3) protrudes from the lateral wall (1.12), as a sill, towards the cavity (1.11). It is thus achieved that the condensates that drain down the portion of the lateral wall (1.12) corresponding to the primary condensation chamber (1.112) do not go into said ducts (1.2, 1.3), going back into the electrolyte contained in the cavity (1.11).

[0027] On the other hand, as shown in Figure 2, the base (1.13) of the shell (1.1) and the base (1.61) of the plate (1.6) are fastened on a centring plate (1.7) made of insulating material. This plate (1.7) is called a centring plate because one of its functions is to centre the plate (1.6) with respect to the lateral wall (1.12) of the shell (1.1). For example, the centring plate (1.7) could be made of nylon or Teflon, depending on the conditions and power of the device (1), Teflon being used when very high performance is required. The bases (1.13, 1.61) are fastened to the centring plate (1.7) by means of bolts (7) that go through the latter, to which respective washers (8) and nuts (9) are screwed to carry out said fastening.

[0028] Preferably, between the bases (1.13, 1.61), of the shell (1.1) and of the plate (1.6), and the centring plate (1.7), a silicone sealing sheet (1.9) could be arranged.

[0029] Likewise, the bases (1.13, 1.61) on the centring plate (1.7) are covered with an insulation layer (1.8) made of an inert material not taking part in an electrolysis reaction, forming a bottom (1.111) of the cavity (1.11). For example, the insulation layer (1.8) could be made of bi-component epoxy resin.

[0030] Additionally, it is preferred that the insulation layer (1.8), made of an inert material not taking part in an electrolysis reaction, forming the bottom (1.111) of the cavity (1.11) extends between 10 and 20 cm over a lower portion (1.62) of the plate (1.6), so that the lower portion (1.62) of the plate (1.6) and the bottom (1.111) of the cavity (1.11) form a cold chamber (1.113), which provides thermal and corrosive protection to the connection between the bases (1.13, 1.61), the shell (1.1) and the plate (1.6), and the centring plate (1.7).

[0031] The cold chamber (1.113), formed in the lower part of the cavity (1.1), constitutes a "dead" or unreactive space, that is, without electrolysis reaction, proportional to the length of the lower portion (1.62) of the plate (1.6) and the bottom (1.111) of the cavity (1.11), filled with cold electrolyte. In other words, said cold chamber (1.113) makes it possible to have two different densities and two very different thermal levels in a single liquid, that is, in the electrolyte contained in the cavity (1.11) of the shell (1.1). This prevents the high increase in temperature, produced by the electrolysis reaction, from reaching the centring plate (1.7), to which the bases (1.13, 1.61) of the shell (1.1) and of the plate (1.6) are fastened respectively, whose material is suitable for withstanding high pressures, but not high temperatures. And with all this,

it is guaranteed that, during the operation of the device (1), the centring plate (1.7) is subjected to pressure, but not to high temperatures, so that its material is maintained at a temperature that ensures that the device (1) is watertight, without electrolyte spilling out of the device.

[0032] This particular design of the device (1) and combination of materials of its components, allows the electrical connection of its anode (1.42) through the lower part of the device (1) and avoids exposing the connections and delicate materials to very sudden thermal changes, thus prolonging the service life of the device (1), protecting the welding areas, joints and bolts, silicone gaskets, electrical power cables, etc. The cold chamber (1.113) is not only used to protect said elements, but also, it is easier to keep the device (1) hermetic in its lower part than in its upper part, that is, it is easier to retain water (the electrolyte) than to retain hydrogen (H₂).

[0033] Thus, there is a device that solves the current problems of capacity to withstand pressure, as well as, it is possible to solve the airtightness issue; that is, it has a more hermetic and safer device design, capable of withstanding high pressures during prolonged use.

[0034] A design of a device is achieved that, by controlling the voltage, provides resistance to temperature, corrosion pressure and an anode design that wears out its service life before the surrounding cathode does.

[0035] Advantageously, the main components of the device can be manufactured from ANSI 316 STEEL, enhancing the safety and sustainability thereof.

[0036] For its part, the system for generating oxyhydrogen gas (HHO), also an object of the invention, comprises at least one device (1) as that described above, and a direct current source (2), with respective positive (2.1) and negative (2.2) terminals connected to the anode (1.42) and to the cathode (1.41) of the electrode means (1.4) of the device (1).

[0037] As shown in Figure 3, in a preferred embodiment, the system comprises a set of devices (1) arranged in series, obviously with a view to producing a higher flow rate of oxyhydrogen gas (HHO). In this case, the negative terminal (2.2) of the direct current source (2) is connected to the cathode (1.41) of the last of the devices (1) in the set, the cathode (1.41) of the rest of the devices (1) being connected to the anode (1.42) of the next device (1) in the set, and the positive terminal (2.1) of the direct current source (2) being connected to the anode (1.42) of the first device (1) in the set, thus, its connection in series is possible.

[0038] Additionally, with a view to carrying out the condensation of the vapours that accompany the oxyhydrogen gas (HHO) generated by the device(s) (1), the system comprises condensation means (3), which are arranged downstream of the gas outlet duct (1.2) of the device (1), or of the respective gas outlet ducts (1.2) of the devices (1) that form the set of the embodiment shown in Figure 3. In the latter case, it is preferred that each gas outlet duct (1.2) of the devices (1) be in fluid communication with the condensation means (3) through a collec-

tor duct (4), where the collector duct (4) is made of a non-metallic or electrically non-conductive material.

[0039] For its part, as shown in Figure 4, the condensation means (3) comprise a coil section (3.1). Preferably, the condensation means (3) comprise a fan (3.4) that generates an air flow over the coil section (3.1), which favours the condensation of the water vapour that accompanies the oxyhydrogen gas (HHO) running through said coil section (3.1).

[0040] Additionally, with a view to momentarily accumulating the condensed water vapour through the gas outlet ducts (1.2), the collector duct (4) and the coil section (3.1), the condensation means (3) comprise a condensate chamber (3.2), which is connected to an outlet (3.11) of the coil section (3.1) and arranged above said coil section (3.1).

[0041] Likewise, with a view to achieving safe use of the oxidising gas (oxyhydrogen gas (HHO)), the condensation means (3) comprise a silica filter (3.3), connected to an outlet (3.21) of the condensate chamber (3.2) and arranged above said condensate chamber (3.2). The silica filter (3.3) is suitable for retaining moisture from non-condensable gases. All the solid electrolyte particles dragged by the Oxygen (O_2) and Hydrogen (H_2), the water vapour that still continues accompanying these generated gases, as well as flashbacks attempting to enter the system, are retained in the silica filter (3.3), which is the last step of system condensation. When the silica filter (3.3) is not capable of retaining more water vapour condensates, these are released into the condensate chamber (3.2) in the form of condensed drops, as if it were the excess of a sponge, allowing the deposit of the condensate in said chamber (3.2).

[0042] Thus, when the fouled oxyhydrogen gas (HHO) leaves the device (1), or the set of devices (1), it previously passes through the coil section (3.1), with a view to liquefying the water vapour that accompanies the gas, and retaining it in the condensate chamber (3.2). As the coil section (3.1) and the condensate chamber (3.2) are not usually enough to filter and purify the gas generated, the silica filter (3.3) is provided, which retains the rest of the moisture and solids dragged by the oxyhydrogen gas (HHO) generated.

[0043] Subsequently, when the device (1), or the set of devices (1), stop working, said device (s) (1) cool down, which produces a negative pressure coefficient that forces the entry, inversely, of flow of air through the silica filter (3.3) to compensate in balance with the outside atmospheric pressure, producing the return of the condensate accumulated in the condensate chamber (3.2) towards the cavity (1.11) of the shell (1) of the device (s) (1), also dragging with it the condensate existing in the coil section (3.1) and in the collector duct (4), said condensate being introduced into the cavity or cavities (1.11) through the corresponding gas outlet duct(s) (1.2) of the set of devices (1).

[0044] The silica filter (3.3) of the invention replaces the water bubbler used in known systems, where, due to

the negative pressure coefficient that occurs when cooling the oxyhydrogen gas (HHO) generator of these known systems, the water content of the bubbler is sucked towards said generator, and with it, its flashback arrestor capacity is eliminated, making the use of these known systems very dangerous.

[0045] In the case of the invention, the chamber forming the silica filter (3.3) constitutes a safe space for combustion in the event of flashback. When for some reason detonation is generated, said chamber filled with silica allows said detonation to develop in a safe and controlled manner, generating a vacuum and a discontinuity of the exit of the oxyhydrogen gas (HHO), which stops the flame, while the system does not stop producing said oxyhydrogen gas (HHO), whereby it is possible to immediately cut off possible flame propagation towards the inside of the device (1) or of the set of devices (1).

[0046] Preferably, the silica filter (3.3), which constitutes a flashback arrestor, comprises two chambers, a lower one (3.31) that is hollow and empty, and an upper one (3.32) that houses a portion of silica (not shown in the figures). This upper chamber (3.32) has a lower inlet protected by fibreglass and steel wool membranes (3.321) that pressure-retain the portion of silica inside it against a copper wire filter section (3.322), the latter, arranged at the upper outlet of the silica filter (3.3). The copper wire filter section is provided as the last filtering step, with a view to retaining the microparticles released when the oxyhydrogen gas (HHO) passes through the silica in a dry state.

[0047] Likewise, in the event that the system is required to operate continuously, that is, without cooling times, as shown in Figure 3, it is preferred that the collector duct (4) be connected to the condensate chamber (3.2) through a second duct (5), where the second duct (5) includes a solenoid valve (6) that can be actuated to equalise pressure between the devices (1) and the condensate chamber (3.2), when a sensor (not shown in the figures) detects that a maximum level of condensate is exceeded in the condensate chamber (3.2). Actuation of the solenoid valve (6), depending on the measurements made by the sensor, is commanded by the computer. Thus, when the solenoid valve (6) opens for a few seconds, the pressure in the collector duct (4) is compensated with the pressure in the upper part of the condensate chamber (3.2), that is, the part arranged above the level of condensate in said chamber (3.2), letting the cold condensate stored in the condensate chamber (3.2) descend, which also drag the condensate existing in the coil section (3.1) and in the collector duct (4), said condensate being introduced into the cavity or cavities (1.11) through the corresponding gas outlet duct(s) (1.2) of the set of devices (1). All of which occurs without the device or set of devices (1) ceasing to operate, thanks to the effect of gravity, the principle of density and the principle of communicating vessels.

[0048] Thus, designing a system with protection against flashbacks in potentially oxidising means is

achieved.

Claims

1. Device (1) for generating oxyhydrogen gas (HHO), comprising:

- a shell (1.1) forming a cavity (1.11) adapted to contain a quantity of electrolyte,
- a gas outlet duct (1.2), arranged at the top of the shell (1.1),
- an electrolyte inlet duct (1.3), which runs into a lateral wall (1.12) of the shell (1.1), between the gas outlet duct (1.2) and a level of electrolyte contained in the cavity (1.11), and
- respective electrode means (1.4) that act as cathode (1.41) and as anode (1.42) respectively, spaced apart and arranged in contact with the electrolyte contained in the cavity (1.11),

characterised in that the shell (1.1) is made from steel and its lateral wall (1.12) constitutes the cathode (1.41) of the electrode means (1.4), the lateral wall (1.12) surrounding a steel plate (1.6) that constitutes the anode (1.42) of said electrode means (1.4), where respective bases (1.13, 1.61) of the shell (1.1) and of the plate (1.6) are fastened onto a centring plate (1.7) made of insulating material, and covered with an insulation layer (1.8) made of an inert material not taking part in an electrolysis reaction, forming a bottom (1.111) of the cavity (1.11).

2. Device according to claim 1, wherein the gas outlet duct (1.2) is arranged in the lateral wall (1.12) of the shell (1.1), in such a way that it protrudes from the lateral wall (1.12) towards the cavity (1.11).

3. Device according to claim 1, wherein the electrolyte inlet duct (1.3) protrudes from the lateral wall (1.12) towards the cavity (1.11).

4. Device according to claim 1, wherein the electrolyte inlet duct (1.3) is adapted to limit the level of electrolyte contained in the cavity (1.11), forming a primary condensation chamber (1.112) between the electrolyte inlet duct (1.3) and the gas outlet duct (1.2).

5. Device according to claim 1, wherein a thickness of the plate (1.6) is equal to or less than a thickness of the lateral wall (1.12) of the shell (1.1).

6. Device according to claim 1, wherein the insulation layer (1.8) made of an inert material not taking part in an electrolysis reaction forming the bottom (1.111) of the cavity (1.11) extends between 10 and 20 cm over a lower portion (1.62) of the plate (1.6), so that the lower portion (1.62) of the plate (1.6) and the

bottom (1.111) of the cavity (1.11) form a cold chamber (1.113).

7. Device according to claims 1 or 6, wherein the insulation layer (1.8) is made of bicomponent epoxy resin.

8. Device according to claim 1 wherein the centring plate (1.7) is made of nylon or Teflon.

9. Device according to claim 1, wherein between the bases (1.13, 1.61), of the shell (1.1) and of the plate (1.6), and the centring plate (1.7), a silicone sealing sheet (1.9) is arranged.

10. System for generating oxyhydrogen gas (HHO), comprising:

- at least one device (1) according to any of the preceding claims,
- a direct current source (2), with respective positive (2.1) and negative (2.2) terminals connected to an anode (1.42) and to a cathode (1.41) of a number of electrode means (1.4) of the device (1), and
- condensation means (3) arranged downstream of the gas outlet duct (1.2) of the device (1),

characterised in that the condensation means (3) comprise a coil section (3.1), a condensate chamber (3.2) and a silica filter (3.3), where the condensate chamber (3.2) is connected to an outlet (3.11) of the coil section (3.1) and arranged above said coil section (3.1), and the silica filter (3.3) is connected to an outlet (3.21) of the condensate chamber (3.2) and arranged above the condensate chamber (3.2).

11. System according to claim 10, incorporating a set of devices (1) arranged in series.

12. System according to claim 11, wherein the negative terminal (2.2) of the direct current source (2) is connected to the cathode (1.41) of the last of the devices (1) in the set, the cathode (1.41) of the rest of the devices (1) being connected to the anode (1.42) of the next device (1) in the set, and the positive terminal (2.1) of the direct current source (2) being connected to the anode (1.42) of the first device (1) in the set.

13. System according to claim 11, wherein each gas outlet duct (1.2) of the devices (1) is in fluid communication with the condensation means (3) through a collector duct (4), where the collector duct (4) is made of a non-metallic or electrically non-conductive material.

14. System according to claim 13, wherein the collector

duct (4) is connected to the condensate chamber (3.2) by means of a second duct (5), where the second duct (5) includes a solenoid valve (6) that can be actuated to equalise pressure between the devices (1) and the condensate chamber (3.2), when a sensor detects that a maximum level of condensate is exceeded in the condensate chamber (3.2). 5

15. System according to claim 10, wherein the condensation means (3) comprise a fan (3.4) that generates a flow of air over the coil section (3.1). 10

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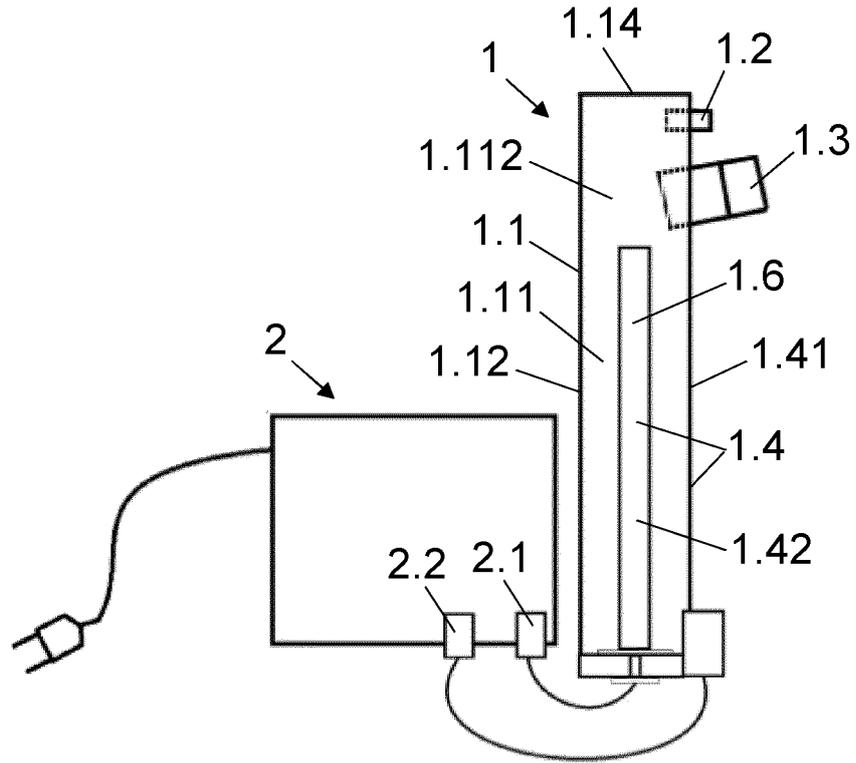


Fig.1

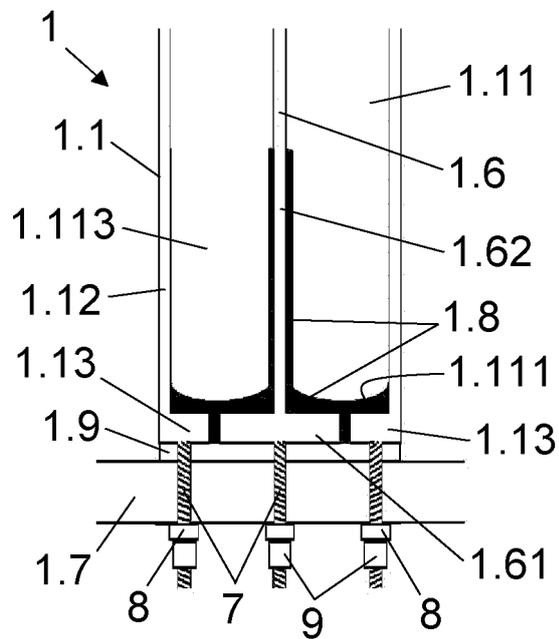


Fig.2

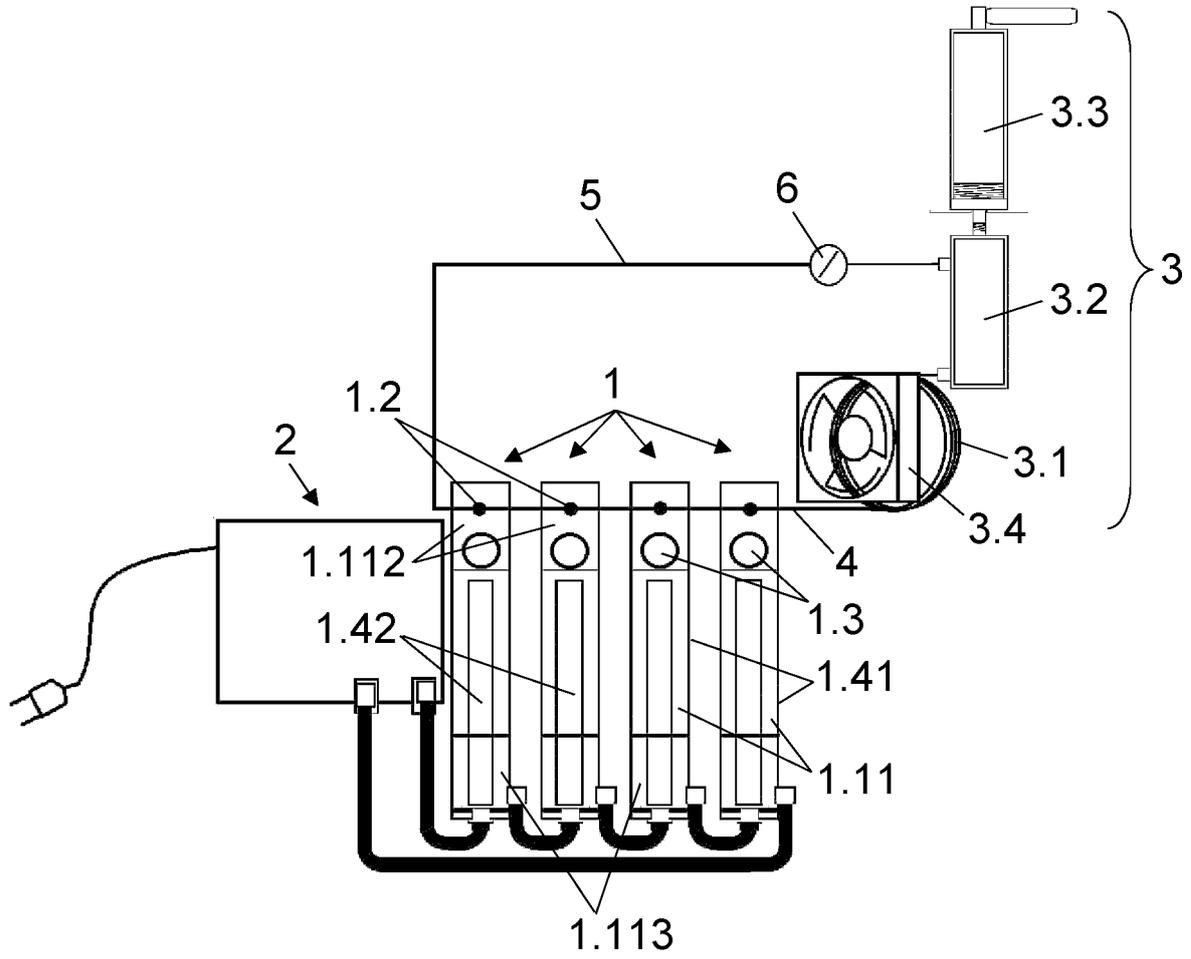


Fig.3

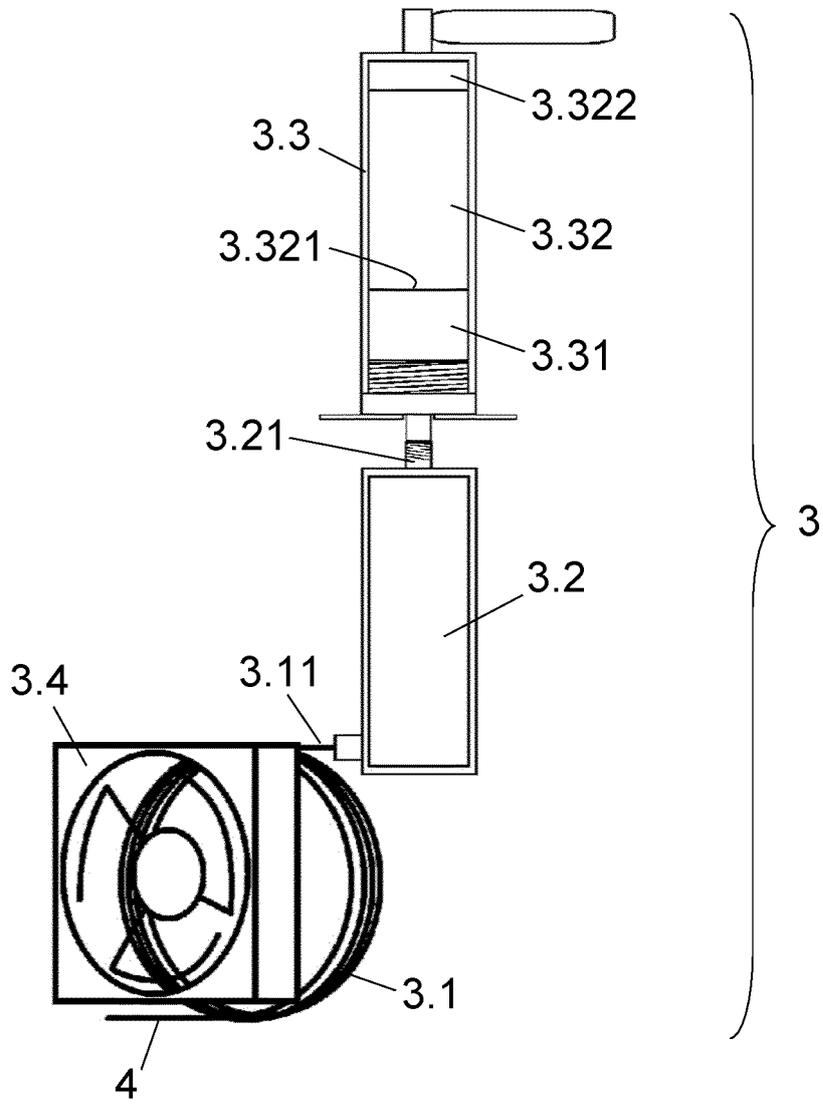


Fig.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2019/070794

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A. CLASSIFICATION OF SUBJECT MATTER

C25B1/04 (2006.01)*C25B9/02* (2006.01)

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

B. FIELDS SEARCHED

10

Minimum documentation searched (classification system followed by classification symbols)
C25B

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

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

EPODOC, INVENES, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 101750308B B1 (SM INNOVATION CO LTD) 26/06/2017, (abstract)	1-15
A	WO 2017115269 A1 (LONGHINI FEDERICO ET AL.) 06/07/2017, pages 6 - 7; figure 3.	1-15
A	US 2018038318 A1 (ROSS WILLIAM BILL JAMES) 08/02/2018, paragraphs [31 - 40].	1-15
A	US 2010065433 A1 (HEIREMANS VICTOR VIDAURRE) 18/03/2010, paragraph [26]; figure 2.	1-15
A	WO 2005075359 A1 (HITACHI MAXELL ET AL.) 18/08/2005, (abstract)	1-15
A	EP 3336220 A1 (LIN HSIN YUNG) 20/06/2018, (abstract)	1-15

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

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* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance.	
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