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(54) **Method for introducing gas into water in superequilibrum quantity, apparatus for carrying out the method and water produced by the method.**

(57) A method for introducing gas into water in excess quantity relative to an equilibrum condition corresponding to the saturation of water with the gas on any predetermined temperature and pressure, in which the water is intensively moved and circulated to form an intensive vortex which resembles to the form of the funnel of a tornado and the free surface of this funnel is exposed to the gas. The, circulation is mainatained for a while, at least as every water particle has entered and left the vortex 100 times.

An apparatus for carrying out the method comprises a balloon-like conatainer (1), with a tapering lower part (4) and an oblique and tangential inlet duct (13) somewhat below the plane where the container (1) has it largest diameter. A feedback circulation path including a pump (14) and a resonator (15) is provided between the lower end of the container (1) and the duct (13). The resonator (15) forces the water flowing therethrough to rotate in a plane normal to the direction of flow. The so injected water forms a vortex in the container above which gas, preferably oxygen or carbon-dioxide is present which will be taken up by the water.

The water made by the method comprises a gas in excess quantity relative to the equilibrum condition in such a way that the gas contained therein is in a stable and bound state.

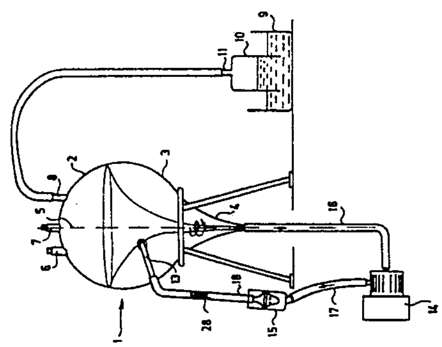

Fig.1

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METHOD FOR INTRODUCING GAS INTO WATER IN SUPEREQUILIBRUM QUANTITY, APPARATUS FOR CARRYING OUT THE METHOD AND WATER PRODUCED BY THE METHOD

The invention relates to a method for introducing gas into water in excess quantity relative to an equilibrum condition corresponding to the saturation of water with the gas on any predetermined temperature and pressure, in which the water is intensively moved so that the free surface thereof be exposed to the gas. The invention relates also to an apparatus for carrying out the method as well as to the water that comprises a gas in superequilibrum quantity.

It is well known in the art that various gases can be dissolved in water and under any given temeperature and pressure there exists always a well-defined maximum or saturation amount of any particular gas in a unity volume of water. In case of oxygen such data can be found e.g. in the book entitled "Standard Methods for the Examination of Water and Waste Water" prepared and published by the American Public Health Association, Managing Editor: Mary Ann H Frason (sixteenth edition). Chapter 421 of this book includes these tables and describes in detail how dissolved oxygen can be determined. Similar data can be found in various textbooks for physics for other gases as well.

It is also known, that water can be oversaturated by a gas if the water is intensively mixed or sprinkled under a gaseous atmosphere or if the gas is introduced therein under a higher pressure. In such cases, however, the excess amount of gas is not bound by the water in a stable condition and bubbles out of the water within a short period of time when the pressure or intensive movement has finished.

The object of the present invention is to provide a method which still can bound excess quantity of a gas like oxygen, carbon-dioxide or certain other gases in water in stable state.

A further object of the invention is to provide an apparatus for carrying out the method.

A still further object is to provide the water containing a gas in superequilibrum quantity which can be utilized for a number of novel and unexpected applications.

It has been recognised that there exists a specific connection between a gas, preferably oxygen or carbon-dioxid and water which can bind more gas than the law of dissolubility would allow. Although the exact structure of this binding is not completely known and understood, it is thought that gas molecules are captured in the polymeric formation of water molecules like the clathrate type binding of gases in solid materials.

Such a binding can be provided if the water is intensively moved so that the free surface thereof be exposed to the gas that should be bound, and according to the invention a vortex of water is formed by this intensive movement, the water leaving one end of the vortex is accelerated and fed back to the other end of the vortex to maintain its existence, and this recirculation is maintained until each particle of water has participated in at least hundred cycles.

In a preferable emodiment the accelerated water is forced to rotate around an axis parallel to the direction of flow thereof just before being re-introduced to maintain the vortex. In such cases the whirling of water in the vortex gets more intensive which assists in creating the binding of the gas adjoining the moving water surface.

It is preferable if the lowest speed of rotation of the vortex is at least about 40 r.p.m.

According to the invention an apparatus has also been provided for carrying out the method which comprises a container that defines an inner space which is circularly symmetrical relative to an axis, the container has an upper part with a substantially spherical shape, a medium part tapering in a direction away from the upper part and a narrow lower part tapering in the same direction, a duct is extending obliquely out of the upper portion of the medium part substantially at a height where the container has a large diameter and closes an acute angle at least with the tangential plane of the container to enable tangential introduction of water, a feedback water path is pro vided between the end of the lower part and the oblique duct which path comprises a water pump and a resonator, the resonator is provided with an element therein which has a number of tangential holes and an outflow opening coupled to the oblique duct, a pressure chamber is formed in the resonator between the inner wall thereof and the element, the pressure chamber is connected through a duct to the outflow end of the pump, the tangential holes are communicating with the pressure chamber, and owing to such design water forced by the pump start whirling and leave the element through the outflow opening and will be injected tangentially in th container to form a vortex , and the free space of the container is filled with a gas.

In a preferable embodiment the inner cross-sections of the outflow portion of the lower part of the container, that of the oblique duct and of the conduits in the feedback path are substantially equal and at any case their respective minimum cross-sections fall within a range of at most 1 : 3.

It is preferred if the oblique duct is tilted slightly also in upward direction.

The upper part of the container is communicating preferably with a dish filled with gas for providing supply for the gas taken up by the recirculating water.

In a preferable embodiment the resonator has a cylindrical house open at one end, the element has a first part with a form of a rotational paraboloid, with an open end that faces said outflow opening and a second part attached to the first part which has a curved contour with an open end that defines said outflow opening, the two parts have a common circular rim attached to the medium zone of the cylindrical house, the tangential holes are provided on the part with paraboloid shape close to the rim, and the closed end of the cylindrical house has a duct that closes an acute angle with the axis of the cylinder to let water flow obliquely into the pressure chamber to increase thereby the rotation of water when passed through the tangential holes.

According to the invention a specific water has also been provided that comprises a gas in excess quantity relative to an equilibrum condition which corresponds to the saturation thereof with the gas on any predetermined temperature and pressure, in which the gas is contained in a stable and bound state under said predetermined temperature and pressure.

It is preferable if the gas is oxygen, carbon-dioxide, helium, argon or oxygen with molecules comprising three atoms.

The invention will now be described in connection with preferable embodiments thereof, in which reference will be made to the accompanying drawings. In the drawing:

Fig. 1 shows the general layout of the apparatus according to the invention,

Fig. 2 shows the elevation view of the resonator of Fig. 1,

Fig. 3 is a sectional top view of the resonator in the plane of the holes,

Fig. 4 illustrates the way how gas consumption is measured,

Figs. 5 to 7 show three sketches of the vortex in starting, medium and final phases of its formation, and

Fig. 8 shows gas take up diagrams as a function of time.

The general arrangement of the apparatus used for carrying out the method according to the invention is shown in Fig. 1. Container 1 has a hollow interior which has a drop-like shape with a substantially spherical upper part 2, a medium part 3 which has a substantially hyperboloidal form that tapers in downward direction and an elongated slightly tapering lower part 4. The upper and medium parts 2, 3 are convex and the lower part 4 is concave. An inflexion plane is thus formed between the medium and lower parts 3 and 4. The interior of the container 1 is symmetrically arranged around an axis of rotation 5. In a preferable embodiment the container 1 is made of glass which enbles the observation of the processes that take place therein. In the upper wall of the upper part 2 three ducts 6, 7 and 8 are provided of which ducts 6 and 7 are sealed.

The arrangement comprises a tank 9 filled with water. A cylindrical dish 10 is immersed with its open mouth in the water and a duct 11 is formed at the closed bottom of the dish 10. Flexible conduit 12 connects the duct 8 on the upper part of the container 1 with the duct 11 of the dish 10.

The container 1 has two further openings. A duct 13 is extending obliquely out of the upper portion of the medium part 2 substantially at a height in which the container has the largest diameter. The duct 13 closes respective acute angles with the equatorial and tangential planes of the container and its axis is directed slightly inwardly and upwardly towards the interior of the container. These angles are generally smaller than 30°. The second one of these further openings is the open lower end of the lower part 4 of the container 1.

A water recirculation path is provided between the lower end of the lower part 4 and the oblique duct 13 which comprises pump 14, resonator 15 and three conduits 16, 17 and 18. The design of the resonator 15 is shown in Figs. 2 and 3.

The resonator 15 comprises a cylindrical wall open at one end 19 and closed at the opposite end 20. A hollow element 21 is defined in this cylinder which has a circular rim 22 attached to the interior of the cylinder at the central portion thereof. A first part 23 of the element 21 has a form of a hollow rotational paraboloid which is located in the closed room between the rim 22 and the closed end 20 of the resonator 15. In about one-third of the height of the paraboloid 23 a number of evenly distributed tangential holes 24 are provided through the wall of the element 21. In the exemplary embodiment this number is five. A duct 25 is extending out of the closed end 20 of the resonator 15 which is slightly inclined relative to the axis of the resonator. The element 21 comprises a second part 26 which communicates with the first part 23 at the plane of the rim 22 and this part has the form of a rotational hyperbola which is continued as a short cylindrical duct 27. In a preferable embodiment the resonator 15 is made of glass.

It will now be explained how water enriched with a gas can be produced by means of the apparatus shown in Figs. 1 - 3.

First, the sealed cork of the duct 7 is opened and 10 liters of normal tap water (available in Zurich, Switzerland) is filled in the container 1. The volume of the container 1 is such that the water level will be by about two inches above the duct 13. The duct 7 is closed and sealed again, the pump 17 is started and water is flown through the system so that any air present in the conduits 16, 17 and 18 as well as in the resonator 15 will be released in the space above the water level. Now the pump is stopped and a cock attached to the duct 6 is opened and oxygen is introduced through the water in the tank 9 in the inner space of the dish 10. The oxygen supply is sufficient to remove (push out) the air from the dish 10, from the conduit 11 and from the free space above the water level in the container 1. After a while the cock is closed and pure oxygen will be filling the total gas volume in the container 1 and in the dish 10.

At this phase the water level in the dish 10 is equal to that in the tank 9.

In this arrangement the pump 14 is started. The pump has a flow output of 25 lit/min and the inner diameter of the conduits 16, 17 and 18 is equally about 14 mm. The direction of the flow is shown by the arrows in Fig. 1. When water is passed through the resonator 15, it flows through the tangential holes 24 and a first vortex will be formed in the hollow paraboloid part 23 as shown by the arrows of Fig. 3, the rotating water flows first back towards the closed end of the parabola and from here it will be reflected forward, and owing to the specific form of the element 21 a rapidly rotating water stream proceeds in the conduit 18 towards the container 1. Arrow 28 shows how this water is rotating in the conduit 18. The water flows tangentially into the container 1 through the oblique inlet duct 13.

In the container 1 the previously quiet water starts whirling and a second vortex is formed. The formation of the steady state of the vortex in the container 1 takes some time (about 1 or two minutes). We have taken a number of photos from the formation of the vortex and Figs. 5 to 7 are the graphical representations of a few number of these pictures.

It can be seen in these pictures that after a diverse whirling a tornado-like vortex is formed, in which there is an almost cylindrical central hollow part which extends till the bottom of the lower part 4 of the container 1. The speed of the water particles in the vortex is very high. The number of revo lutions at the uppermost and largest diameter of the vortex is about 50 r.p.m. and this speed is increased in downward direction approximately according to an exponential function. The speed can be calculated taking into account that the volume flowing through any given height is constant, thus the speed is proportional to the actual water cross-section around the vortex.

When the vortex has stabilized in the container 1, the pump 14 keeps running. After a while the water level starts increasing in the dish 10 relative to the level in the tank 9. This indicates that a portion of the oxygen present in the volume above the water has been taken up by the circulating water.

Fig. 4 shows schematically how the quantity of oxygen taken up by the circulating water has been calculated. The original water level in the dish 10 is indicated by the reference numeral 29. The level increase is expressed by H. The cross-sectional area of the dish 10 is designated by A. The oxygen take up can be expressed as $V = A \times H$.

It is known that the density of oxygen is $d = 1.43\ mg/cm^3$. If we wish to express the consumed oxygen in mg units, then the oxygen mass in milligrams will be $m = d \times A \times H$. The $A \times H$ product should be in cubic centimeter units.

This oxygen is taken up by the water volume. If the relative quantity of the oxygen in the circulating water has to be expressed, then $C_O = d \times A \times H / V_w$ should be calculated. This formula expresses the excess oxygen taken up by the water during the process in mg/l units if the volume of the water V_w is expressed in liters.

It can well be supposed that the tap water that was filled in the container 1 was almost saturated with dissolved oxygen, since normal tap water after some time of free running gets practically saturated. In room temperature this corresponds substantially to a concentration of 9 mg/l.

In the exemplary embodiment the diameter of the dish is 10 cm, and the volume of the water $V_w = 10$ liter. Substituting these data in the expression for the oxygen concentration, it is obtained that $C_O = 11.225$ H. If H is measured in cm units, C_O will be in mg/l units.

The full oxygen concentration will be obtained if the starting concentration is added to the calculated value.

Table 1 below summarizes the measured and calculated results of a test series carried out between May 13 and June 3, 1987.

Table 1

Day/month/hour	time elapsed (hours)	Temp. (^{o}C)	H (cm)	C_0 increase (mg/l)	C_0 total (mg/l)
13.5 12.00	-	18	-	-	9
14.5 12.00	24	21	1.8	20.2	29.2
15.5 17.00	29	22	3.0	13.5	42.7
17.5 11.00	42	19	5.0	12.8	65.1
18.5 08.00	21	19	5.8	9	74.1
19.5 08.00	24	21	6.4	6.74	80.8
20.5 08.00	24	21	7.2	8.98	89.8
21.5 08.00	24	20	8.0	8.98	98.8
22.5 08.00	24	19	8.7	7.9	106.7
23.5 13.00	29	24	9.7	11.25	117.9
25.5 13.00	48	22	12.0	25.88	143.7
30.5 13.00	120	19	19.0	78.75	222.3
1.6 16.45	51.75	21	20.3	14.6	236.9
3.6 07.30	38.75	21	21.3	11.25	248.1

The value of 9 mg/l in the first row of the total concentration column corresponds to the original dissolved oxygen concentration of the water.

Fig .8 shows the data given in Table 1 in diagrammatic form. Fig. 8 includes similarly determined data for a number of other gases than oxygen. In such measurements carbon-dioxide, helium, argon and O_3 were used instead of oxygen. In case of carbon-dioxide a much larger dish was used, since the higher solubility required more gas supply. In the diagram a scale compressed by two was used for illustrating carbon-dioxide take up.

It can be seen from the diagrams that already in a few days of treatment the water takes up substantially more gas than its well-known saturation value for the given temperature. The tem perature has some influence on the speed of the gas absorption process, this dependency has, however, secondary significance only. The colder the water, the more gas it can absorb.

The experiment with water was finished on June 3, 1987. At this time the pump was switched off and the closed system was left alone. In further five days the height difference remained unchanged which was an indication that the gas taken up by the circulating water remained in bound state in the water.

The container 1 was opened after the fifth day and the oxygenized water was filled in 0.1 and 0.2 liter glass bottles under normal pressure.

A bottle was sent to the U.S. for analysis to DataChem, 520 Wakara Way, Salt Lake City, Utah 84108, and the dissolved oxygen was measured. The environmental water report stated that the sample contained 56 mg/L dissolved oxygen determined by the standard Method 360.2 (Modified Winkler, Full-Bottle Technique). The method corresponds to EPA-600/4-79-020 "Methods for Chemical Analysis of Water and Wastes", March, 1983.

Another sample from a previous process was also measured at DataChem with the same method, and this resulted in a dissolved oxygen content of 43 mg/L.

It must be pointed out that these data do not correspond to the values determined in Table 1. The fact that oxygen remains in a stable state in the water in a concentration much above the saturation level indicates that the binding between the oxygen and water molecules is other than in case of regularly dissolved oxygen in water. An example to this hypothesis is that the standard membrane electrode methode is insensitive to the oxygen bound in the water according to the present invention. The same water was measured by a Yellow Springs Instruments Co. Inc Model 54 Oxygen Meter at a temperature of 20.5 °C, and the instrument showed a concentration of 8.5 mg/L only.

The stable presence of the gas introduced in water according to the present invention can be demonstrated by the various effects of such waters.

It is well-known in the art e.g. that carbon-dioxide can be added to beverages under pressure in amounts that exceeds normal saturation, and under normal pressure a bubble formation takes place and after some time the beverage loose its characteristic sour taste.

In an experiment water oversaturated by carbon-dioxide under pressure was compared with water treated with carbon-dioxide according to the invention. It was adjusted by appropriate dilution that the taste of the two waters be the same. An intensive bubble formation was observed in the glass containing the conventionally oversaturated water, while in the glass filled with the water according to the invention there were no bubbles at all. In about an hour the water in the first glass was tasted again, its taste was much less sour and there were no bubbles in it at all. The taste of the water in the other glas remained, however, unchanged, it preserved the original sour character.

We have tried to warm this water up whether it looses its gas content. It turned out that a warming close up to the boiling temperature could not release the carbon dioxide bound in the water. The characteristic sour flavor remained.

The same applies to mechanical treatments. Neither mixing, stirring, whipping could change the characteristic taste of the water.

In the method according to the invention the water takes up the gas in an amount which exceeds the equilibrum quantity in conventional sense, and the gas will be bound to the water in a way other than dissolved gases are. This phenomenon is triggered most probably by the specific surface transitional processes that take place between the whirling water surface and the adjacent gas which is moved by the vortex as well. In the above example there was a slight vacuum above the water which was in correspondence with the height H in the dish. Such conditions are preferable, since the observation of the height H indicates directly the amount of gas take up. The use of a glass system with transparent walls was preferable, since the formation of the vortex could thus be observed. It should be noted, however, that the transitional processes which result in the capture of the gas molecules are largely independent of the pressure prevailing in the system. It has been experienced that up to about 6 bars the gas above the vortex will be taken up by the whirling water, and the system can be made also of stronger metal elements as well.

In the following part of the specification examples will be described that demonstrate various uses and effects of the water which comprises specially bound gases, particularly oxygen provided by the method according to the invention. For the sake of simplicity, the water enriched in oxygen according to the present invention will be referred to as "oxygenized water".

Example 1

Two drops of freshly taken human blood were placed on a clean glass plate. A drop of tap water was added to the first blood sample. The color of the so diluted blood became lighter and a coagulation started about 10 seconds following the administration of water.

The second blood sample was diluted by a drop of oxygenized water. The coagulation started and finished at once and the color of the blood did not change.

The respective dilutions of the blood samples occurred simultaneously.

The excellent coagulation stimulation properties of oxygenized water has been utilized in Dr. Ott's dental practice. The application of oxygenized water substantially reduces bleeding.

Example 2

Alcoholic beverage (brandy) was given to six persons. The alcohol amount in their blood was measured an hour following the alcohol consumption. The average of the measured alkohol concentration was 1.3 °/oo (varying between 1.25 and 1.38). The concentration was expressed as a quotient of consumed pure alcohol and of body weight multiplied by a distribution factor of 0.7 for men and 0.6 for women. In Switzerland this is the standard way of expressing alcohol concentration. The limit for driving is 0.8 °/oo, furthermore if this value is higher than about 2 to 3,5 °/oo, the person gets unconscious and the concentration above 4 °/oo can be fatal.

When the samples were taken each person drank 1 dl of oxygenized water. About 1 1/2 hours later blood samples were taken again and the alcohol concentration of these blood samples was measured. The average of these measurements was 0.3 °/oo of alcohol concentration with a very small deviation among the test persons.

After about half an hour following the consumption of oxygenized water the persons started to report that they felt better and the symptoms of alcoholic influence gradually vanished. By the time the blood samples were taken they all were sober and under full control.

It should be noted that the usual rate of decrease of alcohol concentration in blood is about 0.1 °/oo per hour. If we compare this usual value with the result of this test, in which the rate of decrease was 1 % in 1 1/2 hours, then it can be seen that the presence of 1 dl oxygenized water results in about a seven times higher rate of alcohol metabolism in the human body.

Example 3

Ten women were selected who suffered from candiditis due to the presence of Candida albicans. The ill areas were under the breast (at 6 persons), between the fingers (3 persons), at the genital and anal areas (3 persons).

The ill areas and their vicinity in an excess radius of two cm were smeared twice a day with oxygenized water during a period of two weeks. No other treatment was used.

The patients reported they were relieved from pain about after the third day of treatment. The skin areas were not yet healed by that time. The fastest healing was experienced under the breast areas. It took place by about the 7th day of treatment. The slowest healing was experienced between the fingers and at the tip of fingers. In that cases the healing occurred by the end of the tenth-twelvth day. Concerning the genital and anal areas healing was experienced after the tenth - thirteenth day.

All patients were examined a week and thereafter a month following the treatment. In the examination after one week there was a slight recurrence at a patient who had been treated between the fingers. The area turned to red again. The treatment was repeated for a further four days and the patient healed. In a control after a month she was healthy. In all other control examinations the patients were healed.

Example 4

Seven male patients suffered from frostbite of first grade (congelatio cutis). The frostbitten areas were at the hands and feet and in one case at the ears.

The frostbitten areas were treated three times a day by sterilized tissues soaked previously in oxygenized water. The water was let to dry on the areas thereafter the wounds were bound by antiseptic gauze. No other treatment except for vitamins was applied.

The excessive pain started to decrease by the second or third day of treatment and stopped completely in further 3-5 days. The natural color of the skin returned rather soon and in all cases a complete healing took place by the tenth day of treatment.

Example 5

Absorbent cotton was laid on a petri dish and 50 alfalfa seeds sown thereon. The absorbent cotton was fully soaked with oxygenized water. The wet condition of the cotton was maintained by discrete supply of oxygenized water. After about two days, when the rate of germination was inspected, it was found that 70% of the seeds had germinated. The rate of germination for a control where not oxygenized but normal water had been used was 50%. As a result, it was learned that soaking with oxygenized water led to a 20 % higher germination rate. Further, when the rate of growth was observed after about five days, the average growth was found to be 28 mm, compared with an average 23 mm for the control group. In consideration of this it was learned that oxygenized water can be effective for promoting plant growth.

Example 6

This example relates to the effect of water comprising carbon-dioxide by means of the present invention. In the apparatus of Figs. 1 to 3 the circulation process was mainatained through 24 hours and the oxygen was replaced by carbon-dioxide. Absorbent cotton was laid on a petri dish and 50 alfalfa seeds thereon. The absorbent cotton was fully soaked with the water comprising carbon-dioxide. The wet condition of the cotton was maintained by discrete supply of water including carbon-dioxide. After about two days, when the rate of germination was inspected, it was found that 50 % of the seeds had germinated which was not different from the rate of 50 % for normal water. When the rate of growth was observed after about five days, the average growth was found to be 25 mm compared with an average of 21 mm for the control group with normal water under the same conditions. From these results it was learned that water containing carbon-dioxide according to the invention can also be effective for promoting plant growth.

The above examples can demonstrate that the water comprising excess amount of gases, especially oxygen and carbon-dioxide due to the method according to the invention has many different fields of applications and the results in these fields are surprisingly significant. There can be, of course, much more fields of applications and numerous beneficial effects.

Among these we should mention the drinking of oxygenized water on a regular basis. We have tried this on ourselves and experienced that 1 or 2 dl of such water assists in overcoming tiredness, it keeps one fit and fresh and decreases the daily need for sleeping, although one feels completely fresh after a shorter sleep. These phenomena cannot be defined by scientific accuracy, however, this water can form a possibility in a number of indications in the field of psychology and psychotherapy as well as in normal life.

In connection with such direct applications the question might be raised whether an overdosage of oxigenized water can be possible at all. In human organisation there exists a regulation system which impedes that haemoglobin cannot take more oxygen than required even if oxygen is presented through the intestinal membrane in excess quantity. Excess oxygen can be dangerous when breathed in through the lungs only.

On the other hand the equilibrum between oxygen and carbon-dioxide as well as the oxygen content of haemoglobin is regulated by the medulla oblongata and this regulation is sufficiently effective, whereby oxygenated water cannot be given in such a large amount to cause any harm.

Claims

1. Method for introducing gas into water in excess quantity relative to an equilibrum condition corresponding to the saturation of water with said gas on any predetermined temperature and pressure, in which the water is intensively moved so that the free surface thereof be exposed to said gas, characterized in that a vortex of water is formed during said movement, the water leaving one end of said vortex is accelerated and fed back to the other end of said vortex to maintain the same, and the recirculation is maintained until each particle of water has participated in at least hundred cycles.

2. The method as claimed in claim 1, characterized in that the accelerated water is forced to rotate around an axis parallel to the direction of flow thereof just before being re-introduced to maintain said vortex.

3. The method as claimed in claim 1 or 2, characterized in that the lowest speed of said vortex is at least about 40 revolutions per minutes.

4. The method as claimed in claim 1 or 2, characterized in that said gas is oxygen.

5. The method as claimed in claim 1 or 2, characterized in that said gas is carbon-dioxide.

6. Apparatus for carrying out the method as claimed in any of claims 1 to 5, characterized in that a container (1) is provided that defines an inner space being circularly symmetrical relative to an axis (5), said container (1) has an upper part (2) with a substantially spherical shape, a medium part (3) tapering in a direction away from the upper part (2) and a narrow lower part (4) tapering in the same direction, a duct (13) is extending obliquely out of the upper portion of the medium part (2) substantially at or just below a height in which the container (1) has the largest diameter and closes an acute angle at least with the tangential plane of the container to enable tangential introduction of water, a feedback water path is provided between the end of the lower part (4) and the oblique duct (13) which comprises a water pump (14) and a resonator (15), the resonator (15) is provided with an element (21) therein having a number of tangential holes (24) and an outflow opening coupled to said oblique duct (13), a pressure chamber is formed in the resonator (15) between the inner wall thereof and the element (21), the pressure chamber is connected through a duct (25) to the outflow end of the pump (14), the tangential holes (24) are communicating with the pressure chamber, whereby water forced by the pump (14) starts whirling and leaves said element (21) via said outflow opening and will be injected tangentially in said container (1) to form a vortex, and the space of the container is filled with a gas.

7. The apparatus as claimed in claim 6, characterized in that the inner cross-sections of the outflow portion of the lower part (4) of the container, that of the oblique duct (13) and of the conduits (16, 17, 18) in said feedback path are substantially equal and their respective minimums fall within a range of at most 1 : 3.

8. The apparatus as claimed in claim 6, characterized in that said oblique duct (13) is tilted slightly in upward direction.

9. The apparatus as claimed in claim 6, characterized in that the upper part (2) of the container (1) is communicating with a container (10) filled with gas for providing supply for the gas taken up by the recirculating water.

10. The apparatus as claimed in any of claims 6 to 9, characterized in that said resonator (15) has a cylindrical house open at one end, the element (21) has a first part (23) with a form of a rotational paraboloid, with an open end facing said outflow opening and a second part (26) attached to the first part and having a curved contour with an open end defining said outflow opening, the two parts (23, 26) have a common circular rim (22) attached to the medium zone of said cylindrical house, said tangential holes (24) are provided on the paraboloid part (23) close to the rim, and the closed end (20) of the cylindrical house has a duct (25) closing an acute angle with the axis of the cylinder to let water flow obliquely into the pressure cham ber to increase thereby rotation of water when passed through the tangential holes.

11.Water comprising a gas in excess quantity relative to an equilibrum condition corresponding to the saturation thereof with said gas on any predetermined temperature and pressure, characterized in that said gas is contained in a stable and bound state under said predetermined temperature and pressure.

12. The water as claimed in claim 12, characterized in that said gas is oxygen, carbon dioxide, helium, argon or oxygen with molecules comprising three atoms.

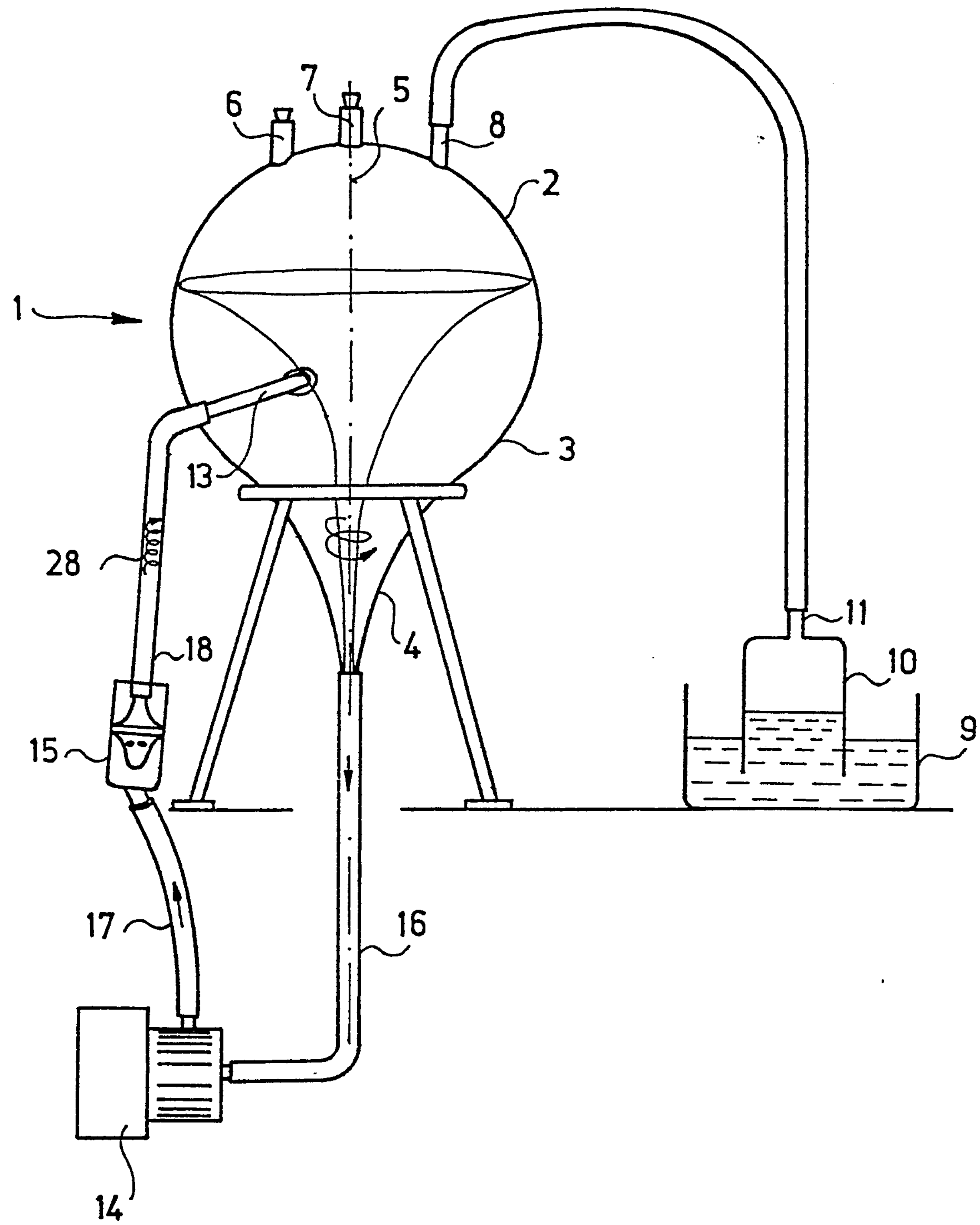

Fig.1

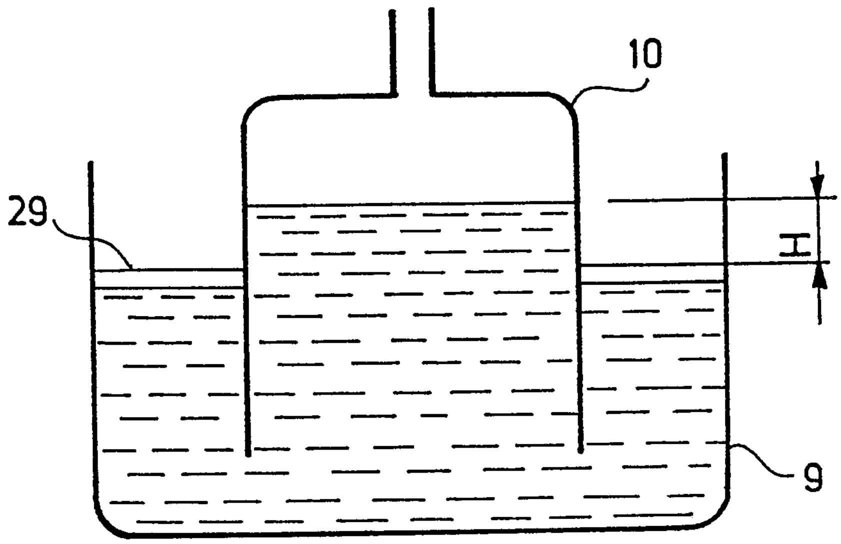

Fig. 4

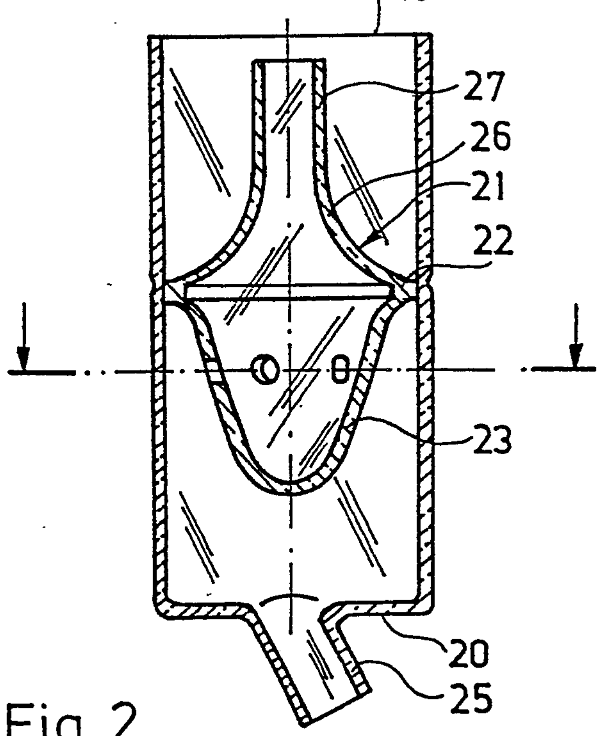

Fig. 2

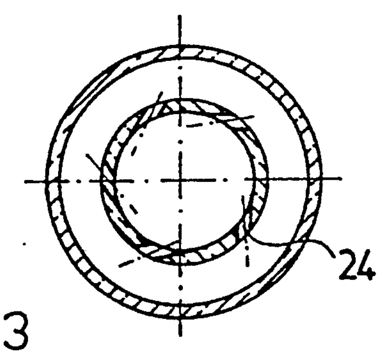

Fig. 3

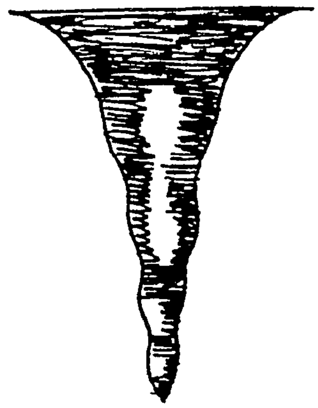

Fig. 5

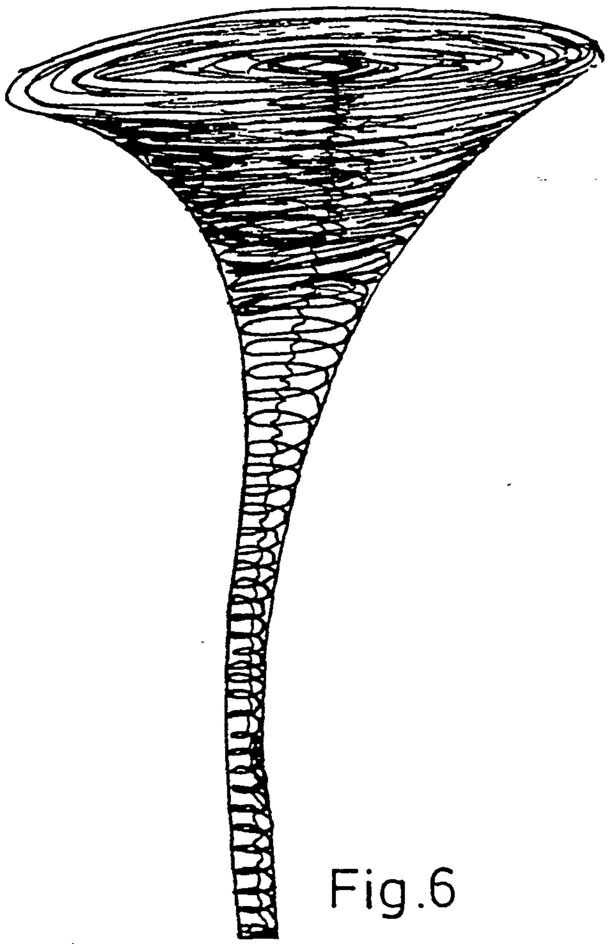

Fig.6

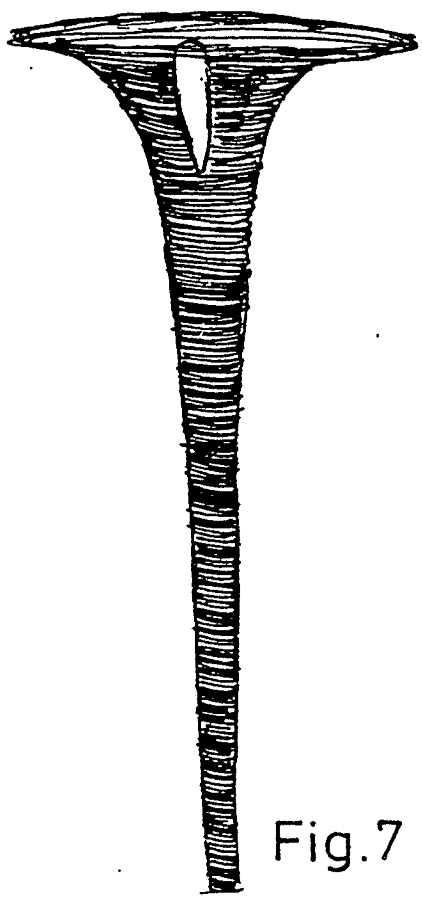

Fig.7

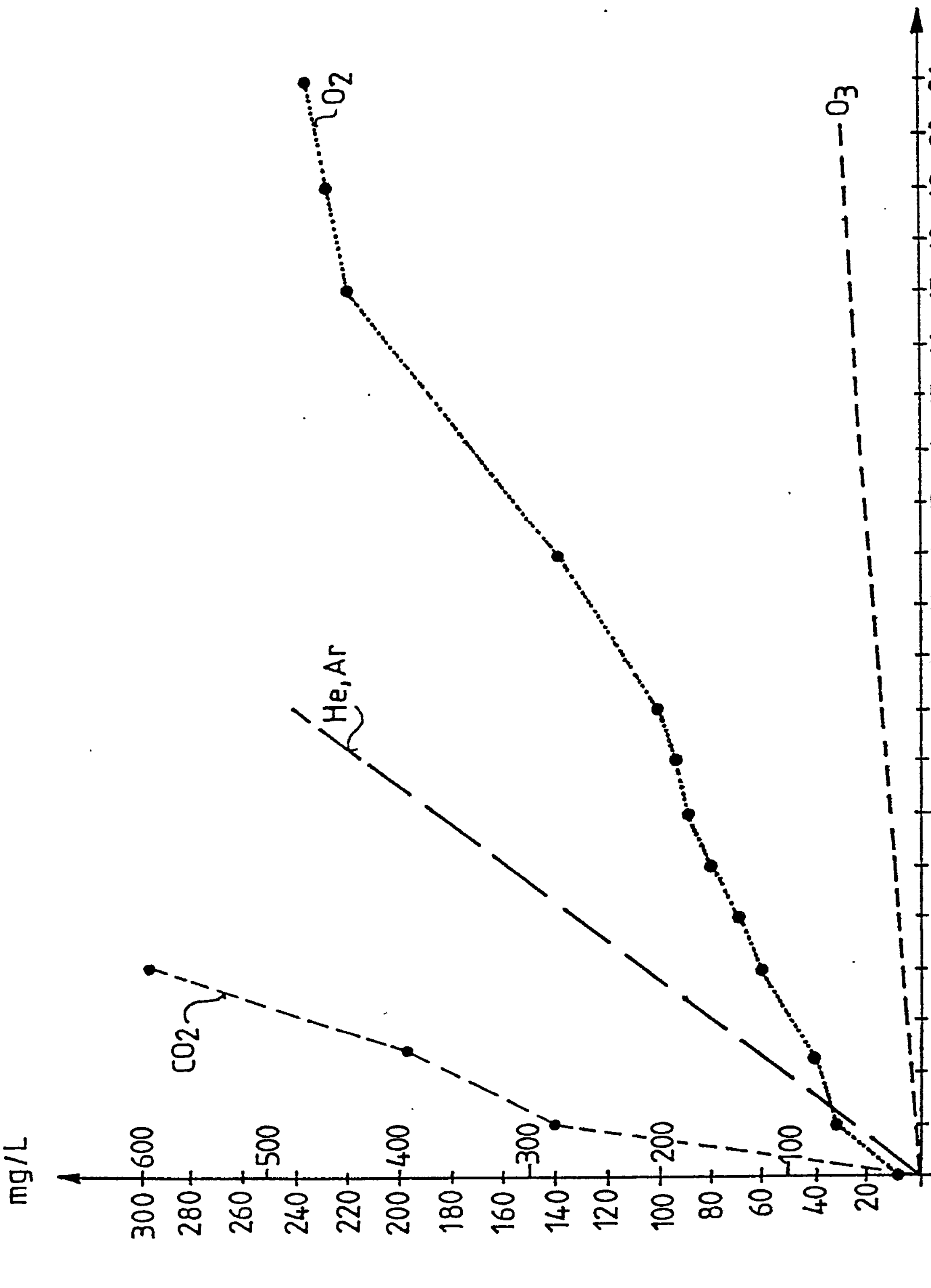
mg/L
300 280 260 240 220 200 180 160 140 120 100 80 60 40 20
600 500 400 300 200 100
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
CO2
He, Ar
O2
O3

Fig.8

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 87 11 5583

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	CH-A- 370 057 (BUSS) * Claims; figures * ---	1,6,11	B 01 F 3/04 B 01 F 5/00
Y	US-A-3 867 195 (PFEUFFER) * Abstract; figures * ---	1,6,11	
A	US-A-3 246 683 (YAP) * Column 4, lines 35-68; figure 2 * ---	1,6	
A	DE-A-1 642 794 (STOCKHAUSEN) * Figures * ---	10	
A	GB-A-1 260 163 (McINNIS) * Claim 1; figures * ---	1,6	
A	US-A-4 008 163 (INGELS) * Abstract * ---	5,12	
A	US-A-4 337 152 (LYNCH) * Abstract * ---	4,12	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	FR-A-1 005 450 (GROS) ---		B 01 F
A	US-A-2 986 343 (TRENTINI) -----		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-06-1988	PEETERS S.

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