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APPARATUS FOR PREPARING SUPERSATURATED SOLUTIONS

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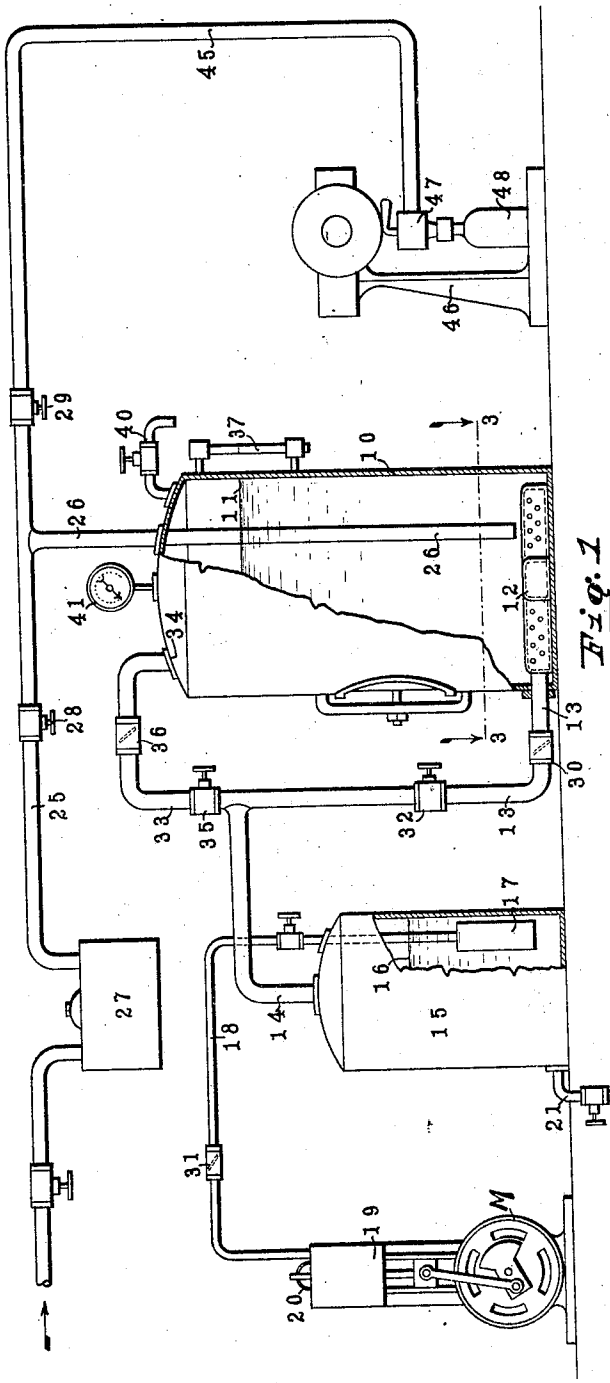


Fig. 1

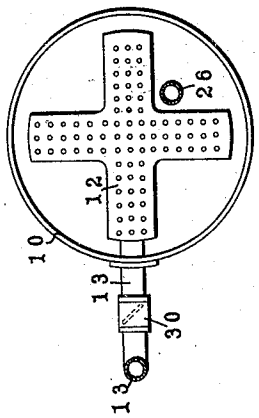


Fig. 3

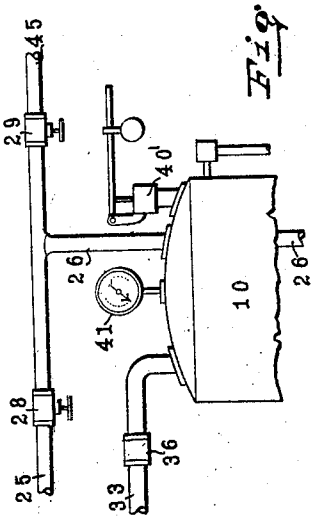


Fig. 2

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR PREPARING SUPERSATURATED SOLUTIONS.

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This invention relates to apparatus for dissolving gases in liquids, and more particularly to apparatus for selectively dissolving gases in water.

This invention has for its general object the provision of an apparatus in which the parts are arranged for both improved structural and functional cooperation in the production of the solution desired in an efficient and economical manner.

Another object is to provide improved apparatus adapted to produce and maintain the critical conditions for the proper periods which yield solutions of gases having high degrees of supersaturation.

Another object is to provide apparatus adapted to produce solutions of atmospheric oxygen containing as high as 48 cubic centimeters of oxygen per liter of water, the oxygen being held in a very retentive manner.

Other objects of this invention will in part be hereinafter specifically pointed out and in part obvious from the arrangements and constructions here set forth.

The invention accordingly comprises the features of construction, combinations of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a more complete understanding of the nature and advantages of this invention reference should be had to the following detailed description, which describes the best illustrative embodiments of this invention at present known to us, taken in connection with the accompanying drawing in which:

Figure 1 shows an arrangement of apparatus for carrying out the steps of the method, parts being broken away in order better to illustrate the construction;

Fig. 2 is a fragmentary portion of the apparatus showing a modification; and

Fig. 3 is a sectional view taken on the lines 3—3 of Fig. 1.

Referring now to the drawing, 10 denotes a substantially closed tank or container which is adapted to be filled with a body of water or other liquid, whose level is indicated at 11, which is to be treated with gas in order to produce the solution desired. In order to treat the water with a large volume of finely divided gas a cruciform distributor shown at 12, having a plurality of fine orifices, is disposed at the bottom of the container 10. This distributor 12 receives the gas from the supply main 13 which leads from the opening at 14 in the top of a gas washer 15. The gas to be washed passes through the washing fluid (preferably water) whose level is indicated at 16 from a suitable nozzle 17 disposed below the liquid surface 16, the gas being supplied from the main 18 leading from the pump or other means 19 for forcing over a body of gas. The pump at 19 is preferably power actuated; an electric motor M here being indicated as the power driving element.

The pump at 19 forcing gas into the container 10 draws it from any suitable source; the source here indicated is the atmosphere, a poppet valve being provided at 20 to control the air inlet to the pump. The air displaced by the pump 19 is thus forced through the main 18 into the washer 15. Here, as it issues from the nozzle 17, it passes through the washing water, and from thence through the main 13 to the distributor 12. The washer 15 preferably has a drain as shown at 21.

The supply of water to the container 10 is provided by means of a pipe connection 25 having a downwardly projecting branch 26 which enters at the top and reaches nearly to the bottom of the container. The connection 25 leads from a suitable source of water supply and preferably is provided with a filter as shown at 27 to remove sand and other foreign matter before the water enters the container 10, thereby initially preparing the water for its subsequent treatment in the container.

A valve at 28 is disposed in the pipe 25 to control the admission of water into the container 10. A second valve 29 is disposed in an extension of the pipe 25 which is normally closed, but when opened while the valve 28 is closed permits the water in the container 10 to be forced out through it. It is for this reason that the depending branch 26 is made to reach substantially to the bottom of the container 10, thus permitting the withdrawal of substantially all the water treated in the container.

Check valves 30 and 31 are provided in the mains 13 and 18, respectively, to pre-

vent the passage of gas or liquid out of the container therethrough. A valve 32 is also provided in the main 13 which is normally open but which is closed when it is desired to draw off the treated solution from the container 10. In order that the apparatus shall be adapted to have the solution drawn off without altering the pipe connections, the main 13 is provided with an extension 33 entering at the top of the container 10 as shown at 34. This connection has a normally closed valve 35 and also preferably a check valve 36. By closing the valve 32 and opening the valve 35, the pump being kept in operation, pressure may be applied to the surface of the liquid in the container 10 which will force the liquid out when the valve 29 is open and the valve 28 is closed. During this operation, the pump 19 is preferably run at reduced speed.

As different gases have different degrees of solubility in various liquids, advantage of this fact is taken in order selectively to dissolve particular gases from the atmosphere or other suitable body of gas in the liquid to be treated. If the liquid in the container 10 is water and the body of gas with which it is to be treated of atmospheric origin, solutions of oxygen having a high degree of supersaturation may be invariably produced by passing a finely divided body of air through the water, oxygen having a greater degree of solubility in the water than any of the other atmospheric gases. By maintaining, for the proper period, the critical conditions under which dissolution takes place, a solution supersaturated with oxygen may be produced.

In the practice of supersaturating liquids, especially water, with this invention, a body of water which has been filtered is run into the container 10 by opening the valve 28. The proper height of the water in the container may be readily ascertained from the gauge glass shown at 37. When the container is properly filled, a body of atmospheric air is caused to pass therethrough by operating the pump 19. The air drawn in from the atmosphere by the pump passes out of the nozzle 17 through the washing water in the washer 15 and from thence through the main 13 to the distributor 12, the valve at 35 being normally closed. The body of air entering the distributor 12 issues therefrom as a plurality of jets, the gas passing in a finely divided state upwardly through the water which selectively dissolves gases therefrom. The gentle and continuous agitation of the water, by the pulsating jets, materially aids in effecting the solution. When a sufficient head of pressure obtains in the container, as ascertained from the gauge 41, the valve at 40 is opened to permit the escape of the undissolved gas accumulating in the top of the container. This escape, when started, is substantially continuous. To produce the desired solution, the critical conditions of temperature and pressure must be maintained throughout the necessary period of treatment. The water in the container should be preferably below 60 degrees F., while the head of pressure in the container should be preferably in the neighborhood of 135 lbs. The period of treatment should be in the neighborhood of one-half an hour, This will yield supersaturated solutions of oxygen in the water containing as high as 48 cubic centimeters per liter of water.

In Fig. 2 a modified form is shown in which the valve escape is of the safety valve type as shown at 40'. Where this form of valve escape is used the head of pressure is automatically maintained constant.

In order to withdraw the solution and bottle it unimpaired, it is preferably withdrawn steadily and without undue agitation from the container 10, while at a pressure somewhat reduced from that at which saturation is effected. The pressure is reduced quickly so that the solution is brought substantially to a condition of equilibrium as it is passed to the vessel in which it is to be stored or placed preparatory to use. By means of the valves provided at 32 and 35 a desired reduced pressure, which can also be ascertained from the gauge 41, is maintained above the solution while it is withdrawn. A connection 45 is provided, which leads from the valve 29 to the place where the solution is finally put into the storing vessel. This is conveniently accomplished, as shown in the drawing, by means of a bottling machine 46 which has a filling nozzle 47 for filling bottles 48 and means for hermetically sealing them. Any standard machine of this character may be used in this combination.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

Having described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. Apparatus adapted to supersaturate liquids with gases comprising, in combination, a closed liquid container, means extending to a point adjacent the bottom thereof for filling said container with a body of

liquid prepared for saturation, means for forcing continuously a finely divided volume of gas through the liquid in the container, means for permitting the constant escape of gas from the top of the container after a predetermined pressure has been attained therein, and means common with said filling means for withdrawing the supersaturated liquid.

2. Apparatus adapted to supersaturate liquids with gases comprising, in combination, a closed liquid container, means for forcing a finely divided volume of air into the container adjacent the bottom thereof, means for washing the air preparatory to its passage into the container, means permitting the constant escape of undissolved constituents of the air after a predetermined pressure has been attained in the container, and means having a single connection extending to a point adjacent to the bottom of said container arranged both to supply to and to withdraw liquid from the container.

3. Apparatus adapted to supersaturate liquids with gases comprising, in combination, a closed liquid container, permanent pipe connections for supplying to the container a prepared body of water, means for forcing continuously a finely divided volume of air through the water, means for permitting the escape of undissolved gaseous constituents of the air from the top of the container after a predetermined pressure has been attained therein, means for reducing the pressure within the container when the water has been sufficiently charged, and means connecting with said permanent pipe connections for withdrawing and bottling the solution at a pressure somewhat reduced below said predetermined pressure.

4. Apparatus adapted to supersaturate liquids with gases comprising, in combination, a closed liquid container, means for filtering and supplying water to be treated to the container, a power driven pump for forcing a body of air into the container, a washer for washing the air prior to its entry into the container, a connection having a distributor for passing the air in a finely divided state through the water being treated, said connection having a branch adapted to supply pressure to the surface of the water, means affording the substantially constant escape of undissolved gaseous constituents of the air from said container, and a bottling machine operatively connected to said container and arranged to withdraw and bottle, at a pressure somewhat reduced below that at which the treatment takes place, the solution produced in said container.

In testimony whereof we affix our signatures.

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