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[54] **FLUID CIRCULATOR**
10 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **261/123,**
15/104.3
 [51] Int. Cl..... **B01f 3/04**
 [50] Field of Search..... **261/123;**
15/104.3

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ABSTRACT: A liquid-circulating device includes a vertical stack submerged in liquid and provided with a large bubble generator adjacent its bottom opening. The bubble generator comprises an open bottomed gas chamber and an inverted tubular siphon including a first vertical leg communicating with the upper part of the chamber, a second leg extending upwardly to a bubble discharge opening above the chamber, and a curved elbow located above the chamber opening. A tubular member is provided for guiding a cleaning tool into the siphon through one of its end openings. The chamber and siphon are enclosed in a casing with openings registering with the chamber opening and siphon discharge opening.

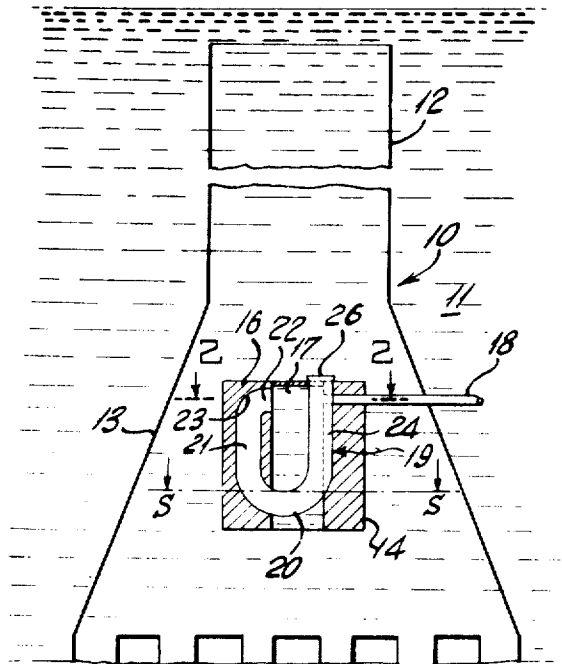


Fig. 1.

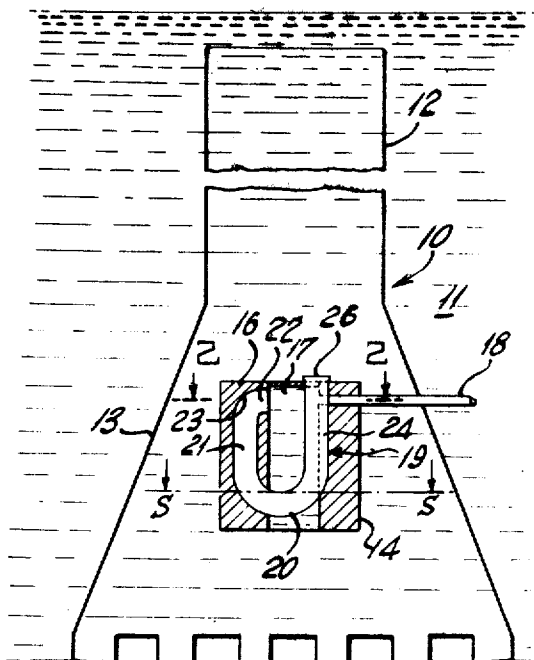


Fig. 2.

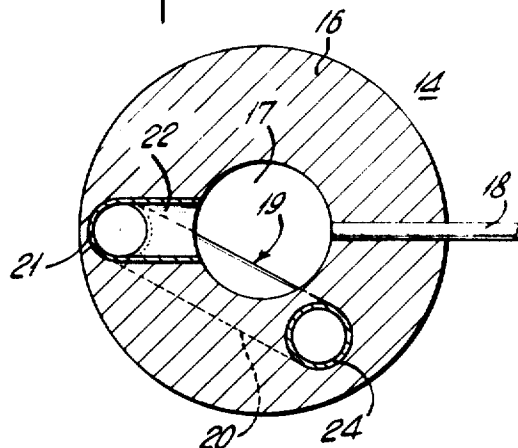


Fig. 3.

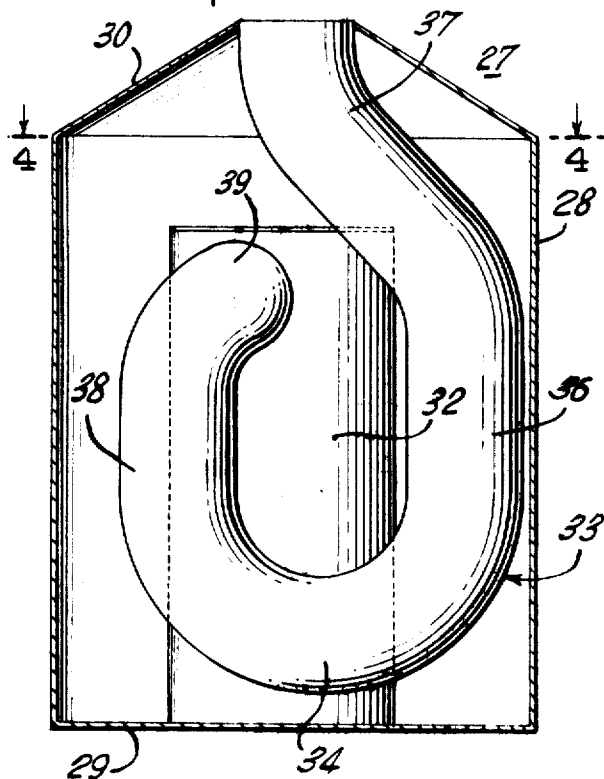
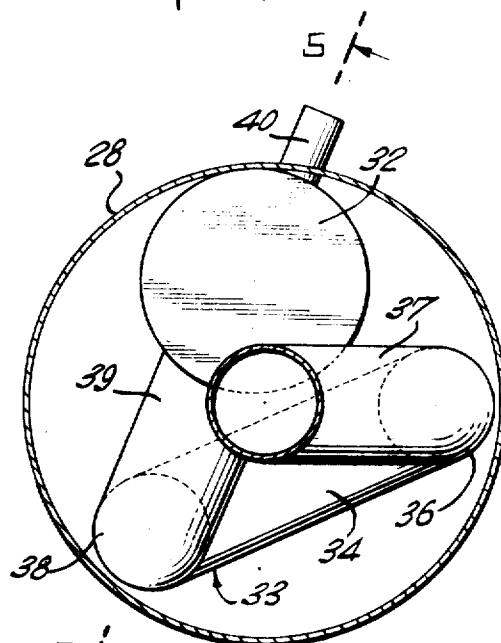


Fig. 4.



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Fig. 5.

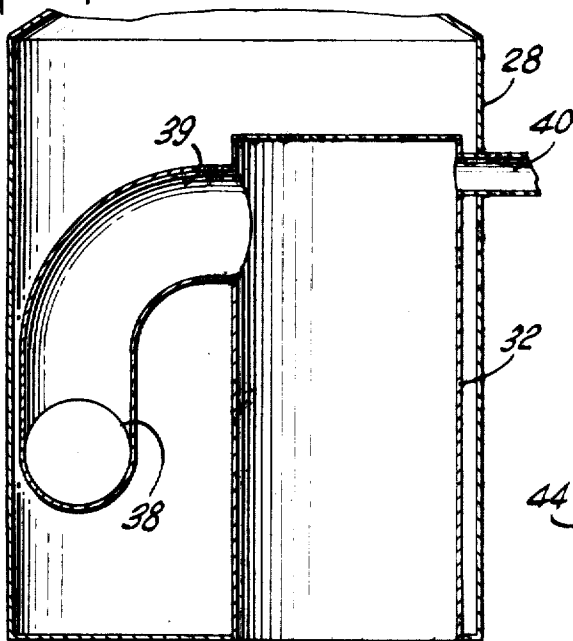


Fig. 6.

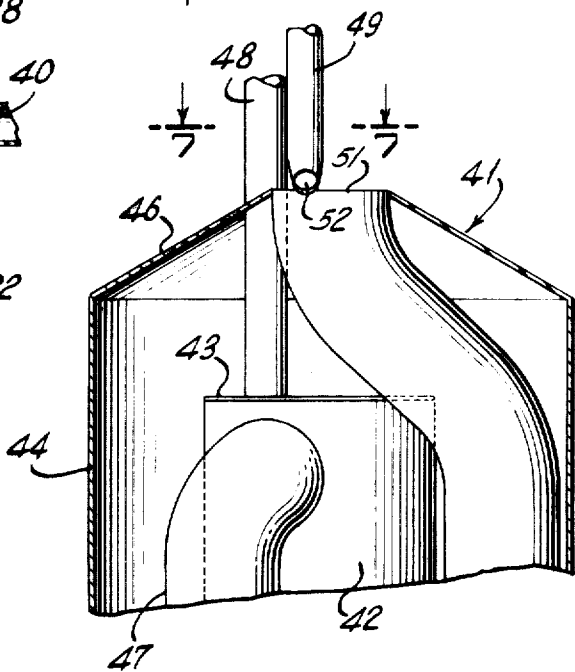


Fig. 8.

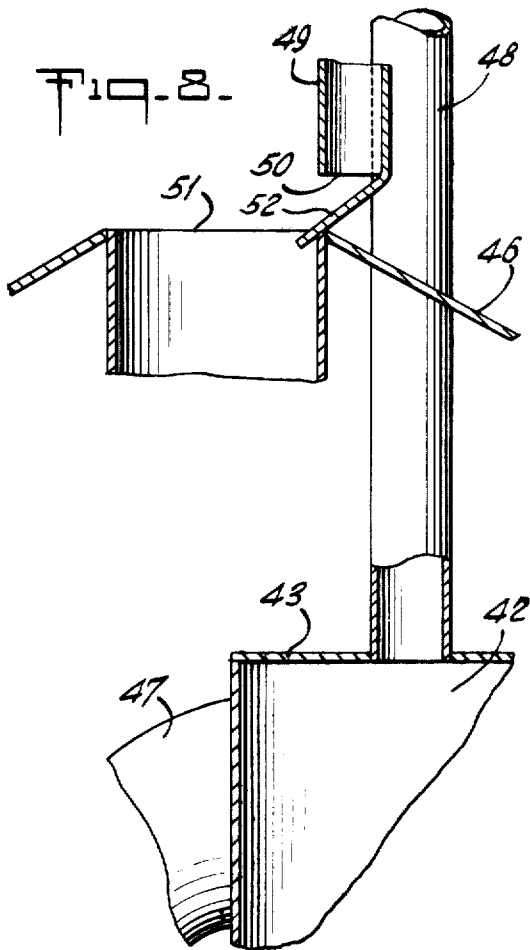
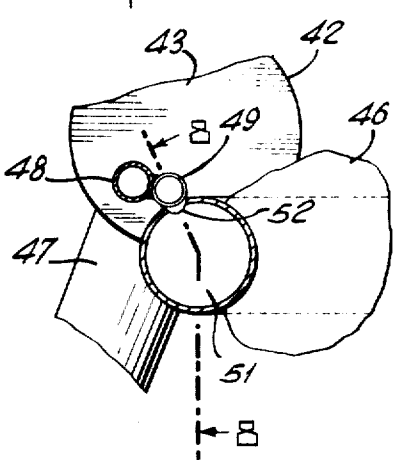


Fig. 7.



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FLUID CIRCULATOR

BACKGROUND OF THE INVENTION

The present invention relates generally to improvements in liquid-circulating devices and it relates particularly to an improved large bubble generator in combination with a submerged stack for effecting the upward lift of liquid in the stack.

The ability has long been known to circulate liquids in large bodies thereof by submerging one or more open ended vertical stacks or conduits in the body of liquid and cyclically forming large bubbles at the bottom of the stacks, each of the bubbles occupying substantially the full transverse cross section of the stack and rising therein to function as pistons to lift the liquid in the stacks and discharge it from the tops of the stacks hereby effecting the circulation and aeration of the liquid. While these devices are generally highly satisfactory the bubble generators employed therewith possesses important drawbacks and disadvantages, particularly when employed in the circulation of liquids having dispersed therein solid matter which readily settles from the liquid, such as the sludge and material which is encountered in the digestion of sewage. The dispersed solid material is drawn from the liquid and settles and accumulates in the bubble generator to block and disable the bubble generator and interrupt the circulation of liquid in the associated stack. It is accordingly necessary periodically to flush and clean the bubble generators in order to assure the proper functioning thereof. However, with the bubble generators heretofore available and proposed the cleaning and flushing operation is highly inefficient, time consuming and inconvenient, and requires an extended interruption in the operation of the respective circulating device, with a consequent reduction in the overall efficiency and capacity of the associated system.

SUMMARY OF THE INVENTION

It is a principal object of the present invention to provide an improved liquid-circulating device.

Another object of the present invention is to provide an improved liquid-circulating device of the bubble lift type.

Still another object of the present invention is to provide an improved large bubble generator highly useful in submerged stack bubble type of water lifts.

A further object of the present invention is to provide an improved large bubble generator which may be easily, rapidly and conveniently cleaned and flushed of accumulated sediment.

The above and other objects of the of the present invention become apparent from a reading of the following description taken in conjunction with the accompanying drawings which illustrate preferred embodiments thereof.

In a sense, the present invention contemplates the provision of a fluid circulating device comprising in combination with a radially extending conduit having an upper discharge opening and a lower inlet opening submerged in said fluid, means submerged in said fluid for cyclically generating and delivering bubbles to said conduit below the top thereof and including a gas-accumulating chamber having an opening in the upper part thereof, a tubular siphon member including a first radially extending leg connected at the upper part thereof to the chamber and a second upwardly extending leg having an upper bubble discharge opening, and an elbow section extending between the lower parts of said legs and positioned above the chamber opening, and means for pumping a gas into said chamber. According to an embodiment of the present invention the siphon member is substantially U-shaped, with one leg projecting above the accumulator chamber and terminating in a discharge opening, the other leg being connected to the upper part of the chamber by a horizontal feed pipe communicating with the chamber and in alignment with the lower leg. The feed pipe functions as a cleaning tool guide and a tool is pushed through the air delivery pipe. In accordance with another embodiment of the present invention,

the chamber and siphon are housed in a casing having openings registering with the chamber bottom opening and the siphon discharge opening. An open bottom pipe extends to a point adjacent to the bubble discharge opening and functions as the cleaning tool guide.

The improved bubble generator may be easily and rapidly cleaned by pushing and manipulating a cleaning or routing tool such as a suitably dimensioned router carrying snake or the like through the siphon by way of the tool guide. The cleaning operation can be effected with little or no interception on the operation of the circulating device.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevational view partially in section, of a liquid-circulating device embodying the present invention;

FIG. 2 is a sectional view taken along line 2-2 in FIG. 1;

FIG. 3 is an elevational view partially broken away, of another embodiment of the present invention;

FIG. 4 is a sectional view taken along line 4-4 in FIG. 3;

FIG. 5 is a sectional view taken along line 5-5 in FIG. 4;

FIG. 6 is a fragmentary elevational view of a further embodiment of the present invention;

FIG. 7 is a sectional view taken along line 7-7 in FIG. 6; and

FIG. 8 is an enlarged sectional view taken along line 8-8 in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and particularly FIGS. 1 and 2 thereof which illustrate a preferred embodiment of the present invention, reference numeral 10 generally designates the improved circulating device or pump which is submerged in a body of water 11, such as for example, a sewage digestion pond. The liquid-circulating device 10 includes an open ended vertical conduit or stack 12 of relatively large diameter coaxially mounted atop and communicating with a hollow open ended frustoconical support 13 resting on the bottom of the pond and provided with a plurality of inlet ports. A large bubble generator 14, constructed in accordance with the present invention, is coaxially positioned proximate the bottom opening of stack 12 so that bubbles produced thereby enter the bottom of stack 12 and rise therein.

Bubble generator 14 comprises a vertical cylindrical ballast body member 16 having a large coaxial bore formed therein which is open at its bottom and closed at its top to define a gas-accumulating chamber 17. A gas feed pipe 18, which also functions as a cleaning or routing tool guide, extends radially from the upper part of chamber 17 through ballast 16 and is connected by an associated pipe to a suitable gas pump. Access is provided at a part of pipe 18 remote from chamber 17 for the insertion of a flexible cleaning tool such as a snake or the like, for example by way of a separable coupling or an opening in the pipe closed by a separable plug or cap.

An inverted tubular siphon 19 is imbedded in ballast member 16 and includes a smoothly curved, preferably arcuate, bottom crossarm 20 positioned a short distance above the bottom of chamber 17 and transversely offset therefrom. A first leg 21 extends vertically upwardly from one side of crossarm 20 and communicates with the upper part of chamber 17 by a radially extending upwardly inwardly inclined tubular leg 22 joining vertical leg 21 by a curved elbow 23, leg 22 communicating with chamber 17 at a point diametrically opposing the point of entry of pipe 18. A second leg 24 extends vertically upwardly from the other side of crossarm 20 and projects vertically upwardly above the top of chamber 17 terminating in a top bubble discharge opening 26.

In operation, air is pumped into chamber 17 through pipe 18 to displace the liquid in chamber 17 and leg 21 until the air level therein drops below the upper part of the crossarm 20 at which time the accumulated air is rapidly siphoned through leg 24 and is discharged through opening 26 to form a large

bubble of a diameter approximately that of stack 12. The bubble separates from generator 14 and rises in stack 12 to raise the water therein, in the known manner. Bubbles are cyclically produced at a rate determined by the rate of air delivery.

In the event siphon 19 becomes blocked or clogged by solid materials from the ambient liquid settling and accumulating therein it may be rapidly and readily cleared by pushing a long flexible cleaning rod or tool through the remote end of pipe 18. The tool is advanced across the chamber 17 into the siphon leg 22 and along the full length of siphon 19 through discharge opening 26 to push the accumulated matter through siphon 19 and discharged opening 26. The tool may be reciprocated and manipulated in known manner to assure the complete cleaning of the siphon. The tool is then removed and the generator reactivated. It should be noted that if the tool is inserted into pipe 18 through a communicating restricted passageway which limits the escape of air, the flow of air to generator 14 need not be stopped during the cleaning operation.

In FIGS. 3 to 5 there is illustrated another form of improved bubble generator 27 which comprises a cylindrical casing 28 having a bottom wall 29 and a frustoconical top wall 30 open at the apex thereof. Eccentrically housed in casing 28 is a vertical cylindrical chamber 32 secured to bottom wall 29 and having an open bottom end registering with a coinciding opening in bottom wall 29. A smoothly curved inverted tubular siphon 33 is also housed in casing 28 and includes an arcuate bottom crossarm 34 located shortly above bottom wall 29 and connected by a vertically extending leg 36 to an upwardly inwardly inclined tubular arm 37 which terminates in an open topped vertical section projecting through the opening in top wall 30. The other end of crossarm 34 is connected to a vertically extending leg 38 which communicates with the upper part of chamber 32 by way of an upwardly inwardly curved leg 39 which joins chamber 32 in a horizontal radial direction. A tool guide functioning air pipe 40 projects through peripheral walls of casing 28 and chamber 32 at the upper part of the latter, the section of pipe 40 proximate the chamber 32 being opposite to and in diametric alignment with the upper end opening of siphon leg 39. Pipe 40 is connected to a source of compressed air in the manner of pipe 18 as set forth above.

The bubble generator 27 operates in the manner of bubble generator 14 and may be cleaned in the manner described above.

In FIGS. 6 to 8 of the drawings there is illustrated another form of bubble generator 41 differing from that last described principally in the air feed arrangement and the cleaning tool guide structure. Specifically, an open bottomed cylindrical chamber 42 with a top wall 43 is eccentrically housed in a cylindrical casing 44 having a centrally apertured frustoconical top wall 46 and a bottom wall with an opening registering with the open bottom of chamber 42. A smooth curved inverted tubular siphon 47 of the configuration of earlier described siphon 33 extends between the upper part of chamber 42 and the aperture in wall 46.

A vertical air feed pipe 48 communicates with chamber 42 through top wall 43 and projects upwardly through casing wall 46 to a suitable air pump. Secured to, as by welding, and extending along the length of pipe 48 is a tool guide pipe 49 having a bottom opening 50 shortly above and adjacent to top bubble discharge opening 51 of siphon 47. An inclined guide plate 52 underlies guide pipe opening 50 and is secured to and extends downwardly from the outer bottom edge of guide pipe 49 over the edge of and into siphon discharge opening 51.

Bubble generator 41 operates in the manner of bubble

generators 14 and 27, as described above. In the event siphon 47 becomes restricted or clogged, a flexible cleaning tool or router is pushed down tube 49 and is deflected by plate 52 into siphon discharge opening 51. The cleaning tool is suitably advanced and manipulated through the full length of siphon 47 to clean and push solid clogging material therein into chamber 42, the material dropping through the open bottom of chamber 42.

While there have been described and illustrated preferred embodiments of the present invention it is apparent that numerous alternations, omissions and additions may be made without departing from the spirit thereof.

What I claimed is:

1. A fluid-circulating device comprising, in combination with a vertically extending conduit having an upper discharge opening and a lower inlet opening submerged in said fluid, means submerged in said fluid for cyclically generating and delivering bubbles to said conduit below the top thereof and including a gas-accumulating chamber having an opening in the lower part thereof, a linearly extending tubular siphon member including a first upwardly extending tubular leg connected at the upper part thereof to said chamber and a second upwardly extending tubular leg horizontally spaced from said first leg and having an upper bubble discharge opening, and a curved tubular crossarm extending between the lower parts of said legs and positioned above said chamber opening, and means for pumping a gas into said chamber.
2. The fluid-circulating device of claim 1, including means for guiding a cleaning tool into said siphon tube.
3. The fluid-circulating device of claim 2, wherein the cleaning tool guiding means comprise the conduit for the movement of gas from the pump into the chamber.
4. The fluid-circulating device of claim 1, wherein said siphon member terminates respectively in an inlet opening communicating with said chamber and an outlet opening defining said bubble discharge opening respectively, and means for guiding a cleaning tool into at least one of said openings.
5. The fluid-circulating device of claim 4 said tool guiding means comprising a guide tube directed toward one of said siphon member openings from the outside thereof.
6. The fluid-circulating device of claim 4, including a horizontal extending tubular leg connecting the upper part of said siphon first leg with said chamber, said tool guide comprising a pipe aligned with said horizontal tubular leg and communicating with said chamber at a point opposing said horizontally extending leg and connected to said gas-pumping means.
7. The fluid-circulating device of claim 4 said guide means comprising a vertically extending guide tube having a bottom opening adjacent and transversely offset relative to said siphon discharge opening.
8. The fluid-circulating device of claim 1, including a casing of greater transverse dimensions than and housing said chamber and siphon member, said casing having a bottom opening registering with said chamber bottom opening and a top opening registering with said siphon discharge opening.
9. The fluid-circulating device of claim 8, wherein said casing is of cylindrical configuration, said chamber being transversely offset relative to the longitudinal axis of said casing, and said siphon discharge opening being coaxial with said casing.
10. The fluid-circulating device of claim 1 wherein said siphon discharge opening is at a level above the top of said chamber.