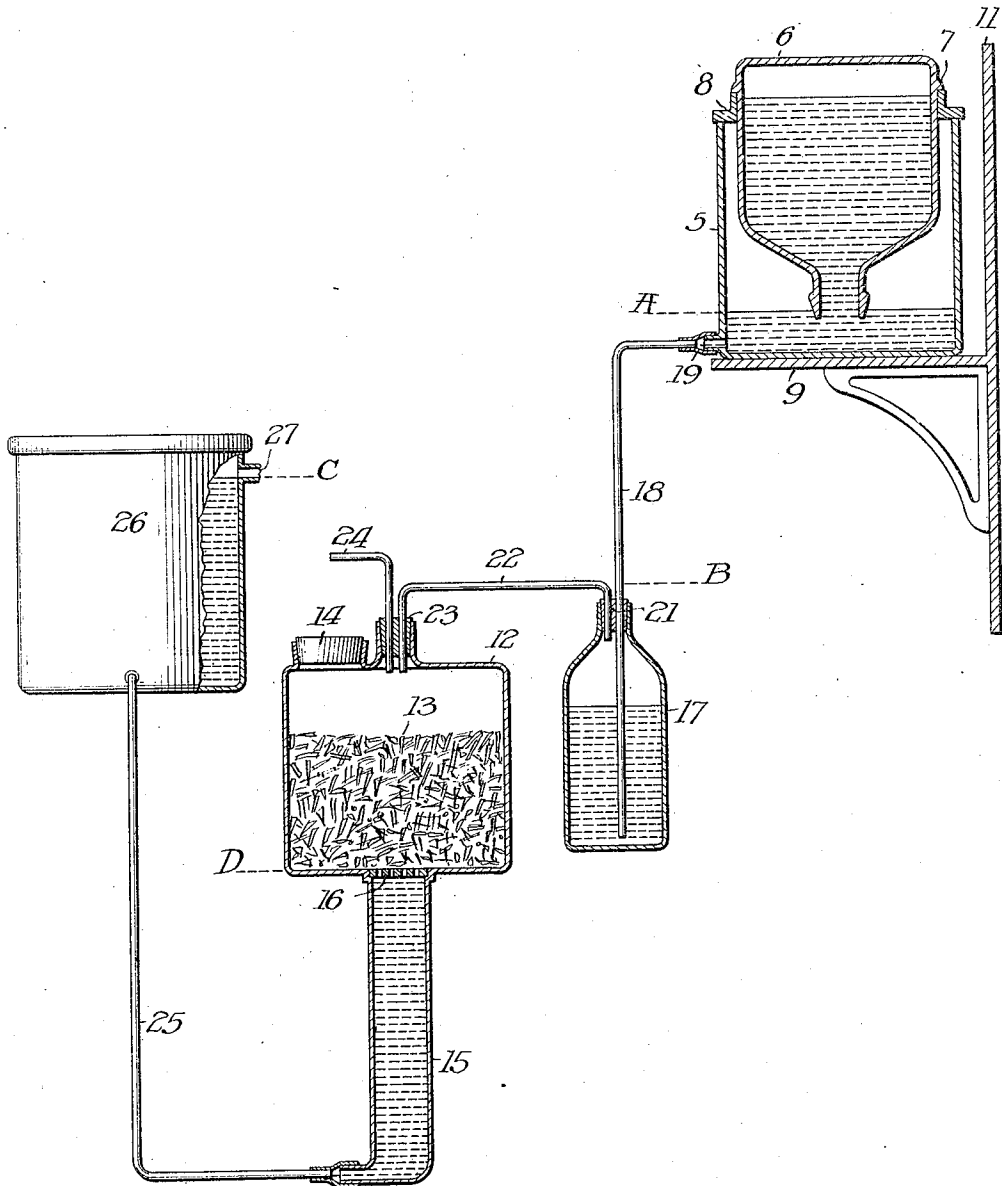


L. I. SHAW.
GAS GENERATOR.
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UNITED STATES PATENT OFFICE.

LEON I. SHAW, OF EVANSTON, ILLINOIS.

GAS-GENERATOR.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, LEON I. SHAW, a citizen of the United States, residing at Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas-Generators, of which the following is a specification.

This invention relates to gas generators, and more particularly to generators for supplying gases such as hydrogen, hydrogen sulfid or carbon dioxid in quantities for use in chemical laboratories and similar places.

One of the primary objects of my invention is the provision of a generator of this character which will generate either large or smaller quantities of gas as rapidly as the gas is used and which will be entirely automatic in its operation, that is, it will supply acid to the solid reagent with sufficient rapidity to generate gas as fast as it is required and will automatically shut off the flow of acid as the demand for gas diminishes or entirely ceases.

Another object of my invention is to provide a generator which will utilize the entire available strength of the acid used, the generator being designed for this purpose so as to subject the solid reagent to the action of the partially used acid so long as any of its available strength is retained and to admit fresh acid to the reagent only when the strength of the partially used acid has become so depleted that the gas generated thereby is not sufficient in quantity to meet the demands made upon the generator.

A further object of my invention is to provide a generator which will be simple in construction and cheap to manufacture, which will be economical in its use of both acid and solid reagent, which will require a minimum amount of care and attention, and which will be positive, efficient and reliable in operation.

Other objects and many of the attendant advantages of my invention will be readily appreciated by those skilled in the art as the same becomes better understood by reference to the following description when considered in connection with the accompanying set of drawings on which the single figure represents somewhat diagrammatically a side view partially in section of a generator embodying my invention.

Referring to the drawings, reference character 5 indicates a liquid container adapted to receive in inverted position an ordinary

commercial carboy 6 of acid. Any suitable means may be provided for supporting the carboy with its mouth disposed a predetermined distance above the bottom of the container 5, the carboy being shown in the present instance as provided with a circumferential bead or flange 7, which rests upon the surrounding edges of an opening formed in the cover 8. If preferred, the container 5 may be designed to receive a bottle or jar of any preferred construction which it may be desirable to use in place of the commercial carboy. I have shown in the present instance the container 5 as mounted upon a shelf or bracket 9 attached to a side wall or upright 11, but obviously, the container may be supported in any convenient position, the only requirement being that it be elevated the requisite distance above the other parts of the apparatus for a purpose which will be later explained.

At a suitable distance below the level of the container 5 there is supported by any suitable means (not shown) a receptacle 12 provided with an opening in its top through which the solid reagent 13 is introduced into the receptacle, a stopper 14 being employed to normally close this opening. The reagent is in the form of a granular solid, the character of which is, of course, dependent upon the gas to be produced by the generator, and, of course, the liquid supplied to the container 5 will also depend upon the gas desired and upon the solid reagent employed. It is sufficient to say in this connection that the generator is capable, by use of the proper reagents and acids, of producing hydrogen, carbon dioxid, hydrogen sulfid, or any other desired gas capable of being produced by the action of a liquid upon a solid reagent.

The bottom of the receptacle 12 is provided with a restricted column 15 made either integrally with the receptacle, as shown, or independently therefrom and suitably connected thereto, the solid reagent being prevented from entering the column 15 by the use of a perforated plate 16 made of acid-proof material, preferably similar in character to the receptacle 12 which may be made of acid-proof stoneware or other preferred material possessing the requisite characteristics.

Liquid is supplied from the container to the top of the receptacle 12 through a suitable connection which preferably includes a

closed jar or bottle 17 supported so that its top is substantially level with the top of the receptacle 12. From the lower end of the container 5 the liquid therein is conducted to the jar 17 through a tube 18, preferably of glass, attached at its upper end by a suitable joint to the container and passing through a perforated stopper 21 in the mouth of the jar 17 and terminating at its lower end near the bottom of the jar as shown. Another tube 22 comprising a horizontal portion and two downwardly turned ends has one of its ends inserted through the stopper 21 into communication with the interior of the jar 17 and its other end inserted through a stopper 23 in the mouth of the receptacle 12 so as to communicate with the interior of the receptacle. It will thus be obvious that the liquid from the container 5 is conducted through the tube 18, the jar 17 and the tube 22 into the receptacle, where it flows over and downwardly through the reagent contained in the receptacle. The gas generated in the receptacle is drawn off through a pipe 24 which may be extended to convey the gas to any desired location and which may be equipped with any desired number of supply cocks or faucets from which the gas is withdrawn.

The liquid which passes through the reagent and into the column 15 beneath the receptacle 12 is conducted by a suitable tube or pipe 25 to a closed receptacle 26, which I will refer to hereafter as a tank, provided near its upper end with an overflow pipe or opening 27 through which the used liquid overflows into any suitable receptacle (not shown) adapted to receive it. It should be observed at this point that the cross-sectional area of the column 15 is relatively small as compared with the cross-sectional area of the tank 26 and also that the cross-sectional area of the jar 17 is relatively small as compared with the cross-sectional area of the liquid container 5. It should also be noted that the various parts of the apparatus are so arranged and positioned that the vertical distance between the line A, indicating the level of the liquid in the container 5; and the line B, indicating the level of the cross-connecting portion of the tube 22, is considerably less than the vertical distance between the line C, indicating the overflow from the tank 26, and the line D, indicating the lower surface of the re-agent contained in the receptacle 12.

With the apparatus assembled as shown on the drawings and the various parts supported by any suitable means in substantially the relative vertical positions shown, the operation of my generator is substantially as follows: The acid or other desired liquid supplied to the container 5 assumes the level indicated by the line A which is determined

by the position of the mouth of the carboy 65 in the container and flows through the tube 18 into the jar 17, thence, when the jar is full, through the tube 22 into the receptacle 12. When the apparatus is initially started the liquid will flow on through the receptacle 70 into the column 15 up the pipe 25 and into the tank 26 until a hydrostatic balance has been established between the pressures of the liquid on opposite sides of the generator receptacle. In order, however, to save the acid 75 which would initially flow through the receptacle and to the tank, it is usually preferable to supply water to the tank 26 sufficient to partially fill the receptacle 12 before the acid is turned on thereby establishing a 80 hydrostatic head with the water without wasting the acid.

The action of the liquid upon the solid re-agent in the receptacle will cause a rapid generation of gas and if the gas delivery 85 pipe 24 is shut off the pressure of the accumulated gas in the receptacle will soon be sufficient to stop the flow of the liquid into the receptacle through the pipe 22 and if sufficient gas has been generated, the liquid will 90 be forced backwardly into the jar 17 and up the pipe 18 back into the container 5. The gas pressure, however, is never sufficient to force all of the liquid out of the jar 17 back into the tube 18, although in 95 many instances the liquid level in the jar 17 is forced downwardly a considerable distance in the jar by the pressure of the generated gas. At the same time the gas, generated in the receptacle will exert a like pressure upon 100 the liquid in the column 15 against the hydrostatic head exerted by the liquid in the tank 26, and if the gas pressure is sufficiently high the liquid will be forced from the column 15 through the pipe 25 into the tank 26 105 until the surplus will overflow through the pipe 27.

Shortly after the flow of liquid from the tube 22 into the receptacle is stopped the generation of the gas in the receptacle will 110 cease and a balance will be established in the apparatus in which the hydrostatic head of the liquid on the supply side of the generator receptacle will be equal to the hydrostatic head of the liquid on the overflow 115 side. The apparatus will then remain in this quiescent condition without generation of more gas until the gas pressure in the receptacle is relieved by drawing off some of the gas through the tube 24. As this 120 pressure decreases the liquid on both the supply and overflow sides of the generator will flow back toward the generator receptacle, but since the vertical distance between the line C—D is greater than the vertical 125 distance between the line A—B, as has been previously explained, it will be obvious that liquid from the column 15 will flow up-

wardly into the receptacle 12 in contact with the re-agent therein before fresh liquid will flow to the receptacle through the pipe 22.

5 For instance, let us assume that the vertical distance between the lines A and B is thirteen inches and the vertical distance between the lines C and D is nineteen inches. If the pressure generated in the receptacle is sufficient to force the liquid downwardly to the line D so that it does not contact with the re-agent the same pressure will have forced the liquid back in the tube 22 and downwardly in the jar 17 until the vertical distance between the level of the liquid in the jar 17 and the line A will also be nineteen inches, as shown on the drawings. If now the gas pressure is relieved in the receptacle by opening the delivery tube 24 the hydrostatic head on the overflow side of the generator receptacle will cause the liquid to rise from the column 15 into the receptacle 12. If the acid rising from the column 15 has any available strength left its contact with the re-agent 13 will cause an immediate generation of gas, thereby bringing up the gas pressure again in the receptacle. If, however, the previously used acid in the column 15 should be weak or entirely spent or if the demands for gas through the tube 24 should be large, the gas pressure in the generator receptacle gradually decreases until approximately three inches of the previously used acid is present in the bottom of the receptacle 12, whereupon fresh acid will be supplied through the tube 22. That this is true will be evident from the fact that when the hydrostatic head on the overflow side of the generator receptacle has been decreased from nineteen to thirteen inches the liquid will have risen approximately three inches in the receptacle 12 and will have dropped approximately three inches in the tank 26 below the overflow pipe. At this point the liquid level in the jar 17 will have risen to the line B, which also reduces the hydrostatic head on the supply side of the generator to thirteen inches, but when this point has been reached the fresh acid will flow through the tube 22 into the generator receptacle, where it will act upon the re-agent, causing a generation of gas which will increase the pressure within the receptacle. When the gas pressure is sufficient to overcome the thirteen inch hydrostatic head on the supply side of the generator the flow of fresh acid will cease and when the pressure has increased sufficiently to overcome the sixteen inch hydrostatic pressure on the overflow side of the generator no acid will be in contact with the re-agent and the generation of gas will entirely cease. The apparatus then remains quiescent until the

gas pressure is reduced by drawing off some of the gas through the pipe 24, whereupon the previously used liquid rises from the column 15 and, when its strength is not sufficient to maintain a gas pressure equivalent to a hydrostatic head of thirteen inches, fresh acid will be supplied from the container 5, thereby again bringing up the pressure in the generator receptacle.

It will be obvious from the foregoing that so long as there is sufficient strength in the previously used liquid in the column 15 to generate the gas demanded from the tube 24 no fresh liquid is permitted to enter the generator receptacle and it is only when the previously used liquid has become practically entirely spent that any fresh liquid is used. The apparatus is, therefore, extremely economical in its use of liquid and is able to utilize the entire available strength of the liquid at all times. Furthermore, the apparatus is extremely simple in construction, entirely automatic in its operation under all conditions of use, and it is not apt to get out of order or require attention or repairs.

I claim:

1. A gas generator comprising a liquid supply container, a reagent receptacle, a connection between the bottom of said container and the top of said receptacle, a tank provided with an overflow, and a connection between the bottom of said tank and the bottom of said receptacle, the vertical height between the point of discharge from the said receptacle and said overflow being greater than the vertical height between the point of entrance of the liquid into the receptacle and the liquid level in said container whereby partially used liquid is returned to said receptacle upon reduction of gas pressure therein prior to the admission of fresh liquid thereto from said container.

2. A gas generator comprising a liquid supply container, a reagent receptacle, a connection between the bottom of said container and the top of said receptacle including a closed jar connected at its upper end to said receptacle and at its lower end to said container, a tank provided with an overflow, and a connection between said tank and the bottom of said receptacle, the vertical distance between the bottom of the reagent in said receptacle and said overflow being greater than the vertical distance between the liquid level in said container and the connection between said jar and said receptacle.

3. A gas generator, comprising a liquid supply container, a re-agent receptacle, a tank provided with an overflow, means for supplying liquid from said container to said receptacle when the pressure in said receptacle falls below a predetermined amount, and means for conducting the used liquid

from said receptacle to said tank, and causing the return of the partially used liquid to the receptacle upon decrease of pressure therein prior to delivery of fresh liquid thereto from said container.

4. A gas generator, comprising a liquid container, a re-agent receptacle, an overflow tank, and means establishing connection between said receptacle and said container and said tank for delivering fresh liquid from said container to said receptacle when the pressure therein falls below a predetermined amount and for returning partially used liquid to said receptacle prior to the admission of fresh liquid thereto.

5. A gas generator, comprising a re-agent receptacle, means for returning partially used liquid to said receptacle when the pressure therein falls below a predetermined amount, and means for supplying fresh liquid to said receptacle upon a still greater predetermined reduction of pressure in said receptacle.

6. A gas generator comprising a re-agent receptacle, means for automatically admitting fresh liquid directly to said receptacle upon a predetermined reduction of pressure therein, and means for receiving liquid from said receptacle and for automatically returning said liquid to said receptacle prior to the admission of fresh liquid thereto.

7. A gas generator comprising a reagent

receptacle, a contracted downwardly extending column connected to the bottom of said receptacle, a perforated plate for preventing the reagent in said receptacle from entering said column, means for supplying fresh liquid to the top of said receptacle when the pressure therein decreases to a predetermined amount, and means for delivering partially used liquid from said column to said receptacle prior to the admission of fresh liquid thereto.

8. A gas generator comprising a receptacle adapted to contain a reagent, means for admitting fresh liquid to said reagent when the gas pressure in said receptacle falls below a predetermined amount, a chamber for receiving the used liquid from said receptacle, and means for returning said used liquid to the reagent in the receptacle upon reduction of pressure therein and prior to the admission of fresh liquid thereto.

9. A gas generator comprising a re-agent receptacle, means for automatically admitting fresh liquid to the top of said receptacle upon a predetermined reduction of pressure in the receptacle, and means for receiving liquid from the bottom of said receptacle and for automatically returning said received liquid to the receptacle prior to the admission of fresh liquid thereto.

LEON I. SHAW.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."