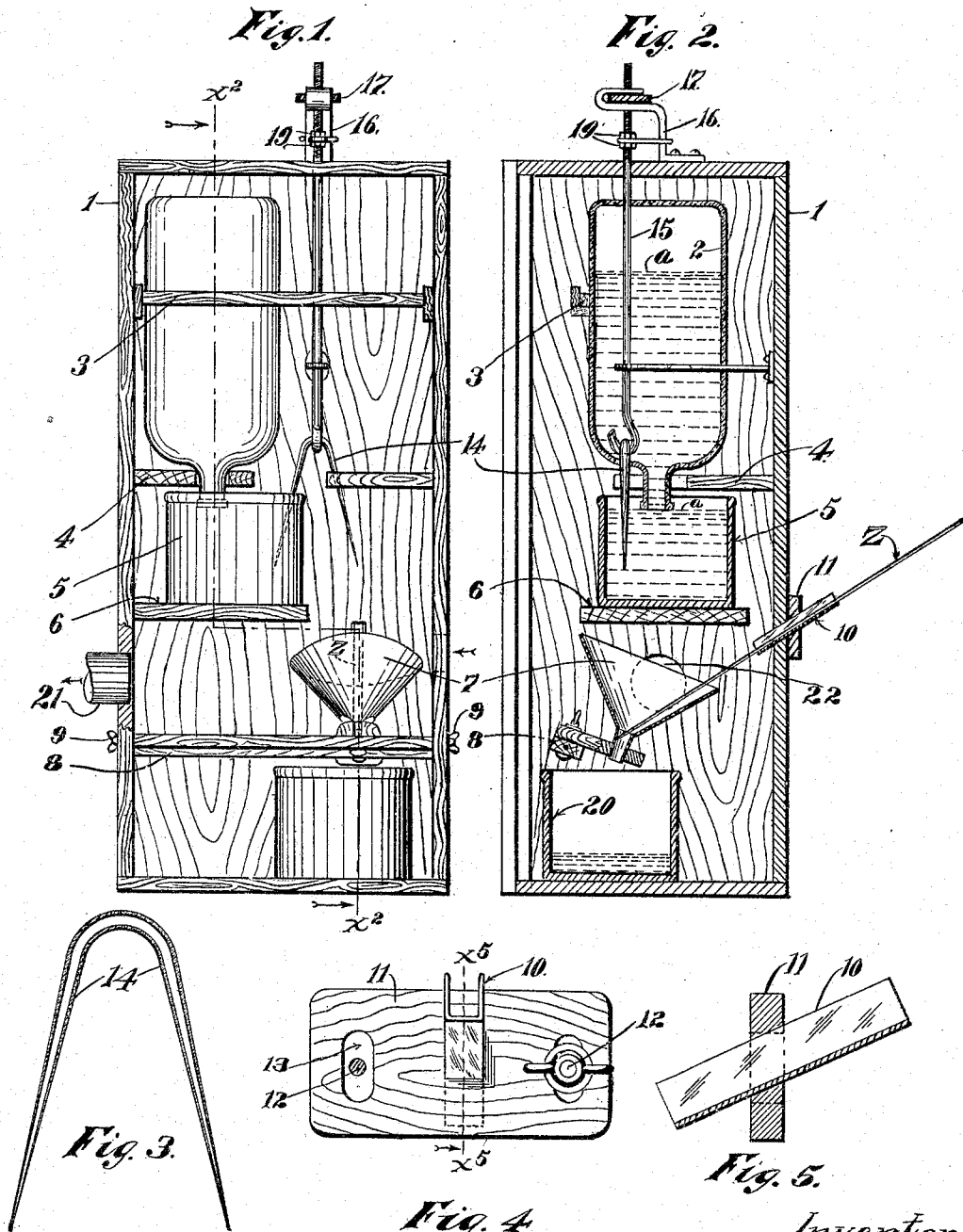


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GAS GENERATOR.

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947,323.

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Witnesses:
C. E. Hick
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Fig. 4

Fig. 5.

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UNITED STATES PATENT OFFICE.

CLARENCE E. BEEMAN, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO THE HYGENIC REFINER COMPANY, OF PRINCETON, MINNESOTA, A CORPORATION OF MINNESOTA.

GAS-GENERATOR.

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To all whom it may concern:

Be it known that I, CLARENCE E. BEEMAN, a citizen of the United States, residing at the city of Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Gas-Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention has for its object to provide an efficient gas generator, which will automatically regulate itself to generate any desired predetermined quantity of gas in any given unit of time, and, to this end, my invention consists of the novel devices and combinations of devices hereinafter described and defined in the claims.

The gas, which this apparatus was especially designed to produce, has the chemical formula N_2O and is known as hyponitrous anhydrid and is also sometimes called "laughing gas." This gas, as is well known, will be generated under the chemical reaction which is produced by dilute nitric acid on zinc.

The use of the gas, which this apparatus was especially designed to meet, is the bleaching of flour; but, of course, it will be understood that the gas generated may be applied to any use for which it is adapted.

The invention is illustrated in the accompanying drawings, wherein like characters refer to like parts throughout the several views.

In said drawings, Figure 1 is a vertical section through the apparatus, with some parts shown in elevation and others broken away; Fig. 2 is a vertical section at right angles to the plane of the section shown in Fig. 1 taken on the irregular line $x^2 x^2$ of Fig. 1; Fig. 3 is a detail, in section, showing the needle-pointed siphon detached; Fig. 4 is a detail showing the adjustable means for the zinc bar, or other base which coöperates with the acid to generate the desired gas; and Fig. 5 is a section on the line $x^5 x^5$ of Fig. 4.

The numeral 1 represents a suitable casing adapted to contain the different parts of the apparatus and to temporarily receive and hold the generated gas. As shown, this

casing is of rectangular oblong form and composed of wood.

The numeral 2 represents a supply reservoir adapted to hold a solution of nitric acid *a*. This may be composed of any material, which will withstand the action of the acid, but is made preferably of bottle-like form and supported upside down, or with the mouth of the bottle lowermost. As shown, the bottle is held in this position by suitable supporting guides 3 and 4 fixed to and projecting from the walls of the casing 1. These supporting guides 3 and 4 are of such form and so applied that the bottle 2 can be removed upward therefrom, whenever so desired, for refilling or other purposes.

The numeral 5 is a distributing holder shown as in the form of an open top porcelain jar resting on a bracket 6 fixed to one of the walls of the casing 1. The bottle 2 and the jar 5 are so related to each other that the mouth of the bottle projects downward a short distance below the top of the jar; and hence, it is possible to control the flowage of the acid solution *a* from the bottle 2 to the distributing jar 5 by the level of the acid in the jar. Otherwise stated, if the bottle 2 be filled with the acid and then applied upside down to the jar 5, as shown in the drawings, the acid will flow from the bottle until it reaches a level in the jar which will submerge and air-seal the mouth of the bottle; and, then, the flowage will stop; because the air can no longer enter to displace the liquid in the bottle. The jar 5 is of considerably less capacity than the reservoir 2.

Below the jar 5 and its supporting bracket 6, and to one side of the same, is located a funnel 7, which may be said to be the generating vessel. This funnel 7 is held by an angularly adjustable support 8, shown as in the form of a crossbar pivoted to the walls of the casing 1 and subject to clamping screws 9 for holding the same in any desired adjustment. The parts marked respectively 10 and 11 constitute an adjustable support for the strips of zinc *Z*, or other base, which chemically coöperates with the acid to produce the desired gas.

The part 10 is of trough-like shape and is held by the part 11 in such position that

the upper end of the trough 10 projects outward beyond the adjacent wall of the casing and the lower end of said trough projects downward and inward toward the funnel 7 on an incline in position to cooperate with the funnel 7 to hold the zinc strip with its lower end projecting against the far side of the funnel nozzle, with freedom for a gravity feed. The part 11 is secured to the casing in such a way as to be universally adjustable thereon. As shown, this is done by clamping screw bolts 12 seated in the casing and working through vertically elongated and laterally enlarged slots 13 in said part 11.

The numeral 14 represents a needle-pointed siphon composed of material which will withstand the action of the acid and which is preferably made of glass so that its ends may be drawn to fine needle points. This siphon 14 is hung from an adjustable support 15, with one of its legs projecting into the liquid in the distributing holder or jar 5 and the other leg depending outside the said jar in position to drop the acid onto the face of the strip of zinc Z within the funnel or generating vessel 7. The holder 15 is of hook-like form at its lower end, to permit the ready removal or application of the siphon, and is screw-threaded at its upper end. The upper or screw-threaded end of the rod 15 works through a hook-ended guide bracket 16 and is engaged by an adjusting nut 17 seated between the hook-forming walls of said bracket; and, hence, by turning the nut 17, the rod 15 and the siphon 14 carried thereby can be raised or lowered as desired. The bracket 16 is of rectangular form in cross section and is embraced by the hook-shaped outer end of a retaining arm 18 through which the screw-threaded portion of the rod 15 projects. This screw-threaded portion of the rod is fitted with a pair of clamping screws 19 located one on each of the opposite sides of the arm 18; and, hence, by tightening these nuts 19, the rod 15 can be securely locked in any desired vertical adjustment. This is of importance, because the siphon 14 will drop the liquid faster or slower according to the height at which it is suspended relative to the level of the liquid in the jar 5. Hence, this siphon adjustment must be nicely graduated and provision must be made for holding the rod 15 and the siphon carried thereby securely in the desired adjustment.

The siphon is, of course, primed or started in the customary way, to-wit, either by sucking the air therefrom or by first filling the same with water and then placing the same in working position without permitting the water to escape therefrom until so placed. Below the funnel 7 is located a jar 20, or other suitable receptacle adapted to catch

the waste from the funnel 7. The casing 1 is provided with a pipe 21 leading to a suction fan not shown; and, at some point, preferably most remote from the mouth of the pipe 21, the casing is also provided with an air inlet 22.

The liquid solution in the reservoir 2 and the distributing holder 5 is one-half commercial nitric acid and one-half water. The base for cooperation with this acid solution to produce N_2O is pure zinc or such as found on the market as pure zinc. It is preferably handled in the form of bars or strips Z, which can be held by the supporting parts 10 and 11 and the funnel 7 as hitherto described, with freedom for a gravity feed.

Assuming that the parts are arranged as shown and described and the parts 2 and 5 to be loaded with the acid solution, then the action is as follows: The needle-pointed siphon 14 will withdraw the acid solution from the distributing holder 5 and drop the same onto the face of the zinc strip Z within the funnel 7. The instant that a drop of acid strikes the zinc, the chemical reaction takes place and the gas N_2O is generated. As this gas is generated, it will be drawn off, together with more or less air, through the pipe 21, under the action of the suction fan not shown. The air does not supply any elements for the required chemical reaction, but serves to keep down the heat at the point of generation and to dilute the gas which is generated and drawn off through the fan and delivered to the point desired for use. As soon as the siphon has lowered the level of the acid solution in the jar 5 far enough to unseal the mouth of the bottle or supply reservoir 2, air will be admitted to the bottle and will displace enough of the liquid, under the action of gravity, to again restore the sealing level of the liquid in the jar 5. This, of course, will take place intermittently, so as thereby to keep the liquid level in the jar 5 substantially constant, or within a minimum range of variation. Hence, by properly adjusting and setting the rod 15 and the siphon 14 carried thereby, the latter may be made to deliver onto the zinc bar Z any desired number of drops per second or other unit of time. It follows that any desired quantity of gas can be generated in any given unit of time. The parts are preferably so arranged that the acid drops from the siphon onto the very lower end of the zinc bar Z; and, hence, that under the generating action, the zinc will be consumed or eaten away from the lower end of the strip; and, in view of the angular position in which the strip is held, by its supporting guide trough 10 and the funnel 7, it will feed down by gravity as rapidly as its lower end is consumed. It is to secure this nicety in the feed of the acid to the zinc that the siphon

is made adjustable and it is to secure this nicety in the feed of the zinc strip, under the action of gravity, that the funnel 7 and the trough 10 are both made adjustable as described. This reliability and uniformity in the generating action per unit of time, particularly well adapts this generator for generating and supplying this gas in the way most desirable for use in bleaching flour or other similar material. When applied to this use, the gas, diluted with more or less air, is forced into a suitable mixer into which the flour is fed and wherein it is agitated.

It is worthy of special notice that, in as much as the acid solution is brought drop at a time into contact with an abundance of zinc, the maximum generation is secured from the acid. The waste which reaches the catch vessel 20 from the funnel 7 is entirely destitute of acid and is only a fraction of the solution which is passed by the siphon.

While this apparatus is especially well adapted for use in generating the above identified gas N_2O , it must be obvious that it could be employed to generate other kinds of gas capable of being produced by the dropping of an acid onto a base which will chemically cooperate with the acid employed to generate the gas desired. It will also be understood that the structure and arrangement of the different parts could be widely varied without departing from the spirit of the invention. The practicability of this invention has been demonstrated by the extensive commercial use thereof to generate N_2O , applied to bleach flour. All statements of fact herein made are based upon this commercial usage.

This application discloses and claims a more highly developed form of the invention disclosed in my caveat filed May 12, 1908, entitled "Machine for dropping liquids."

What I claim is:

1. In a gas generator, the combination with an acid supply reservoir and a holder for the base which cooperates with the acid to generate the desired gas, of an intermediate automatic acid distributor comprising a holder intermittently communicating with said supply reservoir through a passage controlled by the acid level in said holder and a siphon operative to withdraw the acid from said holder and to drop the same onto said base, substantially as described.

2. In a gas generator, the combination with holders for the acid and the base cooperating to generate the desired gas, of a dropper arranged to deliver the acid from said holder onto said base, with the holder for said base arranged to afford a gravity feed thereof into position to receive and be consumed by the drops of acid, substantially as described.

3. In a gas generator, the combination with holders for the acid and the base cooperating therewith to generate the desired gas, of a dropper arranged to deliver the acid from the acid holder onto said base, with the holder for said base arranged to afford a gravity feed thereof and made adjustable to vary the rate of this gravity feed as desired.

4. In a gas generator, the combination with holders for the acid and the base cooperating therewith to generate the desired gas, of a needle-pointed siphon operative to withdraw the acid from its distributing holder and to drop the same onto said base, with the siphon adjustably supported to vary the acid feed and the support for said base arranged to afford a gravity feed and adjustably to vary this feed, substantially as described.

5. In a gas generator, the combination with a suitable casing, of an acid supply reservoir therein, a support below said reservoir adapted to hold the base which is to cooperate with the acid to generate the desired gas, a distributing acid holder directly below said reservoir and intermittently communicating therewith through a passage controlled by the acid level in said holder, a siphon operative to withdraw the acid from said distributing holder and drop the same onto said base and a waste catcher below the said base holder adapted to receive the waste material therefrom, substantially as described.

6. A generator adapted to produce oxids of nitrogen, which generator comprises a suitable casing, an inverted bottle-like supply reservoir containing a diluted solution of nitric acid, a distributing acid holder directly below said reservoir with said parts so arranged that the flow of the acid from the reservoir to the holder will be intermittent under the control of the liquid level in said holder, supports for holding a strip of zinc in generating position under a gravity feed and a needle-pointed siphon adapted to withdraw the acid from said distributing holder and to drop the same onto the lower end of the strip of zinc, substantially as described.

7. A generator adapted to produce oxids of nitrogen, which generator comprises a suitable casing, an inverted bottle-like supply reservoir for containing dilute nitric acid, a distributing acid holder directly below said reservoir with said parts so arranged that the flow of the acid from the reservoir to the holder will be intermittent, under the control of the liquid level in said holder, adjustable supports for holding a strip of zinc in generating position with freedom for a gravity feed of said strip, and an adjustable siphon adapted to withdraw the acid from said distributing holder and

to drop the same onto the lower end of said strip of zinc, an air inlet and air and gas outlet for said casing, substantially as described.

5 8. The combination with a suitable casing 1, of the inverted bottle 2 removably supported within the said casing adapted to contain dilute nitric acid, the distributing holder 5 supported directly below the said 10 bottle, with the mouth of the bottle projecting into the casing, for controlling the flow from the bottle to the holder by the acid level in the latter, the angularly adjustable funnel 7 below said holder and the uni- 15 versally adjustable support 10 for the zinc strip cooperating with said funnel to hold the strip with freedom for a gravity feed, the adjustable rod 15, the needle-pointed siphon 14 removably and adjustably sup- 20 ported by said rod 15 with one leg thereof within the holder 5 and the other in position to drop the acid onto the zinc strip in the funnel 7 and the waste catcher 20 receiving from said funnel, all substantially as de- 25 scribed.

9. A gas generator comprising a closed chamber, an acid holder therein, a siphon for delivering said acid onto a substance for producing gas by reaction, an air inlet to

said closed chamber, and an exit pipe 30 through which said air charged with the evolved gas passes from the chamber.

10. A gas generator comprising a closed chamber, an acid holder therein, a siphon adapted to be raised and lowered in said 35 acid holder to change the rate of delivery of said acid, a support for holding a decomposable substance on which the acid drops to generate a gas, an air inlet pipe, and an exit pipe for the mixed air and gas. 40

11. A gas generator comprising a closed chamber, an acid holder therein, a removable acid reservoir opening into said acid holder, a waste container, a support for a 45 decomposable substance leading to said container, an adjustable siphon for delivering acid at a predetermined rate onto said decomposable substance to generate a gas, an air inlet pipe leading into, and an exit pipe 50 leading from said chamber to carry off the mixed air and gas.

In testimony whereof I affix my signature in presence of two witnesses.

CLARENCE E. BEEMAN.

Witnesses:

JAS. F. WILLIAMSON,
JAY W. CRANE.