

UNITED STATES PATENT OFFICE.

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ACETYLENE-GAS GENERATOR.

SPECIFICATION forming part of Letters Patent No. 635,086, dated October 17, 1899.

Application filed August 8, 1898. Serial No. 688,109. (No model.)

To all whom it may concern:

Be it known that I, FRANK S. WOOD, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Acetylene-Gas Machine, of which the following is a full, clear, and exact description.

My invention relates to means whereby the generation of this gas is more perfectly controlled than heretofore, such control being had by the operation of the pressure of the generated gas upon two water-levels which coöperate in producing the desired result. In devices hitherto operating upon this principle certain undesirable results are obtained, differing in accordance as the water drops upon the carbid of calcium from above or comes in contact therewith from below. To clearly explain this, I would refer to a displacement-holder of well-known form in which the water drips into a generator containing carbid in such a manner that the water falls upon the carbid. Here the design is that when a specified pressure is reached such pressure automatically shuts off the water, and therefore discontinues the generation of gas; but in practice I have found that after a small quantity of gas has been generated a layer of slaked lime forms over the surface of the carbid, and thereby materially delays the access of the water to the same. On this account, even though the pressure does in due time shut off the water-supply, yet before this action can occur a surplusage of water has dripped into the generator and soaked into the slaked lime. Consequently, although the higher pressure has shut off the inflow of further water it cannot prevent the water thus held by the lime from penetrating to the untouched carbid and continuing the generation of gas. This results in an overproduction of the gas and a consequent vexatious variation in the pressure and at times a waste of gas, followed by an underpressure of the same. To overcome these defects in machines designed for practical purposes, separate regulators are required or a bell-gasometer provided to accommodate the overproduction, thereby entailing considerable additional ex-

pense. Further, inasmuch as the underwriters' regulations do not permit of a pressure exceeding the weight of a column of water six and seven-eighths inches in height any excess of gas generated must be allowed to pass off and be wasted. Another defect in this class of machines is that after a layer of slaked lime has formed upon a quantity of carbid and the generation discontinued for some little time whenever the burners are lighted up the volume of gas remaining in the holder is consumed more rapidly than the lime-coated carbid can be made to generate it, and consequently the pressure falls rapidly to a point where the lights are either extinguished or burn very dim. Following this will come an overproduction of the gas for reasons hereinbefore given and a necessary waste thereof. So, also, in that class of generators in which the carbid falls into the water this same irregularity and overproduction of gas constantly occurs.

To entirely prevent such overproduction and irregularity of pressure and to construct a generator which shall supply the burners with gas at a fairly-constant pressure and without the necessity of a distinct gas-regulator is the object of this present invention. While overcoming these defects, I have also succeeded in devising a generator markedly convenient in recharging, one which reduces to a minimum the odor arising from such recharging, which generates the gas in the safest way and with the least possible heating, which utilizes every particle of the carbid and causes no waste of material, and, finally, which can be so combined with a displacement-holder of substantially the usual type as to deliver gas to the latest-model acetylene-burner at the proper pressure—viz., two and one-half inches—to produce the best results.

My invention is illustrated in the drawing forming part of this specification, in which the figure is a vertical section of the generator and of the displacement-holder connected thereto.

Referring to the drawing, A indicates the gas-generator, divided by means of an inverted conical partition into two chambers. The up-

per of said chambers is provided with a tightly-fitting cover a' , kept strongly closed by the yoke B and screw b . Within this upper chamber and supported by the inwardly-depressed or conical partition a are the lumps or fragments V of the carbid of calcium. The inverted apex of said partition a is more or less truncated and said truncation closed against the passage of the carbid by means of a netting or lattice a^2 . The lower chamber of this generator A is designed to contain water W, the level of which is adapted, by means hereinafter to be described, to normally reach said netting a^2 when the generator is working. The water thus being in contact with a portion of the carbid begins at once its disintegrating action thereon, the calcium monoxid thus formed crumbling away and falling to the bottom of the lower chamber, while the acetylene gas generated thereby arises through the carbid and passes to the source of illumination or to the displacement-holder through the pipe h . To retain the water W at such working level and to cause it to sink below such level and out of reach of the carbid when an excess of gas is being generated is the object of the following devices.

In the generation of gas each molecule of water acting upon the carbid unites with the latter to form one molecule of the acetylene gas and one molecule of calcium monoxid. The latter being precipitated to the bottom of the lower chamber of the generator displaces more water than is removed therefrom by such chemical action. Consequently the level of the water W tends to slowly rise and attack a larger quantity of the carbid. This on its part causes an increased generation of gas above the normal quantity used, and hence produces an increased pressure in the generator. To enable this increased pressure to automatically lower the level of said water to the proper point, I provide the generator with the inverted siphon-tube e , the inner end of which is placed at the normal water-level, while the outer end terminates in the reservoir or equilibration-chamber e'' , the floor of which is very nearly one and a quarter inches above said normal water-level. If now under such elevation of the water-level the back pressure of the gas is increased, the water is at once forced through the tube e up into the reservoir or equilibration-chamber e'' . Said chamber being of considerable size, the quantity of water thus received by it is ordinarily sufficient to sink the water in the generator back to its normal level. Should this not be enough and the pressure continue to increase, a portion of the contents of the equilibration-chamber will escape through the outlet e^4 . Now as the acetylene is used and the pressure diminishes the water returns from the equilibration-chamber until sufficient carbid is reached to produce the required supply. In this way the water oscillates back and forth between the generator and equilibration-chamber in ac-

cordance with the variations in the gas-pressure, and thereby maintains a wonderfully even production of the illuminant. In order to further increase the delicacy of this governing device, I usually perforate the walls of the inner end of the tube e for a distance of about one-half inch below said end e' , the letter of reference e^3 indicating said perforations. In case said overflow or equilibration chamber should not for any unforeseen reason prove capable of disposing of the rising water and of the consequent increasing gas-pressure I provide the generator with the water-seal exhaust-pipe f . Through this the water will be forced until its level sinks below the inner end of such pipe, when the water will then be expelled from the inner arm of said pipe and the gas escape up through the contents of the outer arm.

When recharging this generator, I remove the cover a' by first turning the screw b , by means of which the former is normally held air-tight in place, and place therein the required amount of carbid. The discharge-valve C is opened to permit the removal of the accumulated precipitate T, the generator being mounted upon legs d to allow of the introduction of a suitable receptacle beneath the same. The cover a' is then replaced and fastened down, the valve g' of the water-pipe g opened to refill the generator up to the proper level, and the valve h' opened to permit the gas now being generated to pass on again to the burners or to the displacement-holder K, said valves having been closed prior to the recharging.

When my generator is used with a displacement-holder, the pipe h communicates with the gas-storage chamber K^2 thereof and the water-pipe g leads from the same at a point slightly below what will be the level of the water in the chamber K^2 when there is no pressure of gas therein and very nearly upon the level to which the water will be depressed when the pressure of gas therein has reached its normal degree.

At first sight it might seem that since the vertical distance between the water-level in the generating-chamber A is less than the height of the partition k above the pipe g more pressure will be required in the chamber K^2 to force the water therefrom up through the tube l into the chamber K' than would serve to force the water in the tube e entirely out up into the equilibration-chamber e'' ; but as the pressure must of necessity be equal in the chamber K^2 and the generator it would therefore seem that the water in the tube e must be forced therefrom and the gas escape from the generator through the same before the pressure in K^2 will raise the water up into the pressure-chamber K' . In justice to such possible objector it should be explained that the drawing is not drawn accurately to scale and that it is possible that as represented the distance from the pipe g to the partition k is slightly larger in proportion than the dimen-

sions illustrated for the generator and the equilibration-chamber; but considering the drawing as perfectly accurate the above-re-cited fear of the gas blowing out through the tube *e* will be at once removed when we more carefully consider the distance to which the bend of the siphon-tube *e* reaches below its mouth. For instance, suppose the gas-pressure in the generator should be suddenly increased to such a point as to force the water in the inner branch of the tube *e* down nearly to the bend. The vertical distance from this level to the surface of the water in the equilibration-chamber *e''* is still far more than the distance of the partition *k* above the water-level in the chamber *K*². Hence the water in the said chamber *K*² will have been forced up into the pressure-chamber *K'* long before the gas can possibly blow out through the tube *e*. It should be further remembered that the valve *g'* is kept almost closed and can, in fact, be actually closed most of the time for the reason that the volume of the water which unites with the carbid to form gas is far less than the volume of the slaked lime *T* precipitated into the lower part of the generator. Hence the usual tendency is for the water-level to rise in the generator and for such excess to be discharged from the equilibration-chamber through the outlet *e*⁴. Should, however, through any sudden overproduction of gas a considerable amount of water be expelled from the generator through the outlet *e*⁴, then this loss is to be made good from the contents of the chamber *K*² passing through the pipe *g*. If the apparatus is looked after by an attendant, then the valve *g'* may be normally closed and only opened for such special need; but as I design the generator to be automatic in its work the valve *g'* is left slightly open, just enough to admit the passage of the smallest amount of water found necessary—in practice but a few drops per second—for as a matter of fact the generation of gas in my apparatus is so steady and uniform that the additional water is seldom needed.

As is usually the case, the pressure-chamber *K'* is separated from the storage-chamber *K*² by an air-tight diaphragm *k*, entirely separated therefrom except through the tube *l*, the lower end of which reaches nearly to the bottom of the water *W'*. As the pressure increases in the chamber *K*² through the effect of the water dripping from the pipe *g* into the generator, and by thus raising the level of the water *W* into increased contact with the carbid and so causing greater production of the gas, the water *W* is forced through the tube *l* up into the pressure-chamber *K'*. If now the pressure continues to increase, the water-level soon sinks in the holder *K* below the mouth of the pipe *g* and discontinues the supply to the generator.

The displacement holder or cistern *K* is usually supplied with the water-gage *n* and water-seal waste-pipe *m*, while the gas is supplied to the burners through the pipe *o*.

When my generator is used with this holder, I usually dispense with the water-seal exhaust-pipe *f*, the said pipe *m* making sure of the other's being unnecessary.

Although it would appear that the operation of the displacement-holder rendered unnecessary the governing action of the equilibration-chamber *e''*, it will be readily seen that the former is so slow in action, owing to the comparative sluggishness of the water in being forced from the compartment or storage chamber *K*² up into the pressure-chamber *K'* that considerable variations in pressure must ensue. With the generator-governor or equilibration-chamber *e''*, however, the slightest variations in pressure are instantly controlled. Since the falling of but a tenth of an inch in the water-level in the generator is enough to drop the water out of contact with the carbid and to discontinue the generation of gas, and, further, since the slightest increase in pressure is enough to thus expel such small quantity of water from the generator to the chamber *e''*, the great utility and value of my governor are fully apparent even when the generator is used in conjunction with the holder.

When it is remembered that a single burner requires but one-half of a cubic foot of gas per hour and that but one and one-half cubic inches of water are required during that time for the generation of such volume of gas, it is obvious that an exceedingly sensitive machine is necessary in order to give anything like a satisfactorily steady supply of gas. This I confidently claim is the result obtained by my invention.

One other feature which I omitted to describe above is the petcock *p*. This has a double function. First, it serves to indicate the proper water-level in the generator and then when the gas is being generated immediately following the generator's charging or recharging said petcock is opened to permit the air to escape from beneath the partition *a*. Since the air is heavier than the gas being generated, such escape-point should be at the lowest possible level, which level is at the water's surface.

What I claim as my invention, and for which I desire Letters Patent, is as follows, to wit:

1. The combination in an acetylene-gas generator, of a chamber adapted to contain water, means for supporting carbid immediately above the normal level of the water in said chamber, and an equilibration-chamber having its floor located just above said normal water-level, said equilibration-chamber having free communication with the atmosphere and having a water-passage leading thereto from said generator-chamber at a point slightly below said normal water-level, thence downward and then upward to said equilibration-chamber, substantially as and for the purpose set forth.

2. The combination in an acetylene-gas

generator, of a water-chamber, means for supporting carbide immediately above the level of such water, an overflow or equilibration chamber located exterior to said water-chamber and close above the water-level thereof, and the inverted siphon-tube joining the bottom of said overflow-chamber with the interior of said water-chamber and having its inner end near the normal water-level of the latter.

3. In a machine for generating acetylene gas, the combination of the displacement-holder of the usual type, the generator adapted to contain water, means for supporting carbide immediately above the surface of such water, means for conveying the gas from said generator to the storage-chamber of said holder, means for conveying limited quantities of water from a point in said holder near its normal water-level, to said generator at a point above its water-level, the overflow or equilibration chamber located exterior to said generator and slightly above the normal level of its contained water, and

a conduit intermediately depressed and communicating with said equilibration-chamber and with said generator at a point near its said water-level.

4. An acetylene-gas generator comprising a water-chamber, a pendent support for carbide provided with a latticed or netted opening at the normal level of the water, and means for permitting immediate depression of such water-level under sudden increase in gas-pressure, said means consisting of an overflow or equilibration chamber located exterior to said water-chamber, and an inverted siphon-tube joining the same, whereby the operation of the generator is automatically controlled through the fluctuations in the water-level thereof.

In testimony that I claim the foregoing invention I have hereunto set my hand this 5th day of August, 1898.

FRANK S. WOOD.

Witnesses:

F. E. CALLER,
A. B. UPHAM.