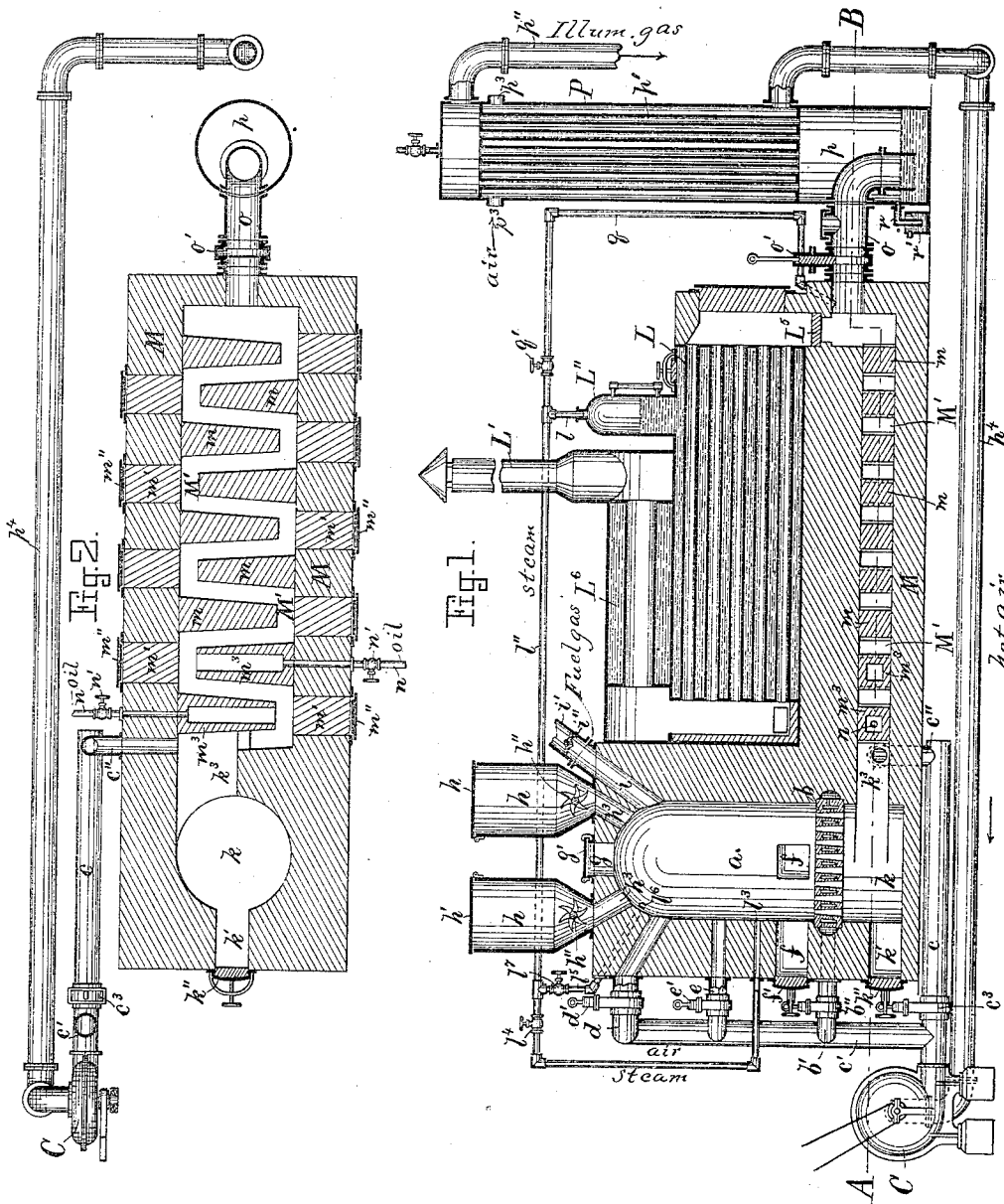


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APPARATUS FOR THE MANUFACTURE OF ILLUMINATING AND HEATING GAS.

No. 338,989.

Patented Mar. 30, 1886.



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# UNITED STATES PATENT OFFICE.

BURDETT LOOMIS, OF HARTFORD, CONNECTICUT.

APPARATUS FOR THE MANUFACTURE OF ILLUMINATING AND HEATING GAS.

SPECIFICATION forming part of Letters Patent No. 338,989, dated March 30, 1886.

Application filed February 2, 1885. Serial No. 154,666. (No model.)

*To all whom it may concern:*

Be it known that I, BURDETT LOOMIS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Apparatus for the Manufacture of Illuminating and Heating Gas; and I do hereby declare that the same are fully described in the following specification and illustrated in the accompanying drawings.

This invention relates to apparatus for manufacturing illuminating and heating gas; and the improvements are applied to that class of gas-generators known as "cupola gas-generating furnaces," with connected superheating and fixing chamber.

My invention includes novelties in the construction of the generating-cupola with connecting steam and air-blast pipes; novel features of construction in the superheating and fixing chamber for vaporizing hydrocarbons and for facilitating the operation of cleaning soot and ashes from such chamber; also, a novel arrangement of an auxiliary heating-furnace in connection with the steam-boiler and a superheater or fixing-chamber and suitable valves or dampers controlling the passages connecting such parts; also, certain combinations of parts, as particularly described in the claims.

The object of the invention is to simplify the construction of the apparatus, to secure improved results in the combustion of the fuel, to provide for keeping the fuel-chamber clear of clinker and ashes, to keep the ash-pit hot and thus prevent condensation of steam therein, to provide for readily cleaning the fixing or superheating chamber, and to provide improved means for heating the steam-generator, all of which are more fully explained in connection with the accompanying drawings, in which—

Figure 1 represents a longitudinal vertical section of the improved apparatus. Fig. 2 represents a horizontal section of the same on the line A B, Fig. 1. Fig. 3 represents a vertical longitudinal section of the apparatus in modified form.

Similar letters refer to like parts in the several figures of the drawings.

The generating-cupola *a* is constructed of

brick, with a lining of fire-brick, and may be provided with a tight external iron jacket. It has hollow perforated grate-bars *b*, which separate the fuel-chamber from the ash-pit *k*. A passage, *k'*, serves for the removal of ashes and clinker from the ash-pit, and is provided with a tight-fitting lid, *k''*. A branch air-blast pipe, *b'*, having valve *b''*, connects with the hollow perforated grate, and other branch pipes, *e*, having valve *e'*, and *d*, having valve *d'*, connect, respectively, with the side and upper portion of the generating-chamber, and these branch pipes connect with the vertical blast-pipe *c'*, connecting at the lower end with pipe *c*, leading from the blower C. A branch pipe, *c''*, connects pipe *c* with passage *k''*, leading from the ash-pit into the fixing and superheating chamber M, commonly called the "regenerator." Pipe *c* is provided with controlling-valve *c'*. Hot air is supplied to the blower, as hereinafter more fully explained. Just above the grate-bars openings *f f* are formed in the wall, and are closed externally with tight-fitting lids *f'*. A fuel-opening, *g*, having a tight-fitting lid, *g'*, is provided in the top of the generator. Through this opening the fuel may be stoked, and clinker which may adhere to the side walls be removed by suitable bars. Fuel-hoppers *h h* connect by means of passages *h'' h'''* with the interior of the furnace, and such hoppers are provided with rotary stirrers *h'' h'''*, located at their lower contracted ends, and with tight-fitting removable covers *h'* at the top.

The take-off pipe *i'*, having valve *i''*, for fuel-gas, connects by means of passage *i* with the upper part of the generator. A branch steam-supply pipe, *l'*, having valve *l''*, connects by passage *l'* with the top of the furnace, and another branch steam-pipe connects by passage *l''* with the generating and fuel chamber for a short distance above the grate. The branch steam-pipes connect with pipe *l''*, which is connected by pipe *l* with the steam-dome *L''* of steam-boiler L. A valve, *l'*, in pipe *l''*, controls the flow of steam through passage *l'*.

The regenerator M, which serves as a superheater for steam and as a fixing-chamber for carbureted water-gas is built of brick, and as a continuation of the walls of the generator *a*, being preferably connected with the base of the generator through the medium of the

ash-pit and passage  $k^3$ , as shown in Figs. 1 and 2. It extends horizontally from the ash-pit, and is provided with a series of check-walls,  $m$   $m$ , projecting alternately from the opposite side walls nearly across the chamber and forming a tortuous passage,  $M'$ , through which the gases are passed and brought into intimate contact with the heated check-walls, and thereby fixed. Opposite to the apex of each check-wall  $m$  is an opening in the wall of the regenerator, which opening is ordinarily closed by loose bricks  $m'$  and a tight-fitting cover,  $m''$ , on the outside of the wall, as shown in Fig. 2, by which arrangement the regenerator is made easy of access and can readily be cleaned and repaired, without letting down the heat, simply by removing the covers  $m''$  and bricks  $m'$  and introducing a suitable scraper-tool through the openings. One or more of the check-walls nearest to the ash-pit  $k$  are made in the form of hollow retorts  $m^3$   $m^3$ , closed at the outer ends and open at the apex, as shown in Fig. 2. Oil-supply pipes  $n$ , having valves  $n'$ , connect with the outer ends of these retorts for the injection of hydrocarbon oil to carburet the water-gas during the manufacture of illuminating-gas. The take-off pipe  $O$ , for illuminating-gas, connects the rear or farther end of the fixing-chamber with the seal-chamber  $p$  at the base of cooler  $P$ , and the bent end of pipe  $O$  dips down into the sealing liquid. An overflow-pipe,  $r$ , conducts surplus liquid into the trap  $r'$ . Chamber  $P$  serves as a cooler for gas and a heater for air which is supplied to the generator. It is constructed of a series of tubes,  $p'$ , extending between tube-sheets at opposite ends for the passage of gas, and has at the top the outlet gas-pipe  $p''$ . Inlet air-pipes  $p^3$  connect just below the upper tube-sheet, admitting air to chamber  $P$  around the tubes, and outlet air-pipe  $B$  leads from the lower portion of the air-heating chamber to pipe  $p^1$ , which connects with the blower  $C$ . A valve,  $O'$ , in pipe  $O$  controls the flow of gas to the cooler, and valve or damper  $L^5$  in the passage between regenerator  $M$  and steam-boiler  $L$  controls the flow of products of combustion from the former to the latter. The steam-boiler is tubular, and may be placed horizontally, as in Fig. 1, or vertically, as in Fig. 3. It has a steam-dome,  $L''$ , from which extends pipe  $l$ , supplying the pipes leading into the furnace, as hereinbefore described, also supplying pipe  $q$ , having valve  $q'$ , leading into the rear end of regenerator  $M$ . A feed-water heater,  $L^6$ , is placed above the boiler, and from it extends the smoke-stack  $L$ .

In the modification shown in Fig. 3 I have arranged the check-walls  $m$   $m$  in two sets, one above the other instead of in one horizontal direction, as shown in Figs. 1 and 2, and thereby save room and make the apparatus more compact.

As shown in Fig. 3, an independent furnace or fire-pot,  $L^3$ , is located adjacent to the boiler, and connected therewith by a passage con-

trolled by a valve or damper,  $L^4$ . This fire-pot may also be connected with the horizontal boiler shown in Fig. 1. The object of this independent fire-pot is to enable steam to be generated in the boiler when the fire in generator  $a$  is low and the waste heat from the latter is not sufficient to generate the required volume of steam. In such case I close damper  $L^5$  and open damper  $L^4$ , make a fire in fire-pot  $L^3$ , and pass the flame and hot products of combustion through the tubes of the boiler, thereby generating the required supply of steam. The independent fire-pot is also to be used while illuminating-gas is being made and passed off through pipe  $O$  and cooler  $P$ , and at such time damper  $L^5$  is closed and damper  $L^4$  opened for admitting flame and hot products to the boiler from the fire-pot, thus keeping the desired pressure of steam. By this arrangement I dispense with an additional boiler, usually employed during this stage of the operation.

As the illuminating-gas on its way to the scrubber, purifier, and holder passes through the cooler  $P$ , it heats the air that is drawn through the cooler by the exhauster and blower  $C$ , and thus two objects are attained—viz., the cooling of the gas and the heating of the air that is to support combustion in the generator and regenerator.

In the practical working of this my improved gas apparatus I find that by forcing air downward through the coal the ashes are blown downward through the grate-bar spaces into the ash-pit, leaving the whole mass of coal quite porous. At this stage of the operation I prefer to add either carbon, in the form of coal-dust, or pulverized fuel, by feeding the same with the air from the blower through the blast-pipes to the upper, central, or lower part of the generator  $a$ , and in this manner I am able to utilize a large proportion of cheap fuel, which may be fed by air-blasts or steam-jets, as desired. I can use to advantage any kind of fuel—such as coal, lignite, wood, sawdust, shavings—in fact, anything that will burn. Bituminous coal cokes readily, and the tar runs down without making a thick coating over the top, as is the case where an upward air-blast is used.

The operation of my improved apparatus for making illuminating-gas is as follows: I first make a fire in generator  $a$ , and cause the gaseous products thereof to pass downward through the grate-bar spaces into the ash-pit and thence through regenerator  $M$ , thereby heating up the refractory check-walls to a high degree of heat, and the products are then passed through the boiler and out at the stack, the damper  $L^5$  for such purpose being opened and damper  $O'$  being closed. The heated products of combustion, consisting in part of carbonic oxide, are brought into intimate contact with heated air introduced through either of the air-supply pipes  $d$   $e$   $b'$  or all of them, as may be required, to cause com-

plete combustion of the carbonic oxide, and if any unconsumed gases should pass by the grate-bars, I introduce heated air at the entrance to the regenerator through the hot-air branch *c'*.

5 After the fuel and decomposing chamber and the regenerator have been heated to the desired temperature, the air-blasts are shut off, damper *L*<sup>5</sup> is closed, and valve *O'*, leading to the cooler, is opened, and a current of steam  
10 is passed from the boiler through inlet *l*<sup>5</sup>, and, if desired, also through inlet *l*<sup>6</sup>, into and through the incandescent fuel in generator *a*, by which the steam, as it passes downward, is decomposed, resulting in the liberation of hydrogen and formation of carbonic oxide. Liquid hydrocarbon is then introduced into one  
15 or more of the heated retorts *m*<sup>3</sup>, where it is quickly volatilized into a thick vapor, which combines with the hydrogen and carbonic oxide, water-gas coming from the generator forming an illuminating-gas, which, as it passes through the heated regenerator, is fixed, and this fixed gas is passed thence through the liquid seal, the cooler, scrubber, and purifier  
20 on its way to the holder, as usual.

In making fuel or heating gas, the operation of heating up the apparatus is the same as that above described, the fuel in the generator being brought to incandescence, and the regenerator brought to the proper temperature for superheating steam which is introduced at its rear end through pipe *q*, after damper *L*<sup>5</sup>, valve *O'*, and steam and air valves  
30 are closed. The steam is passed through the regenerator, where it is highly superheated, and then passes upward through the incandescent fuel in generator *a*, where it is fully decomposed, and the fuel-gas is carried off through outlet-pipe *i* to the cooler, scrubber, purifier,  
40 and holder, as usual. By passing the air-blast down through the fuel and causing combustion of the gaseous products below the grate, the ash-pit is kept hot, so that no condensation can take place there, as occurs when  
45 the air-blast is admitted through the ash-pit into the fuel.

The improvement in the process described herein, constituting my invention, forms the subject of a separate application filed April  
50 22, 1885.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a gas apparatus, the generator *a*, having the air-blast pipe and steam-supply pipe connecting with its top, in combination with the regenerator for fixing gas or superheating steam, connected with said generator by means of the ash-pit or combustion-chamber below  
55 the grate, and a blast-pipe connected to supply air between the fuel and regenerator, for the purpose set forth.

2. The fuel and generating chamber having an air-blast pipe connecting with its upper  
65 portion, in combination with the horizontally-

arranged regenerator connecting with said generating-chamber below the grate, and containing the vertical check-walls extending alternately from opposite side walls of the chamber, and an escape-flue for the products of  
70 combustion from the rear end of the regenerator, for the purpose set forth.

3. The combination of the generator with the regenerator or superheater *M*, connecting with such generator at its base, and having a series of vertical check-walls, *m*, made of fire-brick or other refractory material, projecting  
75 alternately from opposite sides of said regenerator, so as to form the tortuous passage *M'*, and such regenerator having cleaning-openings and closing devices in its side walls, for the purpose described.

4. In combination with a gas-generator, the regenerator *M*, having a series of check-walls projecting alternately from opposite side walls,  
85 one or more of such check-walls being made hollow and open at the inner end to form oil-vaporizers, and the connecting oil-supply pipes *n*, as and for the purpose set forth.

5. In a gas apparatus, the fuel and generating chamber *a*, having one or more self-feeders, *h h'*, and one or more blast-pipes connecting with it at the top, in combination with the hollow perforated grate-bars and connecting blast-pipe, the ash-pit or combustion-chamber *k*, and the connected regenerator  
90 *M*, with its check-walls *m m*, as and for the purpose set forth.

6. In a gas apparatus, the generator *a* and superheater or regenerator *M*, in combination  
100 with the steam-generator *L*, connected to the exit end of the regenerator, the auxiliary fire-pot or furnace *L*<sup>3</sup>, connected with the tubes of the boiler, and the cut-off dampers *L*<sup>4</sup> *L*<sup>5</sup>, arranged as described, and for the purpose  
105 set forth.

7. In a gas apparatus, the combination of generator *a*, regenerator *M*, boiler *L*, air-heater *P*, a flue having a cut-off damper connecting the regenerator with the boiler, and a  
110 gas take-off pipe having a valve connecting the regenerator with air-heater, as and for the purpose described.

8. A down-blast gas-generator having an air-blast pipe connecting with its top, in combination with a regenerator for fixing gas or  
115 superheating steam, provided with check-walls extending alternately from opposite side walls of the chamber, so as to form a tortuous passage.

9. A down-blast gas-generator having an air-blast pipe connecting with its top, in combination with a regenerator for fixing gas or superheating steam, connected with its bottom, and provided with check-walls, as described,  
125 and a steam-supply pipe, for the purpose described.

10. The fuel and generating chamber having a fuel-supply opening and a blast-pipe connecting with its top, in combination with  
130

the hollow perforated grate-bars and connecting blast-pipe and a connecting regenerator, for the purpose described.

5 11. A fuel and generating chamber having one or more self fuel-feeders, one or more air-blast pipes and a gas-exit pipe connecting with its top, and a steam-supply pipe connecting with its bottom, for the purpose described.

10 12. A fuel and generating chamber having a self fuel-feeder, a blast-pipe, and a gas-exit

pipe connecting with its top, in combination with a regenerator connecting with its bottom, and having a steam-supply pipe, for the purpose described.

In testimony whereof I have affixed my signature in presence of two witnesses. 15

BURDETT LOOMIS.

Witnesses:

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HENRY CHADBOURN.