

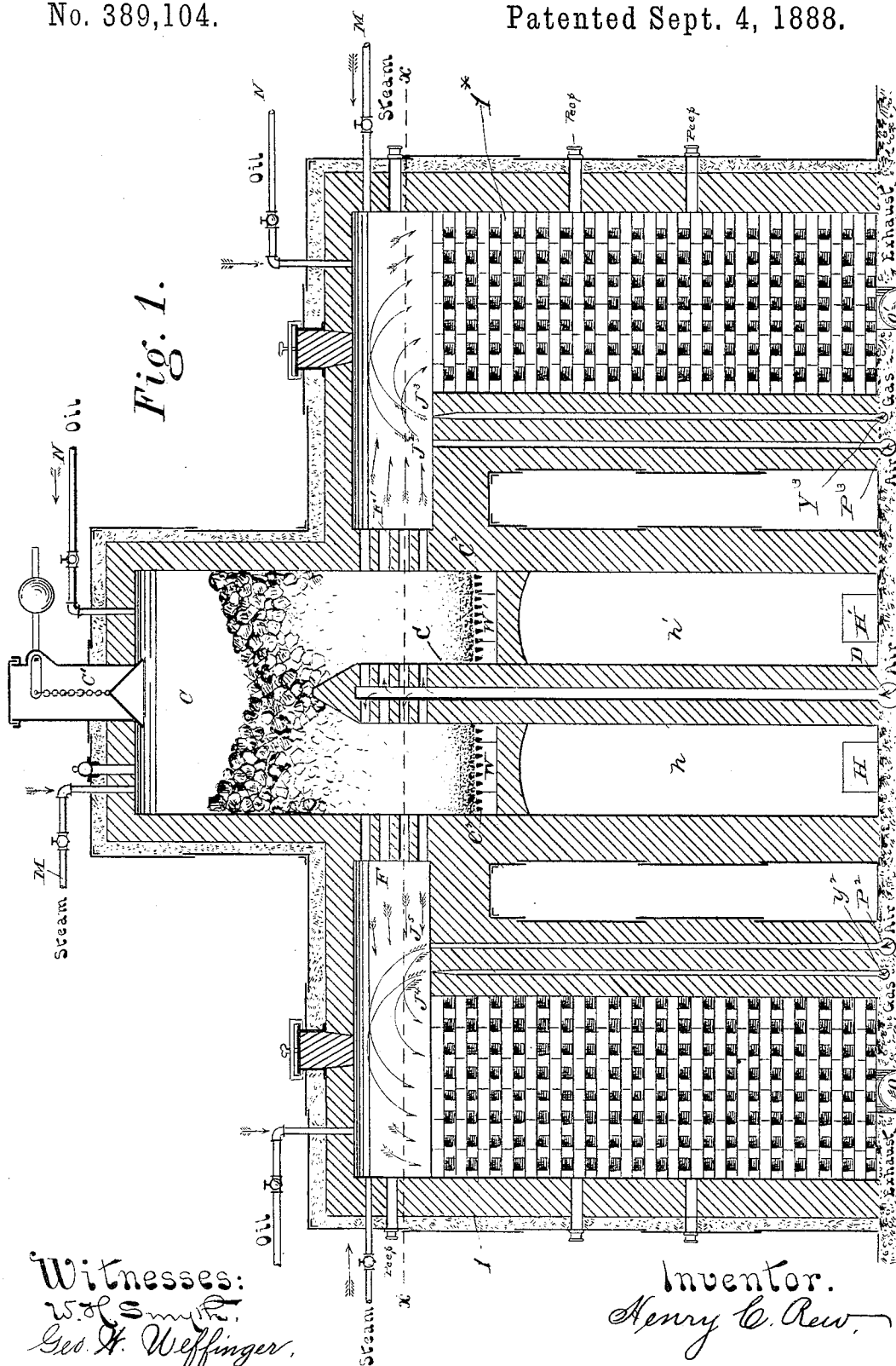
H. C. REW.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 389,104.

Patented Sept. 4, 1888.

Fig. 1.



(No Model.)

3 Sheets—Sheet 2.

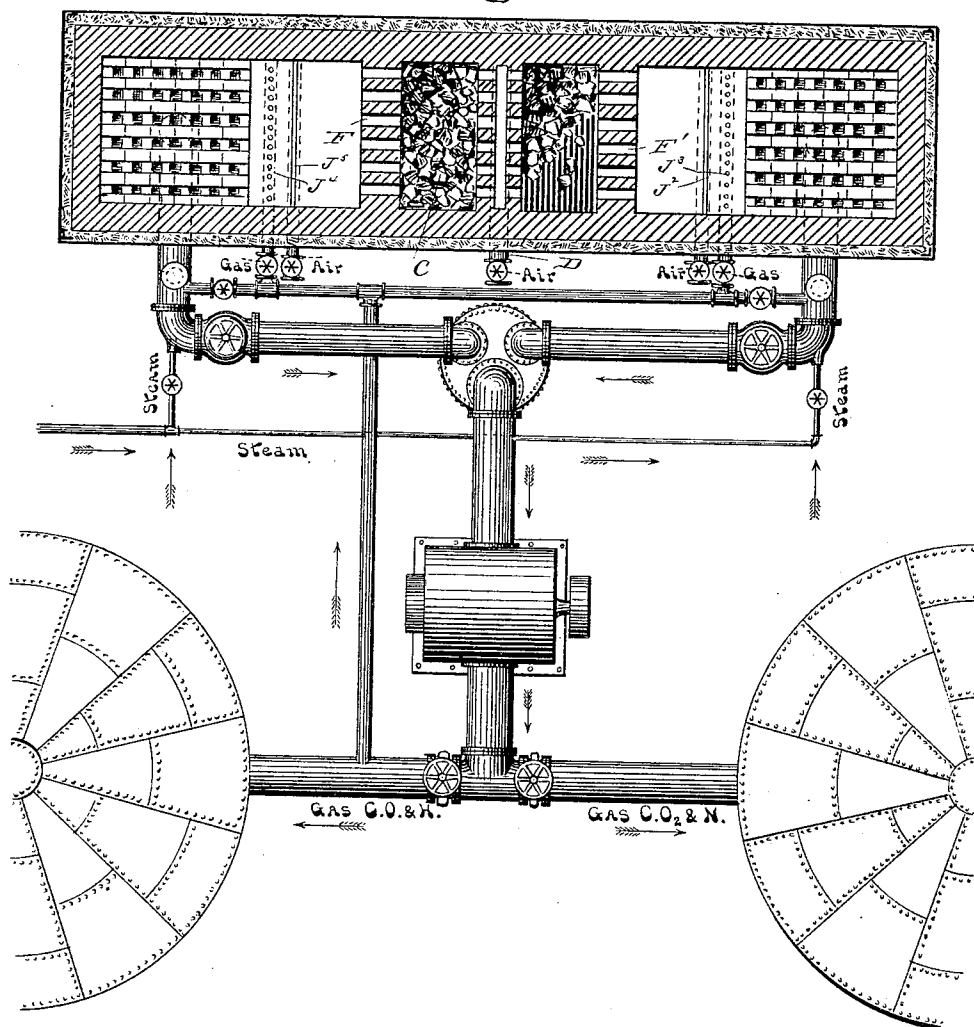
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Fig. 2



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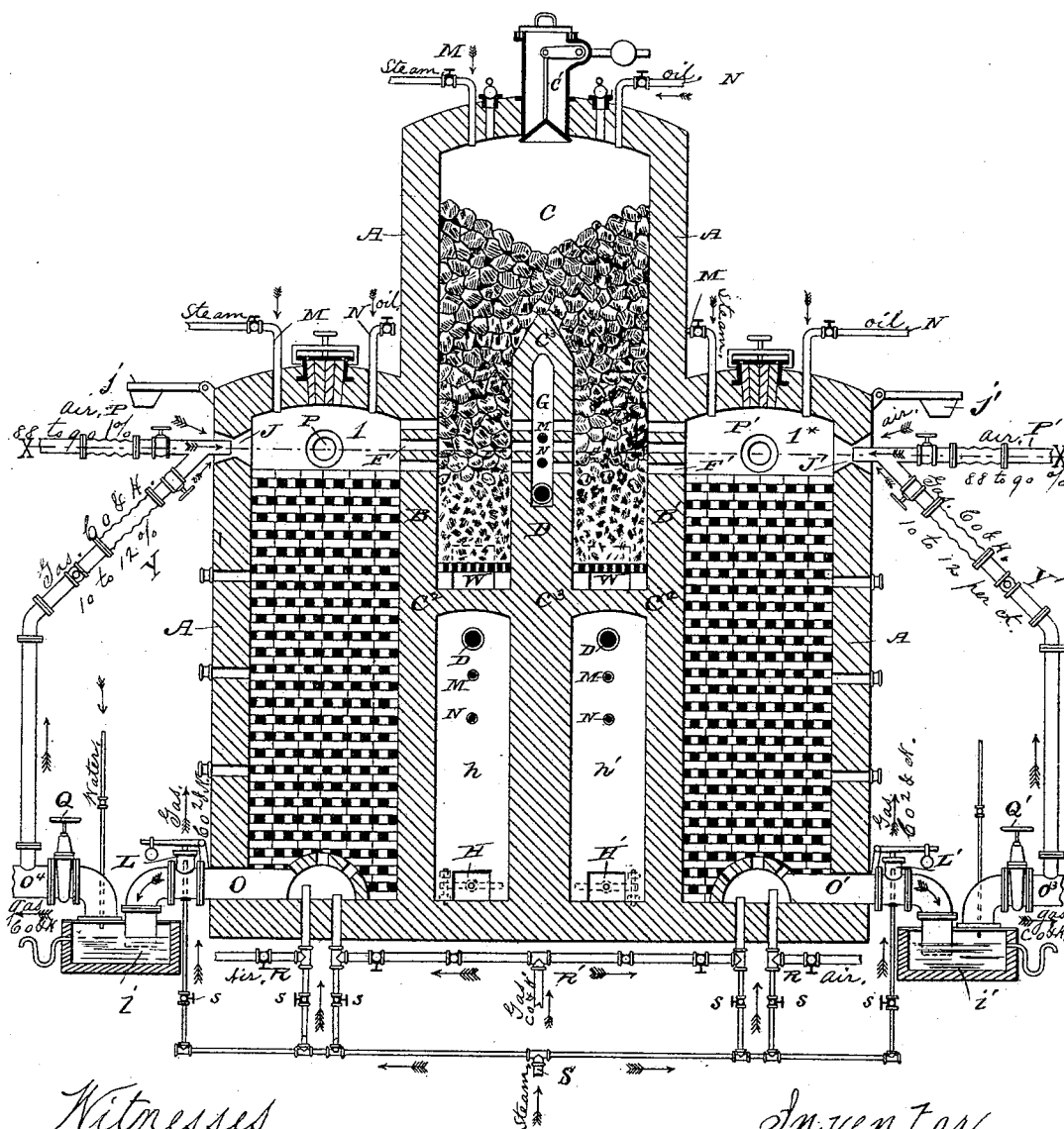
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Fig. 3.



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HENRY C. REW, OF CHICAGO, ILLINOIS.

APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 339,104, dated September 4, 1888.

Application filed October 13, 1886. Serial No. 216,170. (No model.)

To all whom it may concern:

Be it known that I, HENRY C. REW, a citizen of the United States, and a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in the Process of and Apparatus for Manufacturing Combustible and Incombustible Gases, of which the following is a specification.

10 This invention relates to the manufacture of combustible and incombustible gases, and is an improvement upon certain apparatus for which patents have been granted to me.

15 In the practical working of gas apparatus check-valves, relief-valves, water tests or washers, gas-gates, and exhausters are required for the successful working of the apparatus. It is also important to control and apply in the manufacture of gas the strong tendency of
20 heat to rise. My improved apparatus provides all of these requirements to control means for economizing heat which have not been shown in my previous patents.

25 Heretofore the products of combustion (carbon dioxide and nitrogen) have been spoken of as "spent products" and "waste gases," and in practice they have been allowed to go to waste in the open air. I have discovered that these incombustible and hitherto wasted
30 gases are possessed of great value for the quenching of destructive fires, however intense. They are also valuable for the fumigating and disinfecting of buildings, sewers, and holds of vessels, &c., which may contain
35 germs of disease, insects, vermin, bacteria, and fungus growths. My improved apparatus therefore not only provides for the storage and saving of these valuable gases, but also provides for their manufacture in large volumes
40 for the suppression of fires and other uses, so that water, which is now known to be composed of the most highly-combustible gases—oxygen and hydrogen—and which is therefore under favorable conditions only an
45 aggravator and intensifier of combustion and conflagration, may be dispensed with as an agent for extinguishing fires and these incombustible gases substituted in its place. By this means a considerable portion of the capital
50 now employed in the insurance business and in the construction and operation of fire-

engines can be made available for building improved gas-works for both combustible and incombustible gases, stimulating at the same time iron and other industries, while affording an efficient means for extinguishing fires. 55

In some instances heretofore the size of the fuel-space of the generating-chambers has been circumscribed and limited by the size of the regenerative chambers below or by the gas-tight metallic shells surrounding them. By placing the generating-chambers (or chamber) and coking-magazines between the regenerative chambers, as heretofore shown and described, (somewhat on the principle of the
60 melting-chambers or regenerative furnaces used in the metallurgical arts,) they may be enlarged to the extent required by the character of the fuel employed or by other considerations. Former apparatus have provided
70 for heating up, preparatory to making gas, either by blasting fuel in the generating-chambers with air and burning the products of combustion in adjoining superheating and fixing
75 chambers or else by heating the regenerative chambers by burning gas and air, the gas being drawn from the main, both gas and air being supplied to the fuel and to the combustion-chambers at their normal temperature.

My improved apparatus is so constructed
80 that either one or both of the foregoing means, in combination, may be employed, and thus the apparatus may be heated much hotter, if necessary, and quicker. My apparatus also provides that the air to urge combustion in
85 the fuel or generating chamber, and also the air and gas to be burned in the regenerative chambers, may enter inlets at its base and pass up through heated flues in the walls of the chambers, by which means they become highly
90 heated previous to entering the fuel and regenerative chambers and before combustion by taking up and absorbing heat that would otherwise be radiated through the walls of the apparatus and lost.

95 Having stated the nature and objects of my improvement, I will now describe them more particularly with reference to the accompanying drawings.

Similar letters of reference designate like
100 parts, as in Patents Nos. 290,926 and 339,472, heretofore granted to me.

Figure 1 represents a vertical section; Fig. 2, a horizontal section on line *xx* of Figs. 1 and 3; Fig. 3, a vertical section showing also gas-outlets, washers and mains, and check and relief valves.

In Figs. 1 and 2 are shown the centrally-located fuel-chamber, C, with a cup and cone or other suitable tight-feeding apparatus, C', ash-pits *h h'*, reaching to the ground or foundation, and the regenerative chambers 1 1* for super-heating and fixing chambers located partially below and on each side. The fuel-chamber may be supplied with a solid bottom with suitable ash outlets and ports or tuyeres to admit air, or with grate-bars, or it may be constructed with both grate-bars and the wall C³ partially dividing the fuel-chamber into two parts. Air-supply pipes D enter flues in the dividing-wall at the base of the apparatus, which pass up through the wall and supply heated air to the center of the fuel to urge combustion. Pipes M admit steam, and pipes N N to admit oil enter the top of the fuel-chamber and also the top of each regenerative chamber, and may also enter the ash-pits and the air space in the center of the wall partially dividing the fuel-chamber, as indicated in Fig. 3. Openings J² J³ at the top of the vertical flues P³ Y³ and J⁴ J⁵ at the top of P² Y² enter the combustion chamber of each regenerator for supplying heated air and gas when required to heat the regenerator. Gas-outlets O O' connect with the bottom or base of each regenerator and conduct away the products of combustion when heating up the apparatus and also gas subsequently made. Ports or tuyeres F F' connect the combustion-chambers in the tops of the regenerative chambers 1 1* with the generating-chamber C, which ports may also pass through the dividing-wall C³. Ash-doors H H' at the bottom of the ash-pits are provided for the purpose of withdrawing the ashes, and doors W W on the line of the grate-bars are constructed for man-holes and for reaching the grates when necessary. Wash-boxes *i i'*, (see Fig. 3,) for storing water are provided as tests for oil and tar, and gas-outlets O O' enter them below the water-line in the manner usual in water-sealing.

Fig. 2 also shows a plan view of the steam, air, and gas-inlets and gas-outlets connecting the base of the apparatus, which pipes have controlling-valves, relief-valves, check-valves, gas-jets, wash-boxes or water-seals, exhausters, and holders for combustible and incombustible gases for use as heretofore described.

In Fig. 3 variations in the arrangement of gas, air, and steam pipes are represented. S indicates a steam-pipe, and *s* valves in several branches thereof. R R indicate air-pipes uniting with branches of the steam-pipe, and R' a gas-pipe uniting with other branches of said steam-pipe. These pipes discharge into a chamber in the base of the brick-work. Q Q' indicate check and L L' relief valves. The valved air-pipes P P' and valved gas-pipes Y Y' deliver mixed air and gas through openings

J J' into chambers 1 and 1*. *j j'* are valves which may be used to close the openings when the air and gas pipes are withdrawn. G denotes a chamber located in the dividing-wall C³, and D D, M M, N N indicate, respectively, air, steam, and oil inlets, as in other figures which exhibit a preferred form, but do not illustrate some of the adjuncts illustrated in Fig. 3.

The apparatus shown in the above figures and herein described may be operated in many different ways, according to the kind of fuel used and the quality and character of the gases required. For instance, (referring in the main to Fig. 1,) if material is supplied that can be blasted with air—such as hard or bituminous coal—the generating-chamber C is nearly filled with coal through the tight-feeding apparatus C', commencing with coke at the bottom when bituminous coal is used. The fuel is ignited through the openings W W' on the line of the grate-bars C², and air is admitted to the flue in the center of the dividing-wall at the base of the apparatus, and is drawn up or driven by a suitable forcing apparatus to and through the ports in the center of the fuel-chamber. Gas from the main may also be supplied through the vertical flue at either Y² or Y³ to add to the heating effect of combustion in the brick-work chamber. Air is also admitted at P² or P³ to cause the gas and that from chamber C to burn, and the hot products of combustion (drawn out by the exhausters previously put in operation) pass down through the refractory material, and are sent to the holder (or gasometer) of incombustible gases, leaving their heat in the refractory material. When the refractory material is properly heated, the air-blasts are shut off and the exhausters are stopped. Steam is then admitted through a pipe or pipes, M, to drive the products of combustible and incombustible gases remaining in the apparatus into the gasometer. The valve to the main O⁴, Fig. 3, is then closed and the valve to the main O³ is opened. Steam, air, or gas, or any mixture of the same, is then admitted to the bottom of chamber 1 and is driven up through the heated refractory material and through the incandescent material in chamber C into the top of chamber 1*, being mixed at the same time with the gases distilled by the heat in the top of said chamber C. Pipes controlled by valves (not shown) may connect the top of the fuel-chamber with the tops of the regenerative chambers for the purpose of conducting the gases generated in the upper part of the fuel-chamber into the regenerators, when desired.

Suitable chimneys or smoke-stacks may be provided, if desired, to exhaust the incombustible gases generated in heating up the apparatus, the flues connecting the regenerators and chimneys being controlled by suitable valves. The resulting gases (carbon monoxide and hydrogen, provided steam and gas only are admitted to the bottom of chamber

1) are then driven by the incoming steam and gas and also drawn by the proper exhausters through the refractory material in chamber 1*, where they are combined into a homogeneous gas, and then out through the proper main to the holder for combustible gases.

It will be seen that the air-blast in passing both ways from the air-space in the dividing-wall C³ raises a large amount of fuel to the proper incandescence for duly decomposing the mixed and partially decomposed steam or gas driven up through chamber 1. A test-burner may connect with the main for combustible gases, and in case the gas needs enriching, oil or oil-vapors may be admitted into the top of the generating-chamber C or of a regenerative chamber, 1*, where they will be combined and fixed with the other gases into a homogeneous carbureted hydrogen gas while passing down through the heated refractory material in chamber 1.

If it is desired to manufacture an illuminating-gas of the highest possible candle-power, which requires a perfect union of oxygen, hydrogen, and carbon, oil may be used until heat appears as an excess by showing traces in the washers.

In case it is desired to manufacture gases on a more limited scale by exposing less fuel to the air-blasts, one side only of the generating-chamber C may be charged with carbonaceous matter. In this event the outlets for gas and products of combustion at the bottom of chamber 1 would be closed during the operation of the air-blast in order to direct the air-blast and products of combustion through the fuel into chamber 1*. When properly heated, as before, the incombustible gases would be expelled from the fuel and refractory material by steam-jets, as before stated, the inlets for air and outlets for incombustible gases closed, and the outlets for combustible gases opened, and the desired gaseous medium would be passed up through chamber 1 and through the fuel, enriched in chamber 1*, and fixed by passing down through the refractory material as before, and then sent to the holder for combustible gases. Air and steam could be used as a gaseous medium, provided that a heated gas was desired that was only partially combustible and that contained a percentage of incombustible nitrogen. The use of a mixture of gas and air as a gaseous medium in the manufacture of heated combustible or incombustible gases should be avoided, as explosive mixtures might be formed in the regenerative chambers that would be dangerous and uncontrollable when ignited.

The foregoing methods of manufacturing gas are set forth in patents granted to me and dated and numbered as follows, viz: April 6, 1886, 339,471, and May 11, 1886, 341,506; but the apparatus shown and claimed in those patents is not so well adapted to perfect work as the apparatus shown in the present case.

In case breeze or light and bulky carbonaceous materials that cannot be blasted with

air were used in the generating-chamber C, a different method would be pursued. The side chambers are heated by the combustion of gas and air drawn upward through the vertical flues and burned in the combustion-chambers of the regenerators, the resulting incombustible gases being drawn down through the refractory material by the exhausters and sent to the proper holder, and the apparatus would be cleared of incombustible gases by jets of steam, as in the previous case. During and after the operation of heating the side chambers in the manner described the fuel in the generating-chamber would be raised to incandescence by the rising of heat and the succession of hot gases through the ports or tuyeres F F' in direct contact with the gas-making material. Steam and gas or steam and air are then admitted at the bottom of chamber 1 and pass up through that chamber and into chamber 1*, being combined with the carbonaceous material, producing carbon monoxide and hydrogen, provided, as before, that gas or steam were used as a medium for driving or conducting the heat contained in chamber 1 upward into direct contact with the gas-making material in chamber C. Oil could be added to enrich the resulting gases, which are fixed into a homogeneous gas of high candle-power by being passed downward through the heating-chamber 1* to the usual water-seal, scrubbers, and lime (or lime and iron) purifiers, and the holder for combustible gases.

In the use of light and bulky materials the ports or tuyeres through the dividing-walls C³ could be wholly or partially closed in order to force the hot gaseous media (used in driving the heat stored in chamber 1 upward in direct contact with the gas-making material) over the dividing-wall C³, thus exposing the gases to a large amount of carbonaceous materials, and thereby forming a more perfect combination of steam and the carbon contained in the gas and gas-making material employed.

In case it is desired to use liquid hydrocarbons in manufacturing gas, the chamber C is loosely filled with refractory material and used with the side chambers as a heat-storing chamber. The side chambers are heated, as before, by blasts of air and gas, and the resulting incombustible gases are exhausted and stored in the proper gasometer. When the apparatus is properly prepared for manufacturing gas, steam and gas are admitted to the bottom of chamber 1. In passing up through chamber 1 the oxygen of the steam combines with the carbon contained in the gas, forming carbon dioxide and hydrogen. These gases are then completely decomposed into carbon monoxide and hydrogen and enriched by admitting oil-vapors into the central chamber, C, or the fixing-chamber 1*, (or both,) and the mixed gases are combined and fixed into a homogeneous gas of high candle-power by being drawn down through the heated fixing-chamber 1* by the proper exhauster on their way to the scrubbers, purifiers, and holder for

combustible gases. The strong tendency of the heat to rise is controlled by the exhausters and check-valves on the gas-outlet pipes, which prevent any backward or upward flow of gases which would carry off the heat, while the relief-valves operate as safety-valves in the event of any sudden expansion of air or steam admitted too rapidly or suddenly to any part of the apparatus.

The foregoing methods of manufacturing gas by first storing up a large volume of heat in refractory material and then driving heat upward by the use of any suitable gaseous medium in direct contact with the gas-making material, and fixing the gases by carrying them downward through heated refractory material, are embraced in my patents dated and numbered as follows, viz: December 25, 1883, No. 290,926, and April 6, 1886, No. 339,472; but the construction of apparatus set forth in this application embodies material improvements.

The generating-chamber C may be constructed as shown in Patent No. 339,471, previously mentioned, with tight feeding or coking magazines above and without the dividing-wall, and also without grate-bars, and a solid brick base may be substituted therefor and used instead, provided that suitable outlets for ashes and ports or tuyeres for the admission of air are constructed in the base of the fuel-chamber, without sacrificing the advantages of all the present improvements.

Preferably each chamber is provided with a gas-tight metallic shell, in order to cause the heated and volatile gases to pass through the apparatus in the manner indicated, without regard to the small openings or crevices that may appear in the brick walls of the apparatus under the varying conditions of heat and cold. The apparatus, however, shown in Fig. 1 is intended to represent exterior walls eighteen inches thick, regenerative chambers six feet square, and with the loose brick-work fifteen feet in depth, the fuel-chamber six by eight feet, and having three feet of coal on each side of the dividing wall, and other measurements in proportion.

The various chambers may be round or square, as can be most conveniently constructed, and the vertical flues for gas and air may extend entirely around the walls of the regenerators, and thus prevent to a greater extent the escape of either through the walls of the apparatus.

It will also be understood that I do not limit myself to the precise arrangements and details of my improved apparatus, as hereinbefore described with reference to the accompanying drawings, as the construction may be obviously modified without departing from the nature of my invention—as, for instance, the fuel-chambers may be widened on the line of the air-blasts, the dividing-wall may be wholly or partially constructed of suitable water-cooled pipes, and the gases or products of final combustion made in heating up the apparatus

may be exhausted by a suitable smoke stack or chimney.

It will also be understood that the gases passing from the apparatus to the holders may be passed through the usual boilers or water-heaters, washers, exhausters, by-pass purifiers, and other desired apparatus in various combinations, as required.

I am aware that partially-burned gases have been exhausted from furnaces and discharged either into the open air or into other furnaces for complete combustion. The present invention contemplates an apparatus which embraces means for thoroughly burning all gases in or above the regenerators, in heating up the same, and for exhausting or drawing the incombustible gases thus produced immediately away, so as not to interfere with the combustion of other incoming gases, and for storing said incombustible gases.

The above-described apparatus exposes comparatively a small surface for the outward radiation of heat; provides for tightly closing its entire top, including the sides; provides for heating and retaining the heat to the best advantage in an exceptionally large body of fuel; obviates excessive upward radiation and conduction of heat by removing all heated gases and products at the base, and provides flues in the walls for heating incoming air and gas, thereby saving heat that would otherwise be lost through the walls. It also embraces means for forcing air, steam, and gas into and exhausting gas and gaseous products from the apparatus, the outlet-pipes being provided with an exhauster and both with check and safety valves. This exhaustion of gases draws the burned and non-combustible gases away from the burning and combustible gases, thus causing the complete burning of the products of combustion in the regenerators, which cannot be accomplished when the gases are forced out; prevents the necessity of an excessively powerful blast; obviates leakage and the too-hurried passage of air and unburned gases through the regenerator; stores and saves both the combustible and the non-combustible gases for valuable uses, and also makes it possible to "clean" the fires without suspending other operations, as now practiced, and all these several features and advantages are secured in one comparatively compact and economical structure.

I do not claim a hollow perforated wall adapted to introduce air into the midst of a body of fuel, nor devices for exhausting the products of combustion, nor two holders for gas in combination with gas-making apparatus, except in the particular combinations described and hereinafter pointed out.

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

1. The combination of a fuel-chamber, a regenerator or chamber loosely filled with refractory material, pipes communicating with the fuel-chamber to supply a gaseous or vaporous medium whereby gas may be gener-

ated in the fuel, an air-supply pipe and gas-conduit communicating with the upper part of said regenerator-chamber, two gas-holders, an exhausting apparatus communicating with each holder and with the base of a regenerator, and valved flues between the holders and exhauster, substantially as specified, whereby combustible and incombustible gases may be exhausted successively and passed from the regenerator and separately stored in said holders.

2. In a gas apparatus, the combination of a fuel-chamber, pipes to supply a gaseous or vaporous medium to the fuel, two regenerators, outlet-pipes provided with check-valves to prevent backflow of gas or air on one side of the apparatus when gas is exhausted from the other, relief-valves, one in each outlet-pipe, an exhausting apparatus connected with both outlet-pipes by valved pipes, and a holder connected with the exhauster by a valved pipe, substantially as specified.

3. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, and an air-supply conduit leading to the interior of the wall and to the perforations therein, substantially as specified, whereby air can be supplied to the side of fuel in the compartments and the products of combustion passed laterally out of the same and to the regenerators without passing through the fuel in the space above the dividing-wall.

4. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, an air-supply conduit leading to the interior of the wall and to the perforations therein, and air-pipes entering below each compartment to supply air at its base, substantially as specified, whereby air can be supplied to the side and base of fuel in the compartments and the products of combustion passed laterally out of the same and to the regenerators without passing through fuel in the space above the dividing-wall.

5. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, an air supply conduit leading to the interior of the wall and to the perforations therein, air-pipes entering below each compartment to supply air at its base, and air and gas flues communicating with

the upper part of the regenerators, substantially as specified, whereby air can be supplied to the side and base of fuel in the compartments and the products of combustion passed laterally out of the same and to the regenerators without passing through fuel in the space above the dividing-wall and then reburned with additional gas in the regenerator.

6. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, an air-supply conduit leading to the interior of the wall and to the perforations therein, air-pipes entering below each compartment to supply air at its base, air and gas flues communicating with the upper part of the regenerators, and exhausting apparatus, substantially as specified, whereby air can be supplied to the side and base of fuel in the compartments, the products of combustion passed laterally out of the same and to the regenerators without passing through fuel in the space above the dividing-wall, then reburned with additional gas in the regenerators, and drawn through the same.

7. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, an air-supply conduit leading to the interior of the wall and to the perforations therein, air-pipes entering below each compartment to supply air at its base, air and gas flues communicating with the upper part of the regenerators, exhausting apparatus, and a holder, substantially as specified, whereby air can be supplied to the side and base of fuel in the compartments, the products of combustion passed laterally out of the same and to the regenerators without passing through fuel in the space above the dividing-wall, then reburned with additional gas in the generator, drawn through the same, and the incombustible gases passed into a holder.

8. In a gas apparatus, a furnace or chamber provided with two compartments for fuel, separated by a horizontally-perforated wall, each communicating with a common space above said separating-wall, in combination with regenerators the upper parts of which communicate with said fuel-compartments at about the level of the separating-wall, an air-supply conduit leading to the interior of the wall and to the perforations therein, air-pipes entering below each compartment to supply air at its base, air and gas flues communicating with the upper part of the regenerators, exhausting apparatus, a holder, and pipes entering the base

of the regenerators, and a second holder and
valved flues leading from the exhauster to the
holders, substantially as specified, whereby air
can be supplied to the side and base of fuel in
5 the compartments, the products of combustion
passed laterally out of the same and to
the regenerators without passing through fuel
in the space above the dividing wall, then re-
burned with additional gas in the generator,

drawn through the same, and the incombustible
ble gases passed into a holder, and whereby
combustible gas can subsequently be made and
separately stored.

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