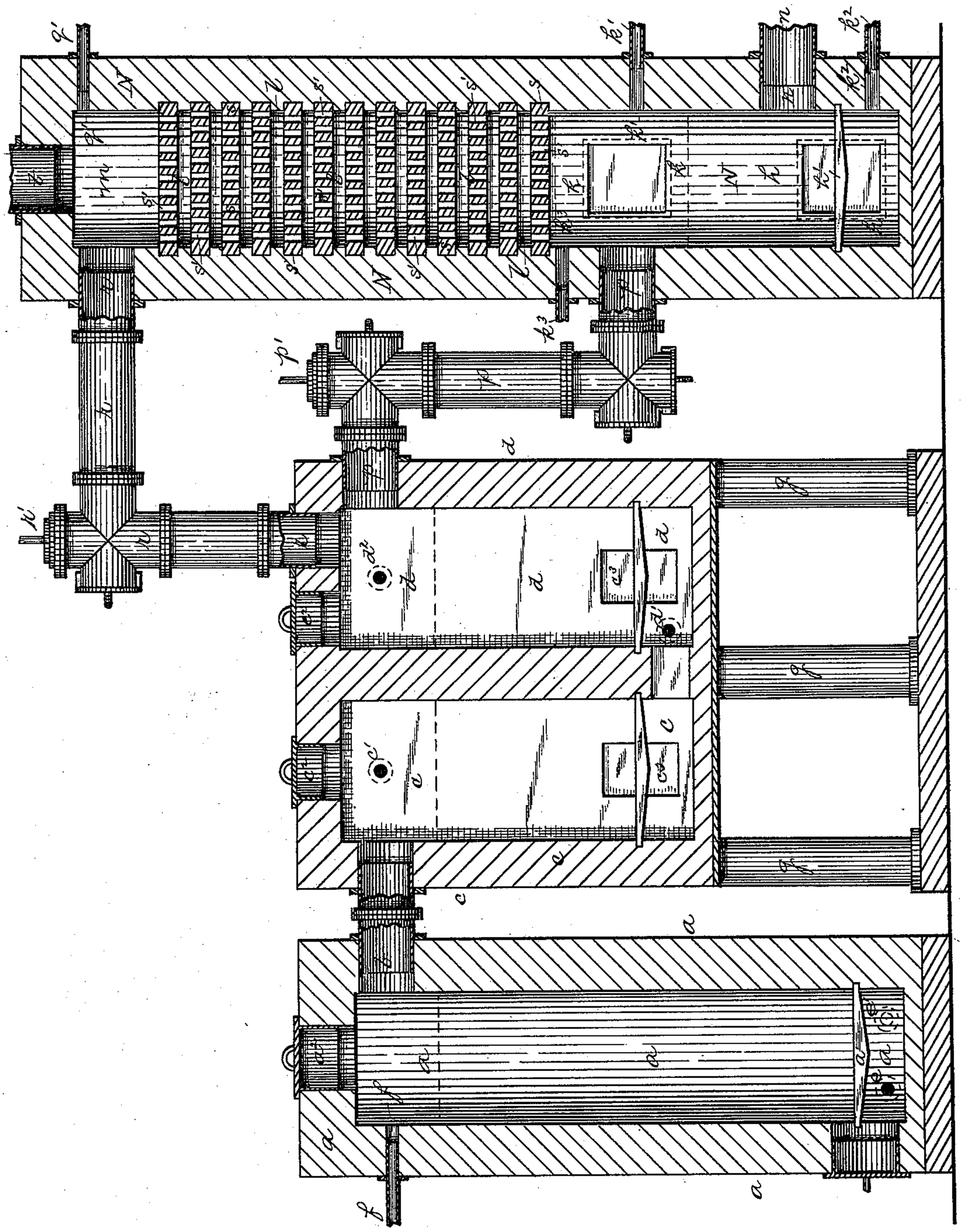
(No Model.)

J. M. ROSE.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 408,533. Patented Aug. 6, 1889.



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APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 408,533, dated August 6, 1889.

Application filed May 9, 1888. Serial No. 273,280. (No model.)

To all whom it may concern:

Be it known that I, JAMES M. ROSE, a resident of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for the Manufacture of Gas; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the manufacture of gas, and more especially to improvements in the apparatus employed in practicing the process described in an application filed by me on March 2, 1887, Serial No. 229,435, and certain improvements thereon, which have been made the subject of subsequent applications.

The process described in the above application consists, generally stated, in heating by the waste products of combustion formed in raising a mass of carbon to incandescence blocks or pieces of limestone or other refractory material coated with a heavy hydrocarbon—such as asphaltum or coal-tar—and thus forming a mass of refractory material impregnated with a heavy hydrocarbon, and subsequently passing a current or currents of steam through said incandescent carbon and impregnated refractory material, the nascent hydrogen so obtained uniting with the heavy hydrocarbon supported by the refractory material, and so forming light hydrocarbon gases—such as marsh-gas or olefiant gas—the resultant gases being composed principally of hydrogen, light hydrocarbons, and carbonic oxide.

My present invention relates to certain apparatus to be used in the generation of gases from the hydrocarbon-bearing material, and in the subsequent treatment of the gases passing from such material to enrich the same, to remove the tarry-matter therefrom, and to form a fixed illuminating-gas of high candle-power.

To these ends my invention consists in certain improvements in the apparatus for mixing liquid hydrocarbons with the gases obtained by the process for enriching them and for fixing the gases after the intermingling therewith of the enriching hydrocarbons, as well as in other improvements, as hereinafter more particularly pointed out.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawing, which shows a longitudinal central section, partly in full lines, of the apparatus.

My improved apparatus consists of a generator-chamber, a double chamber containing the blocks or pieces of limestone or other refractory material coated with asphaltum, coal-tar, or other heavy hydrocarbon, and so forming the mass of hydrocarbon-impregnated material, or containing lime or other suitable solid material for treating the gases formed in the generator *a*, (said chambers being hereinafter referred to as "hydrocarbon-chambers,") and a third mixing, fixing, and further generating chamber of peculiar construction.

The generator-chamber *a* is intended to contain any suitable carbon—such as coal or coke—the same being supported upon the grate-bars *a'* at the base thereof, and the carbon being fed to the generator through feeding-port a^2, the body of coal generally extending up within said chamber to a point just below the discharge-port *b*, leading into the hydrocarbon-chamber *c*. The generator *a* is also provided below the grate-bars with the steam-inlet *e* and the air-inlet *e'* and above the body of carbon therein with the steam-inlet *f*, which is placed opposite the flue *b*, leading into the hydrocarbon-chamber *c*, so that the steam entering through said pipe *f* necessarily passes entirely across the upper part of the generator-chamber and over the mass of incandescent carbon therein.

The hydrocarbon-chambers *c d*, forming the double hydrocarbon-chamber, which I prefer to employ, as set forth in previous applications filed by me, are in the present apparatus shown as arranged the one before the other, so that the heated products and gases must necessarily pass downwardly through the chamber *c*, and thence upwardly through the chamber *d*, and these chambers are raised, being supported on suitable pillars *g*, so as to bring the top of the chambers on a level with the top of the generator-chamber *a*, and the chamber *c* being located close to the generator *a*, so that only a short and direct connecting-flue *b* is necessary, and for this reason the nascent hydrogen generated by the decomposition of the steam in the incandescent carbon can pass directly and quickly into the hydrocar-

bon-chamber, it being found that the hydrogen will unite more readily with the hydrocarbon supported in said chamber if brought in contact therewith immediately after its generation. The hydrocarbon-chambers *c d* are also provided with the feeding-ports c^2 and with the discharge-doors c^3, which latter are arranged opposite the grate-bars, so as to provide means for removing the material from said chambers, and also keeping the portions of said chambers under the grate-bars free from clogging.

If desired, a steam spray or injector *c'* may also be employed at the top of the chamber *c* and a steam spray or injector *d'* at the base of the chamber *d*, while a steam spray or injector d^2 may be employed at the top of the chamber *d*, these spraying-pipes *c' d'* d^2 being employed for feeding to the chambers the liquid hydrocarbons during the passage of the products of combustion through said chambers for further coating the refractory material therein, as described in application filed by me February 23, 1888, Serial No. 264,983.

The casing N, containing the mixing, fixing, and further generating chambers differs from those employed in the apparatus forming the subjects of former applications in some particulars, which will be pointed out, the casing being formed of a long cylinder and lined with fire-brick and forming a long cylindrical chamber, at the base of which are the grate-bars *h'*, supporting a body of coal or other suitable carbon and forming the second coal-generator *h*, which will be referred to as the "carbon-chamber," and above said generator, or forming the upper part of the same, is the combustion-chamber *k*, while above the combustion-chamber *k* is the fixing-chamber *l*, and above the fixing-chamber is the mixing-chamber *m*. Leading from the upper or discharge end of the hydrocarbon-chamber *d*, and from the side of said chamber is the pipe or flue *p*, which communicates with the combustion-chamber *k* above the carbon-chamber *h*, said flue being controlled by the valve *p'*, and leading from the top or discharge end of the hydrocarbon-chamber *d* is the pipe or flue *r*, which communicates with the mixing-chamber *m* at the top of the casing N, said flue *r* being controlled by a valve *r'*.

Below the grate-bars *h'* of the carbon-chamber *h* is the air-blast pipe k^2, by means of which the coal or other carbon supported on the grate-bars *h'* may be raised to incandescence, while in the combustion-chamber *k*, above the body of carbon in the chamber *h*, is the air-blast pipe *k'*, which serves to supply air to the products of combustion which pass from the hydrocarbon-chamber *d* through the pipe *p* to the combustion-chamber *k*, said products of combustion being intermingled with the highly-heated products of combustion from the carbon-chamber *h*, and thus heated and consumed in the combustion-chamber *k*, and the heated products therefrom passing upwardly through the fixing-chamber *l*. In said chamber *k* above said carbon-chamber *h* is the steam-inlet k^3, through which a further portion of steam may be added to the gases before they pass downwardly through the body of incandescent carbon in the chamber *h*. Near the base of the carbon-chamber *h*, but above the grate-bars at about the point where the greatest heat is generated in the mass of carbon in said chamber, is the gas-outlet *n*, which leads to any suitable storage-tank.

The fixing-chamber, as shown in the drawing, is preferably formed of a series of terra-cotta tiles *s*, which extend across the chamber and have formed therein the small perforations *s'*, so forming through this chamber a large number of diminutive flues or passages through which the heated products of combustion rising from the combustion-chamber *k* pass on their upward course to the purge-outlet *t*, which is controlled by a suitable purge-valve, and down through which passages the gases and vapors pass in their course from the mixing-chamber *m* to the storage-tank. It is found that these terra-cotta tiles, while giving a circuitous course to the products of combustion and gases passing through the same, not only act to absorb a large amount of heat from the highly-heated products of combustion, but to readily impart that heat to the gases and vapors passing through such tiling, so acting to decompose any steam which may be carried into the fixing-chamber and to cause the union and fixing of the gases which pass down through the same. However, this fixing-chamber may, if desired, be provided with simply a loose mass of fire-brick, dolomite, or other suitable fixing material supported on the perforated arch, as shown in application, Serial No. 261,139. As the products of combustion rise through said fixing-chamber *l*, the lower portion thereof is raised to a higher heat than the upper portion, while the gases and vapors formed in the gas-making operation pass downwardly through the same and are therefore brought from the coolest to the hottest part of said fixing-chamber, and a more permanent gas is therefore formed. Communicating with the chamber *m* at a point opposite the port *r* is the inlet-pipe *q'*, by means of which liquid hydrocarbon or liquid hydrocarbon and steam are fed to the chamber to enrich the gases passing over from the hydrocarbon-chambers, a further quantity of hydrogen being added to the gases formed from the steam which is decomposed in passing downwardly through the fixing-chamber.

In making gas in my improved apparatus the generator-chamber *a* is filled with coal, coke, or other suitable carbon, and through the air-blast pipe *e'* the same is gradually raised to the proper incandescence. The hydrocarbon-chambers *c d* are filled with blocks or pieces of limestone or other refractory material coated with asphaltum, coal-tar, or other suitable hydrocarbon, so forming the mass of

refractory hydrocarbon-impregnated material therein, and the carbon-chamber *h* is supplied with a mass of coal, coke, or other suitable carbon, which, through the air-blast pipe h^2, is blasted to incandescence. During the blasting of the two masses of carbon the products of combustion from the generator-chamber *a* pass through the flue *b* to the hydrocarbon-chamber *o*, and thence down through the impregnated refractory material in said chamber and upwardly through that in the chamber *d*, and, if desired, as said products pass through said chambers the liquid hydrocarbon can be sprayed into the same, as described in my said application, Serial No. 264,983.

The valve *r'*, leading to the mixing-chamber *r*, has of course been previously closed, while the valve *p'* in the pipe *p*, leading from the chamber *d* to the combustion-chamber *k*, has been opened, and the waste products of combustion, together with any vaporized hydrocarbon which may be taken up thereby, pass through the pipe or flue *p* into the combustion-chamber *k*. On account of the circuitous course of the products through the hydrocarbon-chamber it is generally found that a large amount of heat is taken up by the material in said chambers, so that the heat of said products is generally lowered to such a degree that unless again heated they will not burn properly, and as they pass over the mass of incandescent carbon in the chamber *h* and intermingle with the products of combustion therefrom it is evident that said products of combustion entering from the pipe *p* into the combustion-chamber *k* will be heated, so that with the products of combustion rising from the carbon-chamber *h* they will be consumed within the combustion-chamber, a sufficient supply of air to support combustion being provided through an air-blast pipe *k'*. The heated products of combustion then rise through the fixing-chamber *l*, raising the terra-cotta or other fixing material therein to a high heat and heating the lower part of said chamber especially to a very high heat, the products of combustion then passing through the mixing-chamber *m*, which is also heated, and thence to the purge-outlet *t* and being permitted to escape. This is continued until the two masses of carbon are raised to the proper incandescence and the hydrocarbon-bearing material in the chambers *c d* suitably heated, when the air-blasts are closed, the valve *p'* in the pipe *p* closed, and the valve *r'* in the pipe *r* opened, while at the same time the purge-valve is closed, and the valve controlling the pipe *n* leading to the gasometer is opened. Steam is then admitted at the pipe *e* at the base of the generator *a*, the steam passing upwardly through said generator and being decomposed, forming first hydrogen and carbonic acid, but, on account of the height of the chamber, this carbonic acid being generally converted into carbonic oxide. At the same time steam is admitted at the top of the generator *a*, and on account of the extremely high heat in the upper part of said generator, which has of course been brought to a very high heat in blasting the contents thereof to incandescence, as the steam from the pipe *f* has necessarily to pass across said chamber it comes in contact with the highly-heated walls thereof and with the upper portion of the incandescent carbon therein, and is thus highly superheated before it passes with the water-gas formed in said generator into the hydrocarbon-chamber.

As the hydrocarbon-chamber *c* is placed close to the generator, it is evident that the gases enter into said chamber at a very high heat, and instead of the steam entering the upper end thereof acting to lower the temperature of the impregnated material in said hydrocarbon-chamber on account of its being previously superheated it maintains the temperature thereof and is more easily decomposed, thus enabling me to continue the gas-making operation longer. As the superheated steam mingles with the carbonic oxide passing upwardly from the generator and said gases and vapors are at a high heat, the superheated steam will in some cases be decomposed even in the upper part of said generator, the oxygen uniting with part of the carbonic oxide to form carbonic acid, and a still further portion of hydrogen being thus set free, which, together with the hydrogen generated by the decomposition of the steam in the incandescent carbon, passes over into the mass of refractory material impregnated with a heavy hydrocarbon, and such hydrogen being in a nascent state and brought, shortly after being set free, in contact with the heavy hydrocarbon supported on the refractory material unites with the same and forms light hydrocargon gases, as has been described in said application, Serial No. 229,435. The gases so formed—namely, carbonic oxide, carbonic acid, hydrogen, and the hydrocarbon gases—together with any undecomposed steam, then pass through the pipe *r* to the mixing-chamber *m* at the upper end of the casing N, where a suitable liquid hydrocarbon is sprayed into the mass of gases entering the mixing-chamber to enrich the gases previously formed, said hydrocarbon being preferably sprayed therein by a jet of steam, a Lima oil being preferably employed, as it is of low cost and serves well as an enriching agent, though any suitable liquid hydrocarbon may of course be employed for the purpose. These gases and vapors pass from this mixing-chamber *m* down through the fixing-chamber *l*, being again heated in passing through the same, the steam and the hydrocarbon and solvent vapors being decomposed into hydrogen, carbonic oxide, light hydrocarbon gases, which gases commingle and interchange with the hydrogen, marsh and olefiant gases, carbonic oxide, and carbonic acid entering from the hydrocarbon-chambers, forming a fixed gas of high candle-power. Said gases in their passage through

said mixing and fixing chambers are raised to a high and gradually increasing heat, as the lower part of the fixing-chamber *l* is more highly heated than the upper portion, and as the small openings in the terra-cotta tiles supported in the fixing-chamber offer resistance to the passage of the gases, and it is evident that not only is a pressure generated in the hydrocarbon-chambers, which greatly assists the gas-making process, but the gases are brought into closer contact in the fixing-chamber and a more perfect union of the gases so obtained. These gases, after having been so mixed, then pass down through a thick body of incandescent carbon in the carbon-chamber *h*, in which they are not only more firmly united, but a further body of water-gas is generated, steam being admitted through the pipe k^3 in the combustion-chamber *k*, a further portion of hydrogen being thus added to the gas, and any carbonic acid passing from the fixing-chamber is converted into carbonic oxide under the high temperature of the incandescent coal. The gases pass from the body of incandescent carbon at the hottest part thereof—namely, just above the grate-bars—and thence, through the pipe *n*, are carried to the receiving-tank. At the same time, if any tarry matter has been carried over by the gases, this tarry matter is taken up by the incandescent carbon and a gas free from any such material is obtained. When the heat of the bodies of incandescent carbon is lowered below that suitable for making gas, the gas-making operation is stopped and said bodies again blasted up, and the apparatus so prepared for another gas-making operation.

By thus carrying the products of combustion upwardly through the fixing-chamber and the gases from the hydrocarbon-chambers downwardly through the fixing-chamber I am enabled to obtain a more intimate intermingling thereof and gradually bring the gases into contact with more highly-heated fixing-surfaces, and am also enabled, after passing the gases through the ordinary fixing-chamber, to still further heat and fix them by means of a body of incandescent carbon, and to provide means for highly heating the fixing-chamber *l* and reheating the waste products passing from the hydrocarbon-chambers and utilizing in heating said fixing-chamber, and I am also enabled, as a last step in the process, to remove any tarry matters from the resultant gas, this being found necessary where oil is employed, for the purpose above described, as an enriching means.

I am also enabled through the arrangement of the apparatus as above described to dispense with many different valves and pipes in the construction of the apparatus, rendering it more simple and compact.

My improved apparatus may also be employed in the manufacture of fuel or heating gas by the introduction of hydrocarbons into the heated products obtained in blasting up the generator as said products are carried through the refractory material in the hydrocarbon chamber *c*, as described in my application for patent filed February 23, 1888, Serial No. 264,984.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A gas-making apparatus having the hydrocarbon or treating chamber *c*, containing refractory material, the casing N, having a combustion-chamber therein, a fixing-chamber containing checker-work or like heat-retaining material above the combustion-chamber, and a mixing-chamber at the top of the casing above the fixing-chamber, and separate flues leading from the discharge end of the treating-chamber *c* to said combustion-chamber and said mixing-chamber, respectively, substantially as and for the purposes set forth.

2. A gas-making apparatus having the casing N, provided at the base thereof with the carbon-chamber *h*, for containing incandescent carbon, the fixing-chamber *l* above the same, a purge-outlet above the fixing-chamber, an inlet *p*, for products of combustion, between the carbon-chamber and fixing-chamber, and inlet *r*, for gases, above the fixing-chamber, and a gas-outlet leading to the receiver below the top of the carbon-chamber, substantially as and for the purposes set forth.

3. A gas-making apparatus having a cupola generator, a casing having one or more treating-chambers containing refractory material and provided with an oil-inlet with which said generator communicates, and a casing having a combustion-chamber therein, a fixing-chamber containing checker-work or like heat-retaining material above the combustion-chamber, a mixing-chamber at the top of the casing above the fixing-chamber, and a purge-valve above said mixing-chamber, and separate flues leading from the discharge end of the treating-chamber to said combustion-chamber and said mixing-chamber, respectively, substantially as and for the purposes set forth.

In testimony whereof I, the said JAMES M. ROSE, have hereunto set my hand.

JAMES M. ROSE.

Witnesses:
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BENJ. W. HAINES.