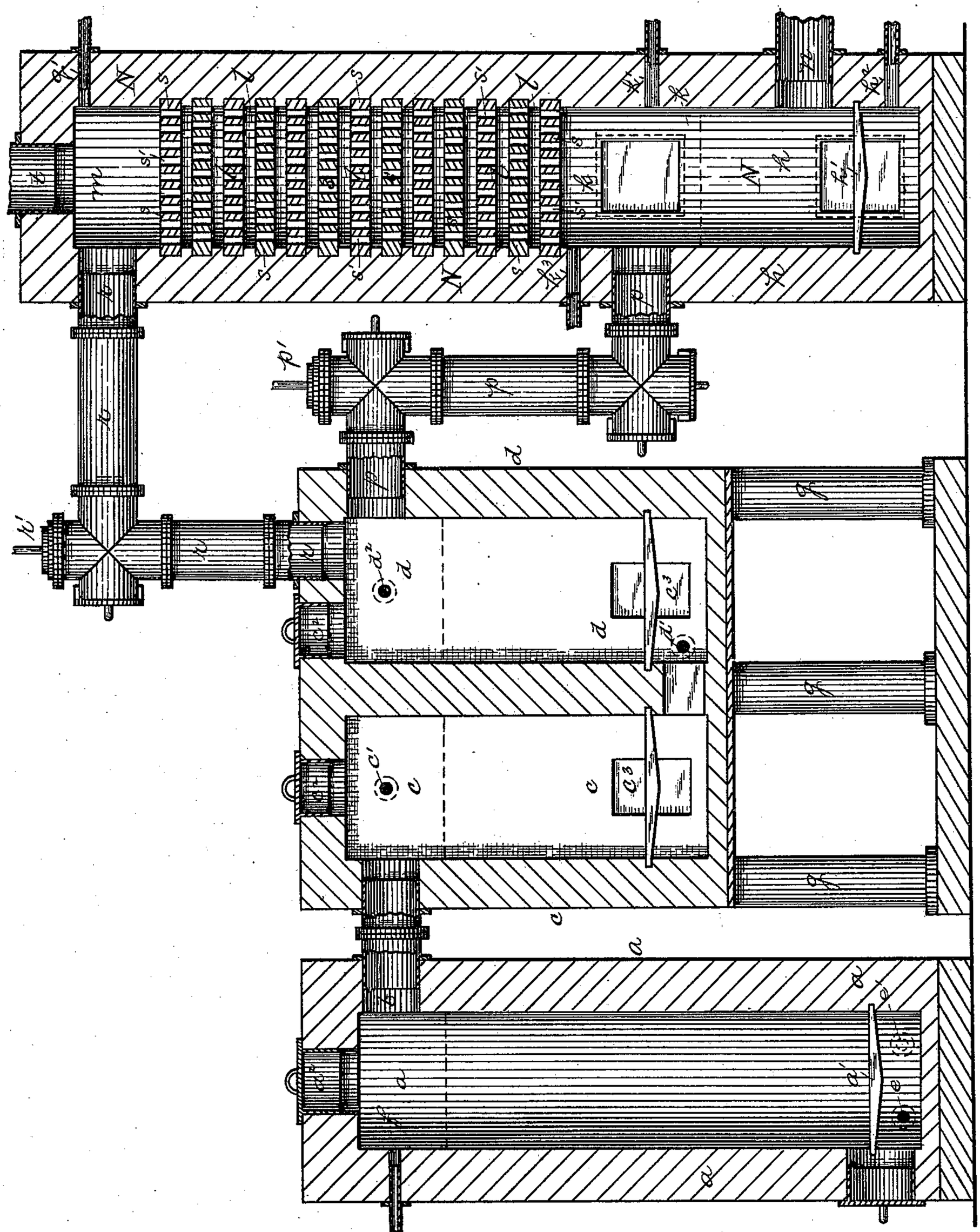
(No Model.)

J. M. ROSE.

PROCESS OF MANUFACTURING GAS.

No. 408,532. Patented Aug. 6, 1889.



Witnesses:

J. N. Coates

Robt. D. Totten

Inventor.

James M. Rose

By James D. Kay

Attorney

UNITED STATES PATENT OFFICE.

JAMES M. ROSE, OF ALLEGHENY, PENNSYLVANIA.

PROCESS OF MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 408,532, dated August 6, 1889.

Application filed May 9, 1888. Serial No. 273,279. (No specimens.)

To all whom it may concern:

Be it known that I, JAMES M. ROSE, a resident of Allegheney, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in the Process of Manufacturing 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 on 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 specially to certain steps in the generation of the 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 superheating of the steam employed in the generation of the gases, in the mixing of liquid hydrocarbons with the gases obtained by the process, and in the fixing of the gas 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 practice my invention, I will describe the same more fully, referring to the accompanying drawing, which shows by a longitudinal central section, partly in full lines, the apparatus best adapted for practicing my invention.

The apparatus preferably employed in practicing my invention consists of a generator-chamber, a double hydrocarbon-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, and a third fixing and further generating chamber of peculiar construction, which, together with the other apparatus, forms the subject of a separate application of even date herewith.

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 coal being fed to the generator through a 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 the 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 car-

bon can pass directly and quickly into the hydrocarbon-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' d²* 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 by me in an application filed February 23, 1888, Serial No. 264,983.

The mixing, fixing, and further generating-chamber N differs from those employed in the apparatus forming the subjects of former applications in some particulars which will be pointed out, the chamber being a long cylindrical chamber supported in a suitable iron casing, 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 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 of the hydrocarbon-chamber *d* is the pipe or flue *r*, which communicates with the mixing-chamber *m* at the top of the chamber 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 h^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 is 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 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 a 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 process 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 pipe *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 carrying out my improved process 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 *c*, 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 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-chambers it is generally found that a large amount of heat is taken up by the material in said chambers, so that the heat of such 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 said products of combustion, entering from the pipe *p* into the combustion-chamber *k*, are heated, so that, with the products of combustion rising from the carbon-chamber *h*, they are consumed within the combustion-chamber, a sufficient supply of air to support combustion being provided through the 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 pipe *n*, leading to the storage-tank, 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 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 it 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 generators, 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 hydrocarbon 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 the vaporized solvent and any undecomposed steam, then pass through the pipe *r* to the mixing-chamber *m*, at the upper end of the fixing-chamber 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, and 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 vapors being decomposed into hydrogen, carbonic oxide, light hydrocarbon gases, which gases commingle and interchange with the hydrogen, marsh and olefiant gases, and 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 chamber 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 *l* and a more perfect union of the gases so obtained. These gases, after having been so mixed and fixed, 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 gases, 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 to provide means for highly heating the fixing-chamber *l* and reheating the waste products passing from the hydrocarbon-chambers and utilizing them in heating said fixing-chamber. 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.

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

1. The improvement in the art of forming gas, consisting in blasting a mass of carbon to incandescence, passing the products therefrom through a mass of refractory material containing hydrocarbon and the resultant products over a bed of heated carbon and burning them to heat a body of fixing material, and then passing a current of steam through said first body of incandescent carbon, a current of steam over said incandescent carbon to superheat it, and the mixed superheated steam and gases through the hydrocarbon-bearing material, and then mixing with the resultant gases a liquid hydrocarbon, and passing the gases and vapors first through the heated fixing material, and then through the second body of incandescent carbon, substantially as and for the purpose set forth.

2. The improvement in the art of making gas, consisting in blasting a mass of carbon in one chamber to incandescence and passing the resultant products through a mass of refractory material containing hydrocarbon, and subsequently passing a current of steam through the incandescent carbon and a current of steam over said incandescent carbon to superheat the same, and the mixed superheated steam and gases through the heated hydrocarbon-bearing material, substantially as and for the purposes set forth.

3. The improvement in the art of forming gas, consisting in passing water-gas through a mass of refractory material containing hydrocarbon and the resultant gases through a mass of heated fixing material, and then through a mass of incandescent carbon, substantially as and for the purpose set forth.

4. The improvement in the art of forming gas, consisting in passing water-gas through a heated mass of refractory material containing hydrocarbon, then spraying into the resultant gases steam and liquid hydrocarbon, and then passing the gases and vapors through a heated mass of fixing material and the resultant gases through a mass of incandescent carbon, substantially as and for the purposes set forth.

5. The improvement in the art of forming gas, consisting in passing water-gas through a heated mass of refractory material containing hydrocarbon, then spraying into the resultant gases steam and liquid hydrocarbon, and then passing the gases and vapors through a heated mass of fixing material, 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:
WM. P. MERCER,
BENJ. W. HAINES.