(No Model.)

T. G. SPRINGER.

PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

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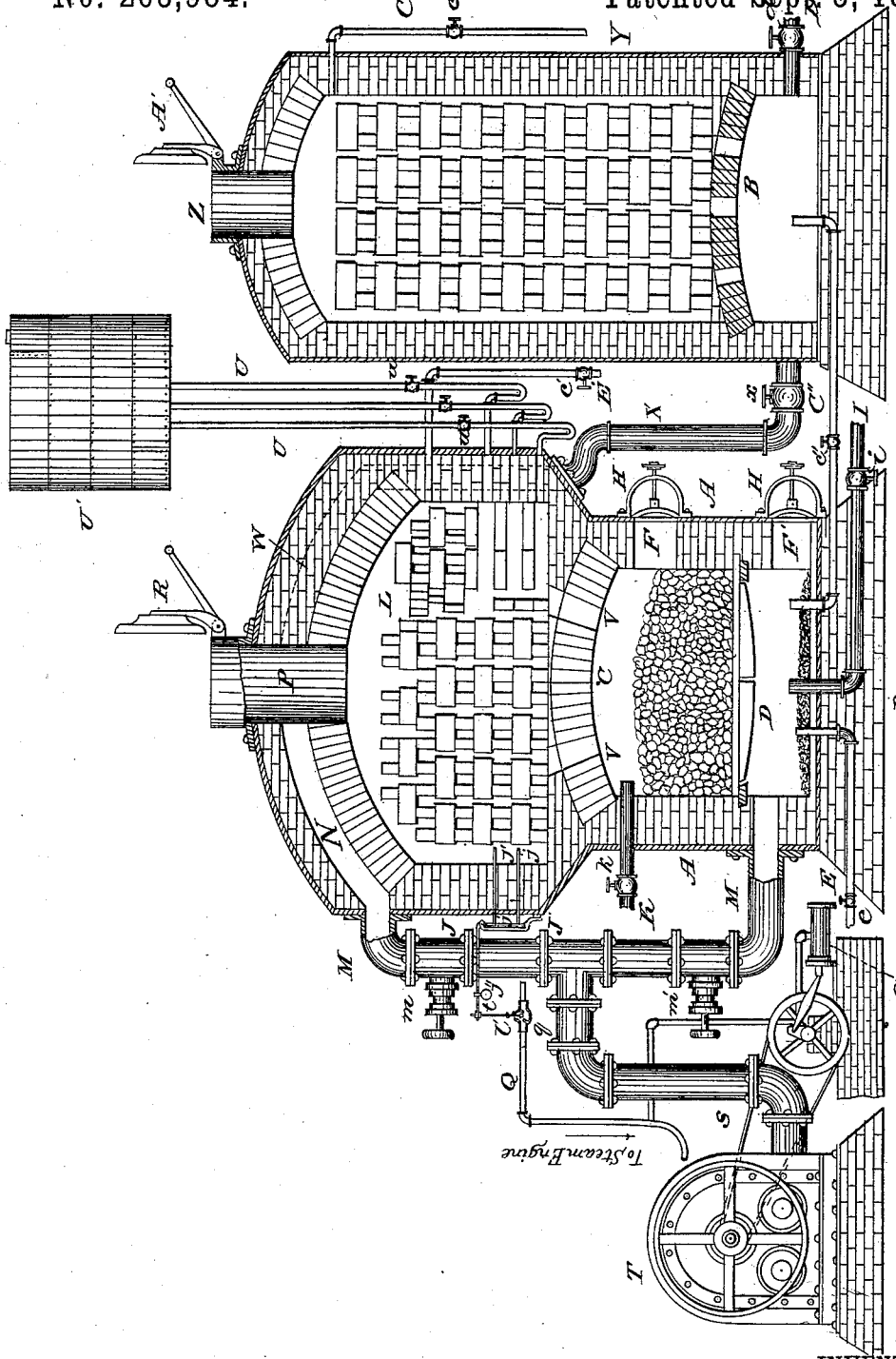

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PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 263,984, dated September 5, 1882.

Application filed August 14, 1882. (No model.)

To all whom it may concern:

Be it known that I, THEODORE G. SPRINGER, of New York, in the county of New York, and in the State of New York, have invented certain new and useful Improvements in Processes of and Apparatus for the Manufacture of Gas; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, and to the letters of reference marked thereon, making a part of this specification.

This invention relates to certain improvements in the manufacture of gas by that process wherein heat from the combustion of carbonaceous material is stored up in a body of refractory material and subsequently employed for decomposing liquid hydrocarbons and forming a permanent fixed gas in connection with the water-gas which is generated by the decomposition of steam by passing the same through the incandescent carbonaceous material previously employed for heating the refractory material.

In the apparatus employed for carrying out such process a combustion-chamber and generator is used in conjunction with a fixing-chamber, the combustion-chamber and generator being charged with carbonaceous material, which is ignited and the combustion urged by a blast of air until it becomes incandescent, the heat developed in raising the mass to incandescence being stored up in the refractory material in the mixing-chamber, the water-gas being subsequently generated by passing steam, superheated or otherwise, through the incandescent carbonaceous material and the resultant gases passed to the fixing-chamber, where they are mixed with the gases generated from liquid hydrocarbon, and the whole decomposed and converted into illuminating-gas.

In this class of apparatus the whole is built upon an extensive scale, in order to save loss of heat from radiation, and this necessitates some means for proportioning the heating to the storing surfaces. It has been demonstrated by practice that the combustion and generating chamber and the fixing-chamber must bear certain relations to each other, as regards their shape and capacity, in order to produce economical and practical results. For instance, the combustion-chamber and generator require to be of such construction as to present a body of carbonaceous material of sufficient depth vertically, or in the direction in which the steam is passed, to insure the thorough decomposition of the steam when passed through it, while the refractory material, on the contrary, requires to be arranged in such manner that the upper and lower portions will be heated as uniformly as possible and at a low temperature compared with that of the generating-chamber, to prevent the vapors or gases resulting from the decomposition of the liquid hydrocarbon from being burned or decarbonized in passing through the said material; and in order to accomplish these objects the first part of my invention consists in a gas-apparatus having a combustion and generating chamber of such proportions as to give the carbonaceous material the proper depth or thickness, and a fixing-chamber of greater horizontal area, so that the refractory material may be distributed laterally to a greater extent and contracted vertically, in order that the upper and lower portions may be as uniformly heated as possible. By such arrangement the heat-storage capacity of the fixing-chamber may be accurately proportioned to the heat-producing capacity of the combustion-chamber and generator, so that the steam, as well as the liquid hydrocarbon, may be thoroughly decomposed and converted into a permanent gas without burning.

Again, it has been found that in order to effectually utilize the stored heat the refractory mass has to be raised to such a temperature at times as to endanger the burning or decarbonization of the liquid hydrocarbon, which constitutes the second part of my invention, and to effect which I employ, in connection with the fixing-chamber, a gas-exhauster, which, by drawing the gases and vapors of the liquid hydrocarbon through the refractory material at a speed proportioned to the temperature of such material affords a means of obviating the above-mentioned defect, as it is evident that the longer the hydrocarbon gases are in contact with the refractory material the greater the heat imparted to such gases will be, and that as the surfaces of the refractory material become hotter the danger of burning the gas will be increased, and that by so proportioning the passage of the hydrocarbon fluid and the resulting vapor through the fixing-chamber a

uniform result in the manufacture of gas may be obtained, however the heat in the fixing-chamber may vary. By the use of a thermostat and proper connections the heat may be caused to regulate the exhaust automatically. Further, it has been demonstrated that the large volume of nitrogen and carbonic-acid gases escaping from the furnace during the periods at which air is blown into the fuel to raise it to incandescence carries off much effective heat, and to obviate this objection I employ a flue or flues in connection with the fixing-chamber, connecting with a regenerating-chamber in which the heat is absorbed for subsequent use, as more fully hereinafter set forth.

In the drawing, the figure represents a vertical sectional view, showing the cupola and regenerator, with the exhauster-engine, oil-tank, and pipes in elevation.

The letter A indicates the walls of my improved apparatus, which are perferably constructed in the form of a metallic shell, mounted upon a base of masonry, B, and lined with fire-brick or other refractory material.

The letter C indicates the combustion-chamber and generator, which is of such relative transverse and vertical dimensions that the carbonaceous material, when the chamber is charged, will be of sufficient depth to thoroughly decompose the steam when passed up through it for the manufacture of water-gas.

The letter F indicates an opening, provided with a door and clamp, H, by means of which it may be closed, the said opening being intended to permit the chamber to be charged with carbonaceous material. The ash-pit D is also provided with a similar opening, F′, and door H′ and clamp for the removal of ashes.

The letter I indicates a blast-pipe for the admission of air below the carbonaceous material in the combustion-chamber and generator, the said pipe having a valve, *i;* and K, a pipe having valve *k* for admitting air above said material. Above the combustion-chamber and generator is located a fixing-chamber, L, which contains refractory material, as usual. The said chamber is of greater horizontal area than the combustion-chamber and generator, in order that the refractory material may be extended laterally and contracted vertically, to obtain the necessary amount of heat-storage surface to decompose the hydrocarbon fluid, and at the same time have it so distributed as to avoid all danger of burning the oil-vapor or fixed gas by the unequal heating of the upper and lower parts of the refractory material, as is the case where the said material is arranged in a high vertical column. To further prevent all danger of burning, the apparatus is provided with a large eduction-pipe, M, having valves *m m′*, which connects with a flue, N, in the arch of the fixing-chamber, the latter connecting with the passage P, through which the fixing-chamber is charged, the passage being provided with a cover, R, for closing it. The lower end of the said pipe connects with the ash-pit, as indicated. The pipe M has a branch pipe, S, extending to an exhauster, T, by means of which the fixed gases may be drawn off when sufficiently fixed and before they have a chance to burn.

The letter U indicates the pipes by means of which the hydrocarbon fluid is admitted to the fixing-chamber, a series of any desired number being employed, so as to admit the hydrocarbon at different points. These pipes are provided with valves *u*, and connect with an oil-tank, U′. The combustion-chamber and generator and the fixing-chamber connect by the usual passages, V.

The letter W indicates a flue, in dotted lines, leading from the passage P to a pipe, X, which is provided with a valve, *x*, and connects with a regenerator, Y. The said regenerator consists of a suitable chamber, having an opening, Z, at the top for charging, which is provided with a cover, A′, by means of which it may be closed. The said chamber is also provided with a perforated arch, B′, near the bottom, and with a pipe, C′, for the admission of steam, which enters near the top, the said pipe being provided with a valve, *c′*.

D′ indicates a pipe entering near the bottom, and provided with a valve, *d′*, for the admission of air.

E indicates a steam-pipe, having a valve, *e*, entering the base of the generating-chamber; and E′ another steam pipe, having a valve, *e′*, entering the top of the fixing-chamber.

A pipe, C″, having a valve, *c″*, connects the base of the superheater Y with the ash-pit D of the generator, for conducting superheated steam to the carbonaceous fuel in the generator.

A thermostatic device, J, is applied to the side of the fixing-chamber, by means of which the operation of the exhauster is automatically regulated and made to run faster or slower in proportion to the temperature of the fixing-chamber, so that when such chamber is at a high temperature the thermostat shall, by its expansion, more widely open a valve in the pipe supplying steam to the engine G running the exhauster, and thus, by the increased supply of steam, cause the latter to run more rapidly and draw the gas more rapidly through the refractory fixing material, thus preventing destructive decomposition or decarbonization of the carbureted gas, which would occur if such gas were allowed to remain too long in contact with the highly-heated refractory material. On the other hand, as the temperature of the superheater is lowered the thermostat acts to reduce the flow of steam to the engine operating the exhauster, causing the latter to run slower, and consequently draw the gas less rapidly through the refractory material, thus providing for retaining the gas long enough in contact with the less highly-heated refractory material to fully fix it. The thermostat consists of two or more metallic rods, *j*, extending horizontally through the walls of the fixing-chamber and connecting with a ver-

tical rod, j', set in a frame, J'. The upper end of this rod is free to move vertically and acts on a lever, j'', fulcrumed at t. To the outer end of the lever is connected the rod l', connected at the lower end to the valve q in the steam-pipe Q. Pipe Q supplies steam to the engine G, which runs the exhauster. It is readily seen that by the expansion and contraction of the metallic rods j j' the lever j'' is oscillated or tilted, opening or closing the steam-valve more or less, and thus controlling the flow of steam to the engine which operates the exhauster, causing it to run faster or slower in proportion to the temperature of the superheating-chamber.

The operation of my invention will be readily understood in connection with the above description, and is as follows: The combustion-chamber and generator being suitably charged, and the carbonaceous material ignited, a blast of air is introduced through the pipe I below said material. Air is then admitted by the pipe K above the mass in order that the products of combustion may be burned. This produces an intense heat, and the intensely-heated gases pass up through the refractory material, which absorbs the heat, the gases finally passing out of the opening P or to the regenerator. When the carbonaceous material is rendered thoroughly incandescent the air-blasts are shut off, the cover shut down, and a current of steam is passed through the incandescent material, the steam being decomposed and converted into carbonic-oxide and hydrogen gases, which pass through the flues V, where they meet with the vapor of the hydrocarbon fluid in the fixing-chamber, which is admitted to the fixing-chamber by one of the pipes U at a point having the proper temperature for the decomposition of the hydrocarbon, and the hot gases and vapors are fixed and converted into illuminating-gas, which passes through the flue N and pipe M, being exhausted by the exhauster, and then passed successively to the scrubber, the condenser, the purifier, meter, and holder.

When it is desired to make water-gas the valve m in the pipe M is closed and the valve m' is opened. Steam is admitted by the pipe E' to the top of the superheating or fixing chamber L and highly heated or superheated by the passage down through the refractory material, the hydrocarbon fluid being at the time shut off. The steam thus superheated is decomposed by the passage down through the incandescent carbonaceous material in the chamber C, resulting in the production of hydrogen and carbonic oxide, which are conducted off through pipes M and S directly to the holder or place of use.

It will be seen from the foregoing description that while it is important to have an extremely high temperature in the combustion-chamber and generator in order to decompose the steam, it is necessary to have a more moderate temperature in the fixing-chamber for the decomposition of the liquid hydrocarbon, which can be decomposed successfully only at a very limited range of temperatures, as, if the temperature falls below a given point, decomposition will not be effected, and if raised very slightly above said point burning and decarbonization of the hydrocarbon results. These objections, as before stated, can be obviated successfully by regulating the size and shape of the combustion-chamber and generator and the fixing-chamber relatively, so that the requisite intensity may be obtained in the said combustion-chamber and the proper moderation in the fixing-chamber. This can be accomplished, as has been seen, by having the combustion-chamber and generator arranged to hold the material in bulk vertically, or in the direction in which the steam is passed, and the fixing material in bulk laterally, the lateral distribution of the fixing material causing the stored heat to be distributed uniformly throughout and reducing radiation to such an extent that the fixing material will retain all the heat uniformly distributed at an almost unvarying temperature that can be accurately and scientifically determined and regulated throughout the entire operation of fixing the gases and vapors, and kept exactly between the limits for successfully decomposing the hydrocarbon fluid without burning or decarbonizing the gas. These relative arrangements of the apparatus are rendered necessary, for the reason that to produce carbonic-oxide gas instead of carbonic acid in the combustion-chamber and generator, and obtain the proper intensity of temperature to heat the refractory material, a proper depth of the carbonaceous material must be obtained, while in order to prevent the gases from being burned in the fixing-chamber the fixing-chamber must have much less depth comparatively. These conditions have been found essential from actual and practical experiment.

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

1. The process of manufacturing gas consisting of the following steps, to wit: raising a body of carbonaceous material to an elevated temperature or an incandescent state by means of a blast of air, burning the products of combustion above the same, stirring the resulting heat at a comparatively-low temperature in a large body, then decomposing steam by passing it through the highly-heated carbonaceous material, and finally fixing the resulting gases and the vapor of liquid hydrocarbon at a more moderate temperature, whereby the burning or decarbonization of the fixed gas is prevented, substantially as specified.

2. In an apparatus for generating gas, the combustion and generating chamber, and the fixing-chamber communicating therewith, the generating-chamber being of suitable dimensions for decomposing steam, and the fixing-chamber of larger lateral dimensions, whereby the depth of carbonaceous material to form the carbonic oxide necessary for heating is pro-

vided for and the proper distribution of the fixing material to prevent destructive decomposition of the oil, vapor, or gas is obtained, substantially as specified.

3. In combination with the fixing-chamber of the cupola, the gas-eduction pipe leading therefrom, the exhauster, and a steam-engine for running the same, a thermostatic regulating device connected to the fixing-chamber and to a valve in the steam-supply pipe connected to the engine, whereby the speed of the exhauster is controlled by the heat of the fixing-chamber and the gas is properly fixed without destructive decomposition or decarbonization.

4. In the manufacture of illuminating-gas, the process of uniformly combining and fixing the water-gas and hydrocarbon vapors and preventing destructive decomposition or decarbonization of the hydrocarbons, which consists in automatically withdrawing the gas faster or slower from the fixing-chamber, and thus retaining it for a shorter or longer period in contact with the heated fixing material in proportion to the heat of the fixing-chamber.

5. The combination, with the fixing-chamber and the combustion-chamber and generator of the apparatus, and the air, steam, and oil supply pipes, of the exhaust-pipe and the exhauster, arranged to operate substantially as specified.

6. In a gas-generating apparatus, the combination of a generating-chamber containing carbonaceous material, and a connected fixing-chamber containing refractory material, the fixing-chamber being greater in transverse area than the generating-chamber, whereby the steam is compelled to pass through a sufficient body of carbonaceous material to be thoroughly decomposed into carbonic oxide and hydrogen, and the resultant gases are diffused laterally to a greater extent than the lateral passage of the steam, so as to decompose the liquid hydrocarbon, and at the same time prevent destructive decomposition of the gas, substantially as specified.

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