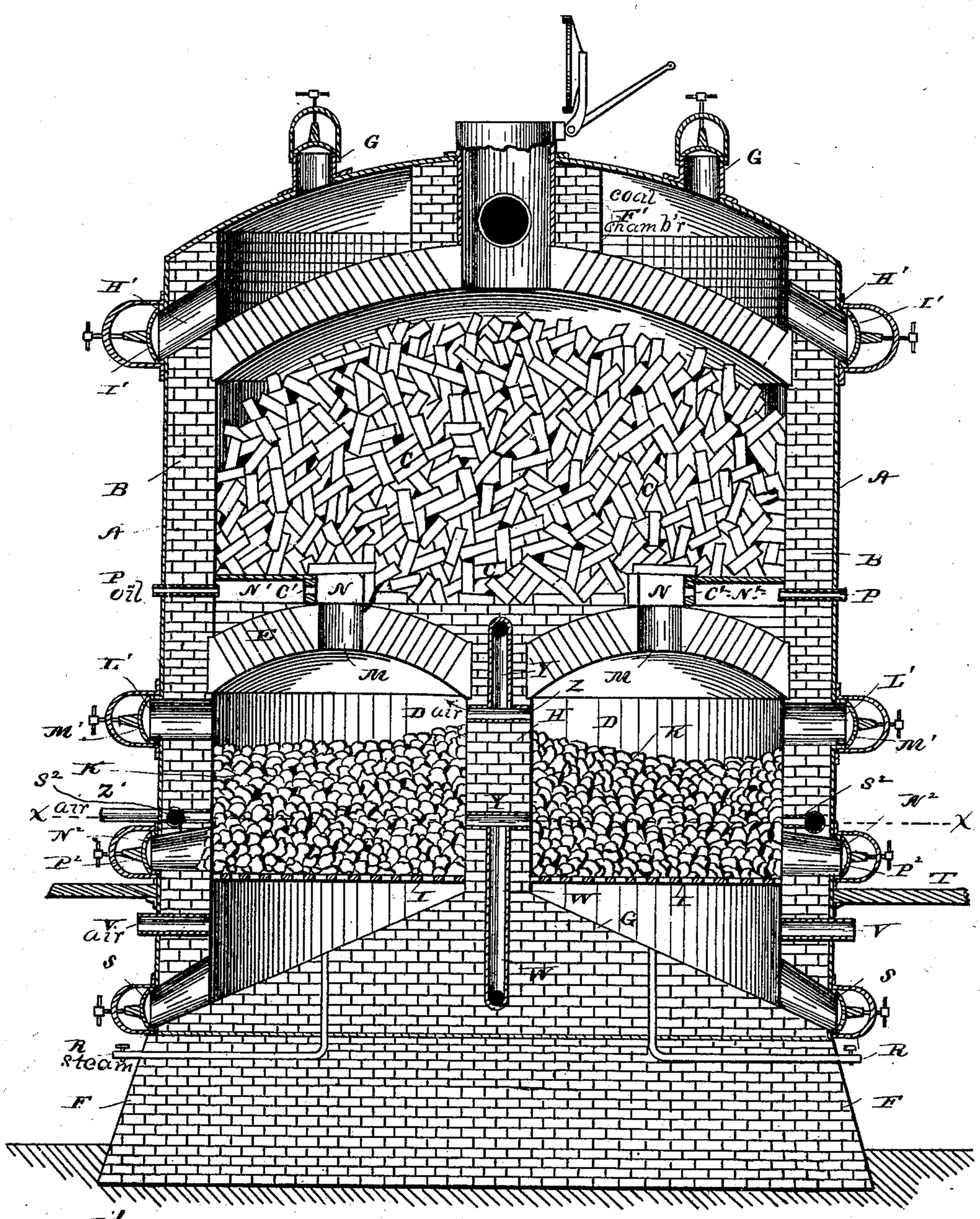
(No Model.) 2 Sheets—Sheet 1.

T. G. SPRINGER.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

No. 257,100. Patented Apr. 25, 1882.

Fig. 1.



Witnesses.
Edwin L. Gerrell.
Chas. L. Combs

Inventor.
T. G. Springer.
By C. M. Alexander. Atty.

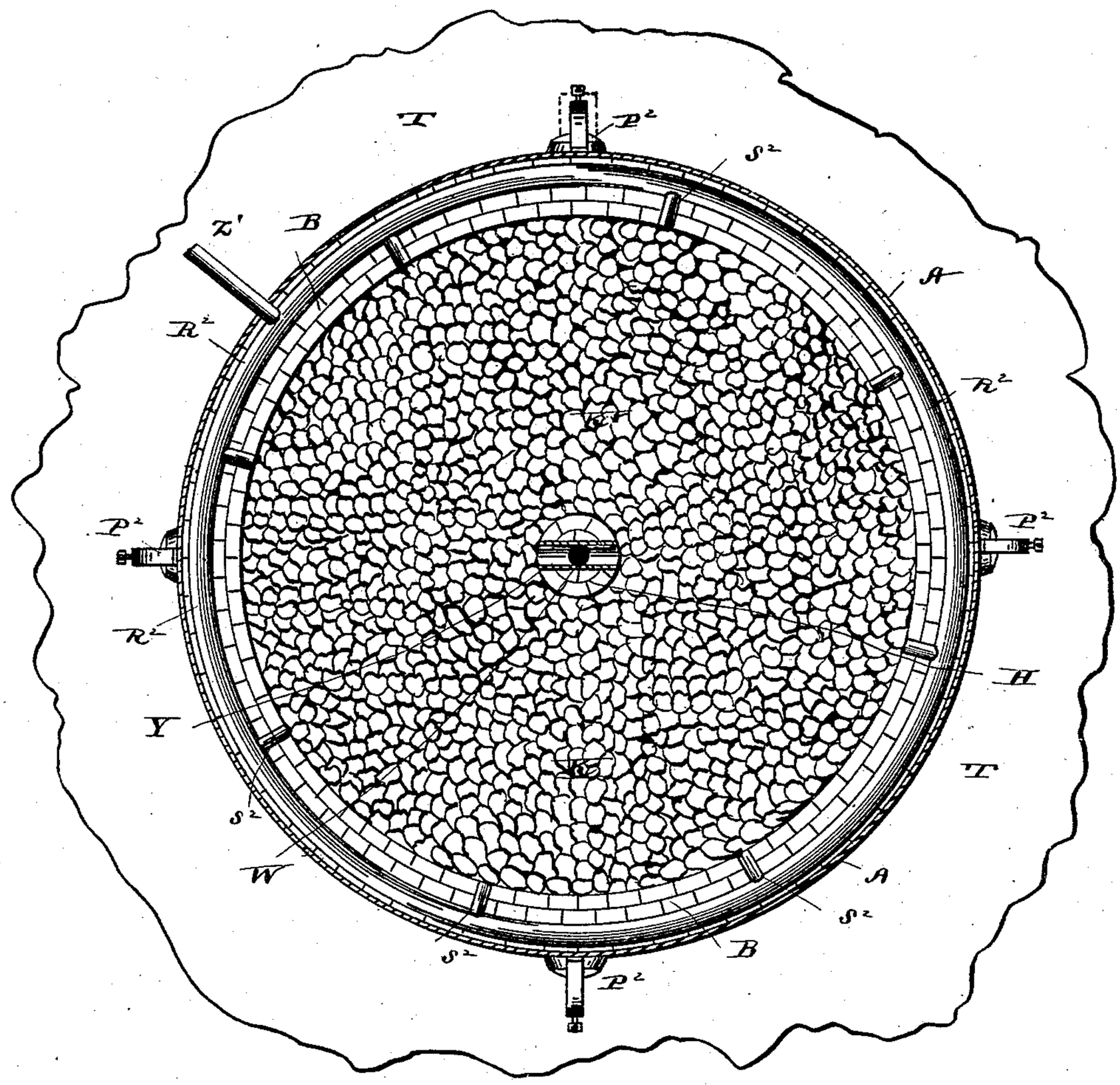
(No Model.) 2 Sheets—Sheet 2.

T. G. SPRINGER.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

No. 257,100. Patented Apr. 25, 1882.

Fig. 2



Witnesses.
Edwin L. Yewell
Chas. L. Coombs

Inventor
T. G. Springer
By C. M. Alexander,
Atty.

UNITED STATES PATENT OFFICE.

THEODORE G. SPRINGER, OF NEW YORK, N. Y.

PROCESS OF AND APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 257,100, dated April 25, 1882.

Application filed January 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 State of New York, have invented certain new and useful Improvements in Process 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 drawings, and to the letters of reference marked thereon, making a part of this specification.

This invention relates to certain improvements in processes and apparatus for the manufacture of gas; and it has for its objects to provide a certain improved process of producing gas from bituminous coal or other gas-producing material by subjecting the same in a large body to the direct action of heat in passing through the mass, whereby loss by radiation is to a great extent obviated, as more fully hereinafter specified; to provide a certain improved process of producing gas from bituminous coal or other gas-producing material and water in conjunction by submitting the coal in a large body or mass to the direct action of heat, uniformly distributed throughout the mass, whereby the light hydrocarbons will be volatilized and converted into mixed vapors and gases and driven off, while the heavy hydrocarbons will meet and be combined with the mixed hydrogen and carbonic oxide or water-gas generated by the decomposition of water, as more fully hereinafter specified.

My invention also has for its objects to provide an improved process of producing gas from bituminous coal or other gas-producing material, in conjunction with water and the various liquid hydrocarbons, by subjecting the coal in a large body or mass to the direct action of heat, whereby the light hydrocarbons are volatilized and partially decomposed and carried off, and in subjecting the heavy hydrocarbons to the action of water-gas in a nascent state in the presence of heat, whereby they are carried off and partially decomposed, and mixing with said gases and vapors the gases and vapors generated from liquid hydrocarbons, and, finally, fixing the commingled gases and vapors by passing the same through a large body or mass of heated refractory material, whereby they are converted into a fixed gas, as more fully hereinafter set forth.

My invention further has for its objects to provide certain means whereby the coal or other gas-producing material may be primarily heated, before being placed in the generator, by means of the radiated heat, and thus further save effective heat; and my invention finally has for its objects to provide certain improvements in apparatus for carrying the above processes into effect, as will more fully hereinafter appear.

In the methods heretofore in use for the manufacture of coal-gas the coal has generally been subjected to destructive distillation in retorts heated from the outside, and as the gas can only be generated at an intense heat these retorts have necessarily been made of limited capacity, in order that the heat may penetrate the whole mass and raise it to the proper temperature. With such retorts, moreover, a uniform temperature cannot be raised and maintained throughout the mass of gas-producing material, since the heat, being distributed from the outside, will always be greatest near the sides of the retorts, rendering the generation of the gas irregular and imperfect. Moreover, while the outer portions of the coal are at a proper heat for the complete conversion of the hydrocarbons of the coal into gas, the central portions are not heated sufficiently for such purpose, resulting in the formation of undecomposed vapors and tar, which pass over and have to be removed from the gas in the hydraulic main and washers, not only causing a loss of gas-producing material, but rendering necessary the employment of expensive and cumbersome apparatus, as well as a large amount of labor in managing such apparatus and handling the waste products. Again, in the old methods of manufacturing coal-gas the retorts have first to be brought to the proper temperature and the coal in a cold state is introduced, not only rapidly reducing the temperature, but giving an initial distillation, which drives off a portion of the hydrocarbon in the form of vapors and tar, which is kept up until the proper temperature for the destructive distillation is reached, up to which time no fixed gas is produced, thus occupying

time and wasting material. Still further, it is found that in the old method of manufacturing the gas in small retorts the solid carbon, which is incapable of being volatilized and by itself converted into gas, remains in the retort in the form of coke. This has to be drawn before the retort can be again used for the manufacture of fresh gas, requiring labor in handling and resulting in a further waste of material. In said old method the undecomposed coke, besides being a comparatively waste product when withdrawn, is in an almost incandescent condition, thus abstracting a large amount of valuable heat that cannot be utilized in the subsequent manufacture of gas, and is dissipated and wholly lost. Furthermore, after the coal has been removed, in order to remove the deposited carbon on the sides of the retort, which adheres with great tenacity, the heat of the fires has still further to be kept up until such carbon can be burned out, which is generally effected by a current of superheated steam, requiring a further waste of heat in its generation, the retorts, besides, during all this time, being useless for the generation of gas.

The present invention is designed to obviate the above-enumerated objections, as well as to secure advantages hitherto unknown in the manufacture of gas, as will be more fully hereinafter explained. These advantages result from the fact that by my present invention of generating the gas by subjecting the coal in mass to the direct action of heat there is comparatively little radiation, for the reason that the radiation is confined wholly to the outside of the mass, or is entirely superficial, while the interior portions of the mass tend to hold the heat in proportion as the cubic volume is increased; also, that by thus subjecting the coal to the action of direct heat in the presence of the combined gases generated by the decomposition of water the hydrogen necessary to combine with and carry off the solid carbonaceous parts of the coal in the form of carbureted hydrogen may be furnished to any desired extent, and by means of the vapors and gases generated from the liquid hydrocarbons and commingled with the gases generated from the coal and water any deficiency of carbon in the coal and water gases generated may be readily supplied, thus bringing and maintaining the gas up to a standard illuminating quality. By my invention not only is all this effective heat saved, but, owing to the comparatively small amount of radiation, the generators, after the charge has been thoroughly converted into gas, can be readily heated up for a fresh charge, and in comparatively little time put into condition for successful operation. Again, in the old process the coal is never subjected to the full effective heat of the fire throughout its entire body, owing to the fact that the heat has to penetrate solely from the outside, first through the walls of the retort and then through the mass toward its center, while in my invention the mass is heated throughout its whole body by distributing the heat directly through the same, thus thoroughly utilizing the whole of the heat at its full intensity.

The objects and advantages above enumerated I attain by the apparatus illustrated in the accompanying drawings, in which—

Figure 1 represents a central vertical sectional view of my improved apparatus, and Fig. 2 a horizontal section taken on the line *x* of Fig. 1.

The letter A indicates my improved generator, which consists of an exterior casing of boiler-iron, preferably of cylindrical shape, and provided with a lining of fire-brick, as indicated by the letter B. The said generator is provided with two compartments, C D, by means of an arched partition, E, of fire-brick or other suitable material, the lower chamber of which I denominate a "combustion and generating chamber," and the upper one a "fixing-chamber." The said generator is supported upon a solid foundation, F, of brick-work or masonry, and the lining of that portion forming the bottom of the generator extends upward into the lower part of the generator, forming a conical floor, G, from which rises a central column of masonry, H, which supports the central portion of the arched partition E. The lower compartment of the combustion and generating chamber is provided with a grate, I, upon which the bituminous coal, wood, or other gas-producing material to be distilled (indicated by the letter K) is supported, the said chamber being charged with the coal or other gas-producing material to about two-thirds of its capacity above the grate, (more or less,) as indicated in Fig. 1 of the drawings. The partition E is provided with openings M, at suitable points, by means of which communication is established with the chamber below the said openings leading into the small chambers N, which communicate by means of the chambers N′ and the pipes P with a reservoir containing hydrocarbon fluid, and by means of which such fluid may be introduced to the apparatus.

The letter R indicates a series of steam-pipes extending through the solid masonry of the base of the apparatus, and terminating at the surface of the conical floor of the same, the outer ends of the said pipes being connected or communicating with a suitable steam-generator, and having suitable cocks or valves, by means of which a regulated supply of steam may be admitted to the generator and permitted to pass up through the incandescent mass of coal, as more fully hereinafter set forth.

The letter S indicates a series of man-holes provided with suitable covers leading to the space below the grate-bars of the generator, through which any débris may be removed, and by means of which access may be had to what may be called the "ash-pit" of the apparatus, for the purpose of removing collections and for repairs, as more fully hereinafter specified. The lower part of the combustion-chamber and generator—that is to say, that portion below the grate—is located below the floor T

of a suitable building or structure, and into such lower portion extends a series of pipes or tuyeres, V, connected with a suitable blower or blast-producing apparatus, by means of which a forced blast of air may be passed up through the gas-producing material, for the purpose more fully hereinafter set forth.

The letter W indicates a vertical pipe or flue extending upwardly through a portion of the solid base of the apparatus and the central column rising from the same. The said flue or tube connects with an air-blast apparatus on the outside, and communicates with the combustion-chamber and generator by means of a transverse branch, X, by means of which air may be supplied to the interior of the mass of coal, so as to keep up the heat of the body thereof, and generate the necessary carbonic oxide to be burned subsequently to heat the fixing-chamber above. Above the said air-tube, and leading downwardly into said column through the central column, is a flue or tube, Y, which is provided with lateral branches Z, leading into the combustion or generating chamber at a point above the gas-producing material contained therein.

The letter M, as before mentioned, indicates the openings through the arched partition separating the combustion or generating chamber from the fixing-chamber, and N a series of chambers formed of loosely-arranged bricks or blocks, so as to provide gas-spaces above such openings, which communicate with the fixing-chamber above. These gas-spaces also communicate by means of suitable openings, C′, with an annular chamber, N′, which connects by means of suitable pipes, P, with a reservoir or reservoirs containing hydrocarbon fluid. These spaces also communicate with the fixing-chamber above, so that the hydrocarbon fluid as it is volatilized and the mixed gases from below will pass upward into the fixing-chamber above, where they will be converted into a fixed gas by the heat stored up in the fixing-chamber, and carried off free from condensable vapors and tar.

Above the arched top of the fixing-chamber is an annular chamber, F′, provided with manholes G′, and suitable covers for closing the same. The said chamber is intended to contain the coal from which the gas is to be ultimately generated, and is intended to furnish a means for heating the coal, initially, so that there will be no loss of time or heat subsequently when the coal is subjected to destructive distillation in the combustion and generating chamber. The said annular chamber, at suitable points, is provided with openings H′, having covers I′, by means of which the coal after being heated may be dropped onto the floor below and charged into the combustion and generating chamber. For this purpose the combustion and generating chamber is provided with a series of doors, L′, which are closed by means of the covers M′, which may be removed and replaced for the purpose of charging said combustion-chambers with the heated coal.

The letter N^2 indicates a series of man-holes provided with suitable covers, P^2, by means of which access may be had to the interior of the combustion and generating chamber, for the purpose of cleaning the same and removing clinkers and other obstructions and collections.

The letter R^2 indicates an annular blast-pipe, provided with tuyeres S^2, by means of which air may be introduced at the outside of the mass of fuel through a pipe, Z′, connecting with said annular pipe R^2.

The operation of my invention will be readily understood in connection with the above description, and is as follows: A fire is started in the combustion or generating chamber, and it is charged with bituminous coal or other gas-producing material, as indicated in Fig. 1 of the drawings. The fire is then urged by a blast of air introduced below the grate, creating an intense heat, the products of combustion passing upward above the incandescent material, where they are met by fresh atmospheric air, and are wholly consumed, the heat generated being absorbed and stored up by the refractory material in the chamber above. As the fuel is burned out fresh fuel is supplied from the heating-chamber at the top of the generator in quantities as required. When the refractory material is heated to the proper temperature the air is shut off and a current of steam is passed up through the incandescent fuel, the lower portion of which consists of coke and the upper part of bituminous coal. The coal on top, while being subjected to destructive distillation, becomes gradually coked and takes the place of the coke below, its place being supplied by fresh quantities of coal or other gas-producing material from the heating-chamber above. The carbureted hydrogen gas and undecomposed vapors pass up into the chamber above, while any heavy hydrocarbons—such as tar and the like—pass downward through the incandescent fuel and are met by the water-gas resulting from the decomposition of the water, mutual decomposition taking place, forming an additional amount of illuminating-gas, which passes upward into the chamber above. As the mixed gases and vapors pass into the chamber above they are met by an incoming current of hydrocarbon vapor, and the whole then passes upward through the heated mass of refractory material, where they are converted into a permanent fixed gas in quantities to supply any required demand.

It will thus be seen that by means of my improved processes and apparatus the tar and condensable products, as well as the coke, are converted thoroughly into gas and no waste products occur.

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

1. The herein-described process of manufac-

turing gas, the same consisting in the following steps, to wit: raising to incandescence a mass of carbonaceous material by a blast or current of air, producing carbonic oxide, burning the carbonic oxide by a blast or current of air above the carbonaceous material; causing the products to pass into a mass of refractory material, and thus highly heating the same, throwing upon the mass of incandescent material carbonaceous gas-producing material sufficient when reduced to coke or charcoal to supply the amount of carbonaceous material consumed during combustion and generation of gas; raising the said mass to incandescence; decomposing steam by passing it through the incandescent material, producing water-gas, causing the water-gas to come into contact with the heavy hydrocarbons being distilled from the carbonaceous gas-producing material, and thus decomposing them and causing recomposition of the different elements; then causing all the gases and vapors distilled to pass through a mass of highly-heated refractory material, where they may be enriched with naphtha and fixed, substantially as specified.

2. The process of generating gas, which consists in subjecting bituminous coal to the direct heat, by contact, of a mass of incandescent fuel for evolving the gaseous vapor from the former, and at the same time decomposing steam by injecting it into the incandescent mass of coke or fuel, and conducting the resulting hot products, hydrogen and carbonic oxide, through the distilling mass of bituminous coal for taking up the heavy tarry vapors therefrom, carbureting the mixed gases and vapor thus formed, while hot, in a separate chamber, and, finally, combining the carbureted mixture into a fixed gas by bringing it into contact with a mass of heated material in a separate chamber, substantially as specified.

3. The method herein described of manufacturing gas, consisting in raising to incandescence a mass of carbonaceous material by a current of air, producing carbonic oxide, then burning the carbonic oxide by a current or blast of air above the incandescent material, causing the products to pass through a mass of some refractory material, highly heating the same, then bringing in contact with the incandescent material bituminous coal or any other solid gas-making material, distilling the gases and vapors from the same by direct heat, then causing the gases and vapors to pass through highly-heated refractory material for the purpose of fixing said gases, substantially as described.

4. The process herein described of manufacturing gas, which consists in raising to incandescence a mass of carbonaceous material by a current of air, producing carbonic oxide; then burning the carbonic oxide by a current or blast of air above the incandescent material, and conducting the hot products into and through a mass of refractory material, thus highly heating the same; then bringing in contact with the incandescent carbonaceous material bituminous coal or other solid gas making material, distilling the gases and vapors from the same by direct contact with hot coke, and at the same time decomposing steam by passing it into the heated coke, and conducting the resulting hot products through the mass of distilling coal for taking up and carrying off the heavy tarry vapors, then causing the commingled gases and vapors to pass through the highly-heated refractory material for combining and fixing them and producing a permanent gas, substantially as described.

5. In an apparatus for generating gas from coal, the combination of the upper and lower chambers and intermediate connecting-chamber, the lower chamber being adapted to contain bituminous coal for distillation, and the upper one refractory material, to store up the heat necessary to fix the gases and vapors passing from the lower chamber, substantially as specified.

6. In combination with the lower chamber of the generator, the conical floor and the grate above the same, and the central column provided with flues for the admission of air into the said chamber, substantially as and for the purposes specified.

7. In combination with the upper and lower communicating chambers, the chambers located above the combustion and generating chamber, wherein liquid hydrocarbon is vaporized and supplied to the gases generated below in a nascent state, and an oil-supply pipe, substantially as and for the purposes set forth.

8. The combination, with the generator or lower chamber, of the heating and annular coal-chambers, located successively above the said generating-chamber, substantially as shown and described.

9. The combination of the upper and lower chambers of the generator, the steam and air induction flues or pipes, the hydrocarbon-fluid chambers, and the coal-heating chamber, the whole being arranged to operate substantially in the manner specified.

In testimony whereof I affix my signature, in presence of two witnesses, this 14th day of January, 1882.

T. G. SPRINGER.

Witnesses:
J. J. McCARTHY,
H. AUBREY TOULMIN.