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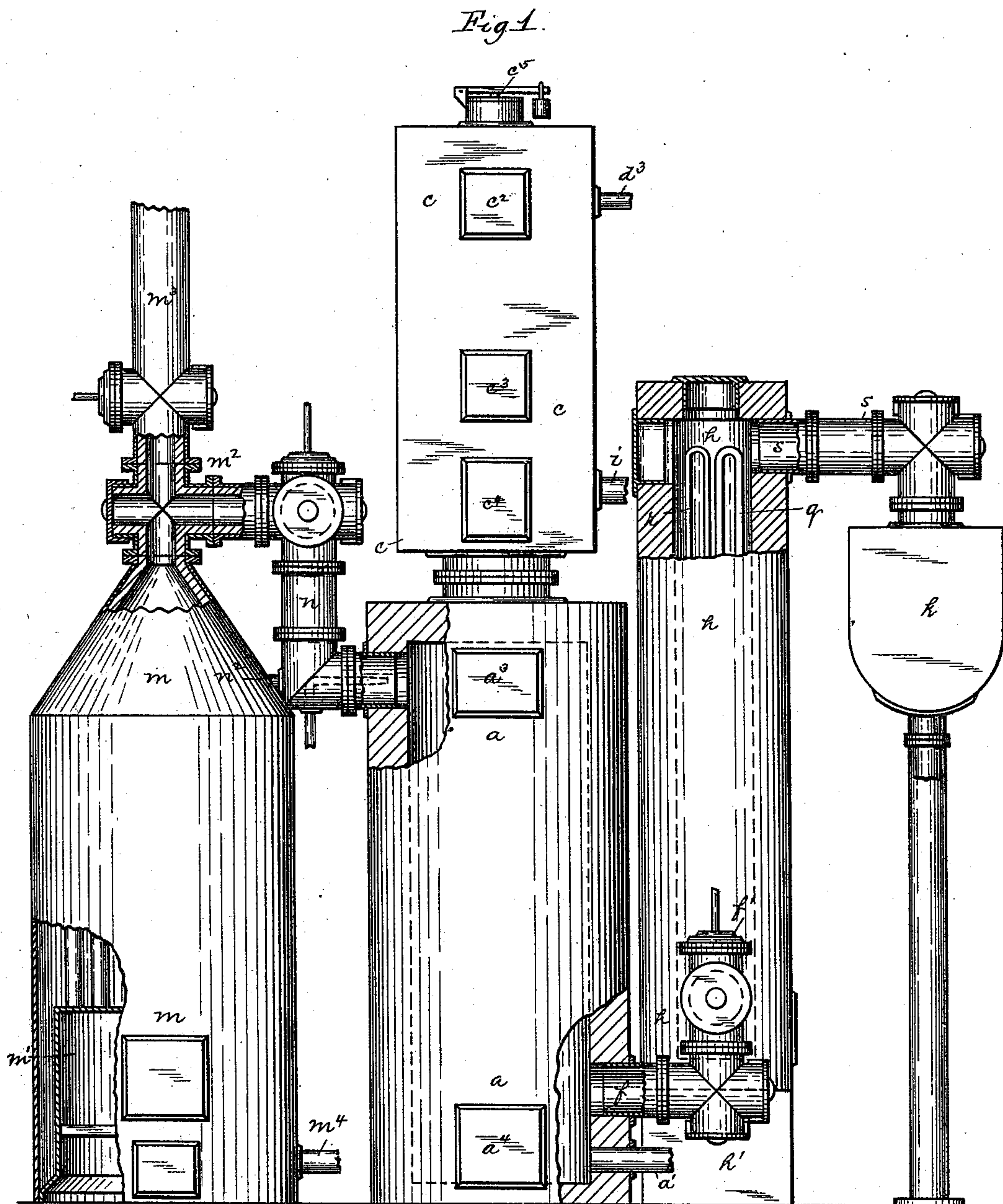
3 Sheets—Sheet 1.

J. M. ROSE.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 408,674.

Patented Aug. 6, 1889.



Witnesses:
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Robt. D. Totten

Inventor
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(No Model.)

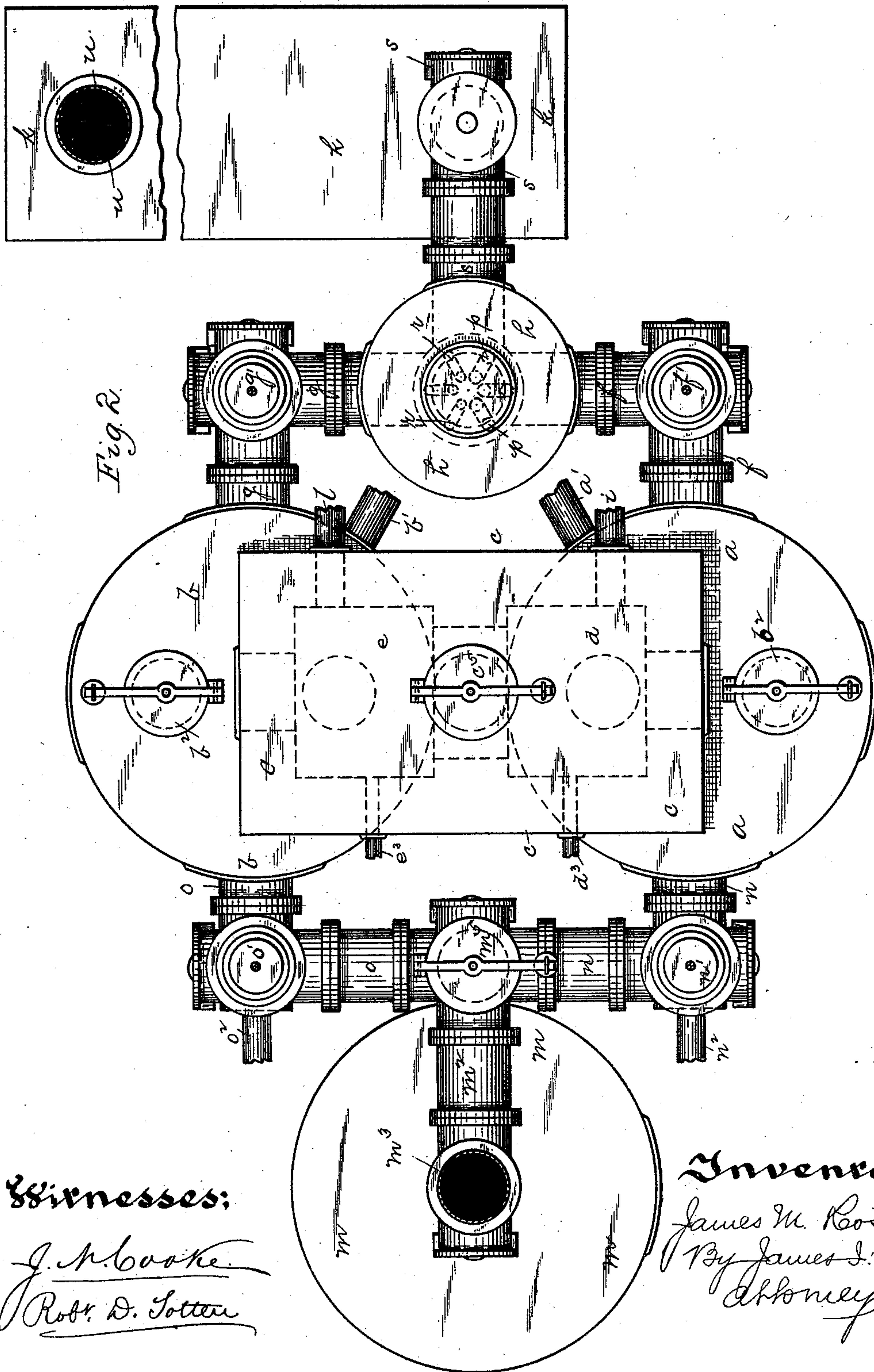
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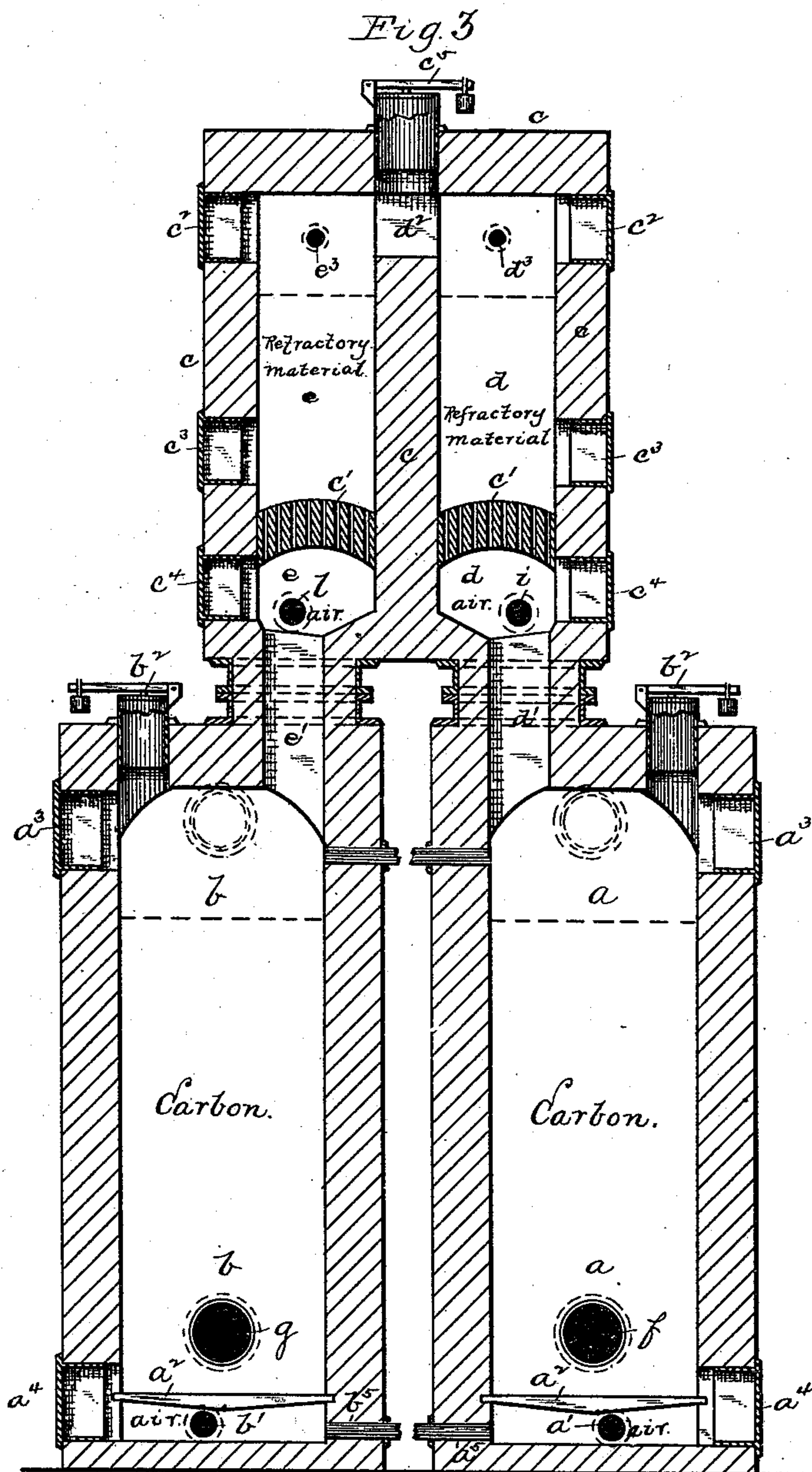
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UNITED STATES PATENT OFFICE.

JAMES M. ROSE, OF ALLEGHENY, PENNSYLVANIA.

APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 408,674, dated August 6, 1889.

Application filed October 4, 1888. Serial No. 287,249. (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 certain improvements in apparatus for the manufacture of gas, said apparatus being substantially applicable to the manufacture of gas by certain processes described in applications heretofore made by me, in which the gases are treated by passing through a body of refractory material, where said refractory material is either previously coated with a heavy hydrocarbon or a liquid or like hydrocarbon is introduced upon or into the refractory material for the treating or enriching of the gases.

The purpose of my invention is to provide a simple and efficient apparatus for such gas-making purposes which shall be compact, and in which the gases or products of combustion employed in generating the steam necessary for making gas in the apparatus can be utilized for gas-making, while the heat of the gases formed is utilized for heating the air and steam employed in the gas-making operations, practically all the heat being thus utilized or retained.

To these ends my invention consists, generally stated, in a gas-making apparatus having two vertical chambers each provided with an air-pipe and outlet-pipe or gas-education pipe at or near the base thereof, a double treating-chamber resting directly upon said generators and having two compartments communicating, respectively, with said two generators and communicating with each other at the top, so that in gas-making the gases generated in one generator can be carried upwardly therefrom into one compartment of the treating-chamber and downwardly through the other compartment thereof, said gases being treated or enriched in said treating-chamber, and the gases can then be carried directly through a body of incandescent carbon in the other generator and thence to the tank, and the course of the gases through said apparatus can be reversed.

It also consists in combining with the gas-making apparatus a steam-generator having its chimney-flue opening into one or the other gas-generator, so that the products of combustion from the fuel utilized in generating the steam can pass into said generator and be subsequently treated to convert them to the gases useful for heating purposes.

It also consists in combining with the gas-generators a heating-chamber containing air and steam pipes, through which chamber the heated gases formed in the apparatus are passed, and are thus utilized while in a heated condition for superheating the air and steam used in generating the gas.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a side view, partly broken away, of my improved gas apparatus. Fig. 2 is a top or plan view thereof; and Fig. 3 is a vertical cross-section on the line $x x$, Fig. 1.

Like letters of reference indicate like parts in each.

My improved gas-making apparatus can be utilized in the manufacture of gas by different processes, some of which have been covered by applications previously made by me and some of which are described in an application of even date herewith, Serial No. 287,148, and an application filed October 16, 1888, Serial No. 288,286, the apparatus being preferably employed in making a generator or producer gas and enriching the same or eliminating the nitrogen therefrom, and some of the methods of employing said apparatus being hereinafter described. The main portion of said apparatus consists of the two gas generators or chambers $a b$, which are set side by side, these two generators supporting the treating-chamber c , containing the two compartments $d e$, and the gas-generator a communicating through the port or flue d' with the compartment d of said treating-chamber, and the gas-generator b communicating with the compartment e thereof through the flue e' , while said compartments $d e$ communicate at the upper end of the treating-chamber through the port d^2 .

Each generator is provided with grate-bars

a^2 and with suitable charging-doors a^3 and discharging or cleaning doors a^4 for removing clinkers and ashes, and each chamber is provided with a safety-valve b^2 , which is
 5 weighted to sustain a considerable pressure, as a high pressure is generally maintained within the apparatus. The chamber a has the air-supply pipe a' communicating with the base thereof, and the generator b has a
 10 like pipe b' , these pipes being controlled by suitable valves and leading from suitable blast apparatus by which a high pressure is maintained; said chambers having also the steam-supply pipes a^5 b^5 communicating with
 15 the bases thereof, respectively, for the purpose hereinafter described. Leading from the said generator a , just above the grate-bars thereof, is the gas-eduction pipe f , while leading from the chamber b is the gas-eduction pipe
 20 g , said pipes f g each communicating with the heating-chamber h , through which the gases formed pass on the way to the hydraulic main k or to the storage-tank. The casings for the said generators a b are made of thick
 25 plate metal, so as to properly withstand the pressure generated within the apparatus, and also to sustain the weight of the treating-chamber c , which rests directly upon said generators a b and is supported thereby.
 30 The treating-chamber c has, as is above set forth, two compartments d e , each compartment having the perforated arch c' and having doors c^2 c^3 c^4 , the doors c^2 and c^3 being used for filling and removing the refractory
 35 material employed therein for treating the gases—such as fire-clay balls, checker-work, or irregular pieces of fire-brick, dolomite, limestone, or hard-burned coke—such materials resting upon the perforated arches c' ,
 40 and the door c^4 being used for examining and repairing the portion of the chamber under the perforated arches c' . In said compartment d of the treating-chamber and under the perforated arch is the air-supply pipe i ,
 45 and in the same part of the compartment e is the air-supply pipe l , these pipes leading from the air-blast apparatus, before referred to, and being controlled by suitable valves. In the upper parts of said compartments d e are the
 50 steam and hydrocarbon injectors d^3 e^3 , respectively, for the introduction of steam and a suitable liquid hydrocarbon, such as coal-tar, Lima oil, or like materials. The said treating-chamber c is also provided with the
 55 weighted relief or safety valve c^5 , which may lead up from the port d^2 between said chambers d e and so provide a means of relieving both said chambers.

Placed in front of the gas-generators in the
 60 apparatus above described is the steam-generator m , which can be of any desired construction, though a suitable vertical steam boiler or generator is preferred for the purpose, and this generator is provided with a
 65 suitable fire-chamber m' , and its chimney-flue m^2 leads by suitable branch pipes n o to the upper part of the gas-generators a b , re-

spectively, said branch pipes being controlled by the valves n' o' and so directing the pas-
 sage of the products of combustion from said
 70 chimney-flue into either gas-generator a or b , as desired. The generator has also the escape-flue m^3 , which can be controlled by suitable damper or valve to permit the direct
 escape of the products of combustion, and, if
 75 desired, a suitable relief-valve m^5 can be arranged either on said escape-pipe m^3 or in the chimney-flue m^2 .

Leading into the pipes n o , respectively, at about the point where they enter the gas-gen-
 80 erators a b , are the steam-supply-pipes n^2 o^2 , which act as injectors to carry the products of combustion into the gas-generators, and also supply a portion of steam to the upper
 part of the gas-generators, as is desirable in
 85 the gas-making operation. The heating-chamber h is formed of a long plate-metal cylinder supported upon suitable foundations h' and lined with fire-brick, as are all the other
 exposed portions of the apparatus, and the
 90 eduction-pipes f g communicate with the base of this heating-chamber, said pipes being controlled by the valves f' g' and carrying the upper gases formed in the apparatus into the
 base of said chamber. Arranged within this
 95 heating-chamber in suitable coil or return pipe form, as may be found best suited for the purpose, are the air-superheating pipes p and steam-superheating pipes r , the said
 pipes having suitable connections for the air-
 100 blast apparatus and for the steam-generator, so that the air and steam passing through them are raised to a very high heat before they are employed in gas-making, and at the
 same time a large portion of the heat of the
 105 gas generated in the apparatus is absorbed and carried back into the apparatus, so acting to save the heat and reduce the temperature of the gases after they are fixed or rendered
 stable and before they enter the hy-
 110 draulic main or washing apparatus k or the storage-tank. Leading from the upper end of said heating-chamber h is the pipe s , which communicates with the hydraulic main k , the
 main receiving the gases as they pass from
 115 the gas-generating apparatus and washing them and removing certain impurities or volatile matter therefrom and the gases pass-
 ing by the pipe u to the storage-tank.

In employing my improved apparatus for
 120 the manufacture of gas the compartments d e of the treating-chamber c are filled with suitable refractory material—such as fire-clay balls of a few inches in diameter, checker-
 work, dolomite, or limestone in irregular
 125 pieces, the fire-clay balls being preferred on account of the ease with which they can be removed—and these materials are preferably coated prior to placing them in said chamber
 with a heavy hydrocarbon—such as coal-tar
 130 asphalt—the said chambers being filled from the perforated arches about up to the port c^2 . The gas-generators a b are filled with coal or coke and a suitable supply of liquid hydro-

carbon—such as coal-tar in liquid form or Lima oil—is placed in the tanks leading to the injectors d^3 e^3 . The apparatus being so arranged, fire is started in the steam-generator m and the gas-generators a b , and the valve controlling the escape-pipe m^3 of the steam-generator and the relief-valves b^2 of the gas-generators and c^5 of the treating-chamber are opened, so that the products of combustion from said steam-generator and gas-generator can have a free escape and will act to gradually heat the materials therein. As soon as a sufficient supply of steam has been generated the air-blast apparatus is started and the air-blast is applied to the steam-generator and to the gas-generators, this being continued until the apparatus is brought to a proper heat for gas-making, the body of coal or coke in the gas-generators being raised to high heat and the refractory material in the treating-chamber c being also highly heated.

Where my improved apparatus is employed for the purpose of making a generator-gas and of utilizing the products of combustion from the steam-generator in making such gas, as soon as the apparatus has been heated up, as above described, the several relief-valves are closed, and the valves controlling the air-blast pipe a' , leading to the generator a , the air-blast pipe m^4 , leading to the steam-generator m , the flue n between the steam-generator and gas-generator a , and the eduction-pipe g are opened, as also the valves controlling the steam-inlets n^2 and d^3 or e^3 , or both, all other valves being closed. As the air passes upwardly through the mass of carbon in the generator a , it forms what is termed "generator" or "producer" gas, and as the air passes upwardly through and supports the combustion of the fuel in the fire-chamber of the steam-generator the heated products, (which have generally been wasted,) where coal is used as fuel, consisting principally of carbonic acid and carbonic oxide, and the nitrogen of combustion, consisting of carbonic acid and the nitrogen carried in by the air, the nitrogen introduced by the air-blast being highly heated in said steam-generator and gas-generator. These gases pass upwardly through the port or flue d' and through the mass of refractory material in the compartment d of the treating-chamber c , and thence through the port d^2 and downwardly through the compartment e , and thence downwardly through the mass of incandescent carbon in the second gas-generator b , and as said gases are passing through the treating-chamber they take up the hydrocarbons supported on said refractory material in said treating-chamber, or they may be enriched by the introduction of liquid hydrocarbon through the injectors d^3 e^3 , or both, or suitable solid hydrocarbons may be introduced upon the surface of said refractory material, whether it is coated or not, and such gases caused to pass through them.

In case it is desired to increase the proportion of carbon in said gases, as it is very desirable where the products of combustion from the steam-generator are treated as above set forth, a limited supply of air is admitted through the air-pipe i at the base of the compartment d of the treating-chamber, as described in an application filed October 16, 1888, Serial No. 288,286. This air is admitted in limited quantities, the oxygen of which unites with the hydrogen of the highly-heated hydrocarbons, which has a greater affinity for it than the carbon, and the carbon is liberated in a thick, rich vapor, which acts to enrich the gases in carbons and assists in converting the carbonic acid of said products into carbonic oxide.

In order to eliminate the nitrogen from the gases formed where the superheated steam passes into the presence of the said gases and there is an excess of carbon, this steam is decomposed, the oxygen uniting with the carbon, while the highly-heated nitrogen unites with the hydrogen or hydrocarbons, and substantially all the nitrogen is thus eliminated from the gases formed. The gases then pass down through the body of incandescent carbon in the generator b and escape therefrom through the eduction-pipe g . This is continued until the heat of the body of carbon in the generator b is lowered, so that it will not act to fix the gases and recarbonize any carbonic acid passing through it, so as to convert it to carbonic oxide when the apparatus is reversed, the proper valves being opened, so that the products of combustion from the steam-generator pass into the gas-generator b and thence, with the generator-gas formed therein, upwardly through the compartment e and downwardly through the compartment d of the treating-chamber c and through the body of incandescent carbon in the generator a , the generators and their contents being raised to a high heat during the passage of the air-blast upwardly therethrough, so as to act for a considerable period to fix and recarbonize the gases when the current is reversed. As the gases formed pass continuously through the heating-chamber h , it is evident that they act to superheat the air and steam employed in the gas-making operation, so that such air and steam absorb from the gases a large portion of the heat, which is carried back into and utilized in making gas, the finished gases being thus utilized for heating the air and steam, and said gases then passing through the hydraulic main k to the storage-tank.

In case it is desired to form and treat water-gas in said apparatus, the apparatus is heated as above set forth, and a current of steam admitted through the steam-pipe a^5 or b^5 at the base of one generator, and the water-gas generated passes through the treating-chamber e and thence through the incandescent carbon in the other generator, and the air-blast may either be utilized simply to heat the ap-

paratus or to form the generator-gas while heating up the carbon in the generator-chambers.

My apparatus can thus be employed in different ways for the manufacture of gas, and it is compact in form, simple, and cheap, and serves to save a large portion of the heat generated in forming gas by superheating the steam and air, while, as it provides for the subsequent treatment of the products of combustion from the steam-generator, the most of steam is reduced to a minimum, or in some cases I am enabled to even profit by the gases formed by the generation of such steam.

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

1. A gas-making apparatus having a cupola gas-generator, a steam-generator containing a grate and fire-chamber and having its chimney-flue opening into the upper end of the gas-generator, and a casing having one or more chambers containing refractory material for

treating the gases and provided with an oil entrance or entrances through which the resultant waste products of combustion and gas from the gas-generator are carried to treat the same, substantially as and for the purposes set forth.

2. A gas-making apparatus having two vertical gas-generators each provided with an air-blast pipe and a gas-eduction pipe at the base, a casing having a double chamber resting on said generators and containing refractory material for treating the gas, the compartments of said double chamber being connected to said generators and with each other, and a steam-generator having its chimney-flue communicating with each gas-generator, 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.