(No Model.) 4 Sheets—Sheet 1.

J. M. ROSE.

APPARATUS FOR THE MANUFACTURE OF GAS.

No. 415,565. Patented Nov. 19, 1889.

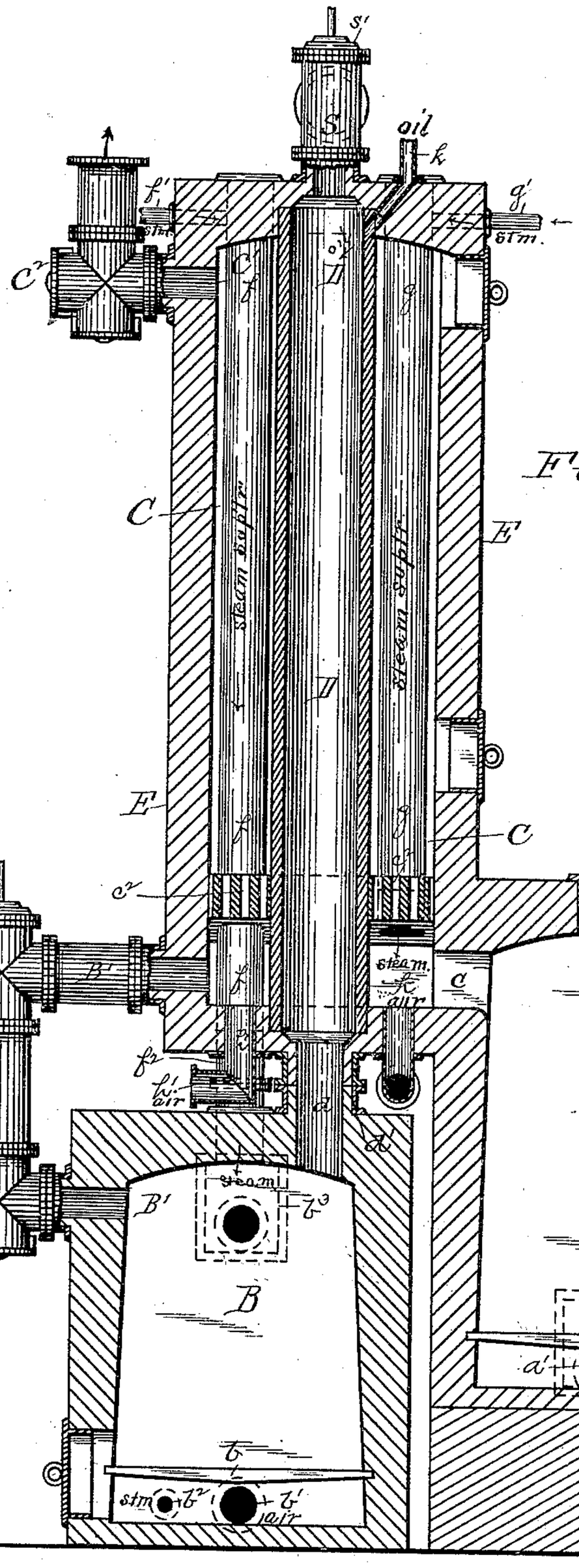

Fig. 1.

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(No Model.) 4 Sheets—Sheet 2.

J. M. ROSE.

APPARATUS FOR THE MANUFACTURE OF GAS.

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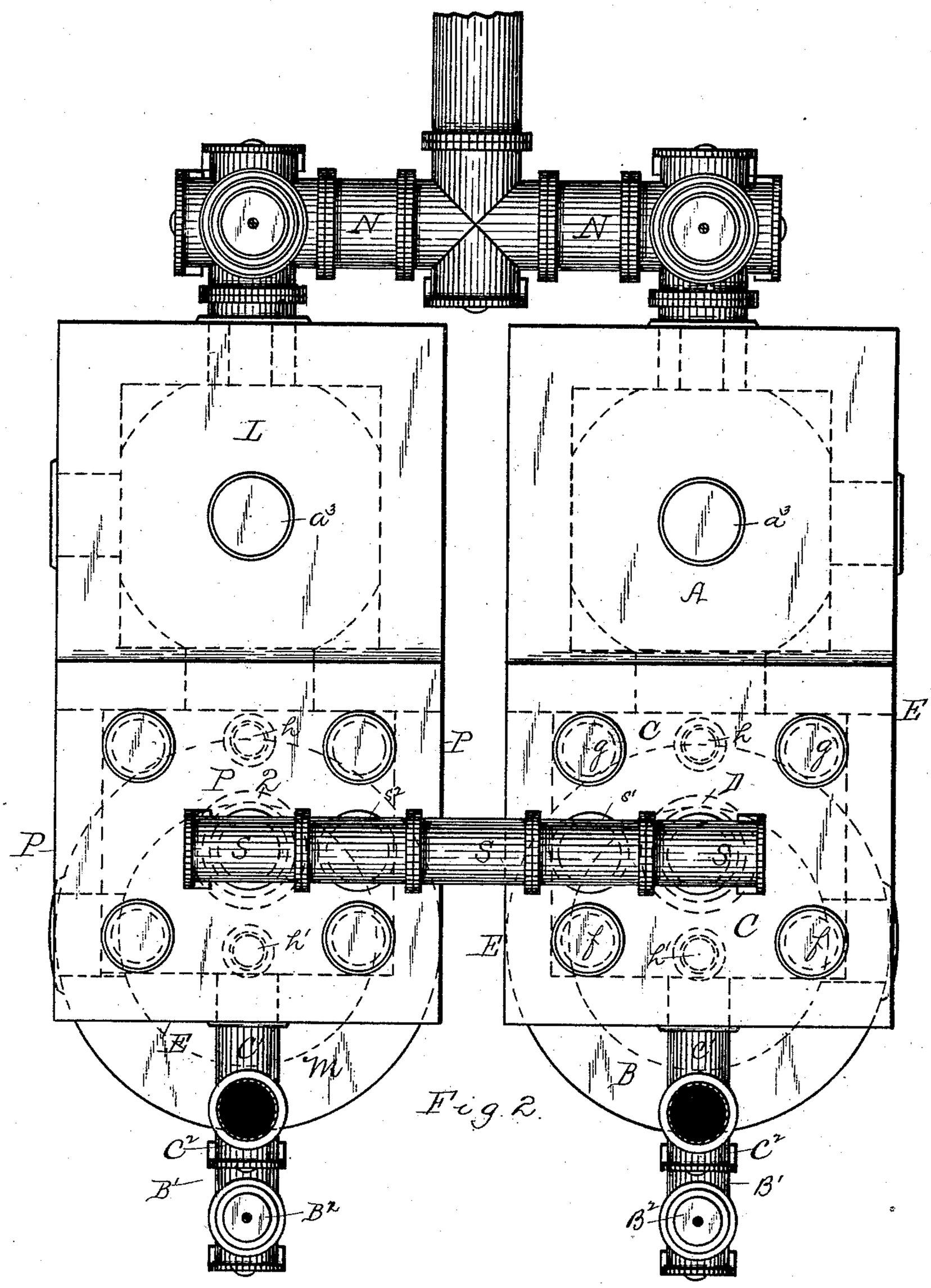

Fig. 2.

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(No Model.) 4 Sheets—Sheet 3.

J. M. ROSE.

APPARATUS FOR THE MANUFACTURE OF GAS.

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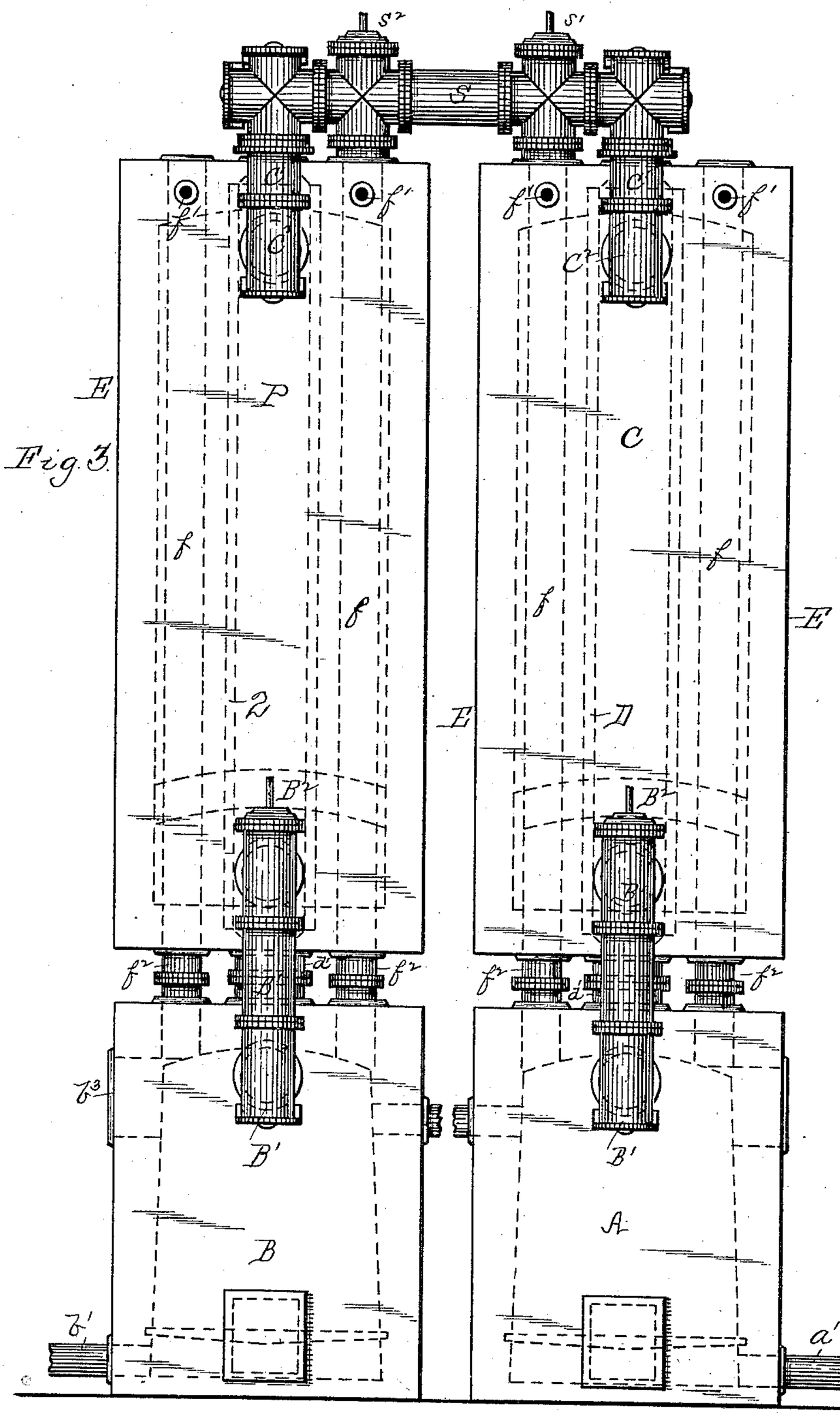
Fig. 3.



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J. M. ROSE.

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No. 415,565. Patented Nov. 19, 1889.

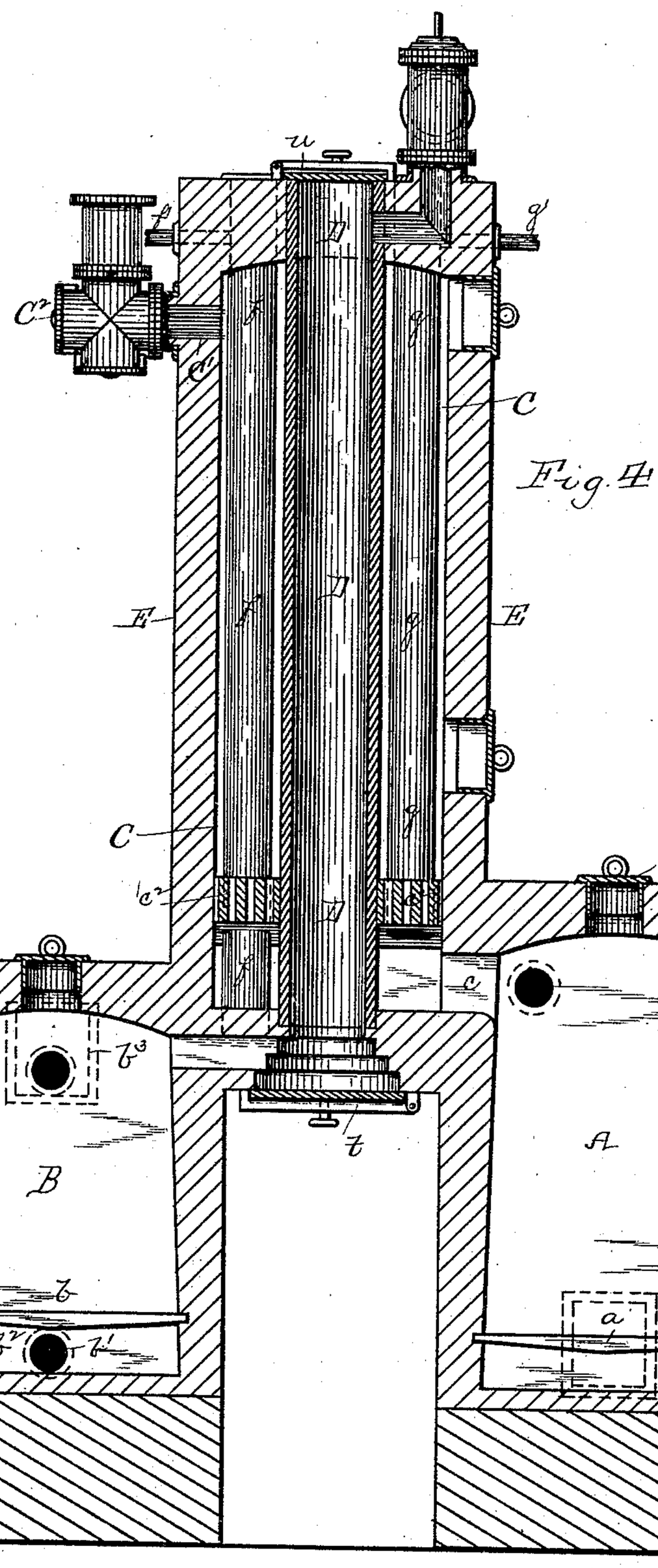

Fig. 4.

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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. 415,565, dated November 19, 1889.

Application filed March 14, 1889. Serial No. 303,314. (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 apparatus for the manufacture of gas, its object being to provide a compact apparatus for that purpose in which there is but little opportunity for the loss of heat by radiation through connecting-pipes, and the parts of the apparatus employed for vaporizing the hydrocarbons can be maintained at such a high heat as to accomplish the desired result without the cooling down of the apparatus so rapidly as to require frequent reversals of the current of gases.

In gas-making apparatus difficulty has been experienced on account of the location of the different parts of the plant in such positions that long connecting-pipes were necessary to carry the gases from one chamber or part of the apparatus to another and in passing through which the gases lost a large part of heat by radiation, while at the same time it had been found very desirable to maintain part of the apparatus, especially the treating-chambers, at a very high heat for both fixing purposes and for the vaporization or breaking up of the coal-tar, crude petroleum, or other liquid hydrocarbon employed in the manufacture of gas.

In the apparatus forming the subject-matter of the present application I have been enabled to produce the result and also to provide a means for the manufacture of an extremely-large quantity of fuel or like gases, and I am also enabled to provide for the distilling off of hydrocarbonaceous material—such as asphaltum and like substances—contained in certain deposits of gravel, sand, or earth, and to employ that material in its natural state in the manufacture of the gas.

To these ends my invention consists, generally stated, in a gas-making apparatus having a vertical iron casing containing a chamber and having a cylinder extending through the chamber, a cupola-generator communicating with the base of the chamber, a cupola-generator communicating with the base of the cylinder, and exit-passages leading from the upper ends of the chamber and cylinder, whereby the gases arising from the one generator may be burned within the chamber and around the cylinder, so acting to heat up the mass of refractory material contained in the chamber and maintaining the cylinder at the proper heat for converting the liquid hydrocarbon into gas; or the gas may be distilled off from the hydrocarbon-bearing material within the cylinder, while at the same time the gases from the second generator can be passed through said cylinder to unite and carry off with them the gases obtained either from the liquid hydrocarbon or the distillation of the hydrocarbons from the material contained within the cylinder.

It also consists in the combining of two such sets of apparatus so connected that while gas is being formed in two or more of the generators one of the generators may be employed for heating up the mass of refractory material and maintaining the cylinder within the chamber at the proper temperature, and all the gases formed may be united and properly fixed to form a permanent gas for either heating or illuminating purposes.

It also consists in certain other improvements in the construction of the apparatus, all of which will be more fully described and claimed.

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 longitudinal central section of one set of the apparatus illustrating my invention. Fig. 2 is a plan view of the same. Fig. 3 is a back view of the same; and Fig. 4 is a longitudinal central section of the apparatus where employed for distilling off the hydrocarbons contained in gravel, sand, earth, or like materials.

Like letters of reference indicate like parts in each.

I will first describe my invention as employed in connection with the manufacture of gas in which liquid hydrocarbons are employed, and subsequently describe it in connection with the manufacture of gas where

the gases are distilled off from gravel, sand, or earth containing hydrocarbon-bearing material. When employed for the first purpose, I prefer to locate the generators and treating-chambers as shown in Fig. 1, there being two generators placed side by side but at different heights, and a casing extending upwardly at one side of one generator and directly above the other generator, so that the one generator may communicate directly with the chamber within the casing, while the other generator may communicate by means of a port or passage in the roof thereof directly with the cylinder or cylindrical chamber passing through the casing, such a construction being described and claimed, broadly, in an application of even date herewith. When so constructed, the generator A communicates with the chamber C of the casing E through the port *c*, and the generator B communicates with the cylinder D through the vertical port or passage *d* in the roof of the generator B and base of the case E and inclosed within the fitting *d'*. The generator A has the ordinary grate-bars *a*, and the air-inlet *a'* and steam-inlet a^2 below the grate-bars, and the feeding-port a^3; and the port or passage *c*, which leads from the upper part of the generator into the base or other part of the chamber C, is preferably a horizontal passage of sufficient width to provide for the free passage of the gases from the generator into the chamber C or in the opposite direction. The generator B has also the grate-bars *b*, air-entrance *b'*, and steam-entrance b^2 beneath the grate-bars, and the feeding-port b^3, which is preferably made in the side of the generator, but may, if desired, be arranged in the top thereof, to one side of the casing E, containing the chamber C. The cylinder D is preferably formed of fire-clay, terra-cotta, or like material, though iron or steel tubing may be used, and where it cannot be formed of sufficient length in one piece may be formed of sections fitted together by suitable joints. The cylinder extends from the base of the chamber C to the top thereof, as shown, so that there is no direct communication between the cylinder and the chamber. The chamber C has also the steam-superheating pipes *f g*, which lead from the top of the chamber downwardly, the pipes *f* preferably communicating with a fitting f^2 of suitable size between the casing E and the generator B, and opening through the top wall of that generator close to the port *d*, or opening directly into said port or cylinder, so that the steam entering said pipes through the steam-entrances *f'* at the upper ends of said steam-superheating pipes may flow downwardly through the chamber C and be highly superheated therein, as hereinafter described, and the highly superheated steam may be fed to the cylinder D, passing into the same with the gases and arising from the generator B. I prefer that the pipes *f* shall open downwardly into the generator B, so that the steam superheated and expanded therein will be injected with sufficient velocity to force part thereof for some distance into the mass of incandescent carbon, so that it is decomposed thereby. The pipes *g* have the steam-entrances *g'* at the upper ends thereof, and said pipes extend downwardly in the same manner as the pipes *f* through the chamber C to the perforated supporting-arch c^2 thereof just above the port or passage *c*, leading from the generator A, so that the superheated steam passing out from said pipes *g* will be intermingled with the gases at the base of the chamber C. The chamber C has also the exit passage or flue C', which is controlled by a suitable valve C^2, and which may be opened so that the products of combustion may be permitted to escape directly into the air through said flue and passage. In order to carry the products of combustion from the generator B into the chamber C, as may be found desirable, such as where it is desired to quickly heat up the gas-making apparatus, I also provide a separate connecting pipe or passage B', leading from the generator B to the said chamber and controlled by a suitable valve B^2, provision being thus made for the passage of the producer-gas, or products of combustion, from both generators into the casing, so that they may be burned therein. In order to provide for the proper combustion of the producer-gas, I provide the air ports or entrances *h h'* at the base of the chamber C, the air-port *h* opening therein close to the port *c*, so as to feed air to the gases rising from the generator A, and the air-entrance *h'* being located close to the entrance of the pipe or passage B', so as to furnish air to the producer-gas from the generator B. The space within the chamber C which is not occupied by the cylinder D and pipes *f g* above the perforated supporting-arch c^2 is filled with suitable refractory material, such as broken fire-brick, fire-clay balls, limestone, or furnace-slag, furnace-slag being preferred for the purpose, as it is found by practical tests that it will hold a greater portion of heat and maintain a more even temperature within the chamber. Like refractory materials may also be employed in the cylinder D, if desired, the cylinder being partially or entirely filled therewith.

Communicating with the upper end of the cylinder D is the oil injector or entrance *k*, by means of which oil or oil and steam may be fed directly to the cylindrical chamber D, and may descend therein against the upward current of the gases, and be vaporized and converted into gas by the high heat at which the cylinder is maintained, as hereinafter described.

In my preferred arrangement of the apparatus I employ two sets of such generators, and for convenience of description I have marked the other set of such apparatus as follows: The generator corresponding to the generator A is marked L, the generator corresponding to the generator B is marked M,

the chamber corresponding to the chamber C is marked P, and the cylinder within the said chamber is marked Q. The construction of the several parts of the said several chambers is the same as above described. In order to arrange for the most economical operation of the gas-making apparatus, I connect the two sets of apparatus through the horizontal cross-pipe S, connecting the upper ends of the cylinders D and Q within the two treating-chambers, this cross-pipe having ports communicating with the chambers C and P, said ports being controlled by valves s' s^2. As so constructed the eduction-pipes N O lead, respectively, from the bases of the generator A and L, said ports being controlled by suitable valves and communicating with a pipe leading to the hydraulic main or storage-tank.

When employing the above apparatus for gas-making purposes, the several generators are filled with coal, coke, or other suitable carbon, and in order to expedite the heating up of the apparatus the pipes B′, leading from the generator B to the chamber C and from the generator M to the chamber P, are opened, and the exit-flues at the upper ends of the chambers C and P are opened. The products of combustion from both the chambers then pass upwardly into the treating-chambers C and P. The air is fed to said products or producer-gas and a very high heat is generated within the said chambers, this heat acting to raise the cylinders and pipes within said chambers to a high heat, and at the same time storing the heat within the refractory material contained within the chambers and around said pipes. As soon as the apparatus is sufficiently heated, the pipes B′ are closed, and in the preferred process of gas-making are not subsequently employed. The escape-flue C′ from the chamber P is then closed, the air-blast closed from the generator L, the eduction-pipe O, leading from said generator, is opened, and the valve s^2, controlling the port leading from the pipes into the chamber P, is opened. Steam is also fed to the several steam-superheating pipes f within both of the chambers C and P, and steam is also fed to the pipes g within the chamber P. Oil, coal-tar, or other suitable liquid hydrocarbon is also fed to the two cylinders D Q, and the air-blast is continued through the three generators A, B, and M.

The air-blast in passing up through the generator A forms producer-gas, and the producer-gas as it passes into the chamber C meets with a second current of air through the pipe h and forms combustion therewith, the highly-heated products of combustion passing upwardly through the chamber C and acting to maintain that chamber and all the pipes passing through the same at a very high heat, and as practically all the heating properties of said gas are thus utilized said waste products are permitted to escape through the exit-flue or passage C′. This is continued during the entire gas-making operation while the gases are flowing in the one direction, and it insures the holding of the gas apparatus at a proper heat for the proper vaporization, breaking up, and gasification of the oil and steam fed to the apparatus within the cylinder D, while at the same time the heat is stored within the surrounding refractory material, so that the said chamber is maintained at a very high heat for gas-fixing purposes and for sustaining heat within the cylinder and pipes passing through the same upon the reversal of the currents of gas. Meanwhile the air-blast within the generators B and M are forming producer-gas, and part of the steam injected from the pipes f downwardly into said generators passes down into the upper part of the incandescent carbon and is decomposed, the carbon being set free and the oxygen uniting with the carbon or carbonic oxide. The gases pass upwardly from the mass of carbon and are intermingled with the rest of the superheated steam, and with it the gases enter the cylinders D and Q. They rise through these highly-heated cylinders and come in contact with the oil descending through said cylinders, acting to quickly vaporize and carry off the lighter portions of the hydrocarbon, while the heavier portions of the hydrocarbon descend into the more highly-heated part of the cylinders and are in the end either entirely broken up and gasified or descend upon the refractory material in the lower ends of the cylinders, or, if such material is not employed therein, directly through said cylinders and upon the incandescent carbon in the generators. The apparatus thus provides means for the formation of a large portion of hydrocarbon gases—such as marsh-gas—as a large portion of steam is being fed to the gases, and this steam is highly superheated, while at the same time the hydrocarbons are practically entirely broken up and the hydrogen of the steam readily unites therewith at the high heat, so that the gases formed are exceedingly rich in marsh-gas and allied hydrocarbon gas. At the same time, as there is a large portion of hydrogen formed from the steam, this hydrogen, being in its nascent state, will unite with the nitrogen, ammonia, and like substances being formed, which will be removed in passing through the hydraulic main, and the nitrogen thus eliminated from the gas. The gases so generated pass upwardly through the cylinders D and Q and enter the horizontal connecting-pipe S, and as the valve s^2 is opened they then pass downwardly into the chamber P and through the highly-heated refractory material therein, which acts to fix the gas. The gases descend through said mass of fixing material to the lower end of said chamber, where they meet a further portion of superheated steam entering through the pipes g, and together pass downwardly with said steam through the incandescent carbon within the generator L,

the steam being broken up and furnishing a still further portion of nascent hydrogen to unite with the carbon or with the nitrogen, and at the same time the oxygen of the steam being carbonized by the incandescent carbon, and any carbonic acid previously formed being reconverted into carbonic oxide. The resultant gases pass outwardly from the base of the generator through the eduction-pipe O to the tank, the gases so formed containing a very large proportion of marsh or allied hydrocarbon gases, and the remaining gases being hydrogen and carbonic oxide, the mass of nitrogen being eliminated in the manner above described. This course of the gases can be continued for a long period, the only change being the cooling down of the masses of incandescent carbon in the generators B and M by the admission of steam thereto and the formation of water-gas, which passes in the same course through the apparatus. At suitable intervals, however, the courses of the gas are reversed through the chambers D and Q, the gas formed in the generator L being burned within the chamber P, so reheating the refractory material therein and raising the pipes and cylinder therein to the desired high heat, while by the reversal of the valves s' s^2 and of the valves in the eduction-pipes N O the gases rising through the cylinders D and Q are carried downwardly through the highly-heated fixing material in the chamber E, and thence through the incandescent carbon in the generator A, and thence through the eduction-pipe N to the tank. In such course of the gases through the apparatus it is to be noted that of the four generators the producer-gas from only one of such chambers is employed directly and only for heating purposes, and the incandescent carbon therein, when properly heated, is employed for fixing the gases when the current is reversed, so that I am enabled to obtain a very large volume of gases from the apparatus, and am enabled not only to maintain the apparatus at the high heat, but to break up all the liquid hydrocarbon fed thereto, causing its union with the gases, and to provide masses of highly-heated fixing material, which serve the double purpose of fixing the gases and of maintaining the heat within the generating-cylinders and the steam-superheating pipes passing through the same.

When a single set of apparatus is employed, the heating up may be rapidly accomplished, as the producer-gas from both the generators can be thrown into the treating-chamber, and in making gas the air-blast may be passed into the generator B, the producer-gas and steam intermingled therewith passed upwardly through the cylinder D, and then from the upper end of the cylinder, through the connecting-pipe S, the gases may be carried downwardly through the surrounding chamber E, and through the body of incandescent carbon in the generator A, and thence to the tank.

It may in some cases—such as in the manufacture of the gas principally for illuminating purposes—be considered undesirable to pass the gases formed through the mass of incandescent carbon to fix them, and in such case where the double set of apparatus is employed the gases may be carried upwardly from one generator through the cylinder, such as through the cylinder D, and thence downwardly through the cylinder Q in the other chamber, and there be intermingled with the gases arising from the generator N, and they may be passed from said generator through the pipe B′, connecting it with the chamber P, into said chamber P, where the gases formed in the generator L may be intermingled therewith, and all the gases passed upwardly through the heated fixing material in the chamber P, and thence to the tank, and on reversal the gases be carried in the opposite direction.

The construction of my gas-making apparatus when employed for the treatment of hydrocarbon-bearing material—such as gravel, sand, or earthy materials containing asphaltum or like heavy hydrocarbon—is practically the same, except that as it is desired to fry or distill off the materials from the same, and to empty the same from the apparatus after all the hydrocarbons have been driven off therefrom, the generator B is placed at one side of the chamber E and communicates through the base of said chamber with the cylinder D, which cylinder D is arranged, as shown in Fig. 4, with a movable base or bottom, as at t, and with a suitable opening u at the top, so that the hydrocarbon-bearing material may be fed at the upper end of the cylinder, and after the hydrocarbons are driven off therefrom it may be removed through the base thereof. In this case the operation of the apparatus is practically the same, except that instead of the introduction of the liquid hydrocarbon into the cylinders the material is retained within the cylinders and the high heat generated around the same fries or distills off the gases from the material carrying the same, while the producer or other gas arising from the generator B and the superheated steam from the pipes in the superheater act to gasify and carry off the hydrocarbons from such materials; and as soon as the materials are exhausted they may be removed from the cylinder by opening the bottom lid t of the cylinder and permitting them to drop out, said lid closed, the cylinder again filled through the opening u and the lid thereof closed, and the operation continued. In my gas-making apparatus I am therefore enabled to utilize such hydrocarbon-bearing materials for gas-making and provide for the manufacture of a very cheap gas in locations where large bodies of such materials are found, such as on the Pacific slope.

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

1. A gas-making apparatus having a vertical casing containing a chamber and a cylinder or pipe extending through the same, a cupola-generator communicating with the base of the chamber, a separate cupola-generator communicating with the base of the cylinder, and exit-passages leading from the upper ends of the chamber and cylinder, respectively, substantially as and for the purposes set forth.

2. A gas-making apparatus having a vertical casing containing a chamber and a cylinder extending through the same, a cupola-generator communicating with the base of said cylinder, an oil-entrance at the upper end of the cylinder, and an exit-passage leading from the upper end of the cylinder, substantially as and for the purposes set forth.

3. A gas-making apparatus having a casing containing a vertical chamber, a cylinder extending through the chamber, a cupola-generator communicating with the base of the cylinder, and an exit-passage leading from the upper end of the cylinder, and a steam-superheating pipe extending through said chamber and having a steam-entrance at the top and opening at or near the base of the cylinder, substantially as and for the purposes set forth.

4. A gas-making apparatus having a casing containing a vertical chamber, a cupola-generator communicating with the base of the chamber, a cylinder extending through the chamber, a second cupola-generator communicating with the base of the cylinder, and exit-passages leading from the upper ends of said chamber and cylinder, respectively, and a steam-superheating pipe or pipes extending downwardly into or through the chamber and having a steam-entrance at the upper end and opening at or near the base of the chamber or cylinder, substantially as and for the purposes set forth.

5. A gas-making apparatus having a vertical casing containing a chamber and a cylinder extending through the same, a cupola-generator communicating with said cylinder, and a separate valve-controlled pipe or passage leading from the cupola-generator to the chamber surrounding the cylinder, substantially as and for the purposes set forth.

6. A gas-making apparatus having two sets of generators and chambers, each comprising a vertical casing containing a chamber and a cylinder extending through the same, and a cupola-generator communicating with the said cylinder and having a connecting-pipe communicating with the upper ends of both said cylinders and provided with valve-controlled passages leading into said vertical chambers, substantially as and for the purposes set forth.

7. A gas-making apparatus having two sets of generators and treating-chambers, each set comprising a vertical casing containing a chamber and a cylinder extending through the chamber, a cupola-generator communicating with the base of said chamber, and a cupola-generator communicating with said cylinder and having a connecting-pipe communicating with the upper ends of the cylinders of each set and provided with valve-controlled passages communicating with said vertical chambers, substantially as and for the purposes set forth.

8. A gas-making apparatus having two sets of generators and treating-chambers, each set comprising a vertical casing containing a chamber having a valve-controlled exit-passage and a cylinder extending through the chamber, a cupola-generator communicating with the base of said chamber, and a cupola-generator communicating with said cylinder, and having a connecting-pipe communicating with the upper ends of the cylinders of each set and provided with valve-controlled passages communicating with said vertical chambers, 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,
E. P. NEWLIN.