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APPARATUS FOR MANUFACTURING GAS.

No. 480,248. Patented Aug. 9, 1892.

Fig. 1.

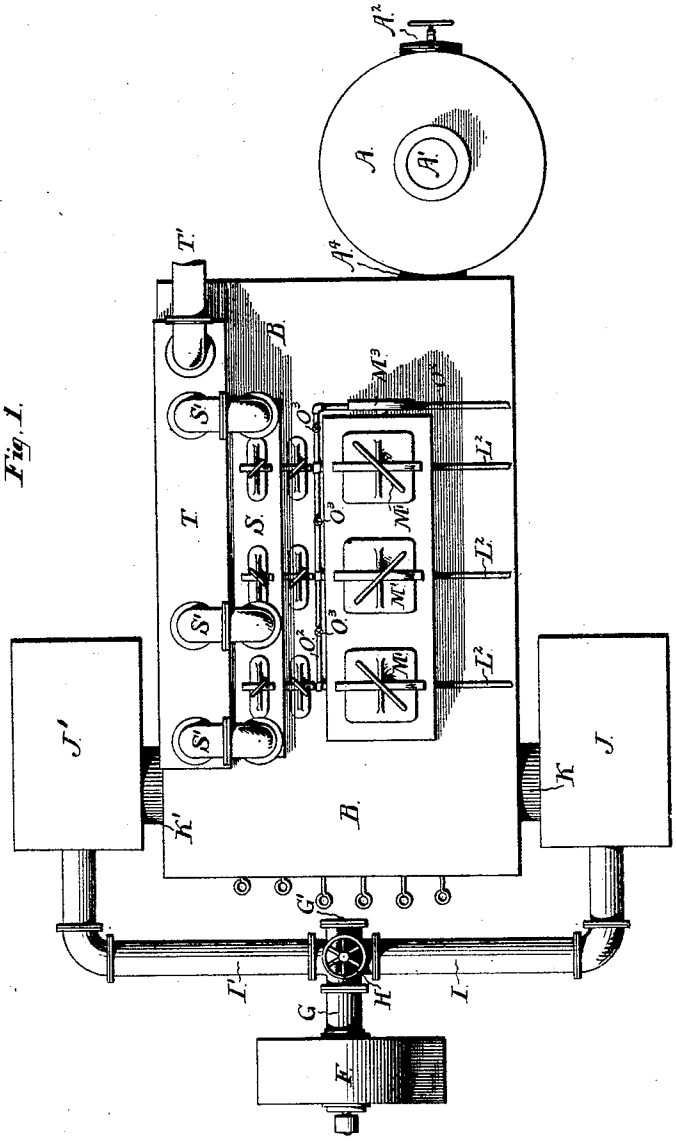

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Fig. 2. 1, 1, 6, Fig 3.

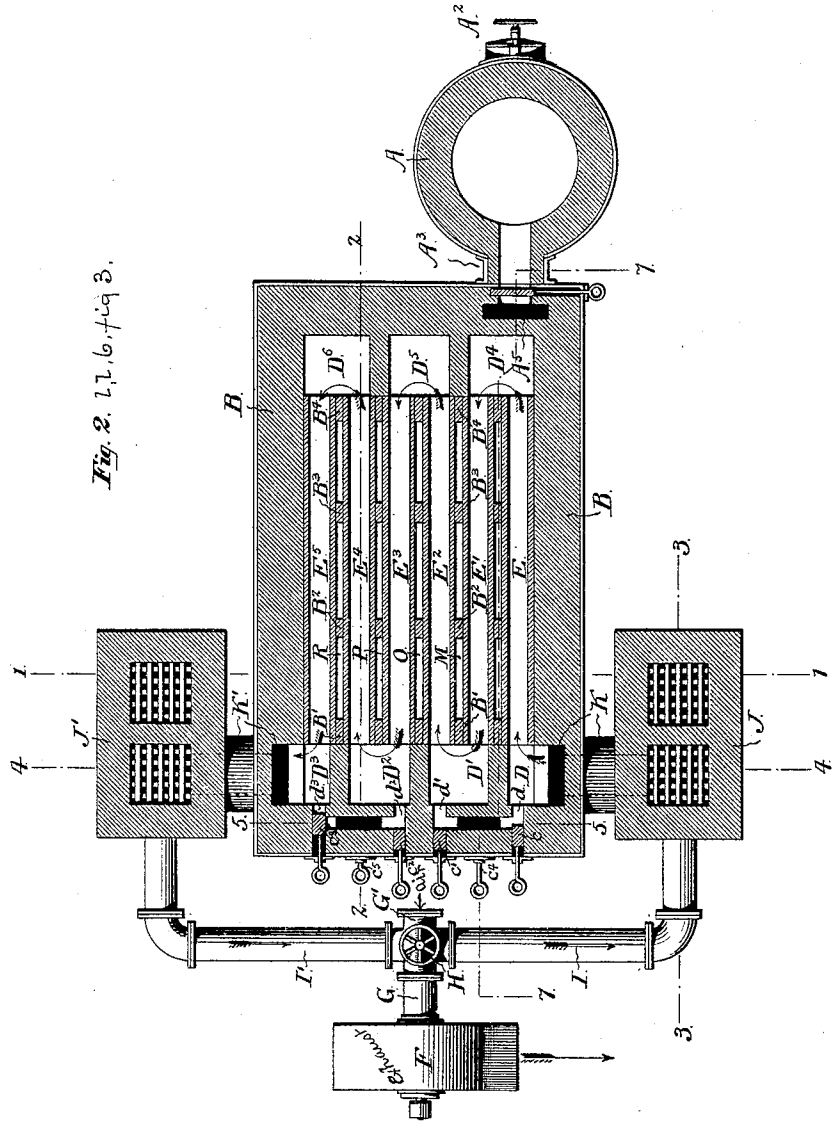
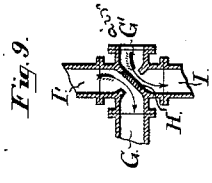


Fig. 9.



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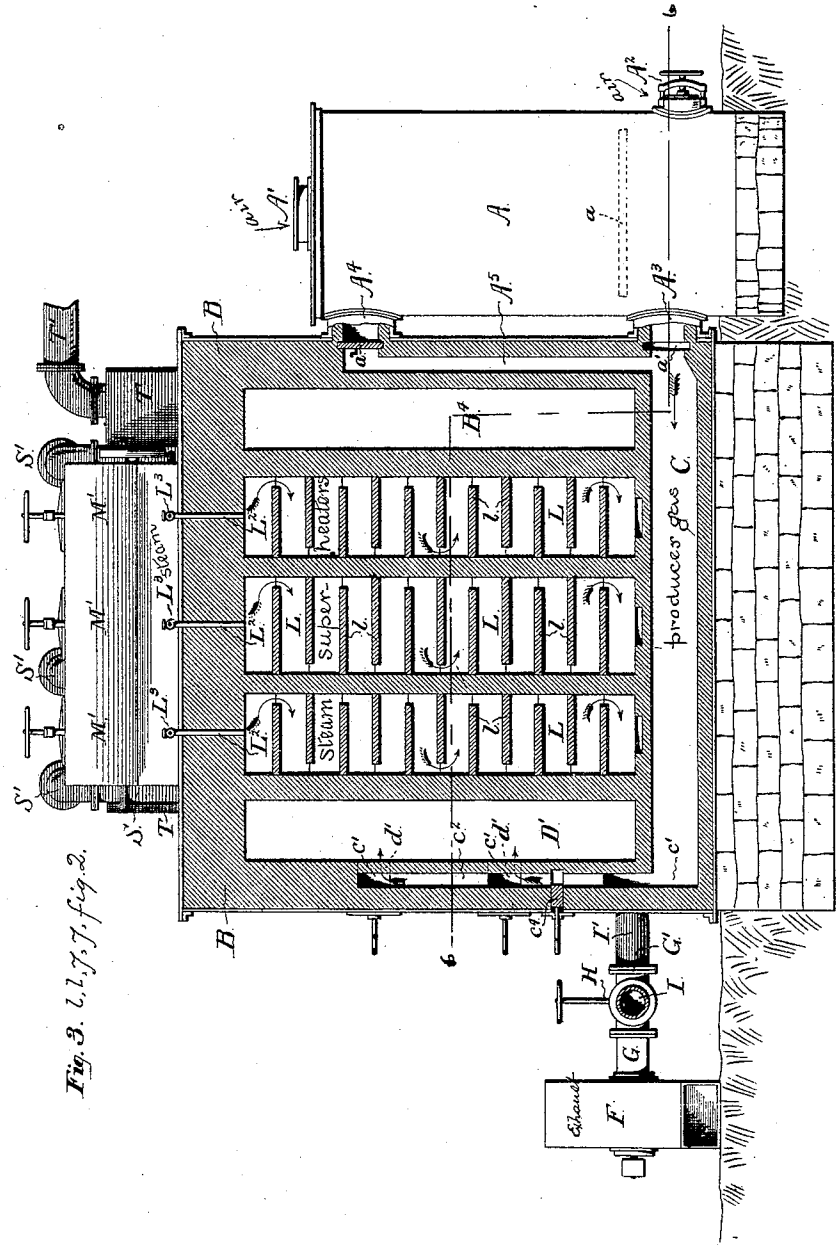

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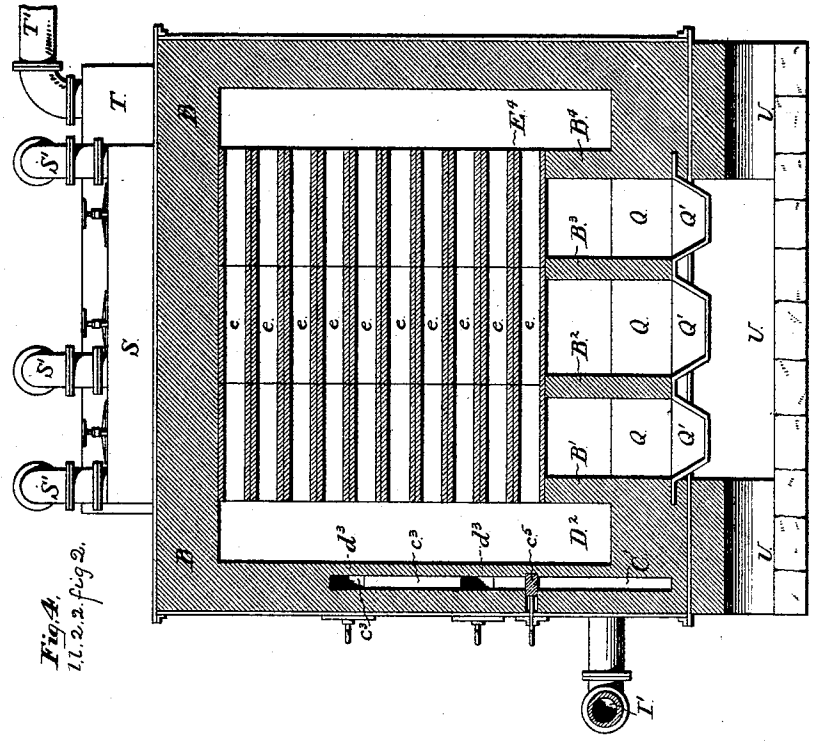

Fig. 4. (1.2.2. Fig 2.)

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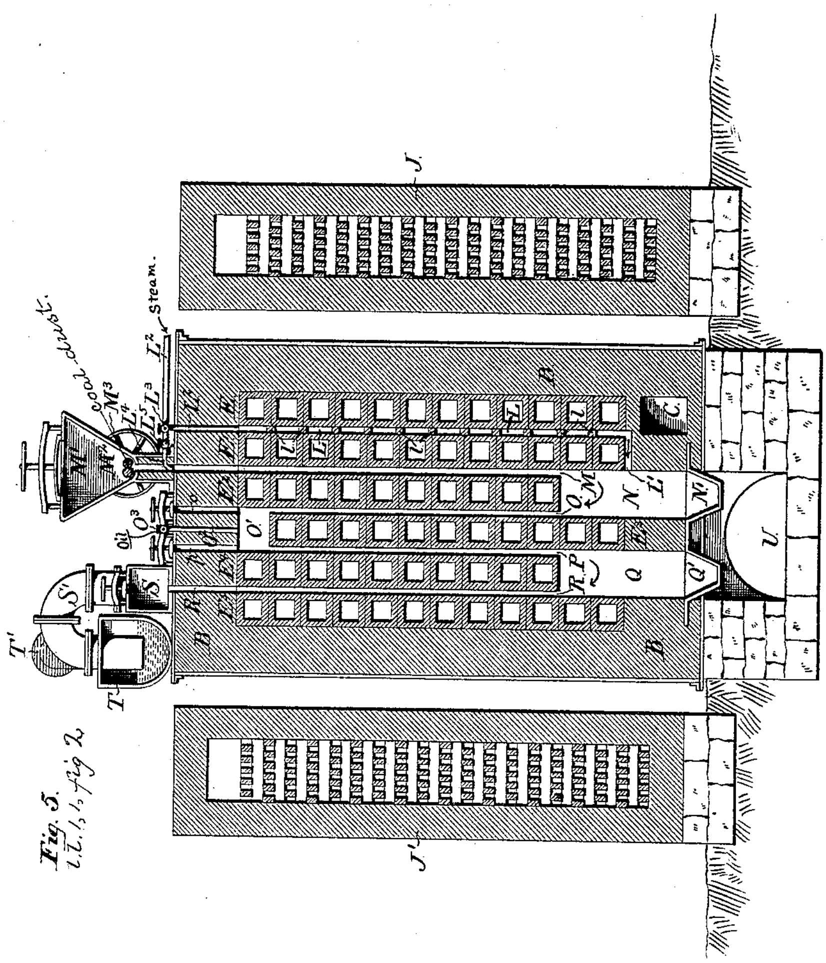

Fig. 5.

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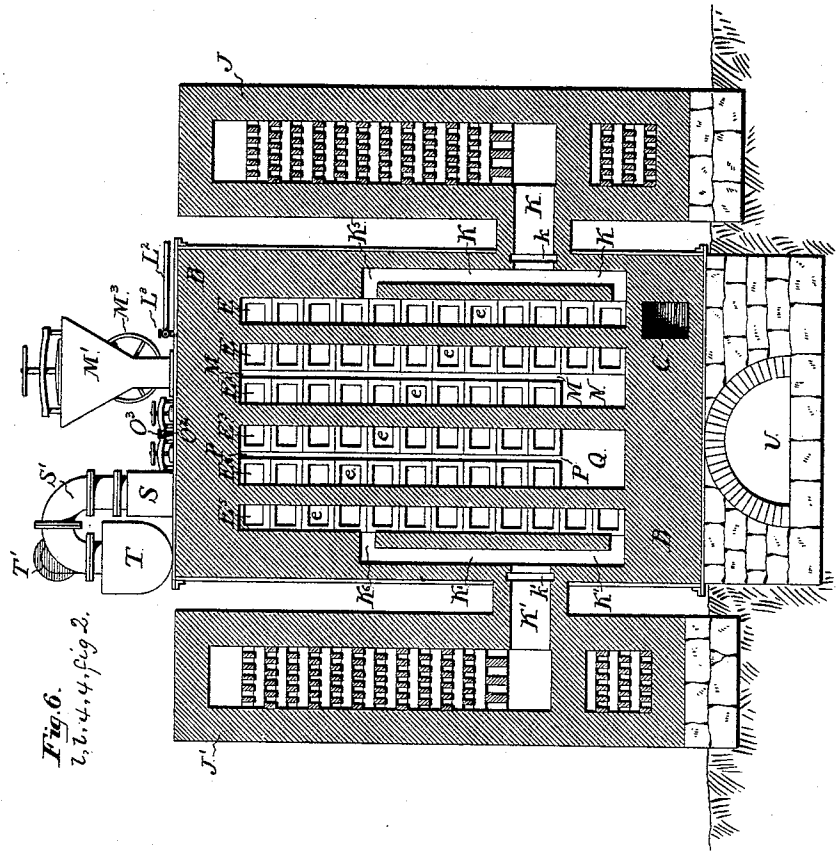

Fig. 6.
1, 2, 3, 4, 5 Fig. 2.

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Fig. 6. 1, 2, 3, 3, fig 2.

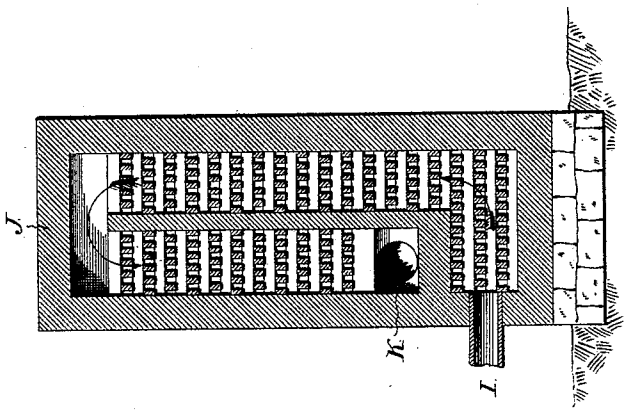
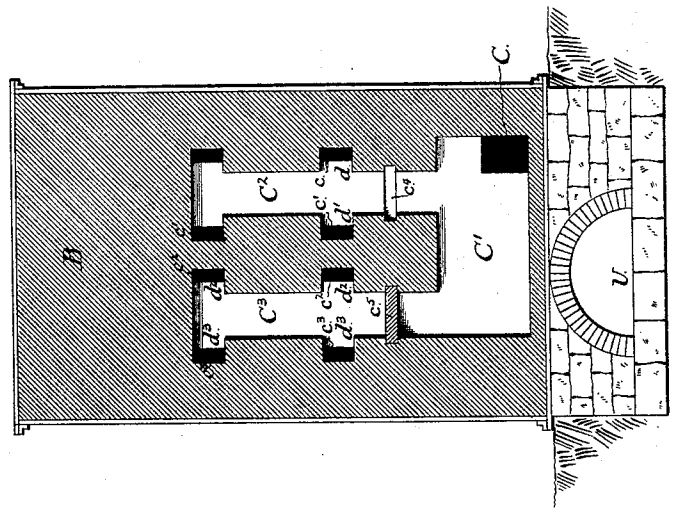


Fig. 7. 1, 2, 5, 5, fig 2.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 480,248, dated August 9, 1892.

Application filed May 5, 1888. Serial No. 272,954. (No model.)

To all whom it may concern:

Be it known that we, JOSEPH H. COLLINS, Jr., of the city and county of Philadelphia, State of Pennsylvania, and ISAAC N. KNAPP, of Greenwich, county of Fairfield, State of Connecticut, have invented a new and useful Improved Apparatus for Manufacturing Gas, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part of this specification.

Our invention relates primarily to the construction of apparatus for manufacturing gas by the practically-continuous destructive distillation of pulverized carbonaceous matter, appliances being preferably used with such apparatus whereby steam at high temperature is brought in contact with the hot carbon residue of the distillation, so as to form by its decomposition carbonic-oxide and hydrogen gas, and provision being also preferably made for the introduction of hydrocarbon oils and for maintaining the mixed gases and vapor at a high heat for a sufficient time to insure the formation of a fixed gas. We have also made certain improvements in producer-gas generators and in the system of burning the producer gas to heat gas-retorts which are especially designed for use with the apparatus before referred to, and which will best be understood after a description of the apparatus shown in the drawings.

The apparatus herein described is designed and intended for the carrying out of certain improvements in the method or process of making gas which we have invented, and which forms the subject-matter of Letters Patent No. 463,139, dated November 17, 1891, the leading features of said process consisting of the continuous production of gas by feeding finely-divided coal-dust or other carbonaceous matter into a narrow vertical and externally-heated retort, so as to effect a destructive distillation of the dust and a high heating of the carbonaceous residue, introducing steam into contact with said heated carbonaceous matter, so as to form water-gas, and, if desired, enriching the gases by the introduction of oil, all of said steps being carried on in externally-heated retorts, so that the production of gas is continuous and uniform for any length of time.

Our present application is intended to cover the mechanical features of what we believe to be the best construction of apparatus for carrying out our said process in its most perfect development, many of said features being, however, capable of useful application independent of each other.

Reference being now had to the drawings which illustrate our invention, Figure 1 is a plan view of a gas-making apparatus having our improvements; Fig. 2, a similar view in section on the horizontal plane indicated by the line 6 6 of Fig. 3. Fig. 3 is a vertical section on the broken line 7 7 of Fig. 2. Fig. 4 is a vertical section on line 2 2 of Fig. 2. Fig. 5 is a vertical section on line 1 1 of Fig. 2. Fig. 6 is a vertical section on line 4 4 of Fig. 2. Fig. 7 is a vertical section on line 5 5 of Fig. 2. Fig. 8 is a similar section on line 3 3 of Fig. 2; and Fig. 9 is a horizontal sectional view of the four-way valve marked H in the drawings.

A indicates a producer-gas generator, as shown in the drawings, and as we prefer to construct it we provide it with two air-admission openings or passages A' and A^2, one above and one below the grate, (indicated at *a* in the drawings,) and each opening being adapted to be closed at will. We also provide it with two gas-exit openings or passages A^3 and A^4, which, like the air-openings, are situated one below and the other above the grate *a*.

a' and a^2 are valves, by which gas-openings A^3 and A^4 can be closed or opened at will, and A^5 is a conduit or flue leading from passage A^4 into the same conduit or flue, (marked C in the drawings,) which leads from opening A^3 and through intermediate flues, &c., hereinafter described, connects it with an exhauster, (marked F in the drawings.) In

normal operation the air-opening A^2 and gas-opening A^4 are closed and the openings A′ and A^3 open. The exhauster then creates a suction in flue C and the air enters the generator through opening A′, passes through the fuel on grate *a*, and the producer gas formed enters the flue C through openings A^3. When it is necessary to clean the fire at the grate *a*, openings A′ and A^3 are closed and openings A^2 and A^4 opened, the suction in flue C then drawing air into the generator through opening A^2 and upward through the fire, the gas passing out through opening A^4 and flue A^5 to the flue C. As will be seen, the generation of gas need never be interrupted where this device is used, a fact of prime importance where, as in our apparatus, an uninterrupted process is to be carried on.

B indicates the main structure of our apparatus. It contains the retorts and heating-flues, and is preferably built of brick inclosed in an iron shell. The flues A^5 and C, already referred to, are formed in this structure, the flue C leading from the generator A to a flue-chamber C′ in the front wall of structure B. (See Figs. 3 and 7.) C^2 and C^3 are upright flues or branches leading out of chamber C′ and having valves C^4 and C^5, by which they can be closed or their opening regulated.

D, D′, D^2, and D^3 indicate upright flue-chambers lying inside the flues C^2 and C^3 and connected with them by means of the flue-passages *d d*, *d′ d′*, d^2 d^2, and d^3 d^3, the flues *d* leading from C′ to D; flues *d′* from C′ to D′; flues d^2 from C^2 to D^2, and flues d^3 from C^2 to D^3, and each of said flues having regulating-valves (indicated at *c*, *c′*, c^2, and c^3.) The duplication of the said flues is advisable, as enabling a better distribution of gas to be effected in the flue-chambers D, &c.

E, E′, E^2, E^3, E^4, and E^5 are vertically-arranged rows of combustion-flues *e e*, &c., preferably made square in section and each row being placed at some little distance from the one adjoining it—say about three inches—so as to form narrow vertical spaces, as shown, and hereinafter referred to as "retorts." The flue-rows E E′, &c., are connected with the flue-chambers D D′, &c., and with similar flue-chambers D^4, D^5, and D^6 at the back of structure B, so as to form a continuous tortuous passage for the gases, as indicated by the arrows in Fig. 2, and we will hereinafter refer to the system of upright flue-chambers D D′, &c., as "connecting-chambers," a name which correctly describes their function.

F is an exhauster; G, a pipe-section connected with the exhauster; G′, a pipe-section opening to the air; I and I′, pipes leading from pipes G and G′, and H a four-way valve, by moving which pipe I is connected with the pipe G and the exhauster and pipe I′ with the air through pipe-section G′, or the reverse connection made at will. Pipes I and I′ lead, respectively, into regenerators—such, for instance, as are indicated at J and J′—the regenerator J being connected by flue K with connecting-chamber D and the regenerator J′ by flue K′ with connecting-chamber D^3, valves *k* and *k′* being provided, so that the opening of flues K and K′ can be regulated at will.

The operation of the above-described heating system of our apparatus is as follows: The valve H is turned, for instance, so as to connect the pipe I′ with the exhauster F and the pipe I with the open pipe G′. The exhauster is then set in operation, with the result of drawing in two currents of air, the first entering the generator A and passing through the fuel therein into flue C as producer gas, which is led to flue-chamber C′ and, the valve C^4 being opened, to flue C^2, from which it is admitted to chamber D through flues *d*. The second current of air is drawn in through pipe-section G′ and passes through pipe I, regenerator J, and conduit K into the chamber D, where it meets the producer gas and supplies oxygen for its combustion. The burning gases are drawn by the exhaust from chamber D through the flues *e* of the vertical row of flues E, thence through chamber D^4 and flue-row E′ to chamber D′, and so on through to the combustion-flues and connecting-chamber, as indicated by the arrows, until from chamber D^3 the gases pass through conduit K′ to the regenerator J′, which they raise to a high temperature, and after leaving which they pass through pipe-section G to the exhauster and thence escape. The combustion in the flues E E′, &c., is regulated by means of the valves shown and before referred to, producer gas being introduced in any or all of the connecting-chambers D, D′, D^2, and D^3, if desired. At intervals the cock H is turned, with the result of reversing the course of the burning gas and air through the flues E E′, &c., and the additional result of causing the air which supports combustion to pass through the regenerator heated up by the products of combustion, while the second regenerator then again begins to store heat.

As we have already pointed out, the vertical rows E E′, &c., of combustion-flues are erected at a short distance from each other, so that a narrow vertical space or chamber is formed between adjoining rows. These chambers are the retorts in which we carry on our process of making gas; and the relative arrangement of retorts shown and which we are about to describe is that preferred by us, but not, as will be recognized, essential; and we would here note that the generator, flue, and regenerator system shown and above described is given by us as in our belief the best for use in heating our retorts and not as essential to the use of said retorts, which might be heated by any convenient system.

L is a vertical, narrow, and externally-heated retort-chamber opening at the bottom into an enlarged chamber N through an elbow L′.

L^2 is a steam-pipe entering the top of retort-chamber L.

L^3 is a valve. *l l*, &c., are baffle-tiles secured in said retort, as shown in Fig. 3. The use of

this retort in our apparatus is as a superheater for steam. M is a similar vertical, narrow, and externally-heated retort, at the top of which is secured a hopper M′, having a feeding device M^2 at its bottom, M^3 being a pulley-wheel for actuating the feeders M^2. We fill the hopper M′ with finely-divided coal-dust or other finely-divided carbonaceous material, and by means of feeder M^2 feed such dust evenly and continuously into the retort M, through which it falls into chamber N. A pipe L^4, with valve L^5, is shown in Fig. 5 to indicate that steam may, if desired, be introduced into retort M as well as coal-dust.

O is a retort-chamber leading out of chamber N; P, a similar retort connected at top with O by passage O′.

O^2 is an oil-injector pipe having a valve O^3.

o and *p* are openings through which retorts O and P can be cleaned.

Q is a chamber into which retort P opens at bottom; R, a retort-chamber leading from chamber Q to a conduit S.

S′ are pipes connecting conduit S with the hydraulic main T in the usual way.

N′ and Q′ are ash-pans.

B′, B^2, B^3, and B^4 are walls which separate the retort-chambers into virtually three independent sets of retort-chambers, the steam-pipes, dust-hoppers, oil-pipes, and exit-conduits being also similarly divided, as is shown, so as to make each division independent of the others. Of course any convenient number of such divisions can be made.

To explain now the operation of our process in the above-described apparatus, the retorts are of course first heated to the necessary temperature and this heat maintained by external combustion, the heating system shown being such as by manipulation of the valves or a reversal of the direction of combustion to enable the engineer to control the temperature of the retorts at will. The finely-divided coal-dust is then fed into the vertical retort M and, falling between the walls thereof, a destructive distillation is effected and coal-gas, together with finely-divided and very hot coke, will issue from the bottom of retort M into chamber N. Steam is introduced into chamber N, preferably through the retort L, already described, so as to heat it very hot, and coming in contact with the hot particles of coke it combines with it, forming water-gas or carbonic oxide and hydrogen and ash, which last falls into the pan N′ and can be removed at will through the openings U. As before noted, steam can at pleasure be admitted into the distillation-retort M, in which case water-gas, as well as coal-gas, will be formed in said retort. The chamber N is made of comparatively-large area compared with the retorts, so that the ash may the more readily settle out of the gases which pass from it through retorts O P, chamber Q, and retort R to the hydraulic main. Where it is desired to enrich the gases, hydrocarbon oil can be introduced, as by pipe O^2. The vaporized oil, passing through the retorts (P and R, as shown) in admixture with the gases, forms a fixed and rich compound gas therewith. The coal-dust can be fed into any number of successive retorts and steam and oil introduced at more than one, the number and arrangement of the connected retorts being, of course, variable at the discretion of the constructor. As ash is to a greater or less extent carried through all the retorts, it will be well to form chambers—such as N and Q—at the bottom of each two retorts and to provide ash-pans in each of said chambers.

Having now described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In a gas-producing apparatus, two sets of vertically-disposed combustion-flues, said sets being spaced at a distance apart substantially equal to the thickness of one of the flue-walls and forming a narrow vertical retort, a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the narrow vertical retort thus formed, a receptacle for solid matter at the bottom of said narrow vertical retort, and a conduit for gas leading from near the bottom of the retort, substantially as described.

2. In a gas-producing apparatus, two sets of vertically-disposed combustion-flues, said sets being spaced at a distance apart substantially equal to the thickness of one of the flue-walls and forming a narrow vertical retort, a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the narrow vertical retort thus formed, an enlarged chamber at the bottom of the narrow vertical retort, a receptacle for solid matter at the bottom of the enlarged chamber, and a conduit for gas, leading from near the bottom of the retort, substantially as described.

3. In a gas-producing apparatus, three sets of vertically-disposed combustion-flues, the proximate sets being spaced at a distance apart substantially equal to the thickness of one of the flue-walls and forming a narrow vertical retort, and the intermediate set being shorter than the other two, and thereby forming an enlarged chamber at the base of the intermediate set, said chamber connecting the narrow vertical spaces between the proximate sets, a feeding device for supplying pulverized carbonaceous material to the top of one of the narrow vertical spaces, and an exit-flue leading from the top of the other of the narrow vertical spaces, substantially as described.

4. In a gas-producing apparatus, a narrow vertical retort, in combination with combustion-flues surrounding said retort for heating the same externally, a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the retort, an enlarged chamber having a receptacle for solid matter at the bottom of the retort, a steam-conduit opening into, and a conduit for gas leading from said enlarged chamber.

5. In a gas-producing apparatus, a narrow vertical retort, in combination with a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the retort, an enlarged chamber having a receptacle for solid matter at the bottom of the retort, a narrow vertical retort provided with baffle-tiles opening at its bottom into the enlarged chamber aforesaid and having a steam-pipe entering its top, a gas-conduit leading from the enlarged chamber, and combustion-flues surrounding the retorts for heating them externally.

6. In a gas-producing apparatus, a narrow vertical retort, in combination with a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the retort, an enlarged chamber having a receptacle for solid matter at the bottom of the retort, a narrow vertical retort provided with baffle-tiles opening at its bottom into the enlarged chamber aforesaid and having a steam-pipe entering its top, a narrow vertical retort leading upward from the enlarged chamber, a suitable gas-exit, and combustion-flues surrounding the retorts for heating them externally.

7. In a gas-producing apparatus, a narrow vertical retort, in combination with a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the retort, an enlarged chamber having a receptacle for solid matter at the bottom of the retort, a steam-conduit leading into said enlarged chamber, a second narrow vertical retort leading upward from the enlarged chamber, a third narrow vertical retort connecting with the second at their tops and having a second enlarged chamber with an ash-receptacle at its bottom, an oil-injector leading into the retorts above the first enlarged chamber, a gas-conduit leading from the second enlarged chamber, and combustion-flues surrounding all of the retorts so as to heat them externally.

8. In a gas-producing apparatus, a narrow vertical retort, in combination with a feeding device for supplying pulverized carbonaceous material in regulated quantity to the top of the retort, an enlarged chamber having a receptacle for solid matter at the bottom of the retort, a narrow vertical retort provided with baffle-tiles opening at its bottom into the enlarged chamber aforesaid and having a steam-pipe entering its top, a third narrow vertical retort leading upward from the enlarged chamber, a fourth narrow vertical retort connecting with the third at their tops and having a second enlarged chamber with an ash-receptacle at its bottom, an oil-injector leading into the retorts above the first enlarged chamber, a gas-conduit leading from the second enlarged chamber, and combustion-flues surrounding all of the retorts, so as to heat them externally.

9. The gas-producer A, having a grate a, air-passages A' and A^2 above and below said grate, and gas-passages A^3 and A^4 below and above said grate, in combination with valves a' and a^2, situated in each gas-passage, a conduit connecting with both of said gas-passages, and an exhauster connected with said conduit and whereby the gas can be drawn from above or below the grate in the producer, according to the arrangement of the valves.

10. In combination with a series of externally-heated gas-retorts, combustion-flues surrounding said retorts, connecting-chambers uniting the combustion-flues, so as to form a continuous conduit passing backward and forward around the retorts, an air-conduit leading into the combustion-flue system at one end thereof, an exhauster arranged to connect with the combustion-flue system at the other end thereof, a gas-producer, a conduit leading from said gas-producer to the combustion-flue system and having gas-passages connected with two or more of the connecting-chambers, and valves whereby said passages are controlled and the gas delivered to the connected chambers at will and in regulated quantity.

11. In combination with a series of externally-heated gas-retorts, combustion-flues surrounding said retorts, connecting-chambers uniting the combustion-flues, so as to form a continuous conduit passing backward and forward around the retorts, two regenerators, each connected with one of the two connecting-chambers at the ends of the combustion-flue system, an exhauster, conduits leading from the regenerators, a four-way valve arranged to connect the exhauster, the regenerator-conduits, and a pipe-section leading to the open air, so that one regenerator will be connected with the exhauster whenever the other is connected to the open-pipe section, a gas-producer, a conduit leading from the producer to the combustion-flues and provided with independent branches connecting, respectively, with the end chambers of said combustion-flue system, and valves to control the flow of gas through said branches.

12. In combination with a series of externally-heated gas-retorts, combustion-flues surrounding said retorts, connecting-chambers uniting the combustion-flues, so as to form a continuous conduit passing backward and forward around the retorts, two regenerators, each connected with one of the two connecting-chambers at the ends of the combustion-flue system, an exhauster, conduits leading from the regenerators, a four-way valve arranged to connect the exhauster, the regenerator-conduits, and a pipe-section leading to the open air, so that one regenerator will be connected with the exhauster whenever the other is connected to the open pipe-section, a gas-producer having a grate, two air-inlet passages, and two gas-exit passages, one of each situated above the grate and one of each below said grate, valves arranged to close and regulate each of said gas-passages, a conduit leading from the producer, and connected with both gas-passages thereof, to the combustion-

flues and provided with independent branches connecting, respectively, with the end chambers of said combustion-flue system, and valves to control the flow of gas through said branches.

13. In a gas-producing apparatus, the combination, with a system of narrow vertical retorts connected together and provided with devices for feeding in pulverized fuel and injecting steam, substantially as specified, of combustion-flues arranged in and forming the walls of the retorts, connecting-chambers at the ends of the retorts, arranged with the combustion-flues so as to form a continuous conduit passing around each retort in the system, an air-conduit leading into the combustion-flue system at one end thereof, an exhauster arranged to connect with the combustion-flue system at the end opposite to that at which the air-conduit enters it, a gas-producer, a conduit leading from the gas-producer to the combustion-flue system and having passages connecting with all the connecting-chambers on the side of the retorts where the air enters said system, and valves arranged in said passages, whereby the gas can be directed into any of the connecting-chambers at will and in regulated quantity.

14. In a gas-producing apparatus, the combination, with a system of narrow vertical retorts connected together and provided with devices for feeding in pulverized fuel and injecting steam, substantially as specified, of combustion-flues arranged in and forming the walls of the retorts, connecting-chambers at the ends of the retorts arranged with the combustion-flues so as to form a continuous conduit passing around each retort in the system, two regenerators connecting, respectively, with the chambers at the two ends of the combustion-flue system, an exhauster, a four-way valve having one port connected with the exhauster, one with the air, and its other two with the two regenerators, respectively, and all so arranged that one regenerator is connected with the exhauster and the other with the air alternately, a gas-producer, a conduit leading from the gas-producer to the combustion-flue system and having gas-passages connecting with the two ends of the combustion-flue system, and valves for controlling said passages.

15. In a gas-producing apparatus, the combination, with a system of narrow vertical retorts connected together and provided with devices for feeding in pulverized fuel and injecting steam, substantially as specified, of combustion-flues arranged in and forming the walls of the retorts, connecting-chambers at the ends of the retorts, arranged with the combustion-flues so as to form a continuous conduit passing around each retort in the system, two regenerators connecting, respectively, with the chambers at the two ends of the combustion-flue system, an exhauster, a four-way valve having one port connected with the exhauster, one with the air, and its other two with the two regenerators, respectively, and all so arranged that one regenerator is connected with the exhauster and the other with the air alternately, a gas-producer having two air-inlet passages, a grate, and two gas-exit passages, one of each situated above the grate and one of each below said grate, valves arranged to close and regulate each of said gas-passages, a conduit leading from the gas-producer, and connected with both gas-passages thereof, to the combustion-flue system and having gas-passages connecting with the two ends of the combustion-flue system, and valves for controlling said passages.

16. In a gas-producing apparatus, substantially as specified, the combination of the parallel vertical flue-rows E E′, &c., made up of square flues *e e*, &c., and placed so as to form a series of narrow retort-chambers between adjacent flue-rows, connecting-chambers arranged to unite the flues into a continuous conduit, and one or more partition-walls separating the series of retorts into two or more independent series, so that the manufacture of gas can be stopped in the retort system on one side of said partition without interfering with the operation of the retort system on the other side thereof.

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