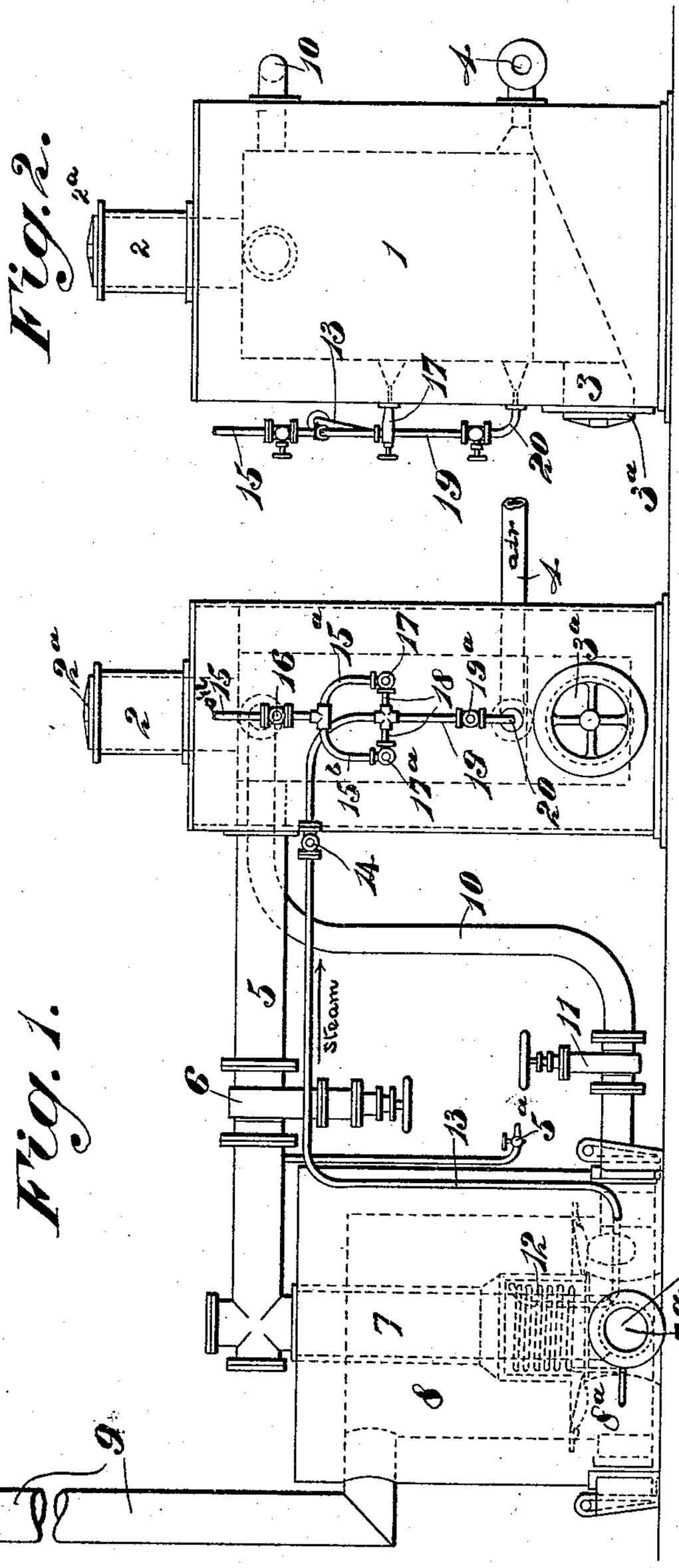
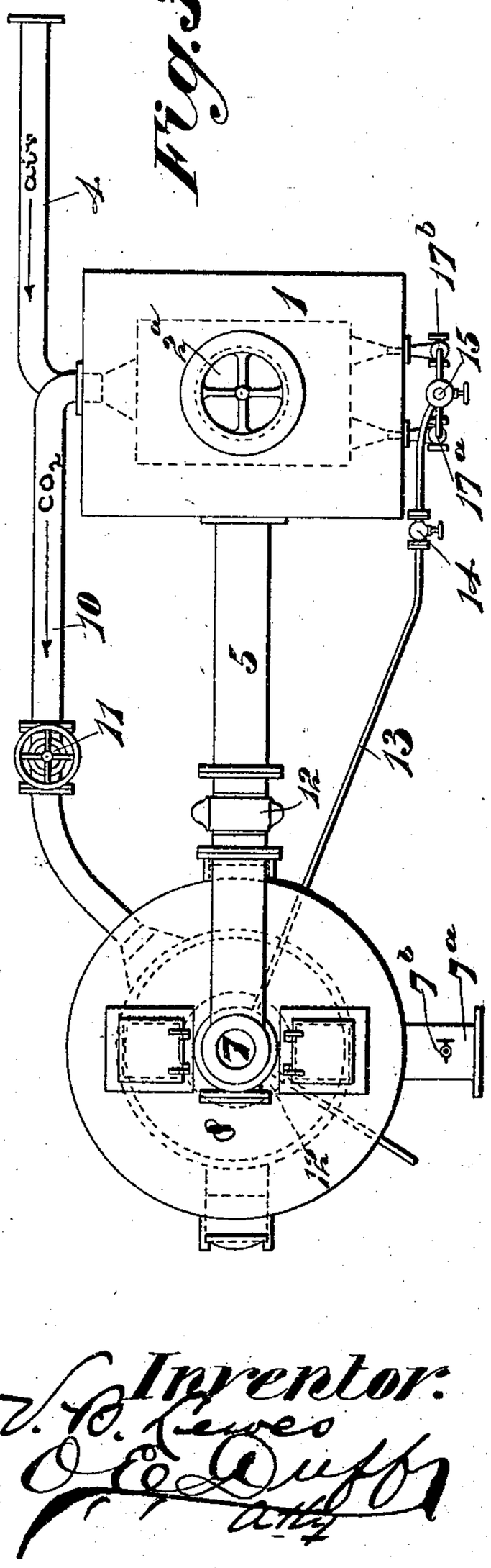
(No Model.) 2 Sheets—Sheet 1.

V. B. LEWES.

PROCESS OF MANUFACTURING GAS.

No. 551,903. Patented Dec. 24, 1895.





Witnesses.
E. E. Duffy
Chas. M. Wenli

per

Inventor:
V. B. Lewes
E. E. Duffy
Atty

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

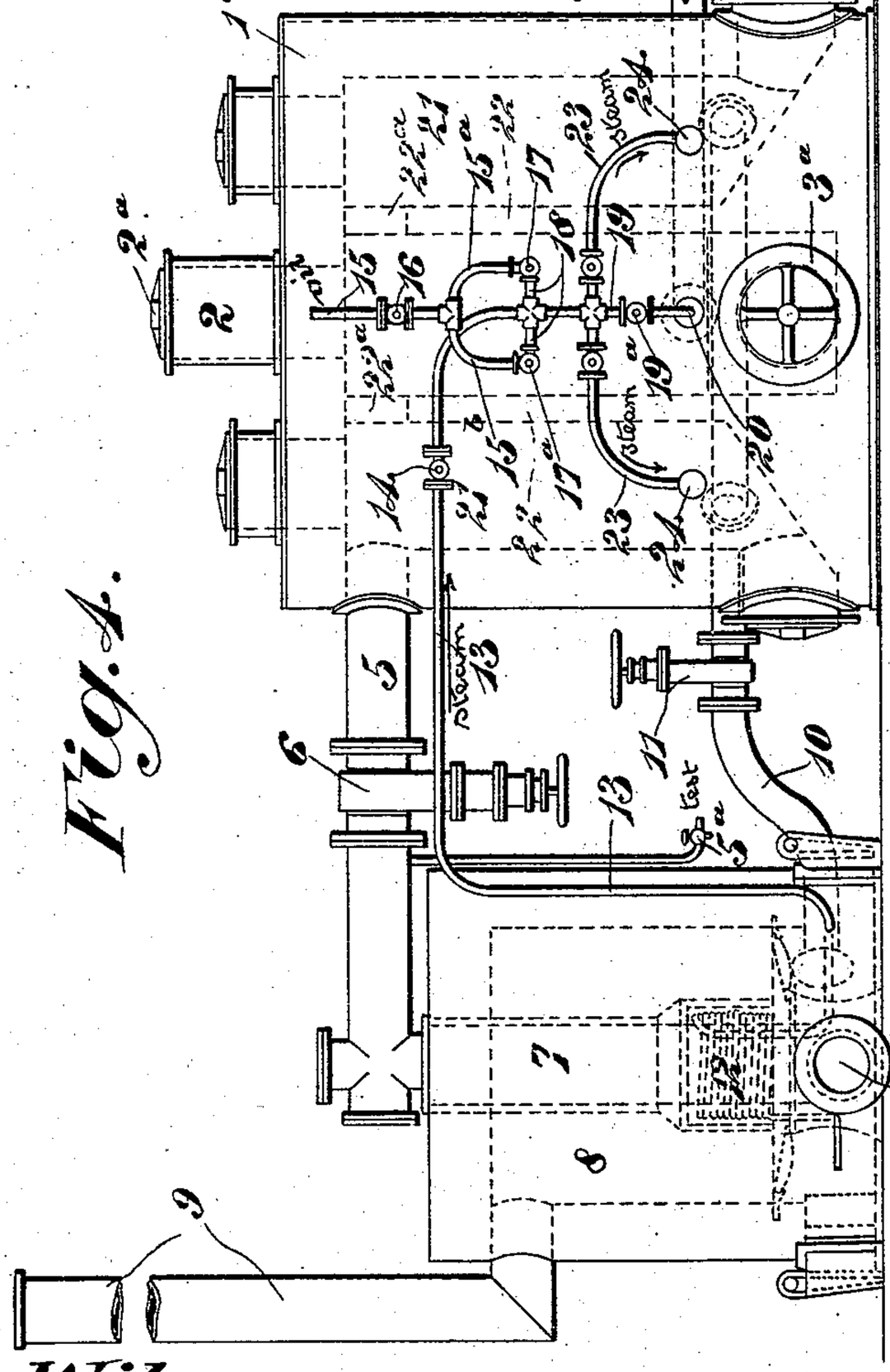
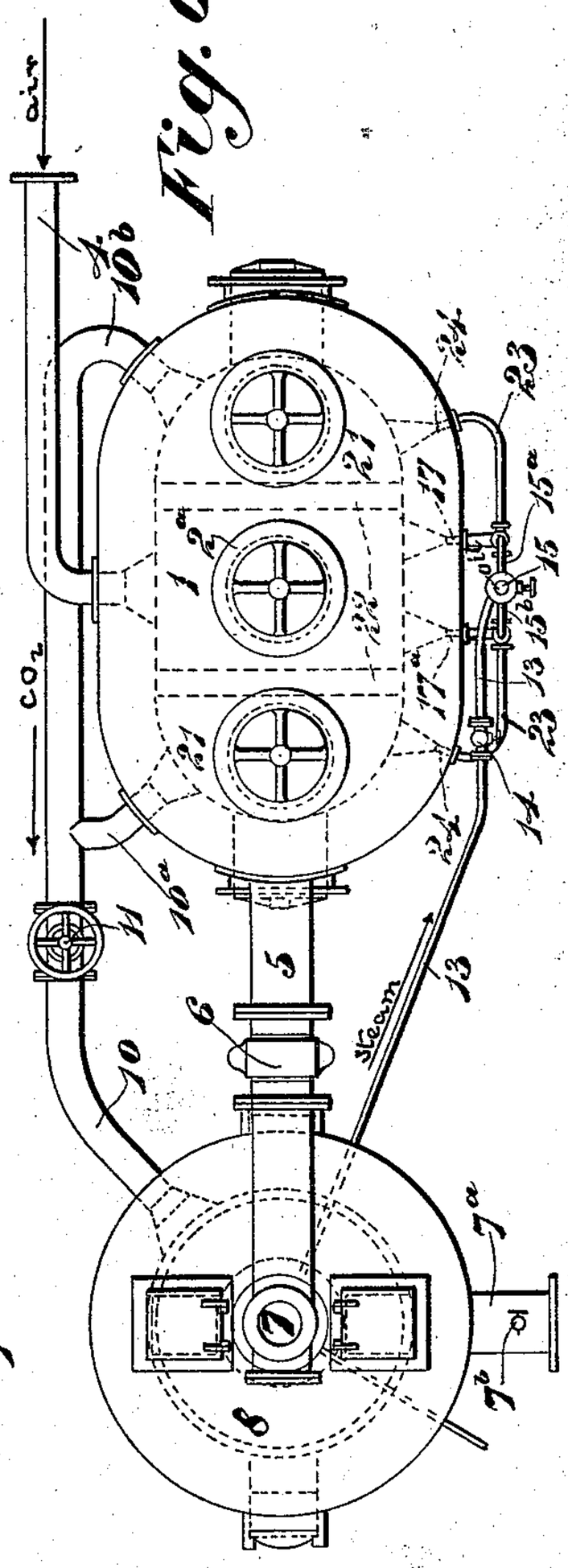


Fig. 6.



Witnesses.
E. B. Duffy
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Inventor.
V. B. Lewes
per E. B. Duffy Atty.

UNITED STATES PATENT OFFICE.

VIVIAN BYAM LEWES, OF LONDON, ENGLAND.

PROCESS OF MANUFACTURING GAS.

SPECIFICATION forming part of Letters Patent No. 551,903, dated December 24, 1895.

Original application filed December 9, 1892, Serial No. 454,630, and renewed January 30, 1895, Serial No. 536,725. Divided and this application filed February 1, 1895. Serial No. 537,012. (No model.) Patented in England December 10, 1891, No. 21,598, and September 10, 1892, No. 16,258.

To all whom it may concern:

Be it known that I, VIVIAN BYAM LEWES, a subject of the Queen of Great Britain and Ireland, residing at the Royal Naval College, Greenwich, London, in the county of Kent, England, have invented Improvements in the Process of Manufacturing Gas, (for which I have received patents in Great Britain, No. 21,598, dated December 10, 1891, and No. 16,258, dated September 10, 1892,) of which the following is a specification.

The present invention is a division of applicant's application filed January 30, 1895, Serial No. 536,725, patented May 7, 1895, No. 538,923, which patent is limited to the apparatus shown and described in the present case.

This invention relates to improvements in the method of "cracking" or decomposing liquid hydrocarbon of considerable density, such as crude petroleum and tar, so as to produce therefrom combustible permanent gases of high illuminating value and which may be used by themselves or for enriching coal-gas or for carbureting water-gas, hydrogen, or other non-luminous gases.

In the process heretofore proposed to be used for decomposing crude oils, so as to obtain from them gases of high illuminating value, the deposition of carbon and pitch has been so great as to rapidly choke the retorts and tubes or superheating-chambers used in the manufacture, and when it has been attempted to decompose the oils by allowing them to flow by gravity into a mass of incandescent or red-hot fuel the decomposition has been carried too far, so that the hydrocarbon gases valuable for illuminating purposes have been decomposed into others of low light-giving power.

Now I have discovered that when hydrocarbon of the kind mentioned is injected by superheated steam at considerable pressure into incandescent fuel within a suitable vessel, such as a gas producer or generator, the steam will attack the incandescent carbon of the fuel-forming water-gas, which will so protect and dilute the vaporizing hydrocarbon that the decomposition thereof will be arrested before it has gone too far, and as a result a permanent gas of high illuminating value will be obtained, while the carbon and pitch deposited from the hydrocarbon on cracking will remain with an increased quantity of fuel in the gas producer or generator, instead of choking the apparatus, as heretofore. A small additional quantity of steam may be injected into the incandescent fuel at the point below that at which hydrocarbon is injected by the superheated steam. Such additional steam, by becoming converted by the incandescent fuel into water-gas, serves to sweep up the hydrocarbon and drive the gas out of the fuel.

In the accompanying drawings, Figure 1 is a side elevation, Fig. 2 is an end elevation, and Fig. 3 a plan, of apparatus suitable for producing illuminating-gas from hydrocarbon oils and hydrogen according to my invention. Figs. 4, 5, and 6 are similar views of Figs. 1, 2, and 3, respectively, illustrating a modified construction.

Referring to Figs. 1, 2, and 3, 1 is a gas-generator comprising an outer metal casing lined with refractory material and provided with inlets 2 for fuel and outlets 3 for clinker, these openings being normally closed by doors 2^a and 3^a respectively.

4 is the pipe through which air can be blown into the lower end of the chamber 1 of the gas-generator.

5 is a pipe with valve 6 connecting the top of the generating-chamber with the top of an iron fixing-retort 7, which may be used in connection with the gas-generator 1. This fixing-retort is located within a suitable furnace or combustion-chamber 8, (hereinafter referred to as a "superheater-furnace,") having an exit-flue 9.

7^a is the outlet of the retort.

10 is the pipe connecting the generator and is provided with the valve 11, and opening into furnace 8, below the grate-bars thereof.

12 is the steam superheating-coil (hereinafter referred to as a "superheater") that may be cast in the wall of the retort or be embedded in the thick mass of iron or other suitable material to prevent its being burned out.

This superheater is connected with a suitable steam-generator (not shown) and with a steam-supply pipe 13, provided with a cock 14.

15 is the hydrocarbon-supply pipe provided with cock 16 and with branches 15[a] and 15[b], that are connected respectively with two injectors 17 17[a]. These injectors may advantageously be arranged to discharge liquid hydrocarbon into the incandescent fuel in the gas-generator 1 at a point about midway in the height of the said gas-generator, as shown. The steam-supply pipe 13 is connected by branches 18 with the two injectors 17 17[a]. It is also connected by a branch 19, having a cock 19[a], with the nozzle at 20 located near the bottom of the chamber 1 of the gas-generator.

The mode of working and the action of the apparatus are as follows: Carbonaceous fuel, such as coke, is introduced into the gas-generator 1, and raised to incandescence by the blast of air forced through the pipe 4 from a suitable blower. The products of combustion, largely consisting of carbon monoxide and nitrogen, are led through pipe 10, past the valve 11, which is then open to the superheater-furnace 8, the combustion of solid fuel in which is supplemented by the combustion of the carbon monoxide in the said products. By this means the fixing-retort 7 and superheater 12 are heated to the required temperature. The air-blasts are then cut off, the valve 11 closed and the steam and liquid-hydrocarbon supply turned on. Steam under pressure is then driven through the superheater and into the pipe 13, whence it passes through the injectors 17 17[a] into the incandescent fuel in the gas-generator, spraying in at the same time liquid hydrocarbon, which is fed to the injectors through the supply-pipe 15.

I have obtained satisfactory results by injecting hydrocarbon, such as crude petroleum and also tar, by means of steam at a pressure of about one hundred and twenty pounds to the square inch and heated to the temperature of about 400° centigrade, (732° Fahrenheit.) By thus injecting hydrocarbon into a mass of incandescent fuel it is "cracked" to gas, any carbon, pitch, or the like that may produce merely adding to the fuel in the gas-generator, while "over-cracking" is prevented by the simultaneous generation of water-gas from the steam used in injecting. The gas thus formed flows from the top of the generator through the pipe 5 and valve 6, which is then open, to the fixing-retort 7, and this being kept at approximately constant high temperature of, say, about 1,000° centigrade, (1,832° Fahrenheit,) uniformly fixes the gas so as to produce a permanent illuminating-gas. The resulting gas, owing to the dilution by hydrogen and the interactions between carbon, monoxide, and the nascent hydrocarbons in the chamber 1, contains but a small and practically harmless percentage of carbon monoxide. Steam from time to time may be also injected through the nozzle 20 into the incandescent fuel in the gas-producer 1 at a point below that at which the liquid hydrocarbons are being cracked, so that in case of overheating and at the end of each run or at other times, as may be desired, the hydrocarbon in the gas-generator may be swept out by the uprush of water-gas produced by the decomposition of the steam thus injected.

The production of gas in the manner described may advantageously be continued until the temperature of the fuel in the gas-producer has fallen below the required point, and then steam and liquid hydrocarbon should be shut off and the varions connections be adjusted as before for the passage of the air-blasts in order to again raise the fuel in the gas-generator to the desired degree of incandescence.

To enable the fuel in the gas-producer 1 to be raised to a suitable state of incandesence in a quicker and more uniform manner than has heretofore been usual, the said gas-producer is or may be constructed with additional air-inlets arranged at a point or points in the generator above the inlet 4 at the bottom of the gas-producer, so that two or more blasts of air can be injected into the fuel simultaneously at different points in its height. This arrangement of air-blasts may advantageously be used in connection with gas-producers for producing gas or other than oil-gas—as, for example, water-gas.

The relative quantities of steam and hydrocarbon admitted through the injectors into the incandescent fuel should be so regulated that the gas generated in the fuel-chamber 1 shall be of a brown color. This may be determined by providing the gas-pipe 5 with a jet-cock 5[a] and an outlet 7[a] with the jet-cock 7[b], through either or each of which small quantities of gas can be allowed to escape from time to time. If the gas thus allowed to escape through either jet-cock be white, it indicates that the hydrocarbons are not sufficiently cracked and the proportions of steam should be reduced. If the gas be black and "sooty" it indicates that they have been over-cracked and the proportion of steam should be increased.

When it is desired to produce carbureted hydrogen containing but a small and practically harmless percentage of carbon monoxide, the gas produced by cracking liquid hydrocarbon in the manner hereinbefore explained is, according to this invention, diluted to the desired extent by admixture with hydrogen simultaneously produced in a separate generator by the action of steam on heated iron.

Figs. 4, 5, and 6 are similar views of Figs. 1, 2, and 3, respectively, illustrating a modified arrangement of the apparatus suitable for producing carbureted hydrogen. In this arrangement there is a chamber 21 at each of two opposite sides of the gas-generator 1,

formed by constructed and internally-lined casing 1^a, with two vertical partitions 22 of refractory material, which may extend to within a short distance of the under side of the top of the casing, or which may, as shown, be provided with a number of openings 22^a that serve to place all of the chambers in communication with each other at the top and through which gas can flow. The chambers 21 serve to contain iron or a suitable compound or compounds of iron, such as sulphate of iron or oxilate of iron, that is or are capable of being readily decomposed by heat into oxide of iron, which is subsequently reduced to a metallic state by the passage over it of carbon monoxide present in the products of combustion that are produced in the gas-generator when raising the fuel therein to incandescence by the air-blasts. In this arrangement also the pipe 10, instead of being connected to the upper end of the oil-gas generator 1, is provided with branches 10^a and 10^b, by which it is placed in communication with the lower ends of the chambers 21, to which are also connected steam-pipes 23, that are provided with nozzles at 24 and are connected with the steam-supply pipe 13 by the branch 19. The mode of working and the actions of this modified arrangement of apparatus are as follows:

Carbonaceous fuel is raised to incandescence in the generator 1 by the blast or blasts of air, as before; but the products of combustion, largely consisting of carbon monoxide and nitrogen, instead of passing direct into the pipe 10 and superheater-furnace, as before, are led thereto through the openings 22^a and the chambers 21 containing iron or compound or compounds thereof. In this way not only will the fuel in the generator 1 and fixing-retort 7 and the steam-superheater 12 be heated to the required temperature, but the iron in the chambers 21 will also be heated to the required temperature to decompose steam, while if the iron be present as a compound of iron it will be decomposed and reduced to a metallic state. The air blast or blasts being then cut off and the proper connections open, the steam under pressure is allowed to flow through the superheater 12, as before, and into the pipe 13, whence part passes by the branches 19 and 23 into the chambers 21 containing the heated iron, wherein it is decomposed, liberating hydrogen, while another part of the steam passes through injectors 17 17^a into the incandescent fuel in the gas-generator 1, so as to spray in liquid hydrocarbon admitted through pipe 15, which is decomposed into gas, as before. Steam may from time to time be also injected through the nozzle at 20, as and for the purpose hereinbefore mentioned. The gas produced, as described, in the gas-generator 1 meets at the top thereof the current of hydrogen generated in the chambers 21 and flows therewith through the gas-main 5 to the fixing-retort 7, and this being kept at an approximately constant high temperature of, say, about 1,000° centrigrade, (1,832° Fahrenheit,) as before, uniformly fixes these gases so as to produce a permanent gas. The resulting gas, owing to the dilution of hydrogen and the interactions between the carbon monoxide and nascent and hydrocarbon in the gas-generator 1, contains but a small and practically harmless percentage of carbon monoxide, as before stated. The productions of carbureted hydrogen continue until the temperature of the fuel in the gas-generator has fallen below the required point. The supply of steam and the hydrocarbon are then shut off, and the various connections are adjusted as before for the passage of the air blast or blasts, any traces of hydrocarbon remaining in the said gas-generator assisting the carbon monoxide to reduce to a metallic state the iron that has been oxidized in the chambers 21 by the steam ready to repeat the foregoing operations.

The relative quantities of steam and hydrocarbon admitted into the incandescent fuel should be determined in the manner hereinbefore explained.

I am aware that it has heretofore been proposed to produce illuminating-gas from crude oil, such as crude petroleum, by injecting the oil by the steam through red-hot tubes, chambers, or retorts; but this method has not been successful, because the steam has injuriously attacked the oil, whereas by injecting the oil by steam into incandescent fuel the steam attacks the incandescent carbon in the fuel in preference to the oil, with the result that permanent gas of high illuminating value can be obtained when carrying out the process on a large scale. It may be made a continuous one by employing two sets of apparatus of the kind hereinbefore described, so arranged and operated that illuminating-gas will be produced in one apparatus while fuel is being raised to the state of incandescence in the other, and vice versa.

What I claim is—

1. The herein described method of manufacturing illuminating gas which consists in simultaneously blowing a bed of fuel to incandescence and a body of iron to a decomposing heat, then cutting off the blast and forming hydrogen gas by injecting steam into the body of iron and producing carbureted hydrogen gas by injecting oil and steam into the body of incandescent fuel, combining said hydrogen and carbureted hydrogen gases and conducting the same through a heated fixing chamber and finally passing steam alone through the body of incandescent fuel, substantially as described.

2. The herein described method of manufacturing illuminating gas which consists in blasting a body of fuel to incandescence and at the same time heating a bed of iron to redness, then injecting oil and steam into the body of incandescent fuel to form carbureted hydrogen gas and at the same time injecting

steam into the bed of iron to form hydrogen gas, combining said carbureted hydrogen and hydrogen gases and passing the same through a heated fixing chamber substantially as described.

3. The herein described method of manufacturing illuminating gas which consists in blasting a bed of fuel to incandescence, and a body of iron to a decomposing heat, then injecting oil and steam into the body of incandescent fuel to form carbureted hydrogen gas and injecting steam into the bed of iron to form hydrogen gas and finally combining said carbureted hydrogen and hydrogen gas at the point of generation, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

VIVIAN BYAM LEWES.

Witnesses:
EDMUND S. SNEWIN,
HENRY MAYKELS.