No. 817,279. PATENTED APR. 10, 1906.

J. S. SMITH.

APPARATUS FOR PRODUCING GAS.

APPLICATION FILED FEB. 8, 1906.

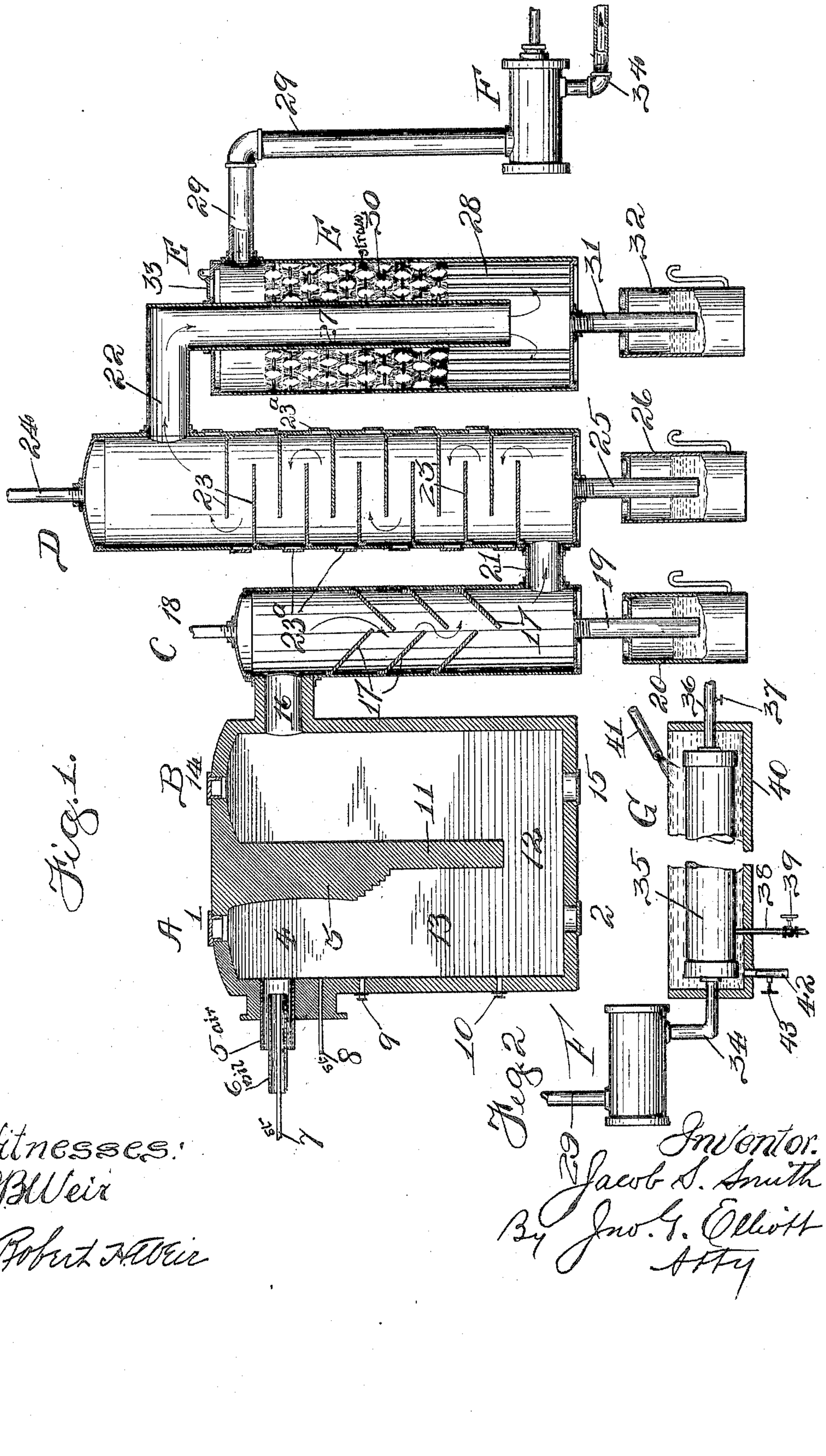

Fig. 1.

Witnesses:
J. B. Weir
Robert A. Weir

Inventor:
Jacob S. Smith
By Jno. G. Elliott
Atty

UNITED STATES PATENT OFFICE.

JACOB S. SMITH, OF CHICAGO, ILLINOIS.

APPARATUS FOR PRODUCING GAS.

No. 817,279. Specification of Letters Patent. Patented April 10, 1906.

Application filed February 8, 1905. Serial No. 244,790.

To all whom it may concern:

Be it known that I, JACOB S. SMITH, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for the Manufacture of Gas for Heating and Illuminating Purposes, of which the following is a full, clear, and exact specification.

This invention relates to improvements in apparatus for manufacturing gas for heating and illuminating purposes from liquid hydrocarbons, steam, and air.

The prime object of my invention is to provide means for dissociating and reassociating entirely by the heats of conversion the gaseous elements of gas-producing materials into gases so thoroughly combined and fixed that they may be washed, filtered, compressed, stored, transported, and distributed in pipes and mains for use without, as near as may be, deterioration in either quality or volume, and this particularly with gas produced from oil, steam, and air.

A further object is to provide means for dissociating into its gases a maximum of the steam with an absence of an excess of carbon dioxid and nitrogen and to at the same time combine the liberated hydrogen with volatilized carbon.

Another object is to provide means for controlling a gas-producing degree of heat in a generator by adding to or subtracting from the supply of one or all of the gas-producing materials to the generating-chamber and in such manner that a gas-producing degree of temperature may be uniformly maintained in the generator in the manufacture of heating and illuminating gas, and particularly by the decomposition of steam in the presence of volatilized carbon in the production of hydrocarbon gas.

A still further object is to provide means whereby gas-producing materials supplied to a generator are first finely divided and then violently exploded and expanded by a forcible impact against a highly-heated resisting-surface in the presence of a decomposing degree of heat in the generator, whereby decomposition is substantially quickened, the quantity of material consumed to sustain the necessary heat therefor reduced, and the volume of fixed gas from a given quantity of gas-producing materials is substantially increased.

A further object is to provide a novel and effective means for discharging from gas heavy hydrocarbons and other solid refuse materials before subjecting the gas to the operation of the ordinary scrubber and to filter the gas after being scrubbed, and all this by an enforced passage of the gases from the generator through said devices to the gas-main or other receptacle.

With these ends in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said object and certain other objects hereinafter appearing are attained, all as fully described with reference to the accompanying drawings, and more particularly pointed out in the claims.

In the said drawings, Figure 1 represents a central vertical section through a gas apparatus embodying my invention, but with the pump employed in connection therewith shown in side elevation; and Fig. 2, a side elevation, partly in section, of a compressor.

Similar letters and numerals of reference indicate the same parts in the drawings.

A indicates a gas-generator provided at its top with a manhole 1 and at its bottom with a manhole 2 for access thereto and with a breaker-wall 3 at the rear of a gas-generating chamber 4.

Into the front of the gas-generating chamber opens an air-supply pipe 5, surrounding an oil or other hydrocarbon pipe 6, in turn surrounding a steam-supply pipe 7, the diameter of the pipe 6 being sufficiently smaller than the pipe 5 to provide a surrounding air-passage and the pipe 7 being of sufficiently less diameter than the pipe 6 to form a surrounding passage for oil, and preferably in practice the pipes 6 7 terminate shortly before reaching the inner end of the pipe 5 for the purposes of promoting a more thorough mixture of the air, steam, and oil before entering the generating-chamber 4. These several supply-pipes may be connected in the usual manner with the sources for their supply, and the oil and air pipe, and particularly the latter two, are preferably connected with means for directing their respective supply thereto under pressure, the said pipes being so arranged relative to the breaker-wall that they shall deliver their supply against the face of the breaker-wall at a right angle thereto, and preferably with a force sufficient to first finely divide the materials and in such a manner that they will first be instantly violently exploded and then thoroughly mixed and ex-

panded within the generating-chamber. A short distance below the pipe 5 above described is a steam-pipe 8, also projecting through the front of the generating-chamber and in a line opposing and at a right angle to the breaker-wall 3, which pipe 8 serves to supply additional steam in a manner, hereinafter described, best promoting its decomposition and combination with the mixed gases evolved in the generating-chamber. Peek-holes 9 and 10 are provided at the front of the structure for observing the heats, current, and generation within.

Adjacently forward of the generating-chamber is a chamber B, separated in part from the generating-chamber by a depending wall 11, which extends from the top thereof to a point sufficiently above the bottom to afford a free passage 12 for the gases from the generator to the chamber B and which must therefore first descend through chamber 13 below the generating-chamber before entering the chamber B. The chamber B is provided with manholes 14 and 15, respectively, at its top and bottom and for access thereto and discharges its gases through a pipe or passage 16 near the top of the generating-chamber into a washer C, which washer may be cylindrical in form, as shown, or of any other desired form. The washer C is provided with a series of downwardly-inclined deflecting-plates 17, set at such an angle that they will shunt water supplied through a pipe 18, entering the top of the washer from one plate to the other and with such force as will prevent any carbon accumulating on the plates, which, together with the water discharging through the pipe 18, will subject the gas discharging from the chamber B to the cleansing, cooling, and contracting effect of water baffled and shunted in the direction of its course. The unassociated carbon or tar and other solids extracted in this manner by the washer are deposited by the current of water through a pipe 19 in the bottom of the washer discharged into a trap 20.

Adjacent to the washer C is a scrubber D, connected by a pipe 21 with washer C and which is located at a point toward the bottom of the washer and the scrubber, so that gases discharged from the washer must ascend through the scrubber and to a pipe 22, near the top thereof, before escaping from the latter. The scrubber is provided with the usual substantially horizontal plates 23, projecting from opposite sides thereof and forming a zigzag passage for the ascent of the gases and for the descent of water supplied to the scrubber through the pipe 24 in the top thereof, the resulting tar and other solid matter accumulating in the scrubber being discharged through the pipe 25 into a trap 26 and access being had to the scrubber-plate through the usual manholes 23ª. Pipe 22 is provided with a vertical extension 27, projecting downwardly and preferably centrally of a filter E, but terminating at a point a short distance above the bottom of the filter.

The filter E, shown to be of cylindrical, but may be of any other desired form, has standing upon its bottom and projecting above the lower end of the pipe 27 pieces of round wood or iron poles or pipes 28, set vertically, filling the space between the pipe 27 and the shell of the filter, the space above the ends of these poles surrounding the pipe 27 up to a point below the discharge-pipe 29 thereof near its upper end, being preferably filled with rye-straw 30, cut about one foot in length and tied in small bundles, with the straws set vertically, but may be of other fibrous material suitable for the same purposes. The tar and other refuse accumulating in the filter E is discharged from the bottom thereof through a pipe 31 into a trap 32, the said filter being also provided with a manhole 33 for access thereto. The filter-discharge pipe 29 is connected with the suction end of a pump F, and gases entering the pump are discharged through a pipe 34 into a compressor G and thence onwardly to a gasometer or other storage vessels or directly into the mains, as may be desired.

The compressor G comprises a closed receptacle 35, which may be of cylindrical or other form, provided with a discharge-pipe 36, in which is a valve 37, which may be used for controlling the degree of pressure to which the gases supplied to the compressor-chamber by the pump F are to be subjected and also to regulate the degree of expansion, and therefore the pressure, of the gases in the mains, a storage vessel, or other receptacle. The compressor is also provided with a pipe 38, controlled by a valve 39, through which are discharged waters of condensation resulting from the compression of the gases. The compressor is preferably located in a vat 40 and immersed in water or other cooling medium supplied thereto through a pipe 41, which cooling medium after serving to remove the heats of compression from the gas and correspondingly contracting it is discharged through a pipe 42, controlled by a valve 43.

In the practical operation of the apparatus described the pump F is put in motion to induce a current of air into the generator A, and at which time the pipe 5 is open and oil is introduced through the pipe 6 into the generating-chamber. When the chamber 4 and the breaker-wall 3 have been sufficiently heated, steam is injected into the generating-chamber through the pipe 7 under a sufficient pressure to deliver the steam and also any oil or air discharging from the pipes 5 and 6, or either of them, forcibly with sufficient impact against the heated surface to very finely di-

vide the gas-producing materials into particles so minute as to thereby produce instantaneous gasification, immediately followed by a thorough mechanical mixing and complete chemical combination. As fast as the gases are thus generated they are by the action of the pump drawn downwardly through the chamber 13, through the passage 12, whence they must rise in the chamber B to the passage 16 before escaping therefrom. Gases rising in the chamber B after discharging through the passage 16 descend through the washer C, which in the meantime is supplied through the pipe 18 with water sufficient in volume and of a temperature capable of discharging a substantial portion of the heavy hydrocarbons and other solid products from the gas and also from the inclined plates, which heavy hydrocarbons, largely in the form of tar, automatically discharge from the washer through the pipe 19 into the trap 20. The gases are discharged from the washer C, through the pipe 21, into the scrubber D at or near its bottom and rising upwardly therein in a zigzag manner, owing to the arrangement of the horizontal plates 23, against a supply of water through the pipe 24, flowing downwardly from plate to plate in contact with the ascending gases, the accumulating by-products in the meantime discharging through pipe 25 into trap 26. Gases from the scrubber discharge through pipes 22 and 27 to a point at or toward the bottom of the filter and escaping therefrom ascend in contact with and between the poles or rods 28 through the straw filtering material 30, the poles 28 serving as desirable surfaces for collecting and conducting undecomposed materials coming in contact therewith and from the straw to the bottom of the filter, and thereby promoting their collection therein and discharge therefrom through the pipe 31 into the trap 32. Gases which have passed through the washer, the scrubber, and the filter enter the pump F substantially, if not entirely, free of all objectionable solids, and in this condition may be discharged onwardly to their destination, but under my invention are preferably discharged into the compressor G through the pipe 34 for the purpose of removing condensable vapors therefrom, and thereby reduce the gases discharged from the compressor to a condition for subsequent storing, transportation, and distribution through mains with an entire absence, as near as may be, of their deterioration either in quality or volume, and this particularly with gas produced from oil, steam, and air.

It is evident that gas generated by the decomposition of the gas materials in the presence of air will contain more or less nitrogen, depending upon the manner of conversion, and it is therefore one of the purposes of this invention to effect a gasification of the gas materials with the least possible quantity of air, to avoid an excess of nitrogen and dioxid in the resultant gases, while at the same time dissociating a maximum of steam to combine the thereby released hydrogen with the volatilized carbon. I have found by injecting oil and steam simultaneously with a comparatively small volume of air forcibly against a hot surface within a generating-chamber heated within to a gasifying degree, that the gasification is instantaneous, and that the conversion of the materials into gas will sustain the heats of the chamber and the surfaces within to the proper degree so long as the materials are so supplied, and that the operation may be continuous without interruption, and that the elements in the gas materials are thus released and combined within the generating-chamber. The mixing, baffling, and contact with the surfaces of the breaker-wall and generating-chamber caused by the explosive impact and instantaneous expansion of the forcible discharge against the heated surface of the breaker so sets, combines, and fixes the escaping gases that the customary brick checker-work intervening between the discharge of the generating-chamber and the outlet of the apparatus is dispensed with entirely and the annoyance and delays caused by the clogging up of the checker-work by carbon or other refractory materials are avoided. This instantaneous conversion of the gas materials into gas in this manner is an important economy in that the saving of the heat by such instantaneous action of the elements necessarily reduces the quantity of air consumed and lessens the resulting nitrogen and the quantity of materials required for heat. A further saving is brought about by conducting the generated gases, so as to apply escaping heat to the rear of the breaker and breaker-wall to assist in sustaining the heats of the breaker and generating-chamber, which correspondingly reduces the materials consumed for maintaining a gasifying temperature within the generating-chamber, and thereby the dioxid of combustion and the nitrogen are reduced to a minimum, or, in other words, a uniform and continuous gasifying heat is maintained without interruption with the least expenditure for the necessary heat.

Obviously the washing, scrubbing, filtering, and compressing of the gas to remove condensable vapors is not practical in the absence of such a complete initial generation of fixed gases sufficient to insure their production with commercial success, and with this in view it will be apparent that the essential feature of the invention herein described is the means employed by which such generation on a commercial scale is insured. The condition precedent to the commercial success for the production of a gas which is free from solids, and particularly condensable vapors, and by which its compression into a

minimum space for storage and transportation, is an initial generation of a large volume of fixed gas rapidly and continuously upon a commercial basis corresponding with that of gases now commonly employed without the absence of the solids and vapors referred to. This condition precedent is supplied by my invention through the directing of the gas-producing materials with forcible impact against a breaker-wall maintained in a uniform highly-heated condition before discharging into a washer, scrubber, or other device employed for cooling and contracting the gases. Another important feature of my invention is the means by which the decomposition of an additional—that is to say, an extra—amount of steam may be decomposed and thoroughly combined, both mechanically and chemically, with the gases of original generation and which is made possible by discharging such steam within the heats of initial generation and across the path traversed before their escape from the generating-chamber, while at the same time contracting all of the gases in a direction best disregarding their several specific gravities, and promote their association within the generating-chamber before and at their immediate discharge therefrom.

Although seemingly the best results are secured by conducting the generated gases downwardly out of the gas-generating chamber and thence upwardly in contact with the rear surface of the breaker-wall, it will be no substantial departure from my invention to have the gases ascend in escaping from the generating-chamber, provided they are caused to descend in contact with the rear face of the breaker-wall, for, as before intimated, the maintaining of a uniformly high degree of heat made possible by heating the breaker-wall from both its front and rear sides is desirable and necessary in order to secure the very best results in the initial generation of the gas.

When the gases ascend out of the generating-chamber, it should be observed that if an excess of steam is desirable then the steam-pipe 8 should be in a plane above instead of in a plane below the point at which oil and steam are injected into the generating-chamber against the breaker-wall for the purposes of initial generation.

While an important feature of my invention is to successfully commercially produce a dehydrated gas from oil and steam, and therefore a gas which may be stored and transported while under excessive pressure and subsequently used at that pressure and a low pressure without precipitation—that is to say, without deterioration in either quality or volume—my invention is not to be so limited, for it includes the means herein described for the generation of the gas to the exclusion of said subsequent compression and also either and both the washing and scrubbing. Neither is my invention limited to the details of construction shown, for it is apparent that they may be substantially varied in substantially every part of the apparatus and yet contain the invention herein described and set forth in the claims.

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

1. In a gas-producing apparatus, a gas-generator, a breaker-wall located therein across the entire path traversed by the gas-producing materials discharging into said generator, means uniformly maintaining the breaker-wall in a highly-heated condition and a decomposing degree of heat in the vicinity thereof, and means discharging gas-producing materials through said decomposing degree of heat and against said breaker-wall with a forcible impact, finely dividing said materials in the presence of a heat, dissociating substantially all of the gaseous elements of said materials into fixed gases, immediately reassociated mechanically and chemically within the confines of the generating-chamber, substantially as described.

2. In a gas-producing apparatus, a generator, a breaker-wall located therein across the entire path traversed by the gas-producing materials discharging into said generator, means continuously and uniformly maintaining the breaker-wall in a highly-heated condition, and a decomposing degree of heat in the immediate vicinity thereof, and means continuously discharging gas-producing materials through said decomposing degree of heat and against said breaker-wall with a forcible impact, finely dividing said materials in the presence of a heat, dissociating substantially all of the gaseous elements of said materials into fixed gases immediately reassociated mechanically and chemically within the confines of the generating-chamber, substantially as described.

3. In a gas-producing apparatus, a gas-generator, a breaker-wall located therein, means for uniformly maintaining said wall in a highly-heated condition, means for discharging gas-producing materials against said wall with forcible impact and in the presence of a decomposing degree of heat, in combination with a supplemental steam-supply pipe discharging steam within the heats of primary generation and across the path traversed by the gases at the point of their discharge from the generator, substantially as described.

4. In a gas-producing apparatus, a gas-generator, a resisting-surface therein and means maintaining said surface in a highly-heated condition, in combination with means directing gas-producing materials against said resisting-surface with forcible impact in the presence of a decomposing degree of heat

and means whereby the generated gases are discharged in a direct line downwardly out of the generating-chamber, substantially as described.

5. In an apparatus for manufacturing gas, a gas-generating chamber, a resisting-surface therein located within the heats of generation, and means maintaining said surface in a highly-heated condition, in combination with means directing gas-producing materials against said resisting-surface with forcible impact in the presence of a decomposing degree of heat and means for conducting the gases directly downwardly out of the generating-chamber and while in a highly-heated condition in contact with the rear of said resisting-surface, whereby the impact of the gas-producing materials shall be against a uniformly and continuously highly heated surface throughout their continuous supply thereto, substantially as described.

6. In an apparatus for manufacturing gas, a gas-generating chamber, a resisting-surface therein, means maintaining said surface in a highly-heated condition, means directing gas-producing materials against said resisting-surface with forcible impact against a decomposing degree of heat, means discharging the gases of initial generation downwardly and out of the generating-chamber, and means discharging steam within the influence of the direct heats of primary generation at a point next below the line on which the materials therefor are discharged into the generating-chamber and in the path of the line traversed by the gases of initial generation in their discharge from the gas-generating chamber, substantially as described.

7. In an apparatus for manufacturing gas, a generating-chamber, a resisting-surface located therein, means maintaining said surface in a highly-heated condition, means directing gas-producing materials against said surface with forcible impact in the presence of a decomposing degree of heat, means discharging additional gas materials into the generating-chamber with forcible impact against said resisting-surface within the confines of the generator, in direct contact with the heats of initial generation and across the path of the latter during their discharge downwardly out of the generating-chamber, in combination with means for conducting the combined gases as generated in a highly-heated condition to and in contact with the rear face of said resisting-surface, whereby the combined heat of initial supplemental generation is utilized to maintain said resisting-surface continuously in a uniformly highly heated condition, substantially as and for the purposes described.

8. In an apparatus for manufacturing gas, a gas-generating chamber, an imperforate breaker-wall arranged therein, means maintaining said breaker-wall throughout in a uniformly highly heated condition continuously, means for discharging gas-producing materials with forcible impact directly against said wall in the presence of a decomposing degree of heat, means for removing heavy hydrocarbons therefrom, means for dehydrating the fixed gases thereof, and means for delivering said gases in a compressed condition into either a fixed or moving storage vessel or receptacle, substantially as described.

9. In a gas-producing apparatus, a gas-generating chamber, a resisting-surface located therein, means maintaining said surface in a highly-heated condition, means directing gas-producing materials against said resisting-surface with forcible impact in the presence of a decomposing degree of heat in the initial generation of gases therein, means supplying additional steam to said generating-chamber in the presence of decomposing degree of heats of generation, and in the path of the discharge of the gases of initial generation from the generating-chamber, means for removing heavy hydrocarbons and other unvaporized materials from the fixed gases discharging from the generating-chamber and means for dehydrating the said fixed gases, substantially as and for the purpose described.

10. In a gas-producing apparatus, a gas-generating chamber, an imperforate resisting-surface located therein, means maintaining said surface in a highly-heated condition, means directing gas-producing materials against said resisting-surface with forcible impact in the presence of a decomposing degree of heat in the initial generation of gases therein, means supplying additional steam to said generating-chamber in the presence of a decomposing degree of heat resulting from initial generation and in the path of the discharge of the gases of initial generation from the generating-chamber, means for removing heavy hydrocarbons and other unvaporized materials from the fixed gases discharging from the generating-chamber and means for delivering said fixed and dehydrated gas to a storage vessel, substantially as described.

JACOB S. SMITH.

Witnesses:
JNO. G. ELLIOTT,
M. B. ALLSTADT.