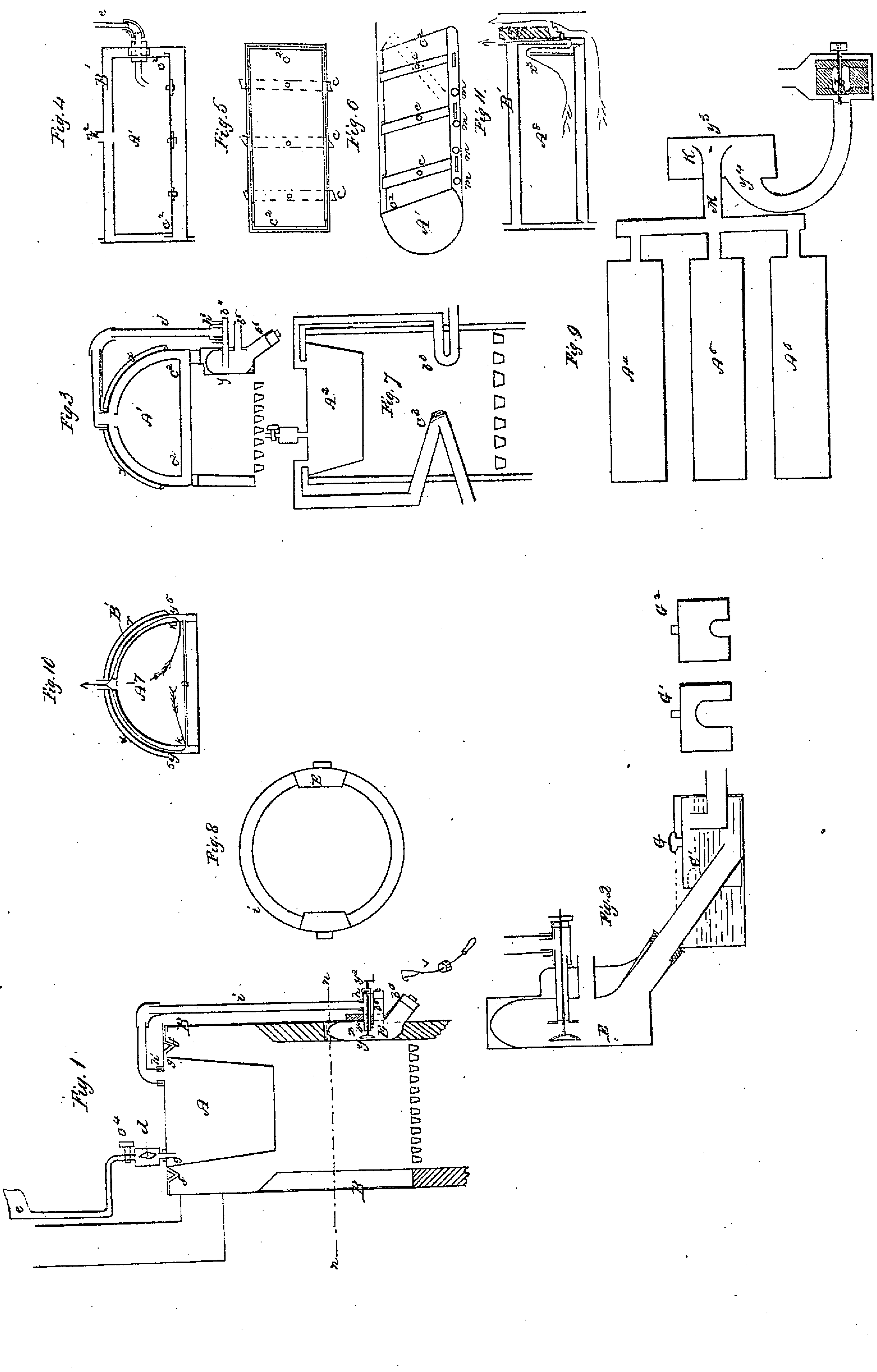
L. D. Gale.

Apparatus for Making Gas.

No. 26028. Patented Nov. 8 1859.



UNITED STATES PATENT OFFICE.

LEONARD D. GALE, OF WASHINGTON, DISTRICT OF COLUMBIA.

MANUFACTURE OF GAS.

Specification forming part of Letters Patent No. 26,028, dated November 8, 1859; Reissued March 8, 1870, No. 3,872.

To all whom it may concern:

Be it known that I, LEONARD D. GALE, of the city and county of Washington, in the District of Columbia, have invented a new and Improved Method of Treating Bitumen, Bituminous Coal, and All Distillates of Bituminous Coal and Its Equivalents for Preparing Coke and Illuminating-Gas; and I hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and references marked thereon, which constitute a part of my invention.

The nature of the invention consists in vaporizing all the volatile portions of coal, coal tar, and their equivalent bituminous substances, (or those susceptible of the same treatment), by first converting them into vapor, at a heat, below a cherry red, and then forcing the vapor so generated into contact or against a red hot surface, whether that surface be the heated side of an outer retort or the passage through a red hot tube or any other heated surface.

Having made a simultaneous application for other gas fuel than bituminous coal and its equivalents, my present application is restricted to bitumen, bituminous coal and their distillates or their equivalents.

In the processes now in use for making coal gas, as well as those for making it from other substances, the crude material is all heated to the cherry red heat at once, while in my process the whole mass is only heated to a temperature approximating to a red heat, while not exceeding one fifth of the mass, or that which is vaporized is heated to a full red heat. Newcastle coal yields an average of not far from 20 pr. ct. of hydrocarbons. Of this about 12 or 13 pr. ct. is illuminating gas and 7 pr. ct. is coal tar, as treated in the London gas works. The difference therefore between the two processes as to the amount of heat required, and consequently the cost of fuel used, is very clear in favor of my process. It is clearer still when we consider that the fuel necessary to heat the whole crude mass to a point below visible redness is quite sufficient, as here used, to heat the 20 pr. ct., or the whole volatile hydrocarbons, to a cherry red heat as required by my process, because that heat is sufficient to keep the gas back red hot. Whatever is saved in fuel by my process will result in a similar saving in the longer use of the retorts from working at a lower heat. My process also diminishes the product of coal tar to such an extent that this refuse is no longer an eye-sore to the manufacturer, but is in itself a large source of emolument, being almost entirely worked up into the best illuminating gas. This adds to the amount of gas produced by the ordinary mode of working a large proportion. Thus the coal tar is about one third of the whole volatile hydrocarbon generated, and as my process converts nearly all of this material to gas it increases the amount of gas produced over that obtained by the ordinary process now in use very largely. And whatever coal tar there may be generated by my process, be it more or less, it is capable of being converted into the best gas in the same retorts used for distilling coal by merely adding a feed apparatus, seen in Fig. 4, which is provided with the retorts, for whatever may chance to escape decomposition in the gas back or decomposing chamber is reserved to be treated as liquid feed, in the manner presently to be described. It requires purification in the same manner as coal gas. The small quantity of coal tar made by my process therefore is not very objectionable, because the selfsame vapor which is deposited as tar is in the best state to be vaporized and presented anew to the decomposing chamber presently to be described. In case the present decomposing chamber is dispensed with the vapor is decomposed in the space between the inner and outer retort, as hereinafter described.

In the accompanying drawings Figure 1 is a sectional elevation of a gas stove in which A is the vapor generator and E the generating chamber or gas back. Fig. 2 is an enlarged view of the gas making chamber E, the tar drip and washer G, of which G′ is a separate view of the left side of the cover and G^2 a separate view of the right side. Fig. 3 is a sectional end view of the double (⌂) retort and gas back. Fig. 4 is a longitudinal sectional elevation of the retort (⌂) showing the mode of supplying it with liquid feed, also the movable bottom c^2 in place. Fig. 5 is the removable bottom of the inner retort, showing the position of the braces *c*, *c*, *c*, and the raised edges of the inner surface. Fig. 6 is a bottom view of the inner retort, showing the locking braces *c*, *c*, *c*, when locked and when unlocked. It also exhibits vapor holes m, m, m, &c., which are used in place of gas back in certain cases. Fig. 7 shows a modification of the decomposing chamber consisting of the U formed tube c^3 or b^3 which though effectual on a small scale is liable to clog by a deposit of carbon. Fig. 8 represents a top view of the fire chamber in the gas stove and of the gas back E, being a section of the stove in line n, n in Fig. 1. Fig. 9 is a top view of a bench of three retorts A^4, A^5, A^6 designed to work large quantities of coal at a charge and deliver the vapor into a large gas back K, heated red hot on the side (y^3) and discharging its gas through pipe (y^4) and the pressure in the retorts is relieved by means of the exhaust fan L, which may be placed in the passage M, in certain cases. Figs. 10 and 11 show the use of the D retort in which the gas back is not used.

In all the drawings similar letters and figures refer to the same parts.

Of the above apparatus that of Figs. 3, 4, 5, 6 and 9 are the most important in the present application, in which the double D retort is used in combination with a decomposing chamber or gas back E or K. In case a single retort is used the heat is controlled in another way to be described presently. The chief reason for using the double D retort in preference to the single one is that the heat of the charge is more readily kept at the desired temperature. Otherwise it might rise to a sufficient degree to convert the charge to gas in the inner retort. This would be fatal to the process which requires that no permanent gas be formed in the inner retort and that none of the vapor escape decomposition into permanent gas in the gas back. If the single D retort could be certainly kept at a heat below redness then it would be preferable in some respects to the double one. These retorts for converting vaporizable gas fuel into vapor may be made very large, so as to contain several tons of material at a time, and discharge their vapor into a very large decomposing chamber, to be described further on. In all small apparatus, applicable to domestic purposes, where the D retort does not exceed three feet in length, the inner retort is more necessary to prevent extremes in temperature, and may be made of Russia sheet iron. If it be a retort 6 to 8 feet long, then the inner retort should be of thin cast iron, as thin and light as it could be conveniently cast. A retort of this kind with fair usage would last many years. The outer retort may be constructed in the usual way now found in our city gas works, except it may be made much larger. Indeed, there can hardly be a limit to the size of the retort from the fact that the temperature is kept so low as not to affect the strength of the metal. The retorts may be immense coking ovens connecting with an exhausting fan so that the pressure be entirely removed from the inner surface of the retorts and carried onward through the purifiers and washers to the gasometers. The exhaust apparatus may be placed with greater advantages between the purifiers and gasometer, which will better equalize the pressure through the whole apparatus from the retorts to the gasometers.

Figures 3, 4, 5 and 6 exhibit the different parts of a D-retort in connection with the decomposing gas back, and 1, 2, and 8 show different views of the gas back. 10 and 11 show views dispensing with gas back. A′ represents the inner retort and B the outer retort, the latter made in the usual way found in our gas works. The former is constructed in a peculiar way, now to be described. It is made of thin cast iron chiefly with reference to the strength required when used at or below incipient red heat. For small retorts not exceeding 3 feet long it may be made of Russia sheet iron with a removable bottom c_2 (Figs. 5, 4, 6, 3) and with a large opening in the top for the free escape of vapor opposite to a similar one in the outer retort. The flanges (a) on the sides project downward to form the legs or resting parts, bearing on the bottom of the outer retort, so that the inner retort may not be heated to redness. The space between the inner and outer retort may be one inch between the two bottoms, and a half or three quarters of an inch between the sides. On the inside of A′ are small flanges or projections (k) running the whole length of the retort and forming a bearing, against which the sides of the removable bottom (c^2) press when it is locked in place by the supports c, c, c, as shown in Figs. 6 and 5. This removable bottom is so constructed to form a convenient means of charging and discharging the gas fuel. In Fig. 3 it is shown in its natural position ready for use. In Fig. 6 it is shown in position ready to be opened for discharging the spent coal or the coke. This is accomplished by turning the supports (c) on their pivots, so that the ends thereof shall slide out of their slotted bearings, when the bottom (c^2) is easily removed and inverted in the position seen in Fig. 5, where are also shown the turned up edges of this bottom, making it a sort of long pan. The design of the pan form is to adapt it to liquid feed, to be fed through pipe (e) through a suitable feed apparatus, shown in Fig. 1, the stop cock (c^4) controlling the amount fed. The nuts 1, 2, 3, in Fig. 4 are for fastening and removing the feed pipe. This feed apparatus is designed to work coal tar, oil, fats, &c., and my process is, as far as I am informed, the only one that is capable of working coal tar economically, from the fact that the gas is made from vapor. But as the carbon in coal tar is greatly in excess over the hydrogen it requires some material that would furnish by itself the light carbureted hydrogen. This desideratum is such in the use of ordinary white-pine sawdust made into hard cakes or blocks pressed like kindling materials only enough coal tar being used to act as a cement to make the woody matter to adhere. The discharge opening at k^2 is a concentric ring space filled with a mixture of 8 pts. bismuth, 5 of lead and 3 of tin, making a cap joint of fusible metal for receiving the pipe (i), the other end of which (h^3) is received into a suitable joint and discharges the vapor received from A into the decomposing chamber E, denominated the gas back. This gas back is somewhat of the form of a hollow fire brick, made a casting in a single piece of iron and having a discharge opening at the bottom (b^6) for the escape of the refuse carbon that falls from the fire plate (y). The tube b^6, which discharges the vapor from the retort delivers it against plate (y) already red hot, and which decomposes it into permanent gas. It is then reflected back and passes out through pipe (b^5) and is conducted to the washer, condenser, purifier and gasometer. Plate (y) is sometimes coated with carbon, and then is cleared by turning crank (y^2) having on its extremity the scraper blade (z) and working through an air tight packing; or it may be cleared by means of the hand scraper (v) worked through (b^6) with also an air tight collar. When scraper (y^2) be not in use, it is drawn back so that the (z) blade rests against the end of tube (b^4). If it should be ascertained in works on a large scale that the cranks need to be turned frequently the shaft may be attached to a belt pulley and worked by power continually.

The conditions required in the gas back are that pipe b^5 shall be somewhat larger than (b^4) so as to discharge freely the gaseous contents which have been expanded by heat from say 700° of Fahrenheit to say 1000°. Practically, if (b^4) be an inch in diameter (b^5) may be an inch and a half in diameter; secondly, it is indispensable that the outside of the chamber E be below a red heat and that plate (y) shall be sustained constantly at a red heat so that all the vapor may be received against the red hot plate and that none of it may escape being converted into illuminating gas.

Plate (y) is sometimes modified by making it a concave parabolic reflector and radiator for the purpose of having the vapor projected against it from the end of pipe (b^4) as from the focal center of said concavity, by which means the reflected currents would flow back in horizontal parallel lines, to be discharged through pipe (b^5). One of the objections to this concave heater is that it is less easily cleaned than the plain surface when the hand scraper (the most convenient in practice) is used. Indeed, with the plain surface very little cleaning is required, from the fact that the cake of carbon curls up and falls by its own gravity from the heated plain plate (y).

In the operation of this retort and gas back we will suppose the whole apparatus in place as seen in Fig. 3. The cover of B is removed, exhibiting A′ in its place and ready to be charged with coal. It is supposed to be a retort 6 feet long and 1 foot wide, and made of thin cast iron. It is drawn out on a sort of table or railway of the same height or level as the outer retort. It is then turned over on its back, the removable bottom (c^2) unlocked and removed, and the retort filled to two thirds of its capacity, the cover replaced and the supports (c) locked in their places and the retort A′ shoved into retort B′, previously heated to redness, the door closed in and the heat continued. Vapor soon escapes through pipe (b^5) and permanent gas soon comes over and so continues till the charge is worked off. Occasionally or say once in an hour the surface (y) should be scraped off with the hand scraper (v). The door may now be opened and the inner retort A′ is drawn out upon the railway and another previously charged is shoved into the retort B′, and thus the generation of gas is made continuous.

In using D retorts 6 feet long, though a single decomposing chamber or gas back of 12 inches width, would give all the necessary space in width which would be required for converting all of its vapor into gas, and a furnace therefore that would heat one retort its whole length would be sufficient to heat 12 gas backs, or would be sufficient to convert into illuminating gas the vapor generated by 12 separate retorts, yet the fire surface in practice is required to be much larger so as to meet all contingencies of sudden liberation of much gaseous matter. In accordance with this view, the benches of retorts as now used in gas works, if the heat were reduced so that the retorts would be sustained at incipient redness only, the vapor from a retort house of 96 retorts might be converted into good illuminating gas by the gas backs, capable of being heated in a single retort furnace or in two or three. Although the estimate here given may not be found to be the exact proportions of retorts and gas backs, yet from the experiment made on a small scale it is believed they cannot be far from correct.

In Fig. 9 a bench of three retorts A^4 A^5 A^6 is so arranged as to deliver their vapor into a single gas back K, the plate y^3 of which is in contact with the fire and heated to a cherry red heat, the gas from which escapes through pipe (y^4) and thence through exhaust fan L, and so on to the gasometer. It is proper to state, however, in regard to the use of the exhaust fan that the power of the exhaust must not be so great as to make the pressure within the retorts less than the ordinary pressure of the atmosphere without, for if it were so the current would be drawn through the decomposing chamber K without striking against plate (y^3). The exhaust fan should act only to take off a part of the pressure. If, however, it were found desirable to remove a greater portion of the pressure than is consistent with a current against the plate (y^3), then we have only to place the exhaust fan at M and the difficulty is obviated. There must be a projectile force in the current that enters the gas back sufficient to dash the jet of vapor against the plate (y^3). If from any cause it fails to do this, a portion of the vapor will fail to be converted into gas and will be condensed as coal tar. The production of coal tar is therefore the result of the defect in the jet of vapor or of the deficiency of the heat of the plate (y^3) or (y), or lastly, the distance between the end of pipe (b^4) and the red hot plate (y or y^3) of the gas back may be such that a part of the jet may fail to be heated to redness. In cases where the pipe (b^4) is large, in comparison with the amount of vapor generated I use a disk of metal (z^2), Fig. 2, screwed on the end of pipe (b^4) and the pipe screwed in sufficiently near the heating plate (y or y^3) to secure the heating of all the vapor to the required red heat. For the peculiarity of my process, differing from every other is, 1st, it prevents any solid or liquid feed to be heated red hot itself but only hot enough to expel its vapor and force it against a red hot surface with means for sudden direct and quick escape to a cooler chamber where decomposition of gas cannot take place; and, secondly, that none of the vapor generated can escape a red heat to convert it all to gas.

There is still another modification of the D retort adaptable to feed coal or to the liquid feed. In this apparatus I dispensed with the gas back altogether and used as a decomposing chamber in place of it, the space intervening between the inner and outer retort, as may be seen by inspecting Figs. 3, 4, 6, 10, 11, by making the following modification: Close the opening in the dome part of the retort A′, Figs. 3 and 4, and open a series of small holes (m) on the sides of A″ near its bottom, (Fig. 6), shown also by the arrows in Figs. 10 and 11, through which the vapor escapes in jets against the red hot sides of retort B′, by which it is converted to permanent gas and escapes up the sides between the two retorts and out through the escape pipe near k^2. In this, where the gas back is dispensed with, the upper part of the outer retort is prevented from being heated to redness by the dome shield piece x, x, which may be of mason work or of iron. This modification requires the outer retort to be heated somewhat higher than when the gas back is used, from the fact that the lower part of the sides must be kept at a full red heat, which is not required in the other case. It has advantages over the gas back, presenting comparatively a larger decomposing surface and preventing any inequality of pressure from affecting the character of the gas, as may arise where the gas back happens to be too small for the amount of vapor generated. It must also be borne in mind that the tubes leading to and from the gas back must be of a size proportioned to the charge of gaseous matter passing through them.

In working liquids, as coal distillates, that are liable to froth and carry over vapor and choke the gasback, I make (b^6) the gas discharge instead of (b^5), attaching the tar drip or gas main to (b^6) and the condenser to that, and the gas then passes to the purifiers and to the gasometers, which, forming no part of my improvement, have not been described in detail except vessel G for washing the gas. See Fig. 2. The above use of (b^6) for discharging the gas may be adopted in working coal and more especially cannel coal.

As experience has thus far shown that in ordinary working of the gas back there is little occasion for using blade z and crank (y^2) this device may be omitted, and scraper (v) depended on.

Of the various forms of retort for working my process represented or described above that shown in Figs. 10 and 11 I regard as the best for efficiency and cheapness. That seen in Fig. 1 does well where small quantities are wanted but is not fitted for large establishments.

I am aware James Hansor in an English patent of 1856 proposed to make gas by first converting the gas fuel to vapor in one retort and then passing it into a second retort, by which it said to be made into permanent gas. But there were no means provided to force the gas making vapor against a red hot surface accompanied with an instantaneous discharge out of the region of red heat, to prevent further decomposition, which inevitably follows except the gas be instantaneously removed from the red hot chamber.

I am aware that Wm. B. McConnell obtained a patent for what was called "reheating the gas," &c.; but as no provision was made to avoid generating permanent gas in the first heating nor for removing from the red hot chamber instantaneously the gas generated in the second heating to prevent further decomposition it does not interfere with my invention.

I am also aware that many inventions have been made proposing to improve the gas already made by pasing it through heated flues, pipes, or chambers; but I have learned that all reheatings of the permanent gas only deteriorate its illuminating quality. All of these contrivances I disclaim.

Having fully described my process for manufacturing illuminating gas from bituminous coal and its distillates or their equivalents, such as bituminous slates and the like, what I claim in the present application as my invention and desire to secure by Letters Patent is—

The treatment of bitumen, bituminous coal and their distillates or their equivalent by first converting their volatile portions to a state of vapor, at a temperature below a cherry red heat, and then forcing the vapor so generated, into contact with a red hot surface, in such a manner that the gas generated, may be instantaneously removed from the said heated surface, and thus be prevented from further decomposition.

L. D. GALE.

Witnesses:

EDM. F. BROWN,

J. H. MERRILL.