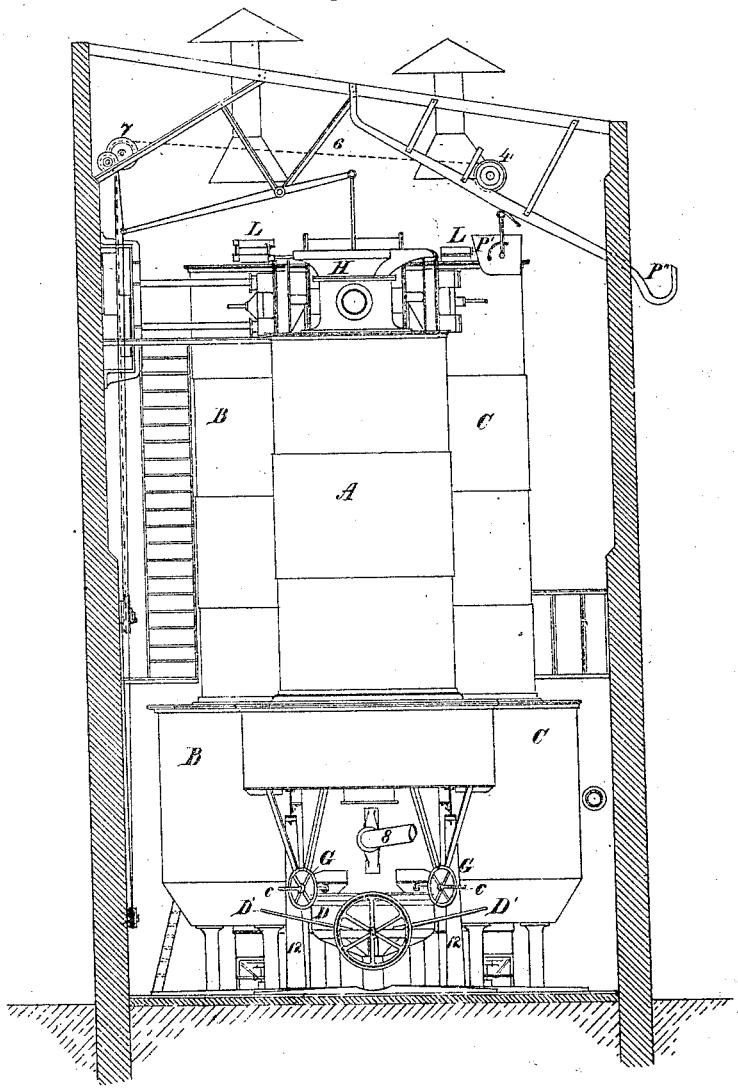
(No Model.) 3 Sheets—Sheet 1.

J. F. ALLEN.

PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

No. 453,752. Patented June 9, 1891.

Fig. 1.



WITNESSES:

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(No Model.) 3 Sheets—Sheet 2.

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PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

No. 453,752. Patented June 9, 1891.

Fig. 2.

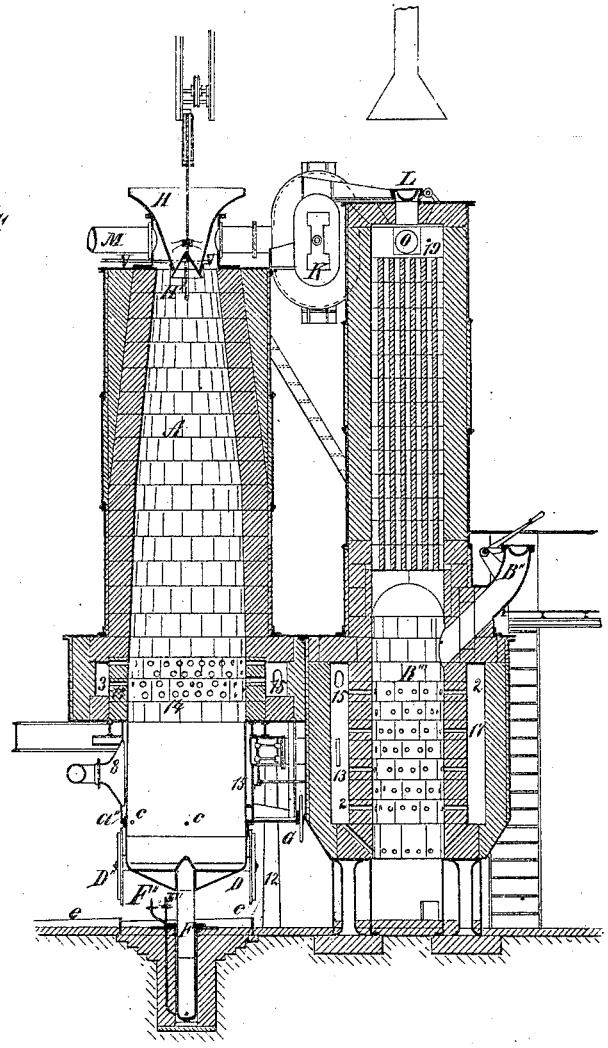
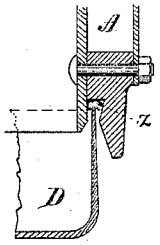


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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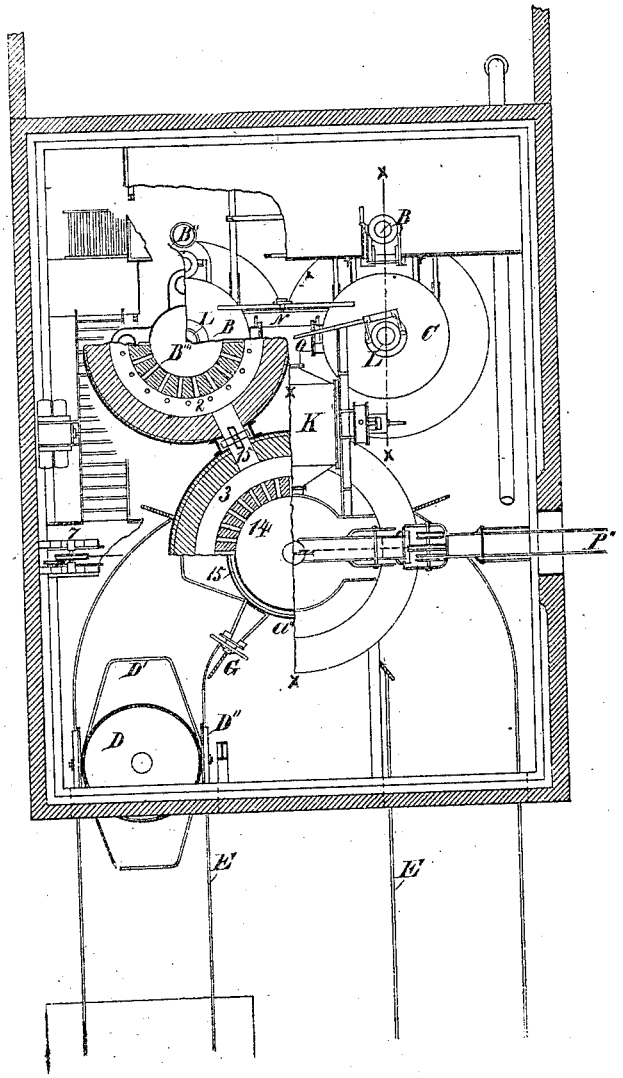
PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

No. 453,752. Patented June 9, 1891.

Fig. 3.



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UNITED STATES PATENT OFFICE.

JOHN F. ALLEN, OF NEW YORK, N. Y., ASSIGNOR OF THREE-FOURTHS TO WILLIAM R. BEAL, OF SAME PLACE.

PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF GAS.

SPECIFICATION forming part of Letters Patent No. 453,752, dated June 9, 1891.

Application filed July 13, 1887. Serial No. 244,127. (No model.)

To all whom it may concern:

Be it known that I, JOHN F. ALLEN, a citizen of the United States, residing in the city, county, and State of New York, have invented new Improvements in the Manufacture of Illuminating-Gas, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

This invention relates to a process for the manufacture of illuminating-gas by the destructive distillation of coal, oil, or other heavy hydrocarbons, and to the apparatus employed in such process. Its object is to secure an increased quantity of ethylene-gas or the homologues thereof in the permanent and lean gas, such as light carbureted hydrogen, which latter gas will also be produced in much greater quantity. I accomplish this object by the continuous circulation through carbonaceous material of the crude gas distilled therefrom, the product in the process of circulation being highly heated in a regenerated fire and the circulation continued until the watery and tarry vapors in the crude gas are decomposed and thereby converted into a permanent gas, and the carbonic acid produced in the distillation is converted into carbonic oxide, a combustible gas, and, further, the necessary heat is conveyed from the regenerated fire to carry on the distillation. This is accomplished by a distillation chamber or cupola and one or more regenerated fires, preferably two, connected therewith by upper and lower passages provided with valves, so that at will the line of circulation through the distillation-chamber may be alternated from one regenerating-chamber to the other, or may pass through both for a part of the time. By this means the products of destructive distillation are brought into continual contact with fires and heated surfaces of incandescent carbon, one of the chamber-fires being heated while the other by the passage of the gas through it is being lowered in temperature. Thus by changing the circulation from time to time from one fire-chamber to the other the increased heat of the crude gas is continually maintained during the process of distillation. I am thus enabled to decarbonize the heavy hydrocarbon vapors of the tars from coal or oil by oxidizing a portion of their carbon by means of the oxide of hydrogen natural to them or added thereto, and by this means produce a portion of hydrogen to hydrogenize the heavy hydrocarbon vapors which is equivalent to decarbonizing them, thereby producing ethylene or its homologues, which only differ in structure or density, all of them possessing the chemical equivalents C_nH_{2n}.

The invention therefore principally consists of the forced circulation of the products of destructive distillation through regenerated fires into and through a primary or distillation cupola or chamber and maintaining such circulation without the admission of air in said distillation-chamber and regenerating chamber or chambers containing regenerated fires, whereby the heat is conveyed to carry on the distillation in the primary chamber and the watery and tarry elements of the crude gas are decomposed and converted into a permanent gas and the resulting coke greatly improved by reason of being coked in mass instead of in small retorts.

It further consists in the process of heating the watery and tarry vapors in the manufacture of gas for illuminating and other purposes by the forced circulation of such vapors through a fire of carbonaceous material previously regenerated to an incandescent state, whereby such vapors are destructively redistilled and decomposed.

It also consists in the various details of the apparatus which are hereinafter described.

In the drawings, Figure 1 is an elevation in perspective of my improved apparatus, showing the distillation-chamber and the two regenerating-chambers connected therewith. Fig. 2 is a transverse vertical section drawn through line $x\,x$ of Fig. 3. Fig. 3 is a plan view in sections at different heights. Fig. 4 is a sectional view of the bottom of the distillation-chamber.

A is the distillation chamber or cupola, supported on pillars 12 and provided with tunnel-head H, through which the coal is fed to the cupola, and tuyeres 14, through which the heated gases are passed from out of the regenerating-chambers B and C. The belt of tuyeres is surrounded by annular space 3, this space being connected by a valved passage

or passages 15 with the annular space around the regenerating-furnace B'''. The tunnel-head is opened or closed by means of the bell-valve H', and when the coal is fed to the cupola its proper distribution therein is secured by the deflecting-surface of the bell-shaped valve.

M is the discharge-pipe which carries the excess of permanent gas to the hydraulic main and purifiers, the pipe being always open, but under seal of water in equilibrium with the atmosphere, as is practiced in the ordinary way of making gas.

That portion of the chamber below the enlarged part A' (which surrounds the annular space and tuyeres leading therefrom) is preferably suspended from the cupola, as best shown in Fig. 2. It is surrounded by a shell a'', thus forming the annular air-space 16 around the base of the cupola. Cold air is admitted into this annular space through opening 8, cooling the coke within the chamber and also utilizing the heat thereof on its way to the furnaces of the regenerating fire-chambers B and C.

D is the tub or barrow, having handles D' and wheels D'', which seals, when in position, the opening at the base of the cupola. This barrow is intended to convey away by means of track E the coke which is being formed in the cupola. It is placed and held in position by the ram F, fitting in a recess beneath the barrow. The water which exerts the required hydraulic pressure to elevate the barrow being admitted through the valve F' from a small tank placed at a proper height to develope the force, the ram is lifted by this means, carrying the empty barrow into position, as shown in Figs. 1 and 2. In this position the valve F' is closed and an increased pressure is put upon the ram by means of valve F'', sufficient to carry the load and seal the base of the cupola. When the barrow is to be removed, the valve F''' is closed and the valve F' opened. The weight of the coke and the barrow causes a back action on the column of water and forces it back into the tank. When the barrow is lowered, the valve F''' is closed. The barrow is run off on the rails, and an empty one is immediately lifted into position by opening valve F'. In order to break out from the base of the cupola a barrow-load of coke and at the same time support the column of carbonaceous material above it, the radial spurs G are provided. These spurs act as wedges to the tenacious body of coke which they enter and break off the coke just above the line of the upper edge of the barrow. The spurs are inserted and withdrawn by means of wheel G', having a threaded opening at its center, engaging with the threaded portion of the spurs G, the wheel acting as a set-screw upon said spurs.

The regenerating-chambers B and C are provided with furnaces, as shown by B''' in Fig. 2. These furnaces are surrounded by annular space 2, from which leads the belt of tuyeres 17, through which the air admitted through opening 8 from the annular space 16, passage 13, and annular space 2, is fed to the fire within the furnace. This belt of tuyeres extends from the bottom of the furnace to nearly the height of the bed of fuel within it. The purpose of this construction is to promote through an equal distribution of the air when forced into the body of the fuel a more perfect and more rapid combustion than could otherwise be obtained in so deep a fire. By this means I prevent the formation of carbonic-oxide gas when the fires are being regenerated, which, if allowed to be formed, would rob the furnace of heat in volatilizing the extra carbon, and consequently secure economy in the utilization of heat elements upon the fuel, and when the currents of hot gases are blown upward through the fire-brick construction to heat the same above the furnace and until the proper temperature is secured out through opening L into the atmosphere.

The furnace is fed through opening B'', a movable cap operated by a lever covering said opening. The two regenerated fires are connected with the distillation-chamber by means of the T-shaped pipe O, connecting with the blower K. Each arm of the T is provided with a valve, so that the line of circulation continually maintained in the distillation-chamber may be caused to alternate at will from one of the regenerating-chambers to the other. Similar valves are provided in the openings 15, which connect the annular spaces 2 3, so that a complete circuit in the movement of the heated gases can be secured during the process of destructive distillation.

P' is the elevated track along which the coal-bucket P'', containing material for the distillation-chamber, is carried by means of wheel-pulley 4, pulleys 5 7, and lifting-rope 6. The curved lower end P''' of the track arrests the inclined movements of the wheel-pulley, and thus permits the empty bucket when it reaches this point to descend for a new load.

The manner of operating my improved apparatus is as follows: The bottom of the distillation-chamber A is closed by the barrow D, the top edge of which impinges against a ring of asbestus Z, placed in a recess or shoulder at the lowest portion of the base of such chamber. The base of the chamber is filled with large coke to a line just above the belt of tuyeres. On this coke and filling the cupola to nearly the base of the tunnel-head is placed the coal which is to be destructively distilled. The valve H is then closed. One of the regenerating fire-chambers—for example, chamber B—being filled with anthracite coal or other carbonaceous fuel, is then fired, the belt of tuyeres surrounding it admitting the forced draft of air to the body of the fuel in the furnace. The cap of the furnace is removed when the fire is to be started, the

valve in upper passage O, leading to the distillation-chamber through blower K and passage N, and the valve on lower passage 15, connecting the annular spaces 2 3, being closed while this blowing up or heating of the fire-brick flues is continued. When the fire and the fire-brick above it have reached the proper temperature, the cap is placed in position, the valves in the upper and lower passages opened, the blower K started, and the contained atmosphere of the distillation-chamber is forced down through the flues and through the furnace-fire of the regenerating-chamber, passing through the tuyeres 17 into annular space 2, through the passage 15 into annular space 3, and through the tuyeres leading from said space into the coal or other carbonaceous material within the distillation-chamber. Passing up through the coal, the crude gas is again forced down through the regenerating-chamber and fire, as before, and the circulation continued until a portion of the heat taken up by the crude gas in the regenerating-chamber is transferred to the distillation-chamber. The watery and tarry vapors in the crude gas in their passage through the regenerating-chamber and fire by exposure to the carbon at the high temperature therein are decomposed and converted into permanent gas. While this rapid circulation of the products of destructive distillation is going on the other regenerating-chamber C is being regenerated or fired to the proper degree of heat. When this has been obtained, the line of circulation is changed by opening the valves in the upper and lower passages which connect with the distillation-chamber, and the valves leading to chamber B are closed, the temperature in this chamber having been reduced by the continuous contact of the dense hydrocarbon vapors with its fire and heated surfaces. Thus the process is continued, alternating from one regenerating-chamber to another, the excess of gas produced passing off through the discharge-pipe M. As the coal within the distillation-chamber is coked a new supply is fed through the tunnel-head, the coke at the base of the cupola being removed in the barrow D, as before described.

In making oil and water gas by this process all that is necessary to do is to fill the distillation-chamber with coke instead of coal. The regenerating-chambers are heated as hereinbefore described.

Oil, preferably in the form of spray, is admitted through the pipe *e* above the line of the coke in the distillation-chamber. Steam injected into the regenerating-chamber through opening 19 becomes superheated and decomposed as it is forced by the action of the blower down through the highly-heated flues and furnace-fire, and, mingling with the hydrocarbon vapors of the oil, passes through the tuyeres up through the body of coke, communicating portions of its heat thereto, the circulation of the highly-heated vapors going on continuously the same as if the destructive distillation of coal was being carried on.

One of the essential features which distinguishes my process from others hitherto used is that the necessary heat for the destructive distillation of the carbonaceous material is created in and transferred from another fire and not generated in the distillation-chamber. By this means I can avoid the admission of atmospheric air into the distillation-chamber, prevent combustion therein, and by the transference of the crude gas at a high temperature and without air into the body of the material giving out the products of distillation, and its circluation through the heated fires decompose the watery and tarry vapors, convert them into a permanent gas, and thus increase not only the quantity but the quality of the illuminating-gas produced.

I claim—

1. The process of making gas for illuminating and other purposes, consisting in causing a forced circulation of the products of the destructive distillation from a primary chamber through a fire previously regenerated and back into and through the primary chamber, whereby the watery and tarry vapors are destructively redistilled and the necessary heat conveyed to continue the destructive distillation in the primary chamber, substantially as described.

2. The combination, with the open base of a cupola, of a removable bottom in the form of a tub or barrow fitted to and movable to and from the mouth or opening in the base of the cupola in a direct vertical direction by means substantially as described, and a ring of asbestus placed in a recess in the base of the cupola and forming a fixed seal for the joint between it and the top edge of the removable barrow, substantially as and for the purpose set forth.

3. The combination, with a distillation-chamber for holding coal or other carbonaceous material to be destructively distilled and provided with a belt of tuyeres, as shown, of one or more regenerating-chambers connected with said distillation-chamber by upper and lower passages provided with valves, said regenerating chamber or chambers having an annular space surrounding the furnace thereof, and a belt of tuyeres opening from said annular space into the furnace, whereby combustion is promoted within said furnace by the equal distribution of air through said tuyeres into the body of the fuel therein, as shown and described, a blower located in the line of circulation in the upper connecting-passages, and means for driving said blower and maintaining the circulation of the crude gas generated through said distillation-chamber and the regenerating chamber or chambers connected therewith, substantially as set forth and described.

4. The combination, with a distillation-

chamber A, having annular spaces 3 and 16, air-supply pipe S, and tuyeres 20, of regenerating-chamber B, having cap L, feed-opening B″, furnace B‴, annular space 2, tuyeres 17, said chamber being connected with the distillation-chamber by upper passages N O and lower passages 15, the two latter provided with valves, and with the air-space 16 by passage 13, blower K, and means for driving said blower, whereby a circulation of the products of destructive distillation may be maintained through one or both chambers and the watery and tarry vapors contained in said products decomposed by the increased temperature imparted thereto, substantially as set forth and described.

5. The combination, with a cupola, of an outer shell *a″*, provided with opening S, forming an annular air-space around the base of said cupola, of connecting-passage 13, regenerating-chamber B, having annular space 2, and furnace B‴, provided with tuyeres 17, substantially as set forth and described.

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Witnesses:
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