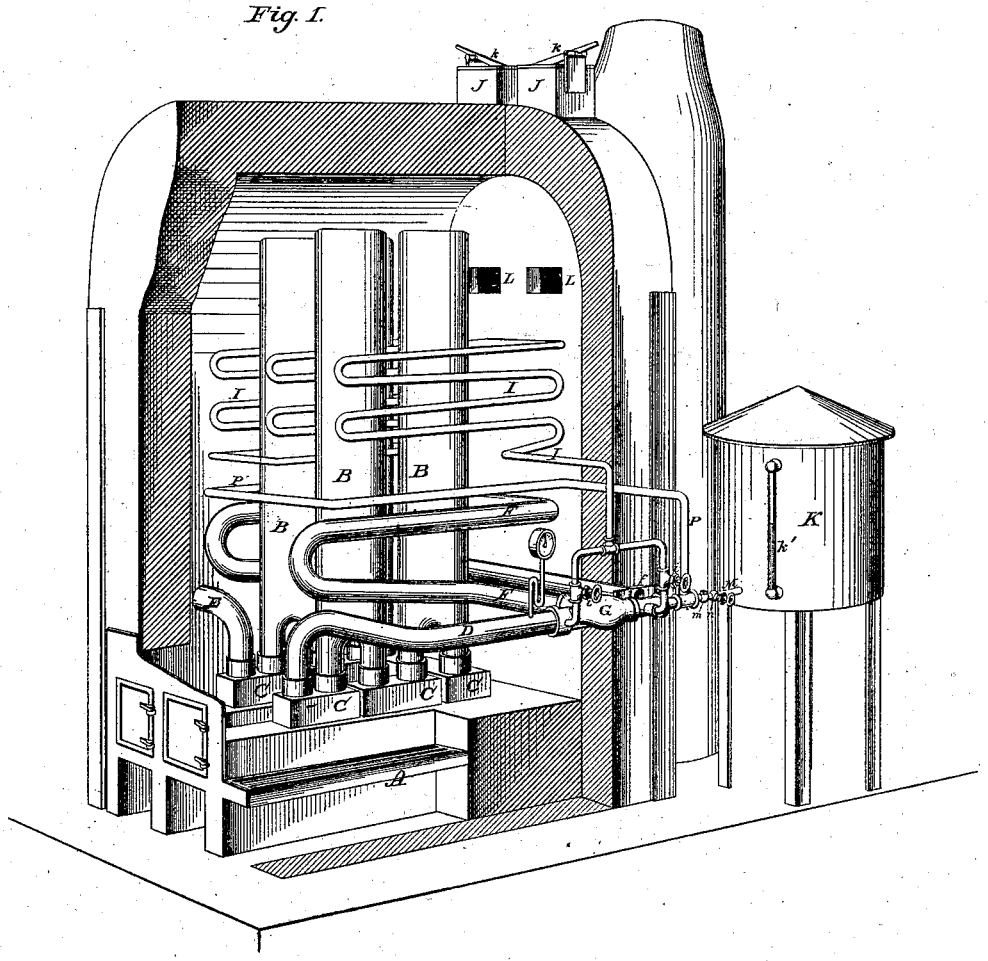
3 Sheets—Sheet 1.

S. C. SALISBURY.

PROCESS AND APPARATUS FOR MANUFACTURING GAS.

No. 187,734. Patented Feb. 27, 1877.

Fig. 1.



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R. D. O. Smith

3 Sheets—Sheet 2.

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Fig. 2.

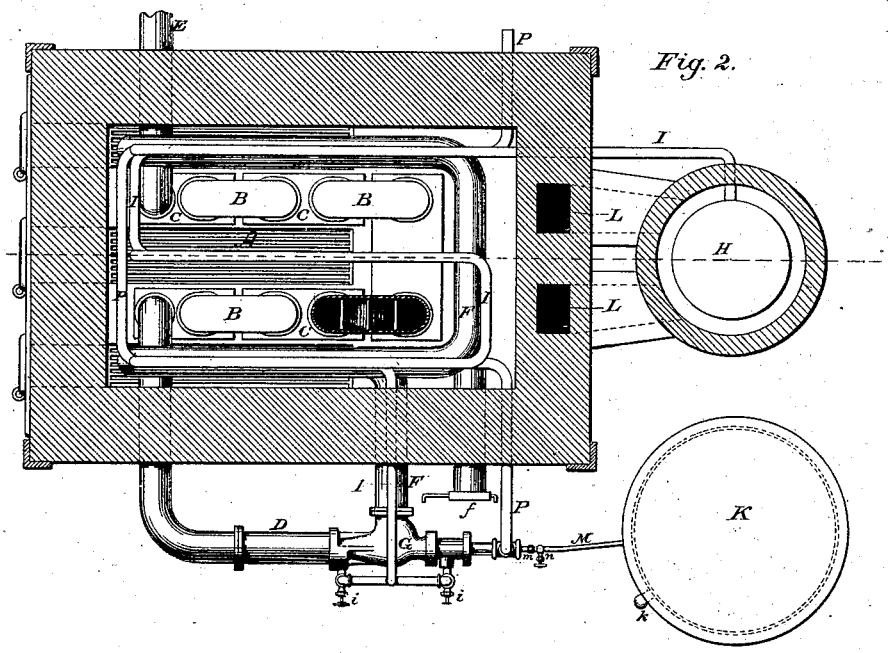


Fig. 4.

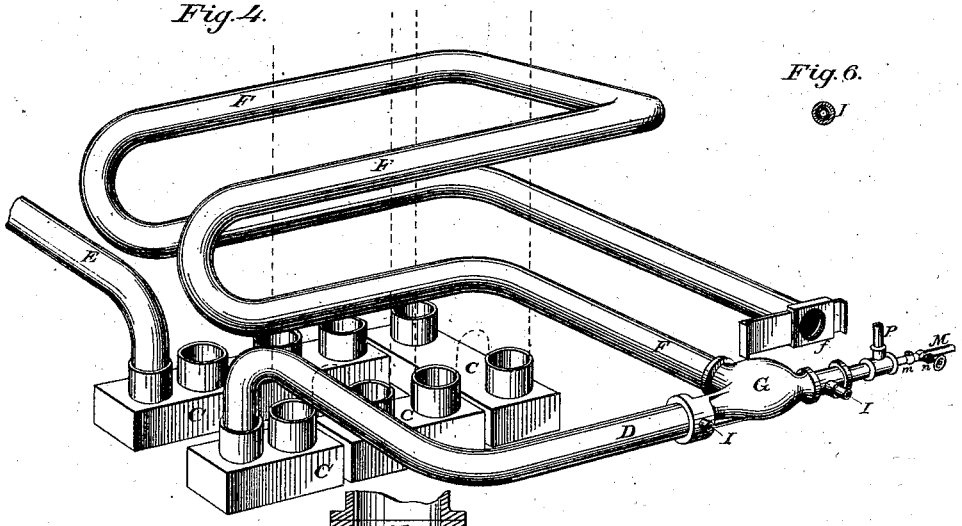
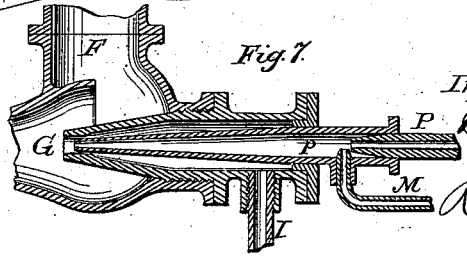


Fig. 6.

Fig. 7.



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PROCESS AND APPARATUS FOR MANUFACTURING GAS.

No. 187,734. Patented Feb. 27, 1877.

Fig. 3.

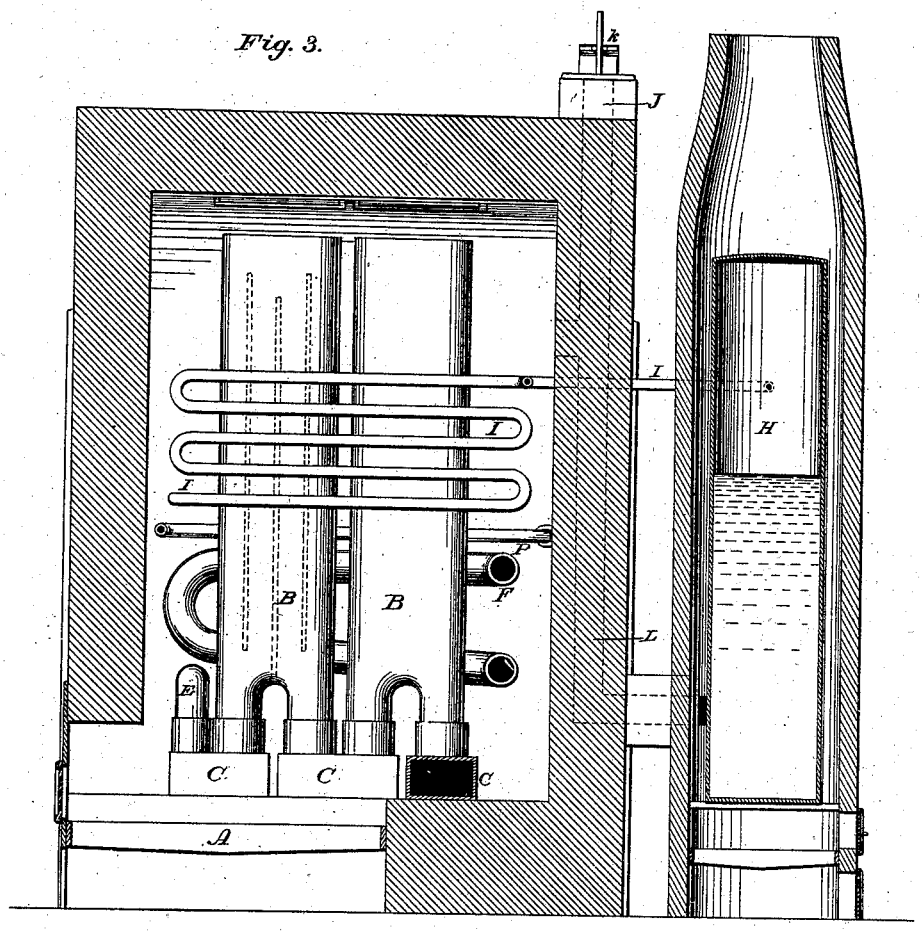
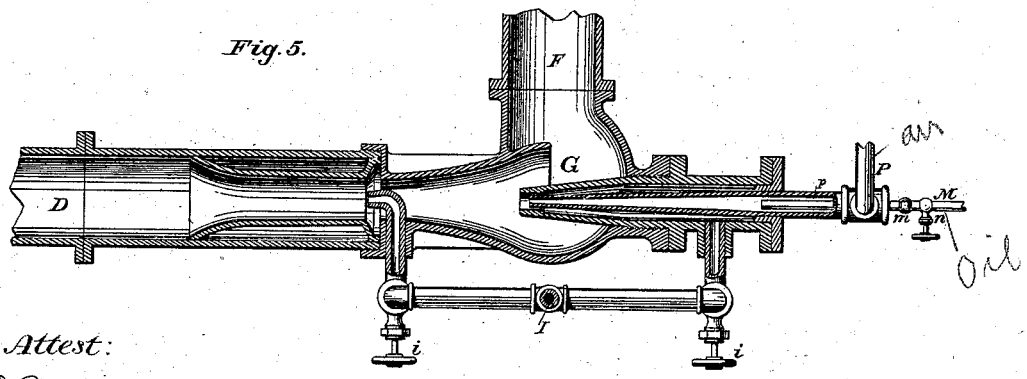


Fig. 5.



Attest:

C. Clarence Poole

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UNITED STATES PATENT OFFICE.

SILAS C. SALISBURY, OF NEW YORK, N. Y.

IMPROVEMENT IN PROCESSES AND APPARATUS FOR MANUFACTURING GAS.

Specification forming part of Letters Patent No. **187,734**, dated February 27, 1877; application filed August 15, 1876.

To all whom it may concern:

Be it known that I, SILAS C. SALISBURY, of New York, in the county and State of New York, have invented an Improvement in the Manufacture of Gas from mineral and other oils, and that the following is a full and clear explanation of the same:

This invention relates to the manufacture of gas from mineral or other oils for either heating or illuminating purposes.

The practical difficulties, both mechanical and chemical, encountered in handling and treating liquid hydrocarbons have heretofore been so great that the production upon a large scale of a fixed gas from these sources has not been practicable; but these difficulties are, by the new method of my present invention, overcome or so reduced in magnitude that they become insignificant. The great volatility of liquid hydrocarbon has rendered it impossible to introduce it into hot retorts, except in minute quantities, without the production of incombustible compounds of free carbon, and the treatment of the hydrocarbon vapors with an insufficient degree of heat fails to produce a fixed gas. Various methods have been suggested proposing to overcome these difficulties, but without producing practical results except upon a limited scale.

I am aware that there are many devices for feeding liquid hydrocarbon and its vapors to fire-chambers, and that superheated steam has been employed with such vapors in a variety of ways, and also that it has been proposed to carburet the blast-air by causing it to pass over a surface of liquid hydrocarbon; but I am not aware that a jet of superheated steam at a pressure so high as that which I employ has been used, with an injector to atomize and force an arbitrary quantity of vaporous hydrocarbon into a blast of hot air as a vehicle to convey said vapor to hot retorts; nor am I aware that in connection with a hot blast and an injector using superheated steam liquid hydrocarbon has been introduced in company with a supplemental blast of hot air, whereby said hydrocarbon has been warmed and prepared for the action of the superheated steam.

The product of this invention must not be confounded with carbureted air produced by the passage of the blast through a carbureter, whereby the blast will become more or less charged with hydrocarbon vapor. These are very essential differences. First, as to the method of feed: The quantity of vapor taken up will vary with the heat of the blast, and the volatility of the hydrocarbon exposed because the process will depend upon evaporation, and in the carbureter there will be a constantly increasing quantity of non-volatile residuum and a corresponding deficiency in uniformity and control. By the present invention the feed is positive and under perfect control, and there is no residuum whatever. Second, as to the quality of result: By the carbureter method no more hydrocarbon vapor is taken up than the air-blast will absorb, and the product cannot be more than a carbureted air entirely insufficient to replace solid carbonaceous fuel. By the present invention the blast of air is employed as a vehicle to convey an arbitrary quantity of hydrocarbon vapor to the retorts wherein its conversion into a gas associated with, but irrespective of the presence of, the atmospheric air, is completed, whereby I am enabled to produce a fuel gas from liquid hydrocarbon competent to replace solid fuel, much superior to it, at much cheaper rate, and by a continuous process under a high pressure.

The elements of my invention are, first, a continuous series of retort-pipes, through which to pass the hydrocarbon vapors for conversion into gas. Second, a hot-air blast for a vehicle, to convey an arbitrary quantity of hydrocarbon vapor to the furnace or fixing-retorts. Third, a jet of superheated steam under high pressure, say from ninety to one hundred pounds per square inch, to atomize and disintegrate said vapors. Fourth, a hydrocarbon supply-pipe, and a supplemental current of hot air to receive the liquid hydrocarbon warm, and discharge it into the jet of superheated steam and hot blast, whereby the vapor of liquid hydrocarbon is, in company with hot atmospheric air and superheated steam under great pressure, subjected to a temperature competent to decompose said vapors and produce therefrom carbureted-hydro-

gen gas, the value of which will be proportionate to the quantity of liquid hydrocarbon employed.

The chemical reactions which take place, or their order, I do not undertake to explain, but the results produced are as herein set forth.

Associated with this gas will be the oxygen compounds derived from the atmospheric air, and from the decomposition of the watery vapor of the superheated steam. For some purposes the fixing-retorts may be dispensed with, but their use insures the most perfect results.

For all purposes requiring the production of high degrees of heat, as in metallurgic furnaces, glass works, steam-generators, and domestic heaters, the gas is designed to be consumed as fast as produced, as will be more fully described hereinafter.

In the specification of my invention of improvement in blast-furnaces, for which my application for Letters Patent was filed of even date herewith, I have described an apparatus for forcing and heating an air-blast, and so far as this patent is concerned, the subject-matter of my said application filed of even date herewith is hereby disclaimed; but without in this patent designing to confine myself precisely to the apparatus therein described, I will say that that structure is at present preferred by me.

That others may more fully understand my invention, I will particularly describe it, having reference to the accompanying drawings, wherein—

Figure 1 is a perspective view of an apparatus competent to carry my invention into effect. Fig. 2 is a sectional plan of the oven. Fig. 3 is a longitudinal section of the same. Fig. 4 is a perspective skeleton of the feed-piping. Fig. 5 is a longitudinal section of the hydrocarbon feed and atomizer. Fig. 6 is a transverse section of the steam-pipe. Fig. 7 is a longitudinal section of the injector and atomizer, showing a modification of structure.

For convenience I will briefly refer to the separate parts named in the specification referred to.

A A are the furnace-grates for the oven. B B are vertical retorts, resting in shoes on the connecting-boxes C C. D is the inlet-pipe, and E is the outlet-main. F is an air feed-pipe coiled within the oven so as to utilize the waste heat. G is the blast-injector, operated by a jet of high pressure superheated steam from the generator H, taken through the superheater-pipe I within the oven. *f* is the feed-pipe gate, and *i* is the steam-pipe throttle. J J are the chimney-flues, closed at top by dampers *k k*, whereby the products of combustion and waste heat may be turned through the diving-flues L to the steam-generator H.

K is my tank or reservoir for liquid hydrocarbon; and this tank may be located at any convenient or desirable distance from the oven; but, when properly protected, there is no objection to placing it in the position represented, or in close proximity to the oven.

A gage, *k'*, indicates to the eye, at any moment, the quantity of liquid in the tank, and, by knowing the caliber of the tank, the quantity discharged during any given time may be easily determined by inspecting the gage.

The tank K is connected with the blast-pipe D by means of the pipe M, which is provided with check and stop valves *m n*, and discharges into the blast or injector nozzle, so that, by exhaustion, liquid is drawn from the pipe M, and carried with the blast into the oven-retorts B B, where its decomposition and transformation, without residuum, into a carbureted-hydrogen gas, associated with the constituents of the atmosphere and superheated steam, is effected—but whether in chemical union with said constituents is not at present known. However, in the production of heat for any purpose the presence of the oxygen derived from the atmosphere is of advantage irrespective of the nature of the union between it and the carbureted hydrogen, because of its immediate influence as a supporter of combustion.

It is desirable to heat the liquid hydrocarbon before it encounters the superheated steam, and in that way facilitate its vaporization and decomposition; and I therefore place an air-pipe, P, in the oven, coiled back and forth, so that the air passing through it shall become highly heated, and insert the end of said pipe into the chamber *p* surrounding the nozzle of the pipe M. The hot air issuing from the pipe P, and sucking the liquid hydrocarbon from the pipe M, vaporizes it almost instantly, and as it passes into the blast-pipe it is subjected to the action of the jet of superheated steam, and from thence to the retort the temperature is continuously rising until decomposition has been effected, and the hydrocarbon vapor associated with the constituents of atmospheric air and the superheated steam has been resolved into a highly-combustible gas, which, when fed to, and fired in, the furnace, produces an intense heat, and deposits no residuum. The quality of this gas is determined by the quantity of liquid hydrocarbon fed to the blast, and this quantity is perfectly under control by means of the valve *n*.

The practical effect of this invention is the production, by a continuous process, of gaseous fuel from liquid hydrocarbon at a cost of less than one-half the cost of coal in the Pittsburg market, and this fuel is produced without risk, and in quantity and quality as desired, and under perfect control. It leaves no residuum; it imparts no impurities to the substance under treatment, and in the working of iron the product is not only superior in quality but there is also an increased yield, due to the absence of impurities and the diminished formation of slugs.

In practice this gas is fed to the furnace at the temperature of the fixing-retorts, and its combustion is correspondingly intensified, with a corresponding economy in consumption.

Having described my invention, what I claim as new is—

1. A continuous process for converting liquid hydrocarbon into gas, substantially as herein described—to wit, injecting, by means of superheated steam, at a pressure of ninety pounds per square inch and upward, a spray or atomized jet of liquid hydrocarbon into a blast of hot air, whereby it is conveyed into and through a series of hot retorts, wherein its conversion into inflammable gas is completed, as set forth.

2. The combination, for the purpose set forth, of a series of retorts, B B, set in a hot oven, a steam-injector, G, a hot-air feed-pipe, F, and a supply-pipe, M, entering the supplemental hot-blast chamber P within the steam-nozzle of said injector, and delivering liquid hydrocarbon, as set forth.

SILAS C. SALISBURY.

Witnesses:

R. D. O. SMITH,

C. CLARENCE POOLE.