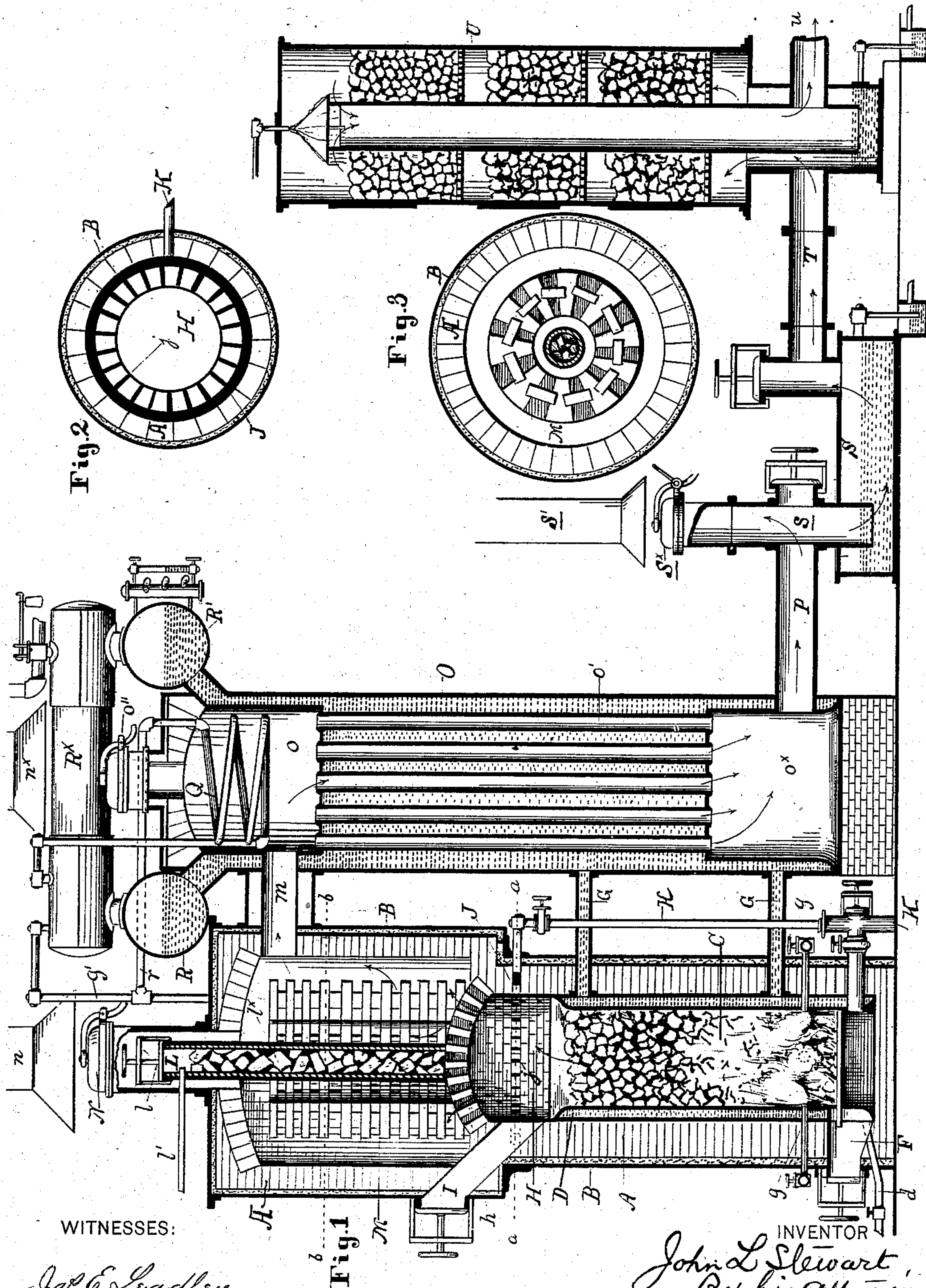


(No Model.)

J. L. STEWART.

APPARATUS FOR PRODUCING ILLUMINATING OR HEATING GAS.
No. 282,399.

Patented July 31, 1883.



WITNESSES:

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Fig. 1

INVENTOR

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UNITED STATES PATENT OFFICE.

JOHN L. STEWART, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR PRODUCING ILLUMINATING OR HEATING GAS.

SPECIFICATION forming part of Letters Patent No. 282,399, dated July 31, 1883.

Application filed January 15, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN L. STEWART, of the city and county of Philadelphia, and State of Pennsylvania, have invented certain Improvements in Apparatus for Producing Illuminating or Heating Gas, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

My invention relates to apparatus for producing hydrocarbon and fuel gas for heating and illuminating purposes.

In the accompanying drawings, Figure 1 represents in central vertical longitudinal sectional elevation an apparatus conveniently embodying my improvements and designed for the carrying out of my process; Fig. 2, a sectional plan, taken on a horizontal plane projected on the dotted line *a a* of Fig. 1, of the air-distributor which communicates with the mixing-chamber; and Fig. 3, a similar view, on the line *b b* of Fig. 1, of the gas-superheater.

Similar letters of reference indicate corresponding parts.

In the accompanying drawings, A represents a vertically erected and preferably cylindrical hollow casing composed of fire-brick or other suitable refractory substance, preferably incased in an envelope, B, of sheet-iron. Within the hollow interior of this casing are contained the gas-generator or combustion-chamber, the mixing-chamber, the gas-superheater, and the retort within which the liquid hydrocarbons are vaporized, while various connections for steam, air, and the liquid hydrocarbons are applied to it, as are also other connections hereinafter more fully described.

C is the gas-generator, located in the lower portion of the casing and formed by a cylindrical water-jacket, D, set within the brick-work or masonry of the casing, and provided with a water-inlet, *d*, through which water is forced into the jacket. The jacket is at its upper extremity in communication with the mixing-chamber, which is formed within the casing immediately below the superheater and above the gas-generator, and at its lower extremity is conformed into or adapted to inclose a fire-box, upon which, as a base, the charge within the generator rests, and through a discharging-port, F, communicating with which said charge can be withdrawn.

G are passages leading from the water-jacket to the water-space of the boiler, hereinafter described, and permitting of free circulation of heated water between the two and the generation of steam.

g are steam-inlets opening within the interior of the water-jacket and designed for the introduction of steam to the charge. They are fed from a steam-supply pipe, *g'*, leading from the major steam-drum, as hereinafter described.

H is the mixing-chamber in which the air-blast is superheated and in which the commixture and fixing of the gases take place, it being, as stated, above the water-jacket of the generator and conveniently inclosed as to its upper portion by means of an arch of masonry which supports the retort and the shelves or other refractory bodies contained in the superheater.

I is a charging-chute opening into the mixing-chamber above the water-jacket for the purpose of charging the generator.

J is an air-distributor, represented in sectional plan in Fig. 2, and being in the apparatus described a circular channel built into the masonry of the casing about the mixing-chamber, and communicating with the latter at a point below the arch by means of radially-disposed tuyeres *j*.

K is an air-supply pipe, supposed in communication with any suitable fan or other blast-producing device, and opening into the air-distributor and also into the gas-generator at a point or points below the charge.

L is a retort vertically erected concentrically within the superheater, and conveniently rested upon the arch which divides the mixing-chamber from said superheater. It is preferably made of fire-clay lined with iron, and is provided with a cover, *l*, adapted to be removed to enable the burning out of any fixed carbon should the latter collect upon the inside of the retort, the burning out being effected at the time when the generator is being heated up. The retort is internally provided with broken fire-brick *l'* or other refractory substances, or, if desired, with downwardly-inclined projections, ledges, or kindred contrivances, the office of which is to retard the too rapid descent of the atomized liquid hydrocarbons in order that they may be con-

verted into vapor before reaching the discharging orifice or outlet at the bottom of the retort, and thereby to prevent the decomposition of a portion of the rich hydrocarbons into fixed carbon by the falling of said hydrocarbons in a liquid condition into the body of incandescent carbon in the generator below.

V is an inlet for the oils or liquid hydrocarbon, which is arranged to open into the upper portion of the retort at a point below the retort-cover, and which is formed and directed in such manner as to occasion the atomizing of the oils at the top of the retort.

M is the gas-superheater, which is preferably a cylindriform chamber formed in the upper portion of the casing, which at such portion is best enlarged, as shown, concentrically around the retort above the supporting-arch. It has communication with the smoke-space of the steam-boiler by means of the lateral conduit *m*, and is closed at the top by a gas-tight valve or man-hole, *N*, of any suitable construction, and placed in line below a stack or funnel, *n*. The office of the superheating-chamber, as such, in the fixing of the gases is well understood.

O is a vertical boiler erected in convenient proximity to the casing above described, and connected in fixed relation thereto by means of the above-described conduit *m*, leading from the superheater into its smoke-space, and by means of the passages *G*, leading from the water-jacket of the generator into its water-space. This boiler conveniently contains an upper smoke-chamber, *o*, and a lower smoke-chamber, *o'*, which are connected by a series of vertical smoke-tubes, *o''*. The conduit *m*, leading from the superheater, communicates with the upper smoke-chamber, and a discharge-conduit, *P*, leads from the lower smoke-chamber to the wash-box hereinafter described. At its upper end the boiler is provided with a safety-valve or man-hole, *o'''*, in line below a stack, *n'*.

R *R'* are two minor steam-drums communicating with the water-space of the boiler at the upper portion thereof, and for convenience disposed upon opposite sides of the boiler, and suitably bracketed or supported therefrom. They both communicate with a major steam-drum, *R''*, suitably supported transversely upon said minor drums and acting as a steam-reservoir. These drums are suitably supplied with gages, safety-valves, and other common contrivances.

Q is a superheating-worm coiled in the upper smoke-chamber of the boiler, communicating at one extremity with the major steam-drum and at the other extremity with a pipe, *r*, leading to the steam-supply pipe *g'*, which latter pipe is also, if desired, in communication with and fed from the major steam-drum. This arrangement of worm and connecting-pipes can be modified at will, that arrangement which I have represented being, however, convenient. By the provision of suitable cocks the generator can be fed either with

wet or dry steam. By the application of the worm *I* supply superheated steam through the steam-inlets *g*, which open within the interior of the water-jacket, to the charge in the generator. As will be readily understood, the water heated in the water-jacket circulates throughout the water-space of the boiler, and aids in the generation of the steam, which, as stated, is introduced to the charge, while first the waste heat and then the highly-heated gases from the superheater pass through the conduit *m* to the upper smoke-chamber of the boiler, and thence pass through the smoke-tubes to the lower chamber, and pass out through the discharge-conduit *P*, in so doing having entered at the top of the boiler, where the water is hottest, and left at the bottom, where the water is coolest, thereby keeping up a continuous generation of steam and utilizing nearly all the heat from the generator.

S is a wash-box of any preferred construction, vertically above which is disposed a branch conduit, *s*, centrally into which opens the discharge-conduit *P* from the boiler. The upper extremity of this branch conduit opens in line below a stack, *s'*, and is controlled by a valve, *s''*, while the lower extremity opens below the level of the liquid in the wash-box. The wash-box communicates through an exit, *T*, with a scrubber, *U*, of any preferred construction, from out of which the gas is conducted to the purifiers and gas-holder through a second exit, *u*. That construction of the wash-box and scrubber represented is convenient. Other forms of devices for similar purposes may, however, be substituted in their stead.

The valves upon the top of the superheater, boiler, and branch conduit all act both as man-holes and (being weighted) as safety-valves in case of any excess of pressure.

The generator-valve may be opened to permit of the escape of the waste heat without passing it through the boiler in case too much steam is generated.

The valve *s''* on the branch conduit is not only, when open, employed to permit of the escape into its stack of the waste gases after they have been passed through the boiler, but is also, when closed, designed to direct the passage of the hydrogen or hydrocarbon gas downwardly through the lower extremity of the branch conduit into the wash-box and off through the scrubber and purifiers to the gas-holder.

Having now described a form of apparatus conveniently embodying and effectuating my invention, the operation of that apparatus is as follows: I first fill the water-jacket and boiler with water up to the water-line in the minor steam-drums, then open the valve *s''* upon the branch conduit *s*, and then, keeping the boiler and superheater valves closed, charge the generator with coal or other desired carbonaceous material through the charging-chute *I*, and fire the same. The blast of air is then, under suitable regulation, admitted both into the

bottom of the generator and through the air-distributor into the mixing-chamber. During this period of the operation, the waste gases generated pass through the boiler, generate steam, and escape through the valve s^x at the top of the branch conduit. As soon as the generator is filled with incandescent carbon, both the superheater and retort heated to the proper temperature and the steam in the boiler raised to the proper pressure, I shut off the air-blast and close the valve s^x of the branch conduit, and at the same time turn on the steam into the incandescent carbon in the generator, and admit the liquid hydrocarbons under pressure into the top of the retort. The liquid hydrocarbons are atomized at the moment of their entrance into the highly-heated retort, and the atomized particles descend through the retort, and are finally converted into vapor without coming into contact with the incandescent carbon or other highly-heated substance in the generator, and said vapors, entering the mixing-chamber, therein commingle with the gases escaping from the generator from the decomposition of the steam in its passage through the body of incandescent carbon, and after said commixture in the mixing-chamber pass up through the superheater, are decomposed and fixed therein, and pass out through its conduit into the upper smoke-chamber of the boiler, thence down through the tubes into the lower smoke-chamber, out through the discharging-conduit, and down through the closed branch conduit into the wash-box, whence they pass to the scrubber, purifiers, and to the gas-holder, where they are stored for distribution.

The above operation is to be repeated as a whole until the desired quantity of gas has been generated. In said operation, as will be readily understood, both the waste heat and the highly-heated gases from the generator are in turn caused to pass through the same chambers and passage-ways to the discharge-conduit, and are there either discharged by the opening of its valve or forced through the water in the wash-box by its closure. In the passage they are also both first caused to enter the boiler at the top, where the water is the hottest, and to leave it where the water is coolest. The air-blast, encountering the brick-work of the air-distributor and mixing-chamber, becomes superheated in said mixing-chamber, and, mixing with the partially-decomposed hydrocarbon gases from the generator, insures their more perfect combustion.

While it is desirable it is not essential that the steam admitted to the generator should be superheated.

It will be understood that the liquid hydrocarbons, while atomized at the top of the retort and vaporized in the course of their passage down through it, are not decomposed until they commingle with the gas in the mixing-chamber and in their passage through the superheater. This is due to the fact that the retort, being heated externally, cannot become so highly heated in its interior as to occasion the decomposition of said hydrocarbon vapors in their passage through it.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. In an apparatus for producing heating and illuminating gas, the generator provided with a water-jacket and supply-pipes, in combination with the superheating and fixing chamber having one or more eduction-pipes, and the central vertical retort, open at the bottom, having an oil-inlet pipe near the top and containing suitably disposed and refractory material, whereby oil may be vaporized by passage over the refractory material and mixed with gas rising from the generator, and the mixture converted into a fixed gas in the superheating-chamber, substantially as set forth.

2. In an apparatus for producing heating and illuminating gas, the generator provided with a water-jacket and supply-pipes for air and steam, in combination with the superheating and fixing chamber having an oil-vaporizing retort, the steam-boiler, a pipe connecting the smoke-flue thereof with the superheater, and pipes connecting the water-space of the boiler with the water-jacket of the generator, as and for the purpose described.

3. In an apparatus for producing heating and illuminating gas, in combination, a gas-generating chamber provided with an inclosing water-jacket and a steam-boiler, the smoke-flues of which at one extremity communicate with said generating-chamber and at the other extremity with a discharge-conduit, and the water-space of which communicates with said water-jacket, as and for the purpose specified.

In testimony whereof I have hereunto signed my name this 10th day of January, A. D. 1883.

JOHN L. STEWART.

In presence of—

RANDAL MORGAN,

J. BONSALL TAYLOR.