

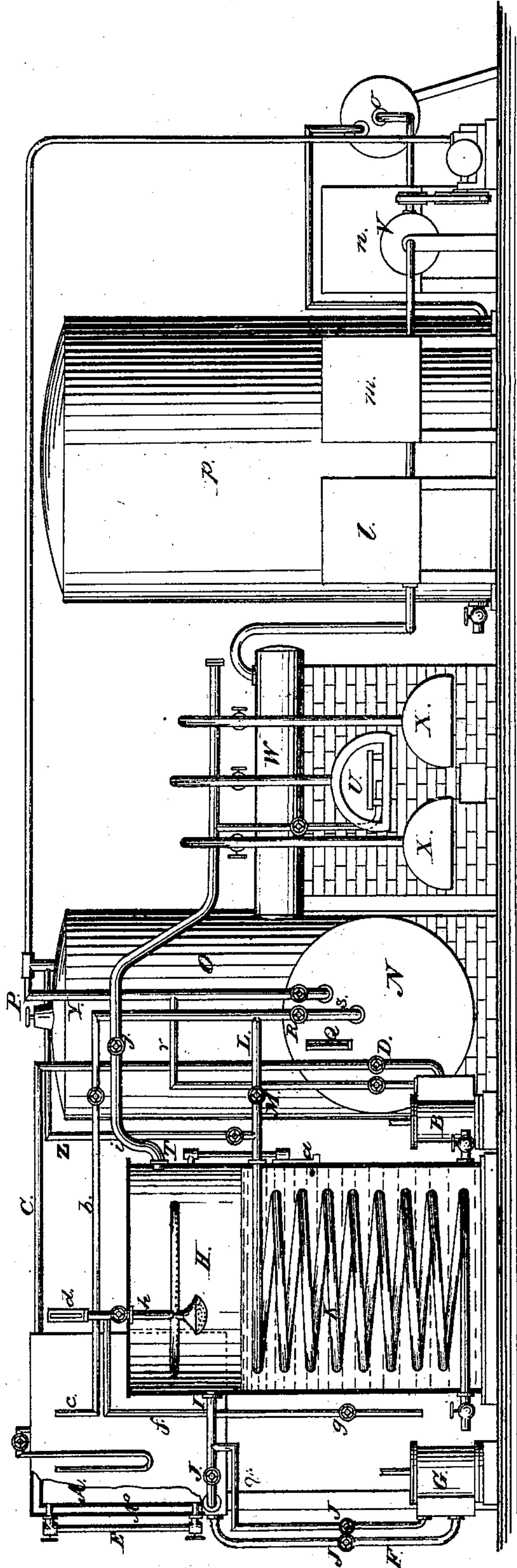
J. W. BEATLEY.

Manufacture of Illuminating Gas.

No. 169,326.

Patented Oct. 26, 1875.

Fig. 1.



Witnesses:  
B. F. James  
Jos. Pearson Gill

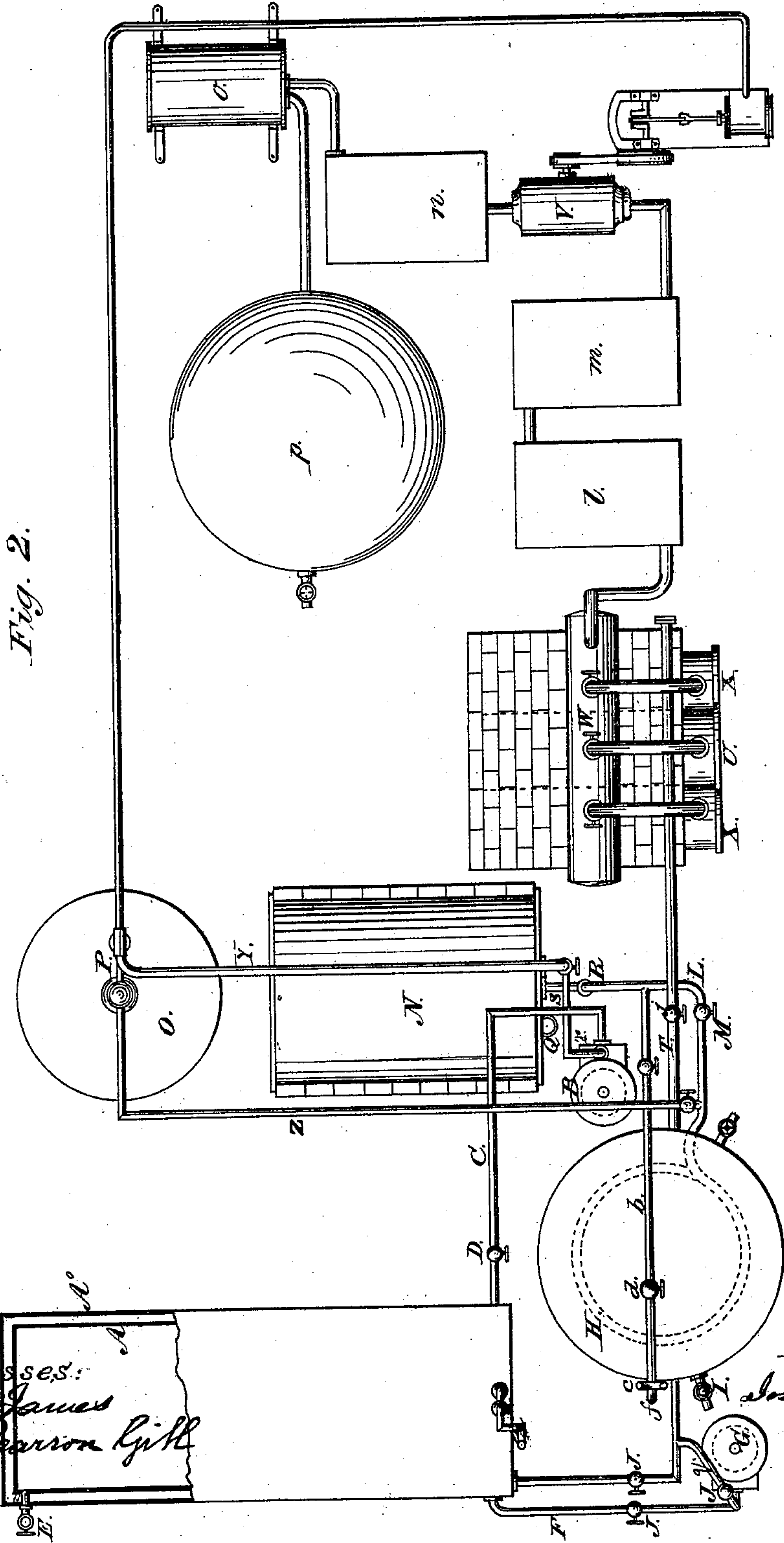
Inventor:  
Jos. W. Beatley.  
by  
W. H. Grenell  
his atty.

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# UNITED STATES PATENT OFFICE.

JOSEPH W. BEATLEY, OF BROOKLYN, NEW YORK, ASSIGNOR TO ROBERT W. RUTHERFORD AND JOSEPH W. BEATLEY, TRUSTEES.

## IMPROVEMENT IN THE MANUFACTURE OF ILLUMINATING-GAS.

Specification forming part of Letters Patent No. **169,326**, dated October 26, 1875; application filed October 20, 1875.

*To all whom it may concern:*

Be it known that I, JOSEPH WILLIAM BEATLEY, of the city of Brooklyn, in the county of Kings and State of New York, United States of America, gas engineer, have invented certain new and useful Improvements on the Process and Apparatus for the Manufacture of Illuminating-Gas; and I do hereby declare that the following is a full, clear, and exact description of the same.

The nature of my invention consists in an improvement in the process and manufacture of illuminating-gas from liquid hydrocarbons, by the commingling of superheated steam and hydrocarbon vapors evaporated from the surface of the liquid hydrocarbon by the action of the superheated steam upon it, and by decomposing the said commingled vapors into a fixed commercial gas in red-hot retorts. This is accomplished by utilizing the light vapors of liquid hydrocarbons obtained by a natural evaporation from the surface of an undisturbed body of a liquid hydrocarbon, and by the expansion and rarefaction of said vapors by superheated steam.

Heavy vapors, by the excess of carbon in them, cause the formation of lamp-black, pitch, and a thick, viscous, tarry substance, which obstruct the retorts, stand-pipes, hydraulic main, condensers, and purifiers, causing trouble and expense, and, at times, stopping the manufacture of gas entirely. They also make a heavy smoky gas, surcharged with undecomposed vapors, which are subsequently condensed in the street-mains and consumers' meters, causing additional trouble and damage, while the light vapors, utilized as herein described, make a fixed commercial gas, free from injurious vapors and smoke, of brilliant quality and of a light gravity, to burn in ordinary coal-gas burners.

The means employed for the production of the said light and rarefied vapors, their conversion into gas and their combination with coal-gas, are as follows: A closed vessel or still, connected with a superheater and steam-boiler; a storage or supply tank and retorts; and a still containing superheated steam and liquid hydrocarbons; and a coil situated be-

neath the level of, and for the purpose of heating, the said liquid, and also a nozzle with rose-head and ring attached, for the admission and distribution of superheated steam above the surface of the liquid, and having inlet and outlet connecting-pipes, all for the purpose and in the manner as herein described and set forth.

The said storage or supply tank or tanks may be made either of wood or of metal, and may be located in any convenient situation, covered and protected by any suitable inclosure or jacket when required, which inclosure may be heated by steam through an iron coil, and the tank may be cooled by cold water when necessary, to preserve an equilibrium of temperature in the hydrocarbon liquid stored therein during all seasons of the year. I fill and refill the said tanks with hydrocarbon liquids, or distillates thereof, by means of a steam-pump, that draws said liquids or distillates from the vessels or packages of transportation, and delivers the same into the upper interior part of said tanks by an inlet-pipe provided with suitable valves. I gage the contents of said tanks by an upright glass gage, by which I am able to ascertain the quantity filled into and withdrawn from said tanks, and I provide each tank with a safety-valve or siphon, to permit the escape of atmospheric air or vapor.

The contents of said tanks I draw away by an outlet-pipe, which extends from the lower side of the tanks, and connects with a steam-pump, and also with one or more closed vessels or stills, in order that a regulated quantity of liquid may be run from the tanks directly into the still through the pipe, or drawn from the tanks and forced into the still with the pump. The said still is a closed metallic cylindrical vessel, vertically set up in any convenient place, having its internal dimensions proportionate to about six feet in diameter and eight feet in height, covered with asbestos or any other non-conducting material, and containing therein liquid hydrocarbon, in the proportion of about five-eighths of its internal area, reserving about three-eighths of said area as a vapor-retaining



chamber, for the purpose of commingling superheated steam and hydrocarbon vapor, evaporated from said liquid hydrocarbon by the action of the said light and thoroughly-diffused superheated steam upon the surface of the said liquid, said proportions being given to obtain the evaporating-surface required to supply the area of the vapor-retaining chamber with hydrocarbon vapors, and at the same time, by the prescribed bulk of the liquid, to assist in maintaining a uniform temperature therein. Said still is provided with pressure-gages, and gages to exhibit the height and appearance of the contents, a pyrometer, and two thermometers, by which the condition of the contents is exhibited, enabling the operator, by use of the valves upon the inlet and outlet pipes, to control and regulate the operation of it under a precise formula for continuous use. Said still is provided with inlets and outlets for the introduction of hydrocarbon liquids and superheated steam, for the outlet of vapor, and also for the inlet and outlet of a coil through the body of the liquid hydrocarbon, for the purpose herein described and set forth. The said coil is a metallic tube of about one inch internal diameter, placed within the cylindrical still, having its inlet into the still about seven-twelfths of the height of the interior of the still above the bottom thereof, said inlet to be made about eight inches below the entrance of the liquid-supply pipe, hereinafter described. Said coil is placed in concentric circles, at about four inches distance from the inner side of the cylindrical still, and each circle kept at an equal distance of about four inches from each other, said coil having its outlet through the side of said still at about eight inches above the bottom thereof, the inlet and outlet of said coil having each a valve to regulate the inlet and outlet flow of steam to and from said coil, and to shut it off entirely when not required, and also to admit the passage of superheated steam through an additional connecting-pipe to the coil when it may be necessary to increase the heat in the coil beyond that of ordinary steam from the boiler; the dimensions and arrangement described being preferably the form, proportion, position, and use of said coil to assist in maintaining the temperature of the liquid contents of the still at a uniform standard within the margin of  $86^{\circ}$  and  $186^{\circ}$  Fahrenheit, and by the equalized distribution of its concentric circles, as already described, within the body of the liquid contents of the still, imparting to said contents the prescribed degree of heat, without disturbing the equilibrium thereof, and without causing ebullition and convective currents therein.

If the coil were of improper dimensions as to diameter and height, and located differently within the body of the liquid, or partly within and partly above the liquid, or if the liquid were heated by means of a jacket surrounding the still, to which steam is admitted, or if

heated by a fire underneath, the result would be a disturbed condition of the liquid, caused by unequal temperature and convected currents in the same, which disturbed condition and varying temperature would cause the formation of heavy and variable vapors, with the pernicious consequences thereof, as herein already described; and would also produce a heavy residuum, amounting at times to a loss of about one-fifth of the entire liquid used, while, when evaporated by the use of superheated steam, in the manner herein described, no residuum whatever remains in the still, as the liquid is entirely and uniformly evaporated when the naphtha distillate of liquid hydrocarbons is the liquid employed.

The inlet-pipe for supplying the still with the hydrocarbon liquid is about three-quarters of an inch in internal diameter, and enters the still preferably at a point two-thirds of the internal height of the still above the bottom thereof, to permit the inflow of the liquid hydrocarbon upon the surface of the liquid contents in such a manner as to maintain it at its maximum level with but slight variation, and without agitating or disturbing the body of the liquid. If the supply were below the surface of the liquid contents it would disturb the same more or less, and interfere with that natural evaporation which is attained by the means herein now described.

The superheated-steam pipe, which connects the still with the superheater, has a nozzle preferably three-quarters of an inch in internal diameter, which enters the still through the top at a point nearer to the liquid-supply pipe than to the vapor-escape pipe, and projects vertically downward to a point below the outlet of the vapor-pipe, and above the inlet of the liquid-supply pipe, the length being in proportion to the diameter and height of the still, and so as to lightly and thoroughly diffuse the superheated steam down upon the surface of the liquid contents without agitating or overheating it. Said nozzle has upon its outlet end within the still a rose-head and distributing-ring. Said rose-head may be made of metal, and is conical in form, with its small end attached to the nozzle, about three inches long, and its base about five inches in diameter, having a convex bottom, which is perforated with small holes. The ring may be composed of a metallic half-inch pipe, and is about four and a half feet in diameter, and is attached eccentrically to the nozzle at a point about one-sixth of its diameter from its center, for the purpose of making it concentric with the still, and is perforated with small holes to distribute the steam in a downward direction. The purpose of the rose-head and ring is more effectually to lightly and diffusively distribute the superheated steam in the vapor-retaining chamber upon the surface of the liquid hydrocarbon, by which it is quietly evaporated, the combined action of the rose and ring being to more thoroughly com-



mingle the superheated steam and hydrocarbon vapors in the space between the inlet of the supply and outlet of the vapor-escape pipe, which are placed on opposite sides of the still.

The superheated steam is admitted into the still in a regulated quantity and temperature without pressure or force. If pressure were used, or if it were forced into the still by means of an exhaustor or pump, the liquid contents would become agitated and overheated, and heavy vapors thrown off with the injurious effects heretofore alluded to.

The effect of the superheated steam admitted into the still, and diffused in the manner described, is to cause the production of a very volatile hydrocarbon vapor of uniform quality and quantity; the commingled vapors are carried off from the still in a highly-rarefied state, the liquid contents maintained at a uniform temperature and density, and a natural evaporation at the surface of the undisturbed liquid is obtained and maintained continuously and uninterruptedly.

If common steam were used instead of superheated, its condensation and the filtration of the boiling water thereof through the liquid contents would equalize the temperature of the liquid with that of the steam, and create ebullition, convective currents, and a high degree of temperature, that would cause the production of heavy vapors, that are not suitable for the manufacture of fixed gas. The vaporizing of the liquid would be also unequal, throwing off the more volatile portions at first, the liquid gradually increasing in density until finally resulting in a dead-oil, when naphtha is the liquid preferably employed.

If the nozzle entered the top of the still in its center, or nearer the vapor-escape pipe, its action would be imperfect, by permitting a too rapid escape of the steam and preventing a perfect evaporation and commingling of the vapors. If it entered in an oblique direction it would cause, by the deflection of the steam, an outward driving force in the one direction or an obstructive force in the opposite.

Superheated steam is not only required to vaporize the liquid, and to expand and rarefy the vapors, but also, by its high temperature and dryness, so to heat and so to combine with and retain them that they shall not condense and separate on their passage to the retorts. If common or wet steam is used, such a condensation and separation takes place, and heavy vapors are discharged into the retorts instead of light ones, and with the further result of injury to the retorts by the introduction of moisture into them, which causes the cracking and disintegration of them; whereas a combination of dry superheated steam and light vapors has the effect of preserving and adding to the life of the retort, it having been found that retorts so treated, after more than a year's service, were in a sound and perfect condition.

Steam and superheated steam are chemically different, and in this connection they are not convertible terms. It cannot be claimed that either the one or the other may be used, as their effects are wholly different.

The outlet-opening in the still to the vapor-escape pipe is made about six inches below the top of the still, the opening and the pipe leading therefrom to be, in internal diameter, from four inches to six inches, according to the quantity of gas required to be made, the pipe to be covered with asbestos or any other non-conducting material. The egress of the commingled vapors is slightly retarded by thus placing the outlet-pipe below the top of the still, and also by two or more bends or angles in the said pipe. This mechanical check or resistance in the outlet-pipe produces a very light back pressure, and consequent diffusion of the vapor in the vapor-retaining chamber, prevents the vapor from being drawn away from the still too rapidly, tends to regulate the evaporation of the liquid, to equalize the density of the vapor, to rarefy it by more intimate contact with the superheated steam, and to create sufficient elasticity or expansive power to pass it, without force or pressure, through the pipes to the retorts. The pipes are without any internal checks or obstacles to the passage of the vapors, thus enabling them, at all times, to act with perfect freedom, and without any undue check to throw a back pressure upon the still, and accumulate vapors therein.

Said outlet-pipe enters the retort at its mouth-piece, whence the vapors pass through a brick or other flue on the bottom of the retort to the rear end, and return through the upper part thereof, becoming in their passage converted into a fixed illuminating-gas. The retorts are operated without mechanical pressure by dispensing with the dip-pipe seal, and their contents are withdrawn by an exhaustor, thus relieving the retorts and hydraulic main from all back pressure. An excess of hydrocarbon vapors in the retorts, or heavy vapors therein, or a back pressure not entirely relieved by the exhaustor, prevents an entire decomposition of the vapor, causing a deposit of lamp-black, tar, and other impurities in the hydraulic main and condensers, and a clogging up of the purifiers. The gas passes from the hydraulic main through the condensers, purifiers, and station-meter to the holder, from which it is delivered into the street-mains for public use. With the converting-retorts and hydraulic main I combine one or more coal-gas retorts, the stand-pipes of which connect with the hydraulic main; and the crude coal-gas formed in said retorts is mixed in a heated state in the hydraulic main with the gas produced in the converting-retorts. During this operation all the retorts and the hydraulic main are kept free from mechanical or intermittent pressure, and the combined gases pass through the ordinary condensers, washers,



exhauster, purifiers, station-meter, holder, governor, and street-mains, without obstructing the purifiers, and without increase of condensation in the drips of the holder and street-mains.

All attempts to pass gas made from hydrocarbon liquids through the purifiers, except in the mode herein described, result in clogging them up and stopping the works, thus demonstrating the inoperative nature of the methods employed.

Superheated steam, to act in the manner desired, should be admitted into the still in such a regulated way as not to be impacted with force upon the surface of the liquid, nor be forced into and through the body of the liquid, nor should it undergo any change in its passage from the superheater to the still, whereby its nature as superheated steam, and the effects that can alone result from its unchanged and peculiar characteristics, are lost. The intervention of an exhauster between the superheater and still not only causes the injurious effects of the force alluded to, but, by the passage of the superheated steam from the small steam-pipe into the large internal area of the exhauster, it is cooled and returned to its former condition of wet steam, thus destroying its nature, and producing a totally different result from that required and claimed.

Referring to the annexed drawings, Figure 1 represents a side elevation of my invention, partly in section. Fig. 2 is a plan or top view of the same.

Similar letters indicate corresponding parts in both figures.

In the accompanying drawings illustrating this invention, A designates the storage or supply tanks, with the siphon for the escape of the vapor; A<sup>o</sup>, the jacket surrounding the tanks; E, the glass gage for observing the height of the liquid; B, the pump that fills the tanks through the pipe C; r, the pipe leading from the boiler O to pump B; D, the valve on pipe C; I, the pipe leading from the tank A to the still H, to supply it with the liquid hydrocarbon; F, the pipe leading from the tank A to the pump G; G, the pump to supply the still with the liquid; q, the pipe leading from the pump G to the still H; J, the valves on said pipes; O, the boiler; P, the regulator of boiler O; Y, the pipe leading from the boiler O to the superheater N; N, the superheater; Q, the pyrometer on superheater N; S, the pipe that conveys the superheated steam to the still H and coil K; R, the valve on pipe S; b, the branch pipe from pipe S, to admit superheated steam to top of still H; d, the thermometer attached to pipe b; c, the pressure-gage attached to pipe b; f, the condensation drip-pipe to pipe b; g, the valve on drip-pipe f; h, the nozzle with rose-head and ring attached in still H; L, the branch pipe from pipe S, leading to the coil K; K, the coil in still H; Z, the pipe leading from boiler O to coil K; a, the thermometer to show the temperature of the liquid in still H; T, the outlet vapor-

pipe from still H to retort U; i, the bends and angles in pipe T; j, the valve on pipe T; U, the converting-retort; X, the coal-gas retorts; l, the condensers; m, the washers; V, the exhauster; n, the purifiers; o, the station-meter; p, the gas-holder; W, the hydraulic main.

Having thus fully described my invention, I do not here claim a still with a steam-pipe above and a coil below; nor do I broadly claim the use of superheated steam in evaporating hydrocarbon liquids in a machine of this class; nor the use of steam for heating or regulating the heat of the hydrocarbon liquid in the still; nor, broadly, the formation of an illuminating-gas by mixing in the hydraulic main, and while hot, gas formed from hydrocarbons and steam and coal-gas, these and other matters described in this specification being the subject of another application now pending in the Patent Office; but

What I do claim, and desire to secure by Letters Patent, is—

1. As an improvement in the process of manufacturing gas from liquid hydrocarbons, the production of a mingled hydrocarbon vapor and superheated steam, by bringing superheated steam into contact with the surface of a liquid hydrocarbon, being kept free from all agitation, and at a temperature below that of the steam, said temperature being proportioned to the density of the liquid employed, and said vapors decomposed into a fixed commercial illuminating-gas by the means used, and as herein described, and for the purpose set forth.

2. The process of manufacturing an illuminating-gas from a mixture of gas produced from bituminous coals and gas manufactured from liquid hydrocarbons, (the production of a mingled hydrocarbon vapor and superheated steam by bringing superheated steam into contact with the surface of a liquid hydrocarbon, being kept free from all agitation and at a temperature below that of the steam,) by simultaneously passing both gases, while in a heated state, from their respective retorts directly into the hydraulic main, thence through the condensers, washer, and purifiers, in the manner and for the purpose herein set forth.

3. In an apparatus for the manufacture of illuminating-gas, the combination of the rose and ring connected with the nozzle of the superheated steam-pipe, located in the top of the still, in relation to the exit vapor-pipe and the internal coil, as herein described, and for the purpose set forth.

4. In an apparatus for the manufacture of gas from liquid hydrocarbons, a coil steam-pipe connected directly with the steam-boiler, the pipe being located within the still at such distance from the outer shell of the still, and of such diameter of coil, as shall produce a uniform heat throughout the hydrocarbon liquid without causing agitation or convective currents, the said coil rising to about the height specified in the still below the entrance of the



liquid-supply pipe, as herein described, and for the purpose set forth.

5. In an apparatus for the manufacture of illuminating-gas, a still of the proportions substantially as described, having an internal coil arranged to uniformly heat without disturbing the liquid hydrocarbons, having its upper coil below the supply-pipe, and the nozzle of the pipe that admits the superheated steam arranged at the specified distance above the upper coil of the heating-pipe and below the opening of the egress vapor-pipe, as herein described and set forth.

6. The combination of the still H, superheater N, superheated steam-pipes S I b,

steam-pipe Z, nozzle h, with rose-head and ring attached, coil K, liquid-supply pipe I, vapor-escape pipe T, gas-retorts U, coal-gas retorts X, hydraulic main W, condenser l, washer m, exhaustor V, and purifier n, constructed and arranged in the manner herein described, and for the purpose set forth.

In testimony that I claim the foregoing as my own, I affix my signature in presence of two witnesses.

JOSEPH. W. BEATLEY.

Witnesses:

B. F. JAMES,

B. LEWIS BLACKFORD.