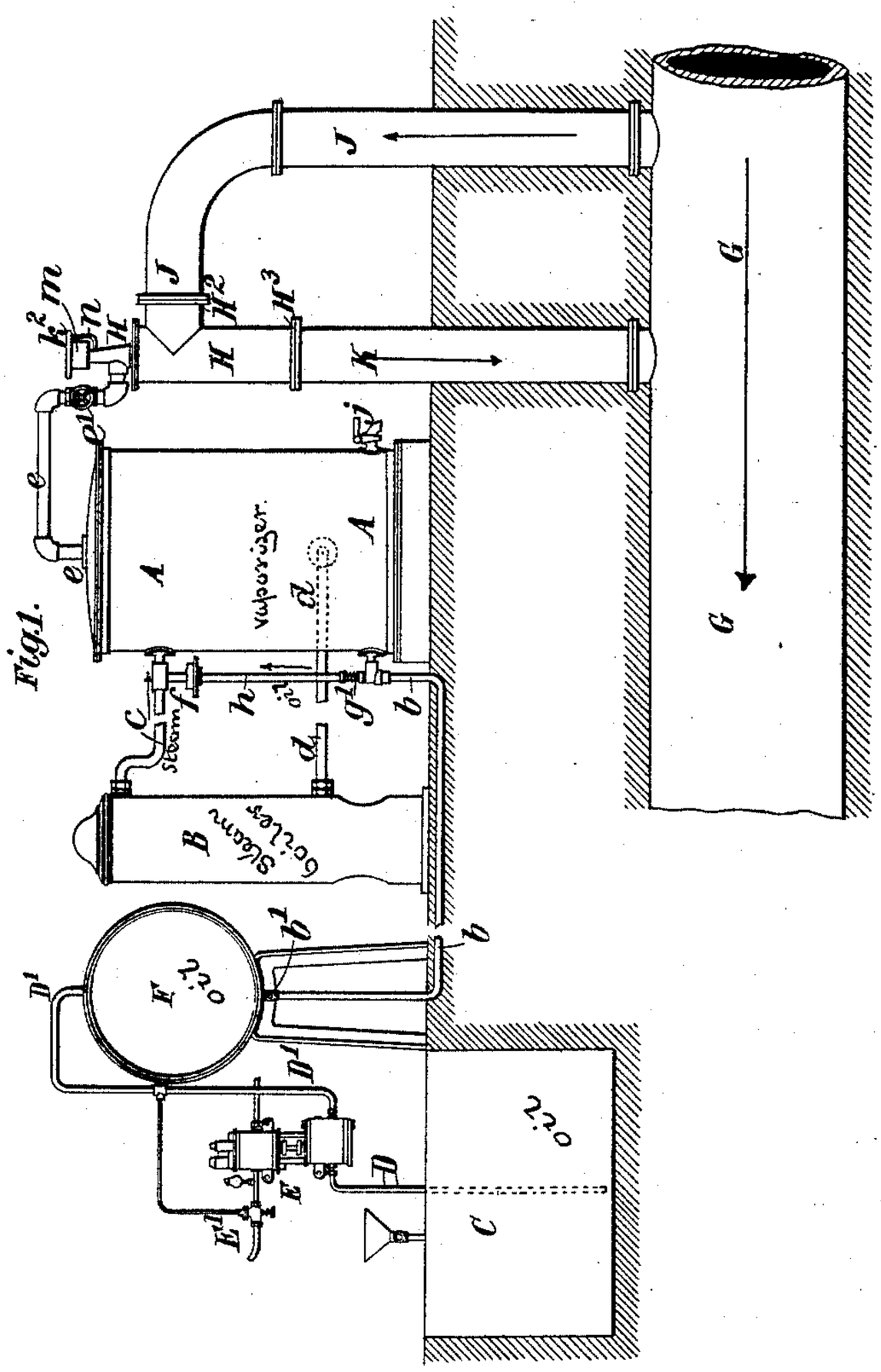
(No Model.) 3 Sheets—Sheet 1.

H. S. MAXIM.

METHOD OF AND APPARATUS FOR CARBURETING GAS.

No. 485,288. Patented Nov. 1, 1892.

Fig 1.



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(No Model.) 3 Sheets—Sheet 2.

H. S. MAXIM.

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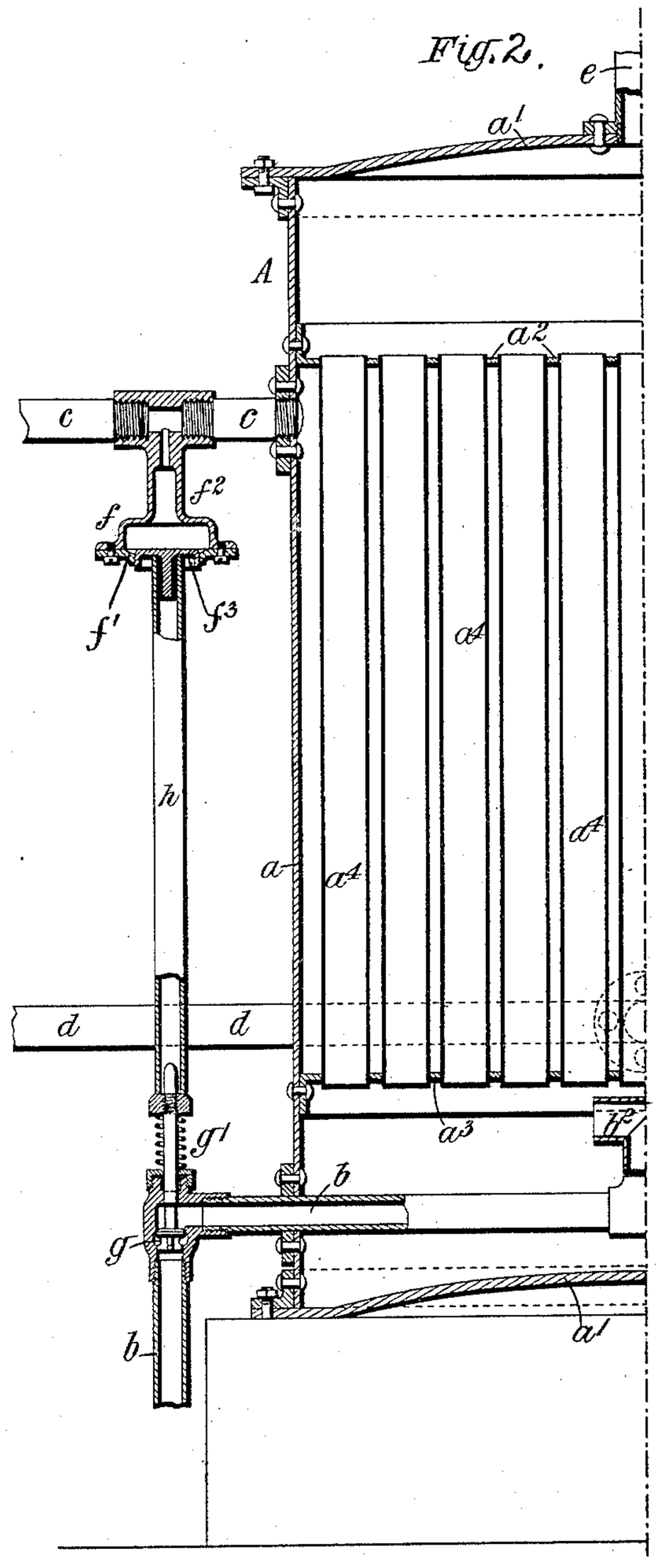
No. 485,288. Patented Nov. 1, 1892.

Fig. 2.



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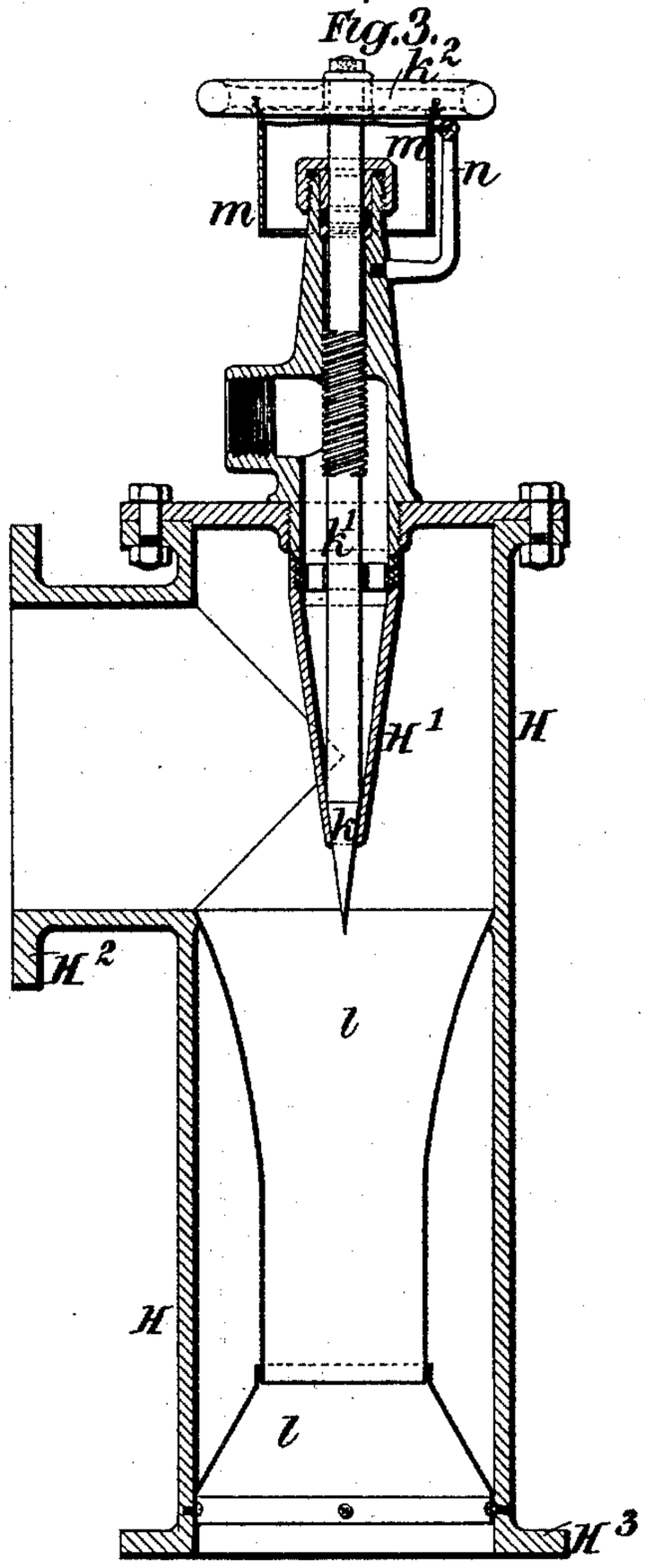
(No Model.) 3 Sheets—Sheet 3.

H. S. MAXIM.

METHOD OF AND APPARATUS FOR CARBURETING GAS.

No. 485,288. Patented Nov. 1, 1892.

Fig. 3.



Witnesses:-
J. A. Rutherford.
Dennis Sumby.

Inventor:
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UNITED STATES PATENT OFFICE.

HIRAM STEVENS MAXIM, OF LONDON, ENGLAND, ASSIGNOR TO THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED, OF SAME PLACE.

METHOD OF AND APPARATUS FOR CARBURETING GAS.

SPECIFICATION forming part of Letters Patent No. 485,288, dated November 1, 1892.

Application filed January 19, 1891. Serial No. 378,314. (No model.) Patented in England February 17, 1890, No. 2,559.

To all whom it may concern:

Be it known that I, HIRAM STEVENS MAXIM, mechanical engineer, a citizen of the United States of America, and a resident of London, England, have invented certain new and useful Improvements Relating to Methods of and Apparatus for Carbureting or Enriching Coal and other Gas, (for which I have obtained a patent in Great Britain, No. 2,559, bearing date February 17, 1890,) of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to an improved method of and apparatus for carbureting or enriching coal and other gas by mixing hydrocarbon vapors therewith, and is chiefly designed to provide for increasing the candle-power of gas as it flows through the mains from gas-works for the purpose of raising the quality of such gas to or above the usual standard.

In cases where it is desired to enrich very large quantities of gas flowing through the mains it is not practicable to pass the whole of such gas through the carbureting apparatus. According to my present invention, therefore, I introduce the hydrocarbon vapor from the said apparatus into the gas-main.

My said invention comprises an improved method of carbureting or enriching the gas flowing through a gas-main by drawing a suitable quantity of the same from the main at any convenient part thereof by means of a jet or jets of hydrocarbon vapor under pressure, carbureting or enriching it to a high degree, and then forcing it by means of said jets back into the main, wherein it becomes intimately mixed with the remainder of the gas. The whole of the gas is thus raised to the required standard or candle-power.

My said invention, moreover, comprises other improvements hereinafter set forth.

In the accompanying drawings I have shown how the invention may be conveniently and advantageously carried into practice.

Figure 1 is a side elevation showing the apparatus for drawing a portion of the gas from the main, carbureting or enriching such gas, and returning it to the main. Fig. 2 is a vertical central section, drawn to an enlarged scale, of part of the evaporator or retort for volatilizing the liquid hydrocarbon. Fig. 3 is a vertical central section, drawn to a still further enlarged scale, of an injector which is operated by the hydrocarbon vapor for the purpose of drawing the gas from and returning it to the main.

Like letters indicate corresponding parts throughout the drawings.

A is the evaporator or retort for volatilizing the liquid hydrocarbon. B is a steam generator or boiler for heating the said evaporator or retort.

C is a storage-tank for the liquid hydrocarbon, which tank is connected by a pipe D with a pump E for raising the liquid hydrocarbon from the storage-tank C and forcing it through a pipe D′ into a tank F, situated at a higher level, so as to obtain the required head or pressure for forcing the hydrocarbon vapor from the evaporator or retort A into the gas-main G.

In the apparatus shown an injector H is connected with the gas-main G by pipes J K, forming a by-pass for the purpose hereinafter specified.

The evaporator or retort A is constructed with a cylindrical shell *a*, Fig. 2, which is closed at its upper and lower ends by suitable plates a' and is divided into three compartments by means of tube-plates a^2 a^3. In these tube-plates are fixed vertical tubes a^4, which extend through the middle compartment and connect the upper and lower compartments of the evaporator or retort. The liquid hydrocarbon from the tank F is admitted to the compartment beneath the lower tube-plate a^3 through a pipe *b*, which is provided with a stop-cock b', and the end of which within the retort is provided with a T-shaped piece b^2 for the purpose of distributing the hydrocarbon throughout the lower compartment of the retort, and thus preventing its introduction directly into the tubes a^4 at the center of the retort. The steam from the boiler B is admitted to the middle compartment of the retort through a pipe *c* and comes in contact with the exterior surface of the said tubes a^4, and the water of condensation returns to the boiler B through a pipe *d*. A pipe is, moreover, provided for conducting the hydrocarbon vapor from the top of the retort A to the injector H, and this pipe is provided with a

suitable stop-cock or stop-valve e' for controlling the flow of hydrocarbon vapor to the said injector.

Although I have shown the boiler and retort placed at about the same level, I prefer to so arrange them relatively to each other that the normal water-level (which is the same in both the boiler and the retort) will be a short distance above the aperture in the retort, which communicates with the outlet-pipe d.

I combine with the evaporator or retort a regulating or controlling apparatus comprising a suitable casing f, which is provided with a flexible diaphragm f', Fig. 2, and which is in communication with the steam-inlet pipe c. A valve g is arranged in the pipe b for the supply of liquid hydrocarbon to the evaporator or retort, and this valve is held against its seat by a spring g'. The diaphragm f' is composed of a flexible sheet containing an opening, in which is secured a head f^3. A rod h is joined to the head f^3 and serves as the connection between the diaphragm and the valve g. When the steam is admitted to the evaporator or retort for the purpose of volatilizing the liquid hydrocarbon, the pressure of the steam acting upon the diaphragm f' compresses the spring g' and opens the valve g, thus permitting the flow of liquid hydrocarbon into the retort. It will be seen, therefore, that the valve g will be opened when but not until the retort has been in some measure heated by the steam. Moreover, if from any cause the supply of steam should fail, instead of the liquid continuing to flow into the retort, and thus filling it and overflowing, the valve g will be closed by the reaction of the spring g' and the supply of liquid hydrocarbon thus arrested. It is desirable to form a hole through the said valve or through its seat or to provide some other suitable by-pass to permit the return of the hydrocarbon liquid from the retort, if necessary. The said regulating or controlling device is preferably constructed with a tube or tubular chamber f^2 above the diaphragm f', as shown, so that the steam will act upon the diaphragm through the medium of a body of water, which is allowed to accumulate by the condensation of the steam above the said diaphragm. I thus obviate any liability to overheating of the said diaphragm by the steam.

The lower compartment of the retort A is provided with a cock j' for drawing off any liquid hydrocarbon, which would otherwise remain unvolatilized in the said retort.

The circulation of the gas from the main through the mixing-chamber in the by-pass J K and back to the main is effected by induction by the volatilized hydrocarbon through the medium of the injector H. (More clearly shown in Fig. 3.) This injector has a nozzle H′, which can be put in communication through the stop cock or valve e' and pipe e with the evaporator or retort. In the said nozzle is arranged an adjustable taper or conical valve k, the screw-spindle k' of which is provided with a suitable hand-wheel k^2. An inner casing or lining l is secured in the outer casing of the injector to form a contracted mixing-chamber therein. The outer casing is provided with a flange H^2 for connecting it to the pipe J and with a flange H^3 for connecting it to the pipe K. It will be seen that the said injector is so arranged in combination with the evaporator or retort and with the said pipes J K that the hydrocarbon vapor which passes through the injector will draw a quantity of gas out of the main and force it when mixed with the said vapor back into the said main, the hydrocarbon vapor being discharged with considerable force from the injector-nozzle H′ in the form of an annular jet into the contracted mixing-chamber l. The spindle k' of the said injector has combined with it a cylindrical or tubular piece m, provided with a graduated scale and operating in conjunction with a fixed index or pointer n for showing to what extent the injector is open, and consequently to what degree the gas is being carbureted or enriched.

I find it advantageous in some instances to employ a steam-pump E, provided with a controlling device E′, comprising a self-acting diaphragm-valve, whereby as soon as a certain pressure is attained in the tank F the steam-supply to the said pump will be shut off, and when such pressure diminishes the steam-supply will be opened and the pump again allowed to operate. I thus insure the maintenance of a constant or approximately-constant pressure in the tank F and retort A, or I combine with a suitable pump an air vessel or chamber, whereby the requisite head or pressure can be maintained. I can, however, obtain the required head or pressure simply by the elevation of the tank above the retort or in any other convenient manner.

The operation of the apparatus is as follows, viz: The tank C is filled with gasoline or other suitable liquid hydrocarbon, a suitable quantity of which is pumped from the tank C into the tank F. The stop-cock b' is then opened to permit the flow of liquid hydrocarbon from the tank F. On the admission of steam or hot water to the retort A through the pipe c the valve g is opened, and the hydrocarbon thus allowed to flow into the retort, in which it is heated by the steam or hot water, as the case may be, and is thereby volatilized. The pressure thus generated in the retort forces some of the liquid hydrocarbon back into the tank F. On opening the cock or valve e' and adjusting the valve k of the injector H as required the hydrocarbon vapor is forced through the nozzle H′ in the form of an annular jet, which induces a current of gas from the main C through the pipe J and forces the said gas, intermingled with the hydrocarbon vapor, through the pipe K back into the main,

wherein the gas thus enriched becomes intimately mixed with the uncarbureted gas, thus raising the standard or candle-power thereof. It will therefore be seen that the whole of the gas does not require to pass into or through the carburetor. By altering the adjustment of the valve *k* of the injector the quantity of vapor thus introduced into the gas-main can be varied as required.

The boiler or heater may be connected in any convenient manner with the circulating chamber or space of the evaporator or retort. In some instances I so connect the said boiler or heater with the retort that one portion of the heating-surface of the said retort will be in contact with hot water and another portion thereof with steam, as shown in Fig. 2, or so that the whole of its heating-surface will be in contact with steam, or I provide for heating the said retort entirely by means of hot water. The said boiler or heater and the evaporator or retort are preferably covered or lagged with suitable non-conducting material. The retort and the boiler or heater may be placed at any convenient distance from the supply tank or tanks, and the boiler or heater may be at any desired distance from the said retort.

I do not claim, broadly, the introduction of hydrocarbon vapor under pressure into a gas-main, as I am aware that various methods and means have been heretofore devised for this purpose. I am also aware that in the patent to McDougall, No. 45,729, of January 3, 1865, a mechanism is described in which a branch or shunt pipe is used, whereby a portion of the gas to be enriched may be allowed to pass through the enriching apparatus, and I therefore make no claim to the said apparatus.

What I claim is—

1. The improvement in methods of carbureting or enriching gas, which consists in generating a hydrocarbon vapor under pressure, inducing in a branch or by-pass of a gas-main a draft by the injector action of a jet of such vapor, whereby a portion of such gas will be drawn from the main, mixed with the jet, and then forced back into the main, and regulating the force of the jet of hydrocarbon vapor escaping in the said branch or by-pass according to the velocity of the gas flowing through the main and according to the desired illuminating power of the enriched gas, as set forth.

2. The combination, with a gas-main, of a by-pass connected therewith, an injector having the passage for the induced current connected with the said by-pass, an evaporator for generating hydrocarbon vapor under pressure, a pipe for conducting the hydrocarbon vapor from the said evaporator to the passage in the said injector for the inducing-current, and a valve in the said pipe for controlling the flow of the hydrocarbon vapor from the evaporator to the injector, substantially as and for the purposes above specified.

In testimony whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HIRAM STEVENS MAXIM.

Witnesses:
DAVID YOUNG,
CHAS. B. BURDON.