(No Model.) 3 Sheets—Sheet 1.

E. P. SHETTER.

APPARATUS FOR GENERATING AND BURNING GASEOUS FUEL IN FURNACES.

No. 423,347. Patented Mar. 11, 1890.

Fig. 1.

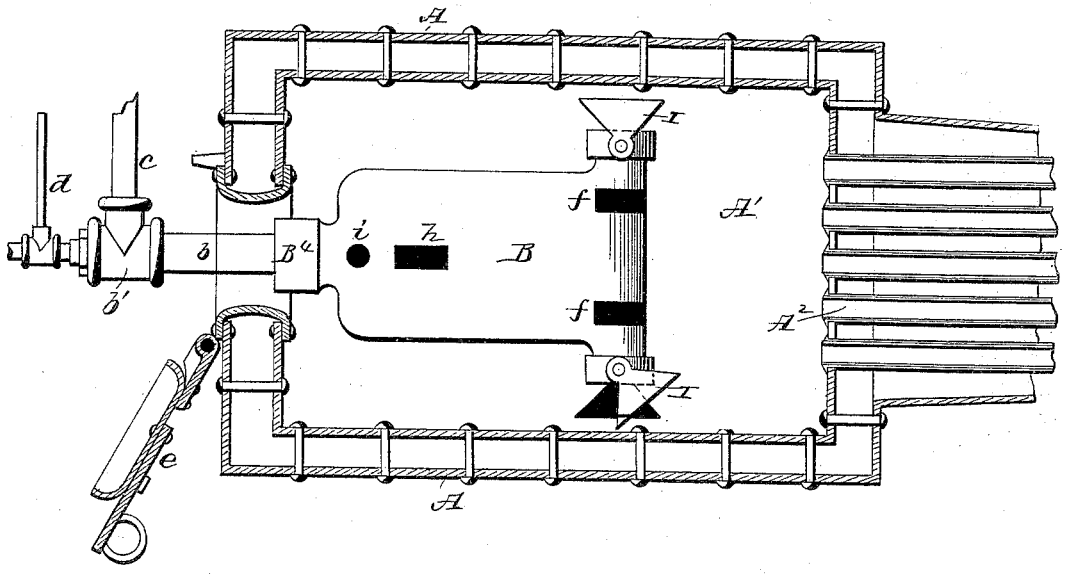
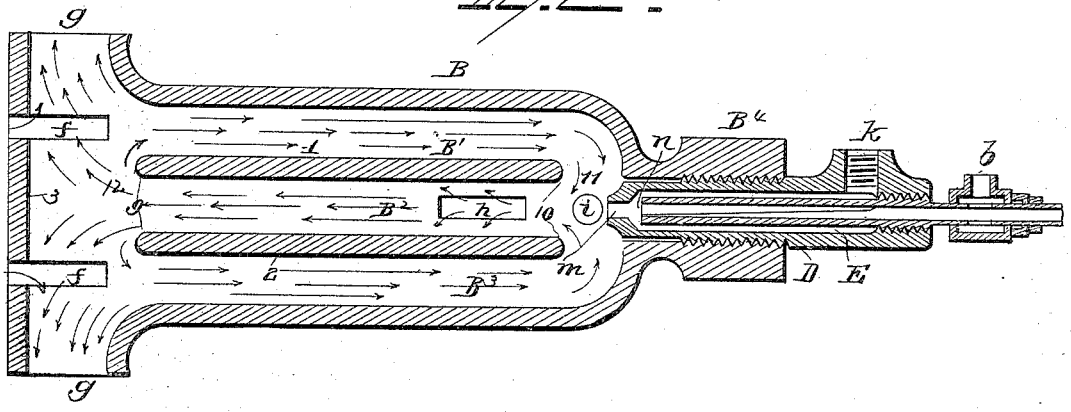


Fig. 2.



Witnesses
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G. F. Downing.

Inventor
Egbert P. Shetter

By his Attorney
H. A. Seymour

(No Model.) 3 Sheets—Sheet 2.

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Fig. 5.

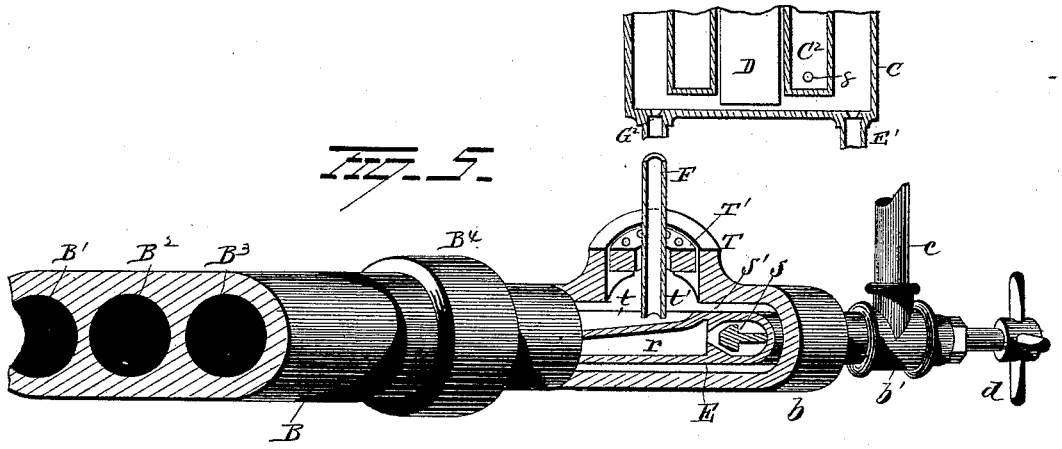


Fig. 6.

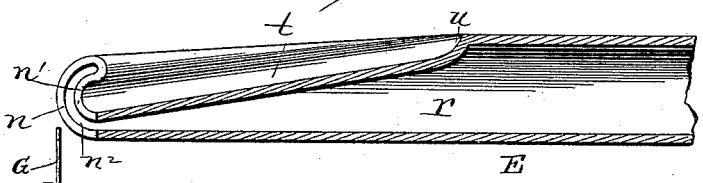


Fig. 3.

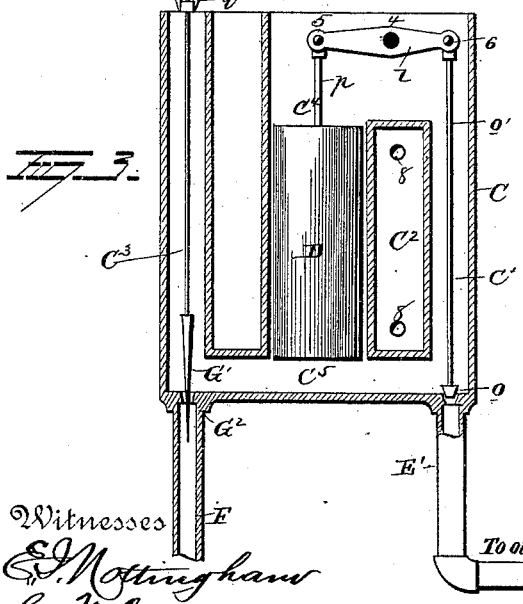
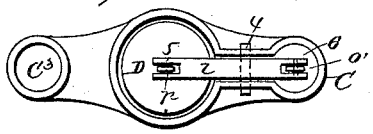


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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Fig. 7.

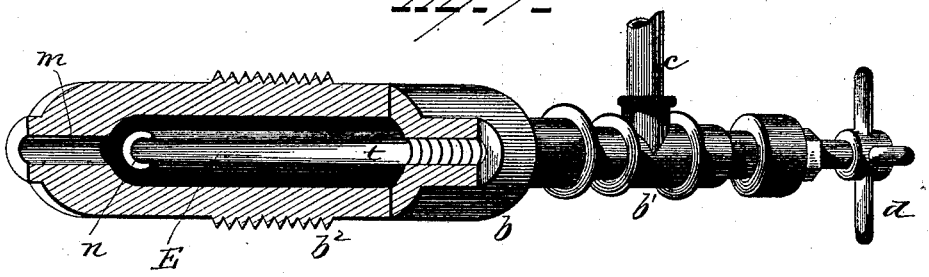


Fig. 8.

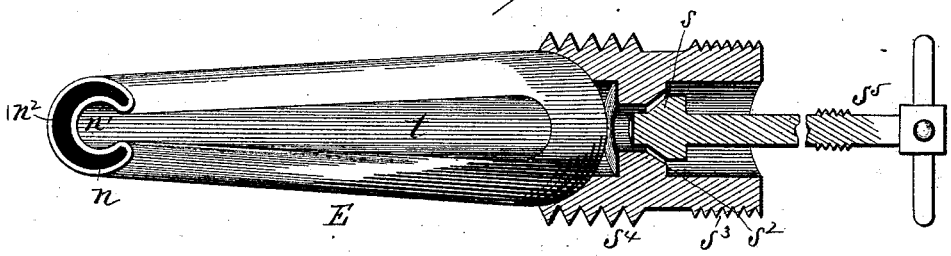
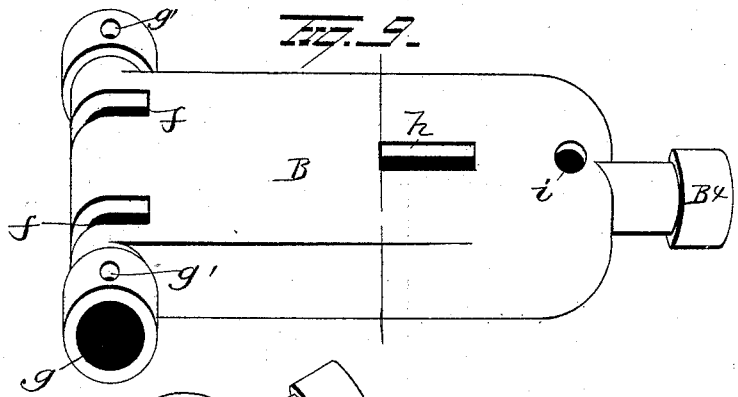


Fig. 9.



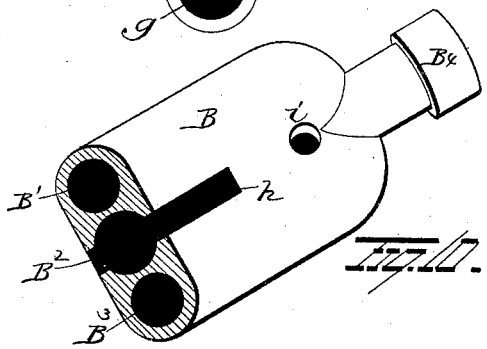


Fig. 10.

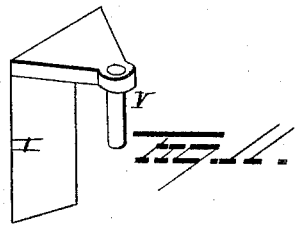


Fig. 11.

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By his Attorney
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UNITED STATES PATENT OFFICE.

EGBERT P. SHETTER, OF RENFREW, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO CHARLES A. MULLEN, OF SAME PLACE.

APPARATUS FOR GENERATING AND BURNING GASEOUS FUEL IN FURNACES.

SPECIFICATION forming part of Letters Patent No. 423,347, dated March 11, 1890.

Application filed May 15, 1888. Serial No. 273,936. (No model.)

To all whom it may concern:

Be it known that I, EGBERT P. SHETTER, of Renfrew, in the county of Butler and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Generating and Burning Gaseous Fuel for Use in Furnaces, &c.; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in apparatus for generating gaseous fuel for use in furnaces and for other purposes.

One object of my present invention is to produce a simple and reliable apparatus whereby oil, tar, or other carbonaceous material may be converted into hydrocarbon vapor and consumed as generated, the carbon vapor evolved by heat being assimilated with superheated-steam flame and heated atmospheric air to produce a hydrocarbon gaseous fuel.

A further object is to provide a feed-regulator to be used with a gaseous-fuel-generating apparatus, that will automatically graduate the flow of carbonaceous liquid from a source of supply to the gas-generating device, and which is susceptible of close adjustment with regard to the delivery of liquid carbon into the feeding mechanism of a gaseous-fuel-generating apparatus.

A further object is to supply a hydrocarbon-gas-generating apparatus with a jet-nozzle which will feed oil or other carbonaceous liquid supplied thereto by the force of gravity or other applied pressure, the oil passing into or through an enveloping thin sheet of high-pressure steam, the nozzle being further adapted to mix this combined volume of steam and vaporized oil with a current of atmospheric air, which is inducted by partial vacuum created around the feeding-jet nozzle by action of steam through it.

A further object is to furnish a gaseous-fuel-generating apparatus with a combining, superheating, and discharging chamber which is connected to a jet-nozzle, so as to receive a volume of mixed high-pressure steam, carbon liquid, and atmospheric air, it being also adapted to permit a destructive combustion of a portion of this injected composite vapor, which will heat the interior of the chamber, expand the volume of the unconsumed vapor, mixing and fixing the oxygen of the air with the hydrogen and carbon of the steam and oil, so as to evolve a compound gaseous fuel that is discharged and consumed to produce heat as it is evolved.

A further object is to provide adjustable devices which are adapted to deflect the forcibly ejected and ignited current of gaseous fuel as it issues from the jet-nozzles of my gas-generator when the latter is located within a glass-furnace, fire-box of a steam-boiler, or other compartment, so that these intensely-hot currents of gas, in state of combustion, will be made to spread over an extended area of wall-surface or thrown into any part of the combustion-chamber without a direct impingement against the walls of the same.

With these objects in view my invention consists in certain features of construction and combinations of parts, which will be hereinafter described, and pointed out in the claims.

Referring to the drawings, Figure 1 is a plan view in section of the fire-box of a horizontal-flue boiler with my gas-generator in position. Fig. 2 is an enlarged sectional plan view of the combining-chamber and attached parts. Fig. 3 is a side elevation in section of a liquid-feeding device that is adapted to graduate and equalize the delivery of carbonaceous liquid to the gas-generating apparatus. Fig. 4 represents a top view of the feed-regulator shown in Fig. 3. Fig. 5 is a view of the rear portion of the combining-chamber and attached devices, which inject steam, oil, and air into the combining-chamber. Fig. 6 is an enlarged longitudinal section of the feed or jet nozzle. Fig. 7 shows the jet-nozzle and its surrounding case, together with attached oil, steam, and air feeding devices, the casing of the jet-nozzle being broken away to expose the latter. Fig. 8 is an enlarged perspective view of the jet-nozzle, the attached steam-regulating valve being shown in section. Fig. 9 represents the combining-chamber in perspective and detached from other parts. Fig.

10 is a view of the combining-chamber, with front end broken away on the line x x, Fig. 9. Fig. 11 represents one of the flame-deflectors employed to divert and direct the flame of an ignited gas-jet as it issues from the combining-chamber.

For the purpose of gaseous-fuel generation conducted in apparatus where liquid carbonaceous matter is utilized as one of the constituent elements of the composite gas evolved it is a prime essential, to insure an even consumption of such material and the production of an even quality of gas, that a reliable means be afforded to graduate the flow of oil or other carbon liquid near where it is delivered into the generator. To effect such a regulation of the oil-delivery I have devised an improved feed-regulator which is adapted to liquefy and regulate the delivery of oil or similar carbonaceous material to the gas-generating apparatus and permit the adjustment for quantity delivered under varying pressures to be exactly graduated.

The feed-regulator just mentioned is introduced in the line of oil-conduit pipe leading from an elevated tank to a point near where the furnace or boiler fire-box is located and in which the gas-generator is placed to furnish gaseous fuel for combustion in it.

The gas-generating apparatus consists of two devices that coact together for gas production. One of these is a novel jet-nozzle, which is constructed to deliver a jet of high-pressure steam intermixed with oil and atmospheric air, these joined currents being forcibly projected into a combining-chamber, which is the other and main portion of the generating apparatus. This latter-named feature is so devised that a portion of the mixed volume of oil, steam, and air injected therein will be ignited and by its intense combustion heat up the thin walls of said combining or mixing chamber, so that the major portion of the injected composite vapor will be thoroughly intermingled, and by intimate contact with the burning jet, as well as the hot metal walls of the chamber, be superheated and fixed, changing from vaporous to gaseous form. The pressure accumulating in the combining-chamber by the rapid generation of vapor forces jets of the same out through orifices in this combiner into the combustion-chamber of a glass or other furnace, where by its ignition it furnishes intense heat in large volume.

A detailed description of the apparatus will now be given.

In Fig. 1, A is the outer walls, and A′ the combustion-chamber, of a horizontal-flue boiler, in which the combining-chamber B of my vapor-generating apparatus is located, its relative position therein being shown. At the outer end B^4 the injecting device is attached.

The oil, steam, and air injector consists of a shell b, (see Figs. 5 and 7,) secured in the front end of the combining-chamber B by the thread b^2, cut on its body so as to align with this chamber longitudinally. Said shell b is axially perforated to receive a jet-nozzle E, which is supported concentric with the cylindrical cavity of the shell in which it is placed by threaded attachment of its end s^3 with the three-way fitting b', into which is also screwed the rod s^5, which is attached to the steam-controlling valve s, to operate it and by its adjustment toward or from its seat regulate the passage of steam through the jet-nozzle, a hand-wheel d affording a means for such adjustment.

The jet-nozzle E is shown enlarged in Figs. 6 and 8, the first being a longitudinal section of the same, taken through its axial center, a portion of the jet-nozzle being also shown in position in Fig. 5. It is cylindrical toward its receiving or forward end, and from the point u (see Fig. 6) the upper side of the wall or shell is depressed and the whole body of the nozzle slightly tapered toward the other end n, an open channel or groove t being thus produced on the top side of the nozzle.

The inward curving of the top surface n' produces a nearly-annular slit or thin curved orifice n^2 (see Fig. 8) between it and the extremity of the exterior wall n, this slit being adapted to deliver a similarly-shaped jet of steam from its open terminal, and it will be noticed in Fig. 7 that this end of the jet-nozzle E is in line with and near to the delivery-orifice m, formed in the end of the shell b.

A steam-supply pipe c is connected with a branch outlet k of the T-piece b', said pipe receiving steam from any adequate source, and above the point t' (see Fig. 5) an inlet T′ is formed in the shell b, so as to permit oil to be introduced to the channel t through the vertical pipe F. The inlet-orifice through which the pipe F enters the shell b is enlarged to allow an annular perforated disk T″ to be seated in the branch inlet T, thus affording free inlet for air which may surround the jet-nozzle in the annular space s' intervening between it and the adjacent concentric wall of the shell.

At a proper point outside of the combustion-chamber A′ of the boiler in which the combining-chamber of the generating apparatus is placed, and preferably above said chamber, the oil-regulating device is situated. This consists of a receptacle C, (see Fig. 3,) in which are formed three vertical compartments C′ C^4 C^3, which are made to communicate by junction with a horizontal passage C^5.

Within the compartment C′ a sealed chamber C^2 is formed or inserted, through which steam is introduced and caused to circulate by the pipes 8 8. In the bottom of the compartment C′, near the vertical side wall of the same, a perforation is made, which is intended to receive and form a tight joint with the valve o, that is connected by a vertical rod o' to the pivoted horizontal oscillating bar l, said rod having a loose connection therewith at 6. On the other end 5 of the bar l a rod p

is pivoted, to which the float D is secured, and thus allowed to reciprocate within the compartment C^4.

At the other side of the receptacle C, in the bottom wall of the passage C^5, just below the compartment C^3, a valve-seat and oil-discharge opening G^2 is formed, in which the needle-valve G′ is fitted, which latter is operated by the vertical rod G, that is engaged by the screw-nut q, to afford means for the exact adjustment of the needle-valve by a revolution of the nut. The oil-feed pipe F, being attached to the orifice below the valve G′, is extended downwardly to enter the inlet branch at k, as has been explained.

In order to liquefy tarry matter, crude coal-oil, or similar thick carbonaceous material and cause it to flow readily through the spindle-valve G′, the steam-chamber C^2 is provided, which will speedily render such sluggish viscid material limpid and free-flowing, so as to be fed in small quantity through said valve G′. (Shown in Fig. 3.)

An oil-conduit pipe E′, which extends from an elevated source of supply, such as a tank, (not shown,) is attached below the valve o to introduce liquid carbon matter within the receptacle C; and in operation, when the several compartments are filled sufficiently to elevate the float D, this upward movement of the float will depress the valve o and cut off oil influx or regulate it to prevent undue pressure within the compartments.

When the valve G′ is adjusted to supply a desired amount to the jet-nozzle E, it is apparent that this discharge of oil will be controlled so as to be equal at all times, and not affected by varying height of oil in the elevated tank, which is the source of supply to the regulator.

In Fig. 2 a longitudinal enlarged sectional view of the combining-chamber B and attached jet-nozzle E is shown. As will be seen, the combining-chamber has two parallel longitudinal walls 1 2 formed in it, which divide the interior into three passages or chambers of about equal diameter. The walls 1 2 terminate at 9 10, leaving the transverse passages 11 12 at their ends, which passages are intersected by the longitudinal chambers B′ B^2 B^3, and it will be noticed that the discharging-orifice m is directly opposite the center of the middle chamber B^2. Preferably in a right line between the discharge-orifice m and the oblong openings h two oppositely-located circular openings i are made through the walls of the combining-chamber for the admission of atmospheric air or another use, as will be explained. Two lateral branches or outlets g g are formed in the combining-chamber B at its inner or rear end, and two parallel spaced slots f f are cut through the transverse end wall 3 of said chamber, these slots f being placed opposite the outer compartments B′ B^3, as shown in Fig. 2.

In use of this apparatus for gas production it is preferred to place a light wood fire on the grate-bars below the combining-chamber B in order to heat the walls of the same. This is not imperatively necessary, as the operation can be started without such a provision; but it is facilitated by its employment.

Steam is allowed to enter the jet-nozzle E by opening the valve s, and oil is caused to drip from the valve G′ into the groove or channel t. The rapid movement of the annular steam-jet which issues from the nozzle at n^2 will exhaust the contained air in the space s' and channel t, so as to create an inward current of air through the perforations in the disk T, and this air will intimately commingle with the steam and vaporized oil that is also drawn toward the exit-orifice m of the shell b by the steam-jet. When the mixed volume of steam, hot air, and vaporized oil is projected through the orifice m, it is ignited and a portion of the same is consumed as a jet of fire. The excess of gaseous vapor not consumed, which is the major portion of the injected current, will be forced through the central chamber B^2 and impinge against the interior surface of the transverse wall 3, which will deflect it laterally. The force of the moving column of composite vapor injected through the orifice m will create an inward draft through the orifices i and elongated slots h and f, so that atmospheric air will be drawn through the grate-bars of the combustion-chamber A′. After being heated and expanded by its passage through this chamber this air will enter the combining-chamber B at the points mentioned and mix with the vaporous current, which will be intimately blended and fixed by the heat of the burning jet, the excess of oxygen furnished by the blended hot rarefied air and fire of the furnace aiding to produce intense smokeless combustion of the composite gas as it is forced out of the jet-holes g g, (shown in Fig. 1,) it being first given a reverberatory motion through the lateral chambers B′ B^3 to pass it through the burning jet.

It is of importance that the intensely-hot burning jets formed by the vapor which issues from the orifices g be deflected at proper angles to throw a sheet of flame along the surface of the fire-chamber walls, so that it shall have contact with an extensive area to heat it. To effect such a change of current I employ the movable deflectors shown in Fig. 11, in which the angular vertical surface I is held to swing opposite an opening g by a pintle v, which is inserted in the hole g', thus permitting the deflector to be set and cause the ignited jet to be diverted from striking squarely against the side walls of the boiler and thrown in any desired direction.

It should be understood that one of the deflectors just described is mounted opposite each jet-orifice g, as shown in Fig. 1, and it is evident that several flame-deflectors, made of cast-iron, fire-clay, or other fire-resisting material, may be employed to direct these flame-

jets and break them up and cause a general heat diffusion in a measurably-close combustion-chamber—such as a glass-furnace or the fire-box of a boiler.

It is contemplated to provide a means for utilization of natural gas with this apparatus, and in case it is employed it may be fed into the combining-chamber B at *i* by a proper pipe attachment inserted in one of these orifices, and so projected that its volume will be forced toward the wall 3 of the combining-chamber, steam and a reduced quantity of oil being employed in conjunction with the gas.

It may be desired to combine coal-dust or pulverized coke with the steam, oil, and air as it issues from the discharge-nozzle *m*, which may be effected by the attachment to one of the openings *h* of a proper conduit-tube, through which the dust may be conveyed into the combining-chamber, mechanically mixed, and forcibly ejected with the gaseous fuel to be consumed therewith in an obvious manner.

The details of construction of the gaseous-fuel-generating apparatus hereinbefore described may be slightly changed in form and method of combination and arrangement of parts without a departure from the spirit or exceeding the scope of my invention. Hence I do not wish to restrict myself to the exact forms and combinations of parts shown; but,

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a gaseous-fuel generator, a combining-chamber having parallel chambers formed in its interior communicating at both ends and provided with inlet and discharge orifices, substantially as set forth.

2. In a gaseous-fuel generator, a combining-chamber which is provided with a central longitudinal chamber and lateral chambers, these chambers communicating at both ends and adapted to receive a gaseous current forced or drawn into the central chamber to mix with fire and superheat it, substantially as set forth.

3. In a gaseous-fuel generator, a combining-chamber having two partition-walls longitudinally extended to divide it into three compartments communicating at both ends and furnished with an inlet-orifice, which is located opposite to the central compartment, substantially as set forth.

4. The combination, with a combining-chamber, of a jet-nozzle consisting of a casing having a nearly annular discharge slit or opening formed by a depression in one side of the casing, substantially as set forth.

5. The combination, with a combining-chamber, of a jet-nozzle consisting of a casing having a nearly-annular slit or discharge-orifice and an external longitudinal channel on one side, substantially as set forth.

6. In a gaseous-fuel generator, the combination, with a combining-chamber and a jet-nozzle grooved longitudinally on its exterior and having a discharge-opening for steam, of a shell surrounding the jet-nozzle and provided with a discharge-orifice in line with the jet-nozzle, substantially as set forth.

7. In a gaseous-fuel-generating apparatus, the combination, with a central longitudinal chamber, and two parallel lateral chambers that are connected at their ends to each other and the central chamber to form a reverberatory combining-chamber, of a jet-nozzle, an enveloping-shell for the jet-nozzle, and means to supply steam, oil, and air to the jet-nozzle and the annular passage surrounding it, substantially as set forth.

8. In a gaseous-fuel-generating apparatus, the combination, with a combining-chamber, which is constructed of several compartments lying side by side and communicating at each end, of a steam-jet nozzle, oil-supply pipe, air-openings, and an automatic regulating device that graduates the flow of carbon liquid to the jet-orifice, substantially as set forth.

9. In a gaseous-fuel-generating apparatus, the combination, with a reverberatory combining-chamber having flame and air inlets and gas-discharge passages formed in it, and an inlet for a mixed jet of steam, oil, and air provided at one end of said chamber, of a steam-jet nozzle, an oil-feeding channel formed on the surface of said steam-jet nozzle, an oil-supply pipe, air-inlet orifices, an enveloping-shell which surrounds the steam jet nozzle, but is not in contact with its side wall, and means for regulating the introduction of steam and oil, substantially as set forth.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EGBERT P. SHETTER.

Witnesses:
JACKSON SPICER,
WM. LONG.