967,459.

C. L. STRAUB.

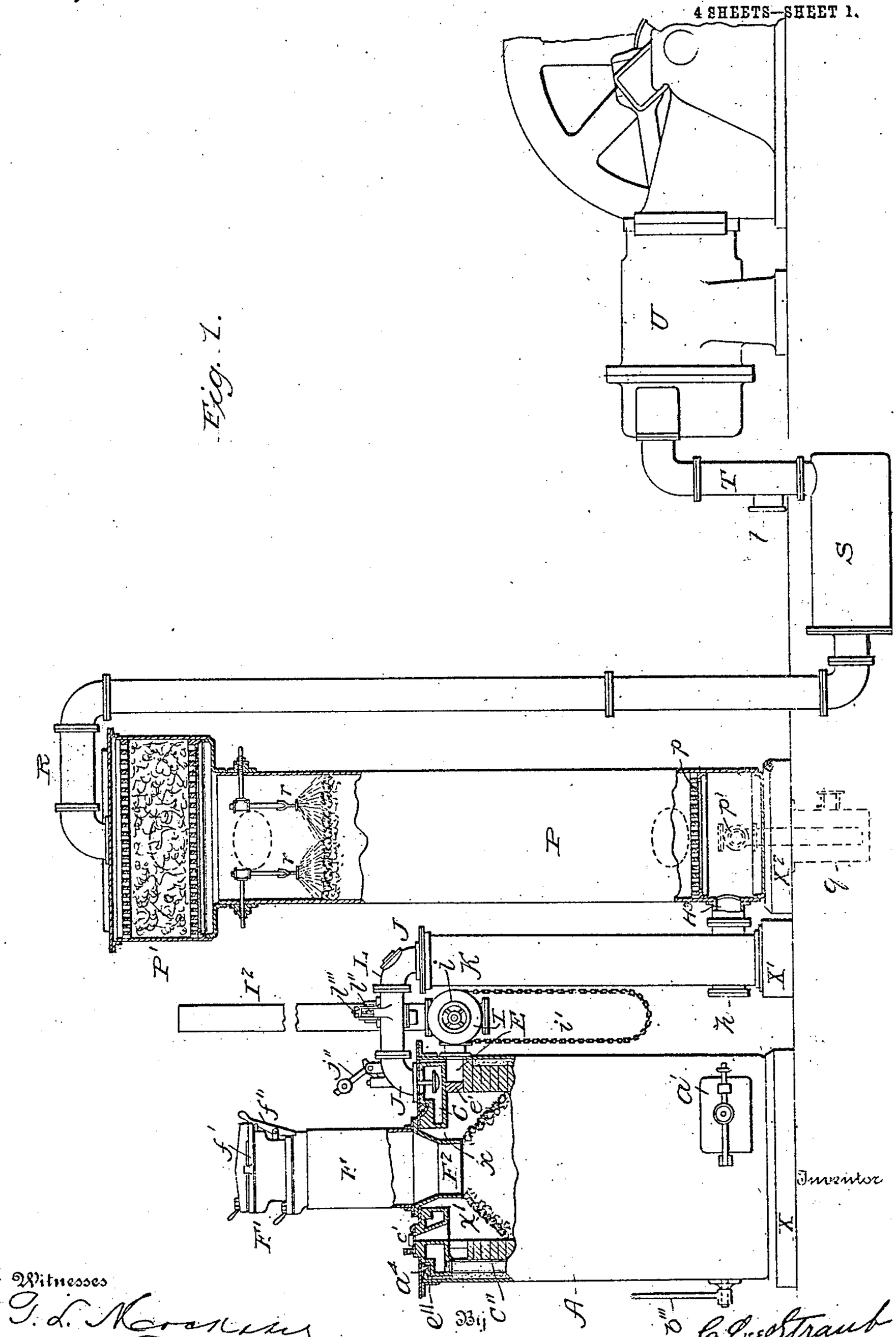
SUCTION GAS PRODUCER.

APPLICATION FILED JAN. 11, 1907.

Patented Aug. 16, 1910.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

T. L. Kraemer

Hawley Pettibone

C. Lee Straub

E. B. Clark, Attorney

967,459.

C. L. STRAUB.

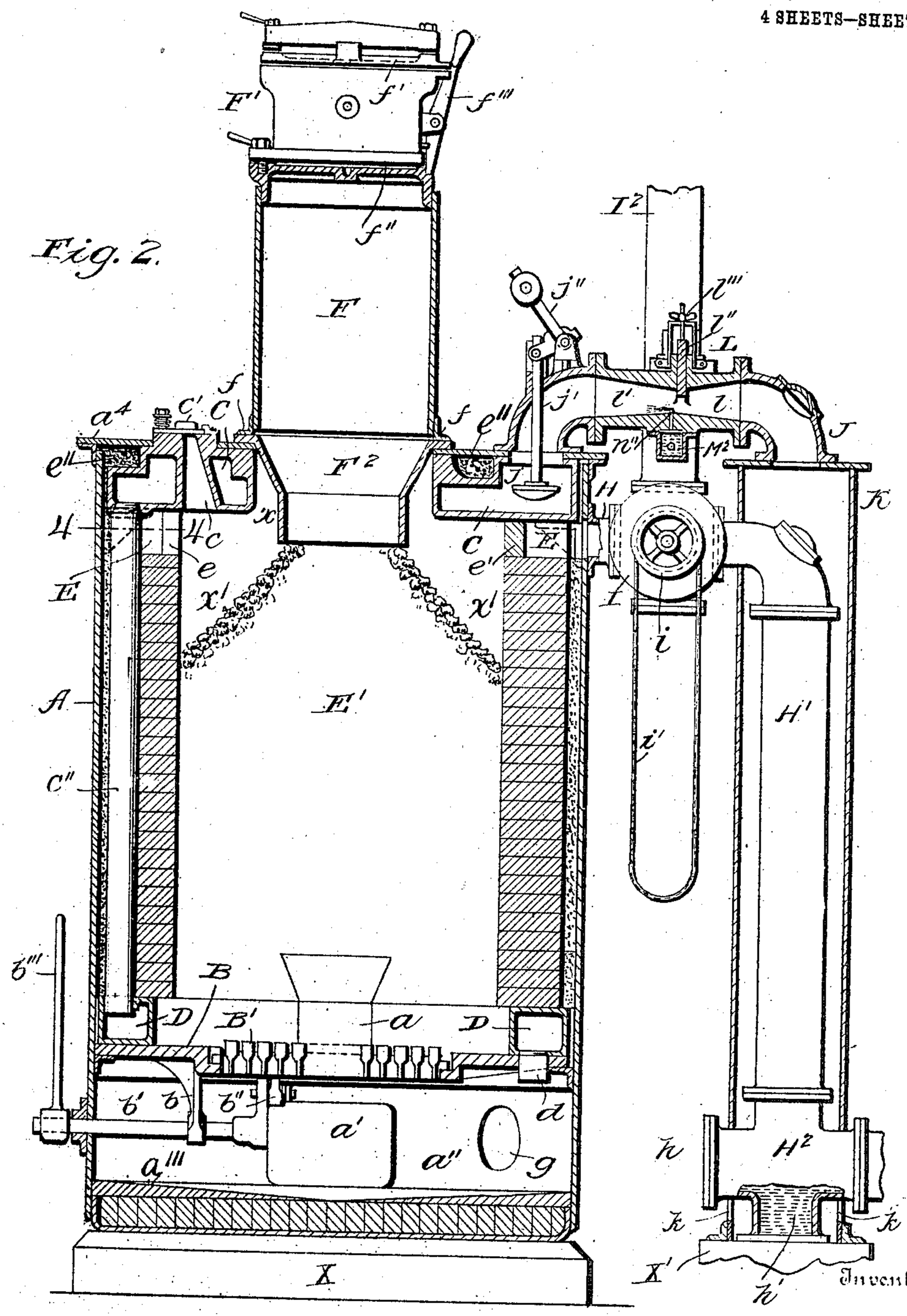
SUCTION GAS PRODUCER.

APPLICATION FILED JAN. 11, 1907.

Patented Aug. 16, 1910.

4 SHEETS—SHEET 2.

Fig. 2.



Witnesses

P. L. Mackaye

Hawley Pettibone

By

C. Lee Straub

E. B. Clark

Attorney.

Inventor

967,459.

C. L. STRAUB.

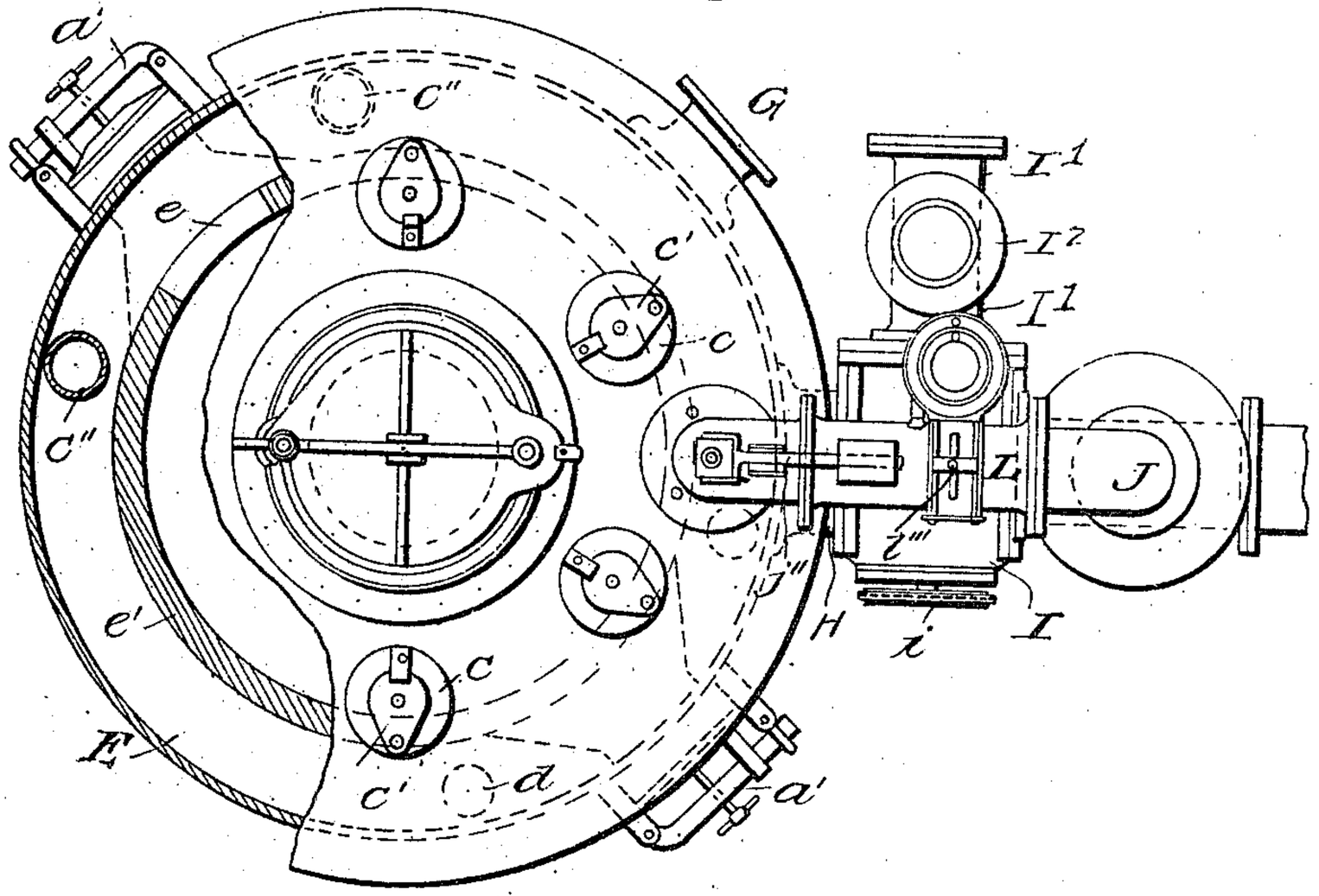
SUCTION GAS PRODUCER.

APPLICATION FILED JAN. 11, 1907.

Patented Aug. 16, 1910.

4 SHEETS—SHEET 3.

Fig. 3.



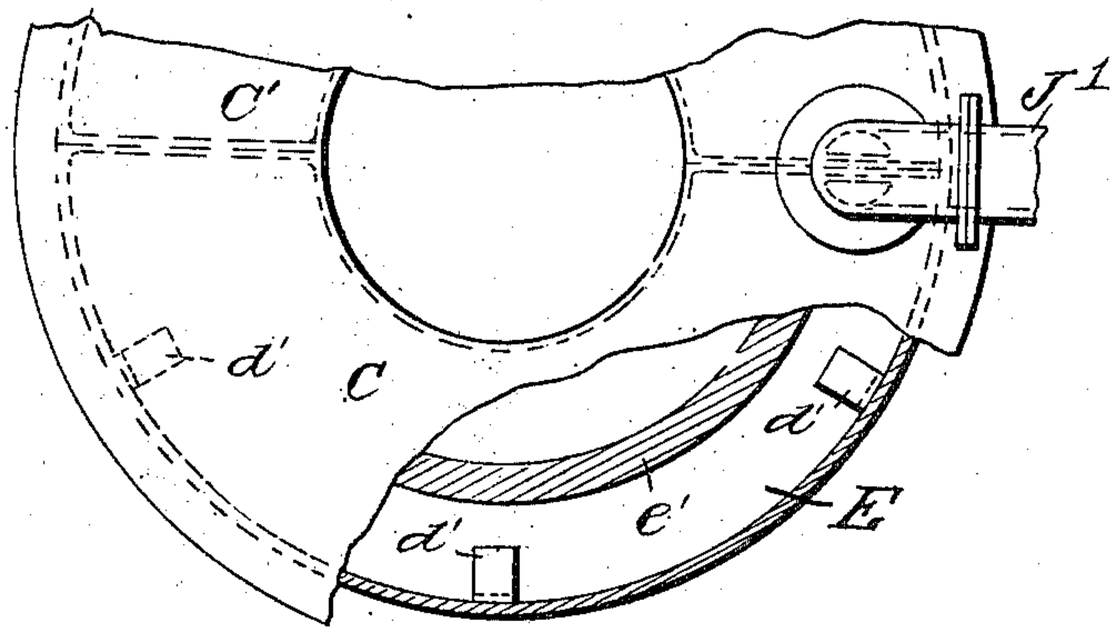


Fig. 4.

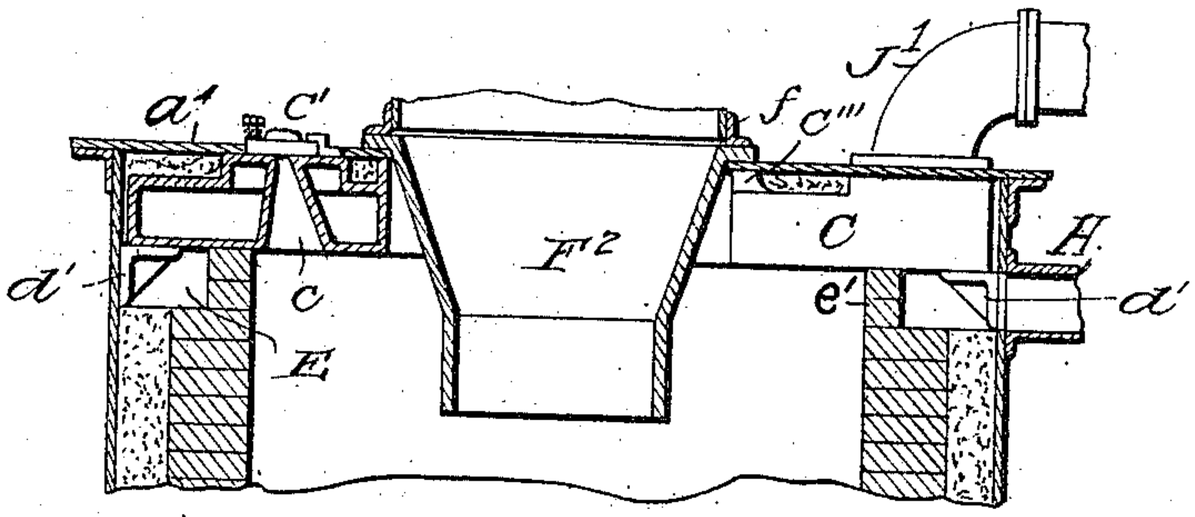


Fig. 5.

Witnesses

D. L. Morehead

Hawley Pettibone

Inventor

C. Lee Straub

By

E. B. Clark

Attorney

C. L. STRAUB.

SUCTION GAS PRODUCER.

APPLICATION FILED JAN. 11, 1907.

967,459.

Patented Aug. 16, 1910.

4 SHEETS—SHEET 4.

Fig. 5.

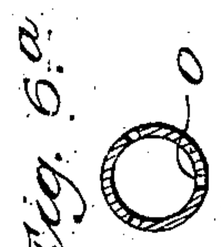


Fig. 7.

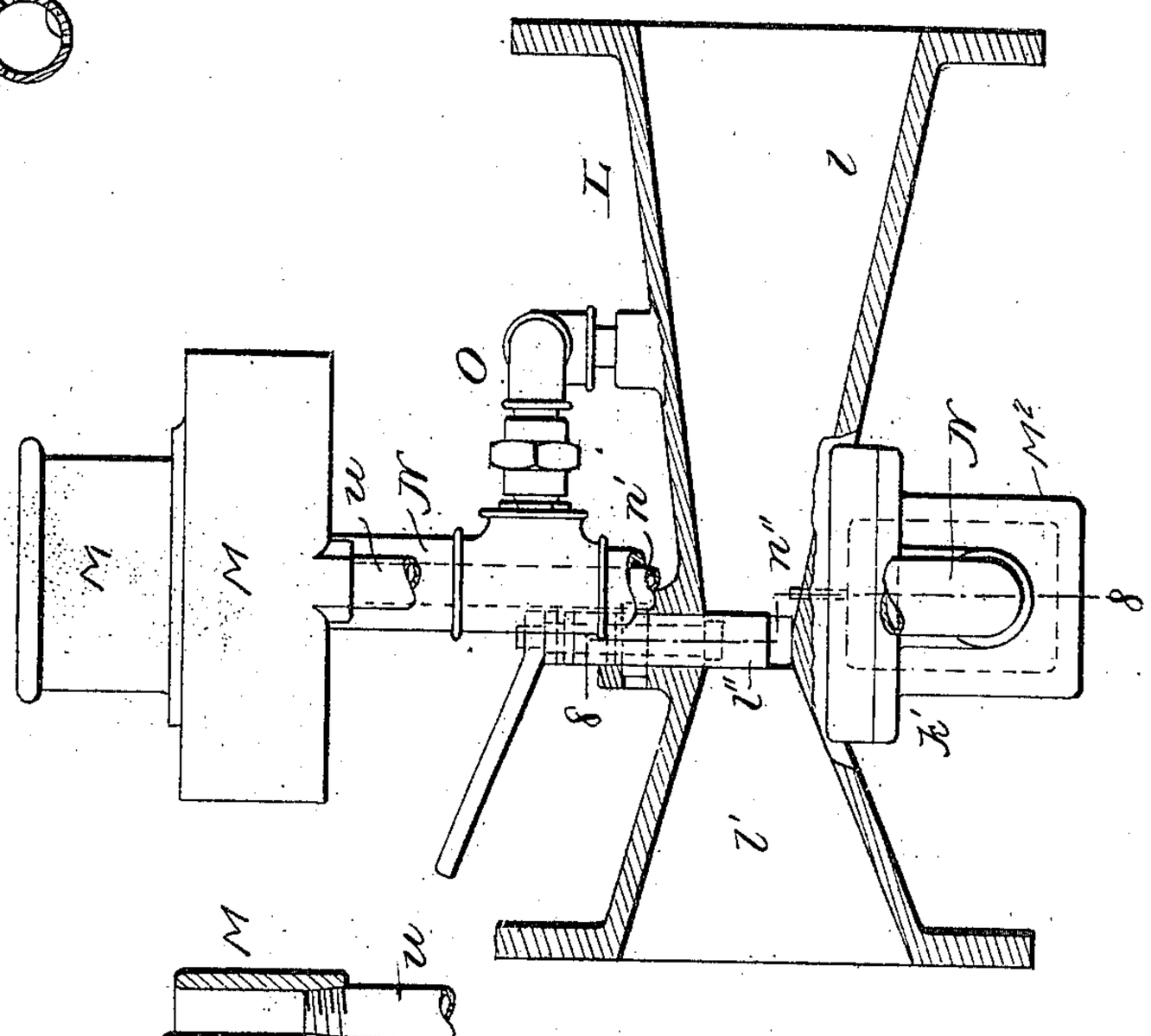


Fig. 6.

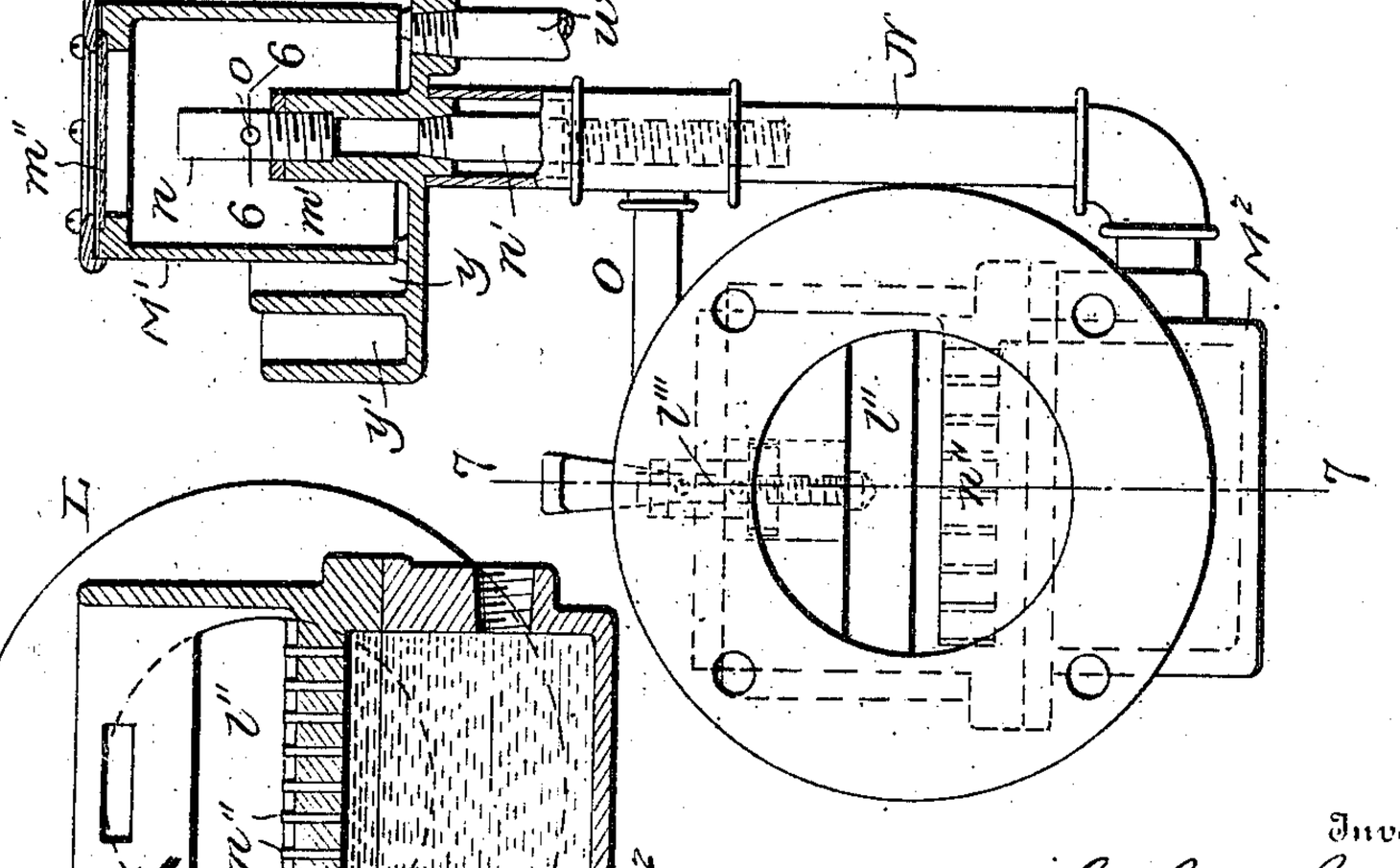


Fig. 8.

Witnesses

T. L. Mockabee

Hawley Pettibone

Inventor

C. Lee Straub

By

E. B. Clark

Attorney

UNITED STATES PATENT OFFICE.

CONSTANTINE LEE STRAUB, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO LOOMIS PETTIBONE COMPANY, A CORPORATION OF CONNECTICUT.

SUCTION GAS-PRODUCER.

967,459. Specification of Letters Patent. Patented Aug. 16, 1910.

Application filed January 11, 1907. Serial No. 351,879.

To all whom it may concern:

Be it known that I, CONSTANTINE LEE STRAUB, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Suction Gas-Producers, of which the following is a specification.

This invention relates to a suction gas producer, of that kind in which air and water vapor or steam are drawn into the body of fuel and the resulting gas is drawn from the producer or generator by a gas engine or other means.

The object of my invention is to provide for generating gas of a more uniform quality or thermal value and supplying the same in a more uniform stream or flow from the producer or generator to a gas engine or other place of use, than has heretofore been attainable with such producers.

Another object of my invention is to provide for effectively and economically heating air, spraying or vaporizing water, mingling the spray or vapor with hot air and instantly converting it into steam in a heater by means of waste heat of the producer and the outflowing hot gas, and supplying such hot air and steam in a substantially uniform flow to the body of incandescent fuel in the producer for generating gas.

Another object of my invention is to provide for supplying a regulated flow of water and air to a special atomizing and vaporizing device in direct proportion to the load on the producer and to the volume of outflowing gas being drawn from the producer by the gas engine or other means.

Other objects of my invention are to provide improved mechanism and devices for securing the above stated results and make a smoothly operating and particularly effective suction producer or generator.

The matter constituting my invention herein will be defined in the claims, and I will now particularly describe the apparatus by reference to the accompanying drawings, in which,—

Figure 1 represents an elevation, partly in section, of my suction producer, a scrubber, an expansion chamber and gas engine, and suitable connections. Fig. 2 represents a vertical section, on enlarged scale, of the gas producer or generator, a preheater and a vaporizer or attenuator connecting the preheater with a flash boiler or super-heater in the top of the producer. Fig. 3 represents a top plan view of the apparatus with parts in horizontal section. Fig. 4 represents a horizontal section on line 4—4, Fig. 2, showing an annular flue for outflowing hot gases. Fig. 5 represents a vertical section of the top of the producer or generator, showing modifications in construction. Fig. 6 represents, on enlarged scale, a sectional elevation of the vaporizer and automatic water feed devices. Fig. 6ª represents a transverse section, on an enlarged scale of the equalizing pipe *n* on line —6— Fig. 6. Fig. 7 represents a sectional side elevation of the same. Fig. 8 represents a transverse section of the vaporizer on line 7—7, Fig. 6.

The gas producer A is constructed with the usual riveted plate-iron shell and fire brick lining upon a concrete foundation X, and is provided near the base with a fire door *a* above the grate and with an ash pit door *a'* opening into the ash pit *a''*. The ash pit is preferably provided with a brick floor *a'''*, but without a brick lining, as shown. An iron top plate a^4 is riveted to the outer shell and extends over the shell or casing of the flash boiler or super-heater C up to the opening for the fuel hopper. A filling of fire sand is placed between the shell and the fire brick lining, as shown in Fig. 2. The top of the ash pit is made of an annular cast-iron plate or hearth B, supported on brackets riveted to the shell and having a large central opening, into which is set the rocking or shaking grate B^1.

In a hanger *b* projecting from the hearth B and a suitable bearing in the shell is supported a rock shaft *b'*, to the inner end of which is connected a lever *b''* which connects with the shaking grate. To the outer end of shaft *b'* is connected a hand lever *b'''* for operating the grate.

The inwardly projecting annular hearth B forms a contracted grate opening and prevents air or air and steam from passing up along the side walls of the producer; it also serves as a support for the re-heater chambers D and brick lining.

The re-heater D while of notable utility,

is not necessarily installed in connection with the other features herein shown, and when installed, is preferably made of two semi-circular or segmental castings arranged to form openings at the fire-doors *a*, as indicated in Fig. 3, and each segmental box is provided with a short downwardly projecting outlet pipe *d*, opening into the ash-pit *a''*. These outlet pipes *d* are preferably placed opposite the inlet pipes *c''* extending down from the flash-boiler. By this arrangement the commingled hot air and steam which enter through pipe *c''* are caused to pass around through the re-heater chambers and become superheated before escaping into the ash pit and passing thence up into the body of fuel.

At the top of the brick lining is constructed a comparatively thin wall *e'*, Figs. 2 and 4, forming an annular gas outlet flue E, having an inlet opening *e* opposite the connection of the gas take-off pipe H. Adjacent to this flue E are riveted to the outer iron shell six cast iron brackets *d'* suitably spaced apart for supporting the annular flash-boiler or super-heater C. The flash-boiler is supported on the cast iron brackets, and in turn supports the fuel feed-hopper F, on the flash-boiler or super-heater C is the top closure sheet plate a^4, so constructed and attached as to prevent the admission of air at the top of the generator. This is an economical and simplified construction as it does away with an extra cast-iron cover, heretofore required, and reduces the cost of construction. The flash-boiler is preferably composed of two segmental half boxes C, C^1, arranged over the annular gas outlet flue E and projecting inwardly from the wall *e'* partly over the fuel-chamber E^1, as shown in Fig. 2. These super-heater boxes have cast with them the vertical or downwardly flaring poke-holes *c*, arranged in a circle, as shown in Fig. 3, and opening into the fuel chamber. These holes have outer close-fitting covers *c'* provided with suitable fastening devices as shown. Two, or any desired number of pipes *c''* connect with the bottom plates of the super-heater boxes and extend down through the brick lining and connect below with the re-heater boxes D, as indicated in Figs. 2 and 3. These super-heater boxes C, C^1 are also provided with inner upwardly-projecting flanges *c'''* which serve as a bearing for the outwardly projecting flanges *f* of the discharge spout F^2 of the fuel hopper. The top of the producer is made tight by a wrought iron plate a^4 which is secured to the angle iron ring at the top edge of the shell and is inserted between the interior flange *c'''* of the boxes and the flange *f* of the discharge spout and is also made tight around the poke-holes *c*. The space between the top of the super-heater boxes and the cover-plate a^4 is filled with a packing *e''* of asbestos or mineral wool to prevent radiation from the flash-boiler. The poke-holes *c* extending through the flash-boiler serve as braces and increase the heating surface thereof.

By means of the construction shown and above described the hot gas passing from the body of fuel circulates around, first under the inwardly-projecting part of super-heater C, thence through port *e* and back around under the outer part thereof, thereby highly heating chamber C before escaping to the take-off pipe H.

When the superheater is made of two segmental boxes a special form of ell inlet pipe J^1 is provided, being so constructed as to connect with the interior of both boxes at their adjacent ends. The superheater is also made as a single annular chamber C with which is connected the air and vapor supply pipe J^1, with valve *j*, shown in Fig. 2.

The fuel feed-hopper is composed of a body portion F, an upper charger F^1 and a lower contracted discharge spout F^2 projecting down centrally through the super-heater into the fuel chamber, as shown in Fig. 2. The discharge spout F^2 is provided at the top with an annular flange *f* which rests upon the top plate a^4 on the flange *c'''* of the superheater chamber C. The charger F^1 is mounted on the body portion F and is provided with a tight fitting cover *f'*, a movable bottom plate *f''*, and with a locking device *f'''*, arranged to lock the closed bottom plate when the cover is open and to engage and lock the closed cover when the bottom plate is open and discharging fuel into the hopper. The details of construction of this charger are not here further described, as it is made the subject of a separate application for patent. An annular gas circulating space *x* is formed between the contracted discharge spout F^2 of the hopper and the superheater C. A gas circulating space *x'* is also formed between the inclined surface of the fuel, the brick lining and the bottom of the super-heater C. A blower-pipe G, Fig. 3, connects with the ash pit at the opening *g*, Fig. 2. In practice, a well-known form of fan-blower may be connected with the pipe G.

A gas outlet pipe H connects with the annular gas flue E and with a specially constructed purge-valve I, with which is connected the gas take-off pipe H^1 extending down through the pre-heater shell K, which is supported upon the concrete foundation X^1. The lower end of pipe H^1 is connected with a cross pipe or four way coupling H^2, which connects by pipe H^3 with the base of the wet scrubber P. One branch of the coupling H^2 extends through the shell of heater K and is closed by a removable cover-plate *h*, and another branch *h'* projects down to the foundation and is adapted to receive

water overflowing from the base of the scrubber for catching dust and ashes deposited from the gas. With the purge valve I connects a horizontal pipe I^1 and with the latter connects the purge stack I^2, which in practice extends up through the gas house, for discharging waste products into the open air. The purge valve is provided with a shaft, to which is secured a hand-wheel I^3, over which is passed an operating chain i', as shown in Fig. 2. The purge valve provides a passage for gas through pipe H and H^1 when properly set for such connection, or a passage for waste gases when placed in connection with the purge stack I^2. The pre-heater K is constructed of sheet metal, resting upon foundation X^1 and incloses the downtake gas pipe H^1 and is provided with a top plate, with which is connected an outlet pipe J. The lower end of the pre-heater shell K is provided with air inlet openings k, for admitting air to be heated by the hot gas pipe H^1. The outlet pipe J connects with a water-spraying device or vaporizer L, which at the opposite end is connected by a pipe J^1 with the top of the flash-boiler or heater-chamber C. The open end of pipe J^1 is controlled by a valve j, having a stem j' extending up through a guide-way and having connected to its upper end a weighted and pivoted operating lever j''.

The vaporizer or attenuator device L is constructed with two conical chambers or passage-ways connecting at their contracted ends, the inlet cone l being in the nature of a rapidly contracting nozzle and the discharge cone l' being in the nature of a long flaring nozzle. At the junction of the conical chambers l and l' is provided a sliding gate l'' in a suitable guide-way and provided with a screw-stem and an adjusting nut l''', for regulating the height of the gate in the contracted passage-way connecting the cones l and l'. Below the device L is centrally connected a water supply tank M^2, from which extend upward into the discharge cone or nozzle l' a series of ducts or tubes n'', opening just in front of the gate-valve l'', as shown in Figs. 6 and 8. An elevated water-feed tank M or vacuum bell M′ is provided for supplying a regulated flow of water to the lower tank M^2, as shown in Figs. 6 and 7. The tank M may be made circular and is provided with an annular partition m and with a central tubular projection m', providing an inlet water chamber y, and an overflow or outlet compartment y'. In the compartment y is placed an inverted vacuum bell M′, supported above the bottom of the compartment by upwardly projecting lugs. This bell is preferably provided with a glass cover-plate m'' set in a frame and screwed to the metallic part of the bell. A water-feed pipe u connects with compartment y and an overflow pipe u connects with the bottom of compartment y'. To the under side of tank M. at the tubular projection m', is connected a pipe N which extends downward and connects with the water tank M^2. An equalizing pipe N, externally screw-threaded at its lower end, is screwed into the tubular projection m' and is provided with an inlet opening o. This pipe may be held in place, after adjustment, by a locking nut o'. A screw-threaded extension n' of the equalizing pipe connects with the lower end of the center tube m' and extends downward partly through pipe N so that its lower end shall project a short distance below the connection of pipe O, which connects with the flaring nozzle or cone l, as shown in Fig. 7. The equalizing pipe n is preferably provided with three openings o Fig. 6ª equally spaced around the circumference thereof for admitting a regulated supply of water to the lower tank M^2.

The wet scrubber P is of a well known construction and has mounted upon it a dry scrubber P^1, with the upper end of which connects the outlet pipe R, extending down to and connecting with an expansion tank or gas reservoir S. A pipe T connects tank S with the gas engine U, and said pipe is provided with an air inlet pipe t. The scrubber P is provided with grids p, for supporting coke, and at the top with water spray pipes r. An overflow pipe p' connects at the proper water level in the lower chamber of the scrubber and leads to a seal-pot or trap q.

Gas engines, and especially those of large power, now generally in use take their gas in large gulps in successive intervals, and when connected with a generator, such as a suction producer, make the generation of gas fluctuating and irregular in quality or thermal value. In order to overcome this difficulty and cause a more uniform production of gas of constant thermal value I provide a supply pipe for air and water spray or vapor with a contracted passage-way, as above described, so that the supply of air and steam to the fuel chamber shall be more evenly and continuously distributed rather than in sudden puffs usually caused by the intermittent suction of the gas engine. The result is that a partial vacuum is produced in the fuel chamber by the suction of the engine, and that the air and water vapor are more uniformly and continuously drawn into the fuel chamber, thereby causing a more continuous and uniform production of gas of constant thermal value.

In starting the operation of the producer the purge valve I is turned in position to communicate with the purge-stack I^2 and a bed of fuel is ignited on the grate. Air is supplied from a blower through opening y to the ash pit and a deep body of fuel is

heated to incandescence. A deep body of incandescent fuel having been formed and good producer gas generated, valve I is turned to open a passage from the producer through the take-off pipe, by means of which gas is passed through the scrubber and into the expansion chamber S for supplying the gas engine. The engine is started in a well known way and takes its gas directly from the chamber S at the same time drawing gas from the producer through the take-off pipe and scrubber. A partial vacuum is thus instantly produced in the fuel chamber, also in re-heater D, flash boiler C, the attenuator device L and vacuum bell M M′. This vacuum in the bell M′ raises the water therein above the openings *o* in feed pipe *n*, and in direct proportion to the head or pressure the water passes through said openings, down through pipe N into tank M² from which it is discharged through the ducts *n″*. By reason of the contracted passage-way in the attenuator L formed by the inlet cone *l*, the flaring discharge cone *l′*, and the adjustable gate *l″*, the heated air from pre-heater K will rush through the contracted passage-way and atomize the water which is supplied thereto by the inlet ducts or tubes *n″* projecting up from the tank M². The current of heated air carries the water into the flash-boiler C where it is instantly converted into highly heated steam, the commingled hot air and steam being passed thence down through the pipes C²; through the re-heater D and thence into the ash pit and fuel chamber. Constantly maintained proportions of air and steam are thus supplied continuously to the body of fuel, where gasification takes place. The production of gas, therefore, is made substantially uniform and of constant thermal value, notwithstanding any variations in the load. In case an increased load is suddenly put upon the gas engine and the demand for gas suddenly increased, the resulting vacuum will be instantly communicated through the fuel chamber and the discharge cone or nozzle *l′* and thence through the pipe connections O and *n′* to the interior of the vacuum bell M′. This will result in the feed water rising higher in the bell and thus supplying a larger quantity of water through the ports *o*, pipe *n′* and pipe N to the lower water tank M². A larger volume of air will also be drawn through the pre-heater and the contracted passage-way in the attenuator L. The increased water supply through ducts *n″* will be finely atomixed by the increased air supply and the commingled hot air and vapor will be passed through the flash boiler C, re-heater D and thence into the fuel chamber, thereby generating an increased volume of gas of uniform thermal valve. The regulating gate *l″* will be adjusted either up or down to regulate the velocity of air admitted through the attenuator and supplied to the fuel chamber, thus increasing or decreasing the relative vacuum in the flaring discharge cone *l′*, and thereby increasing or decreasing in direct proportions the vacuum in the vacuum bell M′. This adjustment serves to increase or decrease the volume of water vapor admitted to the producer in proportion to the amount of air passing and serves to increase or decrease the quality of gas desired; or to supply the requisite amount of water vapor to successfully gasify variable qualities of fuel.

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

1. A gas producer furnace, having an annular gas flue in the upper part of its wall, communicating on one side with the fuel chamber, an annular flash-boiler or super-heater chamber, supported by the wall of the producer furnace and superimposed above the annular gas flue, and projecting inwardly over the fuel chamber and having poke-holes opening downward into the fuel chamber, a fuel hopper projecting down into the fuel chamber and provided with a flange resting on the flash boiler, a gas outlet pipe connecting with the flue, a contracted air inlet having an adjustable valve and water spraying device connecting with the flash boiler, and a steam outlet pipe connecting with said boiler at its bottom plate and communicating below with the ash pit, substantially as described.

2. The combination with a gas producer, having at the top an annular gas take-off flue of a flash-boiler or super-heater chamber, superimposed above said flue, a gas outlet and down take pipe, a pre-heater shell inclosing said pipe and having air inlets at its lower end, a contracted pipe for delivering hot air leading from the pre-heater to the super-heater chamber in the producer, a regulating gate-valve in the contracted portion of said pipe and means in said contracted pipe connection for inducing a spray or vapor of water, substantially as described.

3. The combination with a gas-producer and heater-chamber therein, of an air supply pipe having an inlet cone and a connecting flaring discharge cone or nozzle, water inlet ducts opening near the junction of said cones, and an adjustable regulating gate at or near the junction of the cones, substantially as described.

4. The combination with a gas-producer and a heater-chamber communicating with the fuel chamber, of an air supply or delivery pipe having a contracted opening, water inlet ducts connecting therewith, a regulating gate, an elevated water-feed tank having a pipe connection to said ducts and provided with a vacuum bell and a pipe connecting

the contracted air delivery pipe with the interior of said bell, substantially as described.

5. The combination with a gas-producer and heater-chamber therein, of an air supply or delivery pipe having an inlet cone or nozzle and a connecting flaring discharge cone or nozzle, forming a contracted opening, water inlet ducts discharging at or near said opening, an elevated water-feed tank connecting with said ducts, and means for regulating the air supply, substantially as described.

6. The combination with a gas-producer and heater-chamber therein, of an air supply or delivery pipe connecting therewith and having an inlet cone and a connecting discharge cone or nozzle forming a contracted opening, a water chamber or tank below the same, and having ducts therefrom to the discharge cone, an elevated water tank having a feed pipe and an overflow pipe, a vacuum bell, a pipe connection from the interior of said bell to the lower watertank, and a pipe connection from the discharge cone to the interior of the bell, substantially as described.

7. The combination with a gas-producer, of an air supply or delivery pipe having a contracted opening and provided with water inlet ducts arranged to discharge at said contracted opening, an elevated water-feed tank constructed with an inlet compartment and an outlet compartment and an interior tubular projection, a feed pipe and an overflow pipe connecting respectively with said compartments, a vacuum bell over said tubular projection and a pipe leading from the lower end of said projection to said inlet ducts, and a pipe connection from the air delivery pipe in front of the ducts to the interior of the vacuum bell, substantially as described.

8. The combination with a gas producer, of a flash-boiler having a central opening and an interior upwardly projecting flange at said opening, a series of brackets secured to the producer shell for supporting said flash boiler, a wrought iron cover-plate secured to the upper edge of the shell and extending over the interior flange of the superheater, a fuel-feed-hopper having a downwardly projecting discharge spout provided with flanges resting on the cover plate above the super-heater flange, substantially as described.

9. In a suction gas producer mechanism, a gas producer having a contracted inlet for aeriform fluids provided with an adjustable valve at the contracted portion, a gas take-off pipe, a scrubber mechanism, a gas engine, a stationary gas reservoir tank located near the engine, substantially as described.

10. In a suction gas producer mechanism, a gas producer, a hot gas take-off flue, a flash-boiler or super-heater inserted therein, a contracted air inlet pipe having a regulating valve and connecting with said superheater, means therein for inducing a spray of water, a scrubber mechanism connecting with the gas take-off pipe, a gas engine, a gas reservoir tank located near the gas engine, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CONSTANTINE LEE STRAUB.

Witnesses:
HAWLEY PETTIBONE,
H. A. KIMBER.