No. 767,217. PATENTED AUG. 9, 1904.

J. H. EUSTACE.

GAS GENERATOR.

APPLICATION FILED FEB. 23, 1904.

NO MODEL. 4 SHEETS—SHEET 1.

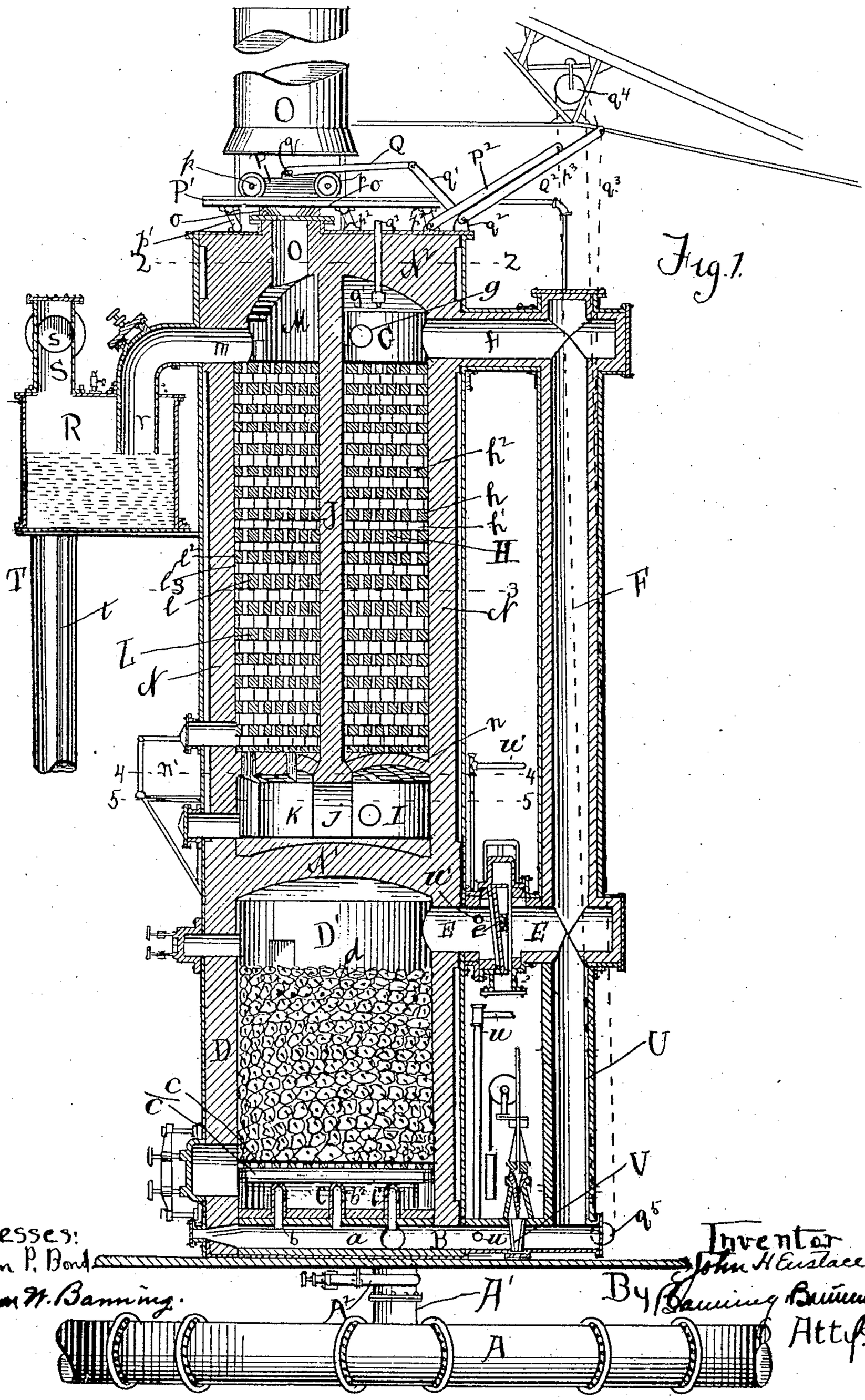

Fig. 1.

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NO MODEL. 4 SHEETS—SHEET 2.

Fig. 2

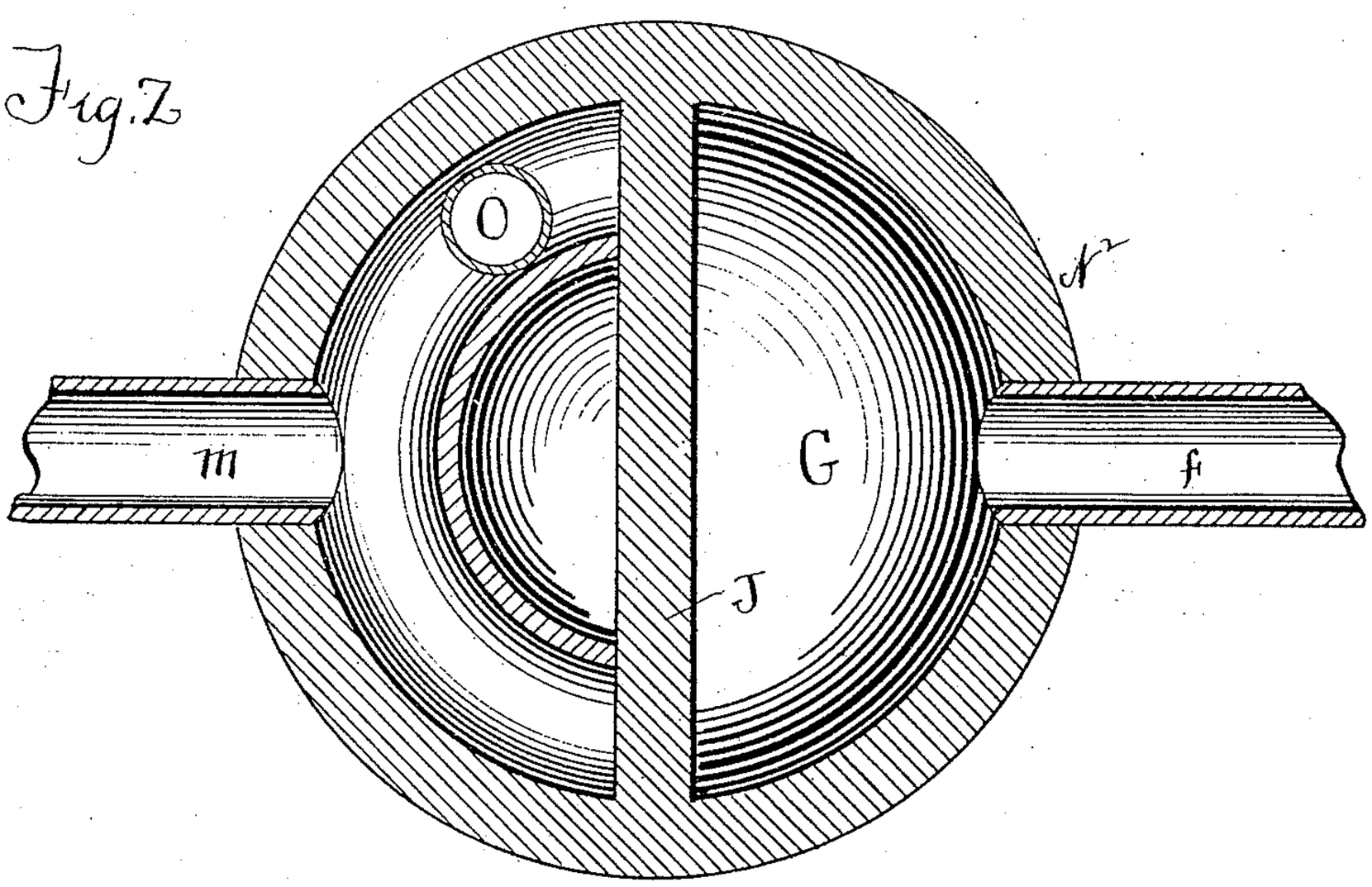
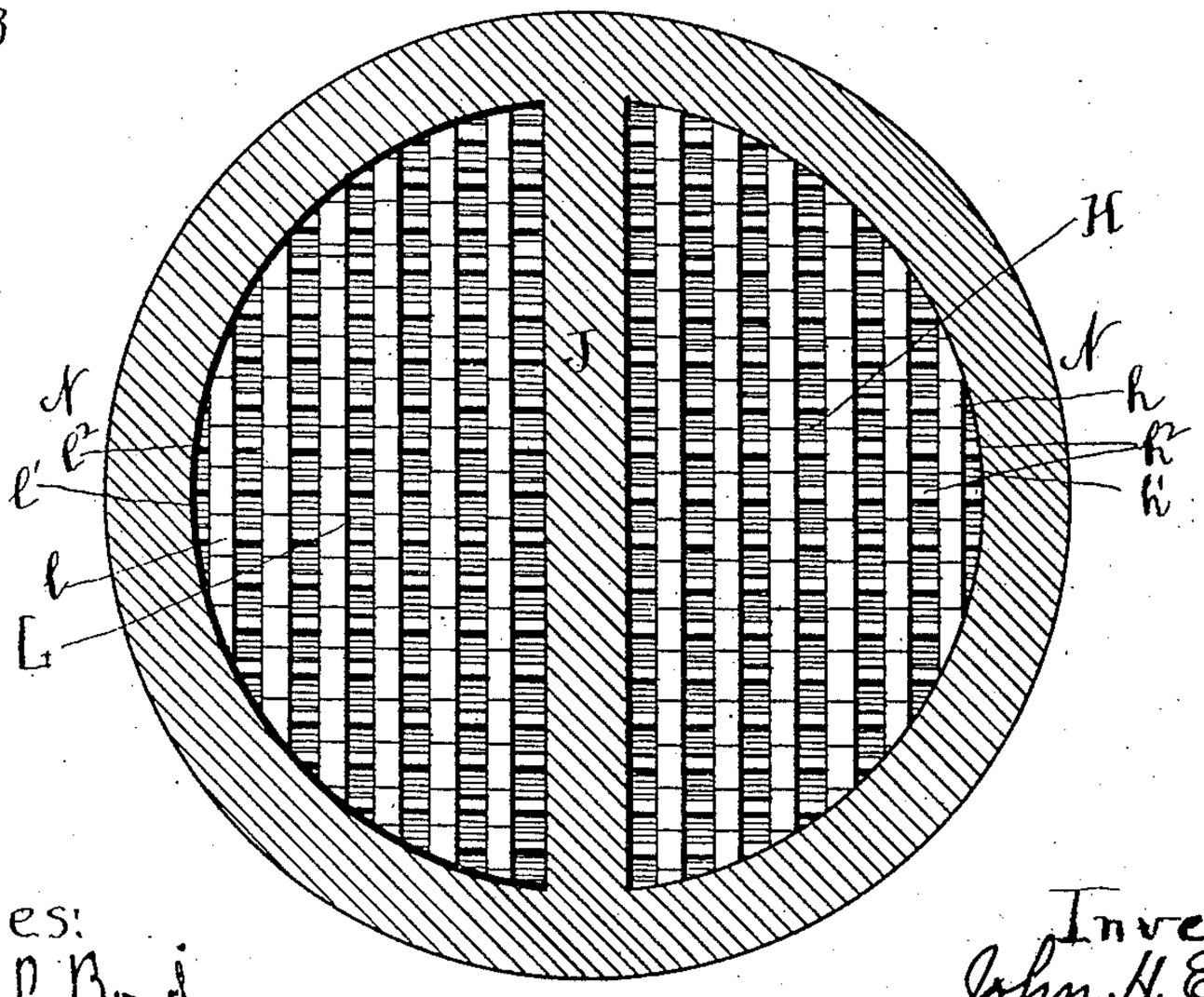


Fig. 3



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NO MODEL. 4 SHEETS—SHEET 3.

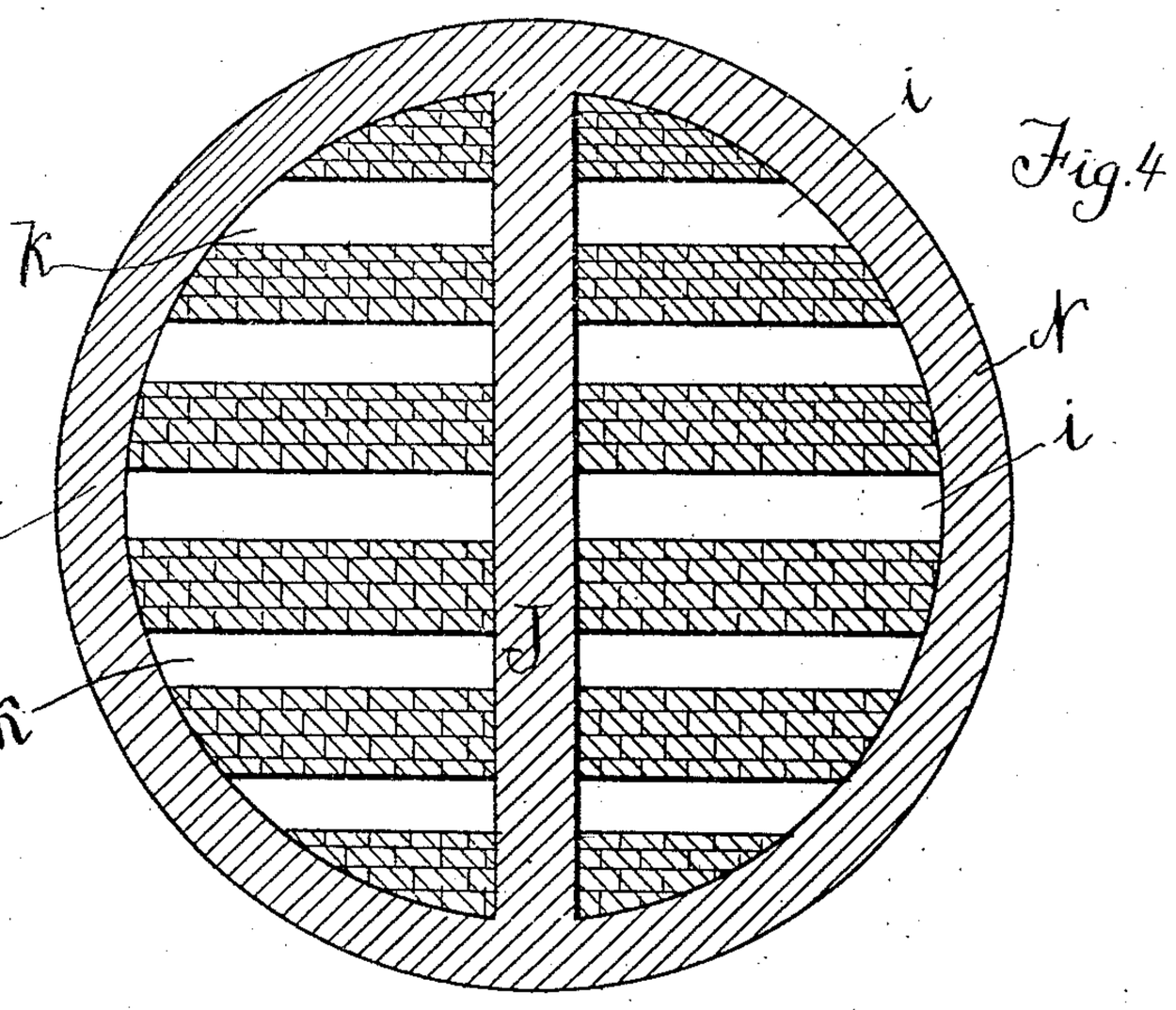

Fig. 4

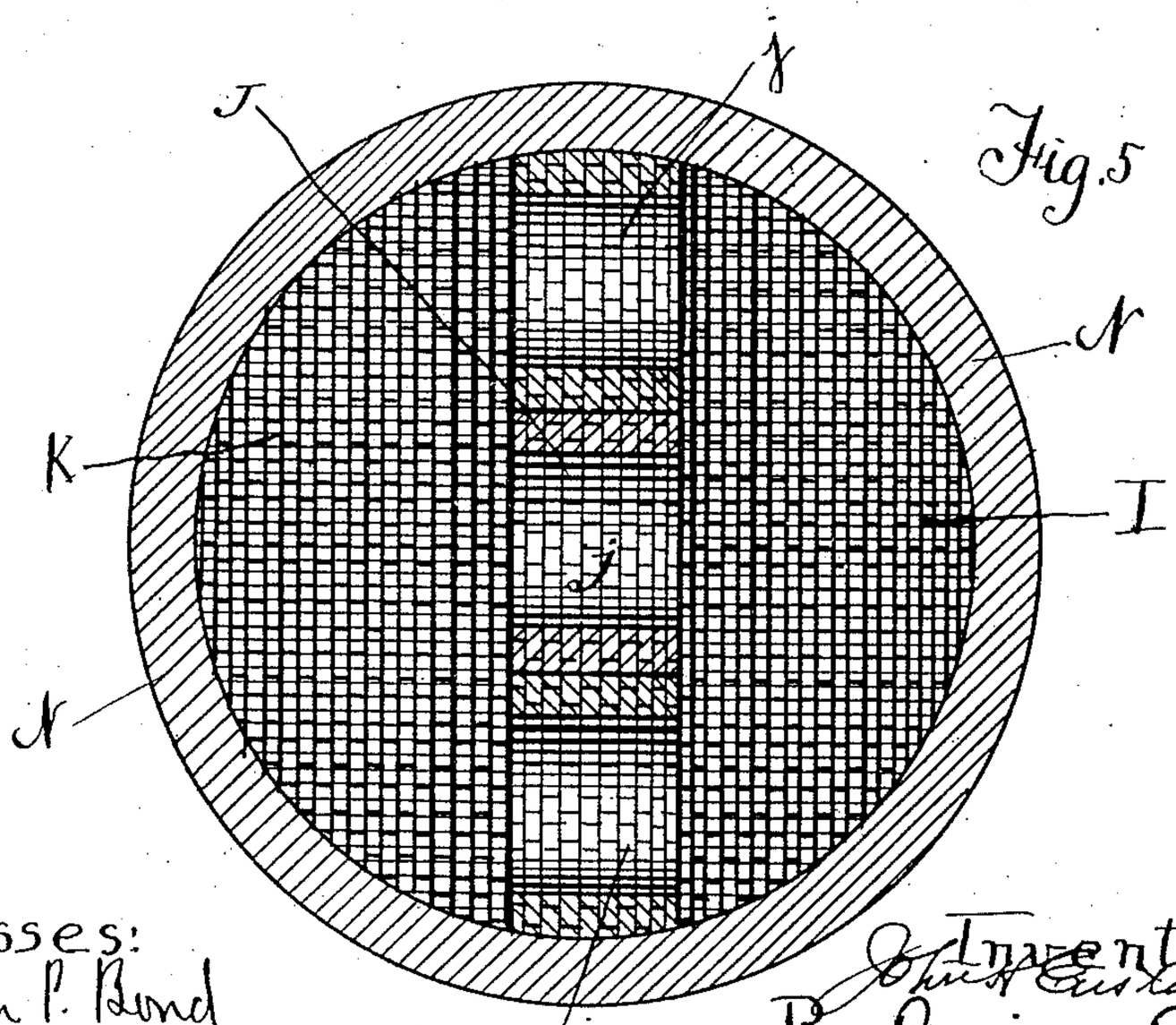

Fig. 5

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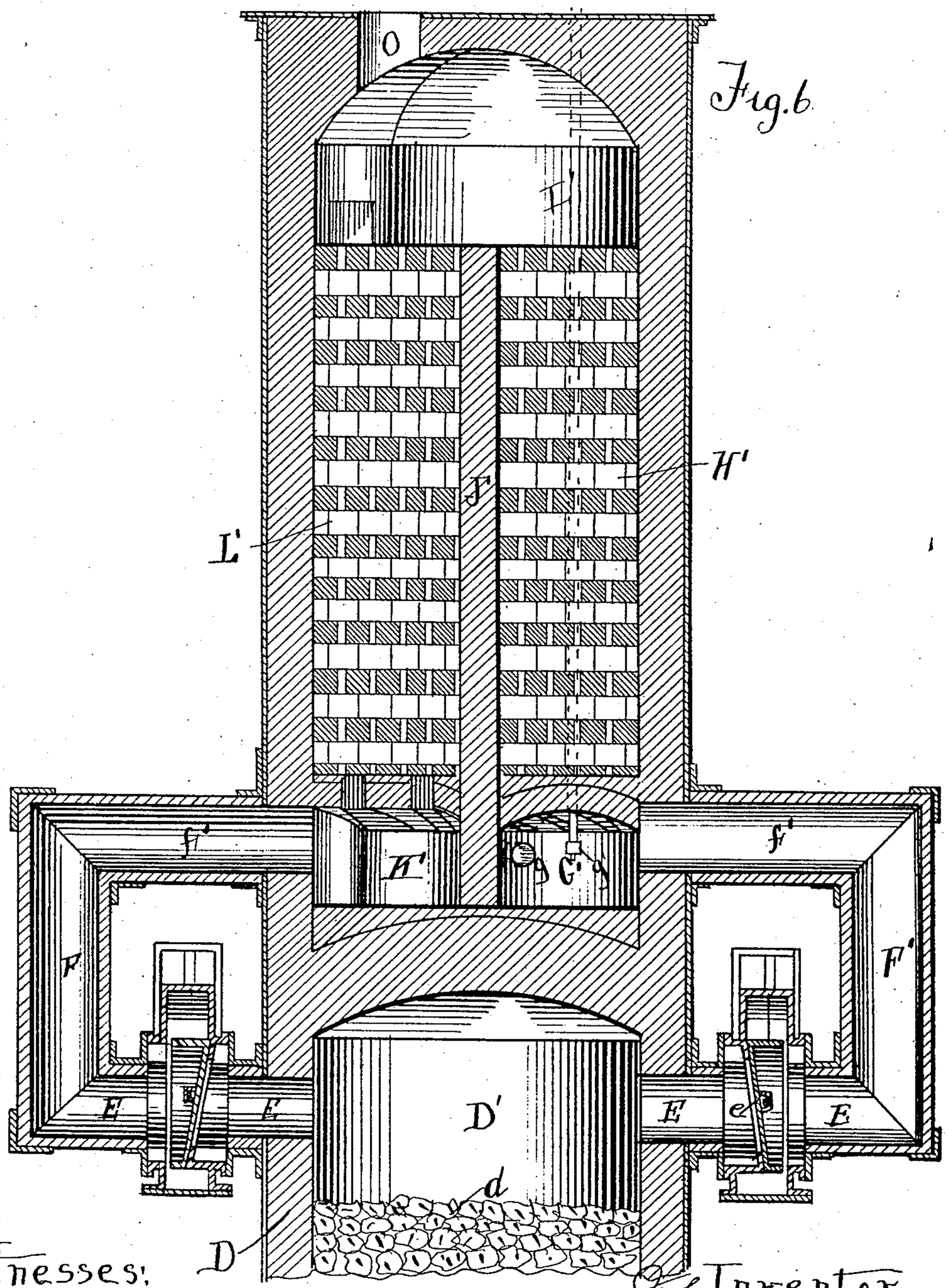
NO MODEL. 4 SHEETS—SHEET 4.

Fig. 6



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No. 767,217. Patented August 9, 1904.

UNITED STATES PATENT OFFICE.

JOHN H. EUSTACE, OF CHICAGO, ILLINOIS, ASSIGNOR TO JOHN WILLIAMSON, OF CHICAGO, ILLINOIS.

GAS-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 767,217, dated August 9, 1904.

Application filed February 23, 1904. Serial No. 194,783. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. EUSTACE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Gas Machines or Generators, of which the following is a specification.

The invention relates to gas machines or apparatus more especially designed for use in the manufacture of what is known or termed "water-gas," and has for its objects to simplify the construction and arrangement of the furnace, the carbureter, and the superheater in their relation one to the other to improve the construction and operation of the carbureter so as to effect a thoroughly commingling and uniting of the vapors in their passage through the carbureter; to insure a more positive and reliable transmission of heat between the furnace and the carbureter, and thereby render the operation of the carbureter more effective; to render the operation of the superheater in fixing the gas more positive and reliable; to improve the relative positions of the carbureter and superheater, so as to transmit the hydrocarbon vapor produced in the carbureter directly into the superheater for making the fixed gas; to give a greater length of travel of the hydrocarbon vapor in its passage through the carbureter and a longer distance of travel for the vapor through the superheater in fixing the gas, and to improve generally the construction, arrangement, and operation of the furnace, the carbureter, and the superheater constituting the machine or apparatus as a whole.

The invention consists in features of construction and combinations of parts hereinafter described and claimed.

In the drawings, Figure 1 is a sectional elevation showing the preferred form of furnace, carbureter, and superheater for the machine or apparatus of the invention; Fig. 2, a cross-section on line 2 of Fig. 1 looking in the direction of the arrow; Fig. 3, a cross-section on line 3 of Fig. 1 looking in the direction of the arrow, but not showing the parts below the carbureter and the superheater; Fig. 4, a cross-section on line 4 of Fig. 1 looking in the direction of the arrow, the parts below the line not being shown; Fig. 5, a cross-section on line 5 of Fig. 1 looking in the direction of the arrow, showing only the chamber below the carbureter and the chamber below the superheater, the parts below the chambers being not shown; and Fig. 6, a sectional elevation showing a modified construction and arrangement of the furnace, the carbureter, and the superheater, the lower part of the furnace not being shown.

The gas machine or apparatus of the invention, as shown in Fig. 1, has a pipe A, leading from a suitable source of air under pressure, and entered into this pipe is a pipe A,′ having interposed therein a shut-off valve A^2, which may be an ordinary gate or other form of valve, and this pipe A′ opens into a pipe or header B, so that air under pressure can be forced into the pipe B for supplying the required amount of air for combustion in the furnace. Leading from the pipe B and in communication therewith in the construction shown is a series of hollow walls or partitions *b*, each having a passage *b*′, leading out from which through each side of the wall or partition is a series of slots or openings b^2 for projecting jets of air into the ash box or chamber below the grate of the furnace. The ash box or chamber C has located therein at its upper end a grate which, as shown, consists of bars *c*, resting on the partitions or walls, and cross-bars *c*′, on which grate the fire rests and through which air and steam can pass.

The ash box or chamber C and the grate are surrounded by a wall D, of fire-brick or other material that will stand a high degree of heat, and above the grate within the inclosing wall D is the fire-pot D′ for the reception of the fuel *d*, which may be coke or coal that can be brought to a white or very high degree of heat. The fire-pot or combustion-chamber D′ has leading therefrom on one side an outlet-pipe E, interposed in which is a controlling-valve *e*, which may be of the form shown, having an inclined plate and a peripheral rim with a seating-face on the solid plate to coact with a seat-

ing-face around the pipe, and this valve is located and operated within a shell or casing in any usual and well-known manner.

A pipe F, having communication at its lower end with the pipe E, extends upwardly and has a branch pipe *f* leading into the mixing-chamber of the carbureter, which chamber in the construction shown has a port or opening *g* for projecting air under pressure into the mixing-chamber and also has a discharge-nozzle *g'* within the mixing-chamber, which nozzle is attached to a pipe g^2, leading to a suitable source of oil-supply. (Not shown.) The mixing-chamber for the hydrocarbon oil and the steam opens at its lower end into the carbureting-chamber or carbureter H, which chamber is filled with fire-brick or other suitable material that can be brought to a white or incandescent heat without injury, and the bricks are set alternately crosswise of each other, so as to have a row of bricks *h* and a row of bricks *h'* arranged lengthwise of each other in opposite directions and so as to leave spaces h^2 between the bricks, through which spaces the hydrocarbon vapor is caused to descend and be subjected to the high degree of heat in the carbureter H, derived from the bricks or other material, for the heat to thoroughly bring together, commingle, and unite the vapors of the hydrocarbon and the steam to form the water-gas. The carbureter or carbureting-chamber H has communication at its lower end through openings or passages *i* with a receiving-chamber I, into which the mixture of vapors descends.

The carbureting-chamber or carbureter H is separated from the superheating-chamber or superheater by a wall J, made of fire-brick or other material that will withstand a high degree of heat, which wall extends to the top of the mixing-chamber G and to the bottom of the receiving-chamber I of the carbureter. The wall J at its lower end has passages or openings *j*, which furnish communication between the receiving-chamber I and a receiving-chamber K, so that the carbureted vapors will pass from the chamber I into the chamber K, and the chamber K has communication, by passages or openings *k*, with the superheating-chamber or superheater L, which is located on the opposite side of the wall J to the carbureter or carbureting-chamber H, as shown in Figs. 1 and 3. The superheater or superheating-chamber L is filled with brick in the same manner as the carbureter or carbureting-chamber, for the bricks to have a row of bricks *l*, a row of bricks *l'* arranged lengthwise in opposite direction, so as to leave spaces l^2 between them, through which spaces the carbureted vapors are free to ascend and in their ascent become superheated and changed into a fixed gas. The bricks or other material in the superheater or superheating-chamber must be of a nature so that they can be brought to an incandescent or white heat without injurious effects and so that the high degree of heat will change the vapors into a fixed gas as they leave the carbureter or carbureting-chamber. The fixed gas discharges from the top of the carbureter or carbureting-chamber L into a discharging-chamber M, from which an outlet *m* leads for delivering the gas to the tank containing water, as usual.

The carbureter and superheater are surrounded by a wall N, which, as shown, is a continuation of the wall D of the furnace or is arranged in the vertical plane, or approximately so, of the furnace-wall, and this wall N is separated from the wall of the furnace by an arch-wall N', which forms a top wall of the combustion-chamber or fire-pot of the furnace. A cross-wall *n* above the cross-wall N' forms the arch for the chambers I and K, the cross-wall *n* extending from the wall N to the division-wall K, as shown in Fig. 1, and at the upper end the wall N has a cross-wall N^2, forming the arch-wall of the chamber G and the chamber M, so that the furnace, the mixing-chamber, the carbureter, the superheater, the receiving-chambers, and the discharge-chamber are located one over the other, bringing the parts into a small compass and at the same time in such relation one to the other as that the generated heat of the furnace is carried direct into the carbureter and superheater without much if any loss in the transmission of the heat, and at the same time the heat of the furnace and the heat of the carbureter and superheater is concentrated and transmitted one to the other, so as to increase the heating qualities of the machine or apparatus as a whole.

A draft-opening O leads from the chamber M and is surmounted by a cap *o*, having a seating edge. The draft-opening O is closed by a solid cap P, mounted on wheels *p*, which rest on a track P', supported by swinging links *p'*, the links at the lower ends being mounted in pivot-plates p^2 on the top binding-plate of the wall N^2 of the apparatus. The closing cap or cover P is raised and lowered by means of a lever P^2, actuated by a chain p^3, which lever is connected to the shaft or pivot of one of the links, so that by moving the lever downward the rails and the cap or cover will be elevated and by moving the lever upward the rails and the cap or cover will be lowered. The cap or cover is moved out of line with the escape opening or flue O for the products of combustion, so that the products can pass into the chimney or stack O' by means of a draw-bar Q, pivoted to ears *q* on the cap or cover and connected by a link *q'* with a rock-shaft mounted in ears q^2 and having connected therewith a lever Q^2, moved by a chain or cable q^3, which runs over a pulley q^4 and under a pulley q^5, as does also the chain or cable p^3 in the arrangement shown.

The construction and arrangement of the controlling-valve *e* constitutes no part of the

present invention, as it will form the subject-matter of a companion application by me, and this is also true of the cap or cover P and its supporting-track and operating-levers, which will form the subject-matter of a companion application by me, and the valve and cap or cover are merely shown in this application for the purpose of illustrating a controlling-valve and a means for raising and lowering the cap or cover.

The fixed gas from the chamber M passes through the opening or port *m* into a pipe *r*, the lower end of which extends into water in a receptacle R, as usual, and from the receptacle R after the gas has been projected into and escaped from the water the gas flows into a pipe S and passes therefrom to an opening *s* into a pipe T, leading to a purifier or other treating apparatus for purifying the gas, and, as shown, adjacent to the pipe T is a water-pipe *t*, entered into the water-receptacle for supplying water thereto. The construction shown in Fig. 1 has a pipe U connecting the outlet-pipe E with the cross-pipe or header B, and, as shown, the cross-pipe or header B has entered thereinto a steam-pipe *u*, and the outlet-pipe E forward of the valve *e* has entered thereinto a steam-pipe *u'*, as shown in Fig. 1. The cross-pipe or header H has therein a controlling-valve V, as usual, and as to the parts shown in Fig. 1 and not herein specifically described such parts are common to gas-making machines or apparatus and need not, therefore, be described, as the invention relates particularly to the construction and arrangement of the heating-furnace, the carbureter, and the superheater and the connection between these three appliances.

The operation is essentially the same as the operation of other machines or apparatus for making water-gas, but briefly is as follows: The furnace has the fire-pot or combustion-chamber D' thereof filled with coke or coal or other suitable fuel that can be brought to a high heat. Air under pressure is admitted into the cross-pipe or header B from the pipe A, and this air under pressure flows into the chamber C through the perforations or slits b^2 and passes up in streams into the ignited fuel *d*, creating and maintaining combustion in the fire-pot or chamber D'. The heat units and products of combustion pass through the outlet E, for which purpose the controlling-valve *e* is opened, and the heat units and products of combustion flow through the pipe F and inlet *f* into the mixing-chamber G, where, if necessary, a fresh supply of air can be admitted to commingle with the heat units and products of combustion to create further combustion in connection with a supply of oil projected into the mixing-chamber from the nozzle *g'*, and the heat units and products of combustion from the mixing-chamber G pass downwardly in the superheater or carbureter or carbureting-chamber H, bringing the bricks or other material in such chamber to a white or high degree of heat. The heat units and products of combustion enter the receiving-chamber I and pass through the opening *j* into the chamber K and thence ascend through the brick or other material in the superheater or superheating-chamber L to enter the chamber M and escape through the flue or outlet O into the chimney or stack, the cap or cover P being raised and carried away from the outlet. This heating process is continued until the heat in the furnace is brought to a white or high degree of heat and the bricks or other material in the carbureter and the superheater are also brought to a high degree of heat, and when this point is reached the supply of air is shut off from the fire-pot or combustion-chamber and steam from a suitable source of supply is admitted into the cross-pipe or header B to flow through the passages or slots b^2 into the chamber C and enter and pass upwardly through the highly-heated fuel in the fire-pot or combustion-chamber. The steam in its progress through the fuel is separated into its component parts, and these parts flow out through the pipe E and pipe F and inlet *f* into the mixing-chamber M, where they are brought into contact with and commingle with the oil projected into the chamber from the nozzle or discharge-head *g'*, creating a hydrocarbon vapor, which vapor descends through the interstices or openings h^2 of the highly-heated brick or other material and coming in contact with the brick is still further vaporized and its nature changed into an inflammable gaseous vapor, which flows into the receiving-chamber I and passes therefrom through the openings *j* into the receiving-chamber K, from which chamber the inflammable gaseous vapor flows upwardly through the interstices or openings l^2 of the highly-heated brick or other material in the superheater and is changed into a fixed gas which enters the chamber M, and as the cap or cover of the outlet or escape flue O has been closed with the shutting off of the air-supply and the admission of steam the fixed gas flows out through the opening *m* and pipe *r* into the water-receptacle, as usual, and from the water-receptacle is transmitted to the apparatus used for purifying and completing the gas. The admission of steam at the bottom in time dulls the fire in the fire-pot or combustion-chamber D', and when the fire becomes dull the valve *e* is closed and the valve V opened and steam is admitted at *u'* to flow downward through the fuel in the fire-pot or combustion-chamber and enter the cross-pipe or header B and flow upward through the pipe U into the pipe F and thence into the mixing-chamber to be commingled with the oil and make a hydrocarbon vapor, which passes down through the carbureter and up through the superheater, as just described.

The gas-generator or apparatus of the present invention is very compact and the arrangement is one which brings the furnace, the carbureter, and the superheater in close working relation, so that no waste of heat is lost between the furnace, the carbureter, and the superheater. The carbureter by reason of the interstices or openings between the bricks gives the hydrocarbon vapor produced in the mixing-chamber a sinuous or zigzag travel in small streams, by which the commingling of the elements is made thorough and effectual, with the result that when received into the chamber I the vapor is highly gaseous and thoroughly mixed as to its component parts. The carrying of the gaseous vapor from the carbureter up through the interstices or openings in the bricks of the superheater gives a sinuous or zigzag course of travel for the gas by which it is subjected to the heat of the furnace and made into a fixed gas, and during its passage upward through the header the component parts of the gas are thoroughly completed as to their admixture, thus insuring the changing of the vapor into a gas and eliminating such parts thereof as are undesirable which were not eliminated by the passage of the vapor downwardly through the carbureter. The passage of the heat units and the products of combustion is approximately in a direct line upwardly from the combustion-chamber or fire-pot of the furnace and in a direct line downwardly through the carbureter and in a direct line upward through the superheater, the heat in the carbureter and superheater being broken up and transmitted to the bricks by reason of the zigzag passage given thereto from the interstices or openings between the bricks, thus insuring the bringing of the bricks or other material in the carbureter and in the superheater to a high degree of heat which is uniform from top to bottom and crosswise. The heat being, in effect, confined in a single structure for the furnace, the carbureter, and the superheater is more direct in its application and more intense than where these appliances are separated and distinct and removed out of unitary relation one with the other, and the heat is thus transmitted more quickly and is maintained for a longer period of time, giving an increased output of fixed gas during a given period of time, thus increasing the capacity of the generator or apparatus in making gas.

The arrangement shown in Fig. 6 utilizes the juxtarelation of the furnace, the carbureter, and the superheater; but instead of causing the heat to enter the mixing-chamber at the top of the carbureter the heat units and products of combustion are carried from the fire-pot or combustion-chamber D′ through outlet-pipes E on each side, each outlet-pipe being controlled by a valve *e*, as in the construction of Fig. 1. The outlet-pipe E in the construction of Fig. 6 is connected with a pipe F′, from which an inlet-pipe *f*′ leads into a chamber G′ on one side and a chamber K′ on the opposite side, the two chambers being separated one from the other by a vertical wall J. The chamber G′ is the mixing-chamber for the oil and the component parts of the steam, and above this chamber G′ is the carbureter or carbureting-chamber H′, which opens into a receiving-chamber I′ common to the carbureter or carbureting-chamber H′ and the superheater or superheating-chamber L′, which at its lower end is in communication with the chamber K′, and from the chamber K′ the fixed gas is carried off to a water-receptacle, (not shown,) as in the construction of Fig. 1.

The operation of the generator or apparatus of Fig. 6 is substantially the same as the operation of the generator or apparatus of Fig. 1, differing, however, in that the carbureter H′ is heated from the chamber G′ and the superheater L′ is heated from the chamber K′, the heat passing upwardly through the carbureter and superheater into the chamber I′ and escaping at the outlet O, which is to be closed by a cap, as in the construction of Fig. 1. After the fuel in the fire-pot or combustion-chamber D′ has been brought to the heat required and the bricks in the carbureter and superheater have been raised to a white or incandescent heat the valve *e*, which controls the pipe F′ leading to the chamber K′, is closed and the steam is then admitted to the combustion-chamber or fire-pot D′ to pass up through the fuel D and be changed into its component parts, which parts enter the chamber G′, which then becomes a mixing-chamber for the oil and the elements of the steam, the oil being admitted through a nozzle or head *g*′, as in the arrangement of the apparatus of Fig. 1. The hydrocarbon vapor passes up between the interstices or openings of the brick in the carbureter H′ and enters the chamber I′, from which chamber it flows downwardly through the superheater, passing between the bricks in the superheater, where it is changed into a fixed gas, which enters the chamber K′, from which the gas is withdrawn to the water-receptacle.

The operation of the carbureter and superheater and the furnace are essentially the same for the constructions of Figs. 1 and 6, the difference being that in the construction of the apparatus of Fig. 1 the mixture of the oil and the separated elements of the steam is at the top of the carbureter and descends through the carbureter and ascends through the superheater, while in the construction of Fig. 6 the mixture of the oil and separated elements of the steam is at the bottom and the vapor passes upwardly through the carbureter and descends through the superheater; but in both constructions the vapor is given a separation and travel in both the carbureter and superheater by which the admixture of the

elements entering into the fixed gas is thoroughly and effectually completed.

What I regard as new, and desire to secure by Letters Patent, is—

1. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a carbureter in communication with the furnace and located on top of and in a vertical plane at one side of the central line of the furnace, and a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, the carbureter and superheater having open communication at one end and closed against communication with each other at the other end, and each having therein openings forming a plurality of passages from the top to the bottom of each, and the carbureter at its end closed against the superheater having a chamber into which the superheated steam from the furnace passes and into which a supply of carbonaceous oil is injected for the steam and oil to combine in their passage through the carbureter and form hydrocarbon gas, and the superheater at the end in communication with the carbureter receiving thereinto the hydrocarbon gas for making a fixed gas in its passage through the superheater, substantially as described.

2. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a carbureter in communication with the furnace and located on top of and in a vertical plane at one side of the central line of the furnace, and a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, the carbureter and superheater having open communication at one end and closed against communication with each other at the other end and each having therein crossing and spaced-apart bricks leaving spaces, the spaces forming passages extending from the top to the bottom of both the carbureter and the superheater, and the carbureter at its end closed against the superheater having a chamber into which the superheated steam from the furnace passes and into which a supply of carbonaceous oil is injected for the steam and oil to combine in their passage through the carbureter and form hydrocarbon gas, and the superheater at the end in communication with the carbureter receiving thereinto the hydrocarbon gas for making a fixed gas in its passage through the superheater, substantially as described.

3. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a mixing-chamber in communication with the furnace and receiving thereinto superheated steam and carbonaceous oil, a carbureter in communication with the mixing-chamber and located on top of and in a vertical plane at one side of the central line of the furnace, and a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, the carbureter and superheater having open communication at one end and closed against communication with each other at the other end, the carbureter and superheater having therein crossing and spaced-apart bricks forming passages from the top to the bottom of each, and the carbureter having at its end closed against the superheater the mixing-chamber for the superheated steam and oil for the steam and oil to combine in their passage through the carbureter and form hydrocarbon gas, and the superheater at the end in communication with the carbureter receiving thereinto the hydrocarbon gas for making a fixed gas in its passage through the superheater, substantially as described.

4. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a mixing-chamber in communication with the furnace and receiving thereinto superheated steam and carbonaceous oil, a carbureter in communication with the mixing-chamber and located on top of and in a vertical plane at one side of the central line of the furnace, and a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, the carbureter and superheater having open communication at one end and closed against communication with each other at the other end, the carbureter and superheater having therein crossing and spaced-apart bricks forming passages from the top to the bottom of each, a receiving-chamber for the carbureter at the opposite end thereof to the mixing-chamber, a receiving-chamber in communication with the superheater and with the receiving-chamber of the carbureter, and a discharge-chamber in communication with the superheater, substantially as described.

5. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a valve-controlled outlet-pipe leading from the furnace, a mixing-chamber into which the valve-controlled outlet-pipe leads and into which a supply-pipe for carbonaceous oil leads, a carbureter in communication with the mixing-chamber and located on top of and in a vertical plane at one side of the central line of the furnace, a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, a vertical wall separating the carbureter and the superheater and closing communication at one end between the carbureter and superheater and allowing communication at the other end thereof, a receiving-chamber on one side of the dividing-wall and in communication with

the carbureter at the opposite end to the mixing-chamber, a receiving-chamber on the opposite side of the dividing-wall in communication with the superheater and the receiving-chamber of the carbureter, and a delivery-chamber in communication with the superheater, substantially as described.

6. In a gas-generator, the combination of a furnace for heating fuel and superheating steam, a valve-controlled outlet-pipe leading from the furnace, a mixing-chamber into which the valve-controlled outlet-pipe leads and into which a supply-pipe for carbonaceous oil leads, a carbureter in communication with the mixing-chamber and located on top of and in a vertical plane at one side of the central line of the furnace, a superheater located in juxtarelation to and by the side of the carbureter and on top of and in a vertical plane at one side of the central line of the furnace, the carbureter and the superheater each having therein crossing and spaced-apart bricks forming passages from the top to the bottom of both the carbureter and superheater, a vertical wall separating the carbureter and the superheater and closing communication at one end between the carbureter and superheater and allowing communication at the other end thereof, a receiving-chamber on one side of the dividing-wall and in communication with the carbureter at the opposite end to the mixing-chamber, a receiving-chamber on the opposite side of the dividing-wall in communication with the superheater and the receiving-chamber of the carbureter, and a delivery-chamber in communication with the superheater, substantially as described.

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