(No Model.) 3 Sheets—Sheet 1.

J. HARLEMAN.

FURNACE FOR PRODUCING FUEL GAS.

No. 516,351. Patented Mar. 13, 1894.

Fig. 1.

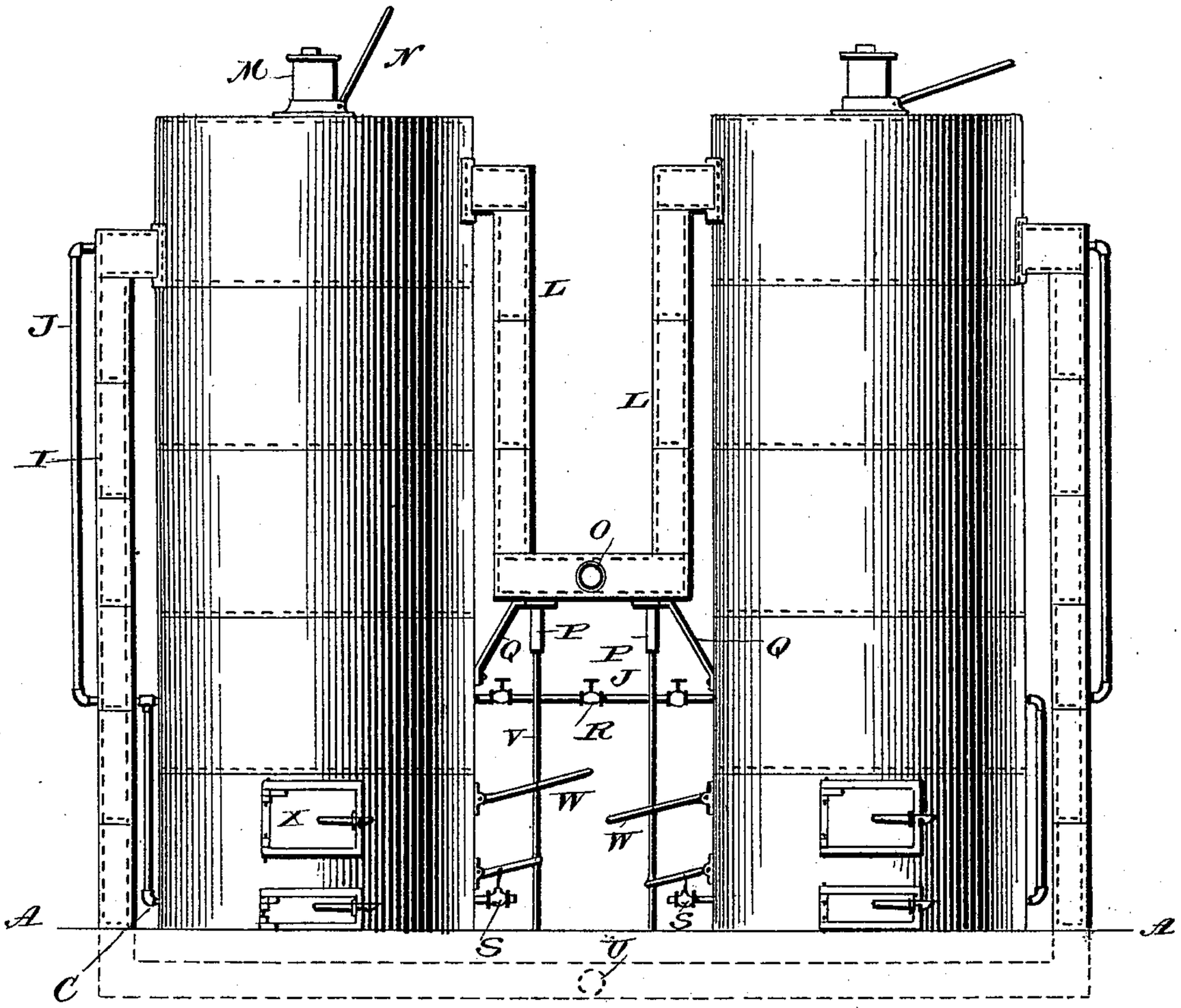

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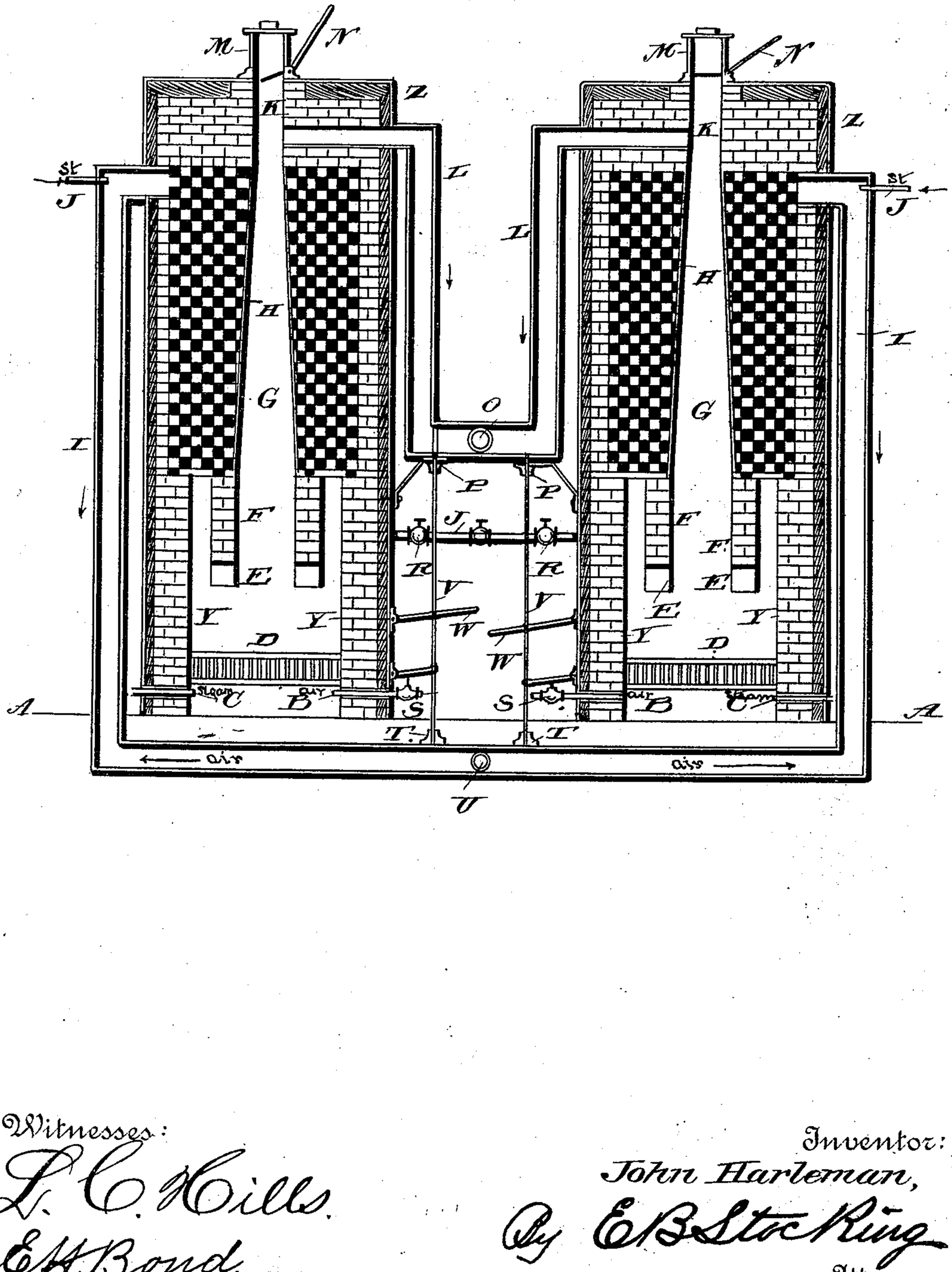
Fig. 2.



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No Model.)

3 Sheets—Sheet 3.

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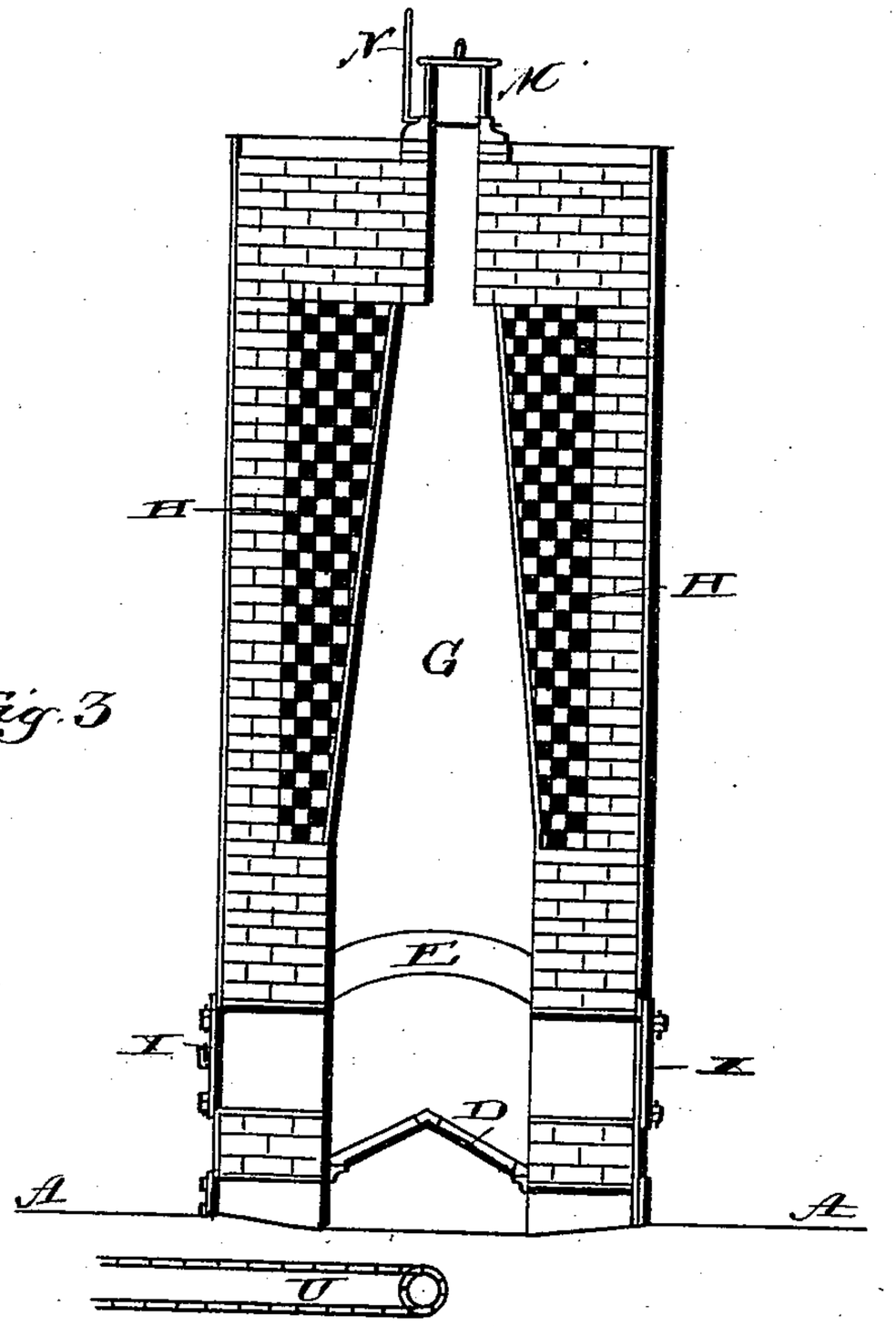
Fig. 3



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UNITED STATES PATENT OFFICE.

JOHN HARLEMAN, OF ST. GEORGE, NEAR ST. JOSEPH, MISSOURI, ASSIGNOR OF FIVE-EIGHTHS TO EDWIN H. COLLINS, STEPHEN J. COLLINS, AND FRANK COLLINS, OF ROCK ISLAND, ILLINOIS.

FURNACE FOR PRODUCING FUEL-GAS.

SPECIFICATION forming part of Letters Patent No. 516,351, dated March 13, 1894.

Application filed September 1, 1893. Serial No. 484,581. (No model.)

To all whom it may concern:

Be it known that I, JOHN HARLEMAN, a citizen of the United States, residing at St. George, near the city of St. Joseph, in the county of Buchanan and State of Missouri, have invented a new and useful furnace for producing fuel-gas from coal for burning brick, heating boilers, smelting ore, and all other purposes for which fuel-gas may be used, of which the following is a specification.

Heretofore, fuel gas has been produced for smelting ore, puddling furnaces, &c., by burning coal in an open draft furnace with water in the ash pit, or in a furnace without fire grates with steam and air admitted through the hearth or perforated chambers therein into the incandescent mass, in all cases the coal being charged in the fire box on top of the incandescent mass, and the heat, smoke and gases are carried by the draft of a stack from the fire box to the furnace or chamber where the combustion is to take place. And the gas is produced by subjecting the coal charged in the fire box on top of the incandescent mass to the action of the heat thereof with the product of the steam and air drawn through the same.

My invention is an air tight furnace for producing fuel gas by the process herein described, and heating air for combustion therewith, with pressure sufficient to drive the gas and hot air into an air tight kiln, fire box, furnace or other chamber for combustion, and consists of two air tight chambers, each having an ash pit, a fire grate above the ash pit, a cold air pipe and steam pipe connecting with the ash pit, a fire box above the fire grate, air tight doors in the ash pit and in the fire box, arches turned and jambs built thereon in the fire box, a hot air flue in the fire box on each side thereof between the jambs and the walls of the chamber, a retort setting on the jambs and reaching to the top of the chamber, the annular space around the retort filled with brick work built loosely to admit the free passage of hot air and steam and expose as much surface as possible to the same, a hot air pipe connecting said annular space with the main hot air pipe which connects with the kiln, fire box, furnace or other chamber for combustion of the gas, a steam pipe connecting with said annular space near the top, an opening from the top of the retort through the top of the chamber to the bottom of the feed top, a gas pipe connecting the retort through said opening with the main gas pipe which connects with the kiln, fire box, furnace or other chamber for combustion of the gas, a feed top setting over the opening leading from the top of the retort, all pipes provided with valves so that while one chamber is producing fuel gas the other is heating air for its combustion. The pressure afforded by the cold air blast in the chamber heating the air, and that afforded by the steam and the expansion of the product of the steam passed through the heated annular space around the retort and through the incandescent mass in the fire box, in the chamber producing fuel gas, no air being admitted to that chamber, being sufficient to drive the hot air and the fuel gas respectively through their proper pipes into an air tight chamber for combustion. By reversing the valves at intervals each chamber is made to produce fuel gas and heat air for its combustion alternately.

The process by which I produce fuel gas from coal in my newly invented furnace is as follows: I close the cold air pipe of the chamber, through which alone air can enter the chamber, charge the retort with coal and subject the mass of coal in the retort to the heat of the incandescent mass which fills the fire box except the hot air flues, and the product of the steam from the upper jet, superheated by passing through the heated brick work in the annular space around the retort and the hot air flues, passing through the incandescent mass between the arches and between the jambs, and the product of the steam from the jet in the ash pit passed through the incandescent mass in the fire box, and thus liberates all the gases from the coal which combine with the product of the steam passed through the incandescent mass in the fire box as aforesaid and form a fuel gas intensely heated which with hot air will ignite and burn in the open air or in any kiln, fire box

or furnace but which gives the best results when burned in an air tight chamber, which prevents the escape of any form of gas and utilizes all the heat.

The objects of my invention are to produce a fuel gas that may be adapted practically to all manufacturing purposes and which can be burned in an air tight chamber for combustion, and, to reduce to a minimum the cost of burning brick, operating steam plants, smelting furnaces and all other plants to which my invention may be adapted.

Figure 1 of the accompanying drawings is a detailed view in perspective of my new furnace, showing the two chambers, their respective pipes, valves and connections, and the front doors to each. Fig. 2, is a vertical section of my furnace on a line crossing the arches in the fire boxes of the chambers and the main pipes at right angles, showing the two chambers and their respective pipes, valves and connections. Fig. 3 is a vertical section of one chamber on a line parallel with the arches in the fire box and with the main pipes.

Similar letters refer to similar parts throughout the several figures.

The chambers are exact duplicates in size, form, materials, dimensions and location of the several parts, pipes, valves and connections, and in Fig. 2 of the drawings similar letters are used to designate similar parts of the respective chambers; hence a detailed description of one will answer for a detailed description of both chambers.

I prefer to construct my furnace with a space of about four feet between the chambers, and place the main hot air pipe about two feet under ground midway between the chambers, and the main gas pipe about five feet above the ground midway between the chambers as shown in Fig. 2. I first prepare a suitable foundation the upper surface of which forms the base line and the hearth A, and which may be on a level with the surface of the ground. On this foundation I build the walls Y, Y, circular in form; outside diameter eight feet. The inside of the chamber for six and one half feet above the hearth is four feet square and above that is circular five feet and two inches in diameter. The fire grate D, is placed with heel about six inches and center about eighteen inches above the hearth; the space between the hearth and the fire grate is the ash pit. A cold air pipe B, six inches in diameter and steam pipe C, one inch in diameter connects with the ash pit. Above the fire grate I turn two arches E, E, across the chamber in the fire box, these arches spring from the front and back walls of the chambers at a point four feet above the hearth. Below these arches I put in air tight iron doors X, X, in the front and back walls opening into the ash pit and the fire box affording access to each from the front and rear. Between each side wall and the arch next to it there is a space of six inches and between the arches there is a space of twenty four inches. On these arches I build jambs F, F. The tops of these jambs are level with the point where the form of the chamber is changed from square to circular. The space below the tops of these jambs and above the fire grate is the fire box, and the spaces between the jambs and the walls are hot air flues in the fire box. On the jambs and shoulders in the front and back walls of the chamber made by changing the interior form of the chamber from square to circular I set a retort G. The retort is ten feet high, four feet long and two feet wide at the bottom, two feet long and sixteen inches wide at the top, inside measurement. Its walls are two inches thick. I case the retort with one course of fire brick. The annular space around the retort I fill with checker work H, H, that is brick work built in loosely to admit the free passage of hot air and steam and expose to the same as much surface as possible. The checker work is supported by the jambs and shoulders in the walls and in turn supports the solid brick work which forms the top of the chamber. A hot air pipe I, connects this annular space with the main hot air pipe U. At the top of the checker work a steam pipe J, one inch in diameter connects with the annular space around the retort. A circular opening K, fourteen inches in diameter connects the top of the retort with the bottom of the feed top M. Through this opening the gas pipe L, connects the retort with the main gas pipe O. The iron feed top M, is placed on the chamber over the opening K, and has an iron dump bottom which is dumped by the lever N. The main gas pipe O, connects with the kiln or other chamber where the combustion of the gas is to take place and has a valve by which the volume of gas entering the chamber for combustion may be regulated. The gas pipe L, may be opened or closed by the valve P, and is supported by a brace Q.

R is a valve in the steam pipe J.

S is a valve in the cold air pipe B.

T is a valve in the hot air pipe I.

The main hot air pipe U connects with the kiln or other chamber where the combustion of the gas is to take place and has a valve by which the volume of hot air entering the chamber for combustion may be regulated. The valve rod V, connects all the valves except those in the main pipes, so that they can be reversed by the operator with one movement by means of the valve rod lever W.

For greater strength and durability I incase each chamber in an iron shell Z, Z, made of one-fourth inch iron leaving a space of five and three-fourths inches on top of the chamber and three and three-fourths inches around the chamber which I fill with mineral wool or sand. The feed top M, is fourteen inches square and thirty inches high, and has an iron lid. The gas pipes and hot air pipes are nine inches square inside, and to secure greater durability and prevent undue heating I make

them of one-fourth inch iron fourteen inches square on the outside and line them with fire brick.

I use fire brick for two courses inside the chambers, the arches E E, the jambs F, F, the checker work H, H, three courses above the checker work, and one course inside of the opening K, the latter however may be faced with iron in lieu of the course of fire brick. The retort is of fire clay. The dimensions herein given are not arbitrary but may be varied as circumstances require or convenience suggests, they are given for convenience in illustrating the construction of the furnace. The materials named while not arbitrary are those which I believe will give the greatest strength and durability, and therefore the most satisfactory results.

The main pipes may lead directly into the kiln or chamber for the combustion of the gas, or the connections may be made by a number of smaller pipes distributing the hot air and gas to different points in the combustion chamber or to different chambers for combustion.

When required by the capacity of the plant to be served my furnace may consist of two or more chambers on each side incased in one iron shell.

I raise the valve rod levers W of each chamber, this closes the gas pipes and opens the cold air pipes and the hot air pipes. I then build a fire in the fire box of each chamber, preferably with coke, filling the fire boxes to the tops of the jambs except the hot air flues, air blasts blown into the ash pits through the pipes B, and B drive the heat through the hot air flues into and through the checker work H, H, heating the same. While the checker work is being heated to the proper degree I charge the retorts with coal by filling the feed tops with coal and after replacing the lid dumping the same into the retorts by means of the levers N, N, this is repeated until the retorts are sufficiently charged. When the checker work is heated sufficiently, that is until it is from a cherry red to a white heat, I push down the valve rod lever of one chamber, for example say the right chamber as shown in Fig. 2, of the drawings, this closes the hot air valve T and the cold air valve S and opens valve P in the gas pipe L of that chamber. The steam pipes C, C, are always open when the furnace is in operation the steam being turned on or shut off by valves near the boilers. The steam introduced into the chamber through the pipes J, and C, passes through the incandescent mass in the fire box into the retort, that from the pipe J first passing through the heated checker work, the product of this steam with the heat from the incandescent mass acts upon the coal in the retort liberating all its gases and combines with the same, and the product which is fuel gas is driven by the pressure of the steam and the expansion of its product through the gas pipes into the kiln, fire box, blast furnace or other chamber for combustion, which may be air tight and should be to secure the best results. The residuum of the coal which is coke may be stoked down into the fire box where it serves as fuel. At the same time the cold air blast and steam from the pipe C, in the ash pit of the left chamber pass through the incandescent mass in the fire box by which the steam is decomposed and the air heated intensely, the volume of hot air thus produced is driven through the checker work, heating the same as it passes, thence through the hot air pipes into the kiln, fire box, blast furnace or other chamber for combustion where from its contact with the fuel gas from the right chamber combustion ensues. As soon as the checker work in the right chamber begins to cool I reverse the valves connected with the valve rods by raising the valve rod lever W of that chamber and pushing down the same lever of the left chamber, the left chamber then produces gas while the right chamber supplies hot air and in doing so again heats the checker work to the proper degree. I reverse the valves at intervals of from twenty to sixty minutes. Having heated the chamber and brought the checker work to a proper degree of heat, the jet of steam introduced by the pipe J is passed through the checker work by which it is superheated, thence into the hot air flues in the fire box, it then passes through the incandescent mass in the fire box under the arches into that part of the fire box between the arches and the jambs, the steam from the pipe C, in the ash pit passes up through the incandescent mass between the fire grate and the arches, then with the steam from the pipe J, or its product through the incandescent mass between the arches and the jambs. The product of the steam thus passed through the checker work and through the incandescent mass in the fire box with the heat from said mass passes into the retort which is charged with coal. The coal in the retort is subjected to the action of this product of the steam and the heat and all its gases are thereby liberated. These gases combine with the products of the steam and form a fuel gas of a superior quality which with hot air may be burned in an open furnace or an air tight chamber.

When burning brick the products of combustion while heating the furnace to a degree necessary to produce gas pass through the hot air pipes into the kiln and are utilized in water smoking the green brick; in the case of heating boilers, &c., these products of combustion pass through the hot air pipes into the fire-box and are utilized in heating the same and escape slowly through a vent for the purpose which may be controlled by a damper.

I claim as new and as my invention and desire to secure by Letters Patent—

1. In a fuel gas furnace, an air-tight cham-

ber provided with arches above the grate in the fire box, jambs supported upon said arches, checker work supported upon said jambs and upon the walls of the chamber, a retort supported upon said jambs and a top supported upon the checker work and retort combined with a steam pipe and a cold air pipe in the ash pit beneath the grate and a steam pipe connecting with the annular space around the retort above the fire box, a pipe connecting the retort with the main gas pipe and an independent pipe connecting the annular space around the retort with the main hot air pipe substantially as specified.

2. The combination with the outer wall of the chamber having interior offset, of the arches sprung from the front and back walls of the chamber, jambs supported on said arches with their upper ends on a plane with the said offsets, checker work supported from the offsets and jambs, a retort within the checker work supported upon said offsets and jambs, a top supported upon the checker work with a space around the retort at the upper part of the chamber, a steam pipe and a cold air pipe in the ash pit beneath the grate, a steam pipe communicating with the air pipe leading into said space, a pipe connecting the retort with the main gas pipe and an independent pipe connecting said space with the main air pipe, substantially as specified.

3. The combination with the outer wall of the chamber having interior offset, of the arches sprung from the front and back walls of the chamber, jambs supported on said arches with their upper ends on a plane with the said offsets, checker work supported from the offsets and jambs, a retort within the checker work supported upon said offsets and jambs, a top supported upon the checker work with a space around the retort at the upper part of the chamber, a top supported on the checker work, a feed top in line with the retort, a pivoted bottom to the feed top and provided with an exterior lever by which it may be operated, a steam pipe and a cold air pipe in the ash pit beneath the grate, a steam pipe communicating with the air pipe leading into said space, a pipe connecting the retort with the main gas pipe and an independent pipe connecting said space with the main air pipe, substantially as specified.

August 24, 1893.

JOHN HARLEMAN.

In presence of—
W. H. PRINDLE,
E. RAY.