(No Model.)

4 Sheets—Sheet 1.

J. DRUECKER.

KILN AND FURNACE.

No. 294,453. Patented Mar. 4, 1884.

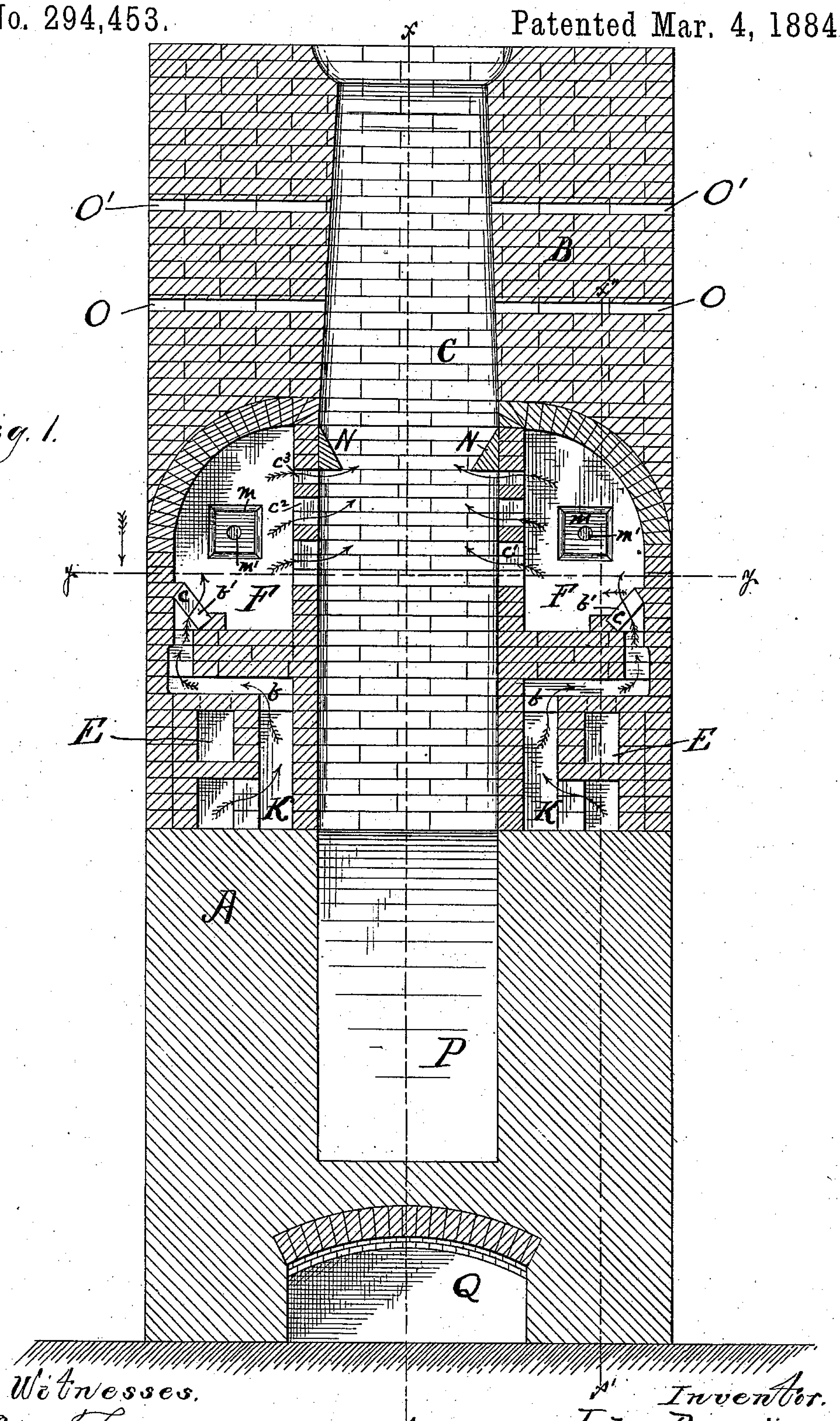

Fig. 1.

Witnesses.
Henry Frankfurter.
J. Warrett Brown

Inventor.
John Druecker
per Munday Evarts & Adcock
his attys.

N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.)

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J. DRUECKER.

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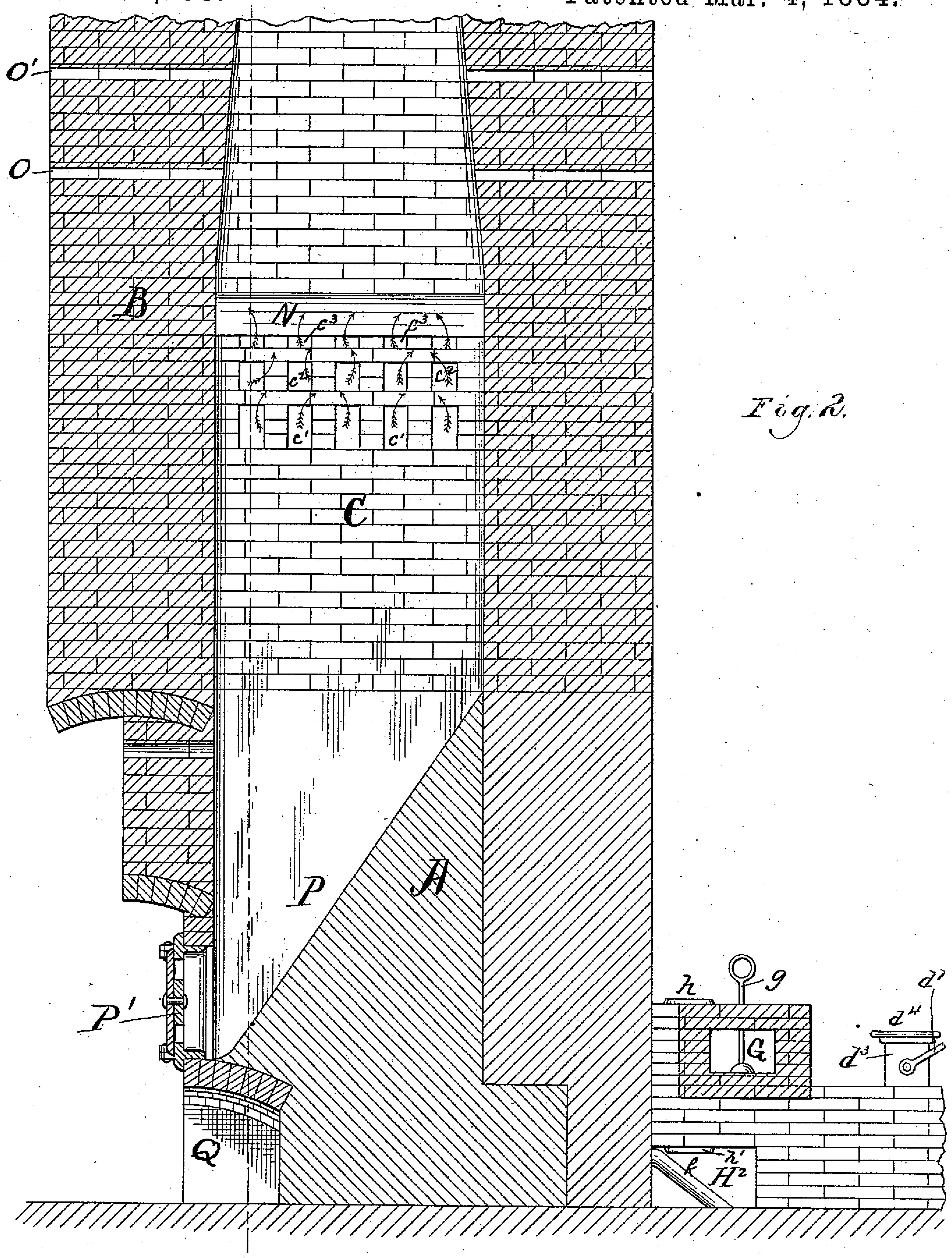

Fig. 2.

Witnesses.
Henry Frankfurter,
J. Everett Brown

Inventor.
John Druecker
per Munday Evarts & Adcock
his Attys

N. PETERS, Photo-Lithographer, Washington, D. C.

(No Model.)

4 Sheets—Sheet 3.

J. DRUECKER.

KILN AND FURNACE.

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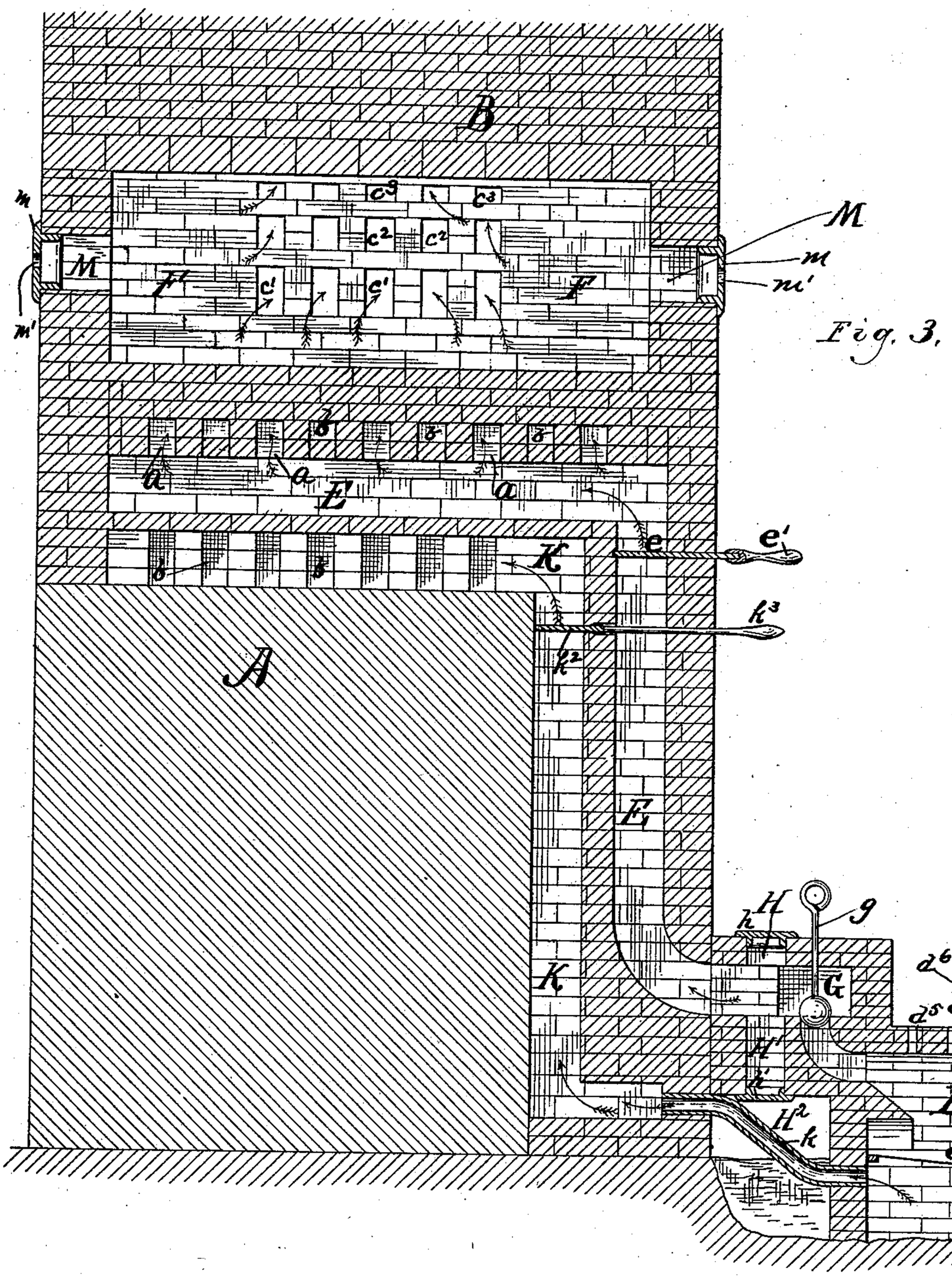


Fig. 3.

Witnesses.
H. Clay Fraukfurter.
J. Everett Brown.

Inventor.
John Druecker
per Munday Evarts & Adcock
his Attys.

(No Model.)

4 Sheets—Sheet 4.

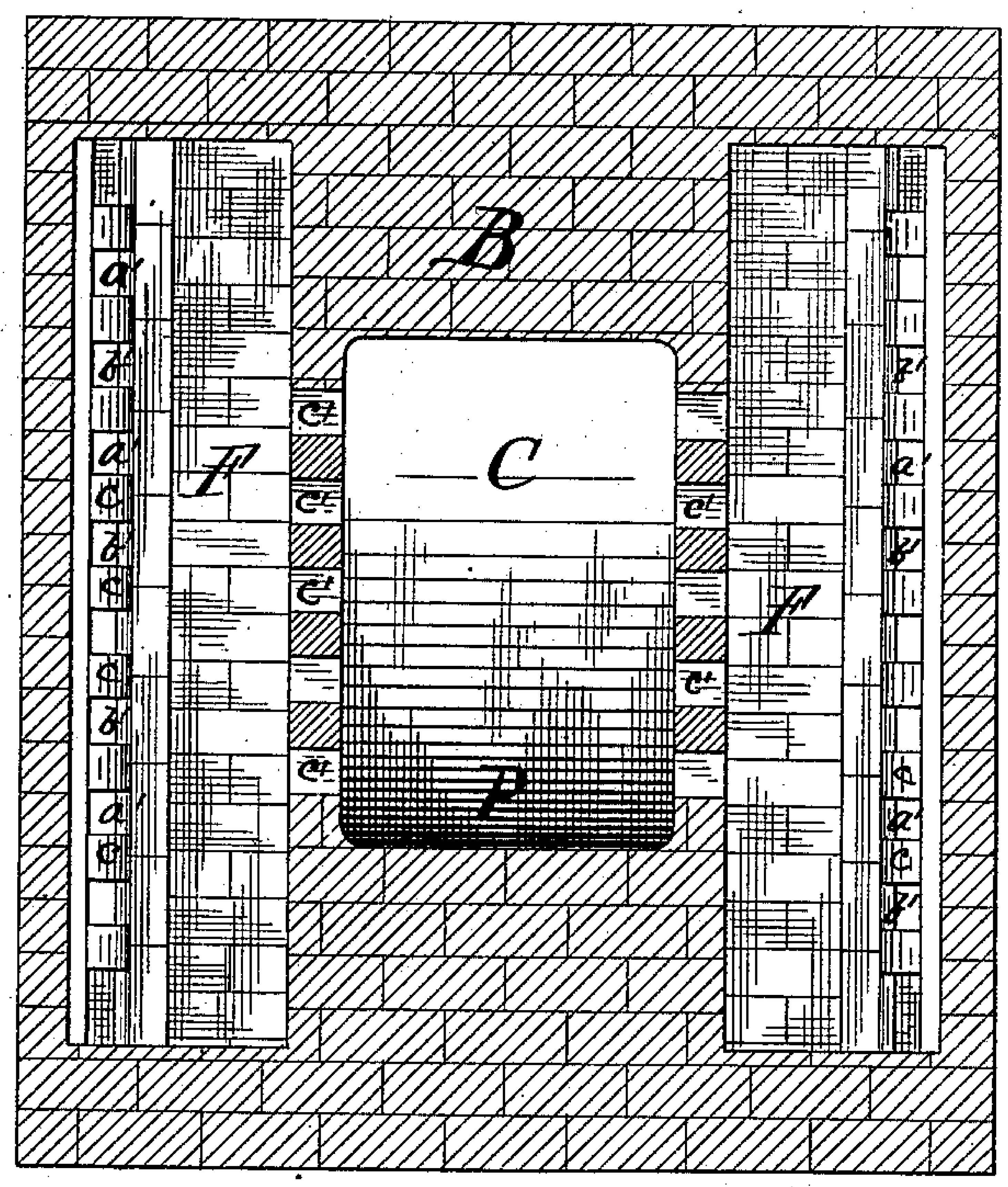
J. DRUECKER.

KILN AND FURNACE.

No. 294,453.

Patented Mar. 4, 1884.

Fig. 4.



Witnesses.
Henry Frankfurter,
W. L. Baker.

Inventor.
John Druecker
per
Munday, Evarts & Adcock
his attys

N. PETERS, Photo-Lithographer, Washington, D. C.

UNITED STATES PATENT OFFICE.

JOHN DRUECKER, OF CHICAGO, ILLINOIS.

KILN AND FURNACE.

SPECIFICATION forming part of Letters Patent No. 294,453, dated March 4, 1884.

Application filed August 13, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN DRUECKER, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Kilns and Furnaces, of which the following is a specification.

My invention relates to improvements in furnaces and kilns for burning lime, cement, brick, &c.

The principal object of the invention is to produce a complete and perfect combustion of the fuel and at the place where the heat is desired, and thus to effect a material saving in the quantity of fuel required in burning the lime, brick, cement, &c., and to also provide means for controlling or regulating the degree of heat and keeping the same at all times under the will of the operator.

These results I accomplish, and herein my invention consists, by first manufacturing or converting the coal or fuel into gas and then conducting the same into a secondary or mixing chamber or fire-box in the kiln in the immediate vicinity of the place where the heat is desired to be used, and where the gas is met by a supply of hot air, which is conveyed from beneath the grate of the gas-producer to this mixing-chamber, so that the actual combustion may be made to take place where the heat is desired. To insure the intimate commingling of the gas and hot air in this secondary chamber and the complete combustion of the former, the gas and hot-air passages are divided and subdivided, near their mouth or the place where the gas and air are delivered into this secondary chamber, and there these small subdivided currents of gas and air as they enter the mixing-chamber meet each other at an angle, so as to more thoroughly commingle the two. Dampers are arranged in both the hot-air-supply passage and the gas-supply passage, so that the supply of either to this secondary or mixing chamber may be instantly regulated and the degree of heat thus controlled. By increasing the supply of air the combustion may be made to take place to a greater or less degree in the secondary mixing-chamber, as may be desired. By diminishing the supply of air or increasing the supply of gas the combustion may be made to take place to a greater or less extent, as may be desired, in the retort of the kiln containing the stone, brick, or other material to be burned, baked, or heated.

In the accompanying drawings, which form a part of this specification, and in which similar letters of reference indicate like parts, I have illustrated my invention as applied to a kiln for burning lime. The base or bottom of the lime-retort of the kiln thus illustrated is inclined, so that the lime as it is formed by the burning of the stone will fall down or automatically deliver itself when the door is opened. The mouth of this inclined base or chute projects or is arched over, so that a wheelbarrow or other receptacle for the lime may be run under said arch to receive the lime as it falls from the inclined base of the retort.

In the drawings, Figure 1 is a central vertical section through the secondary or mixing chamber. Fig. 2 is a vertical section at right angles to the section shown in Fig. 1 on line $x\ x$. Fig. 3 is a section taken on the line $x'\ x'$ of Fig. 1, and Fig. 4 is a horizontal section taken on the line $y\ y$ of Fig. 1.

In the drawings, A represents the masonry forming the base of the kiln, and B the brickwork of the kiln surrounding the retort C.

The gas-producer consists of a simple chamber, D, for the coal or fuel, provided with a grate, d, draft-passage or ash-pan d', door d^2, fuel-receiving hopper d^3, which is closed by a cap, d^4, and poker-holes d^5, for stirring the fires. The fuel-receiving hole or hopper d^3 is provided with the pivoted valve or dumper d^6, which is operated by the weighted lever d^7.

In supplying the coal or fuel to the chamber or fire-box D, the cap d^4 is first removed and the fuel shoveled into the hopper d^3, resting upon the dumper d^6. The cap d^4 is then replaced, when the dumper is turned by the weighted lever d^7, thus discharging the charge of fuel into the fire-box D. By this means it will be observed that the hopper d^3 is always kept closed, thus preventing the gas in the chamber D igniting or breaking into a flame.

E is the passage for conveying the gas from the furnace or chamber D to the secondary mixing recuperator or regenerator chambers

F F. This gas-passage E extends up through the masonry of the kiln, and is provided with an enlargement or gas-reservoir, G, near its base. The function of the gas-reservoir G is to equalize the supply of gas to the mixing-chambers F F by affording a reserve supply, which may be called upon when there is any momentary inequality in the quantity of gas produced from the fire box or chamber D. The lower part of the passage E, connecting the gas-reservoir G with the furnace D, is provided with a valve or dumper, *g*, by means of which connection with the furnace may be absolutely cut off. This valve is of special service when it is desired to clean out the gas-passage E.

H represents an opening closed by the cap *h*, through which the gas-passage E may be cleaned, and H′ is a trap or opening through which the loosened soot or dirt may fall into the receptacle H^2, back of the ash-pan or space *d*′, below the grate *d*. This opening H′ is closed by a door, *h*′. The gas-passage E is provided with a damper or valve, *e*, having a handle, *e*′, by means of which the supply of gas to the mixing-chambers F F may be regulated at will or cut off entirely. The gas-passage E, before it reaches the secondary chambers F F, is divided into a number of small passages, *a*, so as to deliver the gas to the secondary chamber in small currents and distribute the same throughout said chamber.

K is a hot-air-supply passage extending up through the masonry and leading from the space *d*′ below the grate *d*, where the air is heated, to the mixing-chambers F F. The lower part of this air-passage K may be made of iron pipes *k* or masonry, as may be preferred. The air is supplied to the chamber *d*′, below the grate *d*, through the port *k*′. The air-passage K is provided with a damper, k^2, having a handle, k^3. By means of this damper the supply of hot air to the secondary chambers F F may be always regulated. The air-passage K, before it reaches the secondary chambers F F, is divided into a number of small passages, *b*, which alternate with the gas-passages *a*, so as to divide the hot-air current into a number of small currents and distribute them throughout the secondary chamber F F, and at the same time bring them in close proximity with the gas passages or currents. The air-passages *b* and gas-passages *a* are formed by leaving out alternate courses of the brick or masonry, and said passages alternate with each other and issue into the secondary chambers F F through alternate ports *a*′ *b*′, between the inclined course of fire-bricks *c*, which serve to deflect or incline the gas and air currents toward each other, so as to cause the gas and air to intimately mix together as they enter the secondary chambers.

c′, c^2, and c^3 are a series of ports leading from the fire-boxes F into the retort or chamber C, wherein the stone or material to be baked, burned, or heated is contained. The lower set of ports, *c*′, I make the largest, and the upper set, c^3, the smallest, while the middle set, c^2, is of intermediate size.

M M are peek-holes through the exterior wall of the kiln, and opening into the secondary chambers F F, through which the state of the fire may be observed when desired. These peek-holes or windows M M are closed with iron plates *m*, which are provided with small holes *m*′ therein. The attendant can also determine the condition of the heat or fire by observing the degree of pressure or force of the small current of air or gas issuing from the secondary chamber through the holes *m*′.

N is an annular flange or projection projecting from the interior wall of the kiln into the retort or chamber C, for the purpose of deflecting the products of combustion or currents issuing through the ports c^3 c^2 *c*′ from the interior wall of the retort, so that the same will pass up through the mass of stone or material therein.

O and O′ are holes through which the stone or material in the retort may be examined from time to time and poked or stirred, as may be desired. The retort C has an inclined base, P, which serves as a chute to deliver the lime when it is calcined.

P′ is a gate or door at the bottom of this inclined base P, for drawing out the lime and to give it an additional supply of air, if desired.

Q is an arched cavity projecting under the door P′, into which cavity a wheelbarrow or other receptacle for the lime may be placed when the door P′ is opened, so that the lime will fall from the chute into said receptacle, and thus save the labor of shoveling or handling it.

My invention may be applied not only to kilns for burning lime, cement, brick, or other analogous substances, but also to all kinds of furnaces, boilers, and general firing, where a steady or continuous fire is kept up from day to day.

By converting the coal or fuel into gas in a separate fire-box or gas-producer, and then conveying the gas thus formed into a secondary mixing, regenerator, or recuperator chamber, and subdividing the gas-current into a number of small currents as it enters said secondary chamber, and causing the same to there meet and commingle with alternate hot-air currents, the combustion is rendered absolutely perfect and smokeless, and the heat produced at the point where it is desired, so that more than one-half the fuel may be saved.

In the practical operation of my invention as applied to a limekiln, I have found that only about one-fourth of the amount of fuel required by the old kilns I have used is necessary. It will be observed that by my invention none of the heat produced by the combustion of the fuel is lost. The heat produced by the partial combustion which takes place in the chamber D, where the gas is formed, is all

utilized in heating the hot air and gas which are supplied to the secondary chambers F F through the passages E and K and their branches *a a* and *b b*.

The operation of my invention is as follows: The coal or fuel is first converted in the chamber or fire-box D into gas, the draft of air admitted to said chamber through the grate being just sufficient to carry on the combustion of the fuel to the point necessary to produce gas and smoke, but without igniting the gas or causing flame—that is to say, the chamber D is kept at a red heat, fresh fuel being supplied or the fire stirred, or the dampers *g* or *e* regulated whenever required to prevent flame or ignition of the gas in the chamber D. The gas thus produced passes up through the gas-passage E and its branches *a*, and issues into the secondary chambers F F through the ports *a'*. At the same time the hot air heated in the chamber *d'*, beneath the grate *d*, passes up through the hot-air passage K and its branches *b* and issues into the chambers F F through the ports *b'*, which alternate with the ports *a'*, the inclined fire-brick *c* serving to deflect the air and gas currents toward each other, so that the air and gas become intimately mixed in the chambers F F. Any desired extent of combustion may be made to take place in the secondary chambers F F by simply increasing or diminishing the relative supply of air and gas by means of the dampers k^2 and *e;* but ordinarily I maintain the chambers F F at a simple dark-red color. From the chambers F F the intimately-mixed gas and air issue through the ports *c'*, c^2, and c^3 into the retort C, and up through the stone or material therein, wherein the complete and perfect combustion of the gas takes place and the greatest heat is produced, the same burning at a clear white heat and absolutely smokeless.

In the drawings, the air-passages K and *b* are shown of the same size as the gas-passages E and *a*, which is a suitable proportion if cold air should be used; but with hot air, which it is preferable to use, the air-passages should be from twice to thrice the capacity of the gas-passages. By making the lower ports, *c'*, largest the greatest heat is produced low in the retort C. If it should be desired to have the greatest heat up high in the retort, the upper ports, c^3, should be the largest.

I claim—

1. The combination, in a kiln, of a retort or receptacle for holding the material to be baked or burned, with a gas producer or furnace, a separate secondary chamber surrounding said retort, and a passage for conducting the gas from the gas-producer to the secondary chamber, and an air-passage for conducting hot air from the gas-producer to the secondary chamber, substantially as specified.

2. The combination, in a kiln, of a retort, with a gas producer or furnace, a secondary chamber surrounding said retort, and having ports leading into the same, a gas-passage leading from said producer to said chamber and subdivided into a number of small passages or branches, and an air-passage leading from said gas-producer and subdivided into a number of small passages or branches, substantially as specified.

3. The combination, in a kiln, of a retort, with a gas-producer, a secondary chamber surrounding said retort, and having a series of ports leading into said retort, and provided with a series of air and gas inlet ports distributed over its interior, of separate air and gas passages connecting said air and gas inlet ports with said gas-producer, and provided with dampers or valves for regulating and controlling the supply of gas and air, as may be required, substantially as specified.

4. The combination, in a kiln, with a retort, C, of fire-box D, grate *d*, ash-pan *d'*, gas-passage E, gas-reservoir G, valve *g*, for closing said passage E between said reservoir and fire-box, secondary chamber F, and air-passage K, leading into said secondary chamber from the ash-pan *d'*, said secondary chamber F being provided with a graduated series of ports, *c'*, c^2, and c^3, the smaller series of said ports being arranged above the others, substantially as specified.

5. The combination, in a kiln, of a retort or receptacle for holding the material to be baked or burned, with a secondary mixing recuperator or regenerator chamber surrounding said retort, and having a graduated series of ports opening into said retort, and provided with a series of air and gas inlet ports distributed over its interior, said air and gas inlet ports being deflected toward each other at their mouths in pairs, a gas producer or apparatus for converting the fuel into gas, and air and gas passages connecting said air and gas inlet ports with the gas-producer, substantially as specified.

6. The combination, in a kiln, of a retort, with a gas-producer, a secondary chamber surrounding said retort, and having ports opening into the same, and provided with a series of air and gas inlet ports distributed over its interior, separate air and gas passages connecting said air and gas inlet ports with said gas-producer, said gas-passage being provided with a supplemental gas-reservoir for regulating and rendering uniform the supply of gas to said secondary chamber, substantially as specified.

7. The combination, with retort C, of secondary chambers F F, surrounding said retort, and provided with ports *c'*, c^2, and c^3, leading into said retort, and air-inlet ports *b'*, and gas-inlet ports *a'*, gas-producing chamber or fire-box D, gas-passage E, provided with damper *e*, and branches *a*, connecting said chambers F F with said fire-box D, ash-pan *d'*, and air-passage K, provided with damper k^2, and branches *b*, connecting said ash-pan *d'* with said chambers F F, said air and gas branch passages *a* and *b* and inlet-ports *a'* and

b' being arranged alternate with each other, substantially as specified.

8. The combination, with gas-producing chamber or fire-box D and grate d, of fuel-hopper d^3, cap d^4, pivoted dumper d^6, provided with lever d^7, substantially as specified.

9. The combination of retort C with a gas-producer, a secondary chamber surrounding said retort, and provided with ports opening into said retort, and air and gas inlet ports connected with said gas-producer by means of separate air-passages and gas-passages, and a door, P, at the bottom of said retort, through which additional air may be admitted to said retort, substantially as specified.

Chicago, Illinois, August 10, 1883.

JOHN DRUECKER.

Witnesses:

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H. M. MUNDAY.