(No Model.)

4 Sheets—Sheet 1.

J. A. HERRICK.

REGENERATOR FURNACE.

No. 424,480. Patented Apr. 1, 1890.

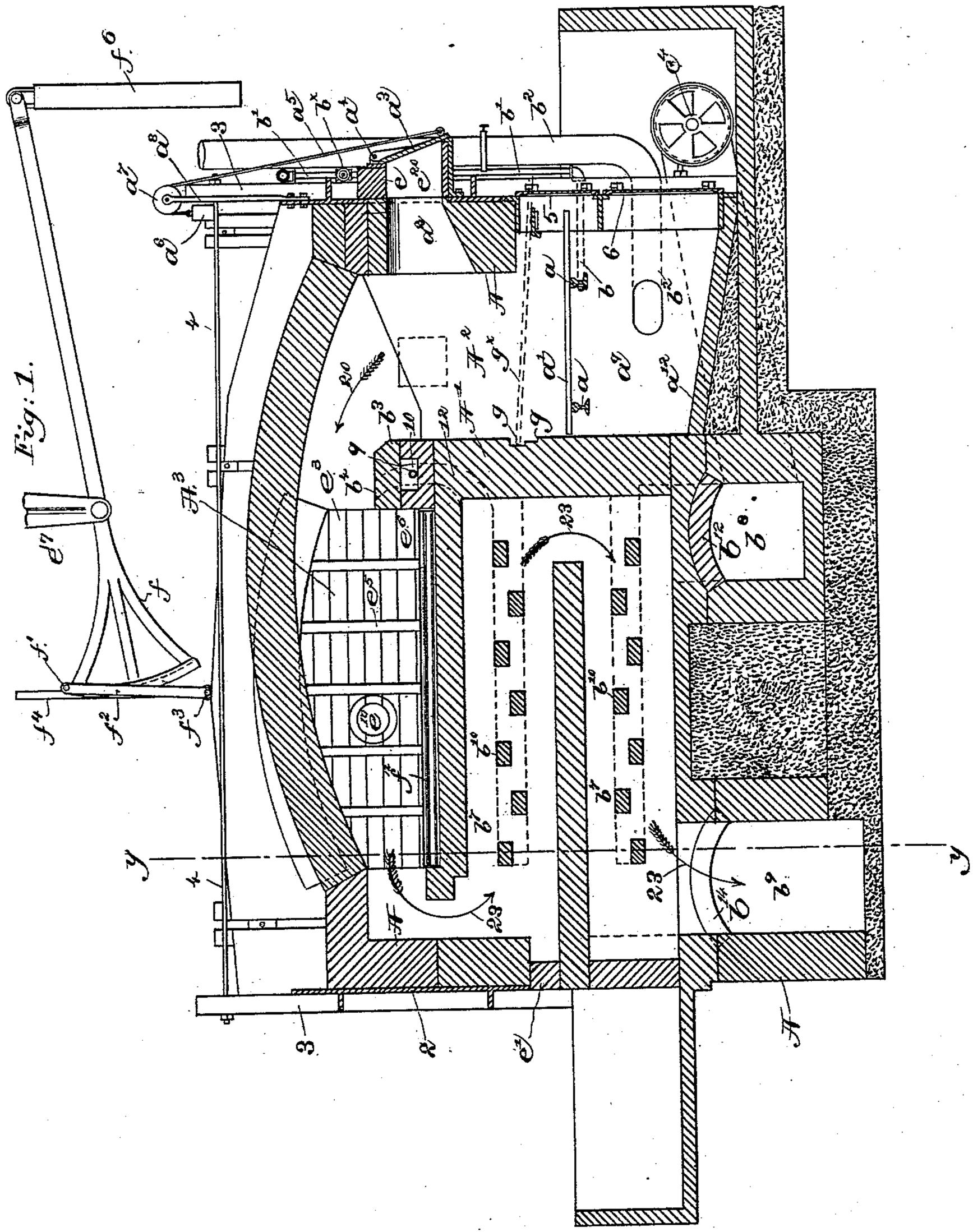

Fig. 1.

Witnesses.
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by Lemby & Gregory.
Att'ys

(No Model.) 4 Sheets—Sheet 2.

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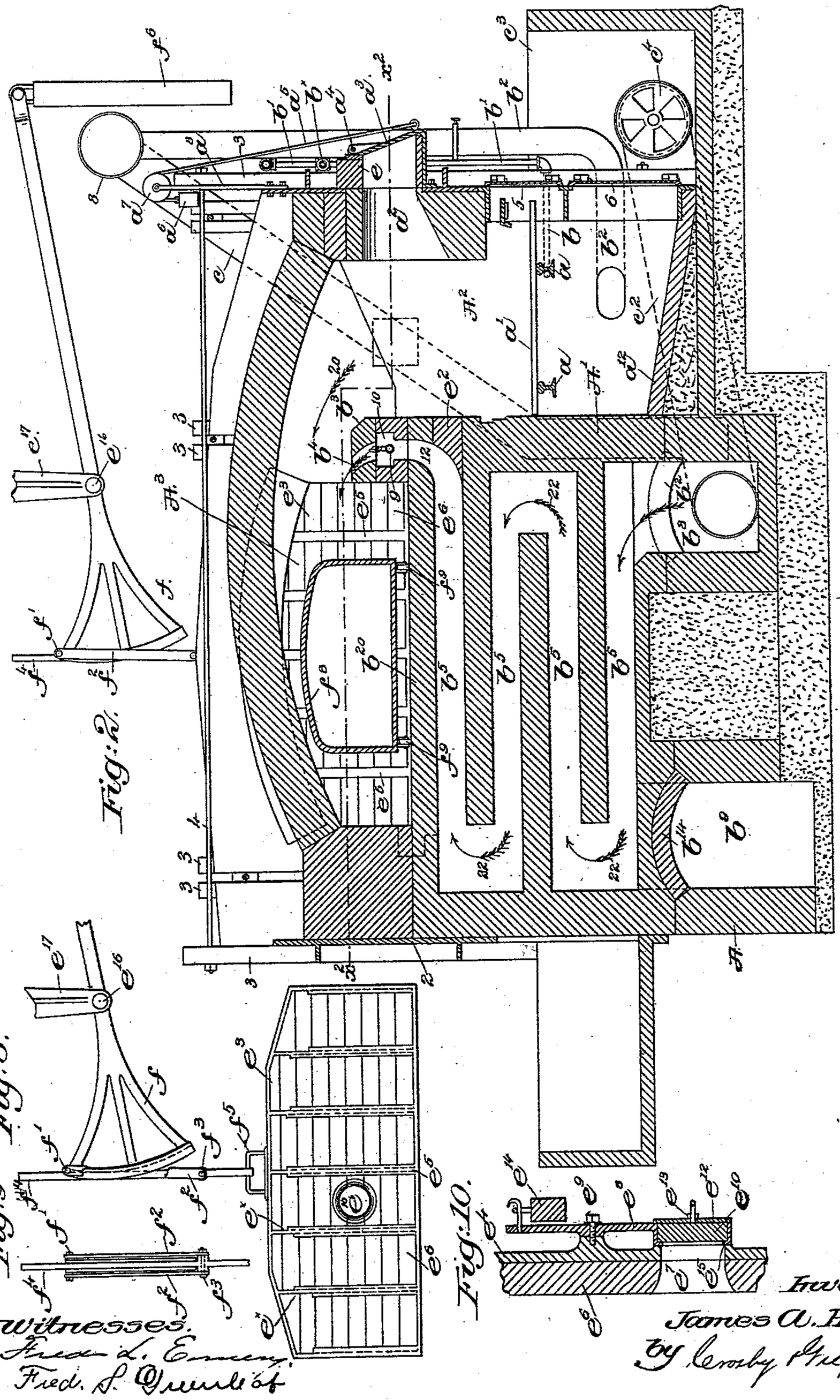

Fig: 2.

Fig: 8.

Fig: 9.

Fig: 10.

Witnesses.
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Fred. L. Grundlof

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(No Model.) 4 Sheets—Sheet 3.

J. A. HERRICK.

REGENERATOR FURNACE.

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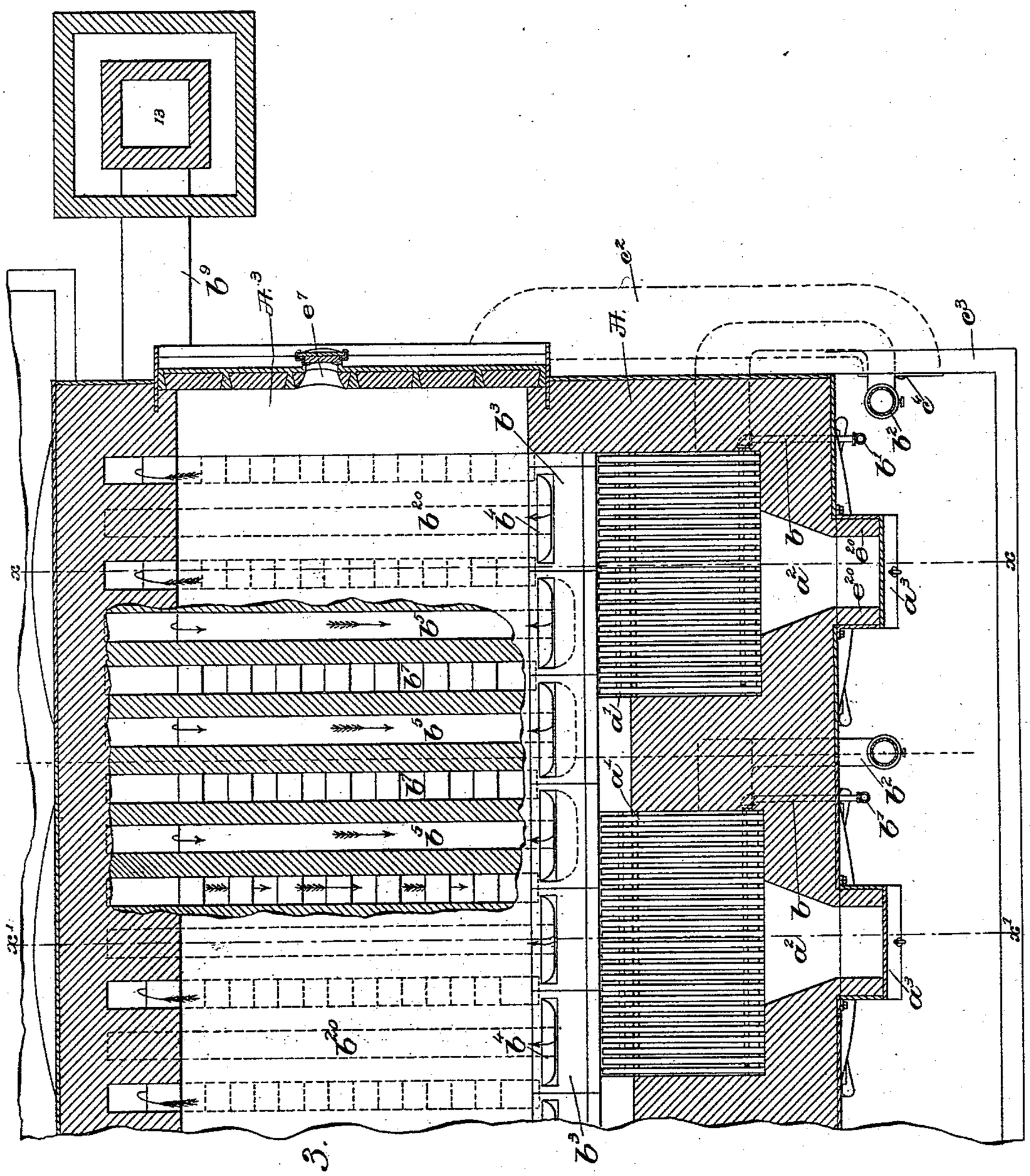

Fig. 3.

Witnesses.
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(No Model.) 4 Sheets—Sheet 4.

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REGENERATOR FURNACE.

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Fig: 4.

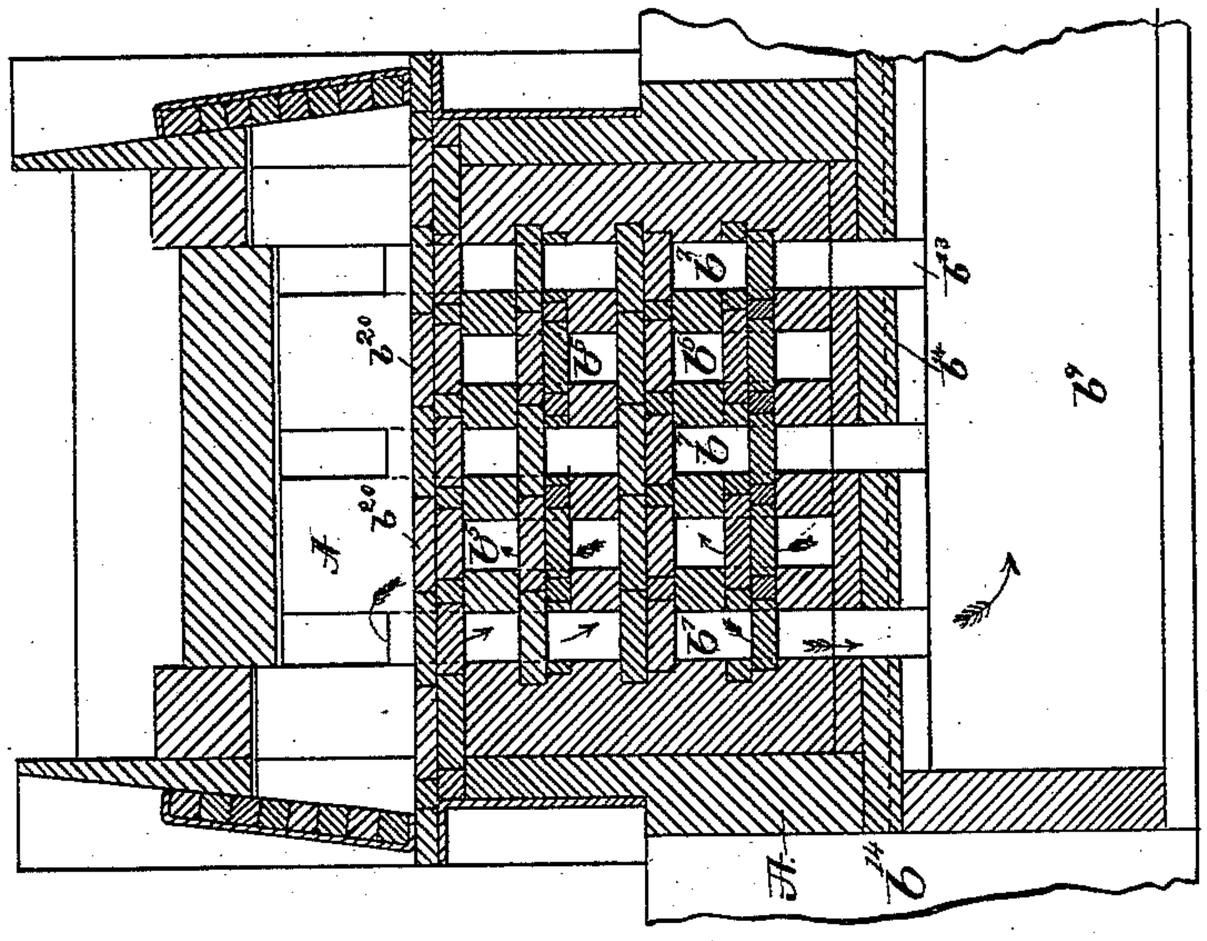

Fig: 6.

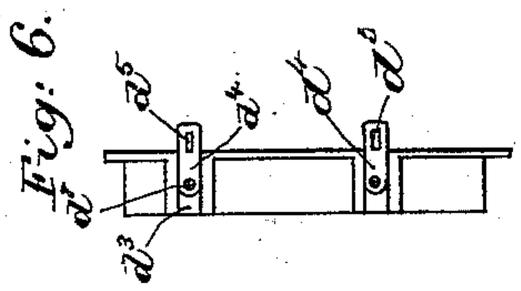

Fig: 5.

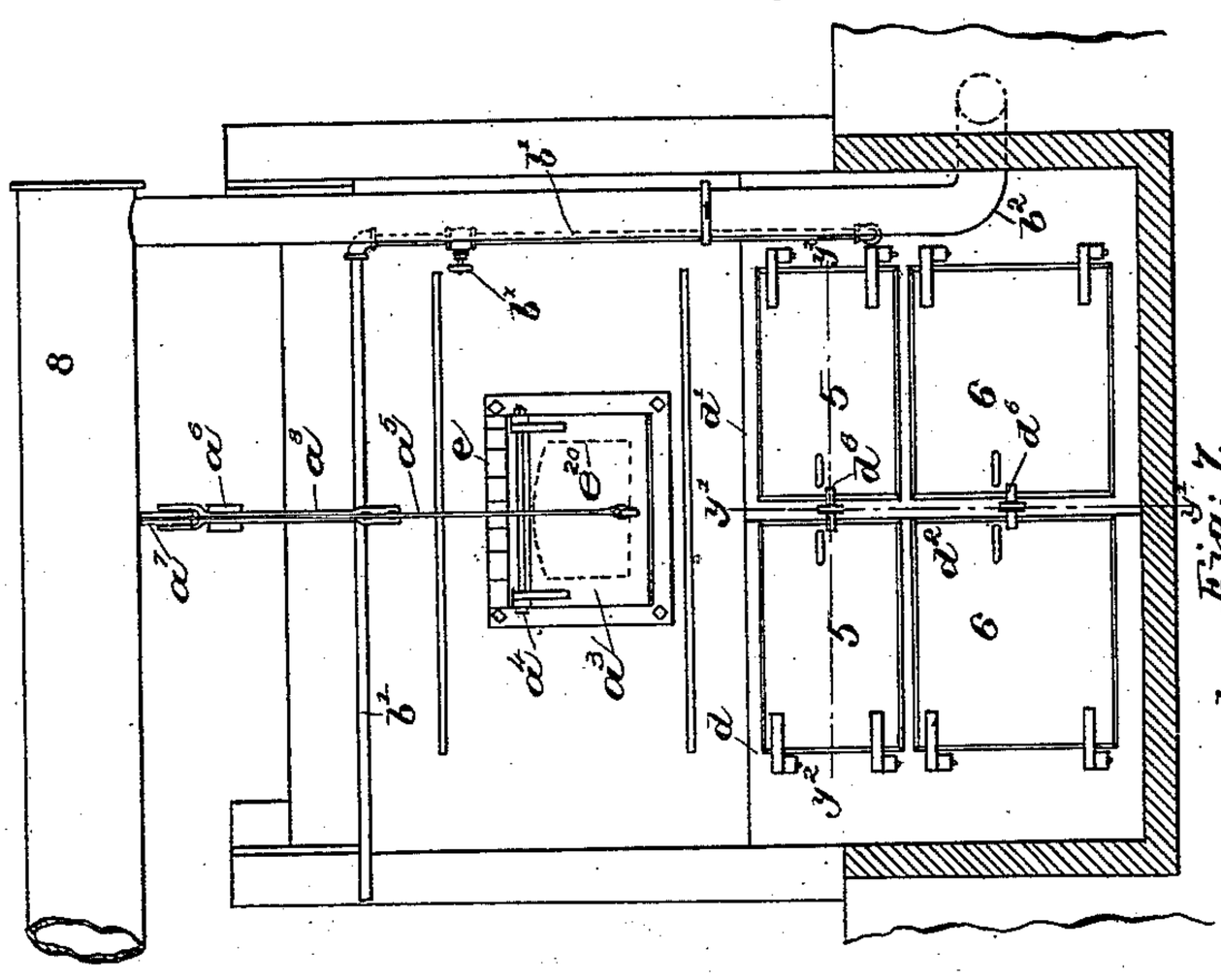

Fig: 7.

Witnesses.
Howard F. Eaton.
Fred L. Emery.

Inventor:
James A. Herrick
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Attys.

UNITED STATES PATENT OFFICE.

JAMES A. HERRICK, OF NEW YORK, N. Y.

REGENERATOR-FURNACE.

SPECIFICATION forming part of Letters Patent No. 424,480, dated April 1, 1890.

Application filed November 21, 1887. Serial No. 255,782. (No model.)

To all whom it may concern:

Be it known that I, JAMES A. HERRICK, of New York, county and State of New York, have invented an Improvement in Regenerator-Furnaces, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to furnaces of the class known as "continuous" regenerators, and has for its object to improve the construction of the same.

In accordance with my invention the gas generator or producer is attached directly to the main structure or furnace proper, the gas generated in the producer passing into the heating-chamber over a hollow bridge-wall, from which issues heated air either alone or enriched by natural, water, or other gas or natural gas alone, the said air or natural gas or mixture of both being commingled with the gas generated in the producer to create the flame by which the material within the heating-chamber is heated, the said air being heated by passing through a system of flues or passages located below the heating-chamber, the said air flues or passages being heated by the waste products of combustion, which pass through a separate series of flues on their way out of the furnace, as will be described.

My improved furnace is especially adapted for heating metals to any temperature below full white heat, for annealing metals, baking crockery, tiles, bricks, &c., and it is also well adapted to be used with "close muffles" for annealing—that is, when it is desired the flame should not impinge or act directly upon the material to be heated.

My invention therefore consists of a furnace having novel points of construction, which will be pointed out in the claims at the end of this specification.

Figure 1 is a vertical section of a furnace embodying my invention, the section being taken on line $x\,x$, Fig. 3, through the fumes-passage. Fig. 2 is a vertical section of my improved furnace on line $x'\,x'$, Fig. 3, the section being taken through the air passage or flue. Fig. 3 is a transverse section on line $x^2\,x^2$, Fig. 2, showing two gas-producers, to illustrate the manner of constructing the furnace when a plurality of gas-producers are employed in one furnace. Fig. 4 is a section of Fig. 1 on line $y\,y$, looking to the left; Fig. 5, an end elevation of the furnace shown in Fig. 1, the outside ash-pit being in section; Fig. 6, a detail to be referred to; Fig. 7, a section of the door-casting in Fig. 5 on line $y^2\,y^2$; Fig. 8, a detail of the door of the heating-chamber and mechanism for operating it; Fig. 9, a detail to be referred to, and Fig. 10 a sectional detail of the door of the heating-chamber and the cover closing the opening therein.

Referring to Fig. 1, the outer walls A of my improved furnace, composed of fire-brick or other suitable material and strengthened in any usual manner, as by iron plates 2 and binders 3, connected together by rods 4, support in usual or well-known manner the dome or roof A.

The furnace is provided with an upright wall A′, (see Figs. 1 and 2,) dividing the said furnace into a gas-producer A^2 and a heating-chamber A^3. The gas-producer A^2 is provided with braces (shown as rails a) to support the grate-bars a', upon which the coal or other fuel to be consumed is supported. The coal or other fuel is supplied or fed into the producer through a chute or hopper a^2, formed in the outer wall A, the said hopper being closed by a door a^3, herein shown as hinged at a^4 and connected by a chain a^5 to a counterbalancing-weight a^6, suspended by the said chain over a pulley a^7, supported by uprights a^8, secured to the outer wall of the furnace.

The side or end of the furnace is provided, as shown, with two sets of doors 5 6, the door 6 communicating with the ash-pit a^9 below the grate-bars a', and through which doors the ashes may be removed. The bottom a^{12} of the ash-pit is herein shown as upwardly inclined toward the back of the ash-pit or away from the door, for a purpose to be hereinafter described.

The rails a support, as herein shown, pipes b, only one of which is shown, the said pipe being extended outside the furnace and connected by pipe b', provided with a cock or valve $b^\times$, to a suitable steam-generator or source of supply, (not herein shown,) said pipe b within the ash-pit being provided with perforations through which steam may issue,

preferably in a downward direction, into the ash-pit.

The ash-pit a^9 has extended into or communicating with it an air-supplying pipe b^2, communicating outside the furnace with a pipe 8, (see Fig. 2,) connected with a suitable blast or air pump, (not herein shown,) the mouth or outlet of the air-pipe b^2 preferably being bell-shaped or expanded to cause the air forced into the ash-pit to be diffused therethrough and more intimately commingled with the steam therein. The downwardly-projected steam mixes with the air and charges the same with moisture, and the moist air is drawn or forced up through the bed of coal or other fuel, producing combustible gases in usual manner. The air entering the producers passes through a layer of steam, which serves to moisten the same, and thereby prevent the burning out of the grate-bars, the said steam tending to prevent the formation of clinkers. The gases generated in the producer A^2 pass over a bridge-wall formed by removable caps or blocks b^3, mounted upon and forming a continuation of the wall A′ in a direction indicated by the arrow 20, Figs. 1 and 2, into the heating-chamber or furnace proper A^3, in which the material to be treated is placed. The gases generated in the producer as they pass over the bridge-wall may be commingled with and enriched by either air, natural, water, or other gas, or a mixture of both, which issues from a duct b^4 in the cap or block b^3, the natural or other gas being supplied through a pipe 9, located, as shown, in a passage or chamber 10 in the wall A′ and connected to a suitable source of supply located outside the furnace and not herein shown. The heat generated by mixing air with the gases generated in the producer will be sufficient for most classes of work for which the furnace will be used, and therefore I shall hereinafter confine my description to the working of the furnace when air alone is used to enrich the said gases. The air issuing from the ducts b^4 is highly heated after the furnace has been running a short time by being caused to pass through flues or passages b^5, Fig. 2, connected with an air culvert or flue b^8, (see Fig. 2,) there being, as herein shown, four passages arranged vertically one above the other and connected at their opposite ends, so that the air admitted into the lowest of the passages b^5 is caused to traverse the furnace four times, as indicated by arrows 22, Fig. 2, before finding an exit through the duct b^4, connected to the uppermost passage b^5 by chamber 10 and passage 12 in the wall A′. It will thus be seen that the air becomes highly heated before mixing with the gases generated in the gas-producer. The flame generated by a mixture of air and gas may be deflected into the heating-chamber or furnace proper A^3 to any desired distance by varying the inclination or curvature of the duct b^4 in the cap or block b^3. The flame and products of combustion after passing through the heating-chamber A^3 pass into flues or passages b^7, Fig. 1, traversing the furnace below the bed or hearth b^{20} of the heating-chamber, the said flame and products of combustion finding an exit into a smoke flue or culvert b^9, (see Figs. 1 and 2,) communicating with the stack or chimney 13, (see Fig. 3,) the course of the flame being indicated in Fig. 1 by arrows 23. The passage b^7, which I shall hereinafter designate as the "fumes-passage," contains a series of slabs or bricks b^{10} of refractory material, which are "staggered" or so arranged as to retard the passage of the fumes through the passages b^7, so that the bottom of the hearth b^{20} and the slabs themselves may become more intensely heated.

As herein shown in Figs. 1 and 2, the passages b^5 b^7 are made continuous in a vertical direction, and, as shown in Fig. 4, a continuous air-passage b^5 is located between each pair of continuous fumes-passages b^7—that is, the air and fumes passages are alternately arranged with relation to each other.

The bottom or lowest of the fumes-passages b^7 communicates with the culvert b^9 through the passage b^{13} in the arch b^{14} of the said culvert, (see Fig. 4,) and the lowest air-passage b^5 communicates with the air-culvert b^8 through similar openings (not shown) in the arch b^{12} of the said culvert. The air may be forced into the culvert b^8 through a pipe c, (see dotted lines, Fig. 2,) communicating with the pipe 8, connected to the blast or air pump, or the said air may be admittted into the culvert b^8 by natural draft through a pipe c^2, having its inlet end supported, as shown, in the end wall c^3 of an outside pit or chamber $c^\times$ for ashes, the said pipe communicating with the atmosphere and being controlled by a register c^4, (see Figs. 2 and 3,) the pipe c being also provided with suitable dampers or valves, (not herein shown,) by which the amount of air supplied to the culvert may be regulated according to the requirements of the furnace and degree of heat required in the heating-chamber A^3.

Referring to Fig. 5, the door frame or casting of the ash-pit is made in two parts d d', which are separated by a space of several inches, the said space being closed in front by a flange d^2 of the part d'. The flange d^2 midway between each set of doors has an opening or slot d^3, (see Fig. 6,) into which is inserted a staple-shaped piece d^4, of iron, which projects beyond the door-frames and through an opening d^5, in which a wedge d^6 is driven to hold the set of doors with which it co-operates firmly against the door-frames. The door-frames d d' and staple d^4 are bound together by a bolt d^7, passed through them, the said bolt being secured by a nut d^8, (see Fig. 7,) thus making an easily fitted and substantial structure. The air-pipe b^2 for each gas-producer is carried through the wall, separating two adjacent gas-producers, and turned substantially at a right angle into the ash-pit of the gas-producers.

To prevent the top and the sides e^{20}, Fig. 1, of the coal-chute a^2 from being rapidly burned out, the said top and sides are lined with fire-brick or other refractory material, the top being made as an independent arch e (see Figs. 1 and 2) outside or beyond the wall of the furnace, to enable the same to be readily renewed, the said arch e abutting against the top arch or roof of the chute or hopper a^2, thus protecting the iron plate forming the front of the furnace from the fire.

To enable any deposition of soot or other material to be readily removed from the fumes and air passages, the walls of the said passages are provided, respectively, with removable sections e', Fig. 1, e^2, Fig. 2, the removable section of the air-passage being shown as a part of the wall A′.

The passage b^4 in the cap b^3, through which the heated air issues into the heating-chamber A^3, is contracted at its outlet or discharge end to increase the force of the air issuing therefrom.

The heating-chamber A^3 is provided with a door e^3, preferably one on each side of the furnace, and composed of an outer metal plate e^4, having on its inner sides, as shown, beveled ribs e^5, (see Fig. 8,) and an inner facing or lining e^6, of fire-brick or other refractory material. The plate e^4 and ribs e^5 will preferably be cast together, and each of the said ribs will preferably be left or made straight at its upper end near the top of the plate e^4, as at $e^\times$, (see Fig. 8,) to permit a brick e^6 to be readily inserted between the said ribs and then dropped toward the bottom of the door, the top brick between each pair of ribs being wedged home in any usual or well-known manner. The lining of the door is thus made up of sections each removable independently of another, the said sections being retained in place by the beveled form of the ribs e^5. The metal plate e^4, Fig. 10, may be perforated, if desired, for sake of lightness. The door is provided with an orifice e^7, through which the operator may view the interior of the furnace and through which the material may be worked, if required. The orifice e^7 is closed by a swinging or sight door e^8, pivoted at e^9, (see Fig. 10,) the said swinging door having an orifice normally closed by a brick e^{10}, interposed between a flange e^{15} of the door e^8 and a cover e^{12}, bolted to the outside of the said door, the said brick e^{10} or other refractory material being readily replaced by means of the said cover. The sight-door is provided with a counterbalancing-weight e^{14}, and the entire furnace-door is raised and lowered, as herein shown, through a lever pivoted at e^{16} to a rafter e^{17} or other suitable support. The lever referred to has a sector-arm f, to which is secured by a bolt f' side pieces or bars f^2, extended, as shown, below the sector-arm and secured together by bolt f^3, the bolt f^3 extending through or having fastened to it a straight link or rod f^4, fixed to the staple f^5 of the door. The weight of the door e^4 is counterbalanced, as shown, by a rail f^6 or other bar having a handle, (not shown,) by which the operator may raise and lower the said door.

By the arrangement described the door e^4 is under perfect control and may be left in any desired position.

The door and mechanism to operate it are not herein claimed.

When it is desired to heat some classes of materials—such, for instance, as copper and brass—a false bottom, preferably made of bars or strips f^{12} of wrought-iron, as shown in Fig. 1, is placed in the heating-chamber. The false bottom of wrought-iron keeps the copper or other material perfectly clean and permits the same to be readily moved.

For annealing and similar purposes, where it is desired that the flame should not come directly in contact with the material, a "muffle" f^8 (see Fig. 2) may be placed in the heating-chamber A^3, the said muffle being supported above the bottom of the chamber by wheels f^9 or in any other suitable manner, so that the flame may pass beneath and heat the muffle uniformly on all sides.

When it is desired to heat a number of light articles but a short time, the said articles may be placed on a suitable bottom, (not shown,) which is adapted to be moved slowly through the heating-chamber by any suitable mechanism in well-known manner.

By inclining the bottom a^{12} of the ash-pit upwardly toward the rear the draft is forced up toward the rear wall of the ash-pit and caused to pass up through the bed of coal or fuel supported at the rear of the grate-bars, thus producing a substantially-uniform consumption of the fuel, and, furthermore, the removal of the ashes is facilitated.

When it is desired to remove the ashes lying upon and above the grate-bars a', crupper-bars g^* may be inserted in usual way through the doors 5, one end of each crupper-bar being extended into and resting upon one of a series of ledges g, (see Fig. 1,) made by recessing the wall A′.

By forming the ledge g, as described, the clinkers formed on and adhering to the wall A′ may be readily detached, and a firm support thus secured for the said crupper-bar.

By providing each gas-producer with independent air and steam pipes controlled by suitable valves each gas-producer may be operated independently of the others—that is, one gas-producer, located at one end of the furnace, may be supplied with a less quantity of air and steam than another gas-producer—as, for instance, the gas-producer at the opposite end of the furnace, and consequently the heat generated by the first gas-producer, will be less than that generated at the other end.

It will be noticed that all the gas-producers communicate with a common combustion-chamber, as clearly shown in Fig. 3, which has a common air-supply—namely, the pas-

sage 12 in the bridge-wall communicating with the said combustion-chamber through the ducts b^4 in the removable caps, as shown in said figure.

I claim—

1. In a continuous regenerator-furnace, the combination, with the outer walls and dome or roof supported thereby, of an inner dividing upright wall, as A′, extended to near the said roof and forming an unobstructed passage for the products of combustion, and provided at its upper end or top with a flue or passage 12, having outlet-ducts b^4, extended up through the top of the bridge-wall, and a gas-producer having its outlet between the said upright wall and roof, the hearth provided at its rear end with openings for the escape of the products of combustion, and upon which the material to be heated is placed, and a checker-work or continuous regenerator located below and contiguous to the said hearth and having alternately-arranged passages b^5 b^7 for air and the products of combustion, the flue or passage in the dividing-wall communicating with the uppermost air-passage and forming the outlet for the air-passage b^5, and the passage b^7, communicating with the stack, the products of combustion passing through the regenerator in an opposite direction to the passage of air, substantially as described.

2. In a continuous regenerator-furnace, the combination, with the outer walls and dome or roof supported thereby, of a plurality of gas-producers A^2, located within the said walls, a common heating-chamber to receive the material to be heated, provided with openings or gas-exits opposite each gas-producer, a checker-work or continuous regenerator located below the said heating-chamber, an exit-flue common to the heating-chamber, and an air-inlet flue common to the checker-work, and a separate air-pipe and steam-pipe for each gas-producer provided with valves by which the quantity of air and steam admitted to the gas-producers may be controlled to vary the heat admitted to the heating-chamber from each gas-producer, whereby different parts of the heating-chamber may be heated to different temperatures to enable the said chamber to be used for different classes of work at the same time, substantially as described.

3. In a continuous regenerator-furnace, the combination, with the outer walls and dome or roof supported thereby, of an inner dividing upright wall, as A′, extended to near the said roof and provided at its upper end or top with a flue or passage 12, a gas-supplying pipe 9, located in said flue or passage, a gas-producer having its outlet between the said upright wall and roof, a hearth upon which the material to be heated is placed, having openings at its rear end for the escape of the products of combustion, and a checker-work or continuous regenerator located below the said hearth and having passages b^5 b^7 for air and the products of combustion, the air-passage b^5 communicating with the flue or passage 12 in the top of the dividing-wall, the gas supplied by the pipe commingling with the products of combustion, substantially as described, and for the purpose specified.

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

JAMES A. HERRICK.

Witnesses:

JAS. H. CHURCHILL,

B. DEWAR.