(No Model.) 3 Sheets—Sheet 1.

L. MAMBOURG & U. HOUZE.

BOILER FURNACE.

No. 536,884. Patented Apr. 2, 1895.

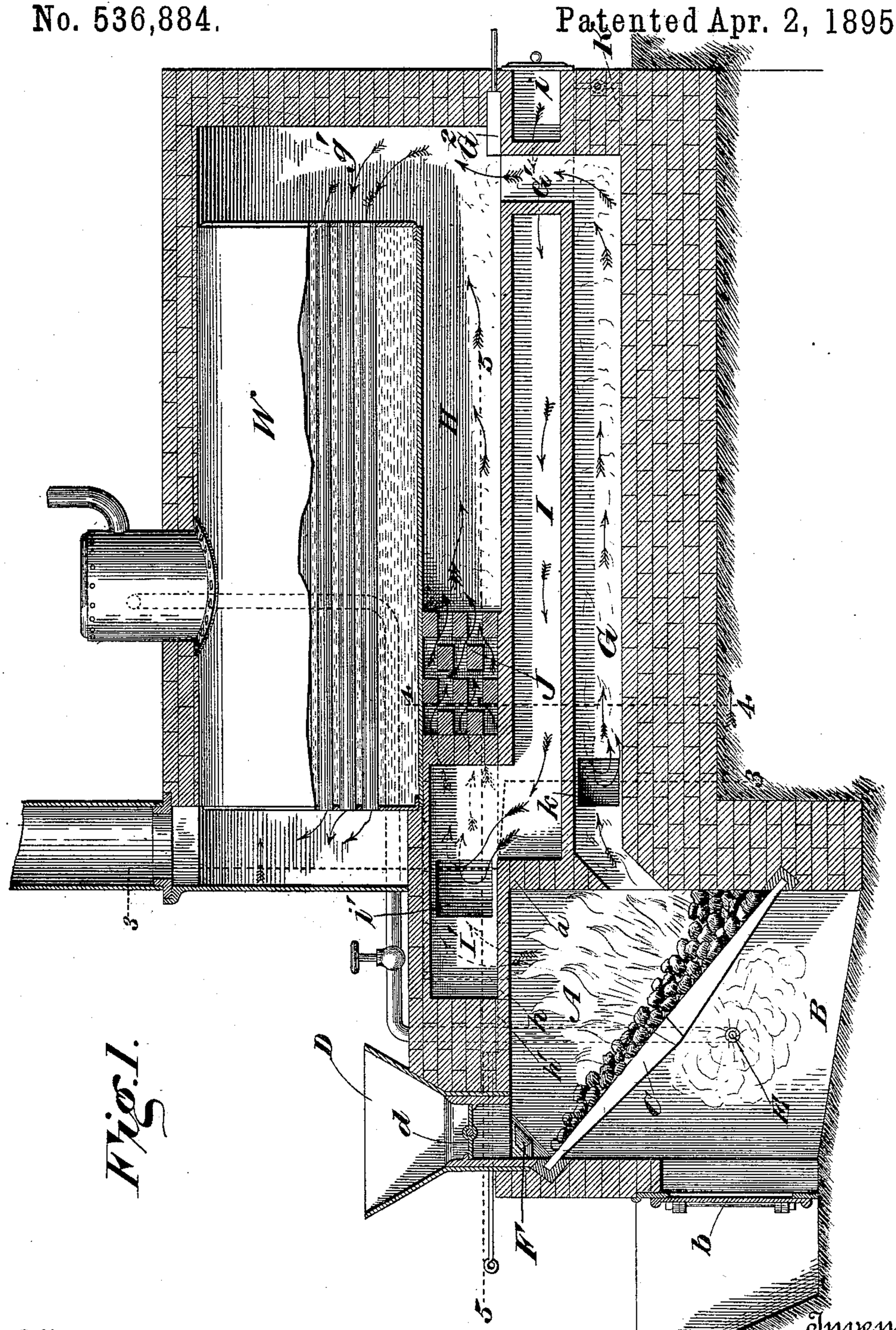

Fig. 1.

Witnesses
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Fig. 2.

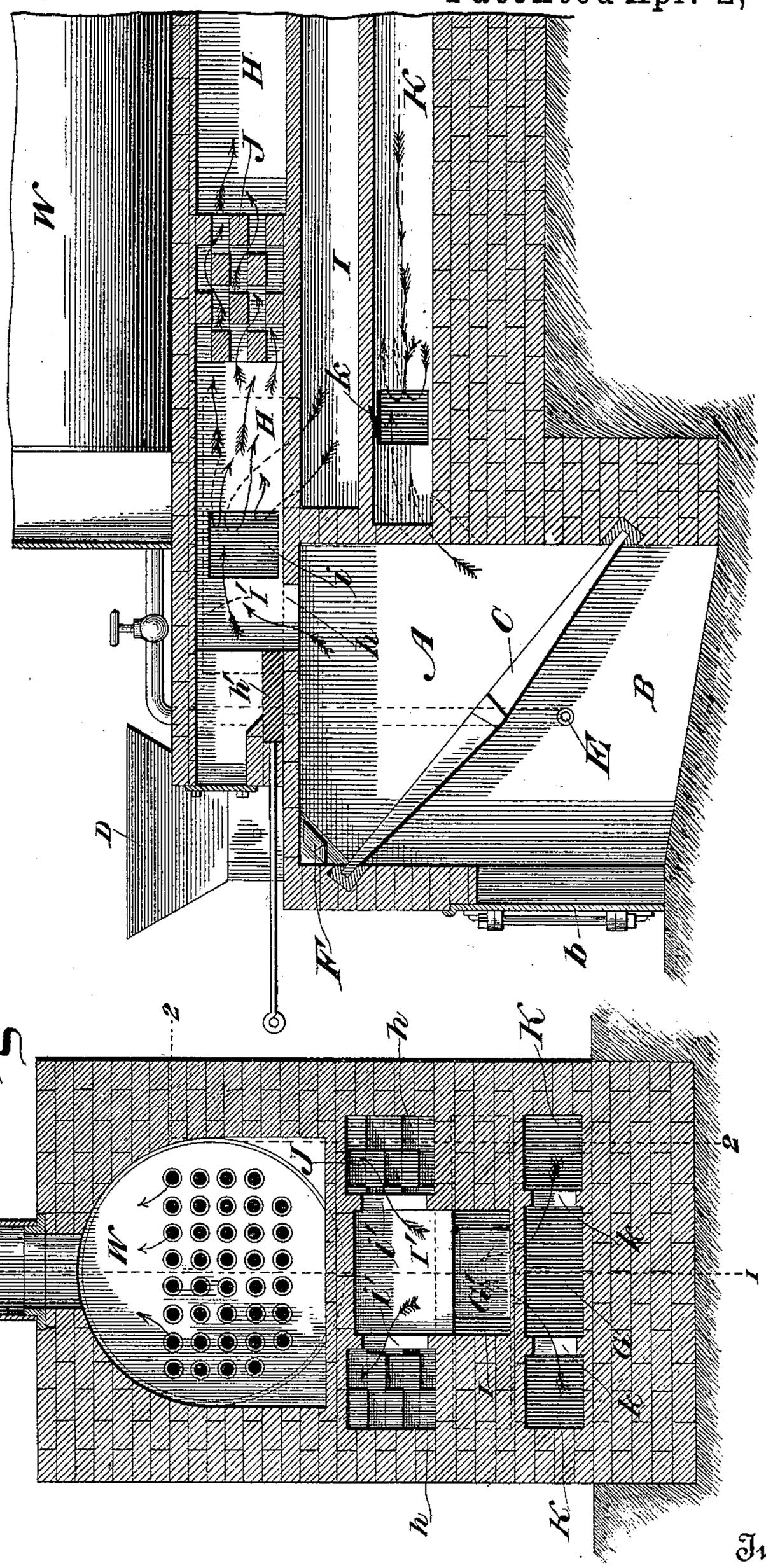

Fig. 3.

Witnesses
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(No Model.) 3 Sheets—Sheet 3.

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Fig. 3.

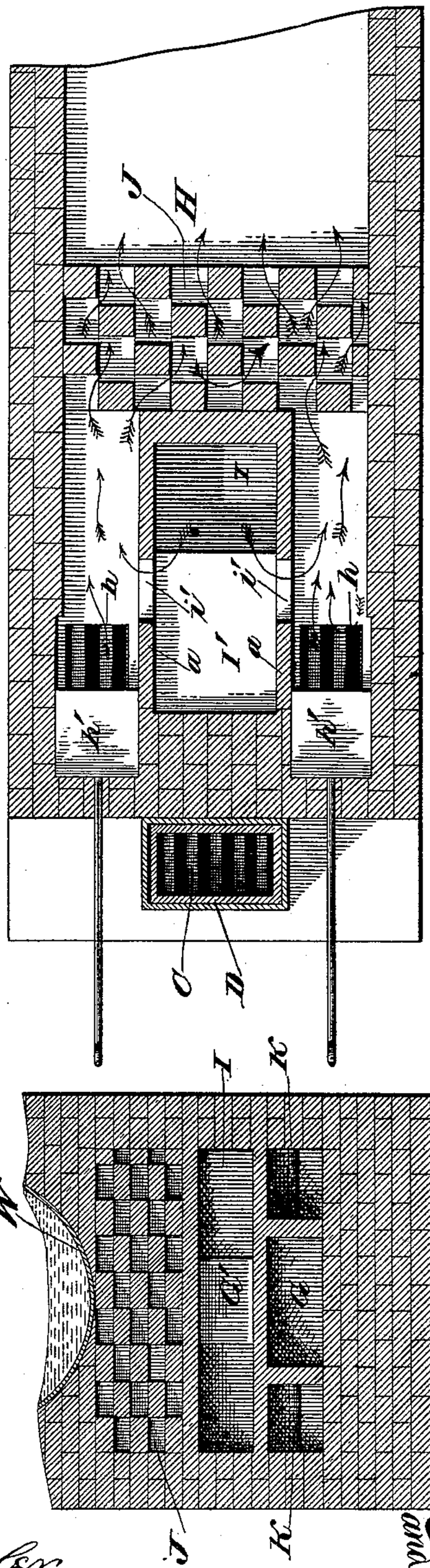

Fig. 4.

Witnesses
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UNITED STATES PATENT OFFICE.

LEOPOLD MAMBOURG AND ULGISSE HOUZE, OF CIRCLEVILLE, OHIO, ASSIGNORS OF ONE-HALF TO ARTHUR C. HUIDEKOPER, OF MEADVILLE, PENNSYLVANIA.

BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 536,884, dated April 2, 1895.

Application filed May 28, 1894. Serial No. 512,752. (No model.)

To all whom it may concern:

Be it known that we, LEOPOLD MAMBOURG and ULGISSE HOUZE, of Circleville, in the county of Pickaway and State of Ohio, have invented certain new and useful Improvements in Boiler-Furnaces; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

Our invention is an improved furnace, especially designed for use in connection with boilers, but useful wherever great heat and thorough combustion of fuel are desired.

The invention is especially designed for burning hard fuels, such as coal, and its objects are to economize the fuel by producing more perfect combustion (without the employment of expensive means or auxiliary engines or appliances to co-operate with the furnace) than has hitherto been practically attained and which will not require skilled labor to operate the furnace.

By our improved invention, as practically tested, we have succeeded in so thoroughly combusting the fuel that the carbonaceous matters and gases generated in the fire-box are consumed or oxidized prior to their entrance into the boiler flues, so that there is no annoying deposit of soot in the flues, and only slight grayish vapors escaping from the chimney to indicate that there is any fire in the furnace; and by it we have evaporated as from seventeen to twenty pounds of water per pound of fuel used. The better the gas-making quality of the coal used, the better are the results obtained, *i. e.*, more heat generated and more water evaporated.

The great saving of fuel effected by our furnace and the consumption of smoke or carbonaceous gases therein, we attribute to the method of dividing the volume of products of combustion generated in the fire-box, commingling the separated currents of said products with air heated by such currents; and finally reuniting the said currents of commingled gases and air before they enter the boiler flues, one of said currents being super-charged with oxygen so that all carbonaceous particles and gases in the reunited volume of products will be oxidized prior to the entrance thereof into the flues.

The furnace proper, as constructed and used by us, comprises a fire chamber from which are two distinct escape chambers for the products of combustion, hot air inlets into both chambers near the fire box; and a communication between the said chambers at a point removed from the fire-box and just before the gases enter the flues of the boiler, or other place of working. A small jet of steam is introduced under the grate during the operation of the furnace to facilitate the production of gas and prevent caking of the fuel.

The invention is summarized in the claims, and the following is a description of one practical form of the apparatus, applied to a stationary tubular boiler, as employed in practically testing the invention.

Referring to the drawings by letters of reference marked thereon, Figure 1 is a longitudinal vertical section through the furnace on line 1—1 Fig. 3. Fig. 2 is a similar section on line 2—2 Fig. 3. Fig. 3 is a transverse section on line 3—3 Fig. 1. Fig. 4 is a section on line 4—4 Fig. 1. Fig. 5 is a horizontal sectional view on line 5—5 Fig. 1.

The fire chamber A is of any suitable construction, and as shown is separated from the ash-pit B by an inclined grate C, of any suitable construction. The walls of the fire-chamber and all parts exposed to the heat should be formed of or protected by, fire-brick as the heat generated is intense. The fuel is introduced into the fire chamber through a chute D in its top, in which is a valve *d*, which should be so constructed that the fire chamber may be closed substantially air and gas tight. There need be no other opening into the fire chamber, if the grate be formed so that the coals thereon can be readily drawn. The ash pit doors *b*, *b*, should also be formed so that they can be closed substantially air and gas tight.

E is a steam jet leading into the ash pit below the grate, and controlled by a suitable valve, steam being supplied from the boiler.

At the outer upper corners of the fire-chamber small sight openings F may be made,

provided with tightly closing doors, through which openings the fire can be raked or stirred. Near the rear lower end of the fire chamber is an opening communicating with the "lower combustion chamber" G, and at the upper rear end of the fire chamber at opposite sides of a division wall *a*, are openings *h*, *h*, which communicate directly with the upper combustion chamber H. The combustion chambers are parallel, but are separated by an intervening air chamber I, to which air is admitted through openings *i*, *i*, at the back of the furnace, which can be more or less closed by suitable doors, to regulate the air supply. The inner end I' of this chamber I is contracted and turned upward and forward something like a goose-neck or bayonet, partly over the top of the fire-chamber, and intermediate the openings *h*, *h*. Openings *i'*, *i'*, are made in the contracted portion I' of air chamber I slightly in rear of the openings *h*, *h*, so that as the products of combustion rise through openings *h*, into chamber H they meet currents of heated air flowing in through openings *i'* from chamber I and the carbonaceous matters in the products of combustion are oxidized by the oxygen in the air commingled therewith. The commingling and oxidation of the products of combustion are facilitated by fire-brick checker-work J, built up across the front end of the upper combustion chamber H so that when the gases finally escape from the checker work beneath the boiler W, they are about perfectly combusted.

The lower combustion chamber is of smaller area in cross section than the upper, and at each side thereof, parallel therewith, is an air flue K into which air is admitted at the rear end of the furnace, through openings, the admission of air being regulated by suitable doors or dampers. The front ends of said air flues communicate through lateral openings *k* with the front end of combustion chamber G, and sufficient air is introduced into said combustion chamber to more than oxidize the carbonaceous matters and gases in the products of combustion passing therethrough, so that when the oxidized gases escape from said combustion chamber they will be charged with free oxygen, which will be utilized in combusting any unconsumed or non-oxidized carbonaceous gases or products of combustion which may have escaped unconsumed through the upper combustion chamber. The gases from the lower combustion chamber are discharged into the rear end of the upper combustion chamber through a flue G' leading up through the rear end of air chamber I, as shown. The flue G' can be wholly or partially closed by a fire brick damper G^2 as shown.

The air in chambers I and flues K is heated by contact with the walls thereof, which are heated by the products of combustion entering the combustion chambers from the fire chamber and the oxidation of such products in passing through the combustion chambers.

By the discharge of heated gases supercharged with oxygen into the rear end of the upper combustion chamber any unoxidized carbon or gases remaining in the upper combustion chamber are oxidized and the gases passing into the flues of the boiler are deprived of oxygen and intensely heated. Then there is less deterioration of the boiler flues and no perceptible free carbon escapes in the form of smoke.

The openings *h*, *h*, may be wholly or partially closed by fire brick valves *h'*, *h'*, which can be operated from the outside, suitably closed doors or openings being formed in the front end of the upper combustion chamber, above the fire chamber, to allow access thereto, as well as to said valves.

In operating the furnace the fire is started with ordinary draft under the grate, and after a sufficient layer of fuel to form a good bed of coke on the grate is fully ignited, the ash pit doors are closed and a small jet of steam turned on, under the grate, this jet being regulated by the observed condition of the bed of fuel, and the amount of carbon driven off into the combustion chambers. The products of combustion escaping into the upper and lower combustion chambers are therein subjected to the oxidizing effects of the heated air, which is introduced in large volumes and then the super oxygenated current of gases is directed into the other current and commingled therewith at the rear of the boiler before entering the flues. The part *g'* of the upper combustion chamber above flue G' might appropriately be called a third combustion chamber as at this point the final combustion of the carbonaceous gases, &c., takes place. When working properly there should be no visible escape of colored gases from the lower combustion chamber, and the gases in the upper chamber should burn with a bright clear flame, and no smoke issue from the chimney. The coal should be fed into the grate in small quantities at frequent intervals, rather than in large quantities after long periods of time.

While we are aware that it is not a new idea to introduce heated air into products of combustion for the purpose of oxidizing them; and that jets of steam have been used under grates in closed ash pits; and that the gases and air have been mixed in various ways, yet we believe ourselves the first to divide the products of combustion into separate currents; oxidizing part of such products by the introduction of air, and super-oxidizing another part of said products, then subsequently commingling the oxidized and super-oxidized products to insure complete oxidation of all carbonaceous matters and gases. This process is novel with us and the secret of the success of our furnace.

In the description and claims by the terms "combustion chamber" or "combustion chambers" we intend to designate chambers wherein combustion or oxidation of combustible gases, &c., derived from the fuel in the fire

chamber, takes place, as distinguished from simple gas exits or flues which have been used in some furnaces to short circuit a portion of the gases from the fire box into the combustion chamber.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent thereon, is—

1. The herein described method of producing perfect combustion in furnaces, consisting in first introducing a small jet of steam under the grate and shutting out air from the ash pit and fire chamber, second dividing the products of combustion as they pass from the fire chamber and passing them through separate combustion chambers; third introducing into the products as they enter said chambers volumes of heated air, to oxidize combustible matters in said circuits one current of gases being super-charged with heated air; and fourth re-uniting the products as they pass from the combustion chambers in a third combustion chamber whereby the free-oxygen in one current of burned products is utilized to oxidize any unconsumed combustible matters or gases in the other current of products; substantially as and for the purpose specified.

2. The herein described method of treating the products of combustion in boiler furnaces to produce perfect combustion; consisting in first separating the products of combustion outside the fire chamber into two distinct currents, one being of less volume than the other; and directing said currents into separate combustion chambers; second introducing into said chambers large volumes of heated air to mix with and combust the products as they traverse said chambers, and third, re-uniting the said products of combustion just before they enter the flues of the boiler, substantially as and for the purpose set forth.

3. A smokeless boiler furnace, having a fire chamber, two distinct combustion chambers exterior to said fire chamber but communicating therewith so as to each receive part of the products of combustion, and communicating with each other at a point remote from the fire-chamber; and means for introducing volumes of heated air into said combustion chambers, substantially as described.

4. A smokeless boiler furnace having a tightly closed fire chamber, means for injecting steam under the grate; a pair of distinct combustion chambers, underlying the boiler, separately communicating with the fire chamber at their front ends and with each other at their rear ends only; and air heating chambers communicating with said combustion chambers near their front ends but outside the fire-chamber, substantially as and for the purpose described.

5. In a furnace the combination of a fire chamber, upper and lower combustion chambers communicating therewith at their front ends and with each other at their rear ends; an air heating chamber intermediate said combustion chambers, having openings to supply heated air to the upper chamber, and air heating passages communicating with the lower chamber, all substantially as and for the purpose described.

6. In a furnace the combination of the fire chamber, the combustion chamber communicating therewith through openings in the top of the fire chamber; the air heating chamber underneath the combustion chamber, having an extension at its front end lying partly over the fire chamber intermediate the gas escape openings therein and lateral openings in said extension whereby air is introduced into the gases as they enter the combustion chamber from the fire chamber, substantially as and for the purpose described.

7. In a furnace the combination of a fire chamber adapted to be tightly closed, a large combustion chamber communicating with the upper end of said fire chamber; a smaller combustion chamber communicating with the fire chamber below the other, and with the other at its rear end; and means for introducing volumes of heated air into said combustion chambers near but outside of the fire chamber; substantially as and for the purpose set forth.

8. In a furnace the combination of a fire chamber adapted to be tightly closed; a pair of combustion chambers, communicating with the fire chamber at their front ends and with each other at their rear ends and an air heating chamber intermediate said combustion chambers, substantially as described.

9. In a furnace the combination of a fire chamber adapted to be tightly closed, a large combustion chamber communicating with the upper end of said fire chamber; an air heating chamber below said combustion chamber communicating therewith at its front end; a smaller combustion chamber communicating with the fire chamber below the air chamber and with the rear end of the upper combustion chamber, and means for supplying heated air to the smaller combustion chamber, substantially as set forth.

10. In a furnace the combination of the fire chamber, the upper and lower parallel combustion chambers communicating therewith at their front ends and with each other at their rear ends; the intermediate air chamber having an extension over the fire-chamber, and lateral openings in said extension for supplying air to the upper combustion chamber, air flues beside and parallel with the lower combustion chamber and openings for supplying air therefrom to the hotter chamber, all substantially as described.

11. In a furnace the combination of the fire chamber, the steam jet thereunder, the combustion chamber H communicating with the fire chamber, the air heating chamber below chamber H having an extension I entering and dividing the front end of chamber H, and openings in said extension to admit air into chamber H, substantially as described.

12. In a furnace the combination of the fire

chamber A, having openings *h*, *h*, and feed hopper; the jet E, the combustion chamber H communicating with the fire chamber through openings *h*, the air heating chamber I, having part I′ extending up into the combustion chamber H and over the fire chamber between openings *h*, *h*, provided with lateral openings *i*′, all substantially as and for the purpose set forth.

13. The combination of the fire chamber A, having lower openings and upper valved openings *h*, *h*; the lower and upper combustion chambers G, H, communicating with said fire chamber through said openings respectively; and the intermediate air chamber I having extension I′ communicating with chamber H, substantially as described.

14. In a furnace, the combination of the fire chamber having valved inlet chute D and sight openings F above the grate; the steam jet below the grate; the combustion chambers G and H communicating with the fire chamber at their front ends, and the air heating chamber I and flues K respectively communicating with chambers H, G, all constructed and arranged substantially as and for the purpose specified.

15. In a furnace the combination of the fire chamber A having openings *h*, *h*, and feed hopper; the jet E, the combustion chamber H communicating with the fire chamber through openings *h*, the air heating chamber I, having part I′ extending up into the combustion chamber H and over the fire chamber between openings *h*, *h*, provided with lateral openings *i*′, and the lower combustion chamber G communicating with the lower part of the fire-chamber at one end and with the rear end of chamber H at its other end; and the air flues, all substantially as and for the purpose described.

In testimony that we claim the foregoing as our own we affix our signatures in presence of two witnesses.

LEOPOLD MAMBOURG.
ULGISSE HOUZE.

Witnesses:
LEON HOUZE,
IRVIN F. SNYDER.