(No Model.)

2 Sheets—Sheet 1.

C. J. DORRANCE.

FURNACE.

No. 559,887. Patented May 12, 1896.

Fig. 1.

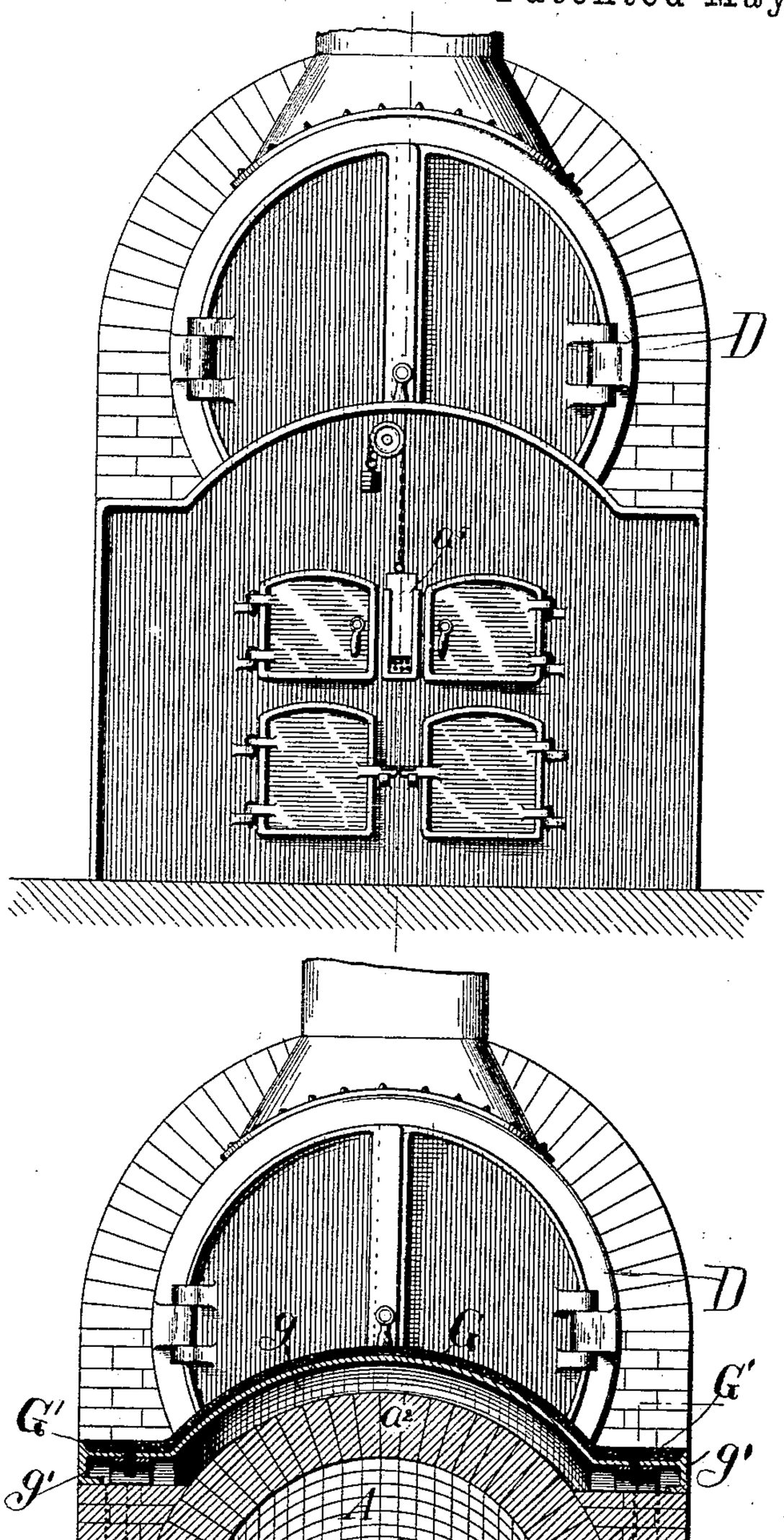

Fig. 2.

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Samuel Kirk.

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(No Model.)

2 Sheets—Sheet 2.

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No. 559,887.

Patented May 12, 1896.

Fig. 4

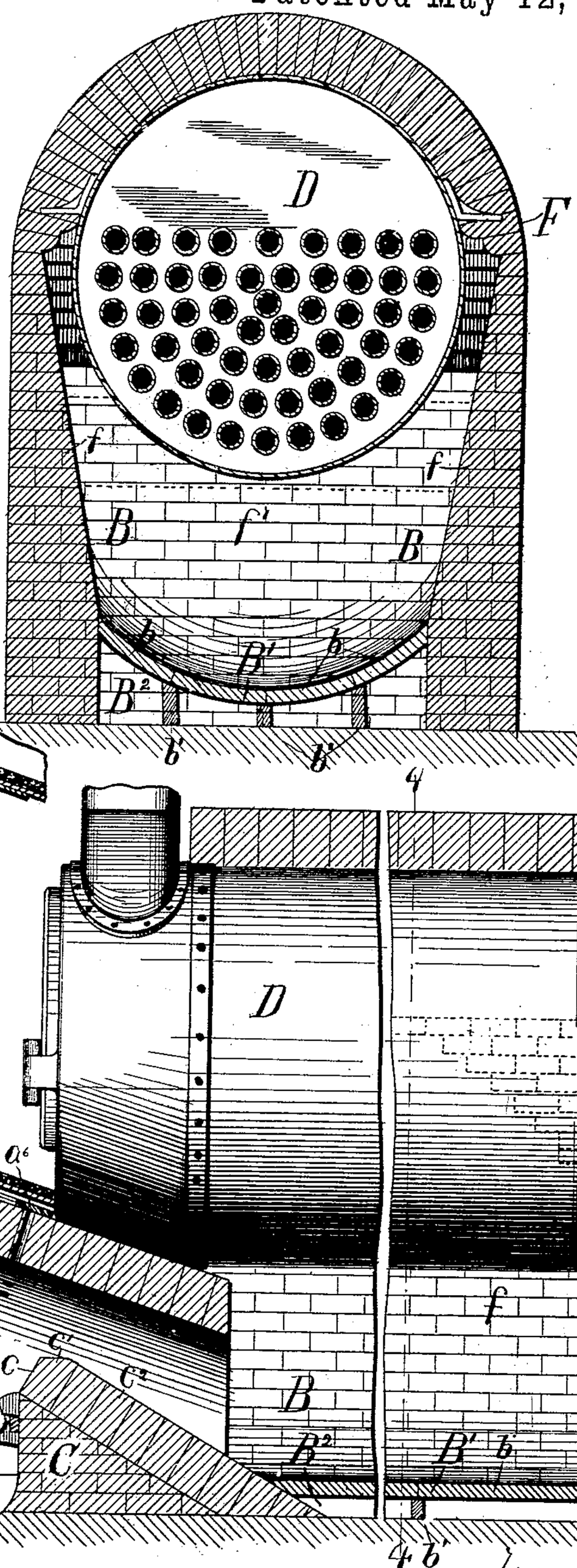

Fig. 5.

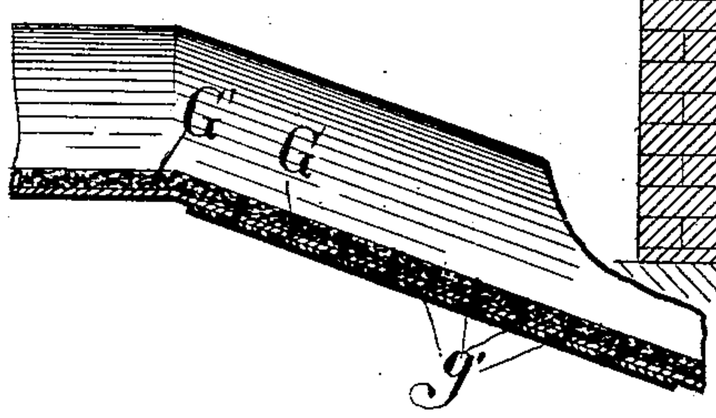

Fig. 3

Witnesses
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UNITED STATES PATENT OFFICE.

CHARLES J. DORRANCE, OF CHICAGO, ILLINOIS.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 559,887, dated May 12, 1896.

Application filed January 26, 1892. Serial No. 419,255. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. DORRANCE, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnaces; and I 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 a part of this specification.

In boiler-furnaces as heretofore constructed the boiler has been generally arranged to extend the entire length of the furnace, its forward end being located above or forming the top wall of the fire-chamber of the furnace to receive the heat rising from the bed of fuel on the grate. While this construction admits of economy of space, it has resulted in the formation of smoke, owing to the rapid cooling or condensation of the highly-heated gases on coming in contact with the cooler surface of the boiler, (which, as is well known, cannot be heated approximately beyond the temperature of boiling water under pressure,) and the consequent fouling of the boiler-flues, thus reducing the heating capacity of a given charge of fuel and at the same time contaminating the surrounding atmosphere.

The object of my invention is to effect a more perfect consumption of the products of combustion, thus increasing the heating capacity of the furnace and avoiding the fouling of the boiler-flues, and this object is attained by the construction illustrated and now to be described.

The invention consists in the matters to be hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, wherein is illustrated one form of steam-boiler furnace embodying my improvements, Figure 1 is a front elevation of the furnace and boiler. Fig. 2 is a similar view with the furnace-front removed. Fig. 3 is a vertical longitudinal section through the furnace and boiler-setting. Fig. 4 is a transverse vertical section on the line 4 4 of Fig. 3. Fig. 5 is a sectional detail illustrating the shell or jacket for the top wall of the fire-chamber and one form of damper for closing the air-inlets thereto.

In said drawings the letter A is used to designate the fire-chamber; B, the combustion-chamber; C, the bridge-wall interposed between the fire and combustion chambers, and D the boiler arranged above the combustion-chamber.

The fire-chamber A comprises a fire-front a, side walls a', and a top or roof wall a^2 of fire-brick or other suitable refractory material. The roof-wall is supported on the side walls and is arched transversely to present a surface which will reflect, radiate, or reverberate heat toward the longitudinal center of the fire-chamber, thus subjecting the products of combustion rising from the bed of fuel upon the grate E to the heat radiated from the walls a' and a^2 of the fire-chamber as well as the heat rising from the incandescent fuel, whereby the gaseous or lighter particles will be consumed before their escape from the fire-chamber A into the combustion-chamber B.

The grate E is preferably downwardly inclined from front to rear to insure a more even supply of air to and through the grate-bars at all points, and should be of a construction to admit of the supply of a great volume of air to the bed of fuel thereon. As fulfilling these requirements, I have shown the furnace fitted with a "Dorrance" grate consisting of a supporting-frame e, on which are mounted rocking bars or plates e', such as shown in Letters Patent No. 403,255, issued May 14, 1889. Other suitable grates may, however, be used.

The bridge-wall C rises vertically from the ash-pit A′ to a point parallel with the rear end of the grate E, from whence its front face c is inclined rearward at an angle, terminating in a straight horizontal crest c'. The rear or inner face c^2 of the bridge-wall is inclined downward at right angles to the front face c.

In the furnace illustrated the roof or top a^2 of the fire-chamber is constructed in the form of a semicircular arch, its radial center being somewhat above the center of the grate, as best shown in Fig. 2. I, however, do not wish to confine myself to this particular form of arched top a^2, as the arch may be in a different arc, the radial center of which may be at or below the center of the grate, the essential feature being a structure in which heat will be radiated from its walls in converging lines

tending toward the center of the bed of fuel upon the grate, thus subjecting the products of combustion rising from the fuel to the heat radiated from the intensely-heated walls of the fire-chamber, as well as to the heat from the incandescent fuel, whereby the combustible atoms released from the fuel by the heat of the fire are entirely consumed within the fire-chamber.

The arched top a^2 of the fire-chamber is shown as inclined downward toward the rear and extending beyond the bridge-wall, the effect of this construction being to emphasize the reverberatory action of the top wall a^2 and to gradually contract the area of the fire-chamber from the front thereof to the bridge-wall, which latter, in conjunction with the arched top a^2, forms a narrow throat or gorge at the rear of the fire-chamber, through which the products of combustion pass on their way to the heating or combustion chamber B, and will be so intimately commingled as to insure the consumption of any atoms or particles that may have escaped combustion above the grate.

Owing to the more perfect combustion in the fire-chamber, the heated gases brought into contact with the cooler surface of the boiler in the combustion-chamber will be free, or practically so, from smoke-forming particles, so that the cooling or condensation of said gases will not result in the deposit of soot or smoke in the heating-chamber or boiler-flues, thus maintaining the normal heating capacity or area of said flues through a greater period of time than heretofore and avoiding the discharge of smoke from the chimney. It has been usual heretofore to lay the bottom wall B′ of the heating or combustion chamber B, where such a wall has been used, directly upon the ground, and this gives rise to the attraction of moisture from the ground, as is evidenced by the moisture of the ashes lodging in the combustion-chamber, the presence of such moisture necessarily reducing the temperature of the heated gases flowing through the combustion-chamber. With a view to utilizing to the greatest extent the heat passing through said combustion-chamber, the latter is lined with a refractory flooring B′, so arranged as to leave a dead-air space or spaces B^2 beneath it to prevent the absorption of moisture by the material of said flooring. This end may be attained by laying the flooring B′ upon a bed of coarse rubble; but I prefer the arrangement shown, wherein tiles b are supported at their meeting edges or corners upon suitable foundations b', or to employ hollow fireproof tiles in the construction of said flooring. This flooring is curved or dished transversely in an arc having its radial center at or somewhat above the longitudinal center of the boiler, as shown in Fig. 4, in order that heat may be radiated therefrom toward the boiler, and in most instances I contemplate using glazed tiles b, or those having a vitreous surface, for the double purpose of reflecting the heat toward the boiler and the more certain avoidance of absorbing moisture. The boiler-setting F is of usual construction, except that at the rear it is drawn down or built in to counteract the tendency of the heat to ascend to the upper flues of the boiler and to direct the flame and heated gases toward the lower flues thereof, as is best illustrated in Figs. 3 and 4. In these figures the side walls f of the combustion-chamber are shown bricked in a number of courses at the rear to attain this end, and in Fig. 4 the rear wall f' is bricked in against the end of the boiler a number of courses below the top of the boiler-shell. I have also shown the rear wall f' fitted at a suitable distance above the lower edge of the boiler with a deflector F′, the purpose of which is to direct a portion of the heat and flame into the lowermost flues of the boiler.

In the practical use of a furnace constructed as herein described—that is to say, one in which the fire-chamber is located in advance of the boiler—a certain small percentage of heat will be radiated from the arch a^2 of the fire-chamber into the furnace-room. To avoid this loss of heat by radiation and the overheating of the furnace-room, the top a^2 of the fire-chamber may be inclosed by a shell or jacket G, of iron or other suitable material, so constructed and arranged that there will be an air-space g between the exterior of the wall a^2 and the jacket G. This jacket may also be covered with an envelop G′, of asbestos or other non-conducting material, to more effectually prevent the radiation of heat.

I have found by experience that in rapid firing with some varieties of coal which are particularly rich in free carbon the volume of free carbon released is so great in proportion to the grate-surface that sufficient air cannot be drawn through the grate to supply complete combustion, and therefore a portion of the free carbon or smoke-forming particles will pass from the fire-chamber A unconsumed. To provide for such contingencies I have supplied the front and the arched top of the fire-chamber with a number of minute air-inlets a^3 a^4, which are normally closed by means of dampers a^5 and a^6. The air-inlets a^3 are formed in the adjacent side plates A^2 of the fire-doors and in a connecting-plate A^3 bridging the space between the inner ends of said adjacent side plates of the fire-doors. A damper a^5 slides in vertical ways formed in the iron furnace-front between the fire-doors, thus constituting a closed chamber A^5, the inner and side walls of which are formed by the perforated plates A^2 and A^3. The damper may be secured in different positions of adjustment by any well-known means—as, for instance, by the counterweight shown. The air-inlets a^4 are formed in the arched top of the fire-chamber at a point adjacent to the bridge-wall, and are normally closed by a

damper arched to conform to the arch of said top wall. The outer ends of these inlets are inclosed by the jacket G, so that air supplied through them to the fire-chamber is first heated in the space between the arched top wall a^2 and its jacket. In order that air may also be drawn from this space to supply the inlets a^3 at the front of the fire-chamber, a passage may be formed between said space and the chamber A^5, said passage being normally closed by any suitable damper to prevent the admission of air through the inlets a^3 under ordinary conditions. Passages or flues A^6 may also lead from this space between the top wall a^2 of the fire-chamber and its jacket G to the sides of the ash-pit in order to supply heated air beneath the grate. To afford an air-supply to said space g the jacket G is provided at its lower edges with openings g', fitted with dampers, by means of which said openings may be closed under ordinary conditions, and thus the space g then becomes or constitutes a dead-air space.

While I do not wish to be limited to the details of construction herein shown and described, yet I have found that the most practical results are attainable by the use of this construction.

I find very great advantages derived by providing the under side of the arched top and side walls of the fire-chamber with a glazed or vitrified surface; but while claiming this feature I do not wish to be limited thereto, as the arched top may be constructed as first described.

I have thus far described my improvement in furnaces as applied to a boiler; but it must be understood that I do not intend to limit myself to this single application, inasmuch as it may be used, with very slight mechanical changes, in constructing smelting, refining, copper-matte, puddling, and other furnaces. It will also be understood that the front of the boiler may overlap the arched top of the fire-chamber to a greater extent than is shown herein, so long as said boiler does not form any part of the walls of the fire-chamber, the essential feature of this part of the invention being that the temperature of the fire-chamber or the heated products of combustion therein shall not be reduced by exposure to or contact with the cooler surface of the boiler forward of the bridge-wall.

What I claim is—

1. A boiler-furnace comprising a fire-chamber and a combustion-chamber separated by a bridge-wall, said fire-chamber being arranged in advance of the boiler and having its side and top walls formed of a continuous arch, said top wall being rearwardly inclined and extended beyond the crest of the bridge-wall and beneath the boiler, substantially as described.

2. A boiler-furnace comprising a fire-chamber arranged in advance of the boiler and having its side and top walls formed of a continuous arch, said top being rearwardly inclined and extended beneath the boiler, a combustion-chamber beneath the boiler, and a bridge-wall the crest of which is arranged somewhat forward of the rear end of the arched top of the fire-chamber and forms in connection therewith a relatively narrow throat or gorge between the fire and combustion chambers, substantially as described.

3. A boiler-furnace comprising a fire-chamber arranged in advance of the boiler and provided with a rearwardly-inclined arched top extending beneath the boiler, a combustion-chamber beneath the boiler having a transversely-concaved bottom wall or flooring, and a bridge-wall between said fire and combustion chambers and in advance of the rear end of the arched top of the fire-chamber, substantially as described.

4. The combination with a boiler-furnace comprising a fire-chamber arranged in advance of the boiler and having an arched top extending beneath the boiler, and a combustion-chamber beneath the boiler, of a jacket arranged to cover the arched top wall of the fire-chamber and leave an air-space between said jacket and top wall, substantially as described.

5. The combination with a boiler-furnace having a fire-chamber arranged in advance of and having its arched top extending beneath the boiler, and a combustion-chamber beneath the boiler, of a jacket inclosing the top wall of the fire-chamber forward of the boiler and provided with valved openings, and ducts or inlets leading from the air-space between the jacket and top wall, to the interior of the fire-chamber, substantially as described.

6. The combination with a boiler-furnace comprising a fire-chamber arranged in advance of and having an arched top wall extending beneath the boiler, and a combustion-chamber beneath the boiler, of a jacket inclosing the upper part of the top wall of the fire-chamber and having valved openings therein, and valved inlets leading from the air-space within the jacket to the interior of the fire-chamber, substantially as described.

7. The combination with a boiler-furnace comprising a fire-chamber arranged in advance of and having a top wall extending beneath the boiler, and a combustion-chamber beneath the boiler, of a jacket inclosing the upper part of the fire-chamber, said jacket being provided with valved openings, valved inlets leading from the air-space beneath the jacket to the interior of the fire-chamber, and passages leading from said air-space to the ash-pit beneath the grate, substantially as described.

8. A boiler-furnace comprising a fire-chamber and a combustion-chamber separated by a bridge-wall, said fire-chamber being ar-

ranged in advance of the boiler and provided with a rearwardly-inclined arched top extending beneath the boiler beyond the crest of the bridge-wall, said arched top being provided with a glazed or vitrified under surface, substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

CHARLES J. DORRANCE.

Witnesses:
TAYLOR E. BROWN,
GEORGE W. HIGGINS, Jr.