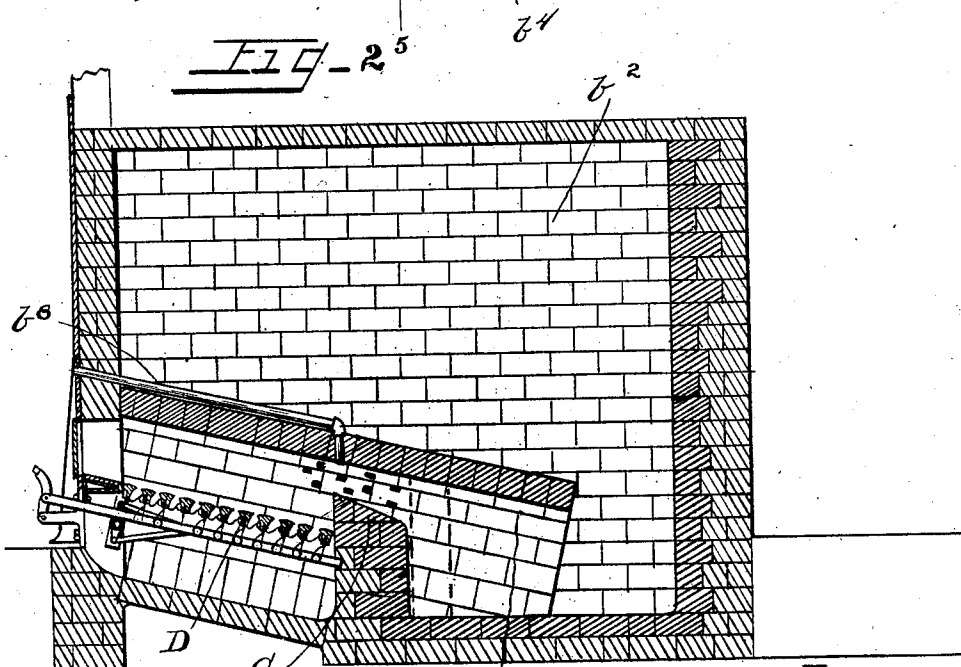
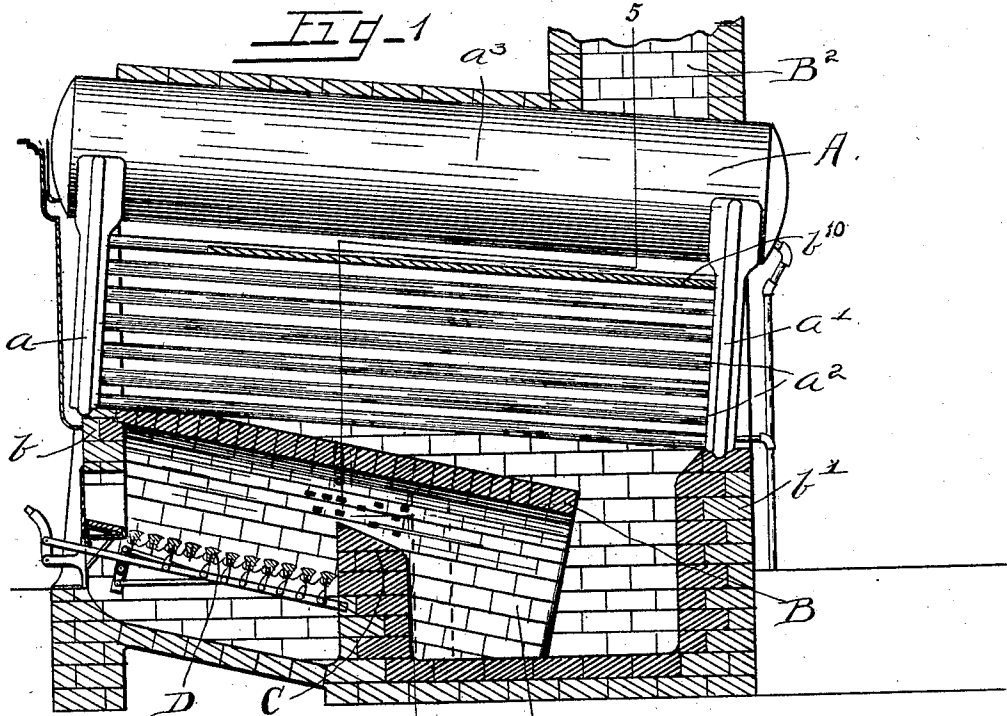


No. 827,854.

PATENTED AUG. 7, 1906.

G. J. DORRANCE.
SMOKELESS FURNACE.
APPLICATION FILED JAN. 18, 1905.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2

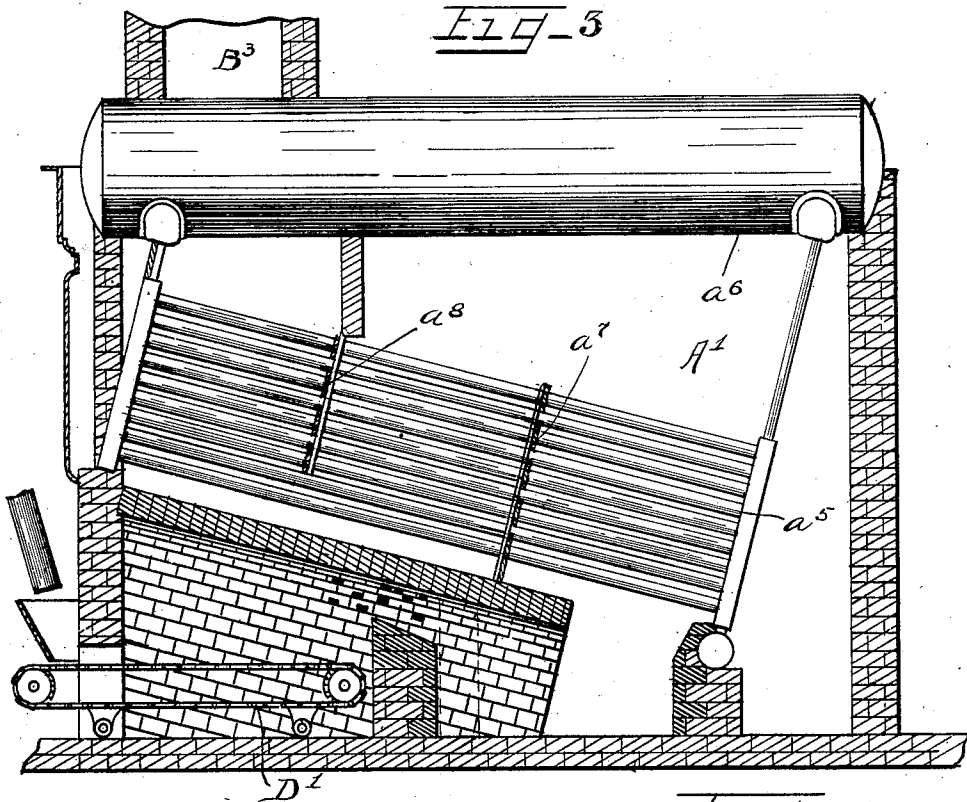


Fig-5

Fig-9

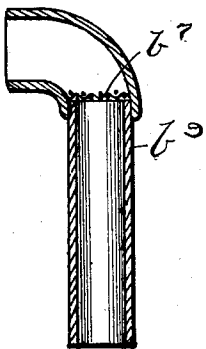


Fig-7

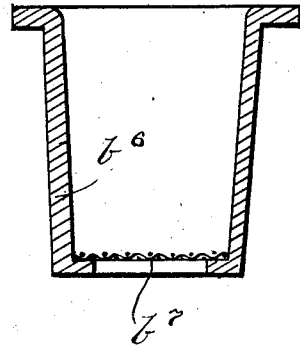
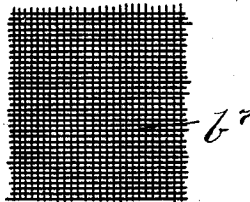


Fig-8



WITNESSES

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APPLICATION FILED JAN. 18, 1905.

3 SHEETS—SHEET 3.

Fig. 4

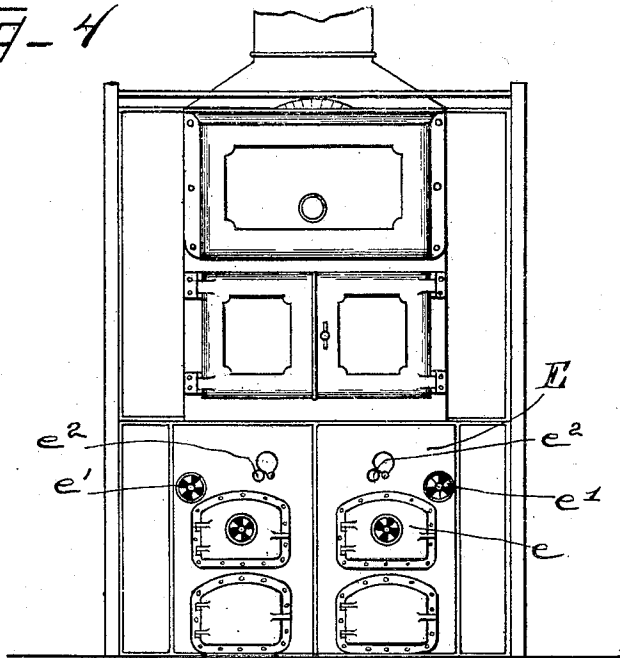


Fig. 5

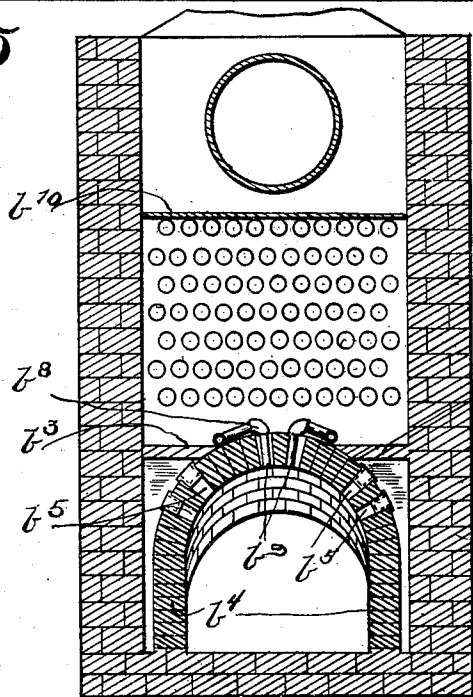
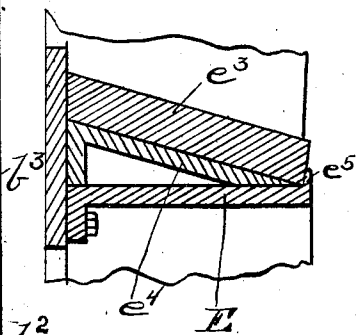


Fig. 6



Witnesses

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UNITED STATES PATENT OFFICE.

CHARLES J. DORRANCE, OF CHICAGO, ILLINOIS.

SMOKELESS FURNACE.

No. 827,854.

Specification of Letters Patent.

Patented Aug. 7, 1906.

Application filed January 18, 1905. Serial No. 241,567.

To all whom it may concern:

Be it known that I, CHARLES J. DORRANCE, a citizen of the United States, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Smokeless Furnaces; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention is shown as a smokeless boiler-furnace, though adaptable for many other purposes.

Heretofore much difficulty has existed in rendering furnaces in which soft coal and similar fuels are used smokeless. For this purpose large sums of money are annually expended and in most instances without satisfactory results. In some instances jets of live steam are thrown into the hot gases. This is partly successful in preventing the delivery of uncombined carbon into the atmosphere, for inasmuch as the steam is rarely over 300° Fahrenheit, while the gases of combustion usually exceed 800° Fahrenheit, the admission of the colder steam results merely in precipitating the carbon in the form of soot within or upon the boiler-flues, impeding radiation and increasing expense, because retarding instead of facilitating the successful operation of the furnace and, furthermore, consuming considerable steam which must be generated through the accumulating soot.

The object of this invention is to afford a furnace in which the fuel values are all consumed instead of precipitated in part and from which no uncombined carbon can be delivered into the atmosphere as smoke because of the perfect combustion assured, therefore securing the maximum efficiency of the fuel, and consequently the maximum heating effect of the furnace and generating power of the boilers.

It is also an object of the invention to afford a smokeless reverberatory furnace peculiarly adapted for use as a boiler-furnace and by the use of which maximum evaporating power of the fuel is secured in the boiler.

The invention consists in the matters hereinafter described, and more fully pointed out and defined in the appended claims.

In the drawings, Figure 1 is a central longitudinal section of a device embodying my

invention. Fig. 2 is a similar view taken at the side of the boiler. Fig. 3 is a view similar to Fig. 1, showing a chain grate and a slightly-different boiler. Fig. 4 is a view in elevation of the boiler and furnace front. Fig. 5 is a section taken on line 5 5 of Fig. 1. Fig. 6 is an enlarged detail of the dead-plate liner at the front end of the furnace. Fig. 7 is an enlarged vertical section of an air-inlet device embodied in my invention. Fig. 8 is an enlarged view of the screen shown in the bottom thereof. Fig. 9 is an enlarged longitudinal section of a pipe provided with a screen adapted for air-inlet purposes.

As shown in said drawings, the furnace is used in connection with water-tube boilers, though obviously capable for use, if desired, with fire-flue boilers or for such other purposes as it may prove adaptable.

Referring first to Fig. 1, it will be seen that the front and rear boiler-head *a a'*, respectively, of the boiler A, known as the "Heime" boiler, are supported upon the front and rear walls *b b'* of the boiler-setting. The side walls *b²* extend upwardly and support the top of the brickwork, which extends over the top of the boiler. Connected in the front end wall *b* and inclining, as shown, downwardly and rearwardly to near the rear end *b'* of the boiler-setting is the furnace B, which, as shown, is constructed of fire-brick or other suitable material, the top or arch of which is approximately semicircular and is supported upon the parallel side walls *b⁴*. Said arch, as shown, extends over and beyond the front side of a bridge-wall C, the top of which inclines rearwardly and downwardly, as shown in Figs. 1 to 3, inclusive, and at the rear of which, as shown in the drawings, is a reverberatory chamber beneath the rear end of the arch and behind the bridge-wall. On the front side of the bridge-wall and supported in the arch at suitable height in any suitable manner is the furnace-grate, which may be of any desired construction and which in Figs. 1 and 2 is shown as a shaking-grate D and in Fig. 3 is shown as a chain grate D'. The inner faces of said arch, which is usually constructed of fire-brick, may, if preferred, be faced with any material affording a reflecting-surface adapted to reflect the heat of combustion back upon the fuel to aid in combustion, and, as shown, above the bridge-wall is provided a plurality of air-inlet passages adapted to deliver a regulable supply of air into the furnace and

above the bridge-wall to afford means for consuming any free carbonaceous material as it passes through the reverberatory chamber at the rear of the bridge-wall. For this purpose, as shown in Fig. 4, apertures are provided in the boiler-front E just above and laterally of the fire-doors *e* and which are controlled, as shown, by draft-regulators *e'*. Said apertures open inwardly into a passage afforded between the side setting-walls *b*² and the walls of the arch or furnace or between adjacent furnaces when more than one are used in one setting and beneath a floor of fire-brick *b*³ or other suitable material, which extends from near the top of the arch laterally to the setting-walls. Said passages are closed at the rear of the bridge-wall. The air flowing through said passages is brought to a high temperature by the radiated heat from the furnace and said floor *b*³.

Apertures are provided through the arch above the bridge-wall, as shown in Fig. 5, and in each of which is seated a flanged casing *b*⁶, of iron, fire-brick, or other suitable material, as shown in Fig. 7. In the bottom of said casing is provided a fine screen *b*⁷, which divides the inflowing current of hot pure air from said passage into fine jets or sprays, which are thus distributed above the bridge-wall in sufficient quantity and at a temperature to support combustion most efficiently. As shown also, pipes *b*⁸, the front ends of which communicate with apertures *e*², opening through the fire-front, extend rearwardly along the top of the arch and open downwardly through the arch on each side the center thereof and above the bridge-wall. As shown, a fine wire-gauze *b*⁷ is provided in the downwardly-directed end *b*⁹ of said pipe, which breaks up the flow of air from said pipe into sprays. As shown, plates *e*³ are pivoted on the front E, adapted to restrict or close said apertures *e*², if desired.

The operation is as follows: By the construction described it will be seen that means are provided for admitting to the furnace above the bridge-wall, and, if preferred, slightly at the rear front face thereof, a regulable quantity of outside air, which, heated in its passage to the point of delivery into the furnace, when sprayed into the furnace is at a temperature to not only prevent condensation, but to insure complete combustion of any carbonaceous matter held in suspension in the gases of combustion. In consequence fierce combustion and heat of great intensity is developed in the chamber at the rear of the bridge-wall. Where such a furnace is used in connection with water-tube boilers set in an inclined position, as is usual, the water-tubes at their lower ends, owing to the tendency of hot water to rise in the circulation, should be subjected to the great heat, and this arrangement is secured with the Heine boiler installation, (shown in Fig. 1,) in which

the rear ends of tubes are subjected to the direct and fiercest heat from the arch and the draft of the furnace forwardly between the flues and beneath the deflector *b*¹⁰, then rearwardly along the boiler to the stack B² at the rear end of the boiler.

In the construction illustrated in Fig. 3, in which a boiler of the Babcock and Wilcox type is shown, the direct heat from the furnace is delivered between the lower ends of the tubes *a*⁵ upwardly to the drum *a*⁶ and is drawn downwardly between the tubes in advance of the baffle or division wall *a*⁷, of tile or other suitable material, and beneath a corresponding division-wall *a*⁸ and upwardly between the tubes *a*⁵ near the front end of the boiler to the stack B³, which in this construction is located at the front end of the boiler, thus affording a longer travel for the hot gases of combustion than has heretofore been usual.

The semicircular top of the arch aided by its downward and rearward inclination becomes intensely heated, and the fire-brick comprising the same not only reflect the heat centrally upon the fire, but also afford an area of exceedingly-high temperature, through which above the bridge-wall or at any desired points in the length of the arch fresh air, also at a high temperature and in regulable quantities, is sprayed into the furnace to meet and mingle with the upwardly and rearwardly flowing gases and more volatile carbonaceous products and uncombined carbons, which may be said to be practically in a nascent state, and in the fierce combustion which ensues in the chamber at the rear of the bridge-wall the fuel values are all consumed, and the oxidizing gases at a temperature much higher than can otherwise be attained are projected against the boiler-surfaces, which are thus kept free from any obstructing coating.

As shown, the dead plate E is provided with an inclined facing of fire-clay *e*³, which is supported on an inclined bench *e*⁴, resting on the dead plate. Said bench and facing are held in place by an upturned lip *e*⁵ at the inner side the dead plate and against which the bench and the lining bear.

Obviously the arch may extend horizontally beneath the boiler or may be partly in front of the boiler, and any suitable grates may be used, and I do not purpose limiting this application for patent otherwise than necessitated by the prior art, as obviously many details of construction and operation may be varied without departing from the principles of my invention.

I claim as my invention—

1. The combination with a furnace having vertical side walls and a semicircular top, provided with apertures therethrough of a transverse bridge-wall near the middle of the furnace and inclining downwardly on its rear

side, a furnace-grate on the front side of the bridge-wall, pipes extending from the front of said furnace and opening through part of said apertures in the top above the bridge-wall and draft-regulators in the front wall adapted to deliver air to the remaining apertures in said top.

2. The combination with a furnace having parallel vertical side walls and a semicircular arched top, of a bridge-wall intermediate the ends of the furnace, grates extending from the front wall of the furnace to the bridge-wall, air-passages opening through the arch above the bridge-wall, screens in part of said passages and screened pipes extending from part of said passages through the front of the furnace.

3. In a boiler-furnace the combination with the boiler and the setting-walls therefor, of a furnace extending beneath the boiler and comprising independent parallel side walls and a semicircular downwardly and rearwardly inclined arch or top of fire-brick, a transverse bridge-wall intermediate the ends of the furnace and having a greater inclination on its rear side than the top or arch, air-inlet passages opening through the fire-front and extending longitudinally of the furnace above the arch and opening through apertures in the arch above the bridge-wall, removable casings in part of said apertures, screens therein and pipes provided with screens in their inner ends and leading inwardly through the fire-front and extending downwardly through part of said apertures.

4. The combination with a boiler and its setting-walls of a rearwardly and downwardly inclined furnace below the boiler having a semicircular top, a transverse bridge-wall intermediate the ends of the furnace, a grate before the bridge-wall, passages opening into the top of the furnace and extending between the setting-walls and furnace-walls, regulable air-inlets therefor, a screen in each of said openings remote from the inner face of the furnace-top and acting to spray the air as it is admitted, and means removably engaged in the top of the furnace acting to support said screens in place.

5. The combination with a boiler and its setting-walls and fire-front, of a furnace extending beneath the boiler and comprising vertical independent side walls affording a passage closed at its inner end between the same and the setting-walls, an arched top thereon approximately semicircular and in-

clining rearwardly, a floor connecting the arch near its top with the setting-walls and affording a closed passage on each side the furnace, a centrally-disposed bridge-wall in the furnace, regulable air-inlets opening into the passages from the front, a plurality of casings inserted in and opening through the top or furnace above the bridge-wall and a screen in each casing adapted to spray the air heated in said passages into the furnace.

6. In a structure of the class described the combination with a boiler and its setting-walls, of a furnace extending beneath the boiler and comprising independent side vertical walls, a downwardly and rearwardly inclined arched top thereon extending beyond the middle of the boiler, a bridge-wall having its top inclined more than said arch, a grate in advance of the bridge-wall, a floor and an inner end wall connecting the arch from near its top with the setting and affording a highly-heated passage on each side of the furnace closed at the inner end and communicating with openings in the fire-front, draft-regulators secured on the fire-front and controlling said openings, screened apertures opening from each passage through the arch above the bridge-wall, pipes extending above and along the top of the arch and opening through the fire-front and also through the top of the arch and screens secured in said pipes.

7. The combination with a boiler and its setting-walls and fire-front of a furnace-arch arranged therein independently of the setting-walls and affording a closed passage on each side the same, regulable inlets for said passages in the fire-front, a plurality of apertures through the furnace-arch near the middle of the same, a centrally-disposed bridge-wall below said apertures affording a front firing-chamber and a rear reverberatory chamber wherein the more volatile constituents of the fuel are consumed by the hot air admitted through said arch, pipes opening from the fire-front and connected in part of said apertures, a casing engaged in each of the remaining apertures and a screen in each pipe and casing.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

CHARLES J. DORRANCE.

Witnesses:

C. W. HILLS,

W. W. WITENBURY.