

(No Model.)

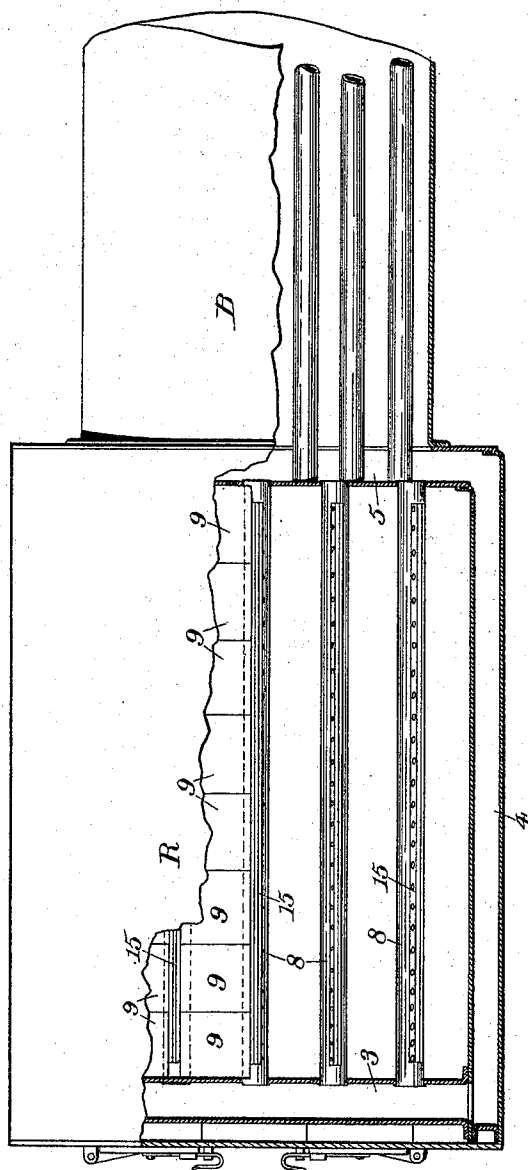
2 Sheets—Sheet 1.

F. H. RICHARDS.
FURNACE.

No. 535,730.

Patented Mar. 12, 1895.

Fig 1.



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Inventor:

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(No Model.)

F. H. RICHARDS.
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2 Sheets—Sheet 2.

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Fig. 3.

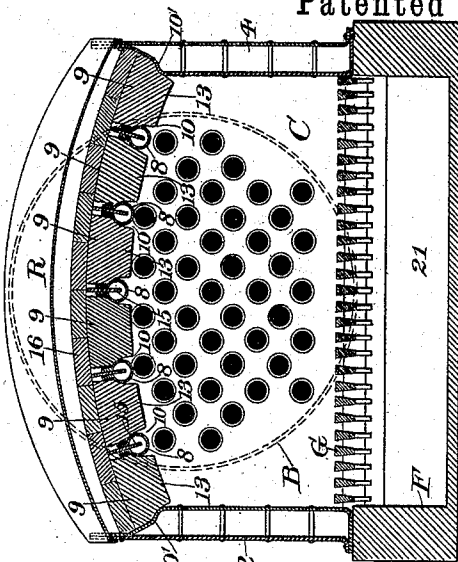


Fig. 6.

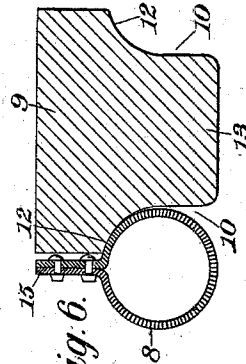


Fig. 2. a

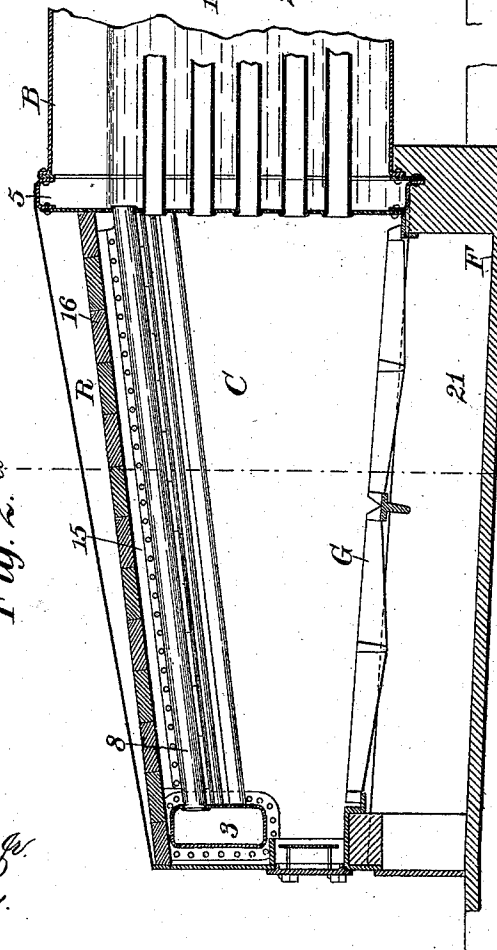


Fig. 5.

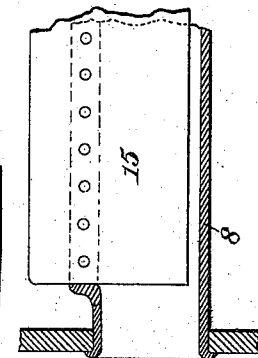
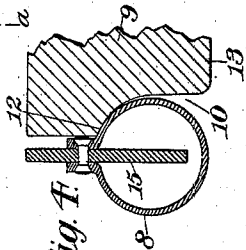


Fig. 4.



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UNITED STATES PATENT OFFICE.

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FURNACE.

SPECIFICATION forming part of Letters Patent No. 535,730, dated March 12, 1895.

Application filed October 8, 1894. Serial No. 525,208. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates to boiler-heating furnaces, and is in the nature of an improvement upon the furnace described in my application for Letters Patent of the United States, Serial No. 526,129, filed October 17, 1894, to which reference may be had, my present invention having special reference to the boiler and to the furnace thereof.

The object of my present invention is, primarily, to provide, in connection with the boiler, an improved furnace-chamber having hollow side-walls in communication with the interior of said boiler, and having a sectional roof comprising a series of roof-blocks adapted to be heated to a high state of incandescence, and to so construct and organize said roof and its component parts that the roof-blocks thereof are made interchangeable and may, one or more of them, be removed or replaced without disturbing others thereof; also to provide improved means in connection with and adapted for sustaining and also for reducing or modifying, the temperature of said roof at certain points in the area thereof.

In the drawings accompanying and forming part of this specification, Figure 1 is a sectional plan view of a portion of a furnace embodying my present improvements. Fig. 2 is a sectional side elevation of the same. Fig. 3 is a cross-sectional view of the same taken in line *a-a*, Fig. 1, looking toward the right hand in said figure. Fig. 4 is an enlarged cross-sectional view of one form of roof-block-supporting beams, showing a portion of a roof-block in connection therewith and in the position it occupies when supported thereby. Fig. 5 is a longitudinal-vertical section of the roof-block-supporting beam shown in Fig. 4. Fig. 6 is a cross-sectional view of another and slightly modified form of roof-block-supporting beam showing the roof-block in connection therewith.

Similar characters designate like parts in all of the figures.

In the drawings, the flue-boiler B (a portion only of which is shown) and the furnace-chamber or fire-box C located in advance of and connected with said boiler, are shown supported upon a foundation or base F, which may be of any usual or suitable construction adapted for carrying the boiler and fire-box. The space inclosed by the side and end walls of said base or frame constitute the ash-pit 21. The grate, G, which may be of any usual or suitable construction is shown supported at the front and rear ends thereof by the end-walls of the ash-pit 21.

As a means for maintaining a circulation of water around the sides and ends of the furnace-chamber C, the side-and-end walls thereof comprise, in part, a series of water-walls, *i. e.*, the two longitudinal recessed side-walls or water-legs 2 and 4, the transverse water-box 3, at the forward end of and communicating with water-spaces of the two side-walls, and the transverse recessed rear end-wall or water-box 5 which communicates with the water space of the boiler B and with the water-spaces of the side-walls 2 and 4. The furnace-chamber C is provided with a roof, R, of peculiar construction and organization which will hereinafter be described in detail.

The furnace-chamber roof, R, which is one of the important features of my invention, consists, in a preferred form thereof herein shown, of a series of remotely- and longitudinally-disposed hollow roof-block-supporting beams 8, and a series of heat-resistant roof-blocks, 9, supported between and by said roof-block-supporting beams. These roof-block-supporting beams are in the nature of flanged tubes, and are shown fixedly supported at the front and rear ends thereof by the adjacent shells of the front and rear water-boxes 3 and 5, respectively, with which water-boxes said roof-block-supporting beams communicate, the flanges of said tubes being disposed respectively in planes corresponding to the directions of the downward stresses exerted upon them by the roof-blocks, so as to prevent the buckling of said beams. These strengthening flanges, or webs, are also disposed in planes perpendicular to the sides of their respective tubes, at the points of junction of such webs with the tubes, and project

inwardly into the water-spaces of the tubes, for the purpose of protecting the webs from heat by the circulation of the water within the roof-beams. It will be apparent, also, that the strain-sheets may be of relatively high tensile strength, as compared with the conduit-forming portions of the tubes, and that the two main parts of each tube may be advantageously formed from different materials, the fire-resisting qualities of the strain-sheets being subordinated to their tensile- or weight-carrying properties.

In the drawings I have shown the roof R as of the arched variety, the roof-blocks 9 thereof of practically constituting segments of the circular arch with their side faces in planes coinciding with lines radiating from a common center. The particular conformation of the roof may, however, be modified without departure from my invention. The lower adjacent edges of adjacent roof-blocks are notched in opposite directions, as shown at 10, in lines parallel to the roof-beams, to form shoulders or bearing faces, 12, which bear upon the roof-beams, 8, and to form depending portions, 13, which rest between said roof-beams with their inner faces in coinciding planes, and substantially in alignment with or below the lower faces of said roof-beams, as will be readily understood by reference to Figs. 3, 4 and 6 of the drawings. By this means the supporting surfaces of the beams are protected from the direct action of the heat.

For the purpose of rendering the several roof-blocks, comprising the roof of the furnace-chamber interchangeable, one with another, and also to provide suitable bearings for the blocks at the extreme side edges of the roof, said roof-blocks will be of duplicate structure, each having both sides thereof notched at the lower edge as shown at 10, and the upper inner edge of the two side-walls 2 and 4, will be of a conformation substantially coinciding with that of the side face of the roof-block, said side-walls having inclined shoulders, 10', adapted for supporting the side blocks of the roof as clearly shown, in Fig. 3 of the drawings.

By providing the roof-beams 8 for supporting and holding in place the roof-blocks 9, and by constructing the roof-blocks in the manner hereinbefore described and supporting them upon and between said beams and between the side-walls of the furnace-chamber, I secure a very rigid roof-structure in which the roof-blocks are interchangeable and in which one or more of the roof-blocks may be removed and replaced without displacement of the remaining blocks and without affecting the continuity of the remaining portions of the roof.

In a composite roof such as herein shown and described, it will be observed that the roof-beams not only support the roof-blocks and prevent sagging or buckling of said roof (which sagging might ensue from excessive

heat in the furnace-chamber) but said beams, in connection with the block-seats 10', at the upper end of the side-walls of the furnace-chamber sustain said blocks against displacement transversely of the furnace-chamber, the weight of several roof-blocks being normally distributed uniformly over, and being sustained by the several roof-beams and the side-walls of the furnace-chamber. This result is increased by the arched construction of the roof as a whole, so that if one beam shall sag, the blocks adjacent thereto transmit the weight laterally to the beams next adjacent thereto.

To secure the greatest rigidity in the roof-beam and prevent the collapsing or bending thereof under the weight of the roof-blocks which are supported by said beams, and to secure lightness, compactness, durability and cheapness in the structure thereof, I have provided a roof-block-supporting beam which, in the preferred form thereof shown in Figs. 4, 5 and 6, is in the nature of a tube having a lateral strengthening web or flange, 15, extending longitudinally from end to end or approximately from end to end thereof. In the drawings, I have shown in Figs. 4, 5 and 6, two slightly modified forms of roof-block-supporting beams embodying my present invention. In the form thereof shown in Figs. 4 and 5 the strengthening web or flange 15 is shown in the nature of a plate or strain-sheet extending into the interior of the tube and projecting outward beyond the periphery of said tube, the tube being divided longitudinally and the adjacent ends of said tube being secured together with the strain-sheet between them; whereas in Fig. 6 the longitudinal strengthening web is formed by bending the ends or adjacent side edges of a divided tube laterally, and securing said ends together. The construction of the roof-block-supporting beam shown in Figs. 4 and 5 is preferable to the one shown in Fig. 6 for reasons hereinafter set forth.

As is well known in this art, the furnace-chamber roof, to facilitate combustion, especially when using a low grade of fuel and a forced draft, must necessarily be heated to a high state of incandescence, and with roofs of this class, as ordinarily constructed, and wherein the roof-blocks were entirely dependent upon one another for support, much difficulty has been experienced owing to the chipping off, disintegration and crushing of the roof-blocks at their inner adjacent edges caused by the melting effect of the excessive heat within the combustion-chamber, combined with the crushing effect of the loads sustained by the successive roof-blocks, it being well known that the intense heat during the combustion of the fuel tends, in an injurious degree, to expand and soften the inner faces of the roof-blocks, and, owing to the load sustained by each block, the softened portions of the blocks are compressed more or less and will, under varying condi-

tions of the temperature in the furnace-chamber, crumble and chip off and sometimes cause the entire roof to sag or cave in. By providing roof-beams such as herein described, for supporting the roof-blocks, said roof-blocks are relieved of the injurious crushing loads which they would necessarily have to sustain if said blocks were entirely dependent upon each other for support.

To further improve the efficiency and lasting quality of the furnace-roof, and to obviate, in a material degree, the injurious melting effect of the intense heat upon said roof without injuriously impairing the incandescence of said roof, I have provided means for slightly reducing or limiting the temperature of the incandescent roof and to do this without, materially, reducing the effective temperature of the combustion area of the furnace-chamber. This means for reducing the temperature of the furnace-chamber, in the form thereof herein shown, consists of a water-circulating apparatus in connection with said roof, and comprises the boiler B, the water-walls at the sides and ends of the furnace-chamber in communication with said boiler, and the hollow roof-block-supporting beams in communication with the end water-walls. This water-circulating apparatus is adapted for maintaining a constant circulation of water through the hollow roof-block-supporting beams which, as hereinbefore described, causes a reduction of the normal temperature of the roof-blocks at the inner faces thereof while the furnace is in use.

In assembling the roof, R, assuming the boiler, the combustion-chamber walls and the roof-block-supporting beams to be set in proper position, the roof-blocks, 8, are placed in position between said beams with their shoulders, 12, resting upon the beams adjacent to said blocks, and the inner faces of said blocks coming approximately flush with the inner faces of said beams in the manner shown most clearly in Fig. 3 of the drawings. The extreme side blocks of the roof rest, as shown in said Fig. 3, upon the inclined bearing faces of the side-walls of the furnace-chamber. By reference to said Fig. 3 and also to Figs. 4 and 6 it will be seen that the strain-sheets or longitudinal flanges, 15, of the roof-beams extend upward between the adjacent side-faces and terminate approximately flush with the upper faces of the roof-blocks, and to effectually cover the joints between roof-blocks, I have provided a relatively thin joint-protector, 16, which, in the form thereof herein shown, consists of a series of blocks which rest upon the roof-blocks 8 and cover the joints between said blocks.

By providing a roof-block-supporting beam of the construction shown in Figs. 4 and 5 having a strain-sheet or web projected within the water-space between the walls of said beam, it will be seen that the cooling influence of the water in the beams upon the said web or flange will reduce the heat of said flange

and obviate in a great measure the injurious effects of the heat thereon.

Having thus described my invention, I claim—

1. In a boiler-furnace, the combination with the boiler; of a furnace-chamber having water-walls in communication with the water-space of said boiler, the water-walls at the sides of said chamber having inclined edge-faces in position and adapted for engaging the sides of the adjacent roof-blocks for supporting the same; and a furnace-chamber roof comprising a series of hollow metal roof-beams in communication with the water-spaces of the furnace-chamber, and a series of heat-resistant roof-blocks supported upon said roof-beams and water-walls, the outer blocks of said roof having inclined side-faces in position and adapted for engaging the aforesaid corresponding inclined faces of the water-walls, whereby said outer roof-blocks are supported in vertical direction, substantially as described.

2. In a furnace, the combination with the furnace-chamber; of a series of longitudinally-disposed cross-sectionally-circular tubular roof-beams fixedly supported above the furnace-chamber, and having radially-disposed longitudinal strengthening flanges in planes respectively corresponding to the directions of the downward stresses exerted by the roof-blocks, and thereby adapted to prevent buckling of said roof-beams; a series of heat-resistant roof-blocks supported upon said beams intermediate of the longitudinal flanges thereof; and means in connection with and adapted for circulating water through said beams, substantially as described and for the purpose set forth.

3. In a furnace, the combination with the furnace-chamber and its inclosing side- and end-walls; of a furnace-roof comprising a series of cross-sectionally-circular water-tubes fixedly and remotely supported in longitudinal disposition relatively to the furnace-chamber, and having radially-disposed longitudinal flanges or strengthening-webs in planes respectively corresponding to the direction of the downward stresses exerted by the roof-blocks, and thereby adapted to prevent buckling of said tubes; and a series of heat-resistant roof-blocks having their adjacent inner edges notched to form bearing-faces, and supported upon the water-tubes, and between the longitudinal flanges of said tubes; and a water-circulating apparatus in connection with and adapted for circulating water through said tubes, substantially as described and for the purpose set forth.

4. In a furnace, the combination with the furnace-chamber and its inclosing side-walls, said side-walls having inclined faces in position and adapted for engaging the sides of the adjacent roof-blocks and for supporting said blocks in vertical direction; of an arched furnace-roof comprising a series of remotely- and longitudinally-disposed roof-beams, and a se-

ries of duplicate and interchangeable heat-resistant roof-blocks supported upon and between said roof-beams, said roof-blocks having inclined lateral faces corresponding with the inclined faces of the side-walls of the furnace-chamber, whereby the outer blocks of the roof are supported in vertical direction by said inclined faces of the side-walls, substantially as described.

5. In a furnace, the combination with the furnace-chamber and its inclosing side-walls, said side-walls having inclined faces in position and adapted for engaging the lateral faces of the adjacent roof-blocks and for supporting said blocks in vertical direction, of a series of duplicate and interchangeable heat-resistant roof-blocks having inclined lateral bearing-faces corresponding with the inclined faces of the side-walls of the furnace-chamber, whereby the outer blocks are supported in vertical direction by said inclined faces of said side-walls; and a series of roof-block-supporting beams fixedly supported one between each two adjacent roof-blocks and engaging the adjacent lateral faces thereof to thereby support all of said roof-blocks in vertical direction, substantially as described.

6. In a furnace, the combination with the furnace-chamber and its inclosing side-walls, said side-walls having inclined faces in position and adapted for engaging the lateral faces of the adjacent roof-blocks and for supporting said blocks in vertical direction; of a series of remotely- and longitudinally-disposed hollow roof-beams fixedly supported equidistant from one another above the furnace-chamber and between the side-walls thereof; a series of duplicate and interchangeable heat-resistant roof-blocks supported upon and between said roof-block-supporting beams, and having similarly-inclined lateral bearing-faces corresponding with the inclined faces of the side-walls of the furnace-chamber, whereby the outer blocks are supported in vertical direction by said inclined faces of said side-walls; and means in connection with said hollow beams and thereby reducing the temperature of the adjacent walls of said roof-blocks, substantially as described.

7. In a furnace, the combination with the furnace-chamber and its inclosing side-walls, said side-walls having inclined faces in position and adapted for engaging the side-walls of the adjacent roof-blocks and for supporting said blocks in vertical direction; of a series of duplicate and interchangeable heat-resistant roof-blocks having inclined lateral bearing-faces corresponding with the inclined faces of the side-walls of the furnace-chamber, whereby the outer blocks are supported in vertical direction by said inclined faces of said side-walls; of a series of roof-block-supporting beams in bearing contact with said roof-blocks, and each having a laterally-projected flange or web extending upwardly between the adjacent faces of adjacent roof-blocks and

adapted for strengthening said beams, substantially as described.

8. In a boiler-heating furnace, the combination with the boiler; and with the water-legs or water-walls forming the side- and end-walls of the furnace-chamber, said side-walls having inclined faces in position and adapted for engaging the lateral faces of the adjacent roof-blocks and for supporting said blocks in vertical direction; of a furnace-chamber roof comprising a series of remotely- and equidistantly-disposed roof-block-supporting water-tubes fixedly supported above and longitudinally of the furnace-chamber and in and having communication with the end water-walls of said chamber; and a series of duplicate and interchangeable heat-resistant roof-blocks supported upon and between said roof-block-supporting beams, and having inclined lateral bearing-faces corresponding with the inclined faces of the side-walls of the furnace-chamber, whereby the outer blocks are supported in vertical direction by said inclined faces of said side-walls, substantially as described.

9. The herein-described roof-block-supporting beam for furnaces of the class specified; it consisting of a longitudinally-divided cross-sectionally-circular tube having an internally- and externally-projecting combined strengthening- and heat-reducing web extending approximately from end to end thereof, and radially-disposed and in a plane perpendicular to the side of the tube at the point of junction of said web, and secured to the tube and filling the space between the divided walls of said tube, substantially as described.

10. In a furnace, the combination with the furnace-chamber and its inclosing walls; of a series of heat-resistant roof-blocks supported above the furnace-chamber and between the side-walls thereof and upon the roof-block-supporting beams; a series of hollow cross-sectionally-circular roof-block-supporting beams located intermediate of the adjacent side-faces of and supporting adjacent roof-blocks, and having radially-disposed longitudinal strengthening flanges extending along the upper sides thereof in planes respectively corresponding to the directions of the downward stresses exerted by the roof-blocks, and thereby adapted to prevent buckling of said roof-beams; and a series of joint-protecting blocks supported upon and covering the joints of the successive beam-supporting roof-blocks, substantially as described.

11. The herein-described roof-beam for furnaces; it consisting of a cross-sectionally-circular water-tube having a radially-disposed strengthening web along one side thereof and in a plane perpendicular to the side of the tube at the point of junction of said web, and said web extending from the wall of the tube into the water space thereof, whereby the web is protected from heat by the water-circulation within the roof-beam, substantially as described.

12. In a furnace, the combination with a

plurality of block-supporting roof-beams in position and adapted for sustaining the roof-blocks, and each consisting of a cross-sectionally-circular water-tube having a radially-disposed strengthening web along one side thereof and extending from the wall of the tube into the water-space thereof, whereby the web is protected from heat by the water-circulation within the water-tubes; of heat-

resistant roof-blocks supported upon said roof-beams; and means in connection with and adapted for circulating water through said water-tubes, substantially as described.

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