Sept. 16, 1947. W. C. BULMER 2,427,547

FURNACE DOOR FRAME

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Fig. 2.

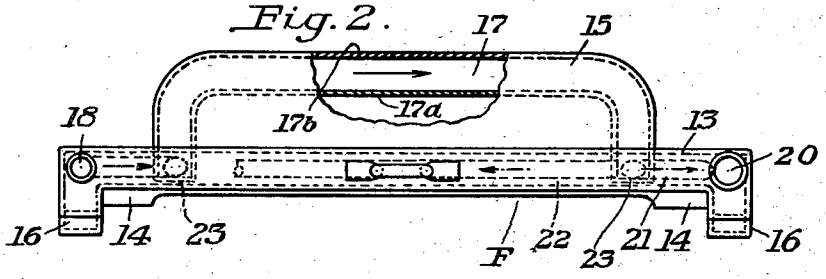

Fig. 1.

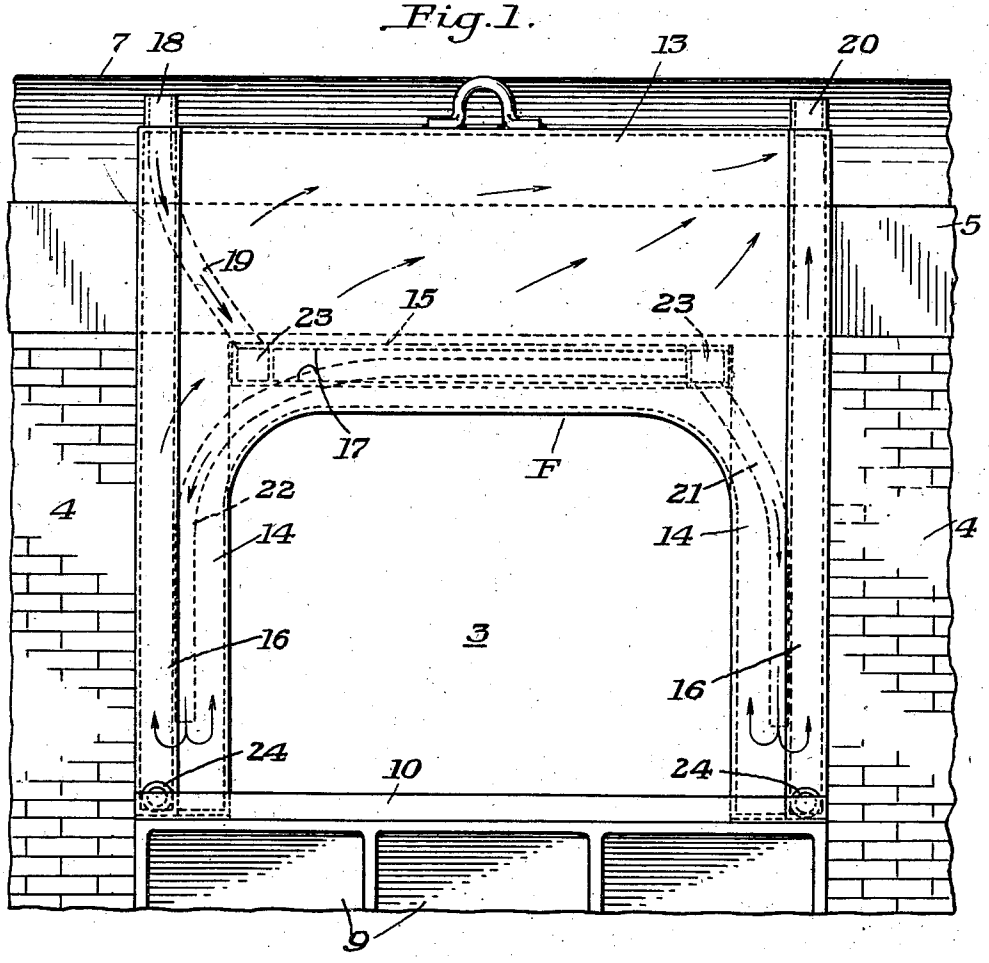

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Fig. 4.

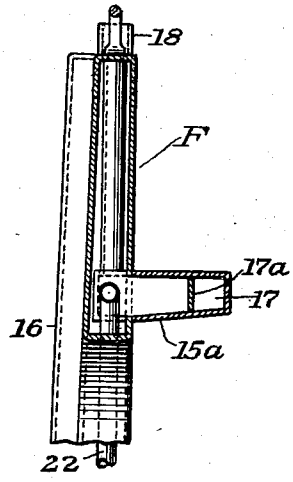


Fig. 3.

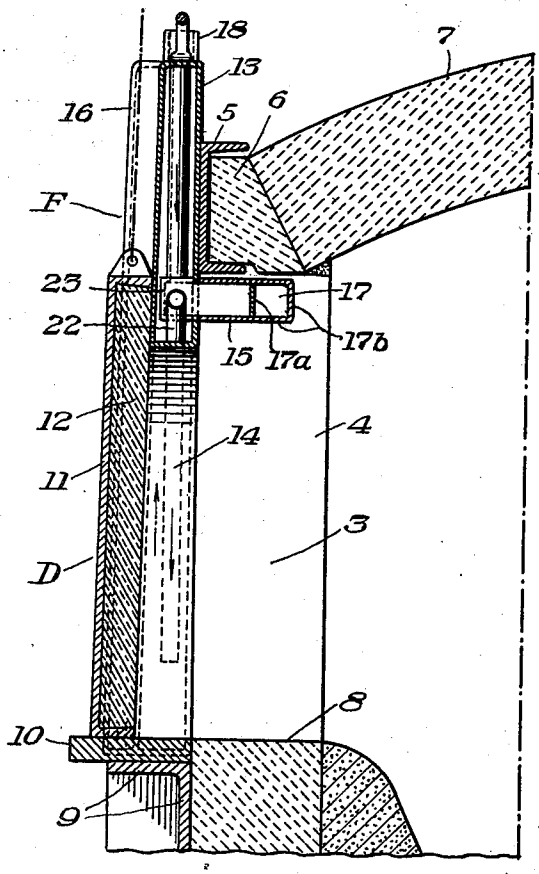
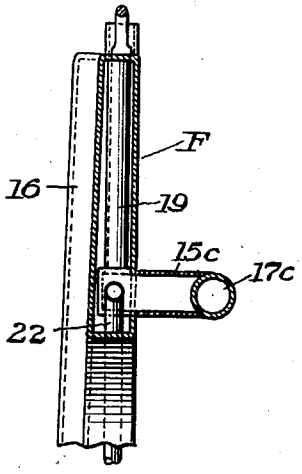


Fig. 5.



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UNITED STATES PATENT OFFICE

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FURNACE DOOR FRAME

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Application November 24, 1943, Serial No. 511,551

2 Claims. (Cl. 122—499)

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My invention relates to door frames for industrial furnaces, particularly metallurgical furnaces, such as the open hearth furnaces of the steel industry, and consists in certain new and useful improvements in fluid-cooled frames for protecting the structure of the doorways of the furnaces from the destructive effects of furnace heat.

The primary, but not the sole, object of the invention is to provide a door frame in which maximum protection against heat is obtained in those regions of the frame exposed to highest furnace temperatures, all with economy in frame construction, and ready adaptability of the frame to the various characteristics of furnace design and conditions of operation encountered in industry.

The invention will be understood upon reference to the accompanying drawings, in which, by way of example:

Figure 1 is a fragmentary view in elevation of the front wall of an open hearth furnace, showing a doorway of the furnace equipped with a frame embodying the invention;

Figure 2 is a view of the frame alone, as seen in plan from above, with a portion of the frame wall broken away to reveal a detail of internal construction;

Figure 3 is a view of the frame in vertical section, the plane of section extending transversely of the furnace front wall and medially of the doorway therein, with adjacent parts of the furnace indicated fragmentarily, and with a furnace door shown in closed position on the frame; and

Figures 4 and 5 are fragmentary sectional views, each shown on a plane corresponding to the plane of Figure 3. In these views certain modifications in structure are illustrated.

The invention will be described as it is applied to an archless doorway of an open hearth furnace. Referring to Figures 1 and 2 of the drawings, the doorway 3 comprises a rectangular opening that extends between two spaced jamb walls or piers 4 of refractory masonry, and is bounded above by the lower edge of the skew channel 5 and skew blocks 6 that support the arched furnace roof 7 along its front edge, and bounded below by the fore-wall 8. The front wall of the furnace below the doorway is protected by means of the conventional breast plate 9 upon whose upper edge is borne the usual metal fore-plate or sill 10. The door frame, indicated generally by the reference character F, is as usual designed to perform a two-fold service. It provides a seat

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for the door D, Figure 3, that closes the furnace doorway, and, being internally cooled by circulating cooling fluid, typically water, the frame protects the furnace structure surrounding the doorway from the destructive effects of the heat generated and maintained within the furnace. Herein the furnace door D is shown simply as a metal shell 11 lined with refractory 12, but it will be understood that a more elaborate door structure, probably a water-cooled door, may be used in conjunction with the frame F of the invention.

In accordance with known practice the frame is of hollow construction, ordinarily formed of steel, and preferably of sheet or plate steel, cut and shaped into appropriately patterned sections and united in fluid-tight welded seams. The door frame includes a vertical lintel portion 13, from the opposite ends of which jamb portions 14 extend downward, and a horizontal lintel portion 15 extends laterally from the vertical lintel portion. The vertical lintel portion 13 is positioned against the outer face of the furnace structure at the top of the doorway; the jamb portions 14 overlie the outer faces of the brick jamb walls 4 at the two sides of the doorway; and the horizontal lintel portion 15 extends inward immediately beneath the skewback channel and skew blocks at the top of the doorway. Cooling water is circulated within the hollow body of the door frame, and as thus organized the frame provides an armor and reinforcement around the doorway, and not only protects the doorway structure from rapid deterioration under furnace heat, but forms a guideway and seat for the vertically movable furnace door D. It will be noted that at the two sides of the frame are formed vertical rib portions 16, 16. These rib portions extend vertically along the outer edges of the jamb and vertical lintel portions of the door frame, and the surface of the frame portions between the ribs provide a seat upon which the door D may be raised and lowered between open and closed positions, the rib portions serving as guides to prevent the door from becoming laterally displaced from its seating or sliding surface. It will be further noted that the surface upon which the door seats is slightly inclined downward and outward from the upper edge of the lintel portion 13, whereby the effect of gravity upon the door serves to hold the door to such seating surface.

Turning now to the features in which the invention is particularly centered, it will be understood that the deleterious effect of furnace heat is most acute upon the metal and refractory

structure at the top of the doorway 3. This being so, it is the horizontal lintel portion 15 of the door frame that is subject to greatest destructive influence, and must dissipate greatest quantities of heat. In adapting the door frame to these conditions, the outer peripheral edge of the horizontal lintel portion is constructed as a duct 17, which is of U-shape in plan, as may be seen in Figure 2. This duct extends in the line of flow in which cooling water is introduced to the hollow body of the frame, and thus a stream of cooling water, at the low temperature at which the water is supplied, is caused to flow in a confined stream along the peripheral edge of the lintel portion 15, and maximum heat dissipation is obtained. The stream of cooling water is introduced from an external supply line (not shown) connected to an inlet 18, and from such inlet a conduit 19 communicates with the duct 17 at its left-hand end, as the frame appears in Figure 1. From the duct 17 an outlet opens into the interior of the frame, and a discharge passage 20 opens from the frame at the top of the vertical lintel portion 13 and is connected to a suitable drain line, not shown. A circulating body of cooling water is thus maintained within the hollow frame. Advantageously, the outlet from the duct 17 comprises two conduits 21 and 22 that extend from the end of the duct, opposite to that into which the inlet conduit 19 opens, downward into the jamb portions 14 of the hollow frame, whereby the water emerging from the primary course of flow within the duct 17 is delivered in divided stream to the bottoms of the hollow jamb portions. The water rises through such jamb portions into the vertical and horizontal lintel portions 13 and 15, whence the overflow escapes by way of discharge passage 20.

It is important to note that not only is the entire inner surface of the duct 17, which forms the outer edge of the horizontal lintel portion, subject to the cooling effect of the primary or inflowing stream of cooling water, but a substantial part 17*a* of the outer surface of the duct is in immediate contact with the body of circulating cooling water within the frame. Only the portion 17*b* of the outer surface of the duct is exposed to the most direct heat of the furnace. Thus, maximum protection and durability of structure are obtained in the region where it is most needed.

The duct 17 is formed by the provision of a partition with in the sheet metal body of the lintel portion 15, the reference numeral 17*a* being immediately applied to this partition. The partition is formed of sheet steel, and parallels the peripheral edge of the lintel portion 15, as may be seen in Figure 2. The partition is welded to the top and bottom walls of the lintel portion, and the ends of the duct 17 thus formed are closed by means of sheet metal disks 23 welded in place, as illustrated.

At the lower ends of the two jamb portions 14 of the frame cleanout openings are provided, and these openings are normally closed by means of removable screw-plugs 24.

Whereas in the structure described, both the top and bottom walls of the laterally extending lintel portion extend horizontally, I show in Figure 4 that the lower wall 15*a* may be inclined to facilitate the circulation of water from the wall 17*a* of the tube 17, and prevent the accumulation of sediment or scale on the inner surface of such wall.

Figure 5 serves to illustrate that the duct which

forms the outer edge of the horizontal lintel portion 15*c* may comprise a preformed steel tube 17*c* of circular cross section, the tube being bent at its ends and shaped in plan to the form of the duct 17 shown in Figure 2. The upper and lower walls of the horizontal lintel portion 15*c* are at their outer edges welded to the body of the tube 17*c*, and the portion of the wall of the tube between the welds, the portion which is exposed to the cooling water circulated within the hollow lintel portion, forms the counterpart of the partition 17*a* of the structure shown in Figure 3. The ends of the tube are closed in the same manner as the ends of the duct 17 are closed, and suitable openings are provided in the wall of the tube for the ingress and egress of cooling water through the conduits 19, 21 and 22 within the hollow door frame.

These and other modifications and variations are permissible within the terms and spirit of the invention defined in the appended claims.

In conclusion it may be noted that the lintel structure of this invention may be readily designed to meet the requirements and specifications of various furnace builders and operators. Some builders and operators prefer that the lintel portion 15 shall extend inward beneath the skewback channel and the skew blocks for substantially the entire thickness of the furnace wall, while others require that the extent of such lintel portion shall be less. In any event the various specifications can be met with minimum departure from a standard of door frame construction.

I claim as my invention:

1. In a furnace door frame comprising a lintel having hollow vertical and horizontal portions of expansive areas, a hollow jamb portion extending downward from each end of said lintel, the hollow interiors of said lintel portions and jamb portions standing in open communication within the door frame structure and being adapted to contain a relatively large volume of circulating cooling water, and an inlet and an outlet for such circulating cooling water; the invention herein described comprising a partition member spaced from and extending substantially parallel to the outer peripheral edge of said horizontal lintel portion to provide a tube for confining a stream of cooling water of relatively small volume along said peripheral edge, said inlet opening into said tube at one end to supply said stream, and a passageway opening at the other end of said tube for delivering the stream into the relatively large volume of water in said hollow frame structure, said partition member being on one side exposed along the peripheral extent of said horizontal lintel portion to the cooling effect of said stream and on the opposite side to the cooling effect of said relatively large volume of cooling water in the hollow frame structure.

2. In a furnace door frame comprising a lintel having hollow vertical and horizontal portions of expansive areas, a hollow jamb portion extending downward from each end of said lintel, the hollow interiors of said lintel portions and jamb portions standing in open communication within the door frame structure and being adapted to contain a relatively large volume of circulating cooling water, and an inlet and an outlet for such circulating cooling water; the invention herein described comprising a partition member spaced from and extending substantially parallel to the outer peripheral edge of said horizontal lintel portion to provide a tube for confining said pe-

ripheral edge, said inlet opening into said tube at one end to supply said stream, two discharge conduits extending from the opposite end of said tube downward into said hollow jamb portions severally for delivering the water of said stream thereinto, said partition member being on one side exposed along the peripheral extent of said horizontal lintel portion to the cooling effect of said stream and on the opposite side to the cooling effect of said relatively large volume of cooling water in the hollow frame structure.

WILLIAM C. BULMER.

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