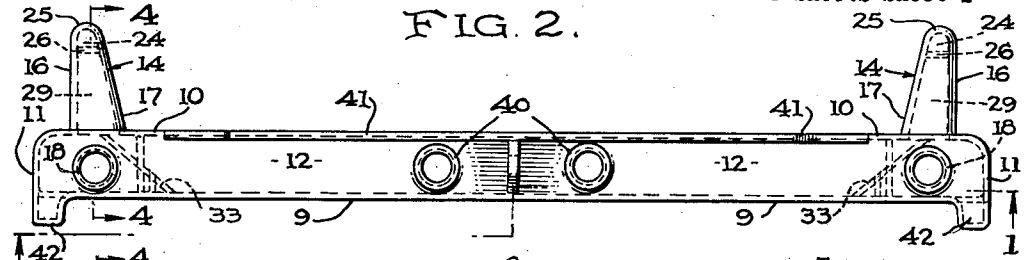
Oct. 15, 1963 V. P. TRAINA 3,106,911

FURNACE DOOR FRAME

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FIG. 2.



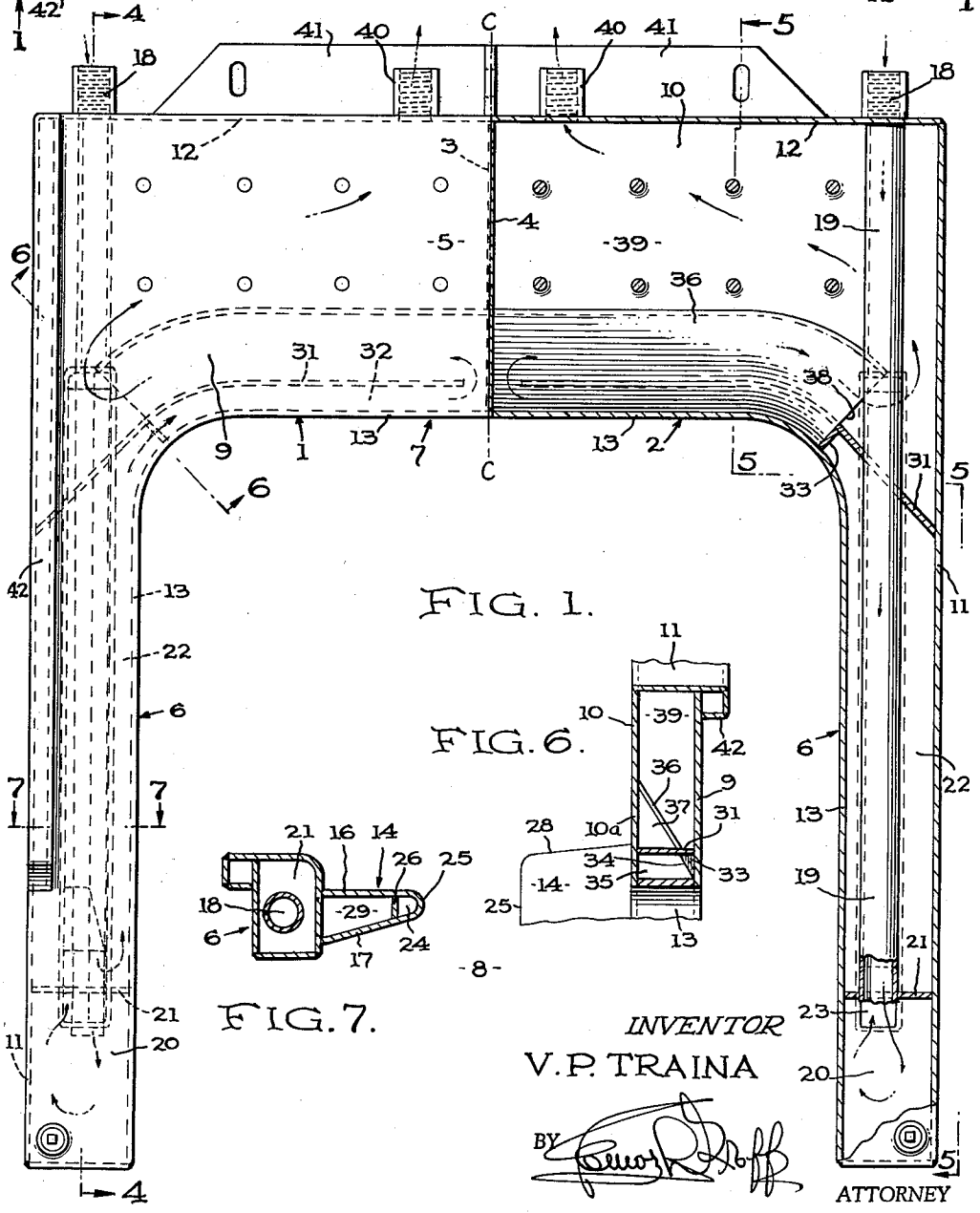


FIG. 1.

FIG. 6.

FIG. 7.

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FIG. 3.

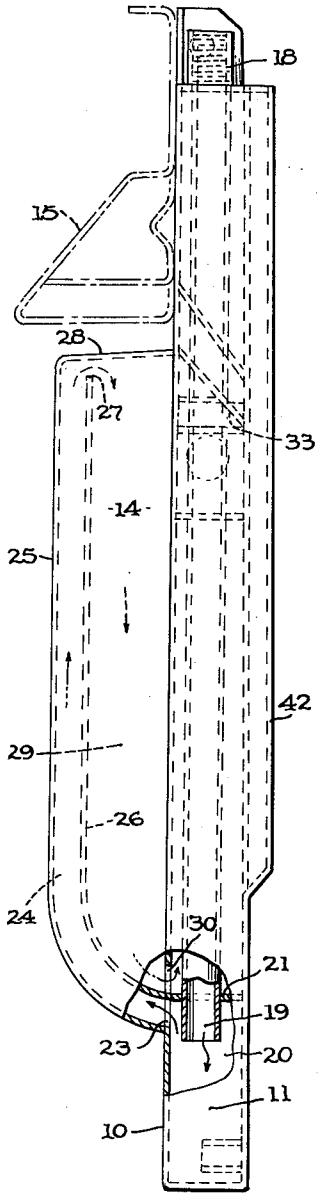


FIG. 4.

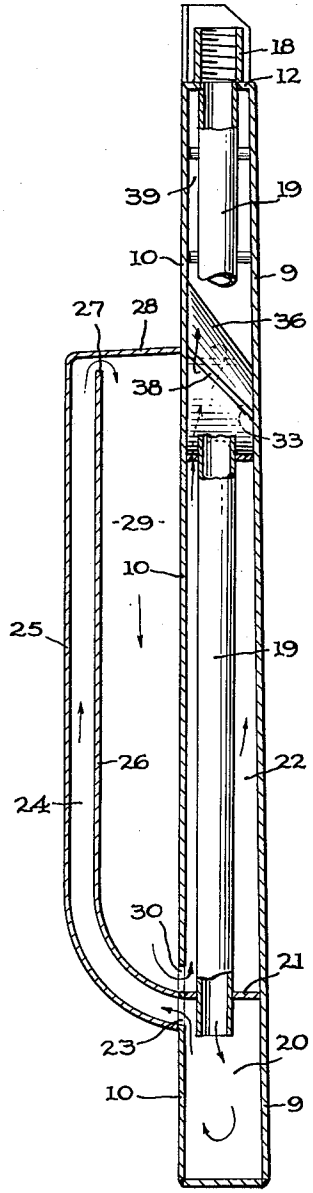
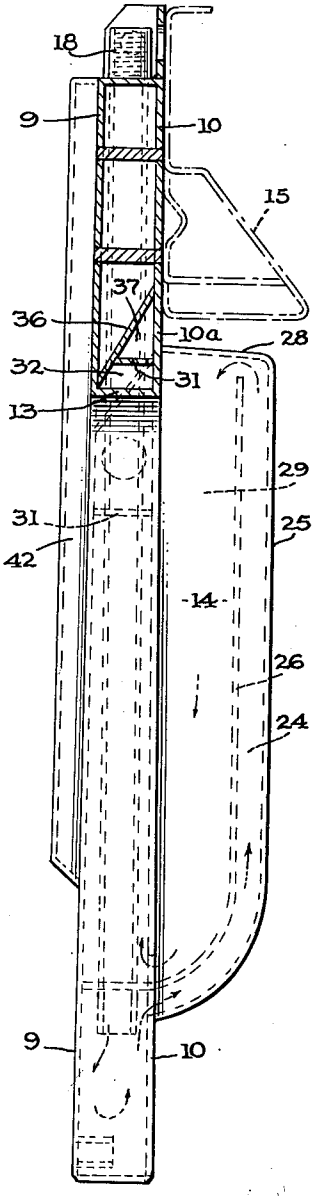


FIG. 5.



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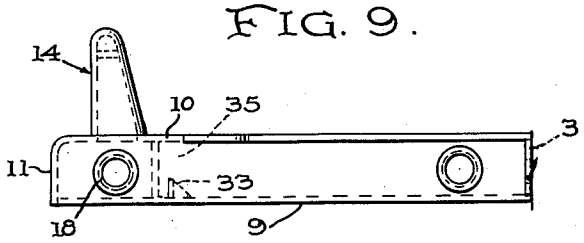
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FIG. 9.



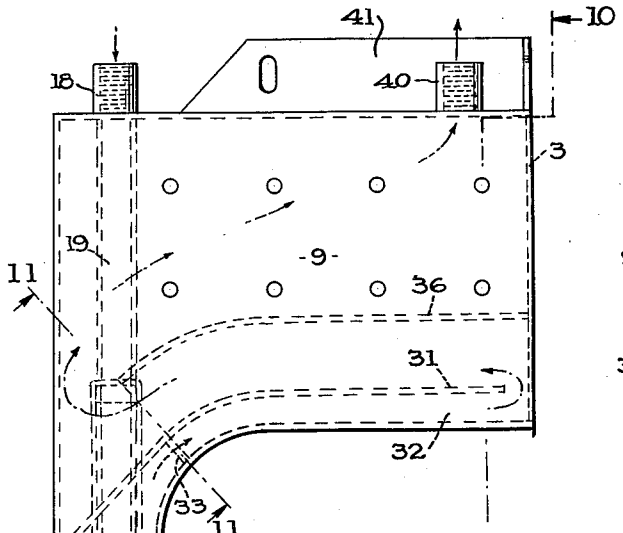


FIG. 8.

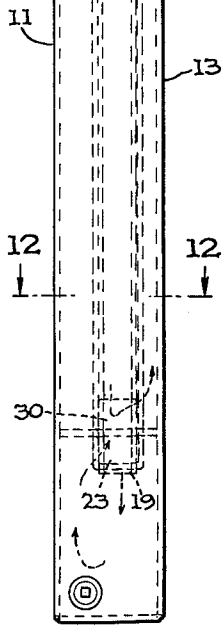
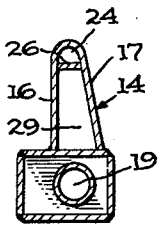


FIG. 12.



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FIG. 11.

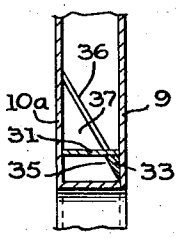
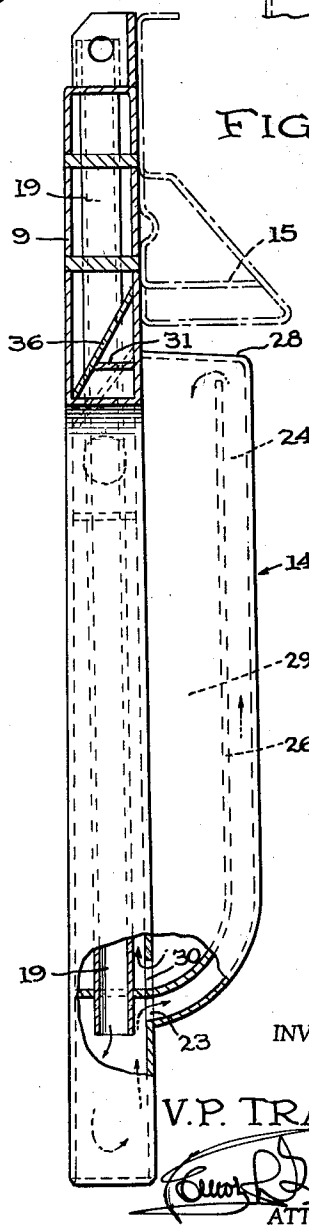


FIG. 10.



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United States Patent Office 3,106,911 Patented Oct. 15, 1963

3,106,911

FURNACE DOOR FRAME

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Filed Mar. 29, 1961, Ser. No. 99,260
5 Claims. (Cl. 122—499)

This invention relates generally to door frames, and more particularly to water-cooled door frames of the character employed in open hearth furnaces and the like.

As door frames provided for open hearth furnaces receive severe use during the course of their lives, it is a common necessity to have to remove, repair and replace such frames more than once during the lifetime of the associated furnace.

It is well known in the art to provide water cooling means in conjunction with furnace door frames in order to retard the wear of the frame elements due to exposure of the frame to the intense heat generated within the furnace; however, heretofore there has not been available a suitably designed water cooling system wherein full advantage is made of the cooling properties of the water to achieve suitable cooling of those portions of the door frame which are subjected to the most intense degree of heat from the furnace.

Another shortcoming of the known types of water cooled door frames is that when it becomes necessary to repair the frame, the entire frame must be removed from the furnace for repair and reinstallation, even though only a portion of the frame may be damaged to an extent requiring repair.

Accordingly, one of the objects of this invention is to provide a water cooled furnace door frame having water compartments and passageways constructed to maintain the maximum degree of cooling throughout the most critical areas of the frame which are subjected to the greatest degree of heat from the furnace.

Another object of this invention is to provide a water cooled furnace door frame comprising two arch forming sections, symmetrical in design, and each of which is provided with its own water cooling circuit, thereby greatly facilitating the installation and maintenance of the complete installation.

The above and other objects and advantages of the invention will be apparent during the course of the following description, considered together with the drawings, wherein:

FIGURE 1 is a front elevation, partly in section, of the two halves of a furnace door frame according to the invention, wherein the circuits of the cooling water are indicated by arrows.

FIGURE 2 is a top plan view of the door frame shown in FIGURE 1.

FIGURE 3 is an elevation view partly in section, of the left side of the door frame shown in FIGURE 1.

FIGURE 4 is an elevation view in section, of the left-hand frame section, taken on the line 4—4 of FIGURES 1 and 2.

FIGURE 5 is an elevation view, partly in section, of the right-hand frame section, taken on the line 5—5 of FIGURE 1.

FIGURE 6 is a partial view in section, taken along the line 6—6 of FIGURE 1, showing the inclined baffle plate over the door opening.

FIGURE 7 is a transverse sectional view rotated 90° and taken on the line 7—7 of FIGURE 1 showing the door guide and partitioned hollow leg.

FIG. 8 is a front elevation of one section of a modified form of door frame.

FIGURE 9 is a top plan view of the door frame shown in FIGURE 8.

FIGURE 10 is an end elevation, partly in section, of the frame section shown in FIGURE 8.

FIGURE 11 is a partial view in section, taken along the line 11—11 of FIGURE 8, showing the baffle plate construction over the arch of the door frame.

FIGURE 12 is a transverse sectional view of the hollow leg as taken along the line 12—12 of FIGURE 8.

Referring now more particularly to the drawings, the furnace door frame comprises a pair of symmetrical frame sections generally designated 1 and 2, constructed of plate steel to form hollow frames which are welded together at the time of installation along their mating center walls 3 and 4 at the center line C dividing the left-hand section 1 from the right-hand section 2.

The conventional elements of the door frame include a lintel portion 5 and leg portions 6, 6 depending from the arch 7 of the frame to the base of the door opening 8.

The front of each frame section comprises an outside flat plate 9 coextensive over the entire front of the frame section. An inside plate 10 forms the rear surface of each frame section and is held in spaced apart relationship to the outside plate by means of an outside edge wall 11, top wall 12, center wall 3 or 4, and an inside wall 13. It will be understood that the foregoing peripheral walls are connected to the outside plate 9 and inside plate 10 by suitable means to insure a watertight compartment within the hollow space formed therebetween.

Jamb extensions 14, 14 project rearwardly from the back of the frame sections and extend vertically from a point adjacent the feet of the leg portions 6, 6 to a height above the level of the arch 7 and immediately below the skewback 15 shown in dotted lines in FIGURES 3 and 5.

The outer faces 16, 16 of the jamb extensions 14, 14 are preferably perpendicular to the back of the frame sections while the inner faces 17, 17 are inclined in respect to the door frame such that the jambs present a tapered cross-section as illustrated in FIGURES 2 and 7, for reasons which will become evident hereinafter.

Inasmuch as each of the sections 1 and 2 forming the door frame is of symmetrical construction, the specific structure of one frame section will be sufficient to describe the entire frame, wherein common reference numerals are used to identify corresponding elements in the two frame sections.

Water-cooled furnace door frames of known design have been found to lack suitable means to provide sufficient cooling of the most critical areas of the frame with the result that undesirable time and labor is lost in the freqeunt removal and repair of the frames. Research has shown that the useful life of these critical areas of the frame may be greatly extended by providing novel partitioning and baffle means within the frame such that the areas exposed to the greatest amount of direct heat from the furnace will be subjected to the greatest amount of cooling water before this water has been warmed by other portions of the frame.

An inlet coupling 18 passes through the outer edge of top wall 12 and is connected to a suitable source (not shown) of cold water supplied under pressure. Attached to the coupling 18 at the underside of top wall 12 is a leg pipe 19 of similar internal diameter as the coupling and which extends downwardly through the leg 6 where it opens into the mud leg 20. A first partition 21 defines the upper limits of the mud leg 20 and forms a leg compartment 22 surrounding the pipe 19 in the upper portion of the leg 6.

A port 23 at the top of the rear of the mud leg 20 leads into the bottom of the jamb extension 14. A passageway 24 is formed in the nose 25 of the jamb extension 14 by a second partition 26 which has its lower extremity located at the level of the first partition 21 in

the leg and its upper extremity 27 disposed at a point spaced apart from the top 28 of the jamb extension.

The main body compartment 29 of the jamb extension, as defined by the partition 26 and the oppositely disposed plate 10 of the leg 6, is of substantially greater volume and cross-section than the passageway 24 in the nose portion 25 and is provided with an outlet port 30 at the bottom, immediately adjacent the partition 21, which port opens into the compartment 22 in the leg.

The upper limit of the leg compartment 22 is defined by a transverse baffle 31 connected at one end to the side wall 11 and curved upwardly over the arch 7 in spaced apart relationship to the inside wall 13 in such a manner that a fluid passageway 32 is formed along the bottom of the lintel 5. A restriction plate 33 is disposed at the corner of the arch 7. The plate 33 forms a dividing line between the leg compartment 22 and the passageway 32 and is abutted against the front wall 9 with its free edge 34 forming one edge of an opening 35 next to the rear wall 10.

The free end of the transverse baffle 31 is located a distance from the end wall 3 or 4 approximately equal to the height of the passageway 32.

Extending across the lower portion of the lintel and abutting the end wall 3 or 4 is an inclined baffle 36 having its lower edge fitted into the corner formed between the front wall 9 and inside wall 13 and extending in an upwardly inclined direction with its upper edge sealed against the rear wall 10 at a height above the lower portion of the skewback, as shown in FIGURES 3 and 5. Thus, a triangularly shaped fluid compartment 37 is provided in the lintel of the frame section with one wall 10^a thereof facing the "hot" side of the frame. The free edge 38 of the inclined baffle 36 forms an outlet into the lintel compartment 37, adjacent the transverse baffle 31 surrounding the leg pipe 19. The baffle 36, which is curved at its free end 38 to comform to the curvature of the arch 7 adjacent the junction with the leg 6, has its free end extending to a point on the rear wall 10 coinciding with the top 28 of the jamb extension. It will thus be seen that the area covered by wall 10^a and passageway 32 covers the entire portion of the lintel between the skewback 15 and the door opening 8.

The balance of the hollow portion of the lintel comprises a lintel compartment 39 which is provided with an outlet coupling 40 through the top wall wall 12 and adjacent the inside wall 3 or 4.

A suitable lift plate 41 is welded to the top of the frame section to provide convenient means for removing the section for repair through the use of a crane hook or other means.

A guide rib 42, preferably hollow, projects outwardly on the front of the frame section and extends along the outside edge of the frame from the top wall 12 to a point below the center of the door opening to act as a guideway for the vertically sliding furnace door (not shown).

The flow pattern of the cooling water will now be described in connection with the various baffles, partitions, etc., heretofore described.

Cold water pumped at a relatively high velocity, enters each frame section through the inlet coupling 18 and flows downwardly through the leg pipe 19 to the mud leg 20 whereupon the flow is reversed and the water enters the port 23 leading to the passageway 24 in the nose of the jamb extension 14.

The outlet of the pipe 19 is preferably below the level of the port 23 to insure that water entering the mud leg 20 is directed to the bottom of the leg prior to its entry into the passageway 24. Otherwise, the flow would become static adjacent the wall 10 beneath the port 23.

The cross-sectional area of the passageway 24 is substantially less than the cross-sectional area of the

inlet coupling 18 and the leg pipe 19, with the result that the velocity of the flow through the passageway 24 is considerably greater than the flow up to this point. The nose portion 25 is the most critical part of the frame section in respect to exposure to heat from the furnace and through this provision of a high velocity water cooling passageway, the jamb extension is afforded the greatest possible protection by the use of the cold water before it has been subjected to any significant exposure to heat elsewhere in the frame section.

The flow progresses over the top 27 of partition 26 and passes downwardly through the body compartment 29 of the jamb extension. The velocity of the flow in this compartment is much less than even the velocity of the flow through the leg pipe 19 because of the increased cross-section of this compartment. Due to the large volume of water flowing through this compartment and because of the inclined face 17 which offers a larger cooling surface than a perpendicular face such as at 16, the entire critical surface of the jamb extension is cooled more efficiently than heretofore.

The water flows out of the jamb compartment 29 through the port 30 into the leg compartment 22 and travels upwardly around the cold pipe 19 which removes some of the accumulated heat from the heated water.

As the water reaches the top of the leg compartment 22 it is deflected by the transverse baffle 31 through the opening 35 and into the passageway 32. The triangular restriction plate 33 is abutted against the front wall 9 with its free edge 34 overlying the baffle 36 so that the water, as it enters the passageway 32 is initially directed along the heated wall 10. Additional cooling is achieved due to the increased velocity of the cooling water as it passes through the restricted opening 35 into the area 32, which is of smaller cross-section than the leg compartment 22.

At the center of the frame the water flow is again reversed as it passes around the free end of the transverse baffle 31 and enters the fluid compartment 37 formed by the inclined baffle 36. The longer leg 10^a of the triangular compartment 37 is directed towards the hot side of the frame to offer the greatest area of cooling towards the direction of the hot rear wall of the frame. The inclination of the baffle 36 precludes the inefficient distribution of cooling water to portions of the frame not directly exposed to the furnace heat and by extending the free edge 38 of the baffle all the way to the jamb extension, it will be seen that the entire arch and lower lintel portion is adequately protected by novel coolant passageways.

From the outside opening of the fluid compartment 37, the water flows through the lintel compartment to the outlet coupling 40 disposed adjacent the center wall 3 or 4. The velocity of the water flow through the upper portion of the lintel is obviously considerably less than the flow through the previously mentioned compartments and passageways which are of smaller cross-section to provide adequate cooling of the more critical areas of the frame.

To further illustrate the relative cross-sectional areas of the various passageways and compartments and the resultant different velocities of water flow therethrough, a table is set forth below, using as a typical inlet flow rate, a velocity of 60 gallons per minute, and showing the various rates of flow and corresponding cooling abilities at different points in the frame:

	Ft./sec.
Velocity at coupling 18 and through leg pipe 19	2.91
Velocity through nose portion 25 or passageway 24	5.8
Velocity in jamb compartment 29	1.18
Velocity through passageway 32	2.27
Velocity in triangular compartment 37	2

The above table would, of course, vary depending upon the rate of the inlet flow, and although the actual dimensions of the various elements of the invention may vary

slighly, they could not be altered to such an extent that the relationships set forth above are lost. In other words, an important feature of the invention resides in the substantially increased velocity of the water flow through the nose portion 25 of the jamb extension as opposed to the relatively lesser velocities through the balance of the door frame.

The modified form of construction illustrated in FIGURES 8–12 embodies the same flow pattern described hereinbefore but relates to a door frame designed for use with smaller door openings.

In this embodiment, the guide rib 42 found in the preferred form, is omitted as it has not been found necessary to include such ribs on door frames of the relatively smaller sizes.

From the foregoing it will now be seen that the present invention includes a pair of hollow symmetrical substantially horizontally disposed arch forming sections which include the relatively horizontally disposed lintel portions communicating with vertical leg portions. The sections may be conveniently handled as a unit to form the complete door frame. Also the hollow leg and lintel portions include partitions which form baffle means 21, 26, 36, which cause a maximum velocity of the cooling fluid after it enters the pipe 19 and before it is discharged from the outlet 40.

I claim:

1. A water cooled door frame for metallurgical furnaces comprising, mating symmetrical sections, each including front, rear, outside, inside and center walls, a hollow lintel having an inlet connection adjacent the outside wall and an outlet connection adjacent the center wall, a hollow leg connected with said lintel, a hollow jamb extension offset rearwardly from the rear wall of said leg and having a partitioned nose portion projecting rearwardly from said rear jamb extension, and means within said hollow leg lintel and jamb extension to conduct cooling fluid from said inlet connection toward the bottom of the leg and thence upwardly into and through the nose portion of said jamb extension and back downwardly through the jamb extension to the leg above the point where the inlet connection admits cooled water to the leg and thence to said outlet connection so that all of the cooling fluid will be directed, while still at its coolest temperature, through the hottest portion of the door frame.

2. A water cooled door frame according to claim 1, wherein said means includes a pipe leading from said inlet connection downwardly into said hollow leg adjacent the bottom of said jamb extension, an inlet port leading from the bottom of said leg rearwardly into said jamb extension, a passageway in the nose portion of said jamb extension connected to said inlet port, said passageway having a cross-sectional area substantially less than the cross-sectional area of said pipe in said leg, whereby, the velocity of the cooling water through the nose portion of the jamb extension is greater than the velocity of the water through said pipe.

3. A water cooled door frame for metallurgical furnaces comprising, mating sections, each section including front, rear, outside and center walls, a hollow lintel having an inlet connection adjacent the outside wall and an outlet connection adjacent the center wall, a hollow leg connected with said lintel, a hollow jamb extension on the rear side of said leg and having inlet and outlet ports at its lower extremity leading into said leg, a pipe within said leg and communicating with said inlet and having a discharge end extending into and adjacent the bottom of said leg, a transverse partition in said leg and extending transversely across the lower portion thereof between said ports and receiving the lower end of said pipe, a second partition attached to said transverse partition and extending within said hollow jamb extension to divide the extension into a restricted passageway on the one side and a main body compartment on the other side, a transverse baffle substantially at the junction of the leg and the lintel and extending into the same and terminating adjacent to and short of the center wall to provide a fluid passageway along the bottom of said lintel, and a flow directing baffle inclined upwardly from the bottom of the front wall of the lintel toward the rear wall, thereby directing the flow of cooling water from said fluid passageway toward the back wall of the lintel.

4. A water cooled door frame according to claim 1, wherein each of the hollow legs is provided with a laterally offset hollow rib on its front wall for receiving and guiding a vertically sliding furnace door.

5. A water cooled door frame for metallurgical furnaces comprising, a pair of hollow symmetrical substantially horizontally disposed arch forming sections adapted to be fitted in a door opening of said furnaces, each section including, a lintel having top and bottom walls and outer and inner side walls, said inner walls adapted for abutting engagement and said top walls having an inlet pipe and an outlet connection, a hollow vertical leg having an outer wall forming a continuation of the outer wall of the related lintel, a jamb extension offset rearwardly from each leg, and cooperating baffle means in each leg, lintel and jamb extension for first circulating all of the cooling fluid from the bottom of a related leg upwardly through the jamb extension and thence downwardly through the jamb extension and upwardly through the same leg to said baffle means in the lintel before said fluid makes its exit through said outlet.

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