The invention relates to water cooled doors and door frames for furnaces such as open hearth furnaces, melting furnaces and heating furnaces, where the door and frame are exposed to high temperatures.

It is customary to provide such furnaces with hollow, water cooled door frames in the general form of a hollow arch, a door being slidably mounted upon the frame. Due to the extreme temperatures to which these door frames are subjected, the depending hollow legs of the arch shape frame soon warp or bend. It is also common practice to provide straight guide ribs upon the door frame, between which a straight edged door is slidably mounted. These guide ribs, as well as the legs of the door frame, become warped and bent, causing the door to bind or stick and making operation of the door difficult if not impossible.

The present application contemplates a construction of furnace door and frame which will prevent binding or sticking of the door.

Another object of the invention is to provide a door frame in which the warping or bending of the depending hollow legs of the arch shape frame, or of the guide ribs thereon, is reduced to a minimum.

A further object is to provide a hollow, water cooled furnace door frame in which the water capacity of the frame is increased, thus adding to the protection of the frame by providing a greater area at the lower end of each hollow leg of the frame in which sediment may be agitated by the circulation of the water.

A still further object is to provide a construction of furnace door and frame which provides a better seal between the door and frame, thus preventing heat loss from the furnace.

Another object of the invention is to provide a furnace door and frame in which bevelled guide ribs are formed upon the frame and the cooperating edges of the door are similarly bevelled.

A further object is to provide such a door and frame in which the bevelled guide ribs on the frame are hollow and water cooled, and the door is provided with hollow, water cooled marginal rails having bevelled edges cooperating with the bevelled guide ribs on the frame. A still further object is to additionally reinforce and strengthen the hollow, water cooled legs of the frame by means of reinforcing bars located therein and attached to the inner walls of the legs in spaced relation thereto so as to permit cooling water to pass between the reinforcing bars and the inner walls of the legs.

Another object of the invention is to form side rails of channel shape, inserted into and welded to the depending legs of the door frame to add maximum structural strength to the legs, thereby eliminating warping and bending of the legs, which is the most common failure.

The above objects together with others which will be apparent from the following description or which may be later referred to, may be attained by constructing the improved water cooled furnace door and frame in the manner hereinafter described in detail and illustrated in the accompanying drawing, in which:

Fig. 1 is a front, or outside elevation of a furnace door and frame constructed in accordance with the invention;

Fig. 2 a transverse, vertical section, taken as on the line 2—2, Fig. 1;

Fig. 3 a transverse, vertical section, taken as on the line 3—3, Fig. 1;

Fig. 4 a vertical sectional view of the improved water cooled door frame;

Fig. 5 a transverse, vertical section, taken as on the line 5—5, Fig. 4; and

Fig. 6 an enlarged, fragmentary, horizontal section through one water cooled leg of the frame and the adjacent portion of the door, taken as on the line 6—6, Fig. 1.

Referring now more particularly to the embodiment of the invention illustrated in the drawing, in which similar reference numerals refer to similar parts throughout, the hollow door frame may be formed of steel plates welded together at their adjoining edges to form the hollow, arch-shaped door frame comprising the hollow upper body portion and the depending hollow legs, forming the arched door opening therebetween.

The front, or outer, plate 13 of the door frame is preferably inclined slightly downwardly and outwardly, while the back, or inner, plate 14 is preferably substantially vertical, as shown in Figs. 2 and 3. Spacing bars 15 are located transversely through the upper body portion of the frame, being welded at opposite ends to the front and back plates 13 and 14 respectively, to reinforce and strengthen this portion of the door frame.

Side rails 14a of channel shape are inserted between the front and back plates of the door frame, and welded thereto as at 14b and 14c, in order to add maximum structural strength to the depending legs of the frame, thereby eliminating warping and bending of the legs, which is the most common failure of such door frames.

For the purpose of continually cooling the hollow door frame, a water inlet 16 is located at the top of the frame, near one side thereof, for connection to a pipe line leading from a suitable supply of cold water. An inlet pipe 17 communicates with the inlet 16 and leads to the central portion of the manifold 18, formed upon the back of the door frame, just above the arched opening 12 therein.

Water feed pipes 19 lead from opposite end portions of the manifold 18 to the lower portions of the hollow legs, whereby cooling water may be continually admitted to these legs, through which the water will rise in the door frame and be discharged through the outlet 20, which is located at the top of the frame, at the opposite side to the inlet, and may be connected by a suitable pipe line to a drain or sewer.

For the purpose of draining the water from the hollow door frame, and cleaning sediment or lime deposit from the interior of the hollow legs thereof, drain plugs 21 may be located in the lower ends of the hollow legs 11. A bevelled, hollow, water cooled guide rib 22 is formed at each vertical edge of the door frame, on the front or outer side thereof, and extends from the top of the frame to the lower ends of the hollow legs 11 thereof.

These bevelled guide ribs add rigidity to the hollow legs of the frame, greatly strengthening and reinforcing the legs, so as to minimize the tendency to warp or bend. They also increase the water capacity of the frame, particularly the depending legs 11 thereof, thus adding to the protection of the frame by providing a greater area at the bottom of each leg in which sediment may be agitated under pressure of the water circulation.
Furthermore, the bevelled, inner, vertical edges 23 of these ribs provide guides for sliding contact by the bevelled or chamfered edges 24 of the door indicated generally at 25. This door may comprise a water jacket 26, at the outer or front side of the door, having the marginal, water cooled rails 27, and the conventional refractory lining 28 at the inner side of the door.

Ears 29 may be provided at the upper edge of the door for attachment of conventional means for raising and lowering the door when the slighly inclined front or outer side of the frame. The door thus lays against the door frame by gravity, and the bevelled edges 23 and 24, of the ribs and door respectively, provide a seal between the door and frame, preventing heat loss from the furnace.

These contacting bevelled edges of the ribs and door will also prevent the door from binding or sticking, when the door is raised or lowered, either bevelled edge 24 thereof may ride outwardly upon the bevelled edges 23 of the corresponding guide rib, so that the door may be easily raised or lowered.

For the purpose of further strengthening and reinforcing the depending, hollow legs 11 of the door frame, a reinforcing bar 29 may be located in each leg, extending from a point near the top of the frame to a point near the lower end of each leg. Each bar 29 is connected to an inner wall of the frame in spaced relation thereto, so that the cooling water in the hollow frame may circulate around all sides of the bar, and between the bar and the adjacent wall of the frame.

This may be accomplished by providing staggered welds 30 on opposite sides of the bar 29, while holding the bar spaced from the adjacent side wall of the frame, so as to provide a space 31 between the bar and said wall, which permits cooling water to pass therethrough between the bar and said wall. Thus cooling water entirely surrounds the reinforcing bars 29, protecting them from the high temperature at which the furnace is operated, so as to further assist in preventing warping or bending of the legs 11 of the door frame.

From the above it will be evident that the improved furnace door and frame provides a construction which permits of easy operation of the door without danger of binding or sticking when the door is raised or lowered; provides a more perfect seal between the door and frame, minimizing heat loss from the furnace; provides greater rigidity and strength in the depending, hollow legs of the frame, so as to resist warping or bending of the legs under the high temperature to which they are exposed; and which materially increases the water capacity of the frame, and particularly of the legs thereof, thus permitting greater agitation of sediment in the lower portions of the legs and reducing the buildup of lime deposits therein.

I claim:

1. A furnace door and frame therefor including a hollow water cooled metal door frame having depending hollow legs at opposite sides thereof, forwardly disposed upright guide ribs upon the front surface of said door frame extending from the top of the frame to the lower ends of the legs, said guide ribs having forwardly diverging bevelled surfaces on their facing sides and extending to their front sides, and a door vertically slidable upon the front side of the frame, both vertical edges of said door having complementary bevelled surfaces slidable upon the bevelled surfaces of said guide ribs.

2. A furnace door and frame therefor including a hollow water cooled metal door frame having depending hollow legs at opposite sides thereof, forwardly disposed upright hollow water cooled guide ribs upon the front surface of said door frame extending from the top of the frame to the lower ends of the legs, said guide ribs having forwardly diverging bevelled surfaces on their facing sides and extending to their front sides, and a water cooled door vertically slidable upon the outer side of the frame, said door being provided with hollow marginal walls, both vertical edges of said door having complementary bevelled surfaces slidable upon the bevelled surfaces of said guide ribs.

3. A furnace door and frame therefor including a hollow water cooled metal door frame having depending hollow legs at opposite sides thereof, forwardly disposed upright guide ribs upon the front side of said door frame extending from the top of the frame to the lower ends of the legs, said guide ribs having forwardly diverging bevelled surfaces on their facing sides, and a door vertically slidable upon the front side of the frame, both vertical edges of said door having complementary bevelled surfaces slidable upon the bevelled surfaces of said guide ribs.

4. A furnace door and frame therefor including a hollow water cooled metal door frame having depending hollow legs at opposite sides thereof, forwardly disposed upright guide ribs upon the front surface of said door frame inclined downward and slightly forward from the top of the frame to the lower ends of the legs, said guide ribs having forwardly diverging bevelled surfaces on their facing sides and extending to their front sides, and a door vertically slidable upon the front side of the frame, both vertical edges of said door having complementary bevelled surfaces slidable upon the bevelled surfaces of said guide ribs.

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