

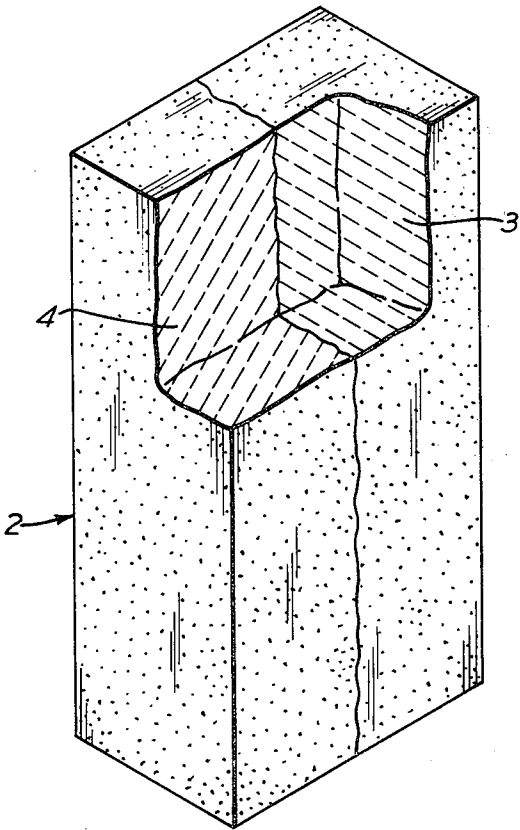
- [54] LADLE BRICK FOR LINING HIGH TEMPERATURE VESSELS
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- [58] Field of Search 161/165, 182, 206, 207, 161/225, 166; 106/55, 65, 67, 68, 72, 73; 423/327, 335, 600; 50/464
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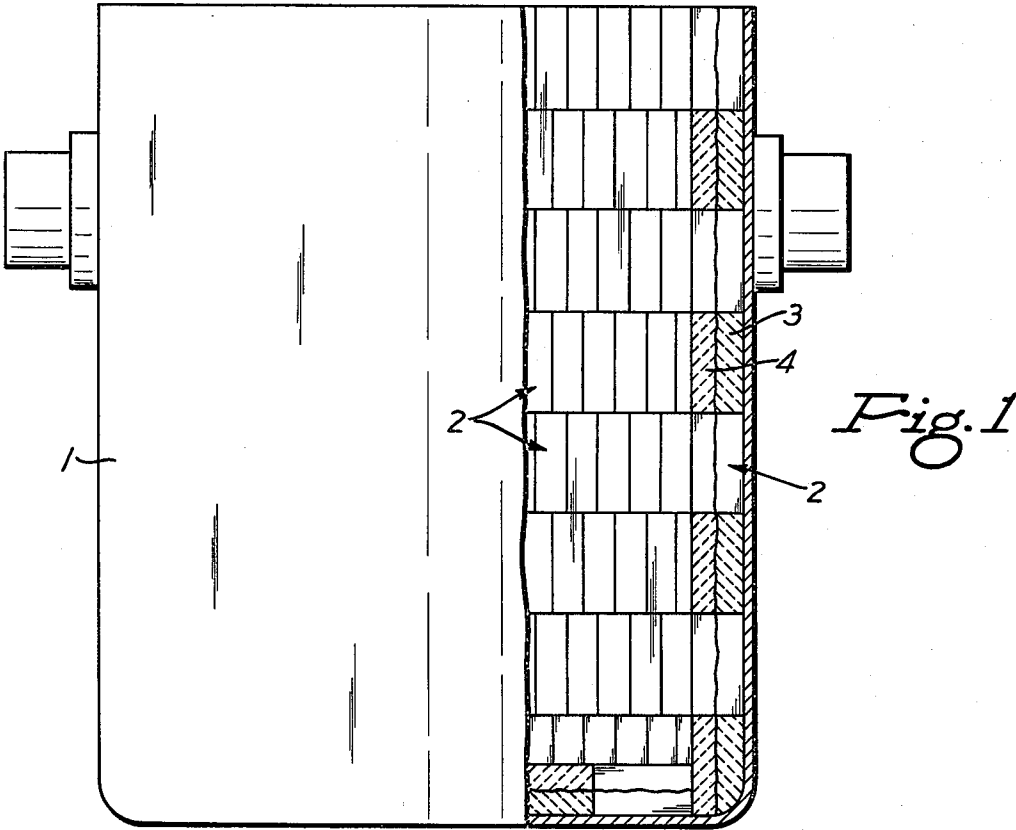
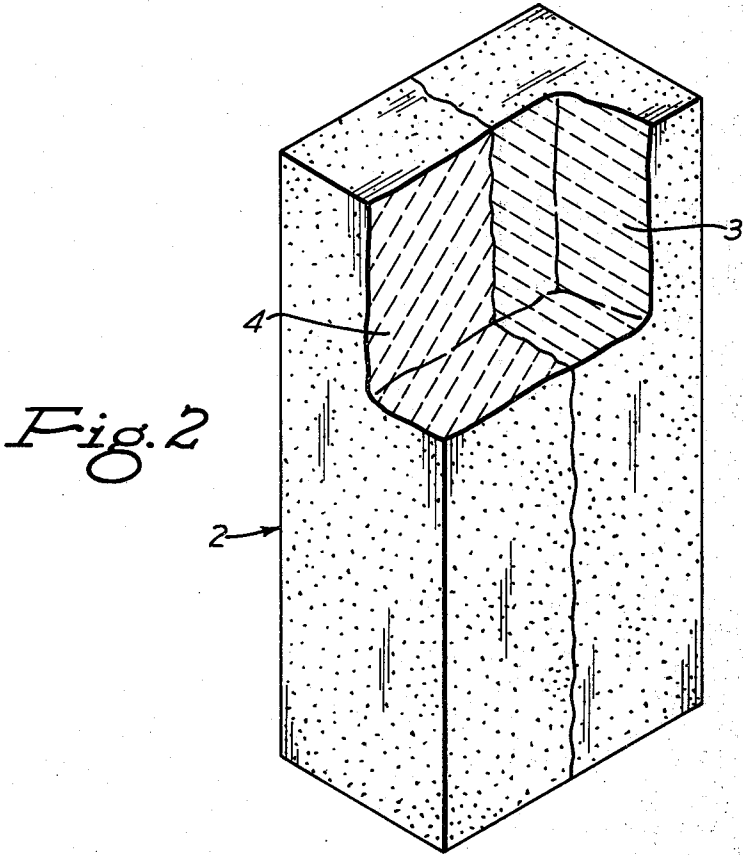
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[57] ABSTRACT

A refractory brick for lining a vessel that receives molten metal has a vessel-engaging face and an opposite face for engagement by the molten metal. The brick is formed from two different compositions that are united between said faces, the composition of the portion of the brick with the vessel-engaging face being a blend of refractory bond clay and calcined fireclay and the composition of the rest of the brick being a blend of refractory bond clay and calcined high alumina material.

6 Claims, 2 Drawing Figures





LADLE BRICK FOR LINING HIGH TEMPERATURE VESSELS

Metal vessels, such as steel mill ladles and holding tanks for molten metal, are lined with refractory bricks to prevent the molten metal from burning through the bottoms and sides of the vessels. For example, in steel manufacturing the hot metal is poured into ladles, from which it is transferred to ingot molds. While in the ladles, additives may be supplied or the steel may be subjected to gasification or some other process. The trend in recent years is toward higher steel melting temperatures, longer residence time of the molten steel in the ladles, and more erosive eddy currents in the molten steel due to the various operations required by modern steel making techniques. The results is increasingly severe attack by the molten steel on the refractory brick by way of corrosion and erosion.

The usual type of brick used for lining steel ladles is made of fireclay that is suitably processed. Ladle bricks are unique among refractory products because, when exposed to temperatures above 2,400°F for a period approximating a ladle cycle holding time, they permanently expand to a volume much greater than their original fired volume. This expansion seals the joints between the brick and thereby prevents the hot steel from penetrating the refractory lining and reaching the metal wall of the ladle. The expansion of the brick also produces a honeycomb area in that portion engaged by the molten steel, the honeycomb area having a low thermal conductivity that helps reduce heat losses through the ladle walls.

Most manufacturers of ladle lining brick use additives to improve the resistance of the brick to the increasingly severe operating conditions to which they are exposed. In terms of consumption, the largest single calcined high alumina material used as an additive is calcined bauxite. These materials change some of the properties of the ladle brick for the worse to some extent. For example, bricks containing bauxite as an additive normally expand less when heated, resulting in increased joint penetration by the molten metal. The bauxite also increases the thermal conductivity of the brick to the point at which heat losses through the ladle wall can cause the steel to solidify against the ladle lining, producing a skull on the lining. Removal of the skull often pulls portions of the lining out of the brickwork. As a result, extensive patching may be required to keep the ladle in service. The use of additives also increases the cost of the brick composition. Also, since a lining is removed from a ladle before being eroded completely through at any one spot, significant amounts of expensive brick are discarded at the end of each campaign.

It is among the object of this invention to provide a refractory lining brick which has good resistance to the high temperature corrosion and erosion action of molten metal, which will permanently seal the joints between the bricks in a refractory ladle lining, which has relatively low thermal conductivity, and which costs less than such bricks known heretofore that have contained high alumina material throughout the body.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is a side view of a steel ladle, shown partly in vertical section; and

FIG. 2 is an enlarged perspective view of one of the lining bricks, also shown partly in section.

Referring to the drawings, a metal ladle 1 is lined with refractory bricks 2 in the usual way. The outer faces of the bricks engage the wall of the ladle, while their inner faces will be in contact with molten metal in the ladle when the ladle is in use. In accordance with this invention each brick is made from two different compositions that are united or integrally joined together between their inner and outer faces. The portion 3 of the brick nearest the wall of the ladle is made of conventional ladle brick material. This is a blend of refractory bond clay and crushed previously burned fireclay; i.e. calcined fireclay. The rest of the brick, which is the portion 4 between that just mentioned and the brick face that engages the molten metal, has a different composition. It is a blend of refractory bond clay and calcined high alumina material. The calcined high alumina material used with this invention can be any commercially available product containing at least 40 percent alumina, such as calcined bauxite. The alumina content of best grade aluminum oxide may run over 99 percent. The two compositions from which the brick is made are fed into two different adjoining areas of a mold, pressed and then fired in the usual way to form an integral brick made of two different materials. During feeding of the material to the molds and the subsequent pressing, there is some mixing of the two compositions at their interface, but that helps bond them together when the brick is fired. The two compositions must have similar processing characteristics so that when the brick is fired they will bond together at their interface and not create a line of weakness, such as would occur if the coefficients of expansion of the two compositions were materially different.

The composition that forms the portion 3 of the brick next to the ladle wall should consist principally of about 30 to 95 percent refractory bond clay, and about 70 to 5 percent calcined fireclay to reduce shrinkage during firing of the brick. Preferably, the ratio of bond clay to calcined fireclay is approximately 35 to 65. The other composition from which the brick is made likewise should consist principally of about 30 to 95 percent refractory bond clay, but about 70 to 5 percent calcined high alumina material. All of these percentages are based on the raw dry mix of each composition. The preferred ratio of bond clay to be calcined high alumina material, normally bauxite, is approximately 35 to 65. Each of the compositions, before firing, contains approximately 5.5 percent moisture, such as water or other plasticizer. The brick may be made of equal parts of the two compositions if desired, but in any event, the portion 4 of the brick that contains the calcined high alumina material should be at least half as thick as the brick. The other part of the brick should have a thickness of at least one inch to insure sealing of the joints between the bricks when they are heated by molten metal in the ladle.

After the ladle has been lined with these bricks and the molten metal poured into it, the portions of the bricks next to the wall of the ladle, and which are made of conventional ladle brick material, will expand considerably, thereby sealing the joints between the bricks sufficiently to prevent the molten steel from reaching the wall of the ladle. This portion of the lining also retains the low thermal conductivity of conventional ladle bricks. On the other hand, although the portions of the brick containing the high alumina material and which are in direct contact with the molten metal will

not expand as much, they will have considerably greater resistance to deterioration resulting from the severe operating conditions of modern steel making processes. That is, the lining will have much more resistance to corrosion and erosion by the molten metal than is the case with linings made from conventional ladle brick. A further advantage of the brick disclosed herein is that, since a material portion of it does not contain any additives, the brick is cheaper to make than one in which bauxite or other high alumina material is distributed throughout the entire brick, and when a lining is replaced, there is little or no waste of the more expensive brick composition.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A fired refractory brick for lining a vessel for molten metal, the brick having a vessel-engaging face and an opposite face for engagement by molten metal, the brick being formed from two different compositions integrally united between said faces, the composition of the portion of the brick with said vessel-engaging face being at least one inch thick and essentially a blend of refractory bond clay and calcined fireclay, and the composition of the portion of the brick with said metal-engaging face being essentially a blend of refractory bond clay and calcined high alumina material, whereby said last-mentioned face has more resistance to corrosion and erosion by molten metal than said first-mentioned face, said blends having substantially the

same coefficients of thermal expansion during firing of the brick, and said first-mentioned portion of the fired brick having the property of greater expansion than the other portion of the brick when the fired brick is heated above 2,400°F in use.

2. A fired refractory brick according to claim 1, in which said first-mentioned composition amounts to about 30 to 95 percent of said refractory bond clay and about 70 to 5 percent of said calcined fire-clay, and said second-mentioned composition amounts to about 30 to 95 percent of said refractory bond clay and about 70 to 5 percent of said calcined high alumina material, said percentages being based on the raw dry blend of each composition.

3. A fired refractory brick according to claim 1, in which the ratio of refractory bond clay to calcined fire-clay in said first-mentioned composition is approximately 35 to 65, and the ratio of refractory bond clay to calcined high alumina material in said second-mentioned composition is approximately 35 to 65.

4. A fired refractory brick according to claim 1, in which said calcined high alumina material is bauxite.

5. A fired refractory brick according to claim 1, in which said second-mentioned composition is at least half as thick as the brick.

6. A fired refractory brick according to claim 1, in which said second-mentioned composition is at least half as thick as the brick, the ratio of refractory bond clay to calcined fireclay in said first-mentioned composition is approximately 35 to 65, and the ratio of refractory bond clay to calcined high alumina material in said second-mentioned composition is approximately 35 to 65 also.

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