March 31, 1931. E. B. FORSE 1,798,934

INSULATING REFRACTORY

Filed Nov. 14, 1928

Fig. 1.

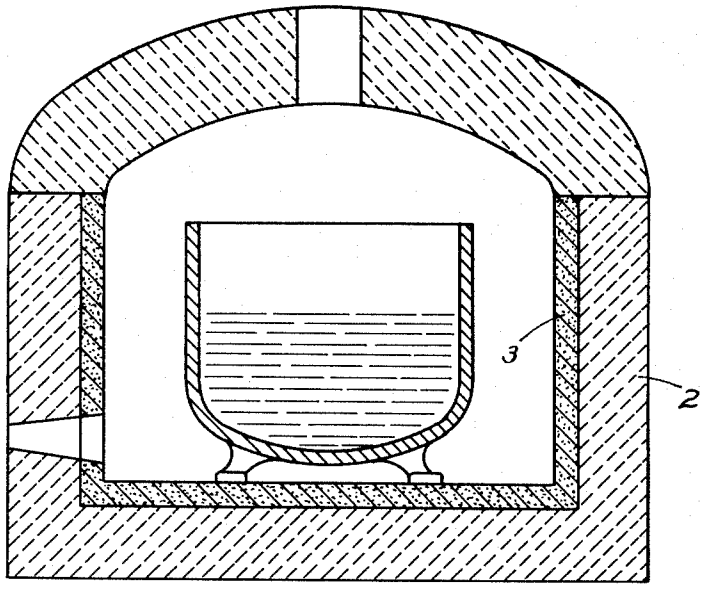
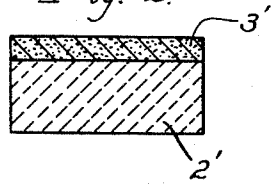


Fig. 2.



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INSULATING REFRACTORY

Application filed November 14, 1928. Serial No. 319,439.

This invention relates in general to linings for bricks used as heat insulators in furnaces, the function of the said linings being to protect the insulating bricks from the destructive action of the flaming gases in the furnace. In particular the invention relates to linings for insulating bricks such as are described in U. S. Patent No. 1,545,559 to M. L. Hartmann. The insulating bricks described in this patent are composed principally of clay with a refractory material consisting largely of silicon carbide or other refractory materials, but are manufactured in such a way as to have a porosity of about 75 percent by volume and a thermal conductivity less than one-half that of ordinary firebrick. These bricks also show a crushing strength of more than 25 pounds per square inch at temperatures of 1350° C. There are numerous instances in which furnace conditions are not sufficiently severe to require that the inner lining be made of a dense, high grade refractory material and in which it is desired to minimize heat losses by the use of heat insulating brick of the kind described above. Such installations include gas, oil and electrically heated furnaces such as heat treating furnaces or pot furnaces for brass melting crucibles. In the heat treating furnaces the facing serves more to prevent the hot gases from escaping through the pores of the bricks and in the pot furnaces it serves the double purpose of preventing the escape of heat and reducing the erosion of the insulator by the hot gases and particles in the burning fuel. These faced bricks are also particularly adaptable for use in boiler settings above the clinker line, where the erosion is not as severe as it is at the clinker line.

Where, for economical construction, the furnace wall is made of such insulating material alone I have found that there is a distinct tendency to damage the insulating refractories either by flame impingement or by breakage due to thermal shock or to other less definite causes. The trouble is intensified by the fact that in furnaces operated under even slight pressures the insulating brick are so permeable to gases that hot gases travel outward from the furnace through the walls and cause an unnecessary loss of heat. The alternative has heretofore been to use such insulators behind a wall of ordinary refractory brick capable of withstanding these destructive influences.

I have discovered that by applying to the surface of the insulating brick a very thin layer of adherent denser material capable of withstanding the required temperatures, this trouble can be greatly reduced. This facing may be applied either as a facing applied to and burned on to each individual brick before it is laid in the wall, or the unfaced brick may be built into a wall and the denser material plastered thereover. In either case the pores of the insulating material provide a very secure hold for the outer material extending to some depth below the surface of the brick. Under these conditions even if the coating material is cracked by thermal shock, it does not fall from the face of the insulator, and due to its compact nature it offers increased resistance to abrasive action and to penetration by the furnace gases. This increase in resistance to abrasion may be demonstrated by applying a rotating chisel-like tool to the unfaced brick and to the faced brick. With the tool applied under identical conditions of pressure and number of turns, I have found that the tool will penetrate the unfaced brick over ten times as far as it will the facing of the brick.

The density of the insulating brick is from 0.7 to 0.9 times that of water, and I have found that the material which offers a satisfactory facing for such insulators must have a density approximately double that or greater than 1.8 after being burned in place.

My invention is illustrated by the accompanying drawing in which:

Figure 1 is a sectional elevation of a pot furnace in which the body of the furnace wall is composed of insulating brick, while the lining adjacent the combustion chamber is composed of a comparatively impermeable and dense substance; and

Figure 2 is a section of an insulating brick or tile which is provided with such a comparatively impermeable and dense lining.

Referring to the drawings in more detail,

the pot furnace shown in Figure 1 has a wall 2 of insulating bricks or tiles while the lining 3 adjacent to the furnace chamber is comparatively impermeable and dense. The lining 3′ may be plastered as a wet mix on the individual tiles 2′ as indicated in Figure 3 and hardened by heat. The lining 3 may, however, be placed on the wall 2 of the furnace after the wall has been built up in the form 2 of Figure 1.

For the facing material, I have utilized cements made of burned clay admixed with raw clay and silicate of soda in the approximate proportions of 50 parts of grog (fine clay vitrified, crushed and screened to size) 50 parts of clay and 20 parts of silicate of soda. I have also used simply siliceous clay cements or, in cases where greater refractoriness is required, cements made of silicon carbide or of fused alumina suitably bonded with clay or silicate of soda. In any case, the facing is applied as a cement of such consistency that it can be worked to a relatively smooth surface with a trowel. The porous structure of the insulating brick allows the facing material to become well anchored to it and upon burning the cement becomes firmly attached to the brick.

To measure the change in the permeability of the porous bricks described above (and more fully in the Hartmann application referred to) the following procedure was adopted.

A brick to be tested is supported broad face down on a felt gasket which contacts with the outer edge of the brick. Both the brick and the gasket are inclosed by an iron container which has an opening below the lower face of the brick. The space between the sides of the brick and the vertical walls of the container is filled with mercury, while the brick is prevented from rising by means of a weight applied to the brick in such a way as not to materially interfere with the passage of air through the brick in a vertical direction. Air is then passed through the brick from the lower horizontal face to the upper horizontal face at such a rate that the pressure drop across the brick amounts to two inches of water. The rate of flow of air across the brick is measured by means of a water manometer connected to the air inlet below the brick. The numerical measurements are reduced to the flow that would be obtained in cubic centimers per minute across two opposite faces of an inch cube with a pressure difference of one inch of water between the said two opposite furnaces. The flow is assumed to be directly proportional to the difference of pressure between the two opposite faces and also directly proportional to the area of cross-section at right angles to the direction of flow, but inversely proportional to the thickness of the brick, that is the brick dimension in the direction of the air flow. My experiments with the insulating bricks showed a permeability of 370 reduced units before the application of the facing material and 53 reduced units after the facing material has been applied and baked on.

If a faced brick having the permeability last mentioned is ground off to the original thickness, the permeability returns to the former value.

What I claim is:—

1. An insulating brick with a dense facing having a permeability of less than 100 units through the brick and said facing and a permeability over 300 units when the facing is removed.

2. An insulating brick having a body portion whose porosity is 75 percent or less by volume and a protective facing of a material whose density is in excess of 1.8.

3. An insulating brick having a thermal conductivity less than half that of ordinary fireback, said brick being provided with a protective facing of density greater than 1.8.

4. A furnace wall comprising insulating bricks of thermal conductivity less than half that of fireclay and of density less than that of water and a common refractory facing therefor having a density greater than 1.8 times that of water.

5. A furnace wall comprising insulating bricks of thermal conductivity less than half that of fireclay and of density less than that of water and a common refractory facing therefor comprising clay grog, clay and silicate of soda baked on the furnace wall after said wall has been laid.

6. A brick having a body portion whose thermal conductivity is less than half that of fire clay and whose specific gravity is less than that of water and a refractory facing therefor having a specific gravity in excess of 1.8.

7. A brick having a body portion whose thermal conductivity is less than half that of fire-clay and whose porosity is greater than 50 per cent, and a refractory facing therefor comprising a mixture of clay and silicate of soda burned on a face of the body portion of the brick.

8. A brick having a body portion whose thermal conductivity is less than that of fireclay and whose porosity is greater than fifty per cent, and a dense facing therefor comprising clay bonded to a face of the body portion with silicate of soda to a thickness which reduces the permeability across said face to less than one third of its previous value.

9. A brick having a body portion with a thermal conductivity less than half that of fire-clay and a porosity of over fifty per cent, and a refractory facing therefor obtained by applying a mixture of vitrified clay, clay and silicate of soda and burning the mixture thereon.

10. A brick having a body portion with a porosity of approximately 70 per cent and a thermal conductivity of approximately 0.001 calorie/cm.^{3}/sec./C°., and a refractory facing therefor of the character obtainable by applying to a face of the brick a mixture of approximately 4 parts of vitrified clay, 4 parts of unbaked clay and 2 parts of silicate of soda and burning said facing on the brick.

In testimony whereof I affix my signature.

EDWIN B. FORSE.