Dec. 19, 1950 H. L. WHITMAN 2,534,328

VITRIFYING REFRACTORY COMPOSITION AND PRODUCT

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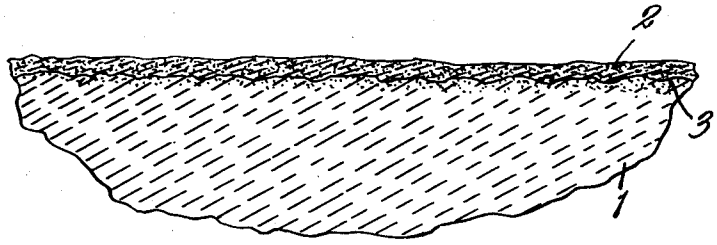



FIG. 1

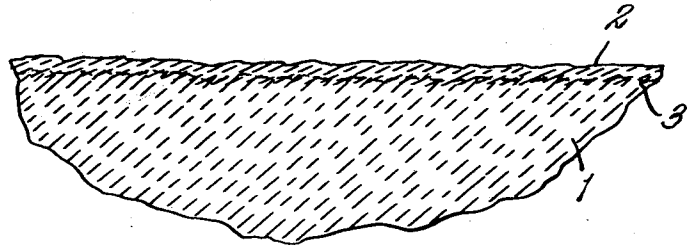



FIG. 2

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## VITRIFYING REFRACTORY COMPOSITION AND PRODUCT

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8 Claims. (Cl. 106—49)

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This invention relates to improvements in vitrifying refractory composition and product.

The main objects of this invention are:

First, to provide an improved vitrifying composition adapted to be readily applied as a coating to furnace and fire box bricks and to crucibles of graphite, silicon carbide and fire clay, and to similar articles, and when so applied adapted to be readily converted by heat into a very hard outside refractory coating which is resistant to very high temperatures.

Second, to provide a composition of the above type which is adapted to be converted by heat into a neutral or alkaline type material and which is highly impervious to gases and most fluxes and acids, and which protects the walls, crucibles and other articles to which it is applied against spauling, cracking or melting, and which greatly prolongs the life of such articles.

Third, to provide a composition of the above type which may be economically applied as a coating and in which a relatively small amount covers a substantial area.

Fourth, to provide an improved spinel type crystalline product, alkaline or neutral in reaction, which is very hard, resistant to very high temperatures, a good reflector of heat, and highly impervious to gases and most fluxes and acids.

Further objects relating to details and economies of the invention will appear from the description to follow. The invention is defined in the claims.

An embodiment of the invention is illustrated in the accompanying drawing in which:

Fig. 1 is a fragmentary view in section of a wall of a furnace, crucible or other article having a coating of vitrifying ingredients applied thereto, the ingredients being shown before vitrification of the same to the wall of refractory material.

Fig. 2 is a view similar to that of Fig. 1 illustrating the wall after vitrification of the coating thereto.

Referring to Fig. 1 of the drawing, 1 designates the wall of a furnace, crucible or other article, the wall having a coating 2 of vitrifying ingredients applied thereto. These ingredients, hereinafter named and described in detail, are mixed in powdered form with water to the proper consistency, preferably that of molasses, and applied to the wall with a spray or brush. The wall 1 is cold or only slightly warm when the coating is applied; otherwise blisters would form. After the coating is applied it is first thoroughly dried, either in the air, sunlight, a heating oven or with a torch, until all signs of dampness disappear,

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after which it is exposed to a temperature of about 1900° F. or over for an hour or until vitrified. To save time vitrification can take place during the regular melting operation of a furnace or crucible.

The best results are obtained by applying a second coating after the first has been thoroughly vitrified, as some of the first coating is absorbed by the raw brick into the cracks, holes and pores thereof. The second coat will completely seal all weak spots and will form a hard crystalline surface that will resist heat and the destructive action from flames, gases and acids. Fig. 1 at 3 illustrates a portion of the ingredients absorbed into the body of the wall 1. Fig. 2 illustrates this absorbed portion 3 forming a bonding connection of the coating into and beneath the surface of the body wall 1 after the coating has been vitrified to the wall. This provides a very strong bonding connection between the wall and vitrified coating. The depth of the vitrified coating 2 beneath the surface of the wall 1 will vary according to the consistency of the coating and the porosity of the wall.

The coating 2 applied to the wall 1 as above described comprises the following ingredients in maximum and minimum percentages by weight as indicated:

| | Minimum—Maximum |
|---|---|
| Magnesium Oxide | 20% to 25% |
| Zirconium silicate | 25% to 30% |
| Aluminum oxide | 5% to 15% |
| Clay | 8% to 15% |
| Asbestos | 5% to 15% |
| Litharge | 3% to 10% |
| Soda ash | 2% to 8% |
| Salt | 3% to 8% |
| Mica | 2% to 8% |
| Sodium silicate | 1% to 5% |

The following is a more detailed description of some of the above ingredients which vary in analysis according to the purity or source of supply:

Magnesium oxide—calcined magnesite;
Zirconium silicate—granular, chemical composition $ZrSiO_4$;
Aluminum oxide—chemical composition $Al_2O_3$;
Clay—kaolin or china clay;
Asbestos—tremolite (amphibole) chemical composition $CaMg_3Si_4O_{12}$;
Salt—chemical composition NaCl;
Mica—muscovite, chemical composition $H_2KAl_3(SiO_4)_3$

The product resulting from vitrification of the

above ingredients is basic or neutral in chemical reaction, having basic elements in excess of silicates. During vitrification the magnesium oxide base combines in such manner with the aluminum oxide, the silicates together with the litharge, soda ash, clay and asbestos, as to precipitate a spinel type crystalline coating. The reaction takes place when the ingredients are heated to 1900° F. or over, which results in the formation or precipitation of a synthetic crystalline magnesia spinel having a hardness close to that of diamond, equal to approximately 8½ on Mohs scale.

The remaining ingredients of the coating **2**, comprising sodium chloride, sodium silicate and mica perform the function more of a binder to prevent the other ingredients from drawing away from the wall **1** of the brick, crucible or other article during vitrification and during the reaction resulting in the precipitation of the crystalline spinel type coating into the body of and onto the surface of the wall **1**.

After the crystalline spinel type coating **2** is actually formed no further precipitation takes place. To soften the now finished crystalline surface requires temperatures to approximately 3000° F. and to re-fuse the same requires temperatures of 3750° to 3800° F. There is therefore a great saving to fire brick from such high temperature. Also, tests have shown that the vitrified coating reflects heat in such manner that it does not penetrate through the coating, for the side of the brick wall opposite the coating remains cool. Such reflection of heat results in quicker heat-up time for a furnace, quicker melting of the metals, and a saving of fuel. The action is the same for crucibles having this coating. This vitrified coating will withstand long periods of reheating, and is impervious to fluxes, gases and acids common in all melting furnaces and fire boxes so destructive to brick.

The vitrification of the ingredients of the coating **2** and the precipitation of the crystalline spinel type product is not dependent upon the material of the wall to which the ingredients are applied as the ingredients go through the same process of vitrification and precipitation on flint-brick, fire-brick, silica-brick, magnesite-brick, set-up clays, dolomites, graphite, silicon carbide, etc. The only requirement is that the material to be coated be able to withstand the proper vitrifying temperatures. If the coating is applied to materials that cannot withstand the proper vitrifying temperatures, such as Pearlite, the material melts down from the vitrified coating.

The vitrified coating is adapted for many uses but being of a neutral or alkaline type is particularly adapted for use on furnaces and crucibles used in melting aluminum and magnesium alloys, and also for open hearth furnaces, Bessemer type furnaces, and all such furnaces used extensively in the manufacture of basic and stainless steels.

The use of the ingredients is very economical as a relatively small amount covers a substantial area, one pound when properly applied covering from six to eight square feet of brick surface.

The product of the invention is characterized by its property of being resistant to temperatures up to approximately 4000° F., by a hardness close to that of diamond, its imperviousness to gases and chemicals common to furnaces and crucibles, its property of reflecting heat to prevent the escape thereof, the economy in the use thereof, and its property of being neutral or alkaline in reaction.

I have illustrated and described my improved



composition and product in embodiments thereof which I consider practical. I have not attempted to illustrate and describe other embodiments or adaptations as it is believed the disclosure made will enable those skilled in the art to embody or adapt my invention as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A vitrifying composition adapted to produce a refractory vitrified crystalline spinel type coating for refractory materials, comprising by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; soda ash 2% to 8%; sodium chloride 3% to 8%; mica 2% to 8%; and sodium silicate 1% to 5%; said last three named ingredients facilitating a binding connection of the coating to the refractory material.

2. A vitrifying composition adapted to produce a refractory, vitrified crystalline spinel type product, comprising by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; a carbonate 2% to 8%, selected from the group consisting of sodium carbonate and potassium carbonate; a chloride 3% to 8%, selected from the group consisting of sodium chloride and potassium chloride; mica 2% to 8%; and a silicate 1% to 5% selected from the group consisting of sodium silicate and potassium silicate.

3. A refractory product comprising a porous body portion of refractory material selected from the group consisting of fire clay, graphite and silicon carbide, and a refractory coating vitrified to said body portion, said coating being produced by vitrifying to said body portion the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%, aluminum oxide 5% to 15%, clay 8% to 15%, asbestos 5% to 15%, litharge 3% to 10%; soda ash 2% to 8%; sodium chloride 3% to 8%; mica 2% to 8%; and sodium silicate 1% to 5%; the above percentages all being by weight, the sodium chloride, mica and sodium silicate acting as a binder between the body portion and the coating to prevent the coating from drawing away from the body portion during the vitrification of the coating in the pores of the body portion and on the surface thereof.

4. A refractory product comprising a porous body portion of refractory material selected from the group consisting of fire clay, graphite and silicon carbide, and a refractory crystalline coating vitrified to said body portion, said coating being produced by vitrifying to said body portion the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; a carbonate 2% to 8%, selected from the group consisting of sodium carbonate and potassium carbonate; a chloride 3% to 8%, selected from the group consisting of sodium chloride and potassium chloride; mica 2% to 8%; and a silicate 1% to 5%, selected from the group consisting of sodium silicate and potassium silicate; the above percentages all being by weight, the mica, the chloride selected from the group consisting of sodium chloride and potassium chloride, and the silicate selected from the group consisting of sodium silicate and potassium silicate, acting as a binder between the body portion and the coating to prevent the coating from drawing away from the body portion during the vitrifica-

tion of the coating in the pores of the body portion and on the surface thereof.

5. A refractory product including a crystalline magnesia spinel produced by vitrifying by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; soda ash 2% to 8%; sodium chloride 3% to 8%; mica 2% to 8%; and sodium silicate 1% to 5%, said ingredients being vitrified at a temperature not less than approximately 1900° F.

6. A refractory product including a crystalline magnesia spinel produced by vitrifying by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; soda ash 2% to 8%; sodium chloride 3% to 8%; mica 2% to 8%; and sodium silicate 1% to 5%.

7. A refractory crystalline spinel-type product produced by vitrifying by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; a carbonate 2% to 8%, selected from the group consisting of sodium carbonate and potassium carbonate; a chloride 3% to 8%, selected from the group consisting of sodium chloride and potassium chloride; mica 2% to 8%, and a silicate 1% to 5%, selected from the group consisting of sodium silicate and potassium silicate, said ingredients being vitrified at a temperature not less than approximately 1900° F.



8. A refractory crystalline spinel-type product produced by vitrifying by weight the following ingredients: magnesium oxide 20% to 25%; zirconium silicate 25% to 30%; aluminum oxide 5% to 15%; clay 8% to 15%; asbestos 5% to 15%; litharge 3% to 10%; a carbonate 2% to 8%, selected from the group consisting of sodium carbonate and potassium carbonate; a chloride 3% to 8%, selected from the group consisting of sodium chloride and potassium chloride; mica 2% to 8%, and a silicate 1% to 5%, selected from the group consisting of sodium silicate and potassium silicate.

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