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REFRACTORY

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This invention relates to refractories adapted for building, repairing or lining apparatus, pots, and furnaces subjected to high temperatures, such as electric metallurgical furnaces.

Heretofore, refractories have been more or less definitely classified in three classes. The first of these classes is that of acid refractories which are particularly adapted to resist the scoring and corrosive action of acid material, such as acid slag, in metallurgical work. These acid refractories are generally employed for roofs or arches of high temperature furnaces in that they function to resist high temperatures although they do not satisfactorily resist serious fluxing reactions. Typical acid refractories are silica brick, chrysolite, sand and ganister.

The second type of refractory material is called the neutral type. Neutral refractories are adapted to resist the action of neutral substances which are neither basic nor acid. Typical neutral refractories include graphite, chromite, fire clay, carbon brick and the like and they are employed for example in a basic open hearth furnace as an interposed layer between the roof of an acid refractory and the hearth of a basic refractory. This interposed layer terminates ordinarily slightly above the hearth lined with basic material so that the molten contents of the furnace will not attack the neutral refractory. Moreover, if the basic and acid refractories are placed in contact with each other a reaction resulting in melting may occur.

The third class of refractories is that of basic refractory materials such as dolomite, which is a magnesian lime stone, periclase, magnesite, "Magnefer", which is a trade name for a calcined dolomite, etc. These basic refractories are employed for example in the hearth of the basic open hearth furnace where other refractories would be quickly scored and corroded by the basic slags.

From the foregoing it will be recognized that refractory materials heretofore had to be selected very carefully from the proper class and in view of the relation in which the same was to be employed in order to prevent premature scoring and corrosive action on the refractories and in order to eliminate frequent replacements. The difficulty of selecting refractory materials for particular use is very evident in the selection of refractories for electric furnaces employed in the production of steel. These electric furnaces are ordinarily of the induction or arc type and are particularly adapted to the manufacture of stainless and other chrome steels in that the particular chrome and carbon content necessary for these steels can be produced therein which production is difficult, and in many cases impossible, in open hearth furnaces.

The basic lined electric arc furnace for the production of steel is ordinarily lined heavily with magnesite or "Magnefer" on the bottom, while above the slag line silica brick is employed for the side walls, door jambs, arches and roof of the furnace. Certain portions of the walls and jambs are apt to be cut or worn away so that patching of the furnace becomes necessary. This patching operation was formerly accomplished by mixing ground magnesite with some suitable binding material such as water glass, pitch or the like and then attempting to burn this patching material into the place to be repaired.

It was found that patching jobs performed in this manner, although highly satisfactory from a refractory standpoint, were not the most economical from the standpoint of furnace operation. The high prolonged temperature required for bonding the magnesite made it impractical to patch with such material, particularly where the holes were deep for it was essential that the next charge of metal be placed in the furnace as promptly as possible after the prior head had been tapped. If magnesite and the ordinary binding material were used a long time was required for bonding.

By the present invention an improved refractory substance is provided which can be employed for patching work such as in electric furnaces and which can likewise be employed as original linings or in other refractory relations as will be understood. The refractory of the present invention comprises a combination of magnesite, olivine and chrome ore. Magnesite is a double burnt or sintered magnesium oxide having certain oxides of calcium and iron present. The magnesium oxide content is ordinarily about 85%. Olivine is a form of chrysolite which is relatively inexpensive and which can be readily obtained from extensive deposits in the United States. It is a magnesium silicate of iron having a typical chemical formula: $(MgFe)_2SiO_4$. A common sample of olivine indicated the following general components (or elements which would form their equivalents): about 48% MgO, about 42% SiO_2, about 10% FeO. The chrome ore or chromite is a double oxide of iron and chromium and ordinarily includes a little gangue. Its chemical formula is $FeOCr_2O_3$.

In the foregoing composition the magnesite is

the essential refractory material and the olivine and chrome ore supply the fluxing or bonding ingredients. I believe that the olivine reacts with the chrome ore to produce a readily fusible substance and that either such substance of the olivine soaks into the magnesite grains and makes the magnesite more readily fusible. The small sized particles of olivine contact with much of the surface of the magnesite grains and thus can readily soak into those grains before any tendency for it to run out develops. Chrome ore serves the additional function of stabilizing any dicalcium silicate which may be formed when a lime slag comes into contact with the patching material.

By mixing the foregoing refractory materials in certain definite relations a new and improved refractory material will result. The exact proportions in which the materials can be combined may vary considerably. However, a typical mixture consists of two parts by weight of olivine, three parts by weight of magnesite and one part by weight of chrome ore. The olivine is in a finely comminuted form and distributed throughout the mixture for the purpose of having the olivine in contact with substantially all of the outer surface of the magnesite grains. This mixture was particularly adapted for use in electrical arc furnaces where it could be employed in conjunction with a water glass binder which assisted in fusing the materials together in such a manner that wash outs were prevented and the furnace was found to last for many extra heats.

In employing the refractory substance in an electric induction furnace the mixture was made dry and in the proportion of two parts magnesite, two parts chrome ore and one part olivine. The composition described above for use in electrical arc furnaces has likewise been found very successful in induction furnaces as it fuses very hard, does not crack or spall off and resists knocking and scraping action occasioned by charging the furnaces.

It will be appreciated that the mixture can be applied quite advantageously in paste form to the article or in the pot or furnace in which it is to be used, either as a lining or a repair patch.

The invention contemplates replacing the magnesite with a purer form of magnesium oxide such as periclase, which is crystallized magnesium oxide of about 90% purity. The refractory material produced from this combination is similar to that produced from magnesite but is slightly more refractory. The periclase is bonded together by the remaining constituents in the mixture and tendency for wash outs or other failures is considerably reduced resulting in longer furnace life.

While the invention has been described as comprising a mixture of olivine, chrome ore, and magnesite or periclase, which substances are respectively acid, neutral and basic refractories, it is within the scope of the invention to replace the specified materials with other materials from their general class which will function in a similar manner to the specified materials named herein.

The refractory material produced in accordance with the teachings of the present invention has been particularly described as adapted for use in electric metallurgical furnaces, however, it should be understood that the invention contemplates employing the material in substantially any article or furnace subjected to high temperatures. It will, therefore, be appreciated that the foregoing description has, in accordance with the patent statutes, specifically described certain forms and applications of the invention, but that the scope thereof is not so limited but is defined in the appended claims.

What I claim is:

1. A refractory consisting of about 2 parts by weight of olivine, about 1 part by weight of chrome ore, and about 3 parts by weight of calcined magnesite.

2. A refractory substance resistant to lime slag reactions consisting of about 2 parts by weight of olivine containing about 48% MgO, about 42% SiO_2 and about 10% FeO, about 1 part by weight of chromite and about 3 parts by weight of magnesium oxide.

3. A refractory consisting of about 1 part by weight of olivine, about 2 parts by weight of calcined magnesite and about 2 parts by weight of chrome ore.

4. A refractory substance resistant to lime slag reactions consisting of about 1 part by weight of olivine containing about 48% MgO, about 42% SiO_2 and about 10% FeO, about 2 parts by weight of a magnesium oxide and about 2 parts by weight of chromite.

5. A refractory containing between about 2 and 3 parts by weight of a refractory substance containing above 80% magnesium oxide, between about 1 and 2 parts by weight of olivine containing between 48% MgO, about 42% SiO_2 and about 10% FeO, and about 1 part by weight of chrome ore, said refractory substance being bonded together with the chrome ore and olivine, said olivine being finely comminuted and distributed throughout the mixture.

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