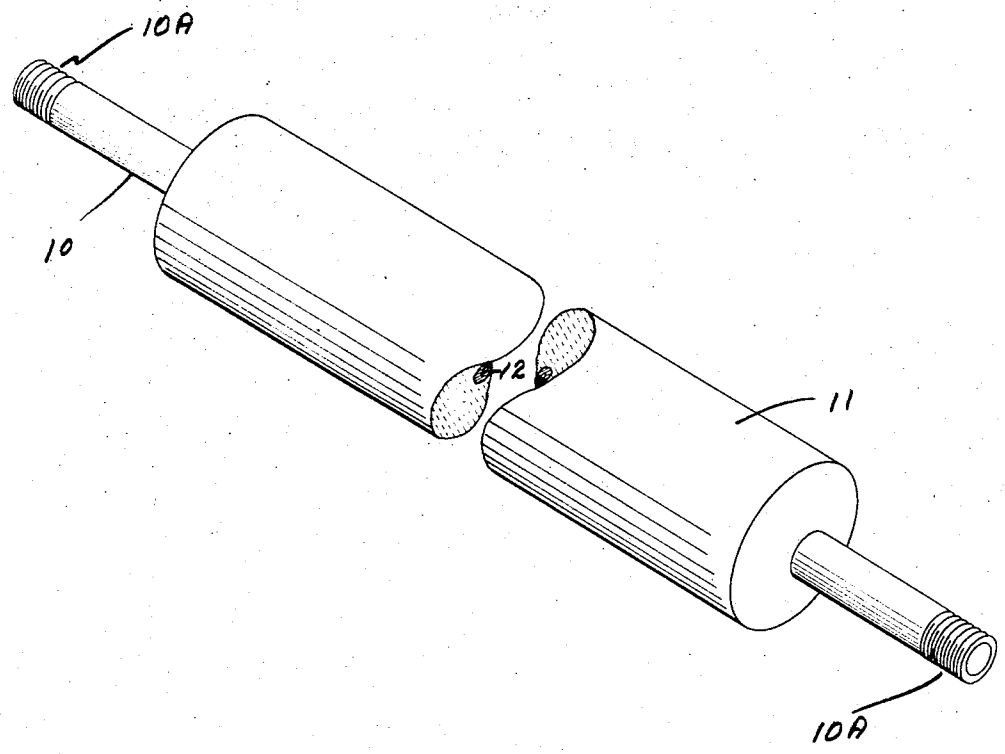
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REFRACTORY-COATED OXYGEN LANCE

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REFRACTORY-COATED OXYGEN LANCE

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ABSTRACT OF THE DISCLOSURE

An oxygen lance construction of the type particularly suited for use in an electric furnace comprised of an elongate, open-ended, tubular metal member having firmly anchored about a substantial portion of its exterior surface a hard refractory sheath, said sheath fabricated from a paste-like mixture of phosphoric acid and material of the group high alumina materials, and zircon.

This invention relates to improved oxygen lance construction. More particularly, the invention relates to oxygen lances of the type useful in the manufacture of steel by contemporary ogygen processes; for example, introduction of oxygen or air into electric furnaces or the like to assist in more rapid removal of carbon and like impurities to obtain high quality steel.

In the manufacture of steel by various oxygen-utilizing processes, it is conventional to use an elongate, tubular member to rapidly blow oxygen over the surface of a molten metal bath. As one can imagine, the very high temperatures of the environment in such a steelmaking vessel is extremely destructive to the tubular members or lances.

It has been suggested that water jackets be utilized about exterior surfaces of the oxygen confining tube, but this would not be satisfactory—particularly adjacent the lower ends of the lance which are, in fact, destroyed and worn away in use—since it would allow escape of water, or such other cooling fluid as might be used, into the molten steel. In fact, it seems as though almost any approach to solving the problem of increased oxygen lance life is one which merely slows down the rate of destruction of the lance. It has been suggested that various refractory materials could be placed over exterior surfaces of the lance to thereby slow down its destruction. One suggestion has been to coat a sheet of paper with a refractory and to then roll this refractory-coated paper about the tube. Of course, the paper is destroyed almost immediately when exposed to the atmosphere of a steelmaking furnace, thereby providing a plane of weakness through the coating which promotes spalling or peeling off of large chunks of the refractory.

Therefore, it is an object of this invention to provide a new lance construction particularly suited for use in certain metallurgical processes utilizing oxygen, which lance construction markedly retards the rate of destruction of the lance over those portions exposed to steelmaking furnace environments.

Briefly, according to a preferred embodiment of this invention, an oxygen lance construction is provided which is comprised of an elongate metal, preferably steel, pipe or tube, over the exterior surfaces of which is firmly bonded a particular refractory composition. In the most preferred construction, the refractory is applied as a series of layers, which layers firmly bond to each other, and which—after a baking treatment—form a substantially monolithic refractory sheath about exterior surfaces of the oxygen-confining tube or pipe.

The preferred refractory composition is a paste-like composition consisting essentially of 15–25%, based on the weight of solids in the paste, of wet 75% phosphoric

acid (or equivalent wet acid providing the same amount of P_2O_5) with the remainder of the paste substantially all being a member selected from the group consisting of high alumina materials and zircon. The selected high alumina material and the zircon are substantially free of materials which will vitrify or form glassy phases at temperatures of about 2000° F.

"High alumina materials" has a well understood meaning in the art. High alumina materials are generally classified by their Al_2O_3 content into groups having approximately 50, 60, 70, 80, 90, or 99% Al_2O_3, by oxide analysis. Such refractories can be made by blending various high alumina refractory materials or by using selected ones having the desired Al_2O_3 content. The more common high alumina refractory materials and their typical Al_2O_3 contents are: calcined Baer process alumina, 99% Al_2O_3; calcined South American bauxite, having 88% Al_2O_3; calcined Alabama bauxite, having 74% Al_2O_3; calcined diaspore, having 76% Al_2O_3; burley diaspore, having 48–88% Al_2O_3; kyanite, having 56% Al_2O_3; etc. All of these materials are, of course, chemically compatible. Further, minor adjustments in Al_2O_3 content are commonly accomplished by including small amounts of clay or silica.

Zircon is generally represented by the formula

$$Zr_2O_3 \cdot SiO_2$$

A usable zircon material of sand sizing has an oxide analysis substantially as follows: 66.1% Zr_2O_3, 32.3% SiO_2, 1% Al_2O_3, and 0.2% each of TiO_2 and Fe_2O_3. Total alkali content runs on the order of 0.2%.

The type of steel used for our lance construction is, of course, variable, depending upon the desires of the user or fabricator and based on such considerations as price, temperature of use, etc. However, it is essential that the steel be of such a type as to react over its exterior surfaces with the phosphoric acid content of the refractory-phosphoric acid paste.

A preferred method of constructing the lances of this invention is as follows: A length of selected steel pipe or tubing of desired inner and outer diameter is coated with a relatively thin layer of the wet pasty mixture, described above. After a substantially even coating has been applied, the construction is passed through an oven and subjected to a temperature on the order of about 450° F. for about 15–30 minutes, during which time the acid reacts with the exterior surfaces of the pipe, roughening it, and promotes a firm bond between the paste coating and the pipe, as well as "curing" the paste to a hard state. The heat-treated member is then recovered and an additional coat or coats of the paste is applied with the heat treatment being repeated after each coating. The subsequent applications of wet paste-like material react with previously applied and set coatings. The result is an oxygen lance construction consisting of a central, metal, tubular conduit open at each end, and about exposed exterior surfaces of which there has been interaction with and firm bonding to a monolithic sheath of highly refractory material.

Just as the size of the tubular member is dependent upon use and the varying requirements of the user, the thickness of individual coatings and the total thickness of the final sheath is variable. However, in the interests of a complete disclosure, a usable lance construction, according to the best mode now known for the practice of our invention, is comprised of an inner, black steel pipe having an inside diameter of about ½", and a wall thickness of about ⅛". The total sheath thickness is about one inch, being built up of multiple coatings.

The attached drawing schematically indicates a lance construction according to this invention. In the drawing there is shown a lance comprised of an elongate, hollow, metal, core member **10** about the exterior surface of which

is a set or cured layer of refractory **11** which is firmly bonded to exterior surfaces of the conduit **10** over all exposed surfaces, i.e., completely over the core-refractory sheath interface **12**. Preferably the ends **10**A of the core member or pipe **10** are threaded for about 1" to allow the stub end of a used lance to be attached to a new lance and completely consumed.

Having thus described the invention in detail and with sufficient particularity as to enable those skilled in the art to practice it, what is desired to have protected by Letters Patent is set forth in the following claims.

We claim:

1. An oxygen lance construction comprised of an elongate, open-ended, tubular, metal member, the material of which said metal member is constructed being capable of reacting with phosphoric acid, and a hard refractory sheath firmly anchored to and surrounding all exterior surfaces of said metal member, said refractory sheath being made from a paste-like batch containing phosphoric acid in an amount sufficient to provide the equivalent of 15–25% of 75% phosphoric acid based on the weight of the solids in the paste, the solids consisting essentially of refractory material selected from the group consisting of high alumina materials and zircon.

2. An oxygen lance construction comprised of an elongate, open-ended, tubular, metal member, the material of which said metal member is constructed being capable of reacting with phosphoric acid, and a hard refractory sheath firmly bonded and anchored to and surrounding all exterior surfaces of said metal member, said refractory sheath being made from a paste-like batch containing phosphoric acid in an amount sufficient to provide the equivalent of 15–25% of 75% phosphoric acid based on the weight of the solids in the paste, said solids consisting essentially of refractory material selected from the group consisting of high alumina materials and zircon, said sheath comprised of a plurality of monolithically bonded layers of said batch.

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