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REFRACTORY COATED TUBE AND METHOD OF MAKING SAME

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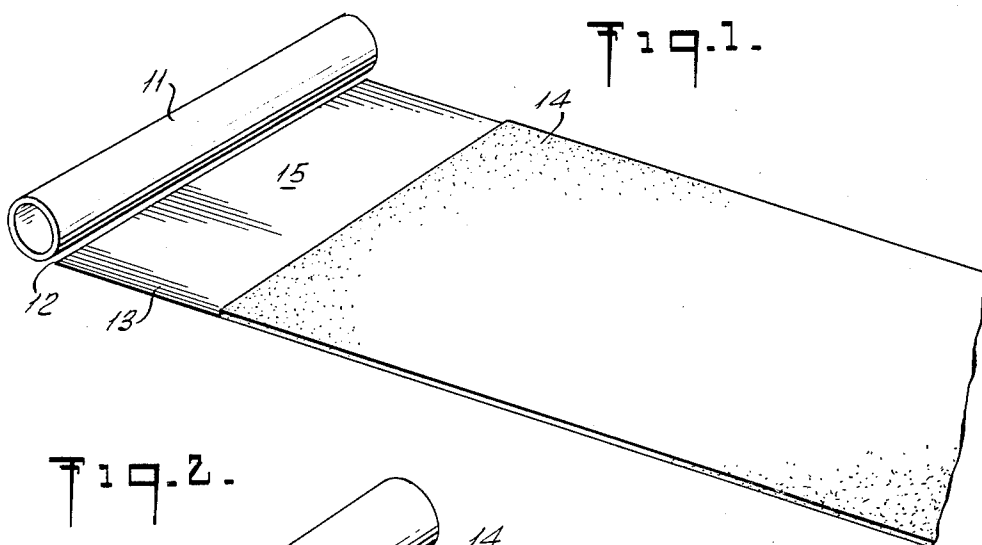


Fig. 2.

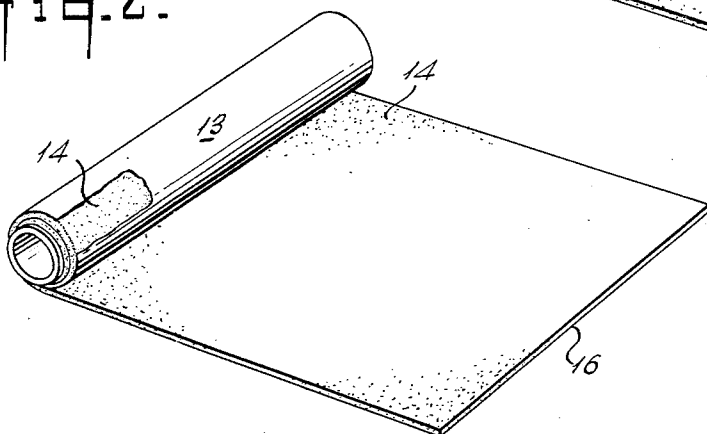
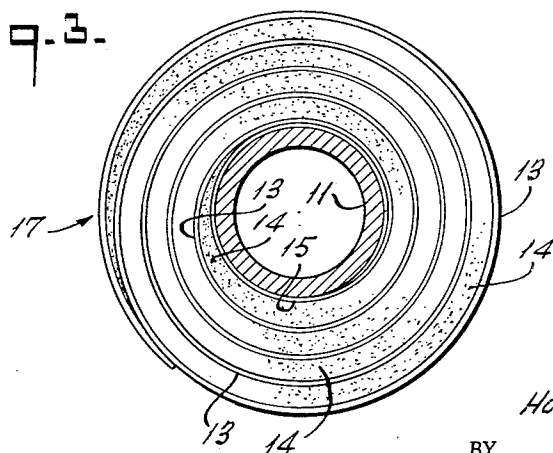


Fig. 3.



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REFRACTORY COATED TUBE AND METHOD OF MAKING SAME

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7 Claims. (Cl. 266—34)

This invention relates to a refractory coated tube and the method of making the coated tube. More particularly, it relates to an improvement in the form of tubes employed to permit injection of gaseous material such as oxygen into a bath of molten steel or other molten metal located within a suitable high-temperature furnace for the purpose of burning off impurities, especially carbon, in the production of purified metals.

The use of refractory coated tubes is a common expedient in purified metal production processes. For example, in producing purified steel, an oxygen lance is often employed to introduce oxygen into the molten metal within an electric or open hearth furnace. The oxygen lance, generally formed by providing a refractory coating around a steel or ceramic tube, when in operative position has its front end or tip subjected to a rather high temperature, normally around 3000° F., at which the tip of the oxygen lance is destroyed to the extent that a conventionally dimensioned lance must be fed at the approximate rate of 12 inches per minute for continued operation. Thus, a conventional refractory coated oxygen lance having a length of 5 feet would have a very short life of 5 minutes. The conventional refractory coated lance is readily subjected to spalling or breakage either in transportation or in a high temperature environment.

One of the objects of the invention is to provide an improved refractory coated tube having a greatly extended life.

Another object of the invention is to form the improved tube of extended life by a new method.

A further object of this invention is to provide an improved refractory coated tube that eases the transportation burdens associated therewith.

In one aspect of the invention the improved tube may include a rigid tubular element and a plurality of refractory layers surrounding predetermined portions of the tubular element, each layer of refractory being separated from each adjacent layer by a sheet-like layer of combustible material. The innermost layer of combustible material preferably is located between the tubular element and the innermost refractory layer. The protective refractory coating preferably is wrapped in convolute manner a plurality of turns around the tubular element.

In another aspect of the invention the coating may be applied to the tubular element by extending lengthwise a sheet-like layer of combustible material with the end portions thereof lying in substantially the same plane, coating one side of the combustible material with a wet layer of refractory material, securing the tubular element substantially lengthwise along an edge of one end portion, and laterally rolling the tubular element toward the other end portion. Preferably, when coating the one side a predetermined uncoated margin is provided at the one end portion of the combustible material.

These and other objects and advantages of the invention will appear from the following description, reference being made to the drawings in which:

FIG. 1 is a perspective view of the essential elements of the invention shown in an unassembled relationship with a portion of one element partially removed;

FIG. 2 is a view similar to FIG. 1 showing the elements in an intermediate or nearly completed stage of assembly with another portion of one element partially removed; and

FIG. 3 is an enlarged end view of the elements completely assembled with the innermost element shown in section.

A rigid tubular member 11, preferably of steel construction is positioned, as viewed in FIG. 1, lengthwise of and adjacent to an edge 12 of a sheet-like layer 13 of combustible material such as paper or cloth which preferably has been presented in an extended or flat position. Any suitable support means may be provided for the layer and tubular member. The upper surface of the layer 13 is substantially coated with a refractory material 14, preferably a common high temperature refractory such as wet cement. However, when the refractory coating 14 is applied to the layer 13, it is preferable that an uncoated margin 15 be provided at one end of the layer adjacent the edge 12.

The tubular element 11 has then secured thereto the uncoated marginal edge 12, by any desired means including the manner of initially rolling the tube 11 along the uncoated margin 15 of combustible material and toward the wet refractory coating. By continued rolling of the tube toward the other end or edge 16 (FIG. 2) of the layer, a substantially cylindrical refractory coated tube is formed and allowed to dry and harden with time. The completely coated tube (FIG. 3) is thus provided with a series of layers or laminations of refractory material, each being separated from adjacent layers or laminations by corresponding portions of the substantially convolutely wound layer 13 of combustible material. The refractory tube, shown generally at 17, may now serve as an oxygen lance wherein oxygen may be delivered through the tubular element 11 into a bath of molten metal when the tube tip is immersed below the surface of the bath.

When the convolutely wound refractory coated tube is subjected to a very high temperature under operating conditions, the paper or combustible material burns, leaving a carbon deposit within otherwise void spaces between the laminations of refractory. The carbon, being slippery in nature, acts as a lubricant in allowing independent unwinding movement of the refractory laminations caused by heat induced expansion, and yet allowing independent rewinding movement of the laminations should the refractory coated tube be withdrawn from the high temperature area. Thus, the laminations of refractory will not spall and break off as readily as the refractory employed in other forms of oxygen lances.

It has been found that by forming oxygen lances with a convolutely wrapped refractory, for a given refractory material and diameter of tubular element, the overall thickness may be less than that of other commonly used forms and yet the life will thereby be extended two to three times. Thus, plants now using 100 oxygen lances daily could maintain an equivalent production with some 30 lances constructed in the above manner.

Since the diameter of each new-type tube can be diminished, the space burdens in packaging and transportation will be lessened. Moreover, breakage in transit is not as critical a problem with this new-type refractory tube.

It is intended that modifications may be made without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. A tube, comprising a rigid tubular element for delivering gaseous material therethrough and into a bath of molten metal, and a plurality of layers of material, refractory at steel making temperatures, surrounding predetermined portions of said tubular element, each layer of refractory material being separated from each adjacent layer thereof by a layer of combustible material.

2. The refractory coated tube of claim 1 in which the innermost layer of combustible material is located be-

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tween the tubular element and the innermost refractory layer.

3. A tube, comprising a rigid tubular element having means for delivering gaseous material lengthwise there-through and into a bath of molten metal, and a protective coating wound in convolute manner a plurality of turns around said tubular element, said coating including a sheet-like layer of combustible material having a coating of refractory at steel making temperatures adhered to its inner surface and extending a substantial portion of its length.

4. The refractory coated tube of claim 3 in which the innermost layer portion of combustible material has an uncoated margin forming at least an initial turn about said tubular element within an initial turn of said refractory coating.

5. An oxygen lance for use in steel production comprising a metallic tubular member, a protecting refractory disposed about said member and comprised of a plurality of convolutely wound layers of a cement material that is a

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refractory at the temperature of molten steel, said layers being separated by a sheet of burnable material.

6. The oxygen lance of claim 5 wherein the burnable material is paper.

7. The oxygen lance of claim 5 wherein the burnable material is cloth.

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