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COMPOSITE STOPPER ROD SLEEVE WITH INSULATING INNER PORTION

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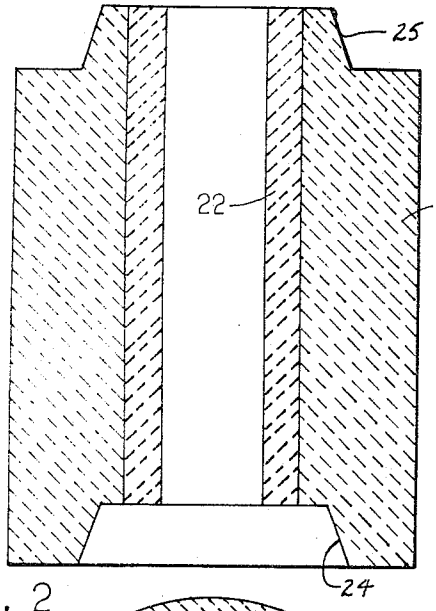


FIG. 2

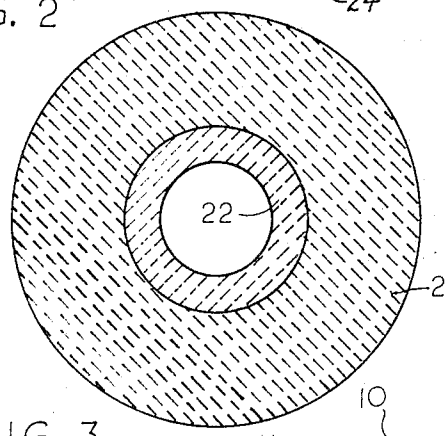


FIG. 3

FIG. 1

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COMPOSITE STOPPER ROD SLEEVE WITH INSULATING INNER PORTION

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The present invention relates to a sleeve for a ladle rod used in steel making ladles, and particularly relates to a sleeve suitable for use in present high temperature steel making.

There is a constant trend toward higher processing temperatures in the steel industry. As higher temperatures are attained, the materials from which the stopper rod sleeves are made have been changed to take care of the higher temperatures.

Furthermore, with the advent of continuous casting, not only has the temperature of the steel been raised to allow for the greater temperature drop during the slower casting process, but also the ladle refractories are in contact with the molten metal for longer periods of time. Therefore, the material from which the stopper rod sleeves are made has been upgraded from fire clay to refractories of high alumina and magnesite-chrome content. This upgrading of the sleeve material introduces a problem in that the greater thermal conductivity of the high alumina and magnesite-chrome materials allows the stopper rod to soften and thereby become inoperable.

Accordingly, it is an object of the present invention to provide a sleeve segment which will withstand the higher temperatures of the molten steel as well as protecting the metal stopper rod from becoming overheated.

A further object of the present invention is to provide a sleeve segment for a ladle rod having an outer cylindrical portion of high refractoriness and an inner cylindrical segment provided with a rod opening and bonded to the inner surface of the outer segment, the inner segment being of low thermal conductivity to protect the rod.

These and other objects and advantages will become apparent hereinafter.

In the drawings, wherein like numbers refer to like parts wherever they occur,

FIG. 1 is a fragmentary view partly in section of a portion of a steel making ladle showing a stopper and stopper rod applied to the nozzle,

FIG. 2 is a vertical sectional view of the composite sleeve segment of the present invention, and

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2.

The present invention comprises a sleeve segment having an outer portion of high refractory material and an inner portion of insulating material of low thermal conductivity and provided with a central opening for a stopper rod.

FIG. 1 shows a steel making ladle **10** formed of refractory blocks **11** and provided with a sloping drain **12** to a discharge nozzle **13** through which the steel is poured from the ladle **10**.

A stopper **14** comprising a metal stopper rod **15** is connected at its upper end to a control mechanism (not shown) and provided with a head **16** at its lower end adapted to seal off the opening to the nozzle **13** while the steel is heated. The head **16** is connected to the rod **15** by means of a pin **17** and key **18**, and the opening in the end of the head **16** is filled with a refractory filler **19** to protect the head of the pin **17**. The metal rod **15** is surrounded throughout its length by a sleeve which is composed of interlocked segments **20**.

Each sleeve segment **20** comprises an outer cylindrical portion **21** of high refractory material and an inner cylindrical portion **22** of good insulating refractory material. The inner portion **22** is fastened to the inside surface of the outer portion **21** by a suitable adhesive, such as an air setting refractory cement or an epoxy resin. The inner portion **22** is provided with a central opening **23** to accommodate the stopper rod **15**. One end of the sleeve **20** is provided with a counterbore **24**, and the other end is provided with an extension portion **25** adapted to engage a corresponding counterbore **24** on the next adjacent sleeve segment **20** in an interlocking fit.

The outer sleeve portion **21** is a high refractory material selected from the class consisting of high alumina and magnesite-chrome materials and has a thermal conductivity of about 10 to 18 B.t.u./hr./sq. ft./° F. difference for one inch thickness and is satisfactory for use at steel temperatures of 3000° F. Other characteristics of this sleeve material are an apparent porosity of about 18–22% and resistance to attack by basic slags.

The inner sleeve portion **22** is a thermal insulating refractory having a thermal conductivity of about 2 to 4 B.t.u./hr./sq. ft./° F. difference for one inch thickness and may be selected from any of the following types of material.

(1) Insulating Refractory composed essentially of an aggregate of expanded refractory clay or other material with a refractory clay and/or refractory alumina bond.

(2) Insulating Refractory composed of a refractory matrix and a bulking agent having low refractoriness.

(3) Insulating Refractory composed of a refractory matrix and a combustible material to provide a cellular structure.

(4) Insulating Refractory composed of a refractory matrix and a foaming agent to provide cellular structure.

(5) Insulating Refractory composed of refractory matrix, bulking agent of either low or high refractoriness, and a hydraulic or chemical bonding agent.

A specific example of a stopper rod sleeve and its formulation is as follows:

Example No. 1

(1) *Outer sleeve.*—The outer sleeve is pressed at a pressure of approximately 5000 p.s.i. from a mix consisting of, by weight, 65% calcined South American bauxite, 15% calcined Missouri flint clay, and 20% crude refractory bond clay which mixture is to have an alumina content of 70%±2.5%. The grain size of this mixture is to be such that 17 to 23% will remain on 10 mesh and 40 to 46% will pass a 65 mesh screen. The pressed outer sleeve is dried at 300° F. and then fired at a temperature of approximately 2380° F. to cone **13–14**.

(2) *Inner Sleeve.*—The inner sleeve is pressed at a pressure of 600 p.s.i. from a mix containing, by weight, 20% perlite, 27% ball milled calcined South American bauxite, 43% minus 35 mesh crude domestic kyanite, and 10% calcium aluminate cement. The formed inner sleeve is dried at approximately 300° F. and then fired at 2380° F. to cone **13–14**.

(3) The two sleeve components are cemented together by coating the outside surface of the inner sleeve with an air setting refractory mortar, such as SAIRSET (manufactured by A. P. Green Fire Brick Co. of Mexico, Mo.) and then inserting it into the outer sleeve. The composite sleeve is then dried at approximately 300° F.

This invention is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. A sleeve segment for a stopper rod of a pouring ladle comprising a cylindrical outer portion of high re-

fractory material having a thermal conductivity of about 10 to about 18 B.t.u./hr./sq. ft./° F. difference for one inch thickness, and a cylindrical inner portion of insulating refractory having a thermal conductivity of about 2 to about 4 B.t.u./hr./sq. ft./° F. difference for one inch thickness, bonded to the outer portion.

2. The segment of claim 1 wherein the inner insulating portion is of a cellular structure.

3. A ladle rod and sleeve assembly for a steel ladle comprising a metal rod surrounded by a plurality of interlocked sleeve segments, each segment comprising a cylindrical outer portion of high refractory material having a thermal conductivity of about 10 to about 18 B.t.u./hr./sq. ft./° F. difference for one inch thickness selected from the class consisting of high alumina and magnesite-chrome and a cylindrical insulating inner sleeve surrounding the rod and bonded to the outer portion, said inner

sleeve having a thermal conductivity of about 2 to about 4 B.t.u./hr./sq. ft./° F. difference for one inch thickness.

4. The sleeve assembly of claim 3 wherein the insulating inner sleeve portion is of a cellular structure.

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