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**COATED STOPPER HEAD FOR CONTROLLING
OUTFLOW OF MOLTEN METAL THROUGH THE
NOZZLE OF A BOTTOM POUR RECEPTACLE****Ronald V. Kilgore, Coraopolis, Pa., assignor to Vesuvius
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Pennsylvania****No Drawing. Filed Mar. 28, 1968, Ser. No. 717,033****Int. Cl. B22d 37/00; B65d 47/06; B67d 3/00****U.S. Cl. 222—541****5 Claims****ABSTRACT OF THE DISCLOSURE**

A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle comprising a stopper head body with a coating thereon so that when the stopper head is in position closing the nozzle and molten metal is introduced into the relatively cold receptacle metal freezes in the bottom of the receptacle and against the coating of the stopper head, the coating being of friable refractory material which fragments when subjected to tensile and/or shear stresses so that when the stopper head is subsequently urged upwardly to permit outflow of molten metal through the nozzle the coating fragments, freeing the stopper head, obviating freezing of the stopper head to solidified metal in the bottom of the receptacle. The coating preferably comprises finely divided refractory material and a binder and may be of such consistency that it may be applied with a brush. The refractory material of the coating is of such character that it does not sinter at the temperature of the molten metal. An unfired refractory powder is preferably employed. The coating is formed in situ on the stopper head body.

This invention relates to a coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle. While the invention is of wide application it has especial utility in stopper heads for bottom pour receptacles for pouring or teeming molten metal such as bottom pour ladles and tundishes used for pouring or teeming molten steel either into ingot molds or into continuous casting apparatus.

For purposes of explanation and illustration the invention will be described as applied to a stopper head for a bottom pour molten steel ladle or tundish. When molten steel at a temperature of the order of 2900° F. is introduced into a relatively cold receptacle such as a ladle or tundish having a nozzle in its bottom which is initially closed by a stopper head (see, for example, United States Patent No. 3,352,534) the great difference in temperature between the incoming molten steel on the one hand and the receptacle, including the nozzle and stopper head, on the other hand is so great that some of the molten steel freezes in the bottom of the receptacle. This is a phenomenon well known to those skilled in the art which has existed since the inception of the use of bottom pour receptacles for handling molten steel. The solidified or frozen steel in the bottom of the receptacle freezes against the stopper head rendering difficult or impossible the raising of the stopper head to permit outflow of molten steel through the nozzle in the bottom of the receptacle. The result is damage to the stopper head in any effort to free it from the frozen steel which in turn makes impossible optimum control of outflow of steel from the receptacle and in many cases results in inability to shut off the flow at all once the stopper head is unseated.

Various efforts have been made to solve the problem but prior to my invention none has been fully successful. For example, materials such as sand or lead have

been introduced around the stopper head at the upper portion of the nozzle in an attempt to provide a temporary barrier between the stopper head and the initial increment of molten steel entering the receptacle. Such procedures are difficult and cumbersome due to the temperature of a preheated receptacle which may be of the order of several hundred degrees Fahrenheit. Moreover they have not satisfactorily prevented the molten steel from freezing against the stopper head, and the introduction of such foreign materials is detrimental to the quality of the steel.

I have solved the problem by providing a coated stopper head comprising a stopper head body with a coating thereon so that when the stopper head is in position closing the nozzle and molten metal is introduced into the relatively cold receptacle the molten metal in the bottom of the receptacle freezes against the coating of the stopper head rather than against the body of the stopper head itself; the coating is of friable refractory material which fragments when subjected to tensile and/or shear stresses so that when the stopper head is subsequently urged upwardly to permit outflow of molten metal through the nozzle the coating fragments, freeing the stopper head, obviating freezing of the stopper head to solidified metal in the bottom of the receptacle. The coating acts in the nature of a friable shell like an egg shell so that when the stopper head is raised the shell disintegrates into pieces allowing free movement of the stopper head without interference from the solidified steel in the bottom of the receptacle.

The coating or shell forming material comprises finely divided refractory material and a binder and is preferably of such consistency that it may be applied with a brush. The refractory material is of such character that it does not sinter at the temperature of the molten metal. Unfired refractory powder is desirably employed. The coating or shell is formed in situ on the stopper head body.

The friable refractory material which fragments when subjected to tensile and/or shear stresses may be of various compositions. Examples are magnesia, dolomite, magnesite, mullite, fused or unfused silica, calcined or uncalcined high alumina fire clay, titania, zirconia, zircon, graphite, clay-graphite mixtures, silicon carbide and chromite. Such material is mixed with a binder to form a slurry, mortar, dip coat or wash. The binder may be of various compositions, examples being dextrose, gulac, starch and phosphoric acid. The slurry or mixture of finely divided refractory material and binder is of such consistency that it may be applied with a brush, or it may be applied by spraying or by dipping of the stopper head body into a container of the slurry. The thickness of the coating may be of the order of one-fourth inch, more or less.

When the molten steel is introduced into the receptacle that portion of it which solidifies in the bottom of the receptacle freezes against the coating or shell which protects the body of the stopper head from the frozen metal so that the stopper head may be lifted without interference from the frozen metal, the coating or shell fragmenting or disintegrating and passing out through the nozzle with the molten steel and either being consumed or ultimately forming part of the slag which may be separated from the molten steel.

While I have described certain present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour re-

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ceptacle comprising a stopper head body with a coating thereon so that when the stopper head is in position closing the nozzle and molten metal is introduced into the relatively cold receptacle metal freezes in the bottom of the receptacle and against the coating of the stopper head, the coating being of friable refractory material which fragments when subjected to tensile and/or shear stresses so that when the stopper head is subsequently urged upwardly to permit outflow of molten metal through the nozzle the coating fragments, freeing the stopper head, obviating freezing of the stopper head to solidified metal in the bottom of the receptacle.

2. A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle as claimed in claim 1 in which the coating comprises finely divided refractory material and a binder and is of such consistency that it may be applied with a brush.

3. A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle as claimed in claim 1 in which the coating comprises refractory material which does not sinter at the temperature of the molten metal.

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4. A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle as claimed in claim 1 in which the coating comprises unfired refractory powder.

5 5. A coated stopper head for controlling outflow of molten metal through the nozzle of a bottom pour receptacle as claimed in claim 1 in which the coating is formed in situ on the stopper head body.

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U.S. Cl. X.R.

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