United States Patent

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[54] **STOPPER STRUCTURE AND COMBINATION OF BOTTOM POUR RECEPTACLE AND STOPPER**
10 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **222/559,** 222/563
[51] **Int. Cl.** **B22d 37/00**
[50] **Field of Search** 222/559, 563, 504, 509, 510, 566–568, 559; 164/337

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ABSTRACT: A stopper structure for controlling outflow of molten metal through the nozzle of a bottom pour receptacle, more particularly a tundish, comprising a refractory stopper head, rigging for raising and lowering the stopper head to open and close the nozzle and a connecting member separate from both the rigging and the stopper head comprising a vertically elongated refractory element connected with the rigging at its upper end and with the stopper head at its lower end through which the stopper head is carried by the rigging. The connection may be threaded or otherwise. It may comprise a separate plug entering both the vertically elongated refractory element and the stopper head or portion integral with one or the other. The vertically elongated refractory element extends upwardly from the stopper head to a level above the level of the surface of molten metal in the receptacle. The invention does away with the time honored steel stopper rod which is subject to softening and melting.

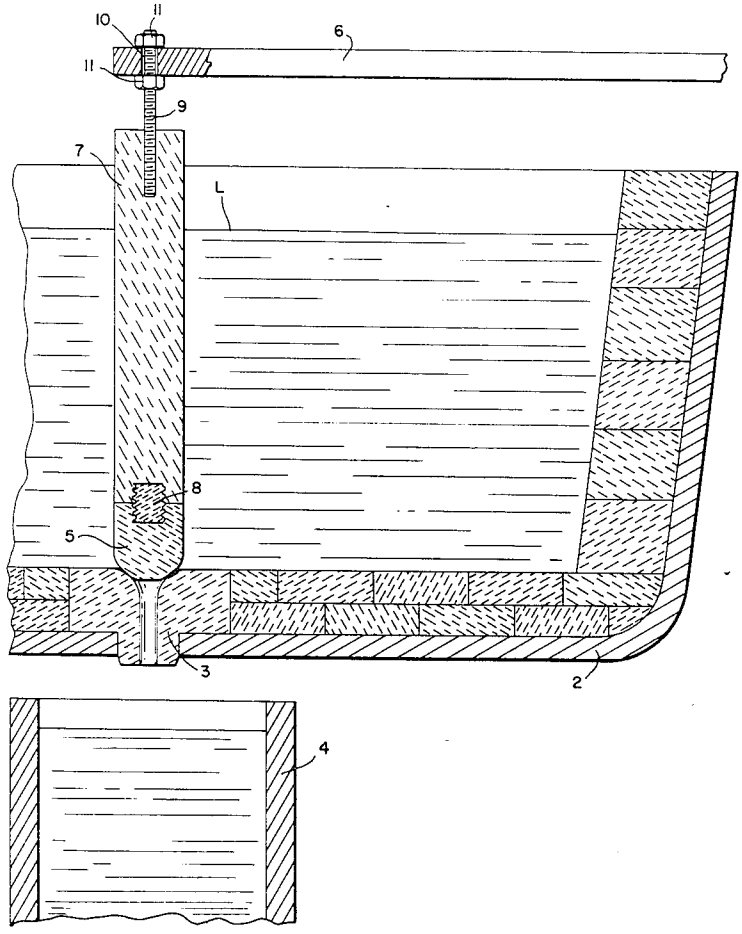

FIG. 1

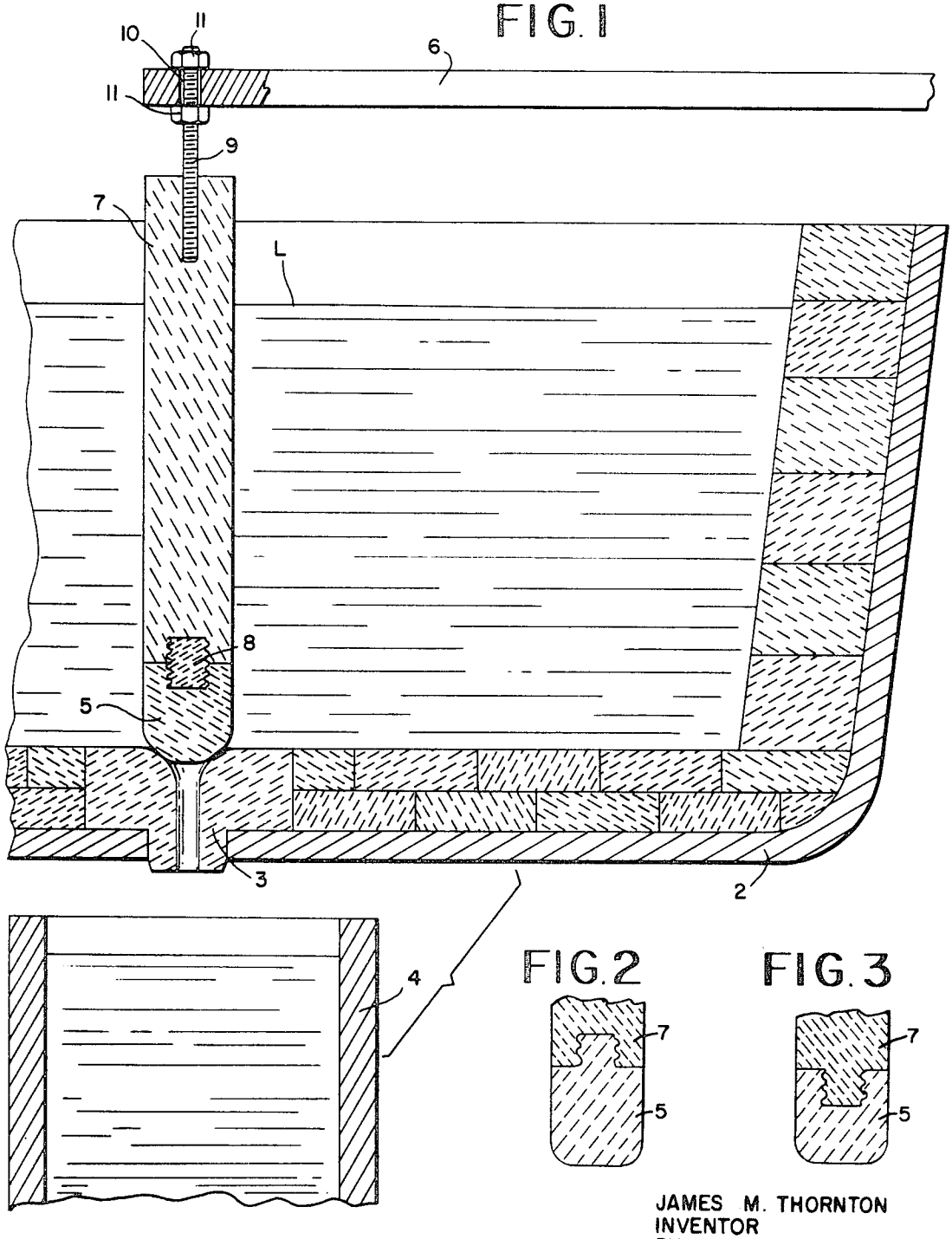

FIG. 2

FIG. 3

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STOPPER STRUCTURE AND COMBINATION OF BOTTOM POUR RECEPTACLE AND STOPPER

This invention relates to a stopper structure and a combination of a bottom pour receptacle and a stopper. It is especially concerned with a stopper structure for a bottom pour receptacle used in handling and pouring molten metal, such, for example, as molten steel.

Molten steel is either teemed into ingot molds through a bottom pour ladle or delivered to a continuous casting mold through a tundish having a nozzle in its bottom. It may be delivered from a bottom pour ladle into the tundish. Outflow through the nozzle in the bottom pour receptacle, whether it be a ladle or a tundish, is controlled by a stopper having a refractory stopper head. Heretofore the refractory stopper head has been carried by a steel stopper rod, various patented and unpatented structures having been employed for fastening the stopper head to the steel stopper rod. Since the steel stopper rod extended from the refractory stopper head upwardly through the molten steel in the receptacle it had to be protected against the heat of the molten steel, and such protection was afforded by refractory sleeves surrounding the steel stopper rod from the top of the refractory stopper head to a level above the level of the surface of the molten steel in the receptacle. This has entailed the employment of heavy, bulky and costly sleeves, and the weight, bulk and cost of the sleeves has increased as the size of heats and the pouring time have increased. The longer a steel stopper rod, even though completely covered by refractory sleeves, is subjected to the heat of molten steel the hotter it becomes and danger exists that the rod will soften or melt.

The condition above described is further aggravated in continuous casting in which heat after heat of molten steel are poured into a tundish and are in turn delivered through the nozzle in the bottom of the tundish into the continuous casting mold. The stopper is subjected to heat continuously for long periods of time and despite intensive efforts to protect the steel stopper rod against the heat of the molten steel the danger of softening or melting of the steel stopper rod is acute.

I have devised a stopper structure for controlling outflow of molten metal through the nozzle of a bottom pour receptacle which eliminates use of a steel stopper rod extending from the refractory stopper head up through the molten steel in the receptacle. This eliminates the danger of failure of the stopper structure through softening or melting of the steel stopper rod and also substantially reduces the cost of the stopper structure.

I provide a stopper structure for controlling outflow of molten metal through the nozzle of a bottom pour receptacle comprising a refractory stopper head, rigging for raising and lowering the stopper head to open and close the nozzle and a connecting member separate from both the rigging and the stopper head comprising a vertically elongated refractory element connected with the rigging at its upper end and with the stopper head at its lower end through which the stopper head is carried by the rigging. The stopper structure may include a threaded connection between the vertically elongated refractory element and the stopper head. The threaded connection may include a threaded portion extending downwardly from the vertically elongated refractory element and threaded into the top of the stopper head or a threaded portion extending upwardly from the stopper head and threaded into the bottom of the vertically elongated refractory element. The threaded connection may include a plug member threaded into the top of the stopper head and into the bottom of the vertically elongated refractory element.

The stopper structure may comprise a plug member entering the top of the stopper head and entering the bottom of the vertically elongated refractory element connecting the vertically elongated refractory element with the stopper head. The connection may be effected in various ways, as by threads, by a bayonet-type joint, by a slot and key device or otherwise. The connection may comprise a portion projecting from one of the vertically elongated refractory element and the stopper head entering and connected with the other thereof whereby to connect together the vertically elongated refractory element and the stopper head.

The stopper structure may include a connecting device carried by the rigging and extending downwardly therefrom and connected with the upper portion of the vertically elongated refractory element whereby the vertically elongated refractory element is carried by the rigging.

I further provide, in combination, a bottom pour receptacle for molten metal having a nozzle in its bottom, a refractory stopper head for controlling outflow of molten metal through the nozzle, rigging for raising and lowering the stopper head to open and close the nozzle and a connecting member separate from both the rigging and the stopper head comprising a vertically elongated refractory element connected with the rigging at its upper end and with the stopper head at its lower end through which the stopper head is carried by the rigging, the vertically elongated refractory element carrying the stopper head extending upwardly from the stopper head to a level above the level of the surface of molten metal in the receptacle. The bottom pour receptacle for molten metal may be a ladle or it may be a tundish, the invention having especial utility when the bottom pour receptacle is a tundish since in a tundish employed in continuous casting the stopper structure is continuously immersed in molten steel for an extended period of time.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have illustrated diagrammatically certain present preferred embodiments of the invention in which:

FIG. 1 is a schematic vertical cross-sectional view of a tundish for delivering molten steel into a continuous casting mold and showing my improved stopper structure employed for controlling the outflow of molten steel through the nozzle of the tundish; and

FIGS. 2 and 3 are fragmentary detail vertical cross-sectional views showing modified forms of connection between elements of my stopper structure.

Referring now more particularly to the drawing, there is shown a tundish 2 which may be of conventional form and which therefore will not be described in detail. The tundish is provided in its bottom with a nozzle 3 which may also be conventional. The tundish is adapted to deliver molten steel into a continuous casting mold 4 in conventional manner. Even though in operation molten steel is delivered continuously through the nozzle 3 of the tundish into the continuous casting mold 4, it is necessary to provide a stopper for controlling outflow through the nozzle to stop the casting when desired and should an emergency arise.

My stopper structure includes a refractory stopper head 5 shaped to fit the nozzle 3 so that when the stopper head is seated in the nozzle as shown in the drawing outflow of molten steel through the nozzle is stopped. The stopper structure is controlled by a rigging which may be conventional and which may comprise a bar, commonly called a gooseneck, which is designated by reference numeral 6. The bar 6 is connected with means well known to those skilled in the art for raising and lowering it and thereby raising and lowering the stopper head 5 since the stopper head is carried by the bar 6. Heretofore a steel stopper rod has been employed through which the stopper head is carried by the rigging. I eliminate the steel stopper rod, at least between the top of the stopper head 5 and the level of molten steel in the tundish 2 is designated by the line L.

I provide a connecting member separate from both the rigging and the stopper head comprising a vertically elongated refractory element designated by reference numeral 7 through which the stopper head 5 is carried by the rigging. It is important that the connecting member be separate from both the rigging and the stopper head to permit replacement of the stopper head without replacing the connecting member and

also, if the occasion to do so arises, replacement of the connecting member without replacing the stopper head. In the form shown the stopper head 5 is connected to the lower end of the element 7 by a threaded plug 8 of refractory material. The plug 8 is shown as being threaded into the top of the stopper head 5 and also into the bottom of the refractory element 7. Various alternative connections may be employed. Instead of the plug 8 being a separate member it may be formed integral with the stopper head and project upwardly therefrom and thread into the element 7 (FIG. 2) or it may be formed integral with the element 7 and project downwardly therefrom and thread into the stopper head (FIG. 3). Instead of a threaded connection a bayonet joint-type connection or a rod and pin connection or any other equivalent connection may be employed. In any event, the stopper head 5 is carried by the vertically elongated refractory element 7 and the previously employed steel stopper rod extending from the stopper head up through the molten steel in the receptacle is completely done away with.

At its upper end the vertically elongated refractory element 7 is connected with the steel bar or gooseneck 6 by any suitable mechanical connection. There is shown a threaded steel rod 9 which is threaded into the upper end of the element 7 and passes through a hole 10 in the rod 6, nuts 11 being applied to the threaded rod 9 a clamp may be provided embracing the upper end of the element 7. The particular connecting means between the rigging and the element 7 and between the element 7 and the stopper head may be widely varied. In any event, no elongated steel rod extending from the stopper head up through the molten steel in the receptacle is used. A steel member such as the threaded rod 9 may be employed at the upper end of the element 7 where it is above the level of the molten steel in the receptacle and not subjected to temperature hot enough to soften or melt it.

The element 7 may be solid or may be hollow or tubular. Its cross section is made sufficient to support the stopper head and withstand the heat to which it is subjected. It is not subject to softening and melting as was the steel stopper rod previously employed.

While I have shown and described a present preferred embodiment 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 stopper structure for controlling outflow of molten metal through the nozzle of a bottom pour receptacle comprising a refractory stopper head, rigging for raising and lowering the stopper head to open and close the nozzle and a connecting member which is in addition to the rigging and the stopper head comprising a vertically elongated refractory element supported by the rigging by means of a connection in the region of the top of the receptacle and connected with the stopper head at its lower end through which the stopper head is carried by the rigging.

2. A stopper structure as claimed in claim 1 including a threaded connection between the vertically elongated refractory element and the stopper head.

3. A stopper structure as claimed in claim 2 in which the threaded connection includes a threaded portion extending downwardly from the vertically elongated refractory element and threaded into the top of the stopper head.

4. A stopper structure as claimed in claim 2 in which the threaded connection includes a threaded portion extending upwardly from the stopper head and threaded into the bottom of the vertically elongated refractory element.

5. A stopper structure as claimed in claim 2 in which the threaded connection includes a plug member threaded into the top of the stopper head and into the bottom of the vertically elongated refractory element.

6. A stopper structure as claimed in claim 1 including a plug member entering the top of the stopper head and entering the bottom of the vertically elongated refractory element connecting the vertically elongated refractory element with the stopper head.

7. A stopper structure as claimed in claim 1 including a portion projecting from either the vertically elongated refractory element or the stopper head entering and connected with the other thereof whereby to connect together the vertically elongated refractory element and the stopper head.

8. A stopper structure as claimed in claim 1 including a connecting device carried by the rigging and extending downwardly therefrom and connected with the upper portion of the vertically elongated refractory element whereby the vertically elongated refractory element is carried by the rigging.

9. In combination, a bottom pour receptacle for molten metal having a nozzle in its bottom, a refractory stopper head for controlling outflow of molten metal through the nozzle, rigging for raising and lowering the stopper head to open and close the nozzle and a connecting member separate from both the rigging and the stopper head comprising a vertically elongated refractory element supported by the rigging by means of a connection in the region of the top of the receptacle and connected with the stopper head at its lower end through which the stopper head is carried by the rigging, the vertically elongated refractory element carrying the stopper head extending upwardly from the stopper head to a level above the level of the surface of molten metal in the receptacle.

10. The combination of claim 9 in which the bottom pour receptacle for molten metal is a tundish.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,632,026 Dated January 4, 1972

Inventor(s) JAMES M. THORNTON

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Abstract of the Disclosure, line 12, before "portion" insert --a--.

Column 2, line 67, before "tundish" insert --receptacle. In the drawing the level of molten steel in the--.

Column 3, line 25, after "9" insert --above and below the bar 6. Instead of the threaded rod 9--.

Signed and sealed this 23rd day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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