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[21] Appl. No. 840,069
[22] Filed Mar. 17, 1969
[45] Patented Jan. 12, 1971
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Continuation of application Ser. No.
609,654, Jan. 16, 1967, now abandoned.

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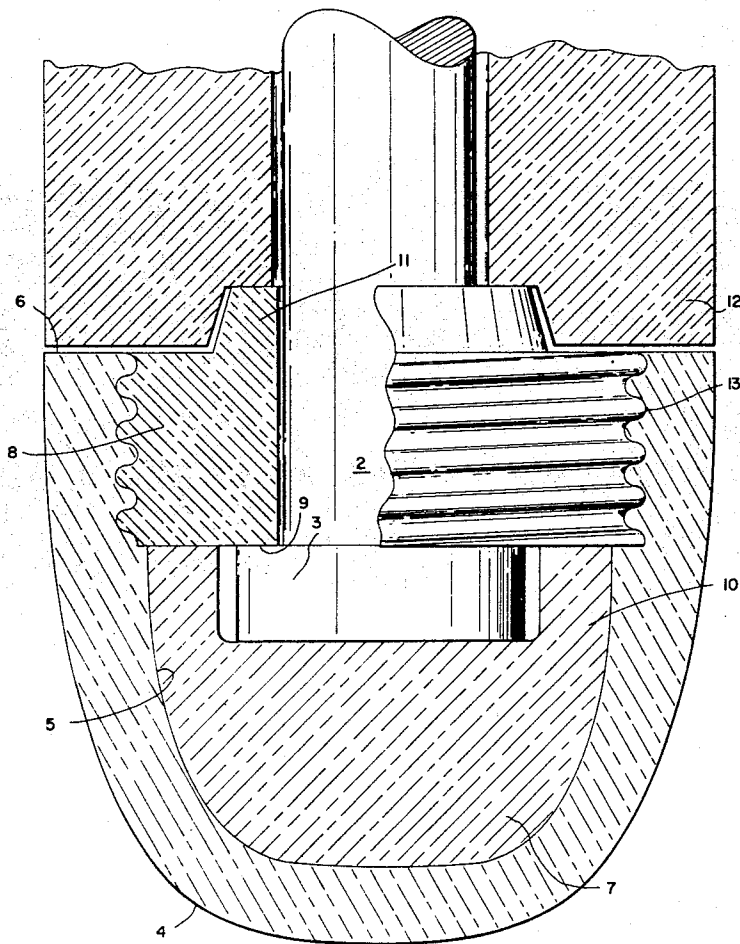
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[54] STOPPER HEAD FOR A LADLE OR SIMILAR
RECEPTACLE
1 Claim, 3 Drawing Figs.

[52] U.S. Cl. 251/356,
251/291
[51] Int. Cl. F16k 21/00
[50] Field of Search 251/356,
291

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ABSTRACT: A stopper head for a ladle or similar receptacle comprising a hollow shell of refractory material having its greatest transverse dimension at its upper portion and tapering to smaller transverse dimension toward its lower portion, the shell being open at its top and closed at its sides and bottom, the shell being adapted to receive the lower end of a stopper rod through its open top, the shell containing at its lower portion and extending up to a level at least two-fifths the distance from the bottom to the top of the shell material having an insulating property greater than the insulating property of the refractory material of the shell, and insert means in the upper portion of the head for holding the lower end of the stopper rod against withdrawal.



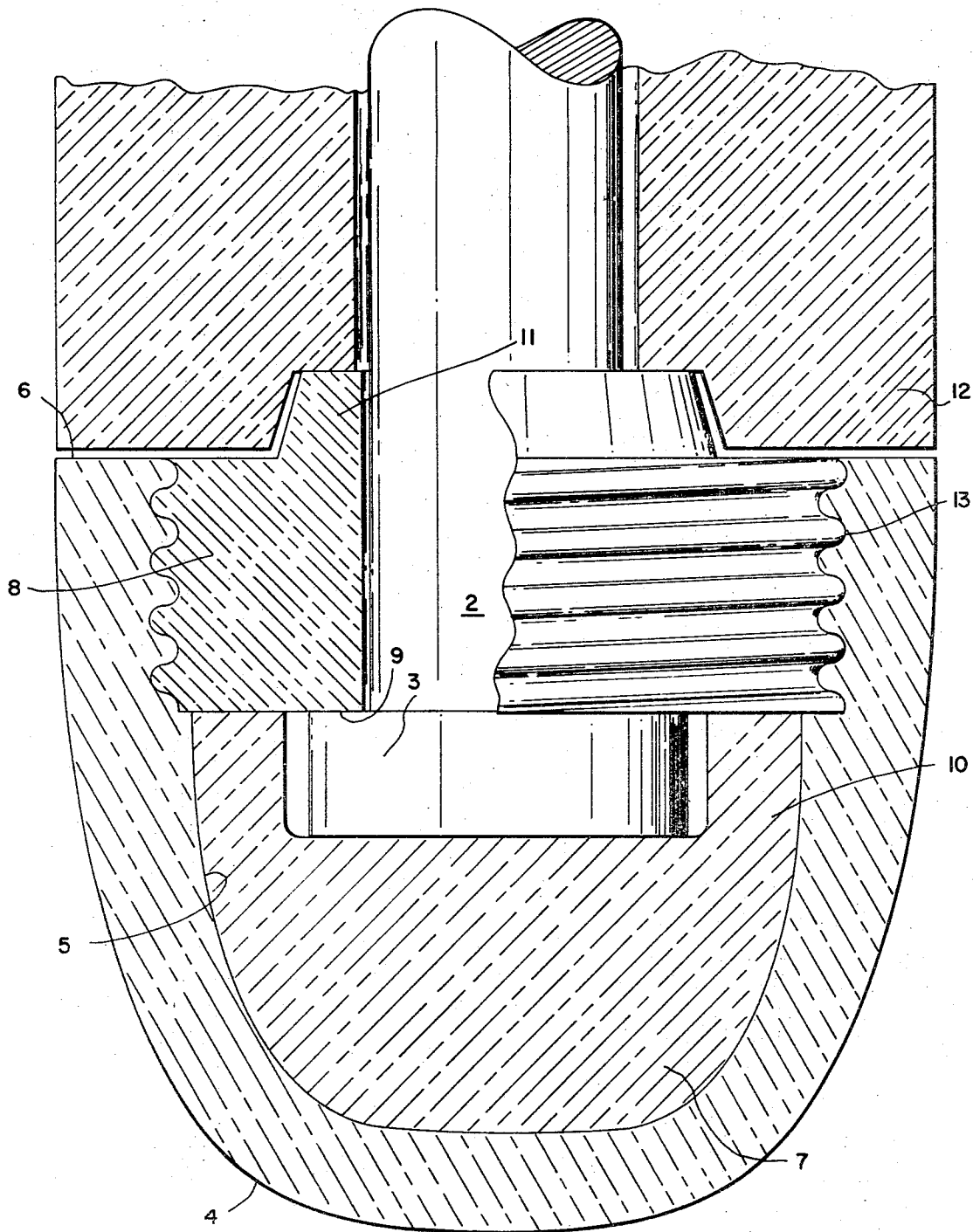


FIG. 1.

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FIG. 2.

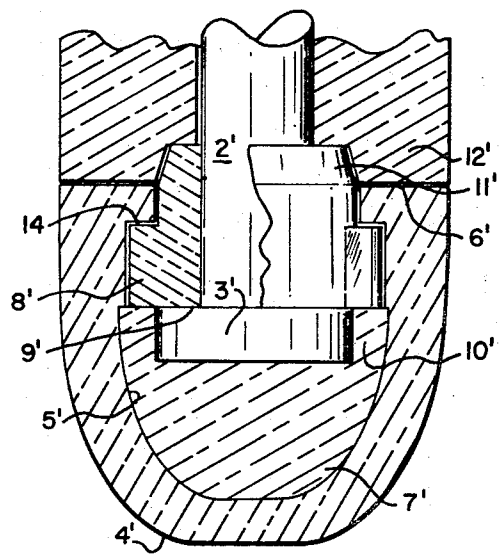
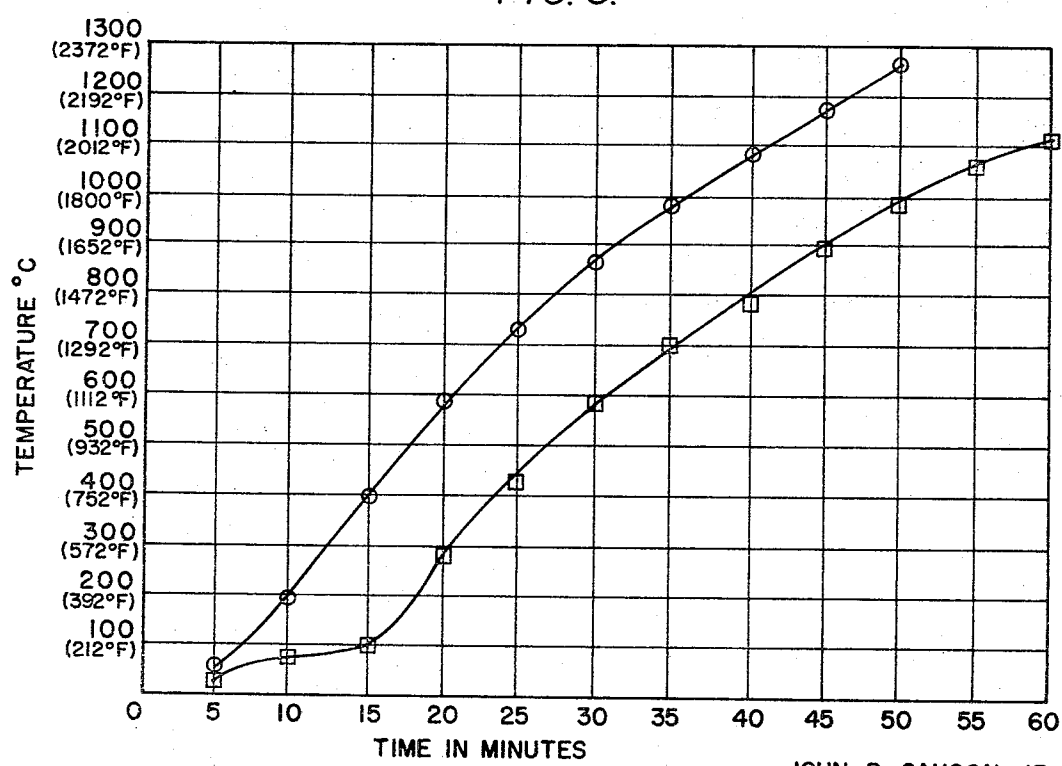


FIG. 3.



○ CONVENTIONAL STOPPER HEAD
□ IMPROVED STOPPER HEAD

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STOPPER HEAD FOR A LADLE OR SIMILAR RECEPTACLE

This invention relates to a stopper head for a ladle or similar receptacle and particularly to an improved form of stopper head which withstands to an unprecedented extent the thermal and mechanical stresses imposed upon the stopper head in use. This application is a continuation of my copending application Ser. No. 609,654, filed Jan. 16, 1967, and now abandoned.

Those skilled in the art have deemed it important to form the lower portion or nose of a stopper head used in a vessel for pouring molten metal as a massive continuous solid homogeneous body of the material of the stopper head. This has been thought to be necessary to withstand the rigors of pouring molten metal such as molten steel, e.g., erosion of the exterior surface of the stopper head nose due to the high temperature to which it is subjected, corrosion of such surface by corrosive alloys present in the molten metal and spalling or peeling off of such surface due to thermal strain occurring when the relatively cold stopper head is suddenly subjected to the great heat of the molten metal.

It has been believed that a massive continuous solid homogeneous body of refractory material is required to withstand the stresses imposed under the conditions mentioned. However, such a massive continuous solid homogeneous body of refractory material is subject to nonuniformity due to inability to completely eliminate body imperfections such as laminations and small air pockets formed when molding the stopper head, such nonuniformity counteracting any advantages otherwise inherent in the body of refractory material and rendering it subject to failure.

I have discovered that the problem can be effectively solved by an approach entirely different than the approach heretofore employed by those most highly skilled in the art. I provide a stopper head for a ladle or similar receptacle comprising a hollow shell of refractory material having its greatest transverse dimension at its upper portion and tapering to smaller transverse dimension toward its lower portion, the shell being open at its top and closed at its sides and bottom, the shell being adapted to receive the lower end of a stopper rod through its open top, the shell containing at its lower portion and extending up to a level at least two-fifths the distance from the bottom to the top of the shell material having an insulating property greater than the insulating property of the refractory material of the shell, and insert means in the upper portion of the head for holding the lower end of the stopper rod against withdrawal. The insert means as well as the filling material are preferably of material having an insulating property greater than the insulating property of the material of the refractory stopper element.

The insert means preferably have a downwardly facing holding surface bearing against an upwardly facing surface of the stopper rod. The filling material in the lower portion of the well desirably has an upwardly projecting annular portion surrounding the lower end of the stopper rod. The top of the upwardly projecting annular portion of the filling material in the lower portion of the well should be in close juxtaposition to the bottom of the insert means.

Such a stopper head seems to be capable of relatively uniform expansion and contraction under temperature changes and maintains its integrity to a greater extent than the massive continuous solid homogeneous body of refractory material heretofore employed.

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

In the accompanying drawings I have shown certain present preferred embodiments of the invention, in which:

FIG. 1 is an axial cross-sectional view through a stopper head in accordance with my invention applied to a stopper rod with sleeve means above the stopper head for protecting the stopper rod against the heat of the molten metal;

FIG. 2 is a view similar to FIG. 1 but to smaller scale and showing a somewhat modified structure; and

FIG. 3 is a graph containing curves illustrating the times required for a conventional stopper head and a stopper head in accordance with my invention to attain predetermined temperatures under identical conditions under which they are subjected to high temperature.

Referring now more particularly to FIG. 1, the stopper rod is designated generally by reference numeral 2. It is of standard construction, fabricated out of steel with an integral flange 3 at its bottom. The stopper head comprises a refractory stopper element or hollow shell 4 having therein a well 5 extending downwardly thereinto from its upper surface 6 for receiving the lower end of the stopper rod 2 including the flange 3. The shell 4 has its greatest transverse dimension at its upper portion and tapers to smaller transverse dimension toward its lower portion and is, as shown, open at its top and closed at its sides and bottom. The wall thickness of the shell 4 is preferably substantially uniform throughout. The lower portion of the well 5 is filled up to a level at least two-fifths the distance from the bottom to the top of the shell with refractory material 7 having an insulating property greater than the insulating property of the material of the shell 4. The material 7 may be packed into the prefired shell 4. Insert means 8 are disposed in the upper portion of the well 5 coacting with the refractory stopper element 4 and the lower end or flange 3 of the stopper rod 2 holding the lower end of the stopper rod against withdrawal from the well.

The insert means 8 are, like the filling 7, of material having an insulating property greater than the insulating property of the material of the shell 4. The insert means 8 have a downwardly facing holding surface 9 bearing against the top of the flange 3 of the stopper rod 2. The filling material 7 in the lower portion of the well 5 has an upwardly projecting annular portion 10 surrounding the rod flange. The top of the upwardly projecting annular portion 10 of the filling material 7 in the lower portion of the well 5 is in close juxtaposition to the bottom of the insert means 8.

The insert means 8 have an upward annular projection 11, and a protective sleeve 12 of refractory material seats thereon as shown, the sleeve 12 protecting the stopper rod 2 from the heat of the molten metal.

In the form shown in FIG. 1 the insert means 8 are screw-threaded into the upper portion of the well 5 of the shell 4 by mating threads 13 although the connection may be otherwise effected, as, for example, by a bayonet joint as shown at 14 in FIG. 2. Elements of FIG. 2 corresponding to elements of FIG. 1 are designated by the same reference numerals each with a prime affixed. Insert means of the type shown in FIG. 2 are shown in FIGS. 2, 4 and 5 of U.S. Pat. No. 3,352,533.

By way of example, the shell 4 may be made of a mixture of fire clay and graphite or a mixture of fire clay, fused alumina and graphite or a mixture of fire clay, fused alumina, magnesite and graphite, while the insulating filling 7 and the insert means 8 may be made of a mixture of calcined fire clay and plastic fire clay or a mixture of calcined fire clay, plastic fire clay and metallurgical coke or a mixture of calcined fire clay, plastic fire clay and sawdust.

In FIG. 3 the upper curve shows the times required for a conventional stopper head whose lower portion is a massive continuous solid homogeneous body to attain predetermined temperatures when subjected to high temperature, while the lower curve shows the times required for a stopper head in accordance with my invention to attain the same temperatures when subjected to identical high temperature. The temperatures plotted on the graph were measured at the inner surface of the head adjacent the stopper rod flange. Thus the recorded temperatures are those to which the end of the stopper rod is subjected and which tend to cause the rod to soften and the stopper head to become disengaged from the rod resulting in uncontrolled flow of molten steel through the nozzle.

The graph shows that at 40 minutes the conventional stopper head attained a temperature of about 1100° C. (2012° F.). The stopper head of the invention did not reach 1100° C. (2012° F.) until 60 minutes had elapsed, wherefore the im-

proved stopper head afforded an additional 20 minutes, or 50 percent more time, to operate in the same temperature range. This is a drastic and far reaching improvement. Putting it another way, after 40 minutes of elapsed time the temperature of the stopper head of the invention reached only 800° C. (1472° F.) as against 1100° C. (2012° F.) for the conventional stopper head. The primary advantage of the invention is that the improved stopper head will control successfully the pouring of molten steel at higher temperatures and for longer times than the conventional stopper head.

While I have shown and 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 claim.

I claim:

1. A stopper head for a ladle or similar receptacle comprising a hollow shell of refractory material having its greatest transverse dimension at its upper portion and tapering to smaller transverse dimension toward its lower portion, the shell being open at its top and closed at its sides and bottom, the shell being adapted to receive the lower end of a stopper rod through its open top, the shell containing at its lower portion and extending up to a level at least two-fifths the distance from the bottom to the top of the shell material having an insulating property greater than the insulating property of the refractory material of the shell, and insert means in the upper portion of the head separate from the insulating material for holding the lower end of the stopper rod against withdrawal.

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