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LADLE VALVE

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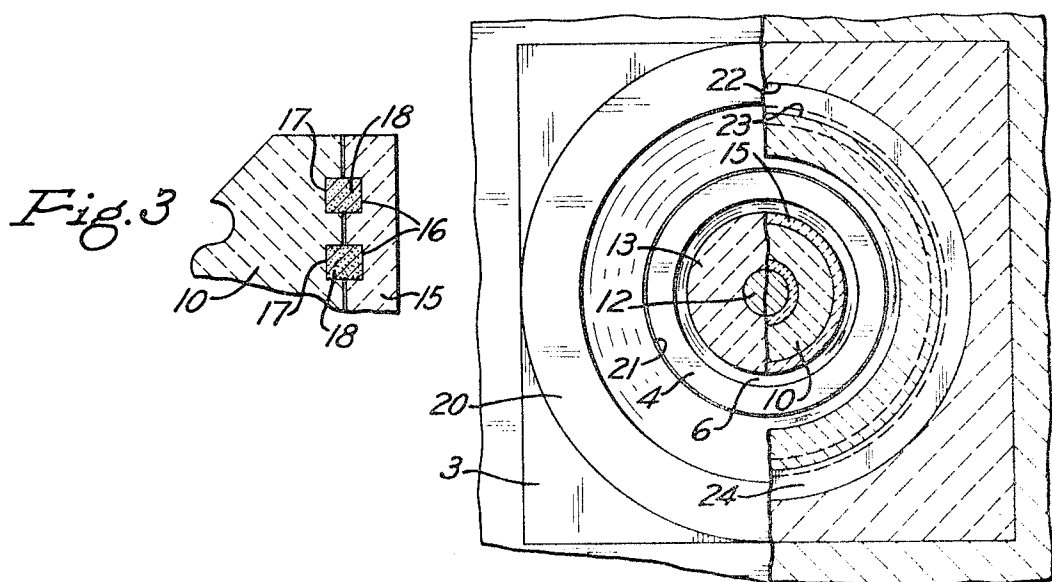
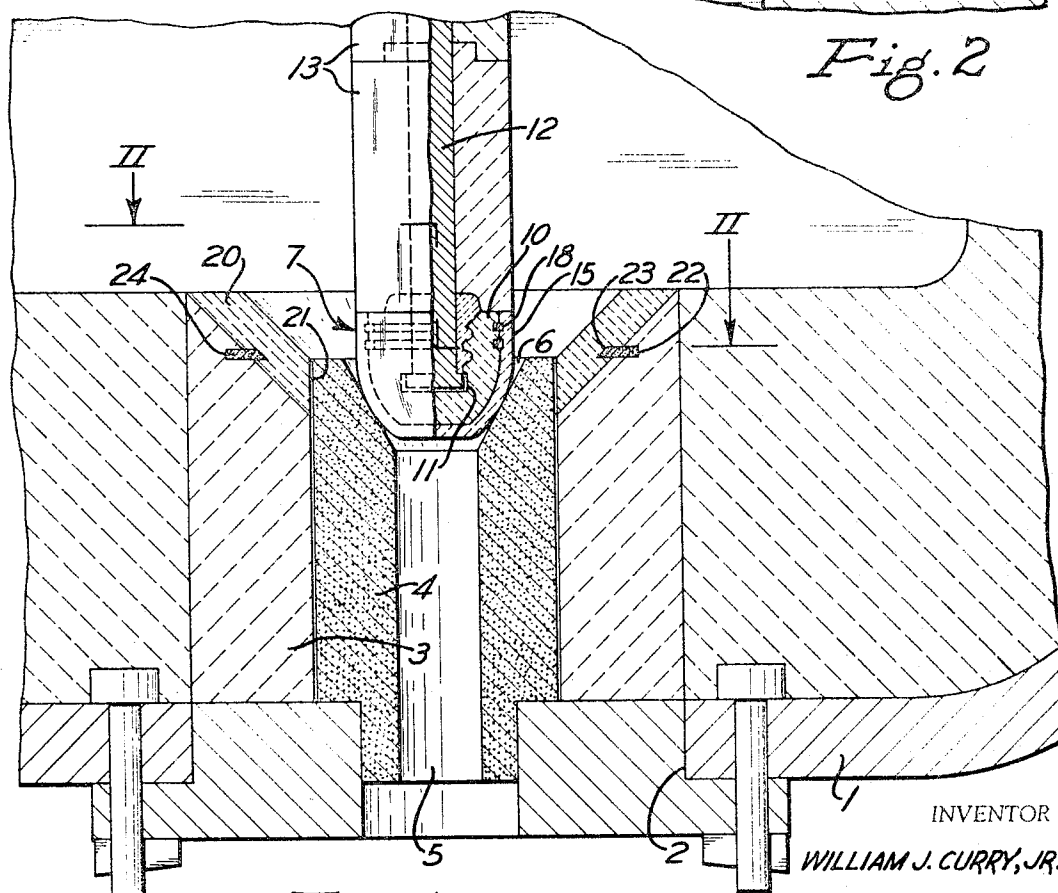


Fig. 1

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LADLE VALVE

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10 Claims

ABSTRACT OF THE DISCLOSURE

A ladle valve includes a fired clay block that has a concave recess in its top and a vertical opening extending down through the block containing a refractory nozzle, the upper end of which is engageable by a vertically movable stopper. An erosion resistant layer of material of zircon or zirconia or high alumina is applied to the block in its recess and to the outside of the fired clay body of the stopper plug, or to either of them.

It is an object of this invention to provide a relatively inexpensive ladle valve stopper which has a much longer life than those known heretofore. Another object is to provide a relatively inexpensive ladle valve nozzle block which has a much greater resistance to erosion from molten metal than known blocks, and which is a poor heat conductor.

The preferred embodiment of the invention is illustrated in the accompanying drawings, in which

FIG. 1 is a fragmentary vertical section through my ladle valve;

FIG. 2 is a horizontal section taken on the line II—II of FIG. 1; and

FIG. 3 is an enlarged detail of the stopper plug.

Referring to FIGS. 1 and 2 of the drawings, a ladle 1 of any suitable construction is provided in its bottom with an outlet opening 2. The bottom of the ladle is lined with a refractory floor including a fired clay block 3 above the outlet opening. This block, known as a nozzle block, has a concave recess in its top, from the center of which a vertical opening extends down through the block. Fitting in this opening is a refractory nozzle 4 that has a vertical passage 5 extending through it. The upper end of the passage is flared to provide an inclined annular seat 6 adapted to be engaged by the lower end of a vertically movable stopper 7. The block and nozzle and stopper form a valve that controls the ladle outlet.

The stopper includes a plug or body 10 made of a suitable refractory that has been pressed and fired, such as a high grade clay or other high-refractory material. The upper part of the stopper body is generally cylindrical, while the lower part tapers downwardly. The plug is provided with a downwardly extending socket 11, in which the lower end of a heavy metal rod 12 is removably mounted in any suitable manner. The rod can be raised and lowered in a known manner to raise and lower the plug. The rod above the plug is protected from the surrounding molten metal in the ladle by refractory sleeves 13 encircling the rod and projecting outwardly from the top of the plug.

It is a feature of this invention that the life of the stopper is increased materially by covering the body of the plug with a heat-consolidated layer of zircon, zirconia or high alumina. The layer of erosion resistant material generally will be from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch thick. It can be formed by grinding the material, adding a suitable binder, casting or pressing it into the shape of a cup-like shell 15 and then firing it at about 3100° F. to 3200° F. The rigid shell is the same shape as the stopper plug and is a size that will fit snugly around the plug and thereby cover it. The shell

may be secured to the plug by providing the upper part of the shell with one or more circumferential grooves 16 in its inner surface, and forming registering grooves 17 in the encircled plug. Each pair of registering grooves is filled with a suitable high temperature cement that forms a solid ring 18 and thereby locks the preformed rigid shell on the plug.

It has been found that such a layer is highly resistant to erosion from molten metal while the valve is open and the metal is pouring out of the ladle through the nozzle. By making the plug itself of inexpensive clay, while only the shell is formed of expensive material, the advantage of an erosion resistant stopper is obtained at a relatively low cost. Furthermore, the clay body is a much poorer conductor of heat than the shell, so the lower end of the metal rod is protected from the intense heat of the surrounding molten metal much better than if the entire stopper were made of the shell material.

Since the nozzle block 3 also is subject to erosion in its concave recess, it is desirable to line that recess with an erosion resistant material like that used to cover the stopper plug. The layer 20 of material used to cover the concave recess may be any desired thickness, such as from $\frac{1}{4}$ to $1\frac{1}{2}$ inches thick. It is preformed in the same way as the stopper shell, except that it has a different shape, and then is placed in the block recess. This preformed member is concavo-convex to fit in the block recess, and is provided with a central opening 21 registering with the block opening around the nozzle. To prevent the liner member from floating up out of the block recess, it is desirable to provide their adjoining surfaces with registering undercut grooves 22 and 23 that are filled with a ring 24 of high temperature cement locking the two parts together.

Liner member 20 greatly increases the life of the nozzle block without raising its cost too much, because most of the block can still be made of a high grade clay that is much cheaper. Also, by avoiding a solid block of the erosion resistant material, the block remains a poor heat conductor so that the molten metal directly above the block is not chilled, which would create pouring problems.

By protecting with zircon, zirconia or high alumina the two parts of the ladle valve that are most subject to erosion, the life of the valve can be increased materially so that replacements are required less frequently than at present. At the same time, the thermal conductivity of those parts is not increased materially, and the valve remains reasonable in cost.

According to the provisions of the patent statutes, I have explained the principle of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A ladle valve comprising a fired clay block having a concave recess in its top and a vertical opening extending down through the block from the bottom of the recess, an erosion resistant layer of material from the group consisting of zircon and zirconia and high alumina lining said recess around said opening, a refractory nozzle fitting in said opening and having a vertical passage therethrough with a seat at its upper end, and a vertically movable stopper normally engaging said seat for closing the upper end of said passage, the stopper having a plug-like fired clay body covered with an erosion resistant layer of material from the group consisting of zircon and zirconia and high alumina.

2. A ladle valve according to claim 1, in which said last-mentioned erosion resistant layer is a preformed rigid shell, and means are provided for securing the shell to said stopper body.

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3. A ladle valve according to claim 1, in which said last-mentioned erosion resistant layer is a preformed cup-like shell provided near its open top with a circumferential groove in its inner surface, and said body is provided with a circumferential groove registering with said shell groove, said stopper including a ring of cement filling said grooves to lock the shell and clay body together.

4. A ladle valve according to claim 1, in which said recess lining is a performed concavo-convex member fitting in said recess and provided with a central opening registering with said block opening, and means is provided for securing said member to the block.

5. A ladle valve according to claim 1, in which said recess lining is a preformed concavo-convex member fitting in said recess and provided with a central opening registering with said block opening, said stopper layer is a preformed cup-like shell provided near its open top with a circumferential groove in its inner surface, and said stopper body is provided with a circumferential groove registering with said shell groove, said stopper including a ring of cement filling said grooves to lock the shell and clay body together.

6. A ladle valve stopper comprising a plug-like fired clay body covered with an erosion resistant layer of material from the group consisting of zircon, zirconia and high alumina.

7. A ladle valve stopper according to claim 6, in which said erosion resistant layer is a preformed rigid shell, and means are provided for securing the shell to said body.

8. A ladle valve stopper according to claim 6, in which said erosion resistant layer is a preformed heat-con-

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solidated cup-like shell provided near its open top with a circumferential groove in its inner surface, and said body is provided with a circumferential groove registering with said shell groove, said stopper including a ring of cement filling said grooves to lock the shell and clay body together.

9. A ladle valve nozzle block comprising a fired clay block provided with a concave recess in its top and a vertical opening extending down through the block from the bottom of the recess, and an erosion resistant layer of material lining said recess around said opening, said material being from the group consisting of zircon, zirconia and high alumina.

10. A ladle valve nozzle block according to claim 9, in which the wall of said recess is provided with an undercut annular groove, and the bottom of said lining layer is provided with an undercut circumferential groove registering with said recess groove, said nozzle block including a ring of cement filling said grooves to lock the lining layer and clay block together.

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