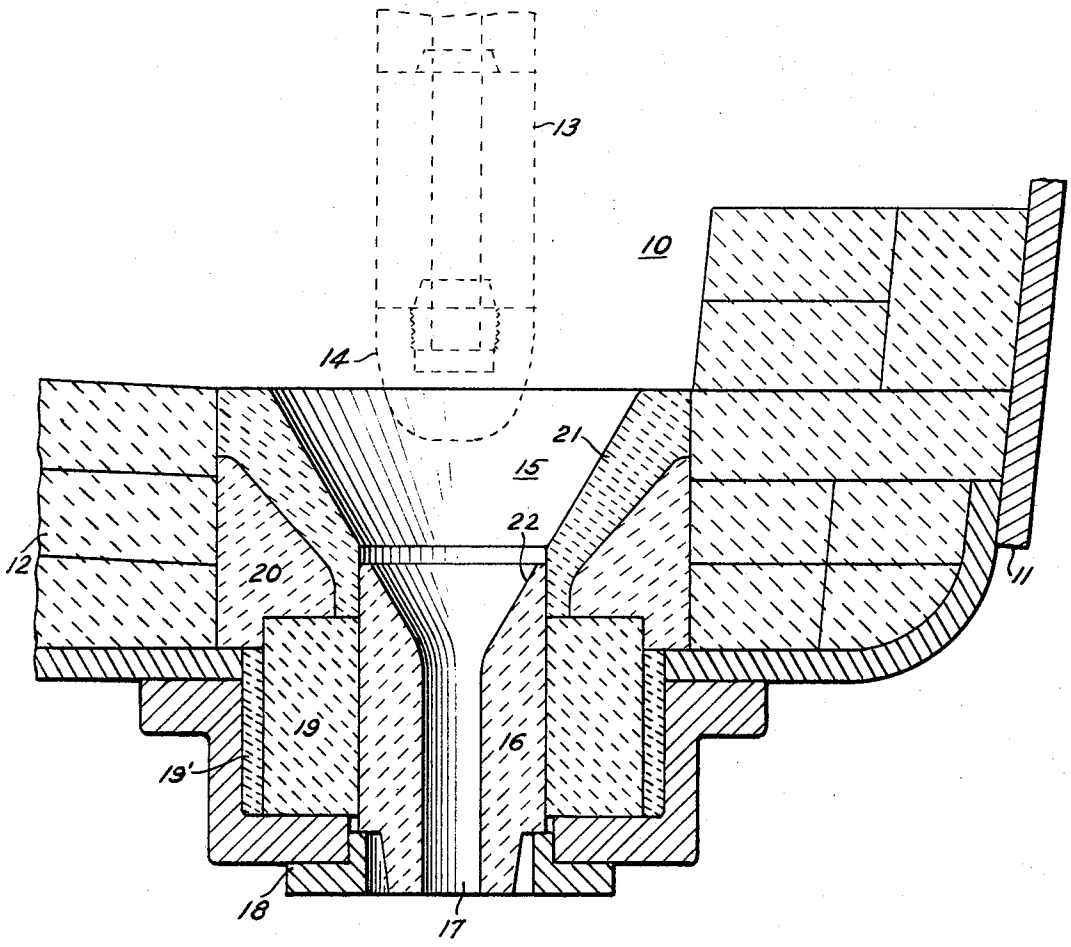
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COMPOSITE NOZZLE POCKET BLOCK

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COMPOSITE NOZZLE POCKET BLOCK

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ABSTRACT OF THE DISCLOSURE

A composite nozzle pocket block in a ladle used to transfer molten metal. A lower portion of the block is a pre-fired cylindrical refractory shape. The upper portion is formed in two rammed sections, one superposed on the other to form a truncated conical opening blending into the nozzle seat. The bottom portion may be of pre-fired high heat duty fireclay while the upper portion may be of a 90%–95% alumina phosphate bonded refractory mix.

This invention relates to a ladle for handling molten metal and in particular to an improvement in the pocket nozzle block in the bottom thereof.

It is the usual practice in steel manufacture to transfer the molten metal from the refining furnace to the ingot molds by means of bottom-pour refractory-lined ladles. With this type of pouring, the flow of molten metal through the ladle nozzle is controlled by means of a stopper assembly. The nozzle, usually made of a fireclay refractory and replaced after each heat, is secured in place in the nozzle well by means of a nozzle retaining plate fastened to the bottom plate of the ladle. A nozzle pocket block, which may be a one-piece or multi-piece preformed refractory shape or a rammed refractory mix, is placed around the nozzle. The surface of the nozzle pocket block guides the stopper head into the nozzle seat to stop the flow of molten metal out of the ladle. As each heat is teemed, the nozzle pocket block, the refractory lining in the bottom of the ladle and the nozzle are eroded by the action of the flowing molten metal. The nozzle pocket block may erode more rapidly than the nozzle, thereby exposing the nozzle seat above the surface of the nozzle pocket block. The nozzle pocket block cannot guide the stopper head to a nozzle seat, resulting in a "running stopper." When the nozzle is replaced after the heat is teemed the new nozzle may project a distance above the nozzle pocket block. As a result it is difficult if not impossible to seat the stopper head properly. The ladle must be removed from service so that the nozzle pocket block may be replaced. This may occur after 4 to 8 heats have been teemed. Usually the ladle lining will have a life of about 18 to 25 heats, therefore, the ladle should not have to be removed from service until the full life of the lining is realized. When the ladle must be removed from service for replacement of the nozzle pocket block the ladle availability of the shop is unnecessarily lowered.

In a multiple basic oxygen furnace shop it is essential that ladles be available at all times, that is, the ladle availability must be high for efficient, continuous operation of the shop. It is therefore necessary that the down-time for repair of ladles be an absolute minimum.

It is therefore the primary object of this invention to provide a nozzle pocket block that will last the life time of the ladle lining.

It is also an object of this invention to provide a nozzle pocket block that will guide the stopper head to the nozzle seat and will afford protection to the pouring nozzle at all times for the life of the ladle lining.

Broadly the invention comprises forming a two-piece nozzle pocket block which includes a composite rammed upper portion and a one piece cast lower portion, said upper portion being of a configuration which will wear evenly with the ladle lining and nozzle so as to provide a smooth surface to guide the stopper head into the nozzle orifice at all times during the life of the ladle lining.

A fragmentary view of a typical hot metal ladle is shown in the drawing. The ladle, shown generally at **10**, comprises an outer metallic shell **11**, an inner refractory lining **12**, a stopper assembly **13**, a refractory stopper head **14** and a nozzle well shown generally at **15**. Inserted in place in the nozzle well **15** is a refractory nozzle **16** having an orifice **17** extending longitudinally axially through the nozzle. The nozzle **16** rests on the nozzle retaining plate assembly **18**. The nozzle pocket block includes a preformed refractory cylindrical shape lower portion **19**, a rammed refractory mix **19'** around said preformed shape, and a composite refractory upper portion which includes a rammed refractory mix base portion **20** and a superposed rammed refractory mix layer **21**. The surface of the layer **21** acts as a guide to direct the stopper head **14** to the nozzle seat **22** when the stopper head is lowered to discontinue the flow of molten metal from the ladle. The layer **21** is also a bridge between the refractory lining **12** in the bottom of the ladle and the nozzle seat **22** and the orifice **17** in the nozzle **16** and is substantially an extension of the upwardly outwardly flared nozzle seat **22** of the nozzle **16**. The layer **21** must have good resistance to corrosion caused by the heat of the molten metal and to erosion by the flowing stream of said molten metal as it is being teemed from the ladle. The layer **21** should erode at the same rate as the refractory lining in the bottom of the ladle and must remain intact above the nozzle seat **22** so as to accurately guide the stopper head to its place on the nozzle seat **22** when said stopper head is lowered to interrupt the flow of molten metal of the ladle.

We have found that the layer **21** should have a thickness of from about one inch to about four inches and may be of a high alumina, high density, phosphate-bonded refractory rammed mix of at least 65% alumina and preferably at least 90% alumina, the remainder being silica or magnesia an incidental impurities. The base **20** may be of a volume stable refractory mix such as high duty or super duty fireclay or a high density, high alumina, phosphate-bonded material. The rammed refractory **19'** is the same composition as the base **20**. The composite upper portion, is made up of the base **20** and the layer **21**, should be from 5 inches to 12 inches in height. The orifice generated by the surface of layer **21** is flared upwardly and outwardly to form an inverted frusto-conical shape. The base or largest diameter of the frusto-cone is parallel with and communicates with the refractory lining in the bottom of the ladle and the apex thereof is adjacent the nozzle seat **22**. The surface of the layer **21** may form an angle of about 15 degrees to about 75 degrees with a vertical axis drawn through the orifice **17** in the teeming nozzle.

The novel composite two-piece nozzle pocket block of the invention has resulted in increasing the life of the nozzle pocket block to equal that of the refractory lining in the ladle which is about 24 heats. The differential wear of the refractory materials in the ladle refractory lining and the nozzle pocket block which heretofore caused the formation of a dam where they join has been alleviated, thereby assuring the teeming of all the molten metal in the ladle. The ladle is removed from service for a very short period of time after each heat is teemed to replace the nozzle. The replacement of the nozzle is best done while the refractory material in the ladle retains the heat absorbed from the molten metal and is a matter of short duration. Because the novel nozzle pocket block of the invention does not have to be replaced for the life of the

ladle lining, the ladle availability of the shop has been increased.

In a specific example of the invention, a 285 ton ladle was lined with a working lining **12** using a conventional bloating-type ladle brick. The novel nozzle pocket block of the invention was then formed in the nozzle well **15** of the ladle **10**. A pre-fired high heat duty fireclay cylindrical shape **19** was inserted into the well **15** so that it rested on the cast iron supporting well casting **18**. The lower cylindrical shape **19** had an inside diameter of 8¼ inches, an outside diameter of 16 inches, and was 9¼ inches long. A wooden mandrel was placed inside the cylindrical shape **19** to act as a form around which the composite upper portion of the nozzle pocket block was formed. The base portion **20** of the composite upper portion of the nozzle pocket block was rammed with a 90% alumina phosphate bonded refractory mix. The layer **21** formed on the base portion of the composite nozzle pocket block was of a 95% alumina phosphate bonded high density refractory mix. The surface of the layer **21** formed an angle of 30° with the vertical axis of the nozzle **16**. The working surface of the layer **21** defined an inverted frusto-conically shaped surface which had a height of 7 inches, a base having a 16 inch diameter and an apex having an 8¼ inch diameter. The overall height of the composite upper portion of the nozzle pocket block was 12 inches. The upper working surface of the layer **21** was formed flush with the ladle lining brick in the bottom of the ladle.

The wooden mandrel was removed and a nozzle having an O.D. of 7⅝", an I.D. of 2¼" and an overall height of 15" was placed in position inside the nozzle pocket block.

Twenty-four heats comprising 6800 tons of steel, were teemed before the ladle was removed from service for relining. The layer **21** in the upper portion of the nozzle pocket block was not completely worn away but since the ladle was out of service, it was repaired to the original dimensions to prepare the ladle for reuse.

Although we have shown the preferred embodiment of the invention, it will be understood that other adaptations and modifications may be made without departing from the scope of the invention.

We claim:

1. In a refractory lined ladle for transporting hot molten metal having in the bottom thereof a nozzle with a teeming orifice therethrough, a pocket nozzle block comprising a cylindrical pre-fired refractory lower portion and a rammed composite refractory upper portion, said upper portion having a base portion comprising a rammed refractory mix and a rammed refractory mix superposed layer, said superposed layer having an inverted frusto-conical shape and forming an extension of the said teeming orifice in the said nozzle to provide a smooth surface to guide the stopper head into the said teeming orifice of the nozzle, the surface of said layer forming an angle of about 15° to 75° with the vertical axis of the said teeming orifice in the said nozzle, said layer comprising a fine-grained phosphate bonded high density refractory mix of at least 65% alumina and the remainder silica or magnesia and incidental impurities.

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