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(54) **Fluted stopper.**

(57) A refractory monoblock stopper of substantially cylindrical configuration having an axial bore (2) provided therethrough for the passage of an inert gas, the outer surface of the stopper rod (1) being provided with an odd number of axial grooves (5) thereby reducing the weight of the stopper without loss of strength.

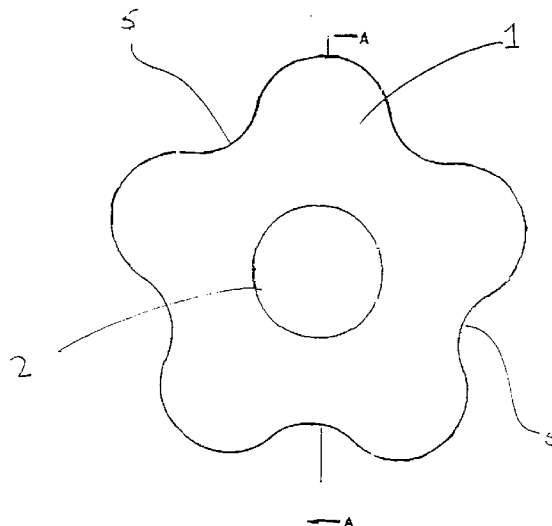


Figure 2

This invention relates to a stopper used as part of a valve mechanism in the control of flow of molten material from a vessel through a submerged outlet. More particularly, it relates to refractory monoblock stoppers, i.e. one piece ceramic stopper rods as currently used to control the flow of molten metal exiting from a nozzle mounted in the bottom of a melt-containing vessel, e.g. ladle or tundish. This is typically applied in the casting of steel through an opening in the base of the tundish via nozzles and shrouds into a water-cooled mould.

Typically, such stoppers consist of an elongate cylindrical refractory ceramic body of isostatically-pressed graphite/alumina having at the lower end a rounded or tapered profile suitable for engagement in the throat of a corresponding exit nozzle, and at the upper end some form of connecting means to fasten the stopper onto an external lifting mechanism by which the flow is controlled.

Operation of the stopper is simple in principle. A mechanical lifting system is used to vertically lift the stopper rod from a seating position on the nozzle to ease or restrict the volume of the molten metal flowing through the nozzle. However, in practice, such a stopper rod has to operate under harsh environmental conditions such as being submerged in the molten metal for long periods of time and must be able to withstand the high thermal shocks encountered in the pouring processes.

The present invention aims to provide an improved stopper.

According to one aspect of the present invention there is provided a refractory monoblock stopper of substantially cylindrical configuration having an axial bore provided therethrough for the passage of an inert gas, the outer surface of the stopper rod being provided with an odd number of axial grooves thereby reducing the weight of the stopper without loss of strength.

Preferably, the grooves in the outer surface of the stopper rod are concave in cross-section.

Advantageously, 3 or 5 grooves are equispaced in the outer surface of the stopper rod.

Therefore this invention provides a refractory monoblock stopper which is characterised in that the exterior surface of the stopper has an undulating contour comprising alternate lobes and recesses to provide a fluted design which surprisingly retains the strength of a regular cylindrical stopper as known for example from EP-A-0074988 or EP-A-0179837 yet results in significant savings in material.

One embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1 is a schematic view of a stopper according to one aspect of the present invention, and Figure 2 is a horizontal cross-section through the stopper of Figure 1.

Turning now to the Figures, there is shown a stop-

per rod 1 for use in the control of flow of molten material from a tundish or vessel (not shown). The stopper rod 1 comprises a refractory body having an axial bore 2 having a restricted section 3 in the lower region of the stopper rod. An inert gas such as Argon is fed from a gas supply, through a transverse bore 4 in the upper region of the stopper rod into the axial bore 2.

The outer surface of the stopper rod 1 is provided with a plurality of axial concave grooves 5. Five grooves are shown in Figure 2 although 3 grooves may alternatively be used. The grooves 5 are equispaced around the outer surface of the stopper rod 1. The grooves produce regions of reduced thickness in the stopper rod 1. An odd number of grooves 5 are provided to ensure that each region of reduced thickness of the stopper rod is diametrically opposite to a solid portion of the stopper rod so as to ensure that it can withstand the harsh working conditions placed upon it.

Experiments carried out on a conventional cylindrical stopper rod and a grooved stopper rod loaded in a similar manner have surprisingly shown that the grooved stopper rod achieves a significant weight saving for the stopper rod without suffering from loss of strength.

Furthermore, the grooves 5 provided in the surface of the stopper rod 1 result in the reduction of the tendency for a swirling vortex to be created around the stopper rod and thence down the exit nozzle of the tundish or vessel. The above described stopper rod allows the tundish to be emptied to a lower level before any surface slag or impurities are drawn down the nozzle and into the mould which would reduce the cast product quality. The yield from each tundish can therefore, be increased.

Claims

1. A refractory monoblock stopper of substantially cylindrical configuration having an axial bore provided therethrough for the passage of an inert gas, the outer surface of the stopper rod being provided with an odd number of axial grooves thereby reducing the weight of the stopper without loss of strength.
2. A stopper according to claim 1, wherein the grooves in the outer surface of the stopper rod are concave in cross-section.
3. A stopper rod according to claim 1 or 2, wherein three grooves are equispaced in the outer surface of the stopper rod.
4. A stopper rod according to claim 1 or 2, wherein five grooves are equispaced in the outer surface of the stopper rod.

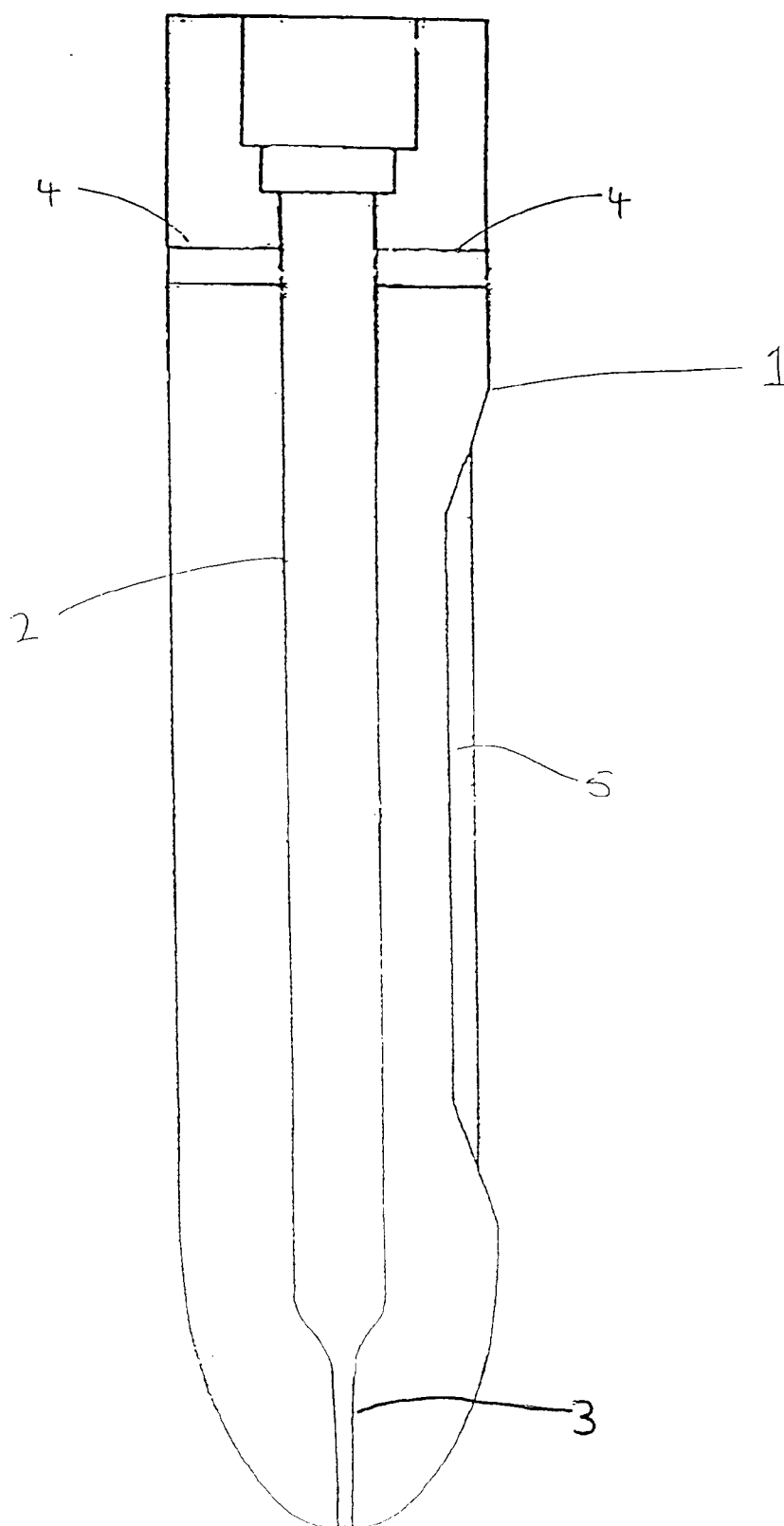


Figure 1

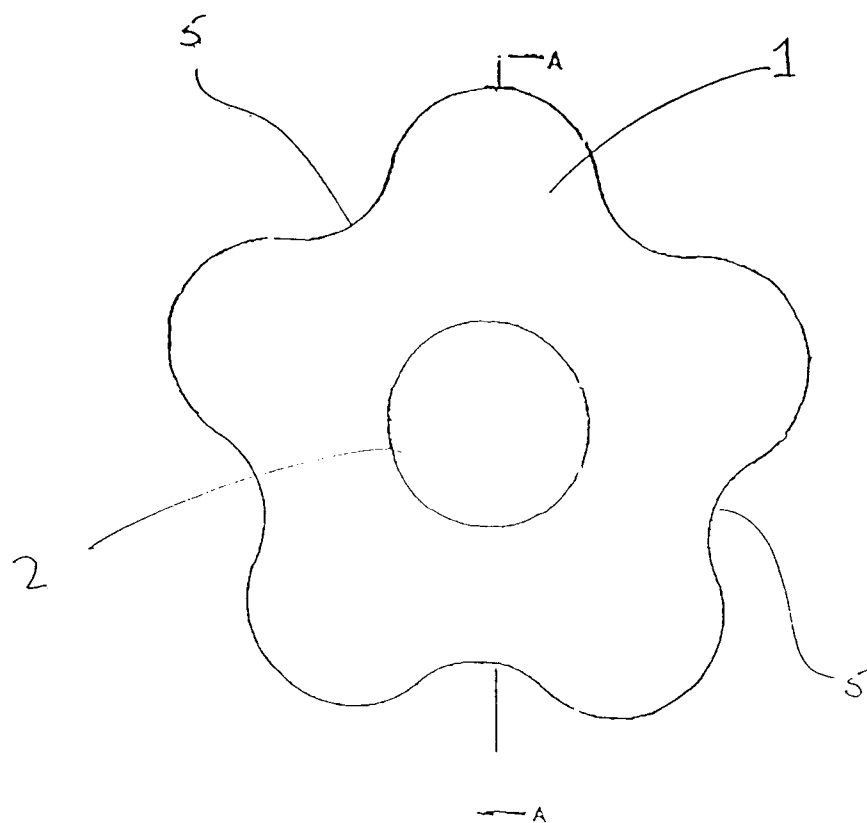


Figure 2



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 2374

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CLS)
Y	WO-A-85 05056 (THOR CERAMICS LTD) * abstract; figures 1-6 *	1-4	B22D41/18
D,Y	& EP-A-0 179 837 ---	1-4	
Y	WO-A-82 03349 (THORNTON J.) * abstract; figure *	1-4	
D,Y	& EP-A-0 074 988 ---	1-4	
Y	US-A-4 799 650 (LABATE) * column 1, line 35 - line 47; figures 1-4 *	1-4	
	* column 1, line 62 - column 3, line 5 *		
A	FR-A-2 681 804 (TERRES RÉFRACIAIRES DU BOULONNAIS) ---		TECHNICAL FIELDS SEARCHED (Int.CLS)
A	CH-A-294 260 (O.HOFER-WEISS) -----		
The present search report has been drawn up for all claims			B22D F27D C21C
Place of search THE HAGUE		Date of completion of the search 1 September 1994	Examiner Mailliard, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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