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(54) **STOPPER ROD FOR DELIVERING GAS INTO A MOLTEN METAL**

STOPFENSTANGE ZUR ZUFUHR VON GAS IN EINE METALLSCHMELZE

QUENOUILLE ADAPTÉE À LA DÉLIVRANCE DE GAZ DANS UN MÉTAL LIQUIDE

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Description

[0001] This invention relates to a mono-block stopper rod used to control the flow of molten metal from a discharge nozzle in a holding vessel during metal teeming.

[0002] In continuous casting processes, the use of gases injected down the stopper has been shown to have significant benefits on the quality of metal being cast. For example, inert gases such as argon or nitrogen can be injected to reduce the problems due to alumina build-up and clogging or to assist in removing solidification products from the vicinity of the discharge nozzle. Reactive gases may also be employed when the melt composition needs modifying. Conventionally, the stopper - generally made from an alumina carbon refractory composition - is provided with an internal chamber connected to gas supply means on the one end and to a gas discharge port at the other end.

[0003] Various systems have been developed to ensure an accurately measured flow of gas is supplied to the stopper. Problems have been encountered with sealing such systems and ensuring that the gas follows its intended path and is not wasted. Stoppers which have proved to be successful in meeting many of these requirements are disclosed in EP-A2-358,535, WO-A1-00/30785 and WO-A1-00/30786 and more recently in WO-A1-02/100579.

[0004] Pursuing its development work in this field, the applicant has now realized that the gas injected into the molten metal through the stopper could be contaminated when passing through the stopper.

[0005] In particular, it is suspected that the carbon present in the composition constituting the stopper body could reduce some of the metal oxides also present in the composition; this reduction is accompanied by the generation of carbon monoxide. The carbon monoxide injected into the molten metal will in turn oxidize the aluminum which has been added to calm the steel producing thereby important quantities of alumina contributing thus to the alumina build-up and clogging.

[0006] It would therefore be advantageous to provide a stopper rod which would not contaminate the gas passing therethrough.

[0007] According to the invention, this problem is solved for a stopper rod adapted to deliver gas during pouring of molten metal comprising a stopper body having an internal chamber and a gas discharge port, a bore connecting the internal chamber to the gas discharge port, the internal chamber and the bore defining a gas passageway. According to the invention, the walls of the gas passageway are provided with a layer of a material which will not produce carbon monoxide at the temperature of use.

[0008] It must be noted that it is, to the applicant's knowledge, the first time that it is proposed to provide a refractory article with such a layer on a portion of said article that will never contact the molten metal. On the contrary, in the prior art as exemplified for example by

the document US-A1-5,691,061 or US-A1-5,681,499, such a layer is only provided on portions that are always in contact with the metal.

[0009] The layer can be formed as a coating applied on the walls of the gas passageway after the manufacture of the stopper rod. Such a coating can be applied by spraying a liquid, wet or semi-wet composition or simply by filling the inner chamber with the appropriate composition. Once the coating is dried, the stopper rod can then be cured. Alternatively, the curing of the stopper can take place before the coating step. Advantageously, the layer is a liner pressed simultaneously with the stopper rod body. In this case, it is indeed possible to reduce the number of manufacturing steps. According to another variant, the layer extends through essentially the whole thickness of the walls of the gas passageway.

[0010] The material constituting the a layer which will not produce carbon monoxide at the temperature of use can be selected from three different categories of materials:

- a) materials which do not contain carbon;
- b) materials essentially constituted of non reducible refractory oxides; or
- c) materials comprising elements which will react with the generated carbon monoxide. Preferably, the selected material will present two or three of the above properties.

[0011] Examples of suitable material of the first category are silica (for example vitreous silica), alumina, mulite or magnesia based material (spinel). In certain cases, these materials can however be somehow difficult to apply as a liner or coating (the lack of carbon in the layer can cause some thermal shock problems) and do not constitute the preferred embodiment of the invention.

[0012] Suitable materials of the second category are for example pure alumina carbon compositions. In particular, these compositions should contain very low amount of silica or of conventional impurities which are usually found in silica (sodium or potassium oxide). In particular, the silica and its conventional impurities should be kept under 2 wt. %, preferably under 1 wt. %.

[0013] Suitable materials of the third category comprises for example free metal able to combine with carbon monoxide to form a metal oxide and free carbon. Silicon and aluminum are suitable for this application. These materials can also or alternatively comprise carbides or nitrides able to react with carbon monoxide (for example silicon or boron carbides).

[0014] Preferably the selected material will belong to the second or third categories, even preferably, it will belong to the second and third category.

[0015] A suitable material constituting the layer which will not produce carbon monoxide at the temperature of use can comprise 60 to 88 wt. % of alumina, 10 to 20 wt. % graphite and 2 to 10 wt. % of silicon carbide. Such a material is essentially constituted of non-oxides species

or non-reducible oxides and comprises silicon carbide which can react with the carbon monoxide if some is generated in working condition.

[0016] The invention will now be described with reference to the attached drawing in which Fig. 1 shows a cross-section of a stopper rod according to the invention. Reference 1 depicts respectively the internal chamber and a gas discharge port of the stopper rod. A bore 3 connects the internal chamber 1 to the gas discharge port 2. The bore 3 and the internal chamber 1 define a passageway for the gas. Fig. 1 represents an embodiment wherein the layer 4 has been copressed as a liner with the stopper body. Very conveniently, the liner 4 can be constituted of several pre-formed tubular portions (41, 42, 43) which are all copressed with the stopper body. A portion of the metal rod 5 connecting the stopper rod to the rigging device (not shown) is depicted in working position. Preferably, the metal rod 5 extends beyond the highest point of the layer 4. Even more preferably, a sealing gasket 6 is inserted around the lower end of the metal rod 5.

Claims

1. Stopper rod adapted to deliver gas during pouring of molten metal comprising a stopper body having an internal chamber (1) and a gas discharge port (2), a bore (3) connecting the internal chamber (1) to the gas discharge port (2), the internal chamber (1) and the bore (3) defining a gas passageway, **characterized in that** the walls of the gas passageway are provided with a layer (4) which will not produce carbon monoxide at the temperature of use.
2. Stopper rod according to claim 1, **characterized in that** the layer (4) is a liner copressed with the body.
3. Stopper rod according to claim 1, **characterized in that** the layer (4) is a coating applied on the walls of the gas passageway.
4. Stopper rod according to claim 1, **characterized in that** the layer (4) extends through essentially the whole thickness of the walls of the gas passageway.
5. Stopper rod according to any one of claims 1 to 4, **characterized in that** the layer (4) extends upwardly beyond the lowest point reached by a metal rod (5) used to attach the stopper to a rigging device.
6. Stopper rod according to any one of claims 1 to 5, **characterized in that** the material constituting the layer (4) is selected from the groups of

- a) materials which do not contain carbon;
- b) materials essentially constituted of non reducible refractory oxides; and/or

c) materials comprising elements which will react with the generated carbon monoxide, or mixtures thereof.

7. Stopper rod according to any one of the preceding claims, **characterized in that** the layer (4) comprises 60 to 88 wt. % of alumina, 10 to 20 wt. % graphite and 2 to 10 wt. % of silicon carbide.
8. Assembly of a stopper rod according to any one of the preceding claims with a metal rod (5) used to attach the stopper to a rigging device wherein the metal rod (5) extends beyond the highest point of the layer (4).
9. Assembly according to claim 8, wherein a sealing gasket (6) is inserted around the lower end of the metal rod (5).

Patentansprüche

1. Stopfenstange, welche zur Zufuhr von Gas beim Gießen einer Metallschmelze geeignet ist und einen Stopfenkörper mit einer inneren Kammer (1) und einer Gasaustrittsöffnung (2) umfasst, wobei eine Bohrung (3) die innere Kammer (1) mit der Gasaustrittsöffnung (2) verbindet sowie die innere Kammer (1) und die Bohrung (3) einen Gasdurchlass begrenzen, **dadurch gekennzeichnet, dass** die Wandungen des Gasdurchlasses mit einer Schicht (4) versehen sind, welche bei der Arbeitstemperatur kein Kohlenmonoxid produziert.
2. Stopfenstange nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schicht (4) eine Auskleidung ist, welche mit dem Körper gemeinsam gepresst ist.
3. Stopfenstange nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schicht (4) eine Beschichtung ist, welche auf den Wandungen des Gasdurchlasses aufgebracht ist.
4. Stopfenstange nach Anspruch 1, **dadurch gekennzeichnet, dass** sich die Schicht (4) im Wesentlichen über die ganze Wandungsdicke des Gasdurchlasses erstreckt.
5. Stopfenstange nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** sich die Schicht (4) nach oben über den untersten Punkt, welcher von einer zur Anbringung des Stopfens an einer Aufhängevorrichtung benutzten Metallstange (5) erreicht wird, hinaus erstreckt.
6. Stopfenstange nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** das die Schicht (4) bildende Material ausgewählt ist aus den Gruppen

von

- a) Materialien, welche keinen Kohlenstoff enthalten;
- b) Materialien, welche im Wesentlichen aus nicht reduzierbaren Feuerfestoxiden bestehen und/oder
- c) Materialien, welche Elemente umfassen, die mit dem entstandenen Kohlenmonoxid oder Gemischen desselben reagieren.

7. Stopfenstange nach einem der bisherigen Ansprüche, **dadurch gekennzeichnet, dass** die Schicht (4) 60 Masse-% bis 88 Masse-% Aluminiumoxid, 10 Masse-% bis 20 Masse-% Grafit und 2 Masse-% bis 10 Masse-% Siliciumcarbid umfasst.
8. Stopfenstangenbaugruppe nach einem der bisherigen Ansprüche mit einer zur Anbringung des Stopfens an einer Aufhängevorrichtung benutzten Metallstange (5), wobei sich diese Metallstange (5) über den höchsten Punkt der Schicht (4) hinaus erstreckt.
9. Baugruppe nach Anspruch 8, bei welcher rund um das untere Ende der Metallstange (5) eine Dichtung (6) eingefügt ist.

Revendications

1. Quenouille adaptée à délivrer un gaz pendant la coulée d'un métal à l'état fondu comprenant un corps de quenouille possédant une chambre interne (1) et un orifice de décharge (2), un alésage (3) reliant la chambre interne (1) à l'orifice de décharge (2), la chambre interne (1) et l'alésage (3) définissant un passage pour le gaz, **caractérisée en ce que** les parois du passage pour le gaz sont garnies d'une couche (4) qui ne produira pas de monoxyde de carbone à la température d'utilisation.
2. Quenouille selon la revendication 1, **caractérisée en ce que** la couche (4) est un revêtement copressé avec le corps.
3. Quenouille selon la revendication 1, **caractérisée en ce que** la couche (4) est un enduit appliqué sur les parois du passage pour le gaz.
4. Quenouille selon la revendication 1, **caractérisée en ce que** la couche (4) s'étend à travers essentiellement toute l'épaisseur des parois du passage pour le gaz.
5. Quenouille selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que** la couche (4) s'étend vers le haut au-delà du point le plus bas atteint par la barre métallique (5) utilisée pour relier la

quenouille à la potence.

6. Quenouille selon l'une quelconque des revendications 1 à 5, **caractérisée en ce que** le matériau constituant la couche (4) est sélectionné dans le groupe des

- a) matériaux qui ne contiennent pas de carbone;
- b) matériaux essentiellement constitués d'oxydes réfractaires non réductibles; et/ou
- c) matériaux comprenant des éléments qui vont réagir avec le monoxyde de carbone généré, ou leurs mélanges.

7. Quenouille selon l'une quelconque des revendications précédentes, **caractérisée en ce que** la couche (4) comprend de 60 à 88% en poids d'alumine, de 10 à 20% en poids de graphite et de 2 à 10% en poids de carbure de silicium.
8. Assemblage d'une quenouille selon l'une quelconque des revendications précédentes avec une barre métallique (5) utilisée pour attacher la quenouille à une potence, dans lequel la barre métallique (5) s'étend au-delà du point le plus haut de la couche (4).
9. Assemblage selon la revendication 8, dans lequel un joint d'étanchéité (6) est inséré autour de l'extrémité inférieure de la barre métallique (5).

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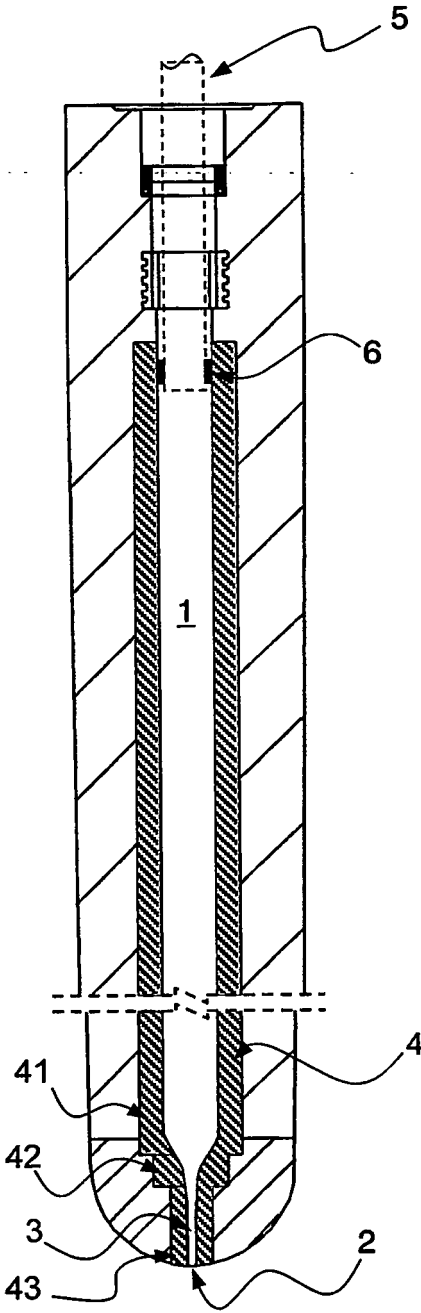


Fig.1

REFERENCES CITED IN THE DESCRIPTION

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