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(54) **Purifying molten metal**

Reinigen von geschmolzenem Metall

Purification de métal fondu

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(56) References cited:
EP-A- 0 187 924 **FR-A- 2 516 415**
GB-A- 1 601 944 **GB-A- 2 149 699**
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Description

[0001] This invention relates to a means for the purification of molten metal, i.e. the removal of unwanted solid non-metallic inclusions contained in the molten metal.

[0002] The need to provide 'clean' metals, e.g. steel, is well known and many methods have been proposed to that end. One well known general technique is to bubble an inert gas through the molten metal, the gas removing inclusions with which it comes into contact by floating them up to the surface of the molten metal.

[0003] Various means have been proposed in order to provide the desired stream of inert gas bubbles through the molten metal.

[0004] For example, EP-A-404641 discloses the use in a tundish of a gas duct set into the permanent refractory lining and leading to a gas distribution chamber in the bottom of, and extending across, the tundish, the chamber being covered with a gas-permeable plate.

[0005] GB-A-2164281 discloses the use of a porous refractory tile extending across the width of, and sitting on the floor of, a tundish, the tile containing a gas conduit with a plurality of exits to deliver gas into the tile.

[0006] EP-A-0239257 discloses passing steel in a tundish through an apertured upright board, while introducing an inert gas at the foot of the board at its upstream side to cause a stream of bubbles to flow over its upstream side.

[0007] EP-A-0059805 discloses the use of a porous nozzle in the bottom of a molten metal vessel, the nozzle having a flanged upper portion and cylindrical lower portion, its body being enclosed in a gas tight steel shell, with means to provide gas into the porous nozzle to escape into the molten metal in the vessel.

[0008] FR-A-2516415 also discloses the use of a porous flanged nozzle in the bottom of a molten metal vessel. The annular flange contains a pipe extending around the flange and gas supplied to the pipe escapes through holes in the pipe and up through the porous flange into the molten metal.

[0009] The present invention aims to provide an improved means of bubbling gas into molten metal in the region of a nozzle in the bottom of a molten metal vessel.

[0010] In a molten metal vessel, such as a tundish used in the continuous casting of steel, it is usual practice to have one or more outlets in the bottom of the vessel, which can be opened to allow the metal to empty out. The vessel will normally be of metal, usually steel, lined with refractory material, e.g. brick or a cast refractory concrete. Each outlet is provided by a nozzle positioned in a correspondingly-shaped hole through the floor of the lined vessel. It is conventional practice not to set the nozzle directly into the vessel lining but to set it into a so-called nozzle block, which latter is set into the vessel lining.

[0011] We have now found that an improved means of

removing inclusions can be provided by utilising the nozzle block surrounding the nozzle as the conduit for inert gas into the vessel.

[0012] Accordingly, in one aspect the invention provides a refractory-lined vessel to contain molten metal, the vessel having an outlet through its floor and comprising a nozzle with a centrally-disposed through bore, the nozzle being sealingly set in a nozzle block which is itself sealingly set in the lining of the floor of the vessel whereby the outlet is defined, a gas-receiving channel extending around the nozzle and means to connect the gas-receiving channel to a source of gas, characterised in that the nozzle block is formed of gas-permeable material and in that the gas-receiving channel is located in the nozzle block so that it surrounds and is spaced from the nozzle.

[0013] In another aspect the invention provides a nozzle block shaped to be sealingly set in the refractory lining of the floor of a vessel to contain molten metal, the nozzle block having a through bore to align with a hole through the lining and the floor of the vessel, and being shaped to lie on the floor without protruding through the hole and to contain a nozzle with a centrally-disposed through bore whereby the nozzle can extend through the hole to the exterior of the vessel, characterised in that the nozzle block is gas-permeable and has a gas-receiving channel located to extend around and be spaced from the nozzle and means to connect the gas-receiving channel to a source of gas.

[0014] Preferably, the gas-receiving channel extends completely around the nozzle.

[0015] Gas, e.g. argon, supplied to the channel escapes upwardly through the porous nozzle block and emerges into the molten metal in the vessel in streams of bubbles rising from the vessel floor around the nozzle.

[0016] The gas-receiving channel preferably contains a pipe connected to the source of gas, the pipe having perforations or slots, preferably in its upper surface, to allow escape of the gas into the porous nozzle block.

[0017] The nozzle block may be a shaped refractory brick containing a centrally-disposed hole shaped to receive the nozzle but preferably it is made of a cast refractory cement into which the nozzle is set. The refractory cement may be of any suitable composition, well known per se in the art, but formulated to have the desired degree of porosity.

[0018] If desired the nozzle block may be designed to have greater porosity above the gas-receiving channel and lesser, e.g. approaching zero, porosity below the gas-receiving channel so as to help to direct the emerging gas upwardly into the molten metal.

[0019] The porous refractory composition may be, for example, of a high alumina content formulation containing alumina and cement. The alumina content should be at least 65% by weight of the composition, preferably at least 75% and especially in the range 90 to 97% by weight. Where an area of different composition or

porosity is used, e.g. corresponding to the above-described area of lesser porosity, this may also be a cheaper formulation and hence, contain less of the better refractory component, i.e. alumina. Thus, part of the alumina may be replaced by an ore such as andalusite and/or bauxite.

[0020] The construction of the present invention is particularly useful in that it can provide inert gas scouring in the immediate vicinity of the nozzle which, in a tundish, can prevent unwanted build up of deposits such as alumina on the nozzle itself while, moreover, it provides streams of inert gas in a wider region surrounding the nozzle to give, thereby, very effective inclusion-removal in the vessel itself.

[0021] One embodiment of the invention is illustrated in the accompanying drawing, which is a cross-section through a portion of a tundish in the region of an outlet.

[0022] The metal tundish 10 has a base 11 and side-walls 12, one only of the latter being shown. It is lined with a permanent refractory lining 13 which is itself covered with an inner, i.e. molten metal-contacting, expendable lining 14. An outlet 15 is provided in the base 11. This can be opened and closed by any conventional means (not shown), for example, by a stopper rod or a slide-gate valve beneath the base.

[0023] A nozzle block 16 of cast refractory cement is positioned in a suitably-shaped recess in the tundish lining so as to rest on the base 11 surrounding the outlet 15. A nozzle 17 sits in the nozzle block so that its lower portion 17A protrudes below the base 11 of the tundish.

[0024] Nozzle block 16 is of gas-permeable formulation and contains a feed pipe 18 to receive gas from a source (not shown). Feed pipe 18 runs completely around the interior of the nozzle block so as to surround the nozzle 17. The pipe 18 is conveniently set into the nozzle block as it is cast. The pipe is perforated in the manner indicated above so as to allow gas to escape into the nozzle block 16 and thereby into the interior of the tundish.

[0025] Escaping gas is indicated by arrows A and B. As shown, the upper surface of nozzle block 16 has a horizontal portion 19, which is set above the level of the upper surface 21 of the nozzle 17, and an angled surface 20 which slopes down to the level of the nozzle surface 21. Gas stream A escapes from horizontal surface 19 and rises vertically to capture inclusions in the molten metal contained in the tundish. Gas stream B escapes upwardly and inwardly over the upper surface 21 of nozzle 17 and thereby helps to scour the nozzle of alumina or other deposits that would otherwise form on the nozzle.

Claims

1. A refractory-lined vessel (10) to contain molten metal, the vessel having an outlet (15) through its floor (11) and comprising a nozzle (17) with a centrally-disposed through bore, the nozzle (17) being

sealingly set in a nozzle block (16) which is itself sealingly set in the lining (13, 14) of the floor (11) of the vessel (10) whereby the outlet (15) is defined, a gas-receiving channel (18) extending around the nozzle (17) and means to connect the gas-receiving channel to a source of gas, characterised in that the nozzle block (16) is formed of gas-permeable material and in that the gas-receiving channel (18) is located in the nozzle block (16) so that it surrounds and is spaced from the nozzle (17).

2. A refractory-lined vessel according to Claim 1, in which the gas-receiving channel (18) extends completely around the nozzle (17).
3. A refractory-lined vessel according to Claim 1 or 2, in which the gas-receiving channel (18) contains a pipe (18) having perforations in its upper surface.
4. A refractory-lined vessel according to Claim 1, 2 or 3, in which the nozzle block (16) is a shaped refractory brick having a centrally-disposed bore to receive the nozzle (17).
5. A refractory-lined vessel according to Claim 1, 2 or 3, in which the nozzle block (16) is of cast refractory cement into which the nozzle (17) is set.
6. A refractory-lined vessel according to any preceding claim, in which the nozzle block (16) has greater porosity above the gas-receiving channel (18) than below it.
7. A refractory-lined vessel according to Claim 6, in which the nozzle block (16) is substantially non-porous below the gas-receiving channel (18).
8. A refractory-lined vessel according to any preceding claim, in which the composition of the nozzle block (16) comprises at least 75% by weight of alumina.
9. A refractory-lined vessel according to Claim 8, in which the composition of the nozzle block (16) comprises from 90 to 97% by weight of alumina.
10. A refractory-lined vessel according to Claim 6, 7 or 8, in which the nozzle block (16) comprises a composition of at least 75% by weight of alumina above the gas-receiving channel (18) and a composition containing less alumina below the gas-receiving channel (18).
11. A nozzle block (16) to be sealingly set in the refractory lining (13, 14) of the floor (11) of a vessel (10) to contain molten metal, the nozzle block (16) having a through bore to align with a hole through the lining and the floor of the vessel, and being shaped

to lie on the floor (11) without protruding through the hole and to contain a nozzle (17) with a centrally-disposed through bore (15) whereby the nozzle (17) can extend through the hole to the exterior of the vessel (10), characterised in that the nozzle block (16) is gas-permeable and has a gas-receiving channel (18) located to extend around and be spaced from the nozzle (17) and means to connect the gas-receiving channel (18) to a source of gas.

12. A nozzle block according to Claim 11, in which the gas-receiving channel (18) extends completely around the nozzle (17).

13. A nozzle block according to Claim 11 or 12, in which the gas-receiving channel contains a pipe (18) having perforations in its upper surface.

14. A nozzle block according to Claim 11, 12 or 13, in which the nozzle block (16) is a shaped refractory brick having a centrally-disposed bore to receive the nozzle (17).

15. A nozzle block according to Claim 11, 12 or 13, in which the nozzle block (16) is of cast refractory cement into which the nozzle (17) is set.

16. A nozzle block according to any one of Claims 11 to 15, in which the nozzle block (16) has greater porosity above the gas-receiving channel (18) than below it.

17. A nozzle block according to Claim 16, in which the nozzle block (16) is substantially non-porous below the gas-receiving channel (18).

18. A nozzle block according to any one of Claims 11 to 17, in which the composition of the nozzle block (16) comprises at least 75% by weight of alumina.

19. A nozzle block according to Claim 18, in which the composition of the nozzle block (16) comprises from 90 to 97% by weight of alumina.

20. A nozzle block according to Claim 16, 17 or 18, in which the nozzle block (16) comprises a composition of at least 75% by weight of alumina above the gas-receiving channel (18) and a composition containing less alumina below the gas-receiving channel (18).

Patentansprüche

1. Feuerfest ausgekleideter Behälter (10) zur Aufnahme von Metallschmelze, wobei der Behälter einen durch seinen Boden (11) führenden Auslaß (15) aufweist und eine Düse (17) mit einer mittig ausgebildeten Durchgangsbohrung, wobei die

Düse (17) in einem Düsenblock (16) abdichtend eingesetzt ist, der wiederum in der Auskleidung (13, 14) des Bodens (11) des Behälters (10) abdichtend eingesetzt ist, durch den der Auslaß (15) definiert ist, einen Gasaufnahmekanal (18), der um die Düse (17) herum verläuft, und ein Mittel zur Verbindung des Gasaufnahmekanals mit einer Gasquelle umfaßt, dadurch gekennzeichnet, daß der Düsenblock (16) aus einem gasdurchlässigen Material besteht und daß der Gasaufnahmekanal (18) so im Düsenblock (16) angeordnet ist, daß er die Düse (17) in einem Abstand umgibt.

2. Feuerfest ausgekleideter Behälter nach Anspruch 1, bei dem der Gasaufnahmekanal (18) ganz um die Düse (17) herum verläuft.

3. Feuerfest ausgekleideter Behälter nach Anspruch 1 oder 2, bei dem der Gasaufnahmekanal (18) ein Rohr (18) enthält, in dessen Oberseite Perforationen ausgebildet sind.

4. Feuerfest ausgekleideter Behälter nach Anspruch 1, 2 oder 3, bei dem es sich bei dem Düsenblock (16) um einen feuerfesten Formstein handelt, in dem mittig eine Bohrung zur Aufnahme der Düse (17) ausgebildet ist.

5. Feuerfest ausgekleideter Behälter nach Anspruch 1, 2 oder 3, bei dem der Düsenblock (16) aus feuerfestem Gußzement besteht, in dem die Düse (17) eingesetzt ist.

6. Feuerfest ausgekleideter Behälter nach einem der vorhergehenden Ansprüche, bei dem der Düsenblock (16) über dem Gasaufnahmekanal (18) eine größere Porosität aufweist als darunter.

7. Feuerfest ausgekleideter Behälter nach Anspruch 6, bei dem der Düsenblock (16) unter dem Gasaufnahmekanal (18) im wesentlichen nichtporös ist.

8. Feuerfest ausgekleideter Behälter nach einem der vorhergehenden Ansprüche, bei dem die Zusammensetzung des Düsenblocks (16) mindestens 75 Gew.-% Aluminiumoxid enthält.

9. Feuerfest ausgekleideter Behälter nach Anspruch 8, bei dem die Zusammensetzung des Düsenblocks (16) 90 bis 97 Gew.-% Aluminiumoxid enthält.

10. Feuerfest ausgekleideter Behälter nach Anspruch 6, 7 oder 8, bei dem der Düsenblock (16) über dem Gasaufnahmekanal (18) aus einer Zusammensetzung mit mindestens 75 Gew.-% Aluminiumoxid und unter dem Gasaufnahmekanal (18) aus einer Zusammensetzung mit weniger Aluminiumoxid

besteht.

11. Düsenblock (16), der in der feuerfesten Auskleidung (13, 14) des Bodens (11) eines Behälters (10) zur Aufnahme von Metallschmelze abdichtend eingesetzt werden soll, wobei der Düsenblock (16) eine Durchgangsbohrung aufweist, die mit einem durch die Auskleidung und den Boden des Behälters verlaufenden Loch fluchtet, und so geformt ist, daß sie auf dem Boden (11) liegt, ohne durch das Loch hindurchzuragen, und eine Düse (17) aufnimmt, in der mittig eine Durchgangsbohrung (15) ausgebildet ist, wobei sich die Düse (17) durch das Loch zur Außenseite des Behälters (10) erstrecken kann, dadurch gekennzeichnet, daß der Düsenblock (16) gasdurchlässig ist und einen Gasaufnahmekanal (18), der so angeordnet ist, daß er in einem Abstand um die Düse (17) herum verläuft, und ein Mittel zur Verbindung des Gasaufnahmekanals (18) mit einer Gasquelle aufweist.
12. Düsenblock nach Anspruch 11, bei dem der Gasaufnahmekanal (18) ganz um die Düse (17) herum verläuft.
13. Düsenblock nach Anspruch 11 oder 12, bei dem der Gasaufnahmekanal ein Rohr (18) mit Perforationen in seiner Oberseite enthält.
14. Düsenblock nach Anspruch 11, 12 oder 13, bei dem es sich bei dem Düsenblock (16) um einen feuerfesten Formstein handelt, in dem mittig eine Bohrung zur Aufnahme der Düse (17) ausgebildet ist.
15. Düsenblock nach Anspruch 11, 12 oder 13, bei dem der Düsenblock (16) aus feuerfestem Gußzement besteht, in dem die Düse (17) eingesetzt ist.
16. Düsenblock nach einem der Ansprüche 11 bis 15, bei dem der Düsenblock (16) über dem Gasaufnahmekanal (18) eine größere Porosität aufweist als darunter.
17. Düsenblock nach Anspruch 16, bei dem der Düsenblock (16) unter dem Gasaufnahmekanal (18) im wesentlichen nichtporös ist.
18. Düsenblock nach einem der Ansprüche 11 bis 17, bei dem die Zusammensetzung des Düsenblocks (16) mindestens 75 Gew.-% Aluminiumoxid enthält.
19. Düsenblock nach Anspruch 18, bei dem die Zusammensetzung des Düsenblocks (16) 90 bis 97 Gew.-% Aluminiumoxid enthält.
20. Düsenblock nach Anspruch 16, 17 oder 18, wobei der Düsenblock (16) über dem Gasaufnahmekanal

(18) aus einer Zusammensetzung mit mindestens 75 Gew.-% Aluminiumoxid und unter dem Gasaufnahmekanal (18) aus einer Zusammensetzung mit weniger Aluminiumoxid besteht.

Revendications

1. Cuve à revêtement réfractaire (10) pour contenir du métal fondu, la cuve ayant une sortie (15) traversant son fond (11) et comprenant une buse (17) avec un alésage traversant disposé centralement, la buse (17) étant placée de manière étanche dans un porte-buse (16), qui est lui-même placé de manière étanche dans le revêtement (13, 14) du fond (11) de la cuve (10), la sortie (15) étant ainsi définie, un canal (18) de réception de gaz s'étendant autour de la buse (17) et un moyen pour relier le canal de réception de gaz à une source de gaz, caractérisée en ce que le porte-buse (16) est formé d'une matière perméable au gaz et en ce que le canal (18) de réception de gaz est situé dans le porte-buse (16) de sorte qu'il entoure la buse (17) et en soit séparé.
2. Cuve à revêtement réfractaire selon la revendication 1, dans laquelle le canal (18) de réception de gaz s'étend complètement autour de la buse (17).
3. Cuve à revêtement réfractaire selon la revendication 1 ou 2, dans laquelle le canal (18) de réception de gaz contient un tuyau (18) dont la surface supérieure présente des perforations.
4. Cuve à revêtement réfractaire selon la revendication 1, 2 ou 3, dans laquelle le porte-buse (16) est une brique réfractaire façonnée ayant un alésage disposé centralement pour recevoir la buse (17).
5. Cuve à revêtement réfractaire selon la revendication 1, 2 ou 3, dans laquelle le porte-buse (16) est en ciment coulé réfractaire dans lequel est placée la buse (17).
6. Cuve à revêtement réfractaire selon l'une quelconque des revendications précédentes, dans laquelle le porte-buse (16) présente une porosité plus importante au-dessus du canal (18) de réception de gaz qu'en dessous de celui-ci.
7. Cuve à revêtement réfractaire selon la revendication 6, dans laquelle le porte-buse (16) est essentiellement non poreux en dessous du canal (18) de réception de gaz.
8. Cuve à revêtement réfractaire selon l'une quelconque des revendications précédentes, dans laquelle la composition du porte-buse (16) comprend au moins 75% en poids d'alumine.

9. Cuve à revêtement réfractaire selon la revendication 8, dans laquelle la composition du porte-buse (16) comprend de 90 à 97% en poids d'alumine.
10. Cuve à revêtement réfractaire selon la revendication 6, 7 ou 8, dans laquelle le porte-buse (16) comprend une composition d'au moins 75% en poids d'alumine au-dessus du canal (18) de réception de gaz, et une composition contenant moins d'alumine en dessous du canal (18) de réception de gaz.
11. Porte-buse (16) destiné à être placé de manière étanche dans le revêtement réfractaire (13, 14) du fond (11) d'une cuve (10) pour contenir du métal fondu, le porte-buse (16) ayant un alésage traversant à aligner avec un trou traversant le revêtement et le fond de la cuve, et étant façonné de manière à reposer sur le fond (11) sans faire saillie à travers le trou et à contenir une buse (17) avec un alésage traversant (15) disposé centralement, la buse (17) pouvant ainsi s'étendre à travers le trou jusqu'à l'extérieur de la cuve (10), caractérisé en ce que le porte-buse (16) est perméable au gaz et présente un canal (18) de réception de gaz situé de manière à s'étendre autour de la buse (17) et à en être séparé, et un moyen pour relier le canal (18) de réception de gaz à une source de gaz.
12. Porte-buse selon la revendication 11, dans lequel le canal (18) de réception de gaz s'étend entièrement autour de la buse (17).
13. Porte-buse selon la revendication 11 ou 12, dans lequel le canal de réception de gaz contient un tuyau (18) dont la surface supérieure présente des perforations.
14. Porte-buse selon la revendication 11, 12 ou 13, dans lequel le porte-buse (16) est une brique réfractaire façonnée ayant un alésage disposé centralement pour recevoir la buse (17).
15. Porte-buse selon la revendication 11, 12 ou 13, dans lequel le porte-buse (16) est en ciment coulé réfractaire dans lequel est placée la buse (17).
16. Porte-buse selon l'une quelconque des revendications 11 à 15, dans lequel le porte-buse (16) présente une porosité plus importante au-dessus du canal (18) de réception de gaz qu'en dessous de celui-ci.
17. Porte-buse selon la revendication 16, dans lequel le porte-buse (16) est essentiellement non poreux en dessous du canal (18) de réception de gaz.
18. Porte-buse selon l'une quelconque des revendications 11 à 17, dans lequel la composition du porte-buse (16) comprend au moins 75% en poids d'alumine.
19. Porte-buse selon la revendication 18, dans lequel la composition du porte-buse (16) comprend de 90 à 97% en poids d'alumine.
20. Porte-buse selon la revendication 16, 17 ou 18, dans lequel le porte-buse (16) comprend une composition d'au moins 75% en poids d'alumine au-dessus du canal (18) de réception de gaz, et une composition contenant moins d'alumine en dessous du canal (18) de réception de gaz.

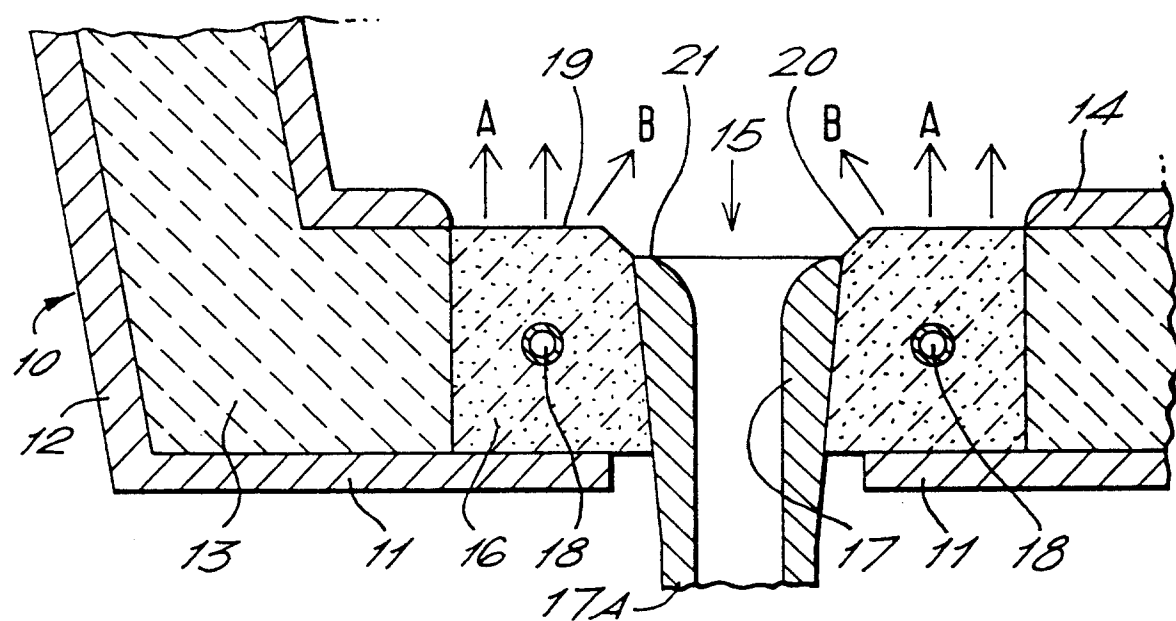


FIG. 1.