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(54) **Pouring molten metal.**

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Description

The invention relates to an insulating slab for use as a covering layer for molten metal in a molten metal handling vessel, according to the preamble of claim 1 and to a method of insulating the surface of molten metal in a handling vessel, according to the preamble of claim 14. Frequently pouring of molten metal from a ladle to another vessel, e.g. a mould is via an intermediate vessel, e.g. a tundish, particularly in the continuous casting of molten metal such as steel.

It has been the practice for many years to apply a covering layer to the molten metal in a vessel such as a tundish in order to provide insulation against excessive heat loss and also to react with the molten metal to remove unwanted inclusions, e.g. of alumina. For example, rice husks are frequently used or other, for example, basic materials formulated for the particularly desired reaction.

Such covering layers have usually been applied in powder form but there have been proposals to apply a covering layer in sheet form. In principle this can be advantageous in reducing dust levels and in containing dangerous splashing of molten metal during the pouring operation. For example, the use of two refractory heat-insulating slabs is described in British Patent Specification No. 1571333. The slabs are pivotally-mounted at an upper edge or in a wall portion of a tundish in spaced apart relationship and extending downward into the vessel. The molten metal is poured between the slabs which can, therefore, contain any splash and, as pouring continues, the slabs rise on the molten metal until they are horizontal. The slabs thereby provide a cover to reduce heat loss and to contain any powder additives.

However, such previous sheet-covering proposals have not been entirely successful commercially and it is still usual in pouring operations to use covering materials in powder form despite their attendant disadvantages. Tundishes, which may be generally rectangular in plan form, usually are frusto-conical in vertical transverse section with the walls sloping outwardly in the upwards direction. One serious disadvantage of covering the molten metal by sheet material, therefore, is that the sheet cannot cover the entire metal surface as the metal level rises and an increasing gap between sheet and tundish wall is unprotected.

Accordingly, in one aspect, the present invention provides an insulating slab for use as a covering layer for the molten metal in a molten metal handling vessel having outwardly sloping side walls, e.g. a tundish, in which the slab is floatable on the molten metal surface and comprises at least a layer of heat-insulating material which is shaped to have thickened portions extending along at least two opposite edges, which thickened portions are capable of expansion and powdering under the action of the molten metal.

In a second aspect, the invention provides a method of insulating the surface of molten metal in a handling vessel having outwardly sloping side walls, e.g. a tundish, which comprises placing a covering layer in the form of a floatable slab of heat-insulating material on the surface of the molten metal, in which the slab is shaped to have thickened portions extending along at least two opposite edges of the slab, which thickened portions of the insulating material layer extend along the two sides of the slab that correspond to the outwardly sloping walls of the handling vessel. Thus, as the level of molten metal rises in the handling vessel, the gap that would otherwise appear between slab and sidewall can be substantially filled with powdered material that has been formed by expansion and erosion of the thickened portions under the action of the hot metal.

Thus the composition of the insulating layer of the slab can be particularly formulated to expand and powder under the action of the heat of the molten metal.

For example, the insulating layer may be formed from refractory fibres, e.g. calcium silicate or aluminosilicate; refractory filler, e.g. silica, alumina, magnesia or refractory silicates; and a binder, e.g. colloidal silica sol, sodium silicate, starch, phenol-formaldehyde resin or urea-formaldehyde resin. Expandable materials e.g. expandable graphite, perlite or vermiculite may conveniently be included in order to give the desired expansion and powdering properties.

In a preferred embodiment a second layer, which can be a reactive flux layer of lesser insulating properties than the insulating layer, is attached to the underside of the insulating layer so that the slab can be chosen to optimise the insulation and reaction properties that are desired.

The second layer may be formed from any desired flux composition. Such compositions are well known and may be based on various metallic oxides, e.g. mixtures of oxides of calcium, aluminium and magnesium, with other additives, e.g. carbon and calcium fluoride.

Preferably, the thickened edge portions of the slab extend downwardly from the plane of the slab when considered in its horizontal position in a tundish.

In use, it will normally be convenient to use two or more covering slabs of the invention in a tundish. For example, if the entry point for molten metal is disposed centrally in the tundish, then two slabs may be positioned in the empty tundish, one to each side of the entry zone.

The invention is further described with reference to the accompanying drawings in which:

Figure 1 is a representation of a prior art slab;

Figure 2 is a representation of an insulating slab of the invention;

Figure 3 is a representation of a further insulating slab of the invention;

Figure 4 is a representation of a slab of the invention showing a second layer in position beneath the insulating layer;

Figure 5 is a section through a tundish showing the position of a slab before filling the tundish with steel;

Figure 6 is a section through a tundish showing a slab after filling the tundish with steel; and

Figure 7 is a section through a part of a tundish in the region of an outlet.

In Figure 1, a flat conventional slab 1 is made of fibre, filler and binder. In contact with molten steel the slab will expand and form powder, the powder and any residual slab forming a layer on top of the rising level of molten metal.

In Figure 2, slab 2 has a thickened, depending edge 3. This edge is of frusto-conical or wedge shape. It too will expand and form powder under the action of contact with molten steel.

Figure 3 shows a slab 4 having a thickened depending edge 5 of different, parallelopiped shape.

Figure 4 shows the insulating slab 2 of Figure 2 with a reactive flux layer 6 attached to its underside.

In Figure 5, a tundish 7 has upwardly and outwardly sloping sidewalls 8 and 9 and a base 10. A slab 11 of the invention is placed in the tundish when empty and rests with its depending thickened edges 13 and 14 contacting the side walls 8 and 9 near to base 10.

Molten steel is then introduced into the tundish. It enters underneath slab 11, which then rises floating on the molten metal surface. The filled tundish is shown in Figure 6. The hot metal causes expansion and powdering of the slab. The edges 13 and 14 have powdered to cover the gaps 15 and 16 that would otherwise have been left uncovered between the sidewalls and the slab. The underside layer 17 of the slab has also started to react with the metal and, as shown, has to a degree insulated the upper layer 18 of the slab from the metal so that the slab has still retained some of its integrity.

In Figure 7, tundish 19 has an outlet 20, closable by a stopper rod 21. A slab 22 of the invention has a thickened edge 23 and an aperture 24 to accommodate the stopper rod. The aperture 24 is also surrounded by a depending thickened portion 25 of the slab.

Claims

1. An insulating slab for use as a covering layer for the molten metal in a molten metal handling vessel having outwardly sloping side walls, e.g. a tundish, the slab being floatable on the molten metal surface and comprising at least a layer of heat-insulating material, characterised in that the slab (2, 4) is shaped to have a thickened portion (3, 5) extending along at least two opposite edges of the slab, which thickened portion is capable of expansion and powdering under the action of the molten metal.

2. An insulating slab according to Claim 1, in which the slab is for use in a tundish (7) of frusto-conical section with opposite walls (8, 9) sloping outwardly as they rise from the base (10) of the tundish, characterised in that the thickened edge portions (13, 14) of the slab (11) correspond to and so can be positioned to extend substantially parallel to the sloping walls (8, 9) of the tundish (10).

3. An insulating slab according to Claim 1 or 2, characterised in that the insulating layer is formed from refractory fibres, refractory filler and a binder.

4. An insulating slab according to Claim 3, characterised in that the refractory fibre is of calcium silicate or aluminosilicate.

5. An insulating slab according to Claim 4, characterised in that the refractory filler is of silica, alumina, magnesia or refractory silicate.

6. An insulating slab according to Claim 3, 4 or 5, characterised in that the binder is colloidal silica sol, sodium silicate, starch, phenol-formaldehyde resin or urea-formaldehyde resin.

7. An insulating slab according to any one of Claims 3 to 6, characterised in that the insulating layer contains as heat-expandable material, expandable graphite, perlite or vermiculite.

8. An insulating slab according to any one of the preceding claims, characterised in that the underside of the insulating layer (2) of the slab has attached to it a reactive flux layer (6) of lesser insulating properties than the insulating layer (2).

9. An insulating slab according to Claim 8, characterised in that the reactive flux layer is formed of one or more metallic oxides with carbon or calcium fluoride.

10. An insulating slab according to any one of the preceding claims, characterised in that the thickened edge portion (3, 5) is of frusto-conical or parallelopiped shape.

11. An insulating slab according to any one of the preceding claims, characterised in that the thickened edge portions (3, 5) extend downwardly

from the plane of the slab when it is positioned horizontally in the molten metal handling vessel.

12. An insulating slab according to any one of the preceding claims, characterised in that there is an aperture (24) through the slab (22) to accommodate, e.g. a stopper rod (21).

13. An insulating slab according to Claim 12, characterised in that the aperture (24) is surrounded by a depending thickened portion (25) of the slab (22).

14. A method of insulating the surface of molten metal in a handling vessel having outwardly sloping side walls, e.g. a tundish, which comprises placing a covering layer in the form of a floatable slab of heat-insulating material on the surface of the molten metal, characterised in that the slab (11) is shaped to have thickened portions (13, 14) extending along at least two opposite edges of the slab and the slab (11) is placed in the vessel (7) with its thickened portions (13, 14) adjacent sloping walls (8, 9), molten metal is poured into the vessel, the slab (11) rises on the surface of the metal and the slab turns to powder under the action of the heat of the metal, the powder formed from thickened edges (13, 14) covering the gaps (16, 17) forming between the rising slab (11) and the sloping walls (8, 9).

Patentansprüche

1. Dämmplatte zur Verwendung als Deckschicht für die Metallschmelze in einem Metallschmelzenbehandlungsgefäß mit nach außen geneigten Seitenwänden, z.B. einem Zwischenbehälter, wobei die Platte auf der Metallschmelzen- oberfläche schwimmfähig ist und mindestens eine Wärmedämmstoffschicht umfaßt, dadurch gekennzeichnet, daß die Platte (2, 4) so geformt ist, daß sie einen verdickten Abschnitt (3, 5) aufweist, der sich entlang mindestens zweier gegenüberliegender Kanten der Platte erstreckt und der unter Wirkung der Metallschmelze expandierfähig ist und zu Pulver zerfallen kann.

2. Dämmplatte nach Anspruch 1, wobei die Platte zur Verwendung in einem Zwischenbehälter (7) mit kegelstumpf- förmigem Querschnitt und sich vom Boden (10) des Zwischenbehälters nach oben erstreckenden, nach außen geneigten gegenüberliegenden Wänden (8, 9) vorgesehen ist, dadurch gekennzeichnet, daß die verdickten Kanten- abschnitte (13, 14) der Platte (11) den geneigten Wänden (8, 9) des Zwischenbehälters (10) entsprechen und daher so positioniert werden können, daß sie sich im wesentlichen parallel zu diesen erstrecken.

3. Dämmplatte nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Dämmschicht aus feuerfesten Fasern, feuerfestem Füllstoff und einem Bindemittel gebildet ist.

4. Dämmplatte nach Anspruch 3, dadurch gekennzeichnet, daß die feuerfeste Faser aus Calciumsilicat oder Aluminiumsilicat besteht.

5. Dämmplatte nach Anspruch 4, dadurch gekennzeichnet, daß der feuerfeste Füllstoff aus Siliciumdioxid, Aluminiumoxid, Magnesiumoxid oder feuerfestem Silicat besteht.

6. Dämmplatte nach Anspruch 3, 4 oder 5, dadurch gekennzeichnet, daß es sich bei dem Bindemittel um Kolloidkieselsol, Natriumsilicat, Stärke, Phenolformaldehyd oder Harnstoff-Formaldehyd-Harz handelt.

7. Dämmplatte nach einem der Ansprüche 3 bis 6, dadurch gekennzeichnet, daß die Dämmschicht als in der Wärme expandierbares Material expandierbares Graphit, Perlit oder Vermiculit enthält.

8. Dämmplatte nach einem der vorhergehenden Ansprü- che, dadurch gekennzeichnet, daß an der Unterseite der Dämmschicht (2) der Platte eine Schicht (6) aus reaktionsfähigem Flußmittel mit geringeren Dämmeigenschaften als die Dämmschicht (2) befestigt ist.

9. Dämmplatte nach Anspruch 8, dadurch gekennzeich- net, daß die Schicht aus reaktionsfähigem Flußmittel aus einem oder mehreren Metalloxiden mit Kohlenstoff oder Calciumfluorid gebildet ist.

10. Dämmplatte nach einem der vorhergehenden Ansprü- che, dadurch gekennzeichnet, daß der verdickte Kanten- abschnitt (3, 5) eine kegelstumpfförmige Form oder die Form eines Parallelepipedons aufweist.

11. Dämmplatte nach einem der vorhergehenden Ansprü- che, dadurch gekennzeichnet, daß sich die verdickten Kantenabschnitte (3, 5) von der Ebene der Platte aus nach unten erstrecken, wenn letztere horizontal im Metallschmelzenbehandlungsgefäß positioniert wird.

12. Dämmplatte nach einem der vorhergehenden Ansprü- che, dadurch gekennzeichnet, daß sich in der Platte (22) eine Öffnung (24) zur Aufnahme z.B. einer Stopfenstange (21) befindet.

13. Dämmplatte nach Anspruch 12, dadurch gekennzeichnet, daß die Öffnung (24) von einem nach unten gehenden verdickten Abschnitt (25) der Platte (22) umgeben ist.

14. Verfahren zur Wärmedämmung der Metallschmelzen- oberfläche in einem Behandlungsgefäß mit nach außen geneigten Seitenwänden, z.B. einem Zwischenbehälter, das das Anbringen einer Deckschicht in Form einer schwimmfähigen Platte aus Wärmedämmstoff auf der Oberfläche der Metallschmelze umfaßt, dadurch gekennzeichnet, daß die Platte (11) so geformt ist, daß sie verdickte Abschnitte (13, 14) aufweist, die sich entlang mindestens zweier gegenüberliegender Kanten der Platte erstrecken, und die Platte (11) so in dem Gefäß (7) angebracht wird, daß ihre verdickten Abschnitte (13, 14) an den geneigten Wänden (8, 9) angrenzen, Metallschmelze in das Gefäß gegossen wird, die Platte (11) auf der Metalloberfläche steigt und die Platte unter der Wirkung der Metallwärme zu Pulver zerfällt, wobei das aus den verdickten Kanten (13, 14) gebildete Pulver die sich zwischen der steigenden Platte (11) und den geneigten Wänden (8, 9) bildenden Lücken (16, 17) bedeckt.

Revendications

1. Plaque calorifuge pour l'emploi en tant que couche de recouvrement du métal en fusion dans une cuve de traitement de métal en fusion, ayant des parois latérales inclinées vers l'extérieur, par exemple un panier de coulée, la plaque pouvant flotter à la surface du métal en fusion et comprenant au moins une couche de matière calorifuge, caractérisée en ce que la plaque (2, 4) est formée de manière à avoir une portion plus épaisse (3, 5) s'étendant le long d'au moins deux bords en regard de la plaque, laquelle portion plus épaisse peut se dilater et se réduire en poudre sous l'effet du métal en fusion.

2. Plaque calorifuge selon la revendication 1, dans laquelle la plaque est destinée à l'emploi dans un panier de coulée (7) de section tronconique ayant des parois en regard (8, 9) inclinées vers l'extérieur depuis leur connexion à la base (10) du panier de coulée, caractérisée en ce que les portions de bord plus épaisses (13, 14) de la plaque (11) correspondent aux parois inclinées (8, 9) du panier de coulée (10) et peuvent donc être positionnées de manière à s'étendre substantiellement parallèlement à celles-ci.

3. Plaque calorifuge selon la revendication 1 ou 2, caractérisée en ce que la couche calorifuge est constituée de fibres réfractaires, de charge réfractaire, et d'un liant.

4. Plaque calorifuge selon la revendication 3, caractérisée en ce que la fibre réfractaire est en silicate de calcium ou en aluminosilicate.

5. Plaque calorifuge selon la revendication 4, caractérisée en ce que la charge réfractaire est en silice, alumine, magnésie ou en silicate réfractaire.

6. Plaque calorifuge selon la revendication 3, 4 ou 5, caractérisée en ce que le liant est un sol de silice colloïdale, du silicate de sodium, de l'amidon, de la résine phénolformaldéhyde ou de la résine uréeformaldéhyde.

7. Plaque calorifuge selon l'une quelconque des revendications 3 à 6, caractérisée en ce que la couche calorifuge contient, comme matériau expansible thermiquement, de la perlite, de la vermiculite ou du graphite dilatable.

8. Plaque calorifuge selon l'une quelconque des revendications précédentes, caractérisée en ce qu'une couche de fondant réactif (6) de moindres propriétés calorifuges que la couche calorifuge (2) est attachée à la face inférieure de la couche calorifuge (2) de la plaque.

9. Plaque calorifuge selon la revendication 8, caractérisée en ce que la couche de fondant réactif est constituée d'un ou plusieurs oxydes métalliques avec du carbone ou du fluorure de calcium.

10. Plaque calorifuge selon l'une quelconque des revendications précédentes, caractérisée en ce que la portion de bord plus épaisse (3, 5) a une forme tronconique ou parallélépipédique.

11. Plaque calorifuge selon l'une quelconque des revendications précédentes, caractérisée en ce que les portions de bord plus épaisses (3, 5) s'étendent vers le bas depuis le plan de la plaque lorsqu'elle est positionnée horizontalement dans la cuve de traitement de métal en fusion.

12. Plaque calorifuge selon l'une quelconque des revendications précédentes, caractérisée en ce qu'il est prévu une ouverture (24) dans la plaque (22) pour recevoir par exemple une quenouille (21).

13. Plaque calorifuge selon la revendication 12, caractérisée en ce que l'ouverture (24) est entourée d'une portion plus épaisse (25) dépendant de la plaque (22).

14. Procédé de calorifugeage de la surface de métal en fusion d'une cuve de traitement ayant des parois latérales inclinées vers l'extérieur, par exemple un panier de coulée, qui comprend la mise en place d'une couche de recouvrement sans la forme d'une plaque de matière calorifuge pouvant flotter à la surface du métal en fusion, caractérisé en ce que la plaque (11) a une forme prévue pour avoir des portions plus épaisses (13, 14) s'étendant le long d'au moins deux bords en regard de la plaque et la plaque (11) est placée dans la cuve (7) avec ses portions plus épaisses (13, 14) adjacentes aux parois inclinées (8, 9), du métal en fusion est versé dans la cuve, la plaque (11) monte à la surface du métal et la plaque se réduit en poudre sous l'effet de la chaleur du métal, la poudre formée à partir des bords plus épais (13, 14) recouvrant les espaces (16, 17) se formant entre la plaque montante (11) et les parois inclinées (8, 9).

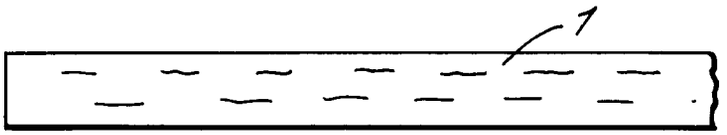

FIG.1.

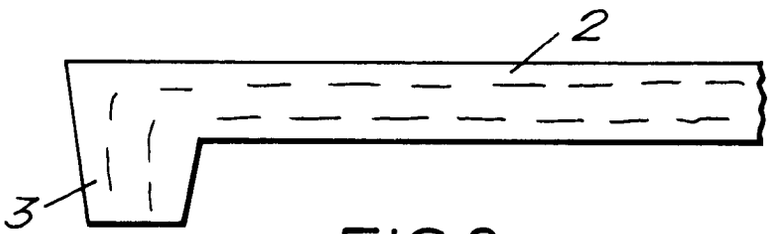

FIG.2.

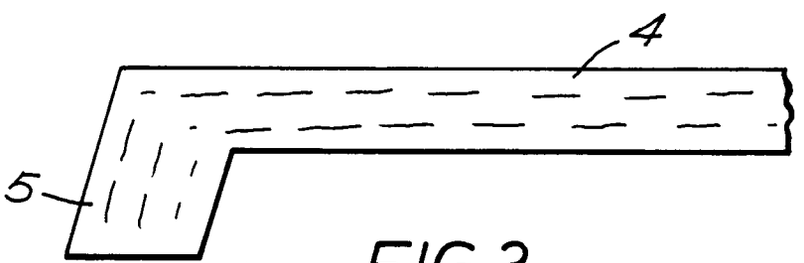

FIG.3.

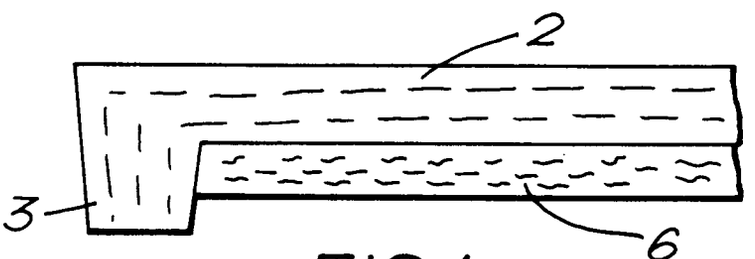

FIG.4.

FIG.5.

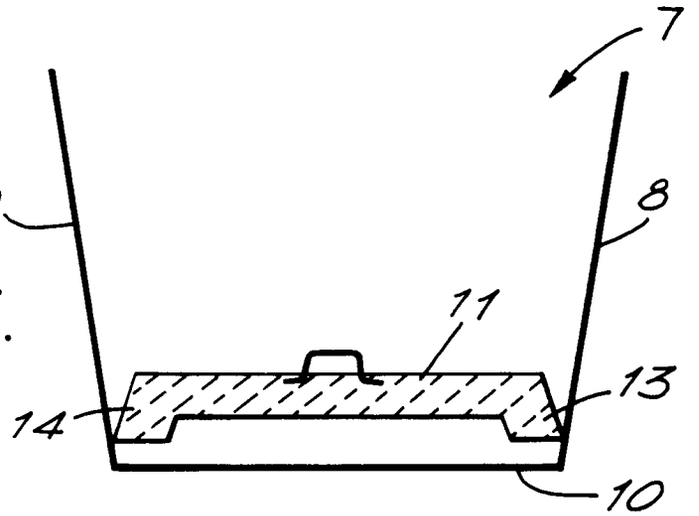

FIG.6.

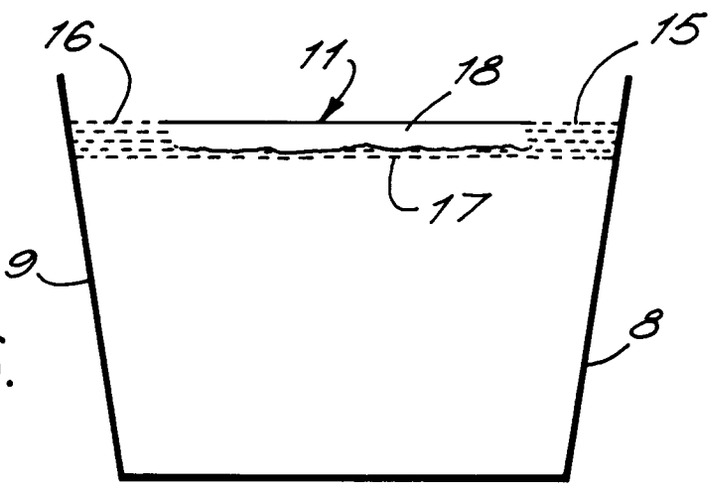

FIG.7.