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(54) **Containers for molten metal.**

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(73) Proprietor: **FOSECO INTERNATIONAL LIMITED**
285 Long Acre
Nechells Birmingham B7 5JR (GB)

(72) Inventor: **Barnes, Andrew**
6 Castle Hall Glascote
Tamworth Staffordshire (GB)
Inventor: **Flood, James**
4 Lomax Close
Lichfield Staffordshire (GB)

(74) Representative: **Moore, John Hamilton**
Foseco Holding International Limited Group
Patents Department 285 Long Acre Nechells
Birmingham B7 5JR (GB)

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Description

The invention concerns the lining of containers for molten metal.

Containers for molten metal commonly comprise a metal casing lined with refractory brickwork or a monolithic refractory lining and this lining is often termed the permanent lining. The permanent lining is subject to damage and is expensive and time-consuming to repair or replace. In particular, after use, a residue (skull) of solidified molten metal and slag may adhere to the lining, and require removal before re-use of the container, and may be difficult to remove and its removal may damage the lining.

In view of the above problems, it has been proposed to protect the permanent lining by an inner layer or layers, which may also serve other purposes. GB—A—1477632 discloses application of two layers over the permanent lining. The first layer is a parting layer comprising particulate carbonaceous material, e.g. coke dust and is free or substantially free of permanent binding agent. The first layer may be applied as a liquid or paste composition by, for example, spraying or trowelling. The second, i.e. inner, layer is of bonded particulate refractory material and may be applied by, for example, trowelling on a coating composition. The combination of the two layers protects the permanent lining and in particular enables clean stripping of skull, e.g from a tundish without damage to the permanent lining. The layers are re-applied before each re-use of the container.

It is one object of the invention to provide a way of protecting the permanent lining when the second layer comprises a set of refractory heat insulating slabs. The invention is based on the realisation that in such a case a thin flexible sheet of heat carbonisable material can serve as the parting layer.

According to one aspect of the invention there is provided a container for molten metal, the container having a permanent lining on which there is a parting layer of heat carbonisable material and a second layer of refractory heat insulating material to be contacted by the molten metal characterised in that the parting layer comprises one or more sheets of heat carbonisable material, each from 0.1 mm to 2 mm thick, the sheet or sheets being held to the adjacent permanent lining irrespective of any irregularities on the surface thereof and in that the second layer comprises a set of refractory heat insulating slabs.

In another aspect, the invention provides a method of treating a container for molten metal, the container having a permanent refractory lining, so that after the metal has been received and removed from the container the container may be lined for re-use, the method comprising applying a parting layer of heat carbonisable material followed by a layer of bonded particulate refractory material characterised in that

(i) the parting layer comprises one or more sheets each from 0.1 mm to 2 mm thick which are held to the permanent lining irrespective of any irregularity in the surface thereof, and

(ii) the second layer comprises a set of refractory heat insulating slabs which define an inner lining to contact the molten metal.

When the container contains molten metal, sufficient heat is conducted from the metal through the inner lining to the sheet material to carbonise the latter to yield a carbonaceous residue. Alternatively, the inner lining may be pre-heated before molten metal is introduced into the container and pre-heating may suffice to carbonise the sheet material to yield a carbonaceous residue. The carbonaceous residue provides a valuable parting layer facilitating removal of skull and the inner lining and without damage to the permanent lining.

The heat-carbonisable sheet material may be, for example, newsprint, kraft paper, cardboard (e.g. laminated corrugated cardboard), wall paper, hessian, straw matting or woven polyethylene or polypropylene.

The heat-carbonisable sheet material is flexible and this is of value in positioning it as desired, especially if the permanent lining has irregularities at its surface e.g. cavities or areas of adhering extraneous matter. Moreover suitable sheet materials are available as large pieces and can easily be cut to size. Accordingly, the layer of heat-carbonisable sheet material can be provided quickly and easily. To hold the sheet material against the permanent lining before the inner lining is applied, clips or an adhesive can be used if desired, for example at places where the permanent lining is generally upright and if the sheet material is very flexible e.g. newsprint rather than less flexible e.g. cardboard. In the case of newsprint even water will provide sufficient adhesion and in general a variety of widely available inexpensive adhesives e.g. starch-based ones are suitable.

If the sheet material used is thin e.g. newsprint it may be desirable to use a number of pieces of it superimposed to form the layer whereas with thicker sheet materials e.g. cardboard a single thickness may suffice.

In containers for molten metal having an inner lining and a permanent lining, the tendency for the inner lining (with adhering skull) to become fused to the permanent lining may only be significant at certain parts of the container. For example, in the case of tundishes the above tendency for fusion to occur is most marked at the floor of the tundish and at the slag line i.e. the usual level of slag on the top surface of the molten metal in the tundish. Accordingly, in a container according to the invention the heat-carbonisable sheet material may be provided only at those places where there is a significant risk of the inner lining becoming fused to the permanent lining.

The inner lining keeps the carbonaceous residue in place to serve its eventual function as a parting layer. The inner lining and the car-

bonaceous residue also protect the permanent lining from attack by molten metal and slag in the container.

The inner lining may be provided by a set of slabs of refractory heat-insulating material as described in relation to tundishes in U.K. patent specification 1364665. In accordance with the invention it is however sometimes preferred that the inner lining should be of a unitary construction, preferably formed *in situ*. The inner lining may be formed by applying a refractory, coating composition and this may be done, for example, by trowelling but it is preferred to apply the composition by spraying.

Coating compositions for forming the inner lining are preferably based on one or more particulate refractory materials and an inorganic binding agent. Examples of suitable particulate refractory materials include silica, chamotte, olivine, sillimanite, zircon, magnesia, alumina and zirconia. Examples of suitable inorganic binding agents include silicates, phosphates and aluminates of alkali or alkaline earth metals, colloidal oxide hydrosols and clays. In order to enhance the initial strength or cohesion of the applied coating composition a proportion preferably 0.5 to 5% by weight, of fibre may be included in the composition. The fibres may also serve to enhance the heat-insulation provided by the composition. It is usually preferred that the inner lining should be heat-insulating. The fibre content may be organic and/or inorganic and an example of organic fibre is chopped straw whilst an example of an inorganic fibre is glass fibre. Organic binder may also be present in the composition.

The thickness of the inner lining is preferably from 10 to 50 mm.

If the inner lining is provided by use of a coating composition containing a significant proportion of moisture or a binder that requires heating to harden, the composition after application can be heated to drive off moisture or harden the binder.

If the inner lining is provided by pre-formed articles, e.g. slabs, when the container is in use or during any pre-heating, certain consitituents of the lining e.g. soda may tend to migrate to the back of the lining under the influence of the heat and, in the absence of the parting layer cause the inner lining to adhere to the premanent lining. Likewise, in the case of an inner lining provided by a coating composition any water-soluble binder e.g. sodium silicate in the composition may tend to migrate to the back of the lining during use or any pre-heating. In such cases the parting layer present in accordance with the invention is particulary valuable.

The invention is of particular value where the container is a tundish but it is also of use in the case of other containers for molten metal, e.g. ladles. The invention is particularly useful in the case of containers for molten ferrous metals e.g. steel.

The method of lining the container forms a part of the invention.

An example of a container according to the invention is a tundish (for use in the continuous casting of steel) having an outer, metal shell, a monolithic permanent lining of cast refractory material adjacent the shell, a parting layer overlying the permanent lining and provided by laminated corrugated cardboard (thickness about 1.5 mm) on the floor of the tundish and a number of layers (total thickness about 0.2 mm) of newsprint on the walls of the tundish, and, overlying the parting layer, a layer applied by spraying a composition of particulate refractory material and inorganic binder.

Claims

1. A container for molten metal, the container having a permanent lining on which there is a parting layer of heat carbonisable material and a second layer of refractory heat insulating material to be contacted by the molten metal characterised in that the parting layer comprises one or more sheets of heat carbonisable material, each from 0.1 mm to 2 mm thick, the sheet or sheets being held to the adjacent permanent lining irrespective of any irregularities on the surface thereof and in that the second layer comprises a set of refractory heat insulating slabs.

2. A container according to Claim 1 characterised in that the sheet or sheets is/are held to the permanent lining by clips or adhesive.

3. A container according to Claim 1 or 2 characterised in that the sheet or sheets is/are formed of newsprint, Kraft paper, cardboard, wallpaper, hessian, straw matting, woven polyethylene or polypropylene.

4. A method of treating a container for molten metal, the container having a permanent refractory lining, so that after the metal has been received and removed from the container the container may be lined for reuse, the method comprising applying a parting layer of heat carbonisable material followed by a layer of bonded particulate refractory material characterised in that

(i) the parting layer comprises one or more sheets each from 0.1 mm to 2 mm thick which are held to the permanent lining irrespective of any irregularity in the surface thereof, and

(ii) the second layer comprises a set of refractory heat insulating slabs which define an inner lining to contact the molten metal.

5. A method according to Claim 4 characterised in that the sheet or sheets is/are held to the permanent lining by clips or adhesive.

Patentansprüche

1. Behälter für schmelzflüssiges Metall, wobei dieser ein dauerhaftes Futter mit einer darüberliegenden Trennschicht aus durch Hitze verkohlbarem Material und eine zweite Schicht aus mit dem schmelzflüssigem Metall in Berührung zu kommendem, feuerfesten Wärmeisolationsmaterial aufweist, dadurch gekennzeichnet, daß die Trenn-

schicht aus einer oder mehreren, je 0,1 mm bis 2 mm dicken Lagen aus durch Hitze verkohlbarem Material besteht, wobei die Lage bzw. Lagen an dem benachbarten dauerhaften Futter angeachtet irgendwelcher Unebenheiten auf dessen Oberfläche gehalten werden, und daß die zweite Lage aus einem Satz feuerfester Wärmeisolationsplatten besteht.

2. Behälter nach Anspruch 1, dadurch gekennzeichnet, daß die Lage bzw. Lagen an dem dauerhaften Futter durch Klammern oder Klebemittel gehalten ist bzw. sind.

3. Behälter nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Lage bzw. Lagen aus Zeitungspapier, Kraftpapier, Pappe, Tapete, Sackleinwand, Strohmatten, Polyäthylen- oder Polypropylengewebe bestehen.

4. Verfahren zur Behandlung eines Behälters für schmelzflüssiges Metall, wobei dieser ein dauerhaftes feuerfestes Futter aufweist, so daß nach Aufnahme des Metalls und dessen Entnahme aus dem Behälter dieser zur Wiederverwendung gefüttert werden kann, wobei man eine Trennschicht aus durch Hitze verkohlbarem Material und danach eine Schicht aus gebundenem teilchenförmigen feuerfesten Material aufbringt, dadurch gekennzeichnet, daß

(i) die Trennschicht aus einer oder mehreren, je 0,1 mm bis 2 mm dicken Lagen besteht, die an dem dauerhaften Futter ungeachtet irgendwelcher Unebenheiten auf dessen Oberfläche gehalten werden, und

(ii) die zweite Lage aus einem Satz feuerfester Wärmeisolationsplatten besteht, welche ein inneres Futter zur Berührung mit dem schmelzflüssigen Metall darstellen.

5. Verfahren nach Anspruch 4, dadurch gekennzeichnet, daß die Lage bzw. Lagen an dem dauerhaften Futter durch Klammern oder Klebemittel gehalten ist bzw. sind.

Revendications

1. Récipient pour métal fondu, le récipient ayant un garnissage permanent sur lequel il y a une couche de séparation en matériau carbonisable à chaud et une seconde couche en matériau réfractaire thermo-isolant destiné à entrer en contact avec le métal fondu, caractérisé en ce que la couche de séparation comprend une ou plusieurs feuilles de matériau carbonisable à chaud, chacune ayant une épaisseur de 0,1 mm à 2 mm, la feuille ou les feuilles étant maintenue(s) contre le garnissage permanent adjacent quelles que soient les irrégularités de la surface de celui-ci et en ce que la seconde couche comprend un ensemble de plaques réfractaires thermo-isolantes.

2. Récipient suivant la revendication 1, caractérisé en ce que la feuille ou les feuilles est/sont maintenue(s) contre le garnissage permanent au moyen de pinces ou de colle.

3. Récipient suivant la revendication 1 ou 2, caractérisé en ce que la feuille ou les feuilles est/sont constituée(s) de papier journal, de papier kraft, de carton, de papier peint, de toile d'emballage, d'une natte de paille, d'un tissue de polyéthylène ou de polypropylène.

4. Procédé de traitement d'un récipient pour métal fondu, le récipient ayant un garnissage réfractaire permament, de telle façon qu'après que le métal ait été reçu et évacué du récipient, le récipient puisse être pourvu d'un nouveau garnissage en vue de sa réutilisation, le procédé comprenant l'application d'une couche de séparation en matériau carbonisable à chaud suivie d'une couche de matériau réfractaire particulaire lié, caractérisé en ce que

(i) la couche de séparation comprend une ou plusieurs feuilles ayant chacune une épaisseur de 0,1 mm à 2 mm, qui sont maintenues contre le garnissage permanent quelles que soient les irrégularités de la surface de celui-ci, en en ce que

(ii) la seconde couche comprend un ensemble de plaques réfractaires thermo-isolantes, qui constituent un garnissage intérieur destiné à entrer en contact avec le métal fondu.

5. Procédé suivant la revendication 4, caractérisé en ce que la feuille ou les feuilles est/sont maintenue(s) contre la garnissage permanent au moyen de pinces ou de colle.