

AUSTRALIA

PATENTS ACT 1990

658013

PATENT REQUEST : STANDARD PATENT

I/We being the person(s) identified below as the Applicant(s), request the grant of a patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying standard complete specification.

Full application details follow:

[71/70] Applicant(s)/Nominated Person(s):

Sollac AND Le Laboratoire Metallurgique

of

Immeuble Elysees-la-Defense, 29, Le Parvis, 92800 Puteaux, France
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respectively

[54] Invention Title:

Method for lining a continuous casting distributor with a refractory material, distributor and refractory material resulting from said method

[72] Name(s) of actual inventor(s):

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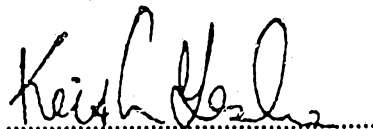
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Basic Convention Application(s) Details:

[31] Application Number	[33] Country	Code	[32] Date of Application
91 13 721	France	FR	4 November 1991

DATED this TWENTY FIRST day of OCTOBER 1992



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a member of the firm of
DAVIES COLLISON CAVE for
and on behalf of the
applicant(s)

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NOTICE OF ENTITLEMENT

We, **Sollac** AND **Le Laboratoire Metallurgique**, the applicants/Nominated Persons in respect of Application No. 27189/92 state the following:-

The Nominated Persons are entitled to the grant of the patent because the Nominated Persons would, on the grant of a patent for the invention to the inventors, be entitled to have the patent assigned to the Nominated Persons.

The Nominated Persons are entitled to claim priority from the basic application listed on the patent request because the Nominated Persons made the basic application, and because that application was the first application made in a Convention country in respect of the invention.

DATED this TWENTY FIFTH day of NOVEMBER 1992



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a member of the firm of
DAVIES COLLISON
CAVE for and on behalf
of the applicant(s)

(DCC ref: 1542061)



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(12) PATENT ABRIDGMENT (11) Document No. AU-B-27189/92
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 658013

(54) Title
METHOD FOR LINING A CONTINUOUS CASTING DISTRIBUTOR WITH A REFRACTORY MATERIAL,
DISTRIBUTOR AND REFRACTORY MATERIAL RESULTING FROM SAID METHOD

International Patent Classification(s)
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(56) Prior Art Documents
US 4789652
US 4760039
US 4681863

(57) Claim

1. Method for lining a distributor for the continuous casting of metals, in particular steel, comprising preparing the material constituting the wear-resistant refractory lining of said distributor with raw natural dolomite, or raw natural calcite, or a mixture of said two materials, which are chosen with a particle size of between 0 and 5 mm, incorporating in said raw material a binder in proportions of 0.4 to 5% by weight and a mineral or organic plasticizer in proportions of 0.2 to 3% by weight, and, after the lining has been placed on the distributor in the aqueous form, proceeding to the decarbonation of said lining in the course of its drying and baking, characterized in that the method further comprises incorporating in said lining material at least one compound having the property of shrinking at temperatures below ~~about~~ 700°C.

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6. Distributor for the continuous casting of metals, in particular steel, provided with a wear-resistant refractory lining which was placed in position in the aqueous form and has a composition comprising decarbonated raw natural dolomite or decarbonated raw natural calcite, or a mixture thereof, the particle size of which is between 0 and 5 mm, a binder which was present before the lining was put into the aqueous form in a proportion of 0.4 to 5% by weight, and a plasticizer which was present before the lining was put into the aqueous form in a proportion of 0.2 to 3% by weight, characterized in that said lining further comprised before it was put into the aqueous form a compound at least having the property of shrinking at temperatures below ~~about~~ 700°C.

8. Wear-resistant refractory lining for a distributor for the continuous casting of metals, in particular steel, initially comprising raw natural dolomite decarbonated in situ, or raw natural calcite decarbonated in situ, or a mixture of said two materials, the particle size of which is between 0 and 5 mm, and initially comprising a binder in an initial proportion of 0.4 to 5% by weight and a mineral or organic plasticizer in an initial proportion of 0.2 to 3% by weight, characterized in that said lining initially further comprises at least one compound having the property of shrinking at temperatures below ~~about~~ 700°C.

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COMPLETE SPECIFICATION

NAME OF APPLICANT(S):

Sollac AND Le Laboratoire Metallurgique

ADDRESS FOR SERVICE:

DAVIES COLLISON CAVE
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1 Little Collins Street, Melbourne, 3000.

INVENTION TITLE:

Method for lining a continuous casting distributor with a refractory material,
distributor and refractory material resulting from said method

The following statement is a full description of this invention, including the best method
of performing it known to me/us:-

5 The present invention relates to the field of the continuous casting of metals, in particular steel. It concerns more particularly distributors or tundishes, and more especially their wear-resistant refractory lining intended to be in direct contact with the liquid metal during the casting.

10 The wear-resistant refractory lining of a continuous steel-casting distributor is at the present time applied in the aqueous form on a permanent undercoat, most generally of dense refractory concrete, by various techniques such as spraying, trowelling, pouring/vibration or tamping. This lining is then dried before use of the distributor.

15 Magnesia is the material most commonly employed for this purpose, in particular owing to its low reactivity with respect to highly deoxidizing elements, such as aluminium or calcium, contained in the liquid steel. However, the
20 magnesian linings usually employed always have a non-negligible content of silica (5 to 15%). Now, the reduction of the silica by highly deoxidizing elements results in the formation of non-metallic inclusions which pollute the metal. Consequently, the part of the lining which is in
25 contact with the liquid metal must have a silica content which is as low as possible when a highly clean condition as concerns inclusions is required of the cast product. The

use of magnesia of higher purity is possible, but this substantially increases the cost of the lining.

Another drawback of magnesia is its high apparent volumic mass which has an unfavourable action on the thermal insulation properties of the lining. Even in cases where
5 the lining is lightened by incorporation of various fibres, its volumic mass remains of the order of 1600 to 1800 kg/m³.

The applicant proposed in the document WO 90/09970 using a refractory lining based on raw natural dolomite
10 MgCO₃-CaCO₃, or raw natural calcite CaCO₃, or a mixture of these two compounds. The lining is first of all applied in the aqueous form against the permanent refractory undercoat by one of the aforementioned conventional techniques. Then it is heated to a temperature which must reach between 800 and
15 950°C within the lining so as to dry the lining and above all achieve its decarbonation in situ. This provides a lining based on CaO or CaO-MgO having a density lower than 1500 kg/m³, which imparts thereto very satisfactory insulating properties. Further, owing to the low contents
20 of silica, alumina and iron oxides of the raw dolomite and raw calcite, this lining exhibits a high chemical inertia with respect to the liquid steel.

The particle size of the raw dolomite and raw calcite is between 0 and 5 mm. They are mixed with a binder and a
25 mineral or organic plasticizer in the respective proportions of 0.5 to 5% and 0.2 to 3% by weight.

This lining method is fully satisfactory for small

distributors. However, when it is applied to distributors having a capacity of several tens of tons of liquid metal, such as those employed on recent large continuous casting machines, it has been observed that, when heated, this lining comes away from the surface on which it has been applied, owing to its expansion. This separation of the lining renders it useless.

An object of the invention is avoid this separation and thereby render possible the use of a lining of decarbonated raw dolomite or calcite even on large distributors.

The invention therefore provides a method for lining a distributor for the continuous casting of metals, in particular steel, which comprises preparing the constituent material of the wear-resistant refractory lining of said distributor with raw natural dolomite, or raw natural calcite, or a mixture of these two materials, which are chosen with a particle size of between 0 and 5 mm, incorporating in said raw material a binder in proportions of 0.4 to 5% by weight and a mineral or organic plasticizer in proportions of 0.2 to 3% by weight, and, after the lining has been placed on the distributor in the aqueous form, proceeding to the decarbonation of said lining in the course of its drying and baking, characterized in that the method further comprises incorporating in said lining material at least one compound having the property of shrinking at temperatures below about 700°C.

In one embodiment, this compound having the shrinkage

property is a hydroxide of an alkaline earth metal or a mixture of such hydroxides incorporated in the material of said lining in the proportion of 5 to 20% by weight.

The invention also provides a distributor lining
5 resulting from the application of this method, and a distributor lined with said lining.

As will have been understood, the invention comprises incorporating in the lining a compound which will produce, in the course of the drying-decarbonation stage, a shrinkage adapted to compensate, by anticipation, for the expansion
10 which is usually the cause of the separation of the lining.

A better understanding of the invention will be had from the following description.

As already explained, after the lining based on raw dolomite or raw calcite has been applied, a heating stage
15 follows. The purpose of this stage is to dry the lining which, it will be recalled, was applied in the aqueous form, and above all to cause the decarbonation of the dolomite and/or calcite. Thus the CaCO_3 is converted into CaO and
20 the MgCO_3 is converted into MgO . The hollows created in this way in the lining result in a final density which is lower than 1500 kg/m^3 , and preferably between 1100 and 1400 kg/m^3 , as compared to the 2800 kg/m^3 of raw natural dolomite, and the $1600 - 1800 \text{ kg/m}^3$ of the usual magnesian
25 linings. The minimum temperature to be reached within the lining for a total decarbonation is 950°C , which implies reaching a surface temperature of over 1200°C . Such a

heating results in a marked expansion which is the cause of stresses within the lining. These stresses are more particularly concentrated in the median zone of the walls of the distributor and they may result in a separation of the lining in the case of distributors whose large walls reach several metres in length.

According to the invention, a solution to this problem consists in incorporating in the lining a compound or compounds which have the property of shrinking when heated and become decomposed. This contraction or shrinkage must occur at a temperature lower than that at which a risk of separation of the lining begins. Conventionally, the last-mentioned temperature is of the order of 700°C. If this shrinkage occurs before the separation can begin, it corresponds to an anticipated compensation for at least a part of the expansion that the lining has already undergone and will undergo during the steps subsequent to the heating. Thus, the deformation of the lining in the course of heating is substantially reduced, which avoids risk of separation if the compound or compounds causing the shrinkage and their content in the lining have been suitably chosen.

Such compounds are to be selected, for example, from the hydroxides which have the property of decomposing at temperatures below 700°C. The hydroxides of alkaline earth metals, such as the calcium hydroxides Ca(OH)_2 and the magnesium hydroxides Mg(OH)_2 , alone or mixed in any proportions, are particularly adaptable to this use, since

their decomposition occurs essentially between 350 and 500°C. Moreover, this decomposition produces a sufficient shrinkage to compensate for the expansion of the lining in the subsequent stages of the heating when these hydroxides are present in the proportion of 5 to 20% of the total amount (these contents and all the contents which will follow are given in percentages by weight in the material which has not yet been put into the aqueous form and is intended to constitute the lining). Lastly, this decomposition produces, in addition to the water which evaporates, lime and/or magnesia, i.e. the essential constituents of the lining in its final form adapted to receive the liquid metal. A lining is in this way provided which is perfectly stable throughout its heating, irrespective of the size of the surface on which it is applied. The density and the other physical properties of this lining are very substantially the same as those of the lining of the prior art.

These hydroxides are ordinary common products and the cost of the lining is hardly affected.

Apart from the raw dolomite and/or the raw calcite and the calcium and/or magnesium hydroxides, in the proportion of 5 to 20%, the material intended to constitute the lining according to the invention includes the same components as the material of the linings described in the aforementioned document WO 90/09970, namely:

a conventional binder, such as sodium silicate in the

proportion of 0.4 to 5%;

and a mineral plasticizer, such as clay, or an organic plasticizer in the proportion of 0.2 to 3% to prevent migration of the binder in the course of the drying.

5 The size of the particles of raw dolomite and/or raw calcite is less than 5 mm, and preferably less than 1 mm. In the last case, it is recommended that 15 to 40% of the particles have a particle size of less than 0.1 mm.

10 It will be understood that other compounds having shrinkage properties comparable to those of the calcium and magnesium hydroxides may be employed, provided their decomposition does not give rise to a compound liable to result in pollution of the liquid metal. Their contents must be adapted in accordance with their intrinsic shrinkage
15 properties and with the extent of the shrinkage that they must produce.

In the known manner in conventional linings, there may also be added to these materials a mineralizing agent or mineralizing agents, such as compounds of boron or alkali
20 metal chlorides in proportions which do not exceed a total of 5% by weight. They have for effect to reduce the friability of the lining after its application. As these products are decomposed when the lining is baked, they cannot constitute a source of pollution of the metal.

25 As an example, a possible composition for a lining according to the invention is:

dolomite 88%
clay 0.5%
sodium silicate 1%
organic fibres 0.2%
5 calcium hydroxide 10%.

Another possible composition is:

calcite 92%
clay 0.5%
sodium silicate 1%
10 organic fibres 0.2%
mineral fibres 0.5%
calcium hydroxide 5%
colemanite ($3 B_2O_3, 2 CaO, 5 H_2O$) 0.5%.

15 As before, the contents of these components are given in percentages by weight in a material which is intended to constitute the lining but has not yet been put into the aqueous form.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Method for lining a distributor for the continuous casting of metals, in particular steel, comprising preparing the material constituting the wear-resistant refractory lining of said distributor with raw natural dolomite, or raw natural calcite, or a mixture of said two materials, which are chosen with a particle size of between 0 and 5 mm, incorporating in said raw material a binder in proportions of 0.4 to 5% by weight and a mineral or organic plasticizer in proportions of 0.2 to 3% by weight, and, after the lining has been placed on the distributor in the aqueous form, proceeding to the decarbonation of said lining in the course of its drying and baking, characterized in that the method further comprises incorporating in said lining material at least one compound having the property of shrinking at temperatures below ~~about~~ 700°C.

2. Method according to claim 1, wherein said compound having the shrinkage property is a hydroxide of an alkaline earth metal or a mixture of such hydroxides, and is incorporated in said material of the lining in a proportion of 5 to 20% by weight.

3. Method according to claim 1 or 2, comprising choosing a particle size of the raw dolomite and the raw calcite of ~~preferably between 0 and 1 mm or less~~

4. Method according to any one of the claims 1 to 3, comprising choosing sodium silicate as the binder.

5. Method according to any one of the claims 1 to 4,



comprising choosing clay as the plasticizer.

5 6. Distributor for the continuous casting of metals, in particular steel, provided with a wear-resistant refractory lining which was placed in position in the aqueous form and has a composition comprising decarbonated raw natural dolomite or decarbonated raw natural calcite, or a mixture thereof, the particle size of which is between 0 and 5 mm, a binder which was present before the lining was put into the aqueous form in a proportion of 0.4 to 5% by weight, and a plasticizer which was present before the lining was put into the aqueous form in a proportion of 0.2 to 3% by weight, characterized in that said lining further comprised before it was put into the aqueous form a compound at least having the property of shrinking at temperatures below ~~about~~ 700°C.

10 7. Distributor according to claim 6, wherein said compound having the property of shrinking is a hydroxide of a alkaline earth metal or a mixture of such hydroxides present before the lining was put into the aqueous form in a proportion of 5 to 20% by weight.

15 8. Wear-resistant refractory lining for a distributor for the continuous casting of metals, in particular steel, initially comprising raw natural dolomite decarbonated in situ, or raw natural calcite decarbonated in situ, or a mixture of said two materials, the particle size of which is between 0 and 5 mm, and initially comprising a binder in an initial proportion of 0.4 to 5% by weight and a mineral or organic plasticizer in an initial proportion of 0.2 to 3% by



weight, characterized in that said lining initially further comprises at least one compound having the property of shrinking at temperatures below ~~about~~ 700°C.

5 9. Lining according to claim 8, wherein said compound having the property of shrinking is a hydroxide of an alkaline earth metal or a mixture of such hydroxides, is present in an initial proportion of 5 to 20% by weight.

10 10. Lining according to claim 8 or 9, wherein the particle size of the raw natural dolomite and the raw natural calcite is ~~between 0 and~~ ^{less than} 1 mm.

11. Lining according to claim 10, comprising between 15 and 40% of particles whose size is less than 0.1 mm.

15 12. Lining according to any one of the claims 8 to 11, having a density after drying and baking which is lower than 1500 kg/m³.

13. Lining according to claim 12, having a density after drying and baking which is 1100 to 1400 kg/m³.

14. Lining according to any one of the claims 8 to 13, wherein the binder is sodium silicate.

20 15. Lining according to any one of the claims 8 to 14, wherein the plasticizer is clay.

16. Lining according to any one of the claims 8 to 15, further comprising at least one mineralizer in an initial proportion which is less than or equal to 5% by weight.

25 17. Lining according to claim 16, wherein said mineralizer is a boron compound.

18. Lining according to claim 16, wherein said



mineralizer is a chloride of an alkali metal.

19. A distributor for continuous casting of metals, a lining therefor, substantially as hereinbefore described with reference to the Example.

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20. A method for lining a distributor substantially as hereinbefore described with reference to the foregoing Example.

Dated this 12th day of December, 1994

10 SOLLAC and LE LABORATOIRE METALLURGIQUE

by DAVIES COLLISON CAVE

Patent Attorneys for the applicants.

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Method for lining a continuous casting distributor with
a refractory material, distributor and refractory
material resulting from said method

ABSTRACT

Method for lining a distributor for the continuous casting of metals, in particular steel, comprising preparing material for constituting a wear-resistant refractory lining of the distributor with raw natural dolomite, or raw natural calcite, or a mixture of these two materials, which are chosen with a particle size of between 0 and 5 mm, incorporating in this raw material a binder in proportions of 0.4 to 5% by weight and a mineral or organic plasticizer in proportions of 0.2 to 3% by weight and, after the lining has been placed in position on the distributor in the aqueous form, proceeding to the decarbonation of this lining in the course of its drying and baking, characterized in that the method further comprises incorporating in the material of the lining at least one compound having the property of shrinking at temperatures lower than about 700°C. This compound is preferably a hydroxide of an alkaline earth metal or a mixture of such hydroxides incorporated in the lining material in the proportion of 5 to 20%. The invention also provides a lining for a distributor and a distributor provided with this lining.

No Figure.