EUROPEAN PATENT SPECIFICATION

Lateral containment device with rings for continuous casting plants with rolls and method to control the temperature of the containment rings

Ringförmige Seitendammanordnung für Doppelrollen-Stranggiessvorrichtung und Verfahren zur Kontrolle der Temperatur der Seitendämme

Confinement lateral annulaire pour machine de coulée continue entre rouleaux et procédé pour contrôler la température des faces latérales

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Description

This invention concerns a lateral containment device with rings for continuous casting plants with rolls 5  
and a method to control the temperature of the containment rings of this device, as set forth in the respective  
preamble of claims 1 and 5.  

To be more exact, the invention concerns a cooling  
and/or heating system cooperating with the lateral  
containment device with rings so as to provide a suitable  
required temperature of the sidewalls of the containment  
rings.  

So as to produce thin strip from a bath of molten  
metal in a continuous casting plant comprising two fac-  

cing, contrarotating rolls, two or more containment rings  
able to rotate together with the rolls are keyed on the  
ends of the rolls.  

As is disclosed in EP 0138059 for instance, the  
containment rings can slide along the axis of the rolls  
and thus enable the width of the cast strip to be adjusted  
continuously.  

The reciprocal displacement of the rings and rolls is  
performed advantageously with hydraulic means.  

The rolls are provided with suitable cooling means  
consisting of cooling water circulating within the rolls, for  
instance. This cooling water causes a thermal flow in a  
direction perpendicular to the surface of the rolls, thus  
leading to solidification of the strip being formed.  

The two half-strips thus created on the surface of  
each roll are drawn during rotation of the rolls and are  
connected together in the vicinity of the line connecting  
the axes of the rolls. The point of meeting of the two  
half-strips is called in the art the "kissing point".  

At the line connecting the axes of the rolls, that is to  
say, in the zone where there is the minimum distance  
between the surfaces of the two rolls, the two half-strips  
are lightly rolled to unite them to each other.  

So that the rolling will be strong enough to produce  
cohesion of the two half-strips, the overall solidified  
thickness at the kissing point should be slightly greater  
than the gap existing between the two rolls.  

The rolling force is generally measured by load cells  
fitted to the supports of at least one of the two rolls.  

One of the typical shortcomings found in this type of  
plant of the state of the art consists of the faults in the  
vicinity of the edges, where the strip is not uniform.  

This shortcoming is due most often to undesired  
solidification of the molten metal caused by the side-  
walls of the containment rings, this solidification being  
due to the heat exchange generated through the con-  
tainment rings. If the heat exchange is too great, a solid  
skin generally forms on the sidewalls of the containment  
rings. This is the case with US-A-2,058,447.  

This solid skin is drawn together with the half-strips  
and is rolled by the rolls; as it is thin and cannot with-  
stand combined bending and compressive stresses, it  
normally tends to be folded back inwards.  

This situation creates a solidified excessive thick-  

ness at the edges of the strip, and this thickness is often  
the cause of mistakes in measuring the rolling force.  

These measurement mistakes may cause a failure  
to bond the two half-strips together in their central zone.  

The prevalent faults encountered on the strip are  
therefore of two types:  

- a central air space in the strip owing to incomplete  
  bonding;  
- a double skin at the edges of the strip.  

FR-A-2,628,993 discloses a heated closure plate  
which is intended to keep hot an upper zone where a  
casting chamber is located. This plate exerts a high  
pressure against the edge of both the rolls but does not  
prevent formation of a thin solidified skin near the rolls,  
thus disclosing again what we have already said but in a  
less prominent form.  

The present applicants have designed, tested and  
embodied this invention so as to overcome the short-  
comings of the state of the art and to achieve further  
advantages.  

The invention is set forth and characterized in the  
independent claim, while the dependent claims  
describe variants of the idea of the main embodiment.  

The purpose of the invention is to provide a contain-  
ment device with rings for continuous casting plants with  
rolls, whereby the temperature of the sidewalls of the  
containment rings in contact with the molten metal is  
suitably controlled and adjusted.  

A further purpose of the invention is to provide the  
relative method to control the temperature.  

The adjustment is prearranged in such a way as to  
prevent excessive heat exchange between those side-  
walls and the metal being cast, and viceversa, since the  
heat exchange, if it is too great and is directed towards  
those sidewalls, will lead to the shortcomings described  
above.  

The device and the method according to the inven-  
tion, therefore, purpose to keep the sidewalls of the  
rings always at a required controlled temperature during  
the processing steps and in any casting conditions.  

The present inventors have found to their surprise  
that, if the ring is kept at the desired temperature, the  
results in the finished product are very good.  

During normal working of the plant the heat trans-  
mitted by the bath of molten metal, which comes into  
cyclic contact with the same part of the ring, causes  
heating of the sidewall of the ring in contact with the  
molten metal.  

When the maximum temperature compatible with the  
task performed by the ring and with the type of  
material composing the ring is reached, the ring has to  
be cooled to avoid too great overheating.  

The rings are therefore equipped with a cooling  
system that lowers the temperature of their sidewalls  
and prevents overheating. This cooling system may  
consist, for instance, of circulation of water fed along the
axes of the rolls.

When the casting step is started or the casting speeds are low, the temperature of the wall of the ring in contact with the molten metal may be too low. The present inventors have found to their surprise that it is advantageous to provide a heating system suitable to raise, and to help in keeping, the temperature of the ring at the desired level in the initial phase.

This heating system may be brought about, for instance, by introducing a plurality of electrical heating resistors into the ring. These electrical resistors may be fed, for instance, by means of circumferential brush contacts arranged on the outer wall of the ring; the electrical conductors connecting the electrical resistors are connected to the brush contacts.

The brush contacts may be connected directly to the network of the electricity supply.

According to a variant, so as to ensure greater safety of the electrical connections, the brush contacts arranged on the ring are connected through conductors to analogous circumferential brush contacts arranged on the neck of at least one of the rolls.

According to another variant at least one protective element is included to protect the electrical contacts and conductors.

By means of these contrivances it is therefore possible, by regulating the flow of cooling water or the intensity of the electrical supply current, to keep the sidewalls of the rings at the optimum temperature in all the processing steps irrespective of the casting conditions.

The attached figures are given as a non-restrictive example and show some preferred embodiments of the invention as follows:

Fig.1a is a diagrammatical plan view of a continuous casting plant with rolls in a processing step;

Fig.1b shows the plant of Fig.1a in another processing step;

Fig.2 shows in an enlarged scale a cross-section of the continuous casting plant with rolls along the line A-A of Fig.1a;

Figs.3a and 3b show, with a section from above, a detail of Figs.1 in two processing steps;

Fig.3c is a diagrammatic plan view of the strip produced by the plant of Figs.1;

Fig.4a shows, with a section along the line B-B, a detail of Figs.1;

Fig.4b shows a detail of Fig.4a in an enlarged scale;

Fig.5a is a partial lengthwise section of the containment device with rings according to the invention;

Fig.5b is a cross-section of the device of Fig.5a along the line C-C;

Fig.6 is a cross-section of a variant of the

device of Fig.5a.

The reference number 10 in the figures indicates a generic continuous casting plant as shown in the diagrammatic plan view of Fig.1.

The plant 10 consists of two facing, contrarotating rolls 11a and 11b, between which molten metal 12 is cast to produce a thin strip 13 at the outlet of the plant.

Two lateral containment rings 14a and 14b which can rotate together with the rolls 11a-11b are keyed at the ends of the rolls 11a-11b. These containment rings 14a-14b can move along the axes of the rolls 11a-11b so as to adjust the width of the emerging strip 13 continuously as required (see Figs.1a and 1b).

The rolls 11a and 11b are provided with cooling means to obtain solidification of the cast metal 12. In this example the rolls 11a-11b include within them a circulation of cooling water 15, which creates a thermal flow in a direction perpendicular to the axes of the rolls 11.

In the example of Figs.5 and 6 the rolls 11 are provided with an annular cooling circuit 29.

This thermal flow causes solidification of the strip 13 or, to be more exact, causes the formation of two half-strips 16a and 16b respectively on the surfaces of the two rolls 11a and 11b.

Rotation of the rolls 11a-11b brings the half-strips 16a-16b into contact at a point 17 called the "kissing point".

The two half-strips 16a-16b are rolled so as to bond them together at the kissing point 17.

The required rolling force is measured by load cells 28 fitted to the supports of one of the rolls 11.

Too great heat exchange between the molten metal 12 and the sidewalls of the containment rings 14a-14b generally leads to shortcomings in the finished strip 13.

In fact, too great heat exchange can lead to undesirable solidification of the molten metal 12 on the sidewalls of the ring 14 in contact with the molten metal 12 (see Figs.3a, 3b and 4b), thus causing the formation of a solid skin 12a, which is drawn by the rolls 11a-11b and is rolled together with the two half-strips 16a-16b.

This solid skin 12a tends to become folded inwards (Fig.3b) and creates a solidified excessive thickness at the edges of the strip 13, thus often causing a failure of the half-strips 16a-16b to be bonded together in their central zone, as can be seen in Fig.3c.

So as to reduce the heat exchange, for instance in the event of overheating of the sidewalls of the rings 14a-14b, the invention provides for the inclusion of an annular circuit 23 for circulation of cooling water within the containment rings 14a-14b.

In this example the cooling water is fed along the axes of the rolls 11 through an inlet conduit 18a and is discharged through an outlet conduit 18b (Fig.5a).

According to a variant shown in Fig.6, so as to convey and direct the cooling water with a view to ensuring an even distribution of the water and therefore an even
cooling over the whole sidewall of the ring 14, which is the ring 14a in this case, the annular circuit 23 includes baffle elements 26 to guide the water which cooperate with the inlet and outlet conduits 18a and 18b respectively.

When the casting conditions do not provide a high enough temperature on the sidewalls of the containment rings 14a-14b in contact with the molten metal 12, the invention includes the provision of a heating system, which in this example (Figs. 15) consists of electrical heating resistors 19 arranged radially in the rings 14.

Embodiments are possible, but are not shown here, which include electrical resistors 19 arranged in a spiral along the periphery of the rings 14 or else include metallic radiant disks which are coaxial and concentric with the rings 14.

Electric current is fed to the electrical resistors 19, in this case, through brush contacts 22 fitted to the outer surface of the ring 14a and connected to the resistors 19 by connecting conductors 24.

The brush contacts 22 in this case are circumferential and are fitted to a drum 20 connected electrically to the neck 21 of the roll 11, the neck 21 being equipped likewise with circumferential brush contacts 22 connected electrically to the supply network 27.

Coordinated adjustment of the flow of cooling water and of the intensity of the electrical current enables the required and most suitable temperature to be provided on the sidewalls of the containment rings 14a-14b directly in contact with the molten metal 12.

The device according to the invention comprises one or more screening elements 25, secured in this example to the periphery of the ring 14a, so as to ensure protection of the brush contacts 22.

Claims

1. Lateral containment device with rings for continuous casting plants with rolls, in which the rolls (11) are substantially coplanar and parallel, the device comprising automatic means to adjust the distance between centres of the rolls and the rolling pressure, each roll (11) cooperating with a containment ring (14), the rings (14) acting on one end of the other roll (11) and determining the width of a strip (13) being continuously cast, the rolls (11) and the rings (14) including annular circuit means (23) for cooling by circulation of cooling fluid, the rings (14) including heating means (19) in cooperation with the wall in contact with the molten metal (12), the device being characterised in that it includes means to adjust, in a coordinated manner, the delivery of the cooling water in the cooling means and the intensity of the electric current of the heating means (19), the adjustment being a function of the required and controlled temperature of the walls of the containment rings (14a, 14b) in contact with the molten metal (12).

2. Device as in Claim 1, in which the heating means consist of electrical resistors (19) fed with controlled power.

3. Device as in Claim 1 or 2, in which the rings (14) can be positioned along the length of their respective roll (11).

4. Device as in any claim hereinafore, in which the rolls (11) can be positioned along their own axis.

5. Method to control the temperature of the lateral containment rings of a lateral containment device with rings for continuous casting plants with rolls as in any claim hereinafore, the method being characterised in that it controls and regulates the temperature of the lateral wall of the rings (14) in contact with the molten metal (12) by means of the coordinated regulation of the delivery of water which flows in the annular circuit cooling means (23) included inside the rings (14) and by means of the intensity of the electric current which feeds the heating means (19) associated with the rings (14).

6. Method as in claim 5, in which at the beginning of the casting process, the temperature of the sidewall of the rings (14) which is in contact with the molten metal (12) is raised by means of the controlled activation of the electrical resistors (19).

7. Method as in claim 5 or 6, in which during the normal functioning of the continuous casting plant the temperature of the sidewall of the rings (14) in contact with the molten metal (12) is lowered by means of the controlled regulation of the delivery of the water circulating in the annular circuit cooling means (23) included inside the rings (14).

Patentansprüche

1. Seitenliche Einschließvorrichtung mit Ringen für Stranggußanlagen mit Walzen, wobei die Walzen (11) im wesentlichen koplanar und parallel sind, die Vorrichtung eine automatische Einrichtung zum Einstellen des Abstandes zwischen den Mittelecken der Walzen und des Walzendrucks umfaßt, wobei jede Walze (11) mit einem Einschließring (14) zusammenwirkt, die Ringe (14) auf ein Ende der anderen Walzen (11) wirken und die Breite eines Streifens (13) bestimmen, der stranggegossen wird, die Walzen (11) und die Ringe (14) eine ringförmige Kreislauf einrichtung (20) zum Kühlung durch Zirkulation von Kühlfluß enthalten, die Ringe (14) Heizeinrichtungen (19) enthalten, die mit der Wand zusammenwirken, die mit dem geschmolzenen Metall (12) in Kontakt ist, wobei die Vorrichtung dadurch gekennzeichnet ist, daß sie eine Einrichtung zum koordinierten Regulieren der Abgabe des...
Kühlwassers in der Kühlseinrichtung und der Intensität des elektrischen Stroms der Heizseinrichtung (19) enthält, wobei die Regulierung von der erforderlichen und gesteuerten Temperatur der Wände der Einschließringe (14a, 14b) abhängt, die in Kontakt mit dem geschmolzenen Metall (12) sind.

2. Vorrichtung nach Anspruch 1, wobei die Heizeinrichtungen aus elektrischen Widerständen (19) bestehen, die mit gesteueter Spannung gespeist werden.

3. Vorrichtung nach Anspruch 1 oder 2, wobei die Ringe (14) entlang der Länge ihrer entsprechenden Walze (11) positioniert werden können.

4. Vorrichtung nach einem der vorangehenden Ansprüche, wobei die Walzen (11) entlang ihrer eigenen Achse positioniert werden können.

5. Verfahren zum Steuern der Temperatur der seitlichen Einschließringe einer seitlichen Einschließvorrichtung mit Ringen für Stranggußanlagen mit Walzen nach einem der vorangehenden Ansprüche, wobei das Verfahren dadurch gekennzeichnet ist, daß es die Temperatur der Seitenwand der Ringe (14), die mit dem geschmolzenen Metall (12) in Kontakt ist, durch koordinierte Regulierung der Abgabe von Wasser, das in der ringförmigen Kreislauf-Kühlseinrichtung (23) strömt, die in die Ringe (14) integriert ist, und mittels der Intensität des elektrischen Stroms, der die Heizseinrichtungen (19) speist, die zu den Ringen (14) gehören, steuert und reguliert.

6. Verfahren nach Anspruch 5, wobei zum Beginn des Gießprozesses die Temperatur der Seitenwand der Ringe (14), die mit dem geschmolzenen Material (12) in Kontakt ist, durch gesteuerte Aktivierung der elektrischen Widerstände (19) erhöht wird.

7. Verfahren nach Anspruch 5 oder 6, wobei während des normalen Betriebs der Stranggußanlage die Temperatur der Seitenwand der Ringe (14) in Kontakt mit dem geschmolzenen Metall (12) durch gesteuerte Regulierung der Abgabe des Wassers, das in der ringförmigen Kreislauf-Kühlseinrichtung (23) zirkuliert, die in die Ringe (14) integriert ist, gesenkt wird.

Revendications

1. Dispositif de confinement latéral à anneaux pour installations de coulée continue à cylindres dans lesquelles les cylindres (11) sont essentiellement coplanaires et parallèles, le dispositif comportant des moyens automatiques pour ajuster la distance entre les centres des cylindres et la pression de laminage, chaque cylindre (11) coopérant avec un anneau de confinement (14), les anneaux (14) agissant sur une extrémité de l'autre cylindre (11) et déterminant la largeur d'une tôle (13) coulée en continu, les cylindres (11) et les anneaux (14) comportant des moyens (23) à circuit annulaire de refroidissement par recirculation d'un fluide de refroidissement, les anneaux (14) comportant des moyens de chauffage (19) coopérant avec la paroi en contact avec le métal en fusion (12), le dispositif étant caractérisé en ce qu'il comporte des moyens pour ajuster de manière coordonnée la fourniture de l'eau de refroidissement dans le moyen de refroidissement et l'intensité du courant électrique des moyens de chauffage (19), l'ajustement étant fonction de la température requise et contrôlée des parois des anneaux de confinement (14a, 14b) en contact avec le métal en fusion (12).

2. Dispositif selon la revendication 1, dans lequel les moyens de chauffage sont constitués de résistances électriques (19) alimentées en énergie de manière contrôlée.

3. Dispositif selon les revendications 1 ou 2, dans lequel les anneaux (14) peuvent être positionnés le long de leur cylindre (11) respectif.

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les cylindres (11) peuvent être positionnés le long de leur propre axe.

5. Procédé pour contrôler la température des anneaux de confinement latéral d'un dispositif de confinement latéral à anneaux pour installations de coulée continue à cylindres selon l'une quelconque des revendications précédentes, le procédé étant caractérisé en ce qu'il contrôle et régule la température de la paroi latérale des anneaux (14) en contact avec le métal en fusion (12) au moyen d'une régulation coordonnée de la fourniture de l'eau qui s'écoule dans les moyens (23) de refroidissement à circuit annulaire (14) et au moyen de l'intensité du courant électrique qui alimente les moyens de chauffage (19) associés aux anneaux (14).

6. Procédé selon la revendication 5, dans lequel, lorsque l'opération de coulée débute, la température de la paroi latérale des anneaux (14) qui est en contact avec le métal en fusion (12) est relevée au moyen de l'activation contrôlée des résistances électriques (19).

7. Procédé selon les revendications 5 ou 6, dans lequel, lorsque l'installation de coulée continue fonctionne normalement, la température de la paroi latérale des anneaux (14) en contact avec le métal en fusion (12) est abaissée au moyen de la régula-
tion contrôlée de la fourniture de l'eau en circulation dans les moyens (23) de refroidissement à circuit annulaire inclus à l'intérieur des anneaux (14).