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(19)

(54) MOULD FOR CONTINUOUS ROTARY CASTING

(71) We, CREUSOT-LOIRE-VALLOUREC, a French body corporate, of 7, place du Chancelier Adenauer — 75016 — Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to moulds for continuous rotary casting and more particularly for preferably oscillating vertical casting of blanks, for example, of steel.

The Applicant under its previous name has described and claimed in UK Patent No. 1,366,336 a mould assembly having a rotary open ended mould with cavity axis vertical for continuous casting and which mould is cooled externally by a cooling liquid, the mould assembly comprising, a rotary part comprising said mould which has an outer face, a stationary supply part co-axial with the mould and via which supply part the liquid is supplied for application to the said outer face, and said rotary and stationary supply parts together forming an annular labyrinth therebetween comprised by a plurality of teeth, the arrangement being such that when the liquid is introduced into the supply part at least the greater part of the liquid cannot leak through the labyrinth seal and is compelled to flow along the outer face of the mould.

A mould of this type, which has a through cavity, can be treated at relatively high speeds without creating significant friction. The mould may be free and can be rotated by the solidified part of the casting which is in itself rotated in its own manner.

The present invention proposes to improve moulds of this type in order to further facilitate the rotation of the mould directly by the blank, whereby in the case of small diameter blanks, the latter rotate at high speed. Moreover, it is an object of the invention to improve the cooling of liquid metal, such as steel, poured into the mould and to improve the formation of the solidified skin, thus making it possible to obtain a better blank quality and to limit the number of accidental breakouts causing an outflow of the liquid metal.

Finally, the invention also has as it object to ensure excellent alignment of the mould, resulting in an improved quality of the casting.

According to the present invention a mould of the type referred to for substantially vertical continuous rotary casting comprises a rotary part forming the actual mould with a cooling wall whose outer face is cooled by a cooling liquid such as water passing through a duct co-axial with the wall and which opens to the outside in the lower portion of the mould, the rotary part being mounted on a bearing supported by a coaxial fixed part for supplying the fluid, whereby the sealing between the said rotary and fixed parts is provided by two annular labyrinth seals having a plurality of ribs for ensuring flow of the liquid to the duct, the fixed part having a liquid distribution chamber located towards the lower portion of the mould above the discharge point of the duct and below the bearing and issuing into a second duct in the rotary part, coaxial with the first duct, between an outer jacket and an inner partition separating the two ducts, the ducts being interconnected towards the upper portion of the mould, and the jacket having two sets of ribs co-operating with two corresponding sets outside the distribution chamber, to form the said labyrinth seals.

Advantageously, the cooling water enters the distribution chamber in a direction which aids the rotation of the rotary part, and according to a preferred embodiment, it is possible to provide means, such as inclined vanes integral with the rotary part to bring about a rotation of the rotary part under the action of the cooling liquid flow.

According to a particular preferred embodiment, the rotary part does not have, externally of the jacket, any radially extending member, with the exception of two small supports for the ribs co-operating

with the corresponding ribs of the fixed part on either side of the bearing. In this way, a particularly compact mould is obtained having a very low inertia and which can therefore be made to rotate by blanks having only a small solid skin thickness in the mould.

Clearly, this low inertia can be obtained due to the arrangement according to the invention which makes it unnecessary to provide any special protection of the bearing against the infiltration of water due to the fact that the upper cooling fluid sealing labyrinth is arranged well below the bearing.

Other advantages and characteristics of the invention can be gathered from reading the following description, made with reference to a non-limitative example and the attached drawing showing an axial section of a mould according to the invention.

The mould shown in the drawings comprises a part which rotates about a vertical axis 1 with a generally cylindrical cooling wall 2, whose inner surface 3 has an inclination with respect to the axis of between 0.6 and 1.8%, the largest diameter being located in the upper portion of the mould where there is an accentuated truncated cone-shaped enlargement 4 of wall 2.

The rotary part has an intermediate partition which, in the present case, is formed by two baffles 5 and 6 and it can be seen that between wall 2 and baffle 5, there is an annular cylindrical duct 7 whose lower portion, located towards the bottom of the mould, is linked with the outside by substantially radial openings 8.

The rotary part also has an outer jacket 9 forming between the latter and baffle 6 an outer annular cylindrical duct 10 co-axial with duct 7 and it can be seen that duct 10 is connected to duct 7 by passages 11 just below the level of the upper enlargement 4.

On a frame 12, the fixed part of the mould has an annular casing 13 supplied with cooling water by a pipe not shown. An annular distribution chamber 14 is arranged co-axially with casing 13 and is supplied from casing 13 by passage 15 which are radial or inclined relative to the radius in such a way as to create in chamber 14 a circular movement of the water. Casing 13 carries two members 16, 17 supporting a race 18 for rollers 19. A complementary race 20 is supported by the outer face of the jacket 9, slightly above the median horizontal plane of the mould, the races 18 and 20 and rollers 19 forming a bearing on which the rotary part of the mould rotates.

It can be seen that the cooling water sealing between chamber 14 and jacket 9 is provided by two horizontal annular labyrinth seals 21, 22 having a plurality of ribs carried respectively by the wall of chamber 14 and jacket 9 and its base 9 B and which interdigitate with respect to one another with a certain clearance. It can be seen that the labyrinth seal 21 is located well below the level of the bearing having rollers 19.

Below rollers 19 but above labyrinth seal 21, jacket 9 has a radial flange 23 extending towards the outside having in its upper portion three ribs which cooperate with three ribs of member 16 to form an oil retaining labyrinth seal 24. The radial length of said flange 23 is relatively small so that it has only a limited inertia.

A truncated cone-shaped side plate 25 extends from the upper portion of jacket 9 in a downwards direction, whilst progressively moving further away from the jacket, whereby its end terminates with three ribs cooperating with complementary ribs on member 17 to form an oil-retaining labyrinth seal 26.

Thus, there is bounded by flange 25 and jacket 9 a chamber 27 which can be supplied with lubricating oil by small, not shown pipes, in such as way that an oil mist is formed in chamber 27 which contributes to the lubrication of rollers 19.

Finally, an annular protecting member 28 with small radial dimensions can be fixed to the upper part of the mould for extending the enlargement 4.

Before commencing casting a steel blank by means of the mould according to the invention, a cooling water circuit is established by supplying the casing 13 which in turn supplies chamber 14, which communicates via openings 9A in jacket 9 with the peripheral duct 10 and the water rises in said duct in the direction of the arrow. In the upper portion of duct 10, the water passes through passages 11 and starts to descend within the duct 7 before being discharged via openings 8. Thus, circulation of the cooling water is obtained. The blind duct 29 located between baffles 5 and 6 also fills with water and makes it possible to increase the thermal inertia of the assembly without any significant increase of the mechanical inertia.

The small amount of water which is discharged via labyrinth 21 drops into a passage 30 between chamber 14 and 13, without there being any danger of its mixing with the oil of the bearing.

The small amount of water which escapes via the labyrinth falls directly without any danger of impairing lubrication.

Thus, the bearing is perfectly protected, so that the danger of seizing or jamming is eliminated.

Once the water flow has been established it is merely necessary to pour molten steel

through the upper portion of the mould, whereby the steel solidifies on a dummy bar previously introduced in per se known manner into the lower portion of the mould and a solid steel skin forms against surface 3. Rotation of the dummy bar, which is then extracted, causes the rotation of this blank skin formed and therefore the synchronous rotation of the rotary part of the mould.

As a result, it is obviously possible to eliminate any mould rotating device, together with the necessary electrical equipment.

In order to facilitate rotation, it is obviously possible to utilise the cooling water flow to bring about the rotation of the rotary part, for example, by appropriately orientating the openings 9A made in jacket 9 or by providing appropriately inclined vanes on jacket 9 to cause the flow to be such as to induce rotation.

Obviously, the frame 12 can be mounted in such a way that it oscillates vertically along axis 1 for a continuous rotary-oscillating casting process.

It is also clear that the mould only has one bearing located substantially adjacent the centre and preferably above the centre of the mould, so that a slight deflection of the latter is possible within the limit of the lateral clearances of the ribs of the labyrinth seals thus bringing about a self-alignment of the mould relative to the blank and reducing the risk of blank and mould being out of alignment.

Obviously, numerous variants are possible of the mould according to the invention. Thus, for further decreasing its inertia, it is possible to eliminate the baffle 6 and correspondingly decrease the diameter of jacket 9 to create a duct 10 directly between said jacket and the intermediate baffle 5.

Attention is directed in pursuance of Section 9 of the Patents Act 1949 to Patent No. 1,366,336.

WHAT WE CLAIM IS:—

1. A mould of the type referred to for substantially vertical continuous rotary casting comprising a rotary part forming the actual mould with a cooling wall whose outer face is cooled by a cooling liquid such as water passed through a duct co-axial with the wall and which opens to the outside in the lower portion of the mould, the rotary part being mounted on a bearing supported by a co-axial fixed part for supplying the liquid, whereby the sealing between the said rotary and fixed parts is provided by two annular labyrinth seals having a plurality of ribs for ensuring flow of the liquid to the duct, the fixed part having a liquid distribution chamber located towards the lower portion of the mould above the discharge point of the duct and below the bearing and issuing into a second duct in the rotary part, co-axial with the first duct, between an outer jacket, and an inner partition separating the two ducts, the ducts being interconnected toward the upper portion of the mould, and the jacket having two sets of ribs co-operating with two corresponding sets outside the distribution chamber to form the said labyrinth seals.

2. A mould according to claim 1 wherein the inflow of cooling water into the distribution chamber is directed in a direction so as to tend to induce the rotation of the rotary part.

3. A mould according to claim 2, comprising means integral with the rotary part for bringing about a rotation of the rotary part under the action of the cooling liquid flow.

4. A mould according to claim 3 wherein the said means are inclined vanes.

5. A mould according to either claim 1 or claim 2 wherein the rotary part does not have, outside the jacket, any radially extending member except for two supports for the ribs cooperating with corresponding ribs of the fixed part on either side of the bearing.

6. A mould according to any one of the previous claims wherein the cooling wall against which the molten metal cools has, for casting molten steel, an inclination with respect to the axis of between 0.6 and 1.8%.

7. A mould substantially as described hereinbefore with reference to the drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*