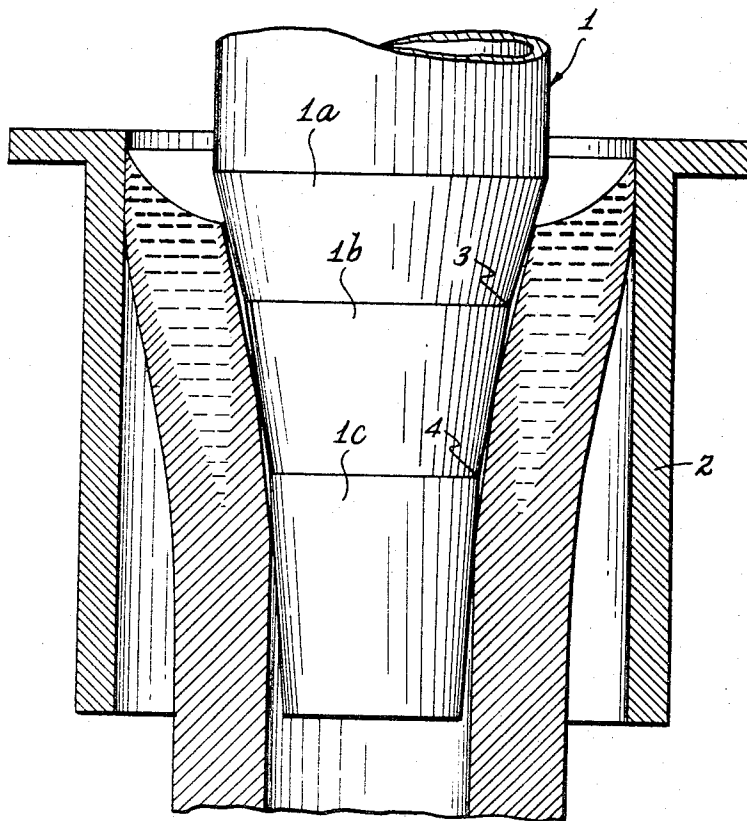


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PROCESS FOR EFFECTING THE CONTINUOUS ROTARY
CASTING OF HOLLOW STEEL BLANKS
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PROCESS FOR EFFECTING THE CONTINUOUS ROTARY CASTING OF HOLLOW STEEL BLANKS

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Patent No. 3,353,587, dated Nov. 21, 1967. Divided and
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929,486

1 Claim. (Cl. 164—85)

ABSTRACT OF THE DISCLOSURE

A process for effecting the continuous rotary casting of a hollow metallic blank formed between a rotating mould and a central mandrel which comprises the step of reducing the rate of heat exchange between the blank and mandrel below that which would result from continuous contact between the blank and mandrel, so as to produce slower cooling of the inner wall of the blank.

This application is a division of application Ser. No. 355,027, filed Mar. 26, 1964, now Patent No. 3,353,587, issued Nov. 21, 1967.

It is known that for many years attempts have been made to produce hollow steel blanks by continuous casting but the obtaining of such blanks involves great difficulties which result mainly from the fact that hitherto the conditions for the cooling and solidification of the inner wall of the blank have been badly controlled.

The problem of the formation of the internal wall of the blank involves great difficulties because, on the one hand, of the necessity of cooling the metal sufficiently to obtain its solidification and, on the other hand, of the shrinkage resulting from the lowering of temperature.

The main disadvantage of many solutions attempted up to date lies in the formation of cracks or flaws situated inside the blank and originating from the fact that the contraction of the internal wall of the blank has been rapid excessively.

The numerous experiments which the applicant has carried out have led to recognition of the fact that, contrary to what was believed, it is necessary, in order to prevent the formation of cracks on the inside of the blank, to cool its internal wall as slowly as possible in such a manner as to form, round the mandrel or core, a wall which is both relatively thick and also raised to a sufficient temperature to have such a plasticity that it can be subjected, without disadvantage, to the stresses resulting from its contraction.

The present invention relates to a new process for effecting the continuous rotary casting of hollow blanks, for example of steel, with the aid of an internal mandrel, said process being characterized in that the cooling of the blank caused by the central mandrel is reduced by providing, on the periphery of the latter and at least at certain points, means slowing down the heat exchange between the blank and the mandrel.

The present invention likewise relates to a new device for the continuous rotary casting of hollow blanks enabling the process defined above to be carried out, said device being characterized essentially in that it comprises a cooled mandrel, the active surface of which is in the form of at least two frusto-conical sections, the apertures of which decrease towards the lower end of the mandrel.

By means of the mandrel which has just been defined above, the formation of a solidified skin is obtained by

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contact between the liquid and the upper frusto-conical section. Then, since the taper of this portion of the mandrel is greater than the taper assumed by the skin thus formed, bearing in mind the speed of extraction and of contraction, the skin moves away from the mandrel and thus causes the formation of an insulating space containing a cushion of gas in an area adjacent where the frusto-conical sections adjoin, which considerably reduces the heat exchange and enables the skin to become considerably thicker without the internal wall becoming too brittle following severe cooling.

The skin then comes into contact with the second frusto-conical section of the mandrel which ensures additional cooling, then the same phenomenon recurs and the skin again moves away from the mandrel which again reduces the heat exchange because of the cushion of gas situated between the blank and the mandrel.

It will be seen that under these conditions, the mandrel according to the invention does in fact permit the solidification of the internal wall of the blank while limiting the heat exchange between the blank and the mandrel in such a manner that the internal wall is formed under such conditions that internal cracks are avoided.

With the object of making the subject of the invention better understood, one embodiment taken by way of example and illustrated on the accompanying drawing will now be described by way of illustration and without any limiting character.

The single figure of this drawing illustrates diagrammatically the mandrel 1 according to the invention which is cooled internally and is held in any manner.

The mold 2, which is also cooled and which can be driven in rotation by any means, is likewise illustrated.

It will be seen that the base of the mandrel 1 consists of three truncated cones 1a, 1b and 1c, the taper of which decreases.

The shape of the blank is also illustrated in section in the drawing, the solidified portions being cross-hatched while the portions which are still molten are represented by broken horizontal lines.

The mandrel 1 may, for example be made with relatively thin copper walls, its interior being copiously irrigated with cold water.

According to the invention, the first contact between the molten metal and the portion 1a of the mandrel is of short duration because, bearing in mind the speed of extraction of the blank and the contraction thereof, the taper assumed by the internal wall of the blank is less than the taper of the portion 1a of the mandrel so that a separation 3 occurs between the blank and the mandrel. Then the portion of the blank in question comes level with the portion 1b of the mandrel which has less taper so that a fresh contact occurs between the blank and the portion 1b, which contact affords both the support of the internal wall of the blank and additional cooling.

The same phenomenon as that described above takes place again and a fresh separation 4 occurs which again enables the cooling of the blank to be slowed down.

Finally, the blank comes into contact with the portion 1c of the mandrel, the taper of which is still less than that of the portion 1b, then moves away from it for the same reasons as those explained above.

It will be noted that from the first contact between the molten metal and the portion 1a of the mandrel, which is vigorously cooled, a fine layer of solid metal is formed which immediately moves away from the mandrel and which can contract freely. This thin layer of solidified metal constitutes a skin which forms the inner wall of an annular bag containing the molten metal which will solidify to form the blank.

It will also be noted that under the pressure of said liquid, the wall of the bag thus formed, which is still plastic, tends to be applied against the mandrel which effectively counteracts the formation of cracks.

Moreover, in accordance with the invention, such a device renders it possible to reduce considerably the cooling of the internal wall of the blank, which enables said wall, which is extremely fragile at the moment when it is formed, to thicken considerably before its internal wall has been subjected to a major reduction in temperature which would render it brittle.

It is, of course, possible to determine the respective heights of the various truncated cones of the mandrel in such a manner as to obtain an optimum effect.

This effect depends in particular on the conditions under which the casting is carried out. If the height of each of the truncated cones is increased, the heat exchange is reduced greatly but the internal wall of the blank is less and less supported by the mandrel which is obviously undesirable. On the other hand, if the lower portion of the mandrel is composed of a large number of truncated cones of low height, the wall is perfectly supported but the heat exchange remains considerable which is contrary to the intended aim.

In any case, it will be seen that the device according to the invention has a double advantage; on the one hand the heat exchange is reduced between the blank and the mandrel which, other things being equal, enables a thicker skin to be obtained having a more homogeneous temperature; moreover, the fact that free spaces are left between the mandrel and the blank which is forming, which spaces ensure the thermal insulation, permits a free contraction of the blank at these points and enables the internal skin of the blank, which is still plastic, to shrink together under the hydrostatic pressure of the molten metal and so to fill in again any cracks which may have formed.

In a specific embodiment of the invention, the rotary casting of hollow steel blanks having an external diameter of 190 mm. and a thickness of 35 mm. was obtained under very satisfactory conditions with a speed of extraction of 1 metre per minute. For this production, a mandrel was used comprising three truncated cones at its lower portion, the first of these, situated at the top, having a height of 40 mm. and a total taper of 4%, the second having a height of 100 mm. and a total taper of 1.5% and

the third having a height of 300 mm. and a total taper of 0.8%.

It is understood that the embodiment which has just been described has no limiting character and may receive any desirable modifications without therefore departing from the scope of the invention.

In particular, it is clear that the mandrel which has been described can be used in various devices which are used to effect the continuous casting of steel. In particular, such a mandrel may be used to advantage in an apparatus in which the mandrel turns at a speed substantially equal to the speed of the mould about an axis which is slightly eccentric in relation to the axis of the mould, the jet of molten metal feeding the blank being projected at a suitable point upstream of the point of the mandrel which is closest to the mould.

What we claim is:

1. A process for effecting the continuous rotary casting of a hollow metal blank formed between a rotating mold and a central mandrel which comprises the step of reducing the rate of heat exchange between said mandrel and the blank being formed below that which would result from continuous contact between the blank and mandrel by contacting said blank with a mandrel formed into a plurality of vertically successive frusto-conical transverse sections each of which tapers downwardly and inwardly, the taper of each section below the uppermost section being less than that of the section immediately thereabove and by advancing said blank at a speed such as to produce successive insulating spaces between the blank and the mandrel in the areas adjacent where said successive sections adjoin each other.

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