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(54) MOLD FOR CONTINUOUS CASTING OF STRANDS

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(57) ABSTRACT

A mold for continuous casting of strands and including a pouring spout, and a housing surrounding the pouring spout and spaced from the pouring spout, forming with the pouring spout a gap that provides for flow of cooling medium therethrough, with the gap having a small width in an upper mold region and a relatively large width in a lower mold region.

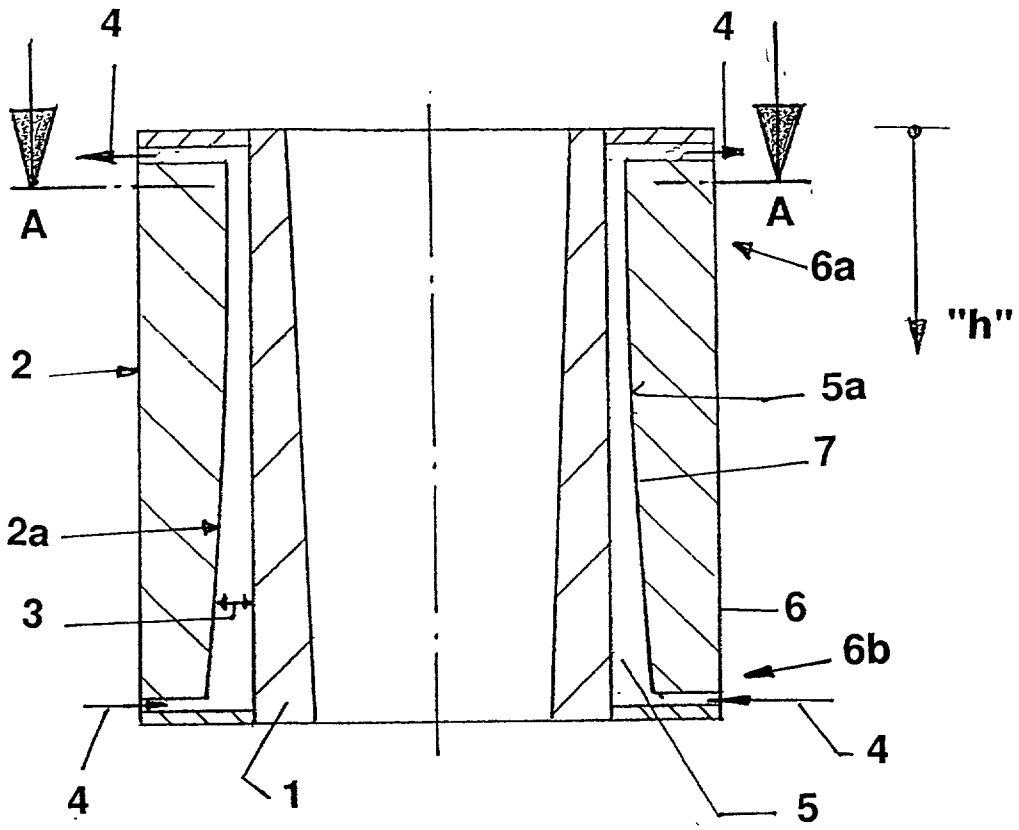


FIG. 1

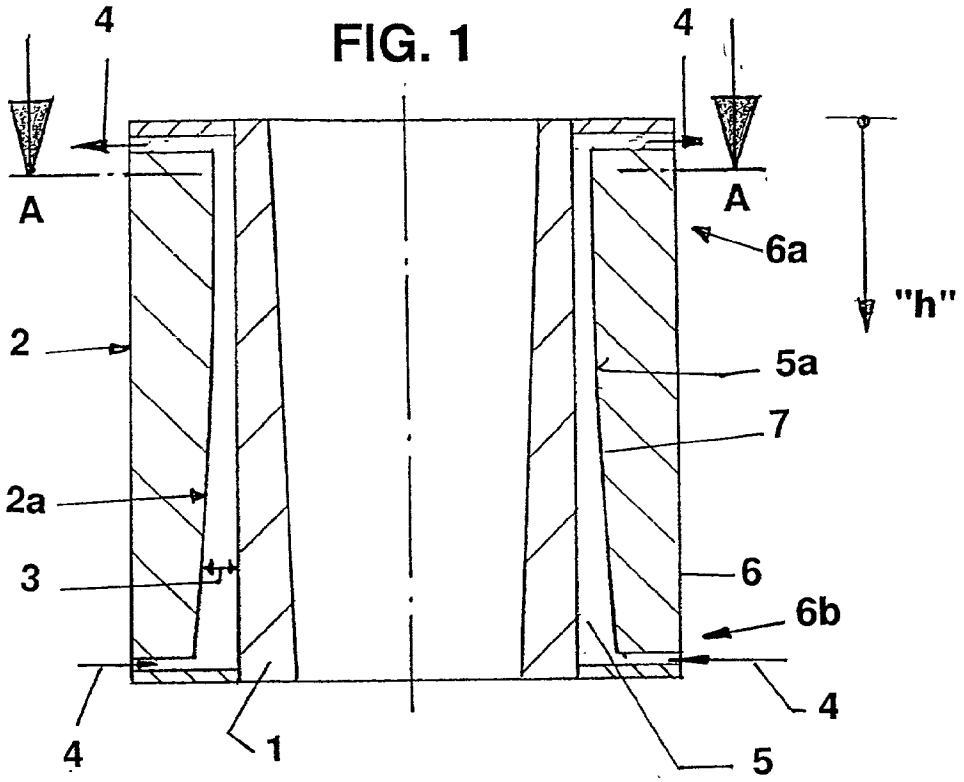
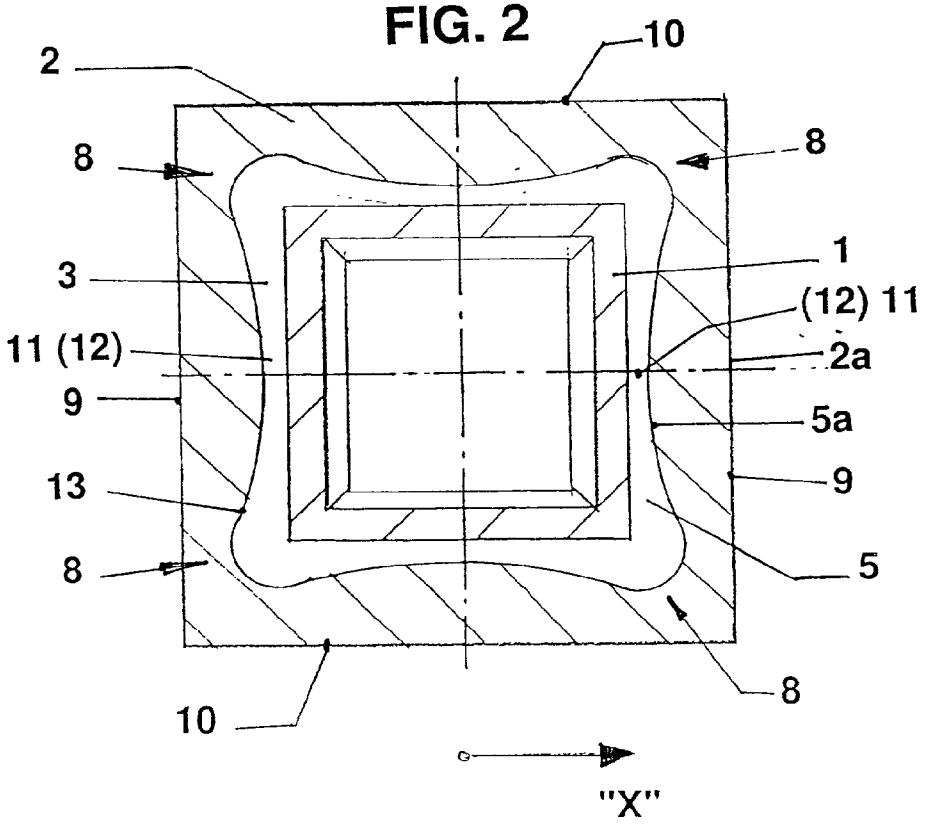

4
4
A
A
6a
"h"
2
5a
7
2a
3
6
6b
4
4
1
5

FIG. 2


2
10
8
8
1
3
(12) 11
11 (12)
2a
9
5a
13
9
8
5
10
8
"X"

MOLD FOR CONTINUOUS CASTING OF STRANDS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a mold for continuous casting of strands, in particular billet or bloom strands, and including a pouring spout, and a housing surrounding the pouring spout at a distance therefrom, forming with the pouring spout a gap that provides for flow of cooling medium therethrough.

[0003] 2. Description of the Prior Art

[0004] During continuous casting of metals, in particular during continuous casting of steel, the liquid steel solidifies, in the course of the casting process, in a continuous casting mold from above downward. The solidification takes place approximately hyperbolically in accordance with an equation

$s=k\times\sqrt{t}$, wherein

[0005] s is a thickness of the strand shell;

[0006] k is a cooling coefficient; and

[0007] t is time.

[0008] In order to provide for the above-determined solidification curve already in the continuous casting mold, the heat removal from the mold can be regulated by controlling local water flow velocities. The maximal heat removal should take place in the meniscus of the mold bath mirror. At the outlet of the mold a correspondingly smaller amount of heat is removed.

[0009] German Publication DE-OS 14 83 556 discloses distribution of cooling zones along the mold height, with the zones being located one above the other and with each cooling zone having its own delivery and removal conduits.

[0010] German Patent No. 1.608,059 discloses flow of a cooling medium in vertical channels from beneath upward through the cooling boxes of the mold, with a high counter pressure.

[0011] An object of the present invention is to provide a mold for continuous casting of strands and in which, the flow velocity of the cooling medium in the cooling channels of the cooling jacket of the mold is controlled by selecting an appropriate geometry of the cooling medium guiding jacket.

SUMMARY OF THE INVENTION

[0012] This and other objects of the present invention, which will become apparent hereinafter, are achieved by providing a gap having a small width in an upper mold region and corresponding to a high cooling medium velocity, and a relatively large width in a lower mold region and corresponding to a relatively low velocity of the cooling medium.

[0013] Thus, according to the present invention, the water flow velocity and, thereby, the removal of heat is controlled by an appropriate selection of the geometry of the cooling medium channel.

[0014] According to the present invention, at least a vertical profile of the outer wall of the cooling medium wall corresponds to a reverse shape of a solidification line in the cast strand running from above downward. The reverse shape results in low cooling medium velocities in the lower region of the mold and in high cooling medium velocities in the upper region of the mold which are caused by the narrowing of the gap.

[0015] A further improvement in the geometry of the cooling medium gap is achieved by additionally increasing its size in its corner regions. Because the corners of a strand require less heat removal than the surfaces of the strand, the cooling medium flow velocity can be reduced in the corner regions of the gap.

[0016] According to the present invention, the gap has a different width along at least one of wide side of the mold and longitudinal side of the mold with a narrowest width being provided in a middle of the at least one of wide side and longitudinal side. By providing the smallest width in the middle of a respective side or sides, an increase of the cooling medium flow velocity is achieved in this region in comparison with corner regions. The reduced velocity in the corner regions is obtained as a result of providing a bulged profile in this regions.

[0017] Forming the pouring spout according to the present invention as a cylindrical member simplifies the manufacturing of the mold.

[0018] A favorable flow, with a reduced flow resistance, is achieved by forming the corner regions, in a horizontal plane, with an oval-shaped bulging profile.

[0019] The novel features of the present invention, which are considered as characteristic for the invention, are set forth in the appended claims. The invention itself, however, both as to is construction and its mode of operation, together with additional advantages and objects thereof, will be best understood from the following detailed description of preferred embodiments, when read with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] In the Drawings:

[0021] **FIG. 1 a** vertical cross-sectional view of a mold for continuous casting according to the present invention; and

[0022] **FIG. 2 a** horizontal cross-sectional view along line A-A in **FIG. 1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] A mold for continuous casting according to the present invention which is shown in FIGS. **1-2**, is used in particular for casting billet and bloom strands. The mold includes a pouring spout **1** and a mold housing **2** which form together a water jacket **2***a*. The cooling medium **4**, usually water or water with additives, is fed through a vertical cooling medium gap **5** between the pouring spout **1** and the housing **2** and, after being heated upon rising, is removed. As shown with arrows in FIGS. **1-2**, the cooling water is introduced into the gap **5** at the lower mold region **6***b* and is removed at the top or upper mold region **6***a*.

[0024] According to the present invention, the width of the cooling medium gap **5** changes along the mold height. As shown in the drawings, the width of the cooling medium gap **5** narrows toward the top of the mold, leading to an increase of cooling medium velocity in the upper region **6***a* of the mold. In the lower mold region **6***b,* the cooling medium gap **5** is relatively wide which results in a relatively small velocity of the cooling medium in the lower region **6***b* of the mold. The flow velocity of the cooling medium **4** corresponds to a reversed shape of the solidification line in the cast strand and to the profile **7** (**FIG. 1**) of the inner wall **5***a* of the mold housing **2** defining, together with the outer wall of the pouring spout **1**, the cooling medium gap **5**.

[0025] As shown in **FIG. 2**, the cooling medium gap **5** has increased dimensions in corner regions **8**. The cooling medium gap **5** can have a different width along the mold wide side **9**, the mold longitudinal side **10**, and along both the mold wide side **9** and the mold longitudinal side **10**, with the narrowest width **11** being provided in the middle **12** of the wide or/and longitudinal side(s).

[0026] The pouring spout **1** can be easily and precisely produced because only the mold housing **2** has a changing profile **7**. The formation of the corner regions **8** with respective oval profiles **13** (in the horizontal projection) also does not affect the profile of the pouring spout **1**.

[0027] The respective gap width follows the functions gap width=f(h) according to **FIG. 1**, and gap width=f(x) according to **FIG. 2**.

[0028] Though the present invention was shown and described with references to the preferred embodiment, such are merely illustrative of the present invention and are not to be construed as a limitation thereof, and various modifications to the present invention will be apparent to those skilled in the art. It is, therefore, not intended that the present invention be limited to the disclosed embodiment or details thereof, and the present invention includes all of variations and/or alternative embodiments within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A mold for continuous casting of strands, comprising a pouring spout; and a housing surrounding the pouring spout at a distance therefrom, forming with the pouring spout a gap that provides for flow of cooling medium therethrough, the gap having a small width in an upper mold region and corresponding to a high cooling medium velocity, and a relatively large width in a lower mold region and corresponding to a relatively low velocity of the cooling medium.

2. A mold as set forth in claim 1, wherein at least a vertical profile of an inner wall of the mold housing, which defines an outer wall of the gap, has a shape corresponding to a reverse shape of a solidification line in a cast strand running from above downward.

3. A mold as set forth in claim 1, wherein the gap for cooling medium is increased in corner regions thereof.

4. A mold as set forth in claim 1, wherein the gap has a different width along at least one of wide side of the mold and longitudinal side of the mold, with a narrowest width being provided in a middle of the at least one of wide side and longitudinal side.

5. A mold as set forth in claim 2, wherein the pouring spout is formed as a cylindrical member.

6. A mold as set forth in claim 3, wherein the corner regions have, in a horizontal plane, an oval-shaped, bulging profile.

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