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GROOVED CONTINUOUS CASTING MOLD FOR SLABS

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Fig. 1

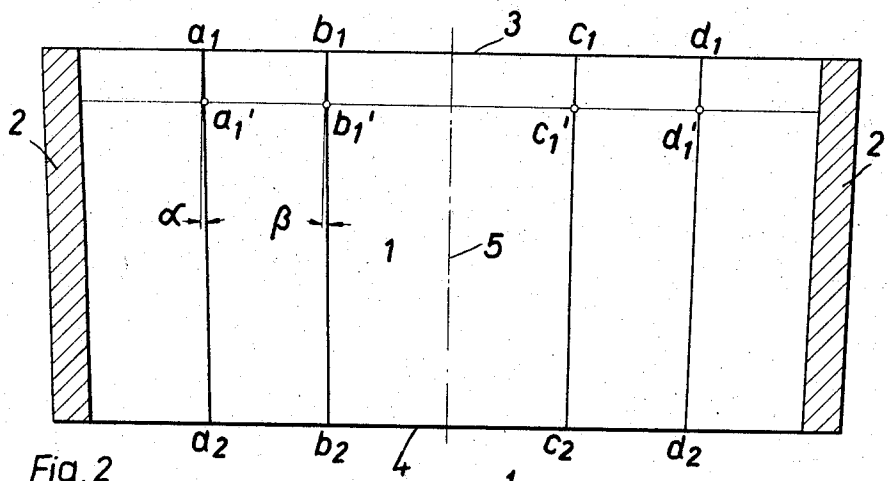
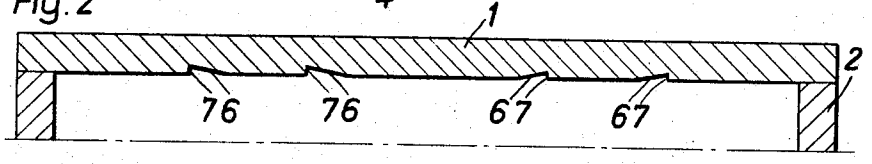


Fig. 2



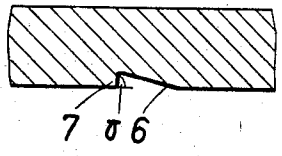


Fig. 3

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GROOVED CONTINUOUS CASTING MOLD FOR SLABS

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ABSTRACT OF THE DISCLOSURE

A continuous casting mold for slabs has two wide and two end sections, and in the internal surface of each wide section has upright grooves that converge downwardly with respect to the central upright axis of the wide section. Each groove has two faces, one that forms a smaller angle of inclination with the said internal surface than the other face and is coordinated with said central axis.

The invention relates to the art of continuous casting, and relates more particularly to water-cooled molds, open on top and bottom, for use in continuously casting of slabs. Still more particularly, the invention relates to an improved mold of this type for use in continuously casting slabs which are free from any break in the solid skin of the casting.

It is known that during the continuous casting of slabs of great width, the solid skin is subject to surface tears. These injuries occur where the weight of the casting is large, causing a longitudinal weakening of the skin of the casting, so that even relatively small transverse stresses in the skin may cause ruptures. These ruptures or tears may, however, occur even in a uniformly thick skin, namely when critically high transverse stresses are encountered. These high transverse stresses may be due to various causes; for instance, they may be due to a premature withdrawal of the skin out of the mold, for example of round forms; or, in connection with slab skins, they may be due to the friction caused by the ferrostatic pressure pressing the slab skin at its wide side against the internal surface of the mold wall, preventing a tear-free thermal contraction of the casting surface. The larger the slab, the greater the risk of surface rupture.

Attempts to decrease this friction by smoothing the internal mold surface and, by lubricating, have, however, not proved successful in avoiding these ruptures.

It is accordingly among the principal objects of the invention to overcome these ruptures, and to provide continuously cast slabs free from surface ruptures.

It is another object of the invention to provide a continuous casting mold which has in its wide wall an internal surface in which there are formed a series of grooves that extend in the casting direction.

It is a further object of the invention to provide such grooves in the internal surface of the wide wall section, which grooves are formed of two intersecting faces of different inclination relative to the said internal surface.

It is still a further object of the invention to provide such grooves symmetrically about the upright central axis of the wide mold wall section in such a manner that the faces with the smaller inclination are coordinated with the said central axis.

It is yet another object of the invention to provide such grooves in the interior surface of the wide mold wall section, the grooves being spaced apart from each other, and each groove extending throughout the entire upright length of the wall section.

It is yet a further object of the invention to provide grooves of this type which converge, the grooves closer to the central axis having a smaller convergence than those spaced further from the central axis, the convergence corresponding to the shrinking contraction of the slab.

Depending on the width of the slab, the amount of grooves in the slab and their distance from the aforesaid central axis of the internal surface of the wide mold wall section, the taper of the grooves will be between 0° 01′ and 0° 40′.

With the above and other objects of the invention in view, the invention consists in the novel construction, arrangement and combination of various devices, elements and parts, as set forth in the claims hereof, one embodiment of the same being illustrated in the accompanying drawings and described in the specification.

In the accompanying drawings,

FIG. 1 is a vertical sectional view showing a wide mold wall section connecting two end sections;

FIG. 2 is a fragmentary horizontal sectional view thereof; and

FIG. 3 is a large scale sectional view of a detail of FIG. 2.

In carrying the invention into effect in one of the embodiments which has been selected for illustration in the accompanying drawings and for description in this specification, and referring now particularly to FIGS. 1 and 2, there is provided a continuous casting mold that has two end wall sections **2** and therebetween wide connecting sections **1**. The connecting sections **1** are wider in the horizontal direction than the end sections **2**.

The mold is open on top at the upper mold edge **3** and on the bottom at the lower mold edge **4**.

The end sections **2** are smooth internally. The wide sections **1**, however, have an internal surface in which there are recessed upright grooves. In the instant exemplification there are shown four upright grooves, designated a_1–a_2; b_1–b_2; c_1–c_2; and d_1–d_2.

These grooves converge downwardly from the upper edge **3** to the lower edge **4**.

The horizontal line drawn in FIG. 1 which intersects the grooves at the points a_1', b_1', c_1' and d_1' corresponds approximately to the position of the molten metal casting level in the mold.

With relation to the upright longitudinal axis **5** of the wide mold section **1**, the inner grooves b_1–b_2 and c_1–c_2 have a smaller convergence as compared to the outer grooves a_1–a_2 and d_1–d_2, respectively.

Although only four upright grooves are shown in the drawing, this has been done for the purpose of illustration only and not in any limiting sense; actually, depending on the width of the wide section **1**, there may be more than four grooves arranged in the internal surface of the wide mold wall section **1**.

Example

In connection with the four exemplified grooves of FIGS. 1 and 2, if the width of the slab is about 1.5 m., each of the grooves b_1–b_2 and c_1–c_2 will be spaced from the upright axis **5** along the upper edge **3** of the mold for a distance of about 25 cm. each; thus, these two grooves will be spaced apart from each other for about 50 cm.

The groove a_1–a_2, in turn, is spaced apart from the groove b_1–b_2 for a distance of about 25 cm.; and likewise, the groove d_1–d_2 is spaced from the groove c_1–c_2 for a distance of about 25 cm.

In this example, the deviations of the grooves from the vertical are as follows; the deviation angles are shown as α and β, respectively (FIG. 1):

For the grooves a_1–a_2 and d_1–d_2 the angle α will range between 0° 04′ and 0° 26′; for the grooves b_1–b_2 and c_1–c_2 the angle β will range between 0° 02′ and 0° 13′, the larger angles being assigned to the lower casting speeds, and the smaller angles to the greater casting speeds.

As shown in FIGS. 2 and 3, each groove comprises two intersecting faces **6** and **7** of different inclination relative to the internal surface of the wide mold section **1**. The faces **6** of smaller inclination are coordinated with the aforesaid upright longitudinal axis **5**; the faces **7** are coordinated with the internal surfaces of the end sections **2**.

As best shown in FIG. 3, the angle γ extends between the face **7** and the internal surface of the wide mold section **1**. This angle γ ranges from about 45° to about 90°. The width of the face **6** ranges from about 1 millimeter to about 20 millimeters. The width of the face **6**, however, accordingly is from about three to about thirty times the width of the face **7**.

As previously stated, the taper of the grooves will range from 0° 01′ to 0° 40′, the convergence of the grooves corresponding to the taper of contraction of the slab depending on the width of the slab, the amount of grooves and their spacing apart. Each groove extends from the top **3** to the bottom **4** of the mold.

Continuous casting molds have been known in the internal surfaces of which grooves were formed. These grooves were put for increasing the heat transfer. Such heat transfer grooves were, however, uniformly distributed throughout the entire mold wall, and had the same form with respect to an upright longitudinal central axis of the mold wall section. The form and purpose of such heat transfer grooves were, however, different from the instant grooves formed and grouped in accordance with the instant invention, and did not lead to the instant results of rupture free wide continuously cast slabs.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

1. In a water-cooled continuous casting mold, open on top and bottom, for use in the continuous casting of slabs, an inner mold wall comprising two end sections and two wide connecting sections, said wide connecting sections having a greater width in the horizontal direction than said end sections, and each wide connecting section having an internal surface adapted to be in contact with a wide surface of a slab being cast, a series of upright grooves recessed in the internal surface of each wide connecting section, each upright groove comprising two intersecting upright faces, one of said faces forming a smaller angle of inclination with said internal surface than the other face, said one face being coordinated with the upright central axis of said wide connecting section, said other face being coordinated with its respective end section, said grooves converging downwardly with respect to said central axis at a predetermined taper, said taper being adapted to be in accordance with the shrinkage downward contraction of said slab.

2. In a water-cooled continuous casting mold, as claimed in claim **1**, said grooves being arranged symmetrically about said central axis.

3. In a water-cooled continuous casting mold, as claimed in claim **1**, said grooves being spaced apart from each other in said internal surface, and extending throughout the upright length of said wide mold wall section.

4. In a water-cooled continuous casting mold, as claimed in claim **1**, said grooves with relation to said central axis increasing in taper with increasing distance from said central axis.

5. In a water-cooled continuous casting mold, as claimed in claim **4**, said taper ranging from about 0° 01′ to about 0° 40′.

6. In a water-cooled continuous casting mold, as claimed in claim **1**, each of said other faces forming with said internal surface an angle of from about 45° to about 90°.

7. In a water-cooled continuous casting mold, as claimed in claim **1**, each of said other faces having a width of from about 1 millimeter to about 20 millimeters.

8. In a water-cooled continuous casting mold, as claimed in claim **7**, each of said one faces having a width of from about three times to about thirty times the width of said other face.

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