July 14, 1970 M. HESS 3,520,352

CONTINUOUS CASTING MOLD HAVING INSULATED PORTIONS

Filed Oct. 19, 1967 3 Sheets-Sheet 1

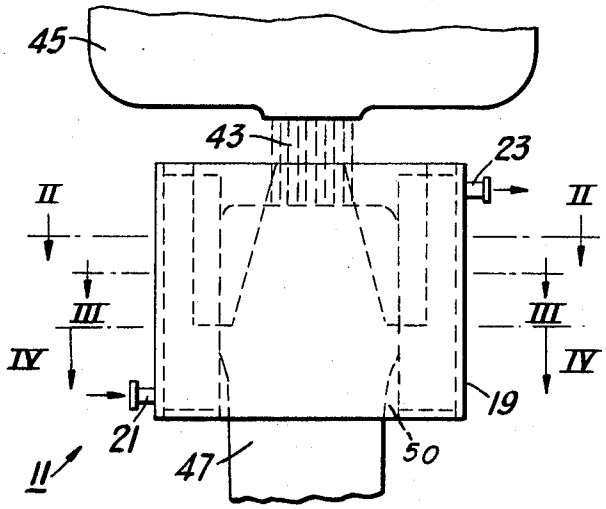


FIG. 1

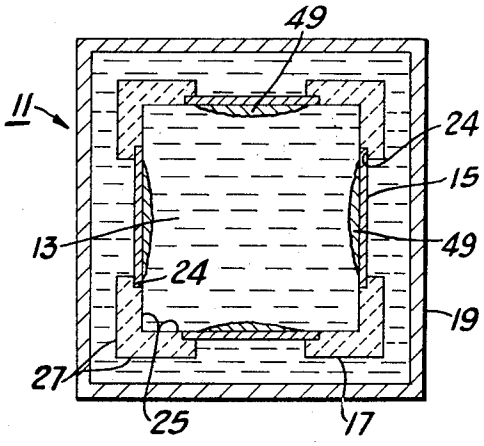


FIG. 2

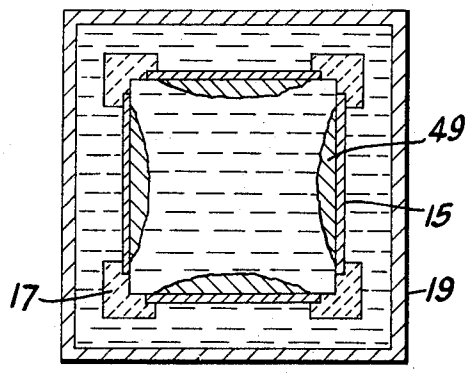


FIG. 3

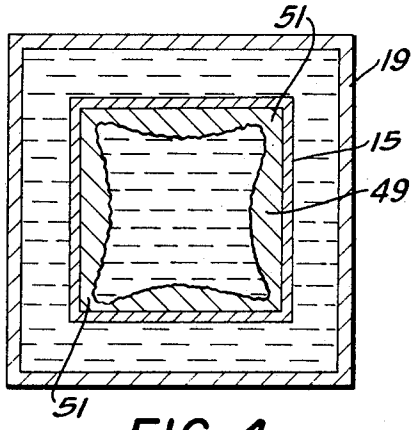


FIG. 4

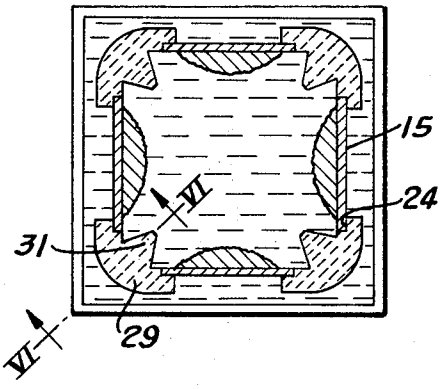


FIG. 5

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CONTINUOUS CASTING MOLD HAVING INSULATED PORTIONS

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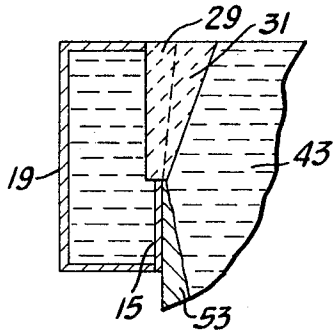


FIG. 6

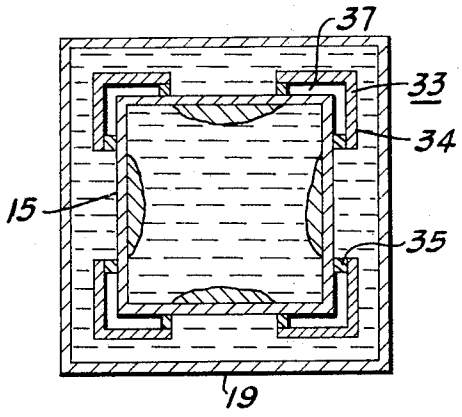


FIG. 7

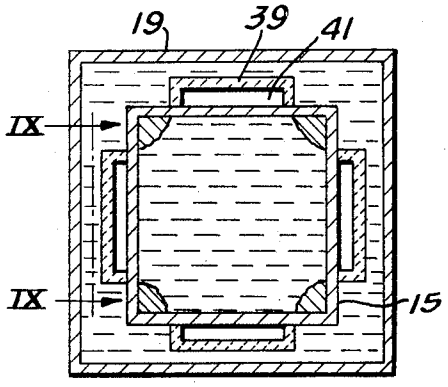


FIG. 8

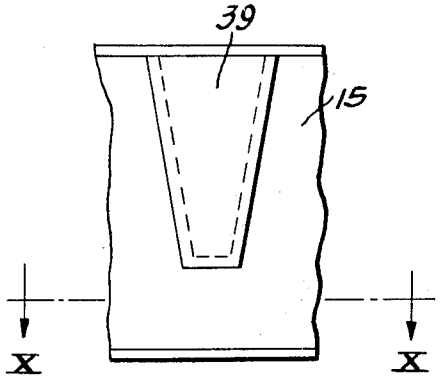


FIG. 9

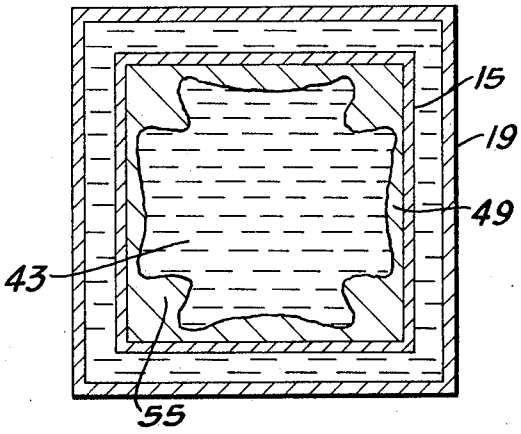


FIG. 10

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CONTINUOUS CASTING MOLD HAVING INSULATED PORTIONS

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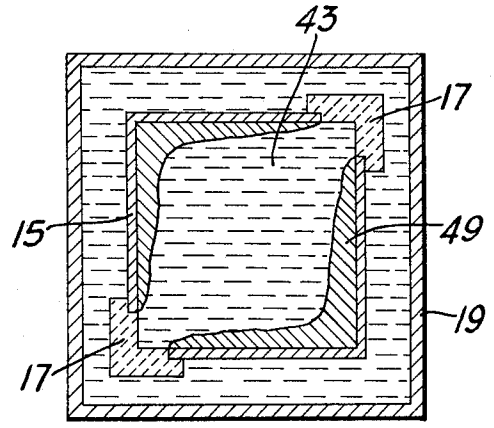


FIG. 11

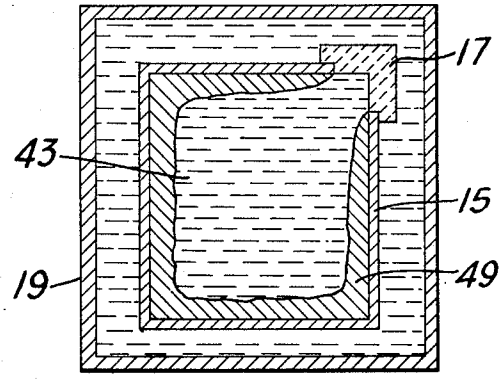


FIG. 12

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3,520,352

CONTINUOUS CASTING MOLD HAVING INSULATED PORTIONS

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Continuation-in-part of application Ser. No. 503,251, Oct. 23, 1965. This application Oct. 19, 1967, Ser. No. 683,069

Int. Cl. B22d *11/00*

U.S. Cl. 164—283 15 Claims

ABSTRACT OF THE DISCLOSURE

A continuous casting mold that enhances heat transfer and reduces the formation of corner cracks comprises a shell that is water cooled, but which is so made that the formation in the mold of a rigid continuous envelope is avoided until just before the strand emerges from the mold when the skin or shell becomes continuous and rigid enough to contain the molten metal of the core.

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application Ser. No. 503,251 filed Oct. 23, 1965 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to continuous casting and more particularly to a casting mold for use in producing a continuous strand of metal.

In the continuous casting metals, and particularly steel, it is desirable to transfer heat as rapidly as possible away from the casting within the casting mold, for then the casting becomes completely solidified in a shorter metallurgical length or depth of pool. Consequently, the casting can be bent toward the horizontal sooner, and the overall height of the continuous casting machine can be significantly reduced. As it is understood in the art, metallurgical length or "depth of pool" is the distance measured along the axis of the cast strand the molten metal extends from the meniscus of the molten metal to the point where the strand is completely solidified.

Studies of the continuous casting of metals in a mold reveal that two relatively different zones of metal state are present in the mold. A relatively shallow first zone of molten metal, surrounded by a thin skin of solid metal, exists near the top of the mold; the depth of this first zone being in the order of a few inches or less. Below this first zone is a second zone wherein the casting strand has developed an outer skin which is thicker and relatively rigid.

The rate of heat transfer from the molten metal to the walls of the mold, which are generally water cooled, is greater in the first zone than in the second zone. It has been found, for example, that about sixty percent of the heat that is removed from the molten metal within molds as heretofore known in the prior art, is removed in a first zone, and only about ten percent of the heat removed in such molds is removed in a second zone. The reason for this difference is that, immediately as the skin becomes rigid in the second zone, there is a contraction of metal and the solid skin shrinks away from intimate contact with the mold walls. Thus, an air gap is formed between the skin of the cast strand and the mold wall, and the rate of heat transfer from the molten metal in this second zone is significantly reduced.

The present invention prevents the complete formation of a skin around the perimeter of the casting until a great percentage of heat has been removed from the molten metal within the mold. Consequently, the metallurgical length of the casting, formed in the mold of the invention, is significantly shorter than in castings made under present practice.

SUMMARY OF THE INVENTION

According to the invention, molten metal in a continuous casting mold is differentially surface cooled in a first zone extending along the length of the mold, and a rigid skin of solid metal does not completely contain the molten metal of the core. When the casting moves into an adjacent zone wherein there is no differential cooling the skin completely contains the molten core. Thereafter, the cast strand emerges from the mold with a skin that is thicker and a metallurgical length that is less than in strands made in accordance with molds of the prior art teaching.

Further, in accordance with this invention, solid portion of the skin remains in contact with the mold walls for a longer period of time than under conventional practice, and a greater percentage of the total heat in the molten metal is removed while the casting is within the mold.

It has been found that this invention greatly reduces the tendency for "corner cracks" to form, that have heretofore plagued the art.

For a further understanding of the present invention and for advantages and features thereof, reference may be made to the following description taken in conjunction with the accompanying drawings which show for the purpose of exemplification embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic representation of a portion of a continuous casting machine, including the casting mold of the present invention;

FIG. 2 is a transverse sectional view along line II—II of FIG. 1;

FIG. 3 is a transverse sectional view along line III—III of FIG. 1;

FIG. 4 is a transverse sectional view along line IV—IV of FIG. 1;

FIG. 5 is a transverse sectional view, similar to FIG. 2; of a first other embodiment of the mold of FIG. 1;

FIG. 6 is a sectional view along line VI—VI of FIG. 5;

FIG. 7 is a transverse sectional view, similar to FIG. 2, of a second other embodiment of the mold in FIG. 1;

FIG. 8 is a transverse sectional view, similar to FIG. 2, of a third other embodiment of the mold of FIG. 1;

FIG. 9 is a view taken along line IX—IX of FIG. 8;

FIG. 10 is a transverse sectional view, similar to FIG. 4, of the embodiment of the mold illustrated in FIG. 8;

FIG. 11 is a transverse sectional view, similar to FIG. 4, of a fourth other embodiment of the mold; and

FIG. 12 is a transverse sectional view, similar to FIG. 4, of a fifth other embodiment of the mold.

DETAILED DESCRIPTION

A continuous casting mold, in accordance with the present invention, is designated generally as **11** in FIGS. 1 and 2, and includes: a molten metal casting cavity **13**, which is generally square in the embodiment illustrated, but which may be round, elliptical, polygonal or any other suitable shape, and which is bounded by vertical, mutually intersecting first wall portions **15**, and second or corner wall portions, **17**, situated in the top portion of the mold (see FIG. 1). A fluid retentive envelope **19** surrounds the walls **15** and corner members **17** of the casting cavity in spaced apart relation thereto. Envelope **19** is adapted to receive a cooling fluid, such as water, via

an inlet conduit **21**, and to discharge the cooling fluid via an outlet conduit **23**.

While the first wall portions **15** are preferably made of a highly thermal conductive material such as copper, the second or corner wall portions **17** are constructed of a lesser thermally conductive material, such as, for example, a ceramic material. As shown in FIG. 1, the corner wall portions **17** have a generally L-shaped or angular cross section, and the vertical edges of each corner portion slope downwardly and convergently toward each other. Thus, the corner member **17** terminates at some convenient level in the mold above of the discharge end of the mold which, as shown in FIG. 1, is between the transverse sections at lines III—III and IV—IV.

Referring to FIG. 2, it will be noticed that each vertical edge of each corner portion **17** is rabbeted to receive the walls **15**, which may be secured to the corner portions by cap screws (not shown), or any other suitable manner, so that the inner surfaces of the walls **15** and corner portions **17** are substantially coplanar. It should be understood, that the corner portions **17** may terminate at any convenient level in the mold **11**, and the termination point suggested in FIG. 1 is not necessarily determinative in all installations.

From FIG. 2, it will be noticed that each side or leg of the ceramic corner portions **17** at the top extends about one-fourth the length of each side, and that the metallic wall portion **15**, at the same level in the mold, is about one-half the length of the side of the mold. At the level of FIG. 3, however, the sides or legs of the ceramic corner portions **17** now extend only about one-tenth of the length of each side of the mold, and the metallic wall portion **15** extends about eight-tenths of the side of the mold. In FIG. 4, which is a sectional view taken below the bottom of the corner portions **17**, there are, of course, no corner portions **17**, and the metallic wall portion **15** extends the full length of each side of the square shaped mold **11**.

FIG. 5 illustrates a cross sectional view of a casting mold which is similar to the mold of FIG. 2, but wherein the ceramic corner portions **29** include an arcuate outer body portion and an inner angularly shaped body portion **31**, which projects inwardly of the casting cavity and generally diagonally across the square shaped mold **11**. The angularly shaped body portion **31** may have any shape and for exemplification herein has a triangular cross sectional shape. The arcuate body portion **29** is provided, as are the ceramic corner portions in FIG. 2, with vertical grooves **24** or rabbets in which the walls **15** fit and to which the walls may be secured by suitable fastening means, as discussed hereinbefore.

The embodiment of the mold **11** illustrated in FIG. 7 discloses a second wall portion **33** which includes an angle shaped member **34** that is maintained in spaced apart relation to an extending portion of the walls **15** by vertical spacer bars **35**. The space **37** between the angle shaped member **34** and the extended portion of the walls **15** may be filed with a suitable insulating material or, the space may constitute an air space. The top and bottom of the space **37**, of course, would be sealed to prevent cooling fluid from entering thereinto; such cooling fluid being normally present in the space between the mold walls **15** and the envelope **19**.

Those skilled in the art will appreciate that in each of the embodiments of the invention discussed hereinabove, the corner members or wall portions **17** effect a retardation of the cooling of the molten metal in intimate contact with the wall portions **17** that are disposed in the areas of the corners of the mold. In some applications, however, it may be desirable to retard the cooling of the molten metal at the middle region of the walls **15**, as shown in FIG. 8. In these instances, there is provided a trapezoidal shaped insulating member **39**, which may be fixed to the walls **15** in any suitable manner; preferably, the insulating member is made of a refractory or ceramic-like material. The insulating member **39** in such cases is provided with an air space **41** between the wall **15** and the main body portion of the insulating member **39**. In some instances, the trapezoidal shaped insulating member **39** may be made of metal, and the space **41**, between the member **39** and the wall **15**, may be filled with a suitable insulating material, or at least the space **41** may constitute an air space, as does the space **37** in FIG. 7.

In operating the conventional continuous casting machine, molten metal flows from a tundish into a casting mold that reciprocates vertically and a cast strand of metal is continuously withdrawn from the mold by conventional means such as pinch rolls. The molten metal is first chilled in the mold upon contacting the cooler mold walls in what may be considered as a first cooling zone. Initially, heat is rapidly removed from the molten metal in this zone and, according to current theory, a skin is formed completely around a central pool of molten metal. The initial formation of the skin is the beginning of the casting.

Thereafter, as the skin thickens and as the casting is withdrawn from the mold, at some level below the meniscus of the molten metal, the casting shrinks away from the rapid heat transfer, which occurs in the first zone, is significantly reduced. In fact, the depth of the molten metal in the first zone is relatively shallow, and during most of the time the casting is in the mold the skin is not in intimate contact with the mold walls.

As soon as the casting leaves the mold, water is sprayed on the outer surface of the casting to cool the surface and to build up a skin thickness that will retain the molten metal comprising the central liquid core of the casting. The central region of the casting remains liquid for a considerable distance below the meniscus, and the distance from the meniscus to the point at which complete solidification of the casting occurs is termed the metallurgical length of depth of pool. Experience teaches, that it is necessary to delay bending of the vertical casting toward the horizontal until the casting has completely solidified in order to avoid damaging the cast strand. This means that in the usual continuous casting machine the mold is elevated considerably above the working ground level, principally because of the excessive metallurgical length in steel castings.

In contrast to the conventional apparatus and method practice, molten metal **43** flows from a tundish **45** into a casting cavity **13** of the mold **11** and a cast strand **47** forms in the casting cavity and is withdrawn from the mold by pinch rolls (not shown), or by any other suitable mechanism.

The following describes what is believed to happen in the mold **11** of the present invention after withdrawing of the casting has become continuous, and as the molten metal **43** is poured into the mold **11**. The molten metal **43** entering the first zone of the casting cavity is chilled by contact with the water-cooled, metallic portion mold walls **15** which comprise the middle portion of each side of the cast strand **47** in this zone. The molten metal **43** which contacts the cooler mold walls **15** loses heat rapidly to the fluid **48** in the space between the mold walls and the envelope, and a part **49** of the skin of the casting commenses to form adjacent the water cooled mold surfaces, as shown in FIG. 2. At the corner portions **17**, however, there is no intimate contact of molten metal **43** with a cool wall surface, since the corner portions **17** are made of ceramic or the like material, and so, in the corner regions of the first zone, the molten metal **43** remains liquid. FIG. 2 depicts what is believed to be a representative cross section of the condition within the first casting zone, at the level II—II in FIG. 1; this first zone level being just below the meniscus of the liquid molten metal **43**. It will be noticed that, adjacent the first wall portions **15** on each side of the mold, the metal has formed a portion of a solid skin in regions designated **49**, but that in the region proximate to each corner wall

portion **17**, the metal **43** is still molten and no skin forms at the corners. It should be remembered, however, that the corner wall portions **17** taper vertically in a converging manner. FIG. 3, therefore, depicts the situation (in a manner similar to FIG. 2) at a slightly lower level in the mold.

In FIG. 3, the metallic wall portions **15** are now longer, or wider as the case may be, and at the level of FIG. 3, a greater portion of liquid metal **43** comes into contact with the water cooled metallic wall portions **15**. Yet, not all of the molten metal has come into contact with a cooler wall surface, and the skin does not completely surround the molten metal. At the corner wall portions **17** in FIG. 3, there is still discontinuity of the skin **49**. It should be pointed out that, because the solid portions **49** at each of side of the casting have not joined at the corners, there is no tendency for the partially solidified wall portions **49** to cause stresses at the corners and form corner cracks, which are commonly found in castings made according to present practice.

In FIG. 4, which is a view below the bottom of the corner wall portions **17**, the molten metal condition at the corners, as shown in FIGS. 2 and 3, had disappeared, because, at the level of FIG. 4, all of the molten metal at the corners contacts the mold walls **15** and is chilled by the cooling fluid or water. Thus, solidification also occurs at the corners, designated **51**, and this newly solidified metal is joined to the already solidified portions **49**, to form a rigid closed skin which is the start of a continuous cast strand having a cross section which is believed to be substantially as shown in FIG. 4. It should be noticed that, because of the delayed solidification at the corners, there is little or no tendency for the casting to form the conventional air gap between the solidified portion **49** and the chilled mold wall **15**, not at least until the cast strand **47** is about to emerge from the mold **11**.

It should be recognized by those skilled in the art that the average thickness of the skin of the casting **47**, produced in the mold **11** of the present invention, is significantly thicker than the skin of a casting made in a conventional type of continuous casting mold. The skin is significantly thicker because there has been intimate contact of the solid skin portions with the cooler mold walls, and a greater heat transfer, for a longer period of time, since there is no air-gap in the region where there is differential surface cooling of the cast strand.

Such a significant increase in the average skin thickness means that the metallurgical length or depth of pool will be considerably shorter in castings made in the mold **11**, than the metallurgical length of conventional castings. This reduction in metallurgical length means that the overall height of a casting machine, using a mold of the type shown in FIG. 1, can be significantly reduced from present proportions.

A casting mold **11**, having the cross section shown in FIG. 5, operates in the same manner to reduce and to delay solidification, of molten metal at the corners, in the same manner as described hereinbefore. Likewise, a mold having a cross section similar to FIG. 7 will reduce the tendency of the molten metal to solidify at the corners for the reasons mentioned hereinbefore.

The formation of a cast strand **47**, in a casting cavity which contains the molten metal **43** within a mold **11** having the cross sectional shape shown in FIG. 8, occurs in a slightly different manner. In the embodiment of the mold **11** shown in FIG. 8, the insulated second wall portions **39** occur at the midlength of the sides and the first or corner wall portions of the mold are chilled. Therefore, the molten metal **43** solidifies initially at the corners, as at **55**.

It should be noticed, however, that even in the embodiment of the invention shown in FIG. 8, the skin of the casting does not become closed and rigid until the casting strand moves downward to about the level of X—X in FIG. 9, at which the cross section has a shape about as shown in FIG. 10. Since even in this embodiment of the invention the skin does not form a rigid closed envelope around the molten metal core, the skin cannot shrink away from the mold wall. Thus here too, more effective heat transfer occurs between the molten metal and the coolant surrounding the mold.

In the embodiment of FIGS. 8–10, there is a considerable thickness of the skin at the corners, and a relatively lesser skin thickness along the lateral sides of the casting. But, in this instance also, the average thickness of the skin of the cast strand **47** is significantly greater than the skin of a continuous strand of cast metal made in molds of conventional design.

FIG. 11 illustrates the cross section of a continuous casting mold **57** wherein ceramic corner portions **59** are located only at diagonally opposite corners. Thus, the skin **49** of the cast strand does not become closed and rigid, because of the two discontinuities at the ceramic corner portions, until the cast strand moves downward below the level at the bottom of the ceramic corner portions **59**.

In like manner, FIG. 12 illustrates the cross section of a continuous casting molding **61** wherein a single ceramic corner portion **63** is used; such single ceramic corner portion also prevents the skin **49** of the cast strand from becoming a closed and rigid envelope until the cast strand moves downward below the level at the bottom of the ceramic corner portion **63**.

Since the diagonally opposite ceramic corner portions **59**, as well as the single ceramic corner portion, effectively prevent the formation of a closed rigid skin the usual air gap between the skin and the mold wall does not form and considerably more heat transfers from the molten metal core to the cooling fluid **48**.

Consequently, the metallurgical length is shorter and continuous casting machines utilizing the mold **11** have a significantly lower or overall height.

In accordance with the present invention, a cast strand emerging from the mold **11** has a thicker skin that will not break out as readily as the skin of strands cast in conventional type molds.

The present invention is directed to a continuous casting mold that significantly increases the overall removal of heat from the molten metal and at the same time avoids or minimizes the occurrence of surface cracks, particularly, at the corners of the cast strand. The significant increase in the overall removal of heat is accomplished by not allowing the skin to form a closed rigid envelope around the molten core or pool, as is customary in conventional continuous casting molds. As long as the skin does not form a closed rigid envelope, the partially solidified metal **49** (FIGS. 2, 3) maintains intimate contact with the metallic portion **15** of the mold wall, and greater and more effective heat transfer occurs between the molten metal and the cooling medium **48** surrounding the walls **15** of the mold. The usual air gap between the rigid skin and the mold wall cannot form as long as there is no continuity in the rigid skin, which is a significant feature of the present invention.

An important feature of the present invention is that, at the corners of the mold, there is no continuity in the skin of the casting, and corner cracks, which usually form in the corner regions of ordinary molds, do not occur in molds constructed according to the present invention. The corner wall portions of the present invention prevent premature cooling of the molten metal in the corner regions and in some applications along the side walls, thereby, prevent the formation of corner cracks, as well and avoiding the formation of a closed rigid skin as mentioned hereinabove.

It is important to note that the corner wall portions **17** taper convergently toward the bottom so that here is a gradual enlargemen of the solid skin portion; that is to say, the solid skin portion becomes thicker at the midlength of the cooled wall portions **15** and thinner near the corners. At a level just below the corner wall portions **17**,

the molten metal solidifies quite rapidly and the skin becomes rigid enough to contain the molten metal core. At the level just above the bottom of the mold, the skin shrinks away from the mold wall **15** and an air gap **50** forms between the skin and the mold wall, but this air gap is relatively short in vertical height.

Another feature of the present invention is found in the increased rate of production of a cast strand in a continuous casting machine utilizing the mold **11**. It is generally recognized that there is a critical rate of descent for a cast strand of any given cross section. Exceeding this critical rate may result in a metallurgical length of depth of pool so deep that the skin may be warped and easily broken by tensile and hydrostatic stresses exerted by the metal within the molten core. Thus, it is necessary to withdraw the casting from the mold at a rate which will allow the casting to build sufficient skin thickness that can resist such tensile and hydrostatic stresses. Thus, because the mold **11** produces a rigid skin having a relatively greater than usual thickness, the metallurgical length is significantly shorter and a continuous casting machine utilizing the mold **11** can produce a continuous strand of cast metal at a faster rate than conventional machines.

A continuous casting machine utilizing the mold **11** of the present invention produces a continuous strand of cast metal that is devoid, or has a minimum number of, corner cracks and tears which frequently are found in castings produced in conventional molds. Corner cracks and tears are frequently the reason why a continuous strand of metal has to be rejected; and so, a continuous casting machine utilizing the mold **11** will produce more acceptable cast strands than conventional machines and thus will be more efficient in operation.

A frequent cause of rejection of continuous cast strands is deformity in cross section. That is, the billet is not rectangular in cross section, but has a rhombic shape. The rhombic shape is due to a more rapid cooling at an opposite pair of corners whereby the metal at these corners shrinks further away from the mold than the metal at the other opposite pair of corners. In the mold **11** of the present invention, however, there is no tendency for one pair of opposite corners to solidify faster than the other pair of corners, since all of the corners remain molten for the same period of time. In the present invention the cooling and solidification of the metal at the corners is retarded equally; hence, the billet produced in a continuous casting machine using the mold **11** will be more nearly rectangular than billets cast in a conventional machine.

While the foregoing has described a continuous casting mold having a rectangular or square shape it will be understood that in the casting of cylindrical shapes, insulating baffles similar to the triangular shaped baffles **31** may be disposed in angular spaced relation around the circumference of a circular shape so that solidification of the skin of a circular or cylindrical casting may be delayed in spaced apart areas or regions similar to the corner regions mentioned before. Likewise, such baffles as depicted in FIG. 5 may be disposed at the corners of continuous cast strands having any polygonal shape or cross section.

Although the invention has been described herein with a certain degree of particularity, it is understood that the present invention disclosure has been made only as an example and that various modifications and changes may be made within the scope of the invention as defined by the appended claims.

What is claimed is:

1. A continuous casting mold that receives molten metal and from which a partially solidified cast strand continuously emerges, comprising:

(a) a wall having a first portion extending both partially around the perimeter and axially along the length of said mold, and terminating anteriorly of the discharge end thereof,

(b) said first portion tapering so as to have more surface area at the inlet end thereof in contact with the molten metal than at the other end thereof,

(c) said first portion having lower heat conductivity than said wall.

2. The structure of claim **1** wherein:

(a) said mold is polygonal in cross section and

(b) said first wall portion includes abutting areas of adjacent sides of said mold.

3. The structure of claim **1** wherein:

(a) said mold is polygonal in cross section and

(b) said first wall portion includes a portion of the area of one of the sides of said mold.

4. The structure of claim **1** wherein:

(a) said first wall portion includes abutting areas of adjacent sides of said mold at two or more corners of said mold.

5. The structure of claim **4** wherein:

(a) said mold is rectangular in cross section; and

(b) said corners are diagonally opposite.

6. In a continuous casting machine wherein molten metal flows into the casting cavity of a mold defined by walls and a partially solidified cast strand continuously emerges from the discharge end thereof, the improvement comprising:

(a) a fluid cooling the exterior of said mold wall,

(i) said wall having a first portion extending both partially around the perimeter and axially along the length of the mold,

(ii) said first wall portion terminating anteriorly of the discharge end of said casting cavity, with

(iii) said first wall portion tapering so as to have a greater surface area in contact with molten metal at the inlet end of said first wall portion than at the other end thereof, with

(iv) said first portion being comprised of abutting areas of adjacent sides of said mold,

(v) said first wall portion being capable of transferring heat from said molten metal to said fluid at a rate that is less than the rate at which heat is transferred from said molten metal to said fluid by the remaining portion of the mold wall, whereby the molten metal adjacent said first portion remains molten.

7. A continuous casting mold comprising:

(a) a wall defining a casting cavity having one end through which molten metal enters and a discharge end from which a cast strand continuously emerges, said cast strand comprising a solid skin of metal surrounding and containing a core of molten metal that gradually solidifies; and

(b) cooling medium contacting and removing heat from the wall of said mold, said wall including

(i) a first zone comprised of first and second inset laterally abutting areas,

(1) said first area tapering so as to have a greater lateral dimension in contact with said molten metal adjacent the inlet end than adjacent the discharge end of said mold, and so constructed that the molten metal in contact with said first area is maintained in a molten state,

(2) said second area extending partially around the perimeter of said mold and being so constructed that heat transfers to said cooling medium at a rate such that said molten metal solidifies adjacent said second area to partially form said skin;

(ii) a second zone axially abutting said first zone and disposed anteriorly of the discharge end of said mold, said second zone being so constructed that the molten metal in contact with the surface of said first area contacts said second zone and solidifies to completely form said skin within said mold.

8. The structure of claim 7 wherein:
(a) said mold is polygonal in cross section; and
(b) said first area is a surface of a ceramic material located at one corner of said polygonal shaped mold.

9. The structure of claim 7 wherein:
(a) said mold is polygonal in cross section;
(b) said first area is a surface of a ceramic material located at diagonally opposite corners of said polygonal mold; and
(c) said second area is a surface of a metallic material.

10. The structure of claim 7 wherein:
(a) said mold is rectangular in cross section; and
(b) said first area has a greater lateral dimension at one end thereof in contact with molten metal than at the other end thereof.

11. The structure of claim 7 wherein:
(a) said first means is a ceramic material that has more surface area at one end thereof in contact with molten metal than at the other end thereof.

12. The structure of claim 7 wherein:
(a) said first means includes a member overlying in spaced apart relation and joined peripherally to said first area.

13. The structure of claim 12 wherein:
(a) said mold is polygonal in cross section; and
(b) said member is peripherally joined to abutting areas of adjacent sides of said mold in said first zone.

14. In the method for producing and withdrawing a cast strand continuously from a mold, the improvement comprising the steps:
(a) pouring molten metal into said mold;
(b) solidifying the molten metal contacting a first area of the wall of said mold and forming a portion of a solid metal skin partially surrounding said molten metal while,
(c) maintaining in a liquid state the molten metal contacting a second inset wall area laterally abutting said first area;
(d) advancing axially of said mold the partially formed solid metal skin;
(e) gradually increasing the perimetrical length of said skin at respective locations of said first area as said partially formed skin advances; and
(f) solidifying the molten metal contacting a third wall area abutting said first and second wall areas and completing the formation of said solid skin within said mold.

15. A continuous casting mold that receives molten metal at one end, from the other end of which a partially solidified cast strand emerges along the axis of said mold, comprising:
(a) a first surface portion of said mold in contact with said molten metal;
(b) means for cooling said first surface portion and solidifying the molten metal in contact with said first surface portion to form a portion of the skin of said cast strand;
(c) a second surface portion of said mold in contact with said molten metal and disposed in abutting lateral relation to said first surface portion, said second surface portion being so constructed that said molten metal in contact therewith remains molten and tapered so that the second surface has a greater lateral dimension adjacent the inlet end than adjacent the other end of said mold;
(d) a third surface portion of said mold disposed adjacent both said first and said second surface portions and along the length of said mold; and
(e) means to cool said third surface portion whereby molten metal in contact therewith solidifies and forms an additional portion of the skin of said cast strand.

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