

[54] **CASTING MACHINE WITH LOW
PROFILE CONVEYOR**[76] Inventors: Enrique C. Chia, 42 Tower Apts.;
George C. Ward, 128 Bennett Cir.;
George E. Lenaues, 301 Sunset
Blvd., all of Carrollton, Ga. 30117

[22] Filed: Jan. 26, 1971

[21] Appl. No.: 109,864

Related U.S. Application Data

[62] Division of Ser. No. 737,719, June 17, 1968, abandoned.

[52] U.S. Cl.164/278, 193/35, 164/282

[51] Int. Cl.B22d 11/12

[58] Field of Search.....164/87, 278, 282;
193/35 C, 35 R[56] **References Cited****UNITED STATES PATENTS**

1,220,211	3/1917	Feldkamp et al.....	164/278
1,507,456	9/1924	Brasted	164/278
1,612,737	12/1926	Lane	164/278
3,349,471	10/1967	Bell et al.....	164/87 X
3,351,126	11/1967	Richards et al.....	164/278
1,079,176	11/1913	Hyve.....	193/35 R
3,318,364	5/1967	Bray et al.....	164/278 X

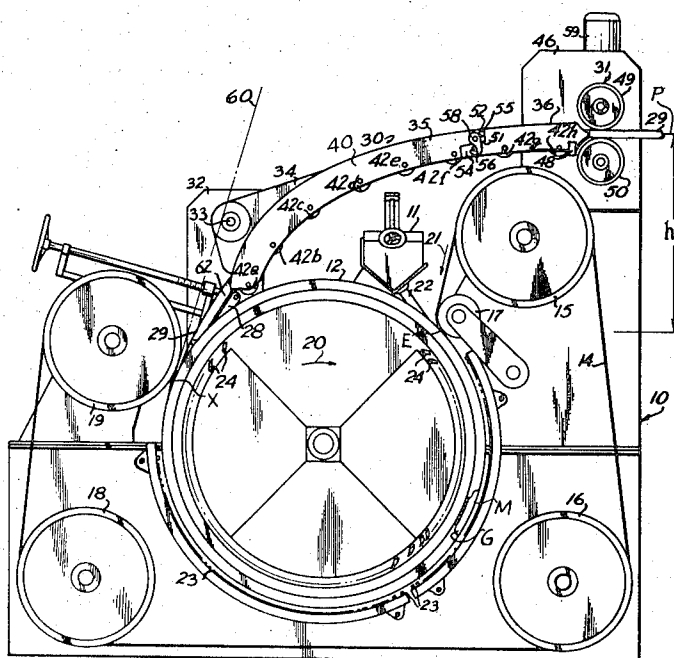
Primary Examiner—R. Spencer Annear

Attorney—Van C. Wilks and Herbert M. Hanegan

[57]

ABSTRACT

Disclosed herein is a continuous casting machine having a casting wheel with a groove closed by a band to form a casting mold and including a conveying means for conveying cast metal between the casting mold and a substantially horizontal path in a manner that reduces voids in the cast metal, that reduces the concentrations of dissolved gases in the cast metal, that increases the production rate of the casting machine, and that facilitates the initial removal of the cast metal from the casting mold while at the same time providing for convenient and efficient pouring of molten metal into the casting mold. Specifically, the conveying means in the casting machine disclosed is a low-profile conveyor positioned and shaped to place the cast metal leaving the casting mold in a predetermined arcuate path which provides for relatively little vertical displacement of the cast metal above the casting wheel, which extends the length of the portion of the circumference of the casting wheel which may be used as the casting mold, which is a path into which cast metal leaving the casting mold will initially pass with a minimum of manual guidance, and which provides for the passage of the cast metal over pouring apparatus used for pouring molten metal into the casting mold. Also disclosed herein are a method of casting molten metal and a method of manufacturing a casting machine which embody the same invention as the casting machine.

6 Claims, 3 Drawing Figures

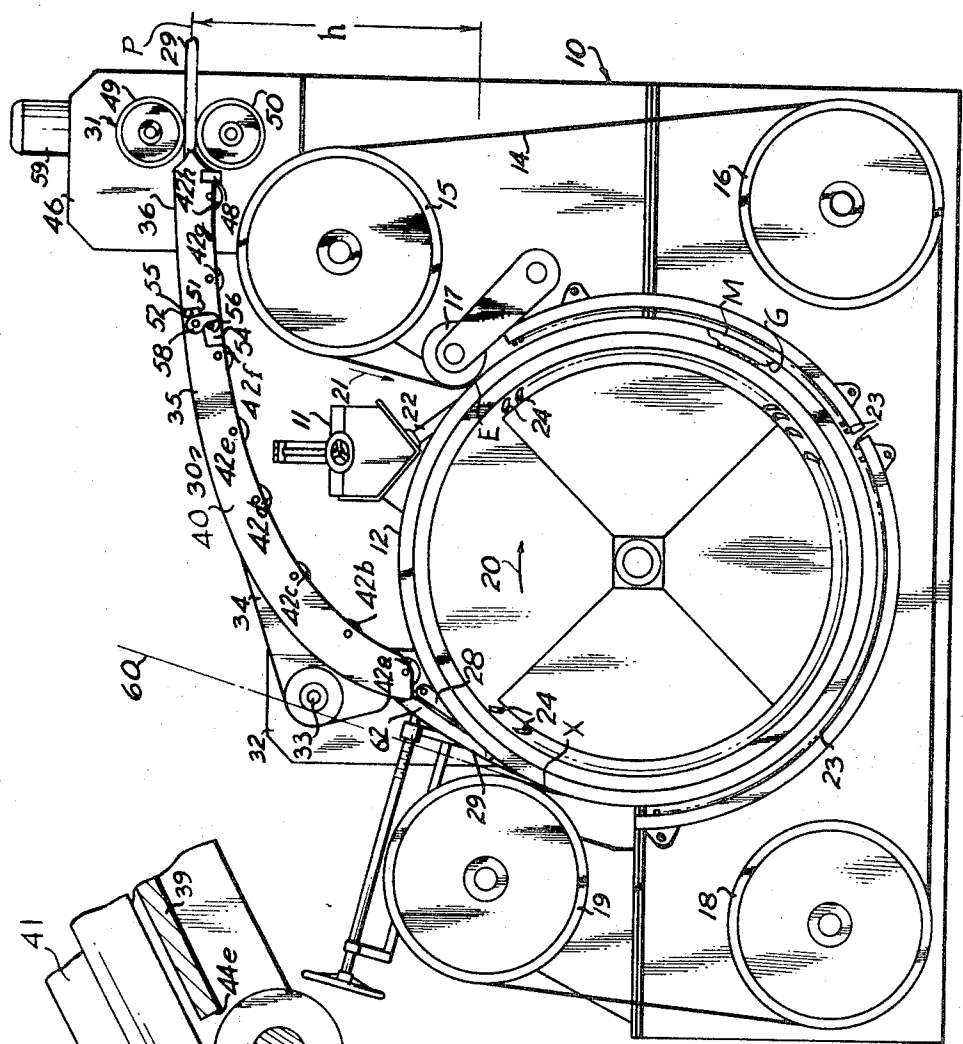


Fig. 1

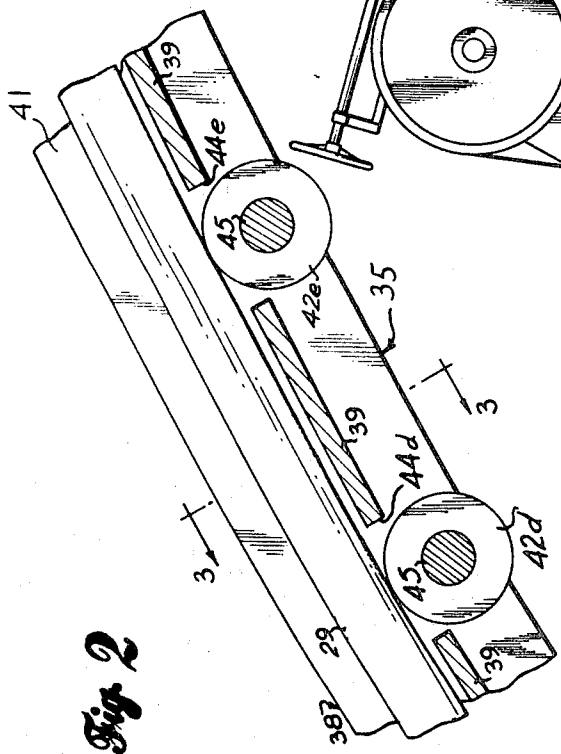


Fig. 2

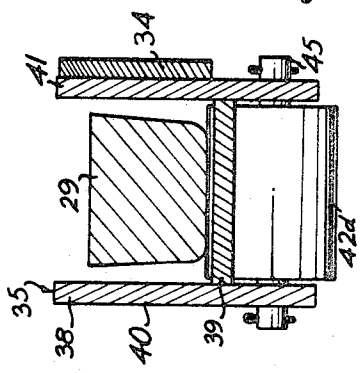


Fig. 3

CASTING MACHINE WITH LOW PROFILE CONVEYOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention disclosed herein relates to the continuous casting of metal and more particularly, to a continuous casting machine having a rotating casting wheel with a peripheral groove closed by a band to form a casting mold and having a conveying means for conveying cast metal along a predetermined arcuate path between the casting mold and a substantially horizontal path extending into a rolling mill or the like.

2. Description of the Prior Art

A continuous casting machine having a rotating casting wheel with a peripheral groove closed by a band to form a casting mold is well-known in the prior art. With such a prior art casting machine, molten metal is poured into the entry end of the casting mold, is solidified as it moves with the casting mold, and leaves the casting mold as cast metal at the exit end of the casting mold.

It is characteristic of such a prior art casting machine for the cast metal as it leaves the exit end of the casting mold to pass along an arcuate path between the casting mold and a substantially horizontal path which may extend into a rolling mill or other apparatus for working or otherwise processing the cast metal. This arcuate path may be defined by a conveyor for the cast metal if the cast metal is supported between the casting mold and the substantially horizontal path or may be defined by the cast metal itself if the cast metal is not supported between the casting mold and the substantially horizontal path. However, whether the cast metal is supported or unsupported in the arcuate path, the arcuate path provided by such a prior art casting machine has caused many difficulties.

Some of these difficulties are because the arcuate path causes a substantial vertical displacement of the cast metal above the casting wheel and the level of the molten metal at the entry end of the casting mold. When there is molten metal in the center of the cast metal as the cast metal leaves the casting mold and passes along the arcuate path because of insufficient cooling of the cast metal in the casting mold, this substantial vertical displacement of the cast metal is frequently sufficiently large to provide the molten metal in the center of the cast metal with a hydrostatic head which is sufficient for the molten metal in the center of the cast metal to move downwardly and form a void within the cast metal. Such a void within the cast metal usually causes difficulties during the subsequent hot-forming of the cast metal.

Moreover, when a void is formed and even before the hydrostatic head is sufficient to cause a void to form within the cast metal, the pressure within the molten metal in the center of the cast metal often becomes so low that dissolved gases in the molten metal tend to pass out of solution. This results in a concentration of dissolved gases which also causes difficulties during the subsequent hot-forming of the cast metal.

These problems relate to the hydrostatic head of molten metal in the center of the cast metal can be partially avoided by sufficient cooling of the molten or cast metal in the casting mold to prevent a center of molten metal within the cast metal as the cast metal leaves the casting mold. However, in addition to substantial verti-

cal displacement of the cast metal above the casting wheel and the level of the molten metal at the entry end of the casting mold, the arcuate path which is characteristic of a prior art casting machine generally requires that the cast metal be removed from the casting mold with the cast metal substantially vertically oriented. This fixes the exit end of the casting mold at a position along the circumference of the casting wheel at which the cast metal is substantially vertically oriented and limits the portion of the circumference of the casting wheel which may be used for the casting mold. Since the cooling time available for the required cooling of molten or cast metal within a casting mold is a function of both the portion of the circumference of the casting wheel which is used for the casting mold and the rate at which the molten or cast metal moves along this portion as defined by the rotational speed of the casting wheel, this limitation on the portion of the circumference of the casting wheel which may be used for the casting mold, and the cooling required to avoid a center of molten metal within the cast metal as the cast metal leaves the casting mold serve together to place an upper limit upon the rotational speed of the casting wheel and upon the production rate of a prior art casting machine.

Furthermore, the vertical orientation of the cast metal as it leaves the casting mold to pass along the arcuate path which is characteristic of a prior art casting machine makes it difficult to start the passage of the cast metal along the arcuate path. As a result, when production is initiated on a prior art casting machine, substantial manual assistance is required to accomplish the initial feeding of the cast metal from the casting mold into the arcuate path.

SUMMARY OF THE INVENTION

The invention disclosed herein overcomes these and other difficulties encountered with a prior art continuous casting machine in that when the invention is embodied in a casting machine, the casting machine includes a conveying means for conveying cast metal from the casting mold into a substantially horizontal path in a manner that reduces or eliminates voids in the cast metal, that reduces or eliminates the concentration of dissolved gases in the cast metal, that increases the production rate of the casting machine, and that facilitates the initial feeding of the cast metal from the casting mold into an arcuate path. Moreover, the conveying means provides these improvements in a continuous casting machine while at the same time providing for the convenient and efficient pouring of molten metal into the casting mold formed by the casting machine.

Specifically, these improvements in a continuous casting machine are provided by a continuous casting machine having a low-profile conveyor which is positioned and shaped to place cast metal in a predetermined arcuate path between the casting mold and a substantially horizontal path. The arcuate path provided by the conveyor limits the vertical displacement of the cast metal above the casting wheel and above the level of the molten metal at the entry end of the casting mold so that even at production rates that cause a center of molten metal within the cast metal as the cast metal passes along the arcuate path, the hydrostatic head of any molten metal in the center of the cast metal is never sufficiently great to cause the forming of a void

within the cast metal or even that low pressure in the molten metal which causes dissolved gases to pass from solution. It is because of this that the invention substantially reduces or eliminates the voids and the concentrations of dissolved gases which have been frequently encountered with cast metal produced by a prior art casting machine.

In addition, the arcuate path provided by the conveyor in the casting machine disclosed herein provides for the removal of cast metal from the casting mold with the cast metal in an inclined orientation and after the cast metal has passed beyond the substantially vertical orientation at which it is characteristically removed from the casting mold formed by a prior art casting machine. This positioning of the exit end of the casting mold serves to increase the portion of the circumference of the casting wheel which is used as the casting mold and as a result, the casting machine disclosed herein provides the same cooling time for molten or cast metal within the casting mold as a prior art casting machine even though the casting wheel is rotating at greater rotational speed than would be possible with the prior art casting machine.

It is because of this greater rotational speed and because a center of molten metal within the cast metal as the cast metal leaves the casting mold does not result in voids and concentrations of dissolved gases that the invention provides a higher production rate than can be achieved with a prior art casting machine of the same size. Moreover, the inclined orientation of the cast metal as it leaves the casting mold facilitates the initial feeding of the cast metal from the casting mold into an arcuate path. This is because the inclined orientation of the cast metal causes the cast metal to pass directly to the conveyor with a minimum of manual assistance.

These improvements in a casting machine are provided by the invention without limiting or otherwise restricting the pouring of molten metal into the entry end of the casting mold. This is because the arcuate path provided by the conveyor of a casting machine embodying the invention provides sufficient vertical displacement of the cast metal as it passes between the casting mold and a substantially horizontal path for the position of the conveyor and the motion of cast metal along the conveyor not to interfere with pouring apparatus at the entry end of the mold.

BRIEF DESCRIPTION OF THE DRAWING

These and other features and advantages of the invention will be more clearly understood from a consideration of the following detailed description and the accompanying drawing in which like figures designate corresponding parts throughout and in which:

FIG. 1 is a side elevational view of a casting machine embodying the invention disclosed herein;

FIG. 2 is an enlarged side elevational view of a portion of the conveyor in the casting machine of FIG. 1, with one side of the conveyor removed; and,

FIG. 3 is a cross-sectional view through the conveyor taken in line 3—3 in FIG. 2.

DESCRIPTION OF AN EMBODIMENT

The foregoing described figures and the following detailed description disclose a specific embodiment of the invention. However, it will be understood that the invention may be embodied in a method of casting molten metal, in a method of manufacturing a casting ma-

chine, and in other equivalent forms which will be understood from the following description of a casting machine.

Referring more particularly to the drawing, FIG. 1 shows a casting machine 10 which includes a pouring pot 11, a casting wheel 12, a continuous band 14, and band support wheels 15, 16, 18 and 19. A presser wheel 17 is positioned adjacent to the pouring pot 11 to maintain the band 14 in position against the periphery of the casting wheel 12 at the entry end E of the casting mold M formed by a peripheral groove G in the casting wheel 12 and by the band 14.

As the casting wheel 12 rotates in a clockwise direction as indicated by the arrow 20, the band 14 moves in a like direction, as indicated by the arrow 21 so that each portion of band 14 which engages the casting wheel 12 moves with the casting wheel 12. Adjacent the support wheel 19 is the exit and X of the casting mold M at which the band 14 passes from the periphery of the casting wheel 12 and back to the presser wheel 17 after passing in sequence around the support wheels 19, 18, 16, and 15.

It will now be understood that molten metal passes from the pouring pot 11 through a spout 22 into the casting mold M formed by the peripheral groove G in the casting wheel 12 and by the band 14, and that the molten metal is carried by the casting wheel 12 and the band 14 about the lower periphery of casting wheel 12 from the entry end E of the casting mold M adjacent the presser wheel 17 to the exit end X of the casting mold M adjacent the support wheel 19. As the molten metal moves within the casting mold M, a coolant is applied to the casting wheel 12 and the band 14 to cool the casting mold M and the molten metal within the casting mold M. As a result, the molten metal is substantially solidified within the casting mold M and leaves the exit end X of the casting mold M as cast metal in the form of a cast bar 29 which may or may not have molten metal in its center depending upon the cooling of the casting mold M.

In the casting machine 10 shown in FIG. 1, coolant is applied by coolant nozzles 24 to the inner periphery of the casting wheel 12 and by coolant nozzles 23 to the band 14. However, regardless of the manner in which coolant is applied, it will now be understood that the casting machine 10 as described above is generally conventional. It is for this reason that only the conveying means for conveying the cast bar 29 between the casting mold M and a substantially horizontal path P will be described in detail below.

In the embodiment of the invention disclosed herein, the conveying means includes a conveyor 30 positioned and shaped to receive the cast bar 29 as it leaves the casting mold M and to place the cast bar 29 in a predetermined arcuate path as the cast bar 29 passes toward and through a pair of pinch rolls 31 and into the path P. The conveyor 30 includes a pivotal section 35 and a stationary section 36. The pivotal section 35 is supported by a support arm 34 which is pivotally connected by a pin 33 to a mounting stand 32. The mounting stand 32 is supported from the frame of the casting machine 10, and extends in an upward direction behind the casting wheel 12.

The pinch rolls 31 are mounted on a pinch roll housing 46 and a bracket 48 positions the stationary section 36 so that it is in alignment with the pinch rolls 31. Moreover, the bracket 48 and the support arm 34 later-

ally position the stationary section 36 and the pivotal section 35 relative to each other so that the two sections 35 and 36 of the conveyor 30 are in alignment as shown in FIG. 1.

The pivotal section 35 and the stationary section 36 of the conveyor 30 are substantially identical in construction and only the pivotal section 35 is shown in FIGS. 2 and 3. Each of the sections 35 and 36 of the conveyor 30 includes an 11-shaped member 38 formed by an intermediate wall 39, a front wall 40, and a rear wall 41. A plurality of rollers 42a-h are spaced along the length of conveyor 30, the rollers 42 being rotatably positioned on axles 45 extending between the front wall and the rear wall 41 and below the intermediate wall 39 in each of the sections 35 and 36.

The intermediate wall 39 has a plurality of slots 44 such as slots 44d and 44c along its length and each roller 42 protrudes through a slot 44. The slots 44 in the intermediate wall 39 of conveyor 30 are of such size and shape that the rollers 42 and the conveyor sections 35 and 36 can be easily cleaned. Also, rollers 42 are maintained relatively cool since they are exposed to ambient air below the slots 44.

The front wall 40 and the rear wall 41 in the stationary section 36 of the conveyor 30 are formed to define lower abutments 54 while the front wall 40 and rear wall 41 of the pivotal section 35 of the conveyor 30 are formed to define complementary upper abutments 55. The lower abutments 54 of stationary section 36 support the upper abutments 55 of the pivotal section 35 when the sections 35 and 36 are in the positions shown in FIG. 1. Pins 56 extend outwardly from the lower abutments 54 of the stationary section 36 and are engaged by latches 58 pivotally connected to the upper abutments 55 of the pivotal section 35.

It will be understood that the latches 58 and the pins 56 serve to hold the pivotal section 35 in position relative to the stationary section 36 so as to provide a continuous conveyor 30. However, it will also be understood that the structure of the conveyor 30 is such that the pivotal section 35 can be pivoted relative to the mounting stand 32 for convenient access to the pouring pot 11 and other portions of the casting wheel 12.

The rollers 42 of the conveyor 30 are positioned along a predetermined arcuate path that extends from adjacent the periphery of the casting wheel 12 to the pinch rolls 31 and the radius of curvature of the arcuate path between rollers 41a and 42b is slightly less than the radius of curvature of the cast bar 29 as the cast bar 29 extends between the casting mold M and the conveyor 30. The radius of curvature of the conveyor 30 gradually increases between rollers 41b and 42c, rollers 42c and 42d, and so on, toward the pinch rolls 31.

The pinch rolls 31 are positively driven by the motor 59 with a surface speed substantially the same as or greater than the surface speed of the casting wheel 12. As a result, a cast bar 29 is maintained under tension as it passes from the casting wheel 12 to the pinch rolls 31. This in turn, serves to pull the cast bar 29 against the rollers 42 and into the predetermined arcuate path defined by the rollers 42. However, it will be understood that the member 38 provides the conveyor 30 with an open upper side so that a bar positioning means (not shown) may be placed above the conveyor 30 for holding the cast bar 29 against the rollers 42 and in the arcuate path defined by the conveyor 30. Moreover, it will be understood that the tension exerted on the cast

bar 29 by the pinch rolls 31 or the pressure applied to the cast bar 29 by a bar positioning means (not shown) is not so great as to substantially elongate or flatten the cast bar 29 as it extends between the casting machine 12 and the pinch rolls 31.

The arcuate path provided by the conveyor 30 and the position of the conveyor 30 adjacent to the casting wheel 12 are such that the cast bar 29 is removed from the casting wheel 12 when the cast bar 29 is disposed farther around the circumference of the casting wheel 12 than with a prior art casting machine. This positioning of the exit end X of the casting mold M is best shown in FIG. 1 from which it will be seen that the cast bar 29 is removed from the casting wheel 12 after the cast bar 29 has passed beyond that position on the circumference of the casting wheel 12 at which the cast bar 29 is substantially vertically oriented and when the cast bar 29 is parallel to a tangent 60 which is tangent to the casting wheel 12 and which forms an angle of approximately 17° from the vertical.

The result of removing the cast bar 29 from the casting wheel 12 when the cast bar 29 is relatively far around the circumference of the casting wheel 12 is that the portion of the circumference of the casting wheel 12 used for the casting mold M is increased relative to that portion used in a prior art casting machine. In the casting machine 10 shown in FIG. 1, the portion of the circumference of the casting wheel 12 used as a casting mold M is approximately 240° and the result of using this relatively large portion of the circumference of the casting wheel 12 is that greater rotational speeds of the casting wheel 12 and greater production are possible with a casting machine 10 embodying the invention than with a prior art casting machine. This is because the cooling time for molten or cast metal in the casting mold M is a function of the total time the molten or cast metal is in the casting mold M and because the rotational speed of the casting wheel 12 may be increased as the length of the casting mold M is increased without decreasing the total time that the molten or cast metal is in the casting mold M.

The casting machine 10 includes a stripper 28 for lifting the leading end of a cast bar 29 from the casting mold M when use of the casting machine 10 is initiated. The inclined position of the cast bar 29 as defined by the tangent 60 and the outer surface 62 of the stripper 28 are such that the cast bar 29 is guided from the casting mold M toward the conveyor 30. The roller 42a and the walls 40 and 41 of the member 38 are positioned so that as the cast bar 29 moves toward the conveyor 30, the direction of movement of the cast bar 29 will cause the leading end of a cast bar 29 to pass into the conveyor 30. As the cast bar 29 passes over roller 42a, the weight of the cast bar 29 will tend to pull the cast bar 29 into contact with the roller 42a and the horizontal component of movement of the cast bar 29 as it passes from the casting wheel 12 in an inclined position moves the cast bar 29 along the conveyor 30 toward the pinch rolls 31.

The front wall 40 and the rear wall 41 of the conveyor 30 prevent the leading end of the cast bar 29 from wandering in a lateral direction, while the rollers 42 cause the leading end of the cast bar 29 to follow an arcuate path toward the pinch rolls 31. It will be understood that the intermediate wall 39 is positioned near the upper portion of the rollers 42 so that as the leading end of the cast bar 29 advances along the conveyor 30,

the leading end of the cast bar 29 will not bind against a roller 42 in the conveyor 30. Thus, it will be understood that the conveyor 30 is constructed and positioned with respect to the casting wheel 12 in such a manner that a cast bar 29 can be initially fed from its inclined position on the casting wheel 12 to the pinch rolls 31 along the conveyor 30 with a minimum of manual assistance.

The conveyor 30 is also constructed and positioned so that the arcuate path provided by the conveyor 30 does not vertically displace the cast bar 29 a substantial distance above the level of the molten metal at the entry end E of the casting mold M. This is because at high production rates, the cast bar 29 frequently has a center of molten metal during a portion or all of its travel along the conveyor 30 to the pinch rolls 31 and because this center of molten metal is continuous with molten metal in the casting mold M and at the entry end E of the casting mold M so that vertical displacement of the center of molten metal causes a hydrostatic head which is determined by the weight of molten metal above the entry end E of the casting mold M.

It has been found that with substantial vertical displacement of the cast bar 29 above the molten metal at the entry end E of the casting mold M, this hydrostatic head can become so great as to exceed the atmospheric pressure on the molten metal at the entry end E of the casting mold M. This causes the center of molten metal in the cast bar 29 to move downwardly within the cast bar 29 and form a void. Such a void causes difficulties during subsequent hot-forming of the cast bar 29. Moreover, as the hydrostatic head approaches the atmospheric pressure on the molten metal at the entry end E of the casting mold M, the pressure in the center of molten metal within the cast metal becomes so low that dissolved gases in the molten metal tend to pass from solution and form concentrations of gases which also cause difficulties during subsequent hot-forming of the cast bar 29.

The arcuate path provided by the conveyor 30 is such that any molten metal in the center of the cast bar 29 is not raised or displaced above the molten metal at the entry end E of the casting mold M by a distance greater than the distance h at which the hydrostatic head of the molten metal in the cast bar 29 causes pressures in the molten metal that result in gases passing from solution or causes the center of the molten metal to move downwardly within the cast bar 29 and form a void. The distance h when casting molten copper or another molten metal in the casting machine 10 is related to a theoretical value which is the computed difference in height between two connected columns of the molten metal when one column is in a closed tube and the surface of the molten metal in the other column is under atmospheric pressure at sea level and when the pressure at the upper end of the closed column is substantially equal to that pressure at which gases dissolved in the molten metal tend to pass from solution in the molten metal at a significantly high rate. For molten copper having the gases such as hydrogen which are usually dissolved in it, this theoretical value is 3.98 feet and a similar theoretical value can be computed for other molten metals by those skilled in the art. However, the distance h is only approximately this theoretical value for a particular molten metal.

This is because the distance h in a casting machine 10 may be greater than the theoretical value for a particu-

lar molten metal since the upward motion of cast bar 29 as it leaves the casting wheel 12 and passes along the conveyor 30 provides a component of force which acts on molten metal in the center of the cast bar 29 in a direction opposite to the hydrostatic head. Thus, at conventional rotational speeds of a casting wheel 12 the distance h may be a distance greater than the theoretical value without the resulting hydrostatic head causing voids and concentrations of gas. However, although the distance h may be a distance substantially greater than the theoretical value, the distance h is preferably less than the maximum possible distance in order to provide a safety factor for variations in atmospheric pressure.

Thus, the distance h in a casting machine 10 is an empirically determined distance based upon a theoretical value. When the casting machine 10 is used for casting molten copper, a distance h of approximately four feet provides a casting machine 10 in which the casting machine 10 may be used with normal variations in atmospheric pressure without a center of molten metal in the cast bar 29 causing the forming of voids or of concentrations of gas in the cast bar 29. Moreover, it will be understood that by avoiding the problems usually encountered with a center of molten metal in a cast bar 29, the distance h provides a casting machine 10 which may be operated at relatively high production rates not only because of the position of the exit end X of the casting mold M but also because it is not necessary to completely solidify the molten metal in the casting mold M.

It will also be understood that while providing for a safety factor, the distance h is as great as possible consistent with a casting machine 10 in which voids and concentrations of gas in the cast bar 29 are avoided. This is because the resulting relatively large distance h causes the arcuate path provided by the conveyor 30 to be sufficiently displaced above the pouring pot 11 for the conveyor 30 and cast bar 29 not to interfere with the pouring pot 11, the support wheel 15, or other adjacent portions of the casting machine 10.

It will now be understood that the casting machine 10 disclosed herein is a casting machine 10 which continuously casts a cast bar 29 at a higher production rate than a prior art casting machine while at the same time reducing or eliminating the forming of voids and of concentrations of gases in the cast bar 29. Moreover, it will be understood that the casting machine 10 facilitates initial feeding of a cast bar 29 from the casting wheel 12 to the arcuate path provided by the conveyor 30 and that the conveyor 30 does not obstruct the pouring pot 11 and other adjacent portions of the casting machine 10.

It will be obvious to those skilled in the art that many variations may be made in the embodiments chosen for the purpose of illustrating the present invention without departing from the scope thereof as defined by the appended claims.

We claim:

1. In a casting machine, a rotatable casting wheel having a peripheral groove, a band closing a portion of said groove to form a casting mold, pouring means for pouring molten metal into said casting mold, means for cooling said molten metal within said casting mold in order to obtain a solidified cast metal, said cast metal retaining a molten core despite said cooling means, removal means for removing said cast metal from said casting mold while said cast metal still retains said mol-

ten core at its center, means for conveying said cast metal from said mold along a path above said casting wheel while simultaneously restricting the elevation of said cast metal in said path, said elevation restriction being to such an extent that gases dissolved in molten copper would not go out of solution prior to solidification of said molten core.

2. The apparatus of claim 1, and further comprising said elevation restriction being to such an extent that said molten core does not move downwardly within said cast metal.

3. The invention of claim 1 in which said molten metal is copper, and in which said molten metal is poured into said casting mold at an entry end of said casting mold, and in which the elevation of said path does not exceed approximately 4 feet above said entry end.

4. In a casting machine, a rotatable casting wheel having a peripheral groove, a band closing a portion of said groove to form a casting mold, pouring means for pouring molten metal into said casting mold, means for cooling said molten metal within said casting mold in order to obtain a solidified cast metal, said cast metal retaining a molten core in spite of said cooling means, removal means for removing said cast metal from said casting mold while said cast metal still retains said mol-

ten core at its center means for conveying said cast metal from said mold along a path above said casting wheel while simultaneously restricting the elevation of said cast metal in said path, said elevation restriction being such that a molten core of copper would not move downwardly within said cast metal when the cast metal is copper.

5. The invention of claim 4 in which said molten metal is copper.

6. In a casting machine, a rotatable casting wheel having a peripheral groove, a band closing a portion of said groove to form a casting mold, a bar conveyor extending over and above said casting wheel, pouring means for pouring molten metal into an entry end of said casting mold, means for cooling said molten metal within said casting mold in order to obtain solidified cast metal, means positioning said band in such a position that cast metal in said groove is prevented from leaving said groove for said bar conveyor until said cast metal is in an arcuate path extending over and above said casting wheel, said positioning means preventing said cast metal from leaving said groove for said bar conveyor prior to attaining a point which is at an angle of at least 17° from a vertical line of reference.

* * * * *

30

35

40

45

50

55

60

65