

[54] SELF-CENTERING BOTTOM BLOCK ASSEMBLY
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[51] Int. Cl. B22d 11/08
[58] Field of Search..... 164/282, 274, 283

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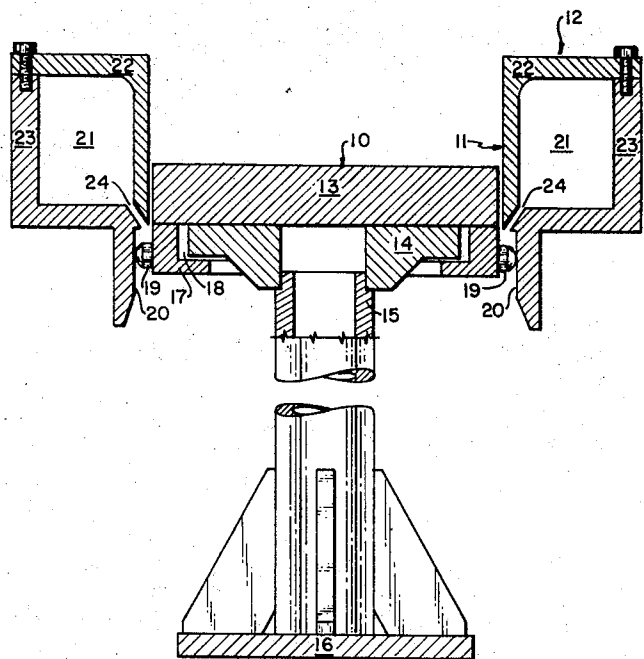
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[57] **ABSTRACT**
This invention relates to a self-centering bottom block for a direct chill (D.C.) casting apparatus. The assembly comprises a bottom block which is slidably mounted on a supporting surface and a retaining ring which loosely locks the bottom block to the supporting surface but which allows for the horizontal movement of the bottom block. As the assembly is raised into position, guide buttons on the exterior surfaces of the assembly ride on guide surfaces which are fixed spatially with respect to the mold bore and thereby center the assembly within the mold bore. In another embodiment of the invention, the bottom block assembly is provided with a means which engages the ingot during the initial phases of solidification and urges the ingot during the initial phases of solidification and urges the ingot out of the mold but which readily disengages the ingot after casting.

4 Claims, 3 Drawing Figures



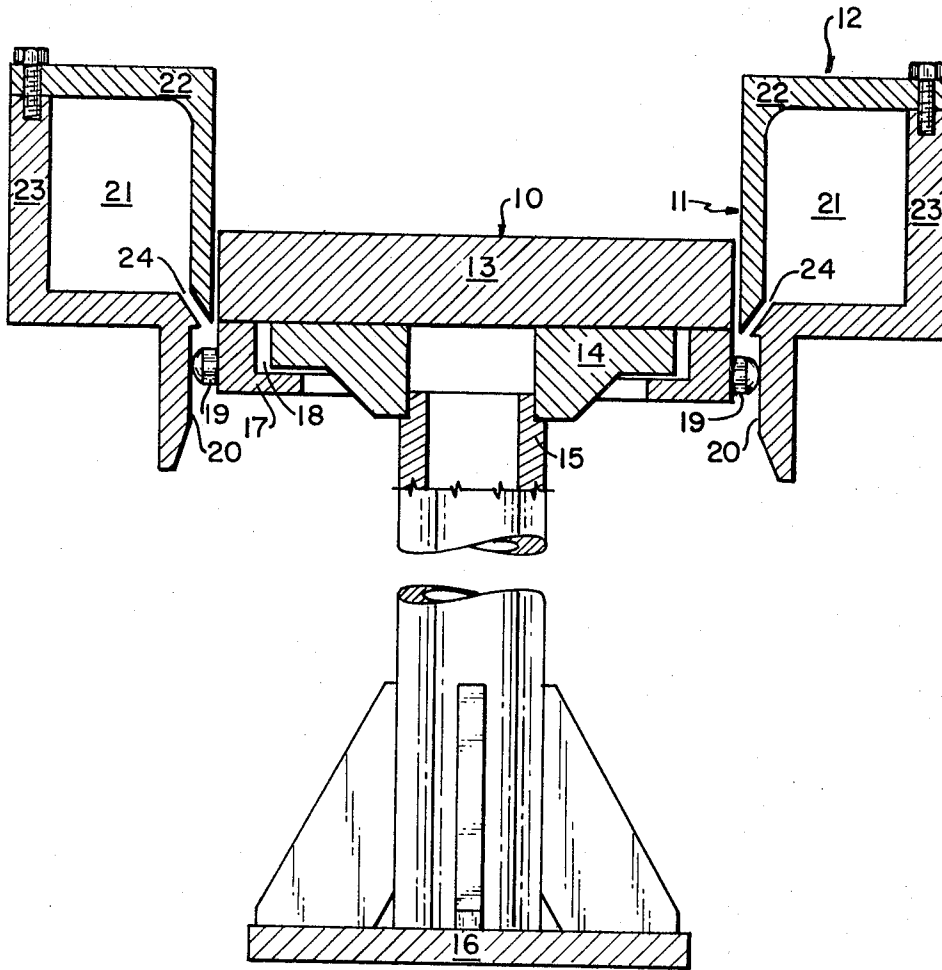


FIG. 1

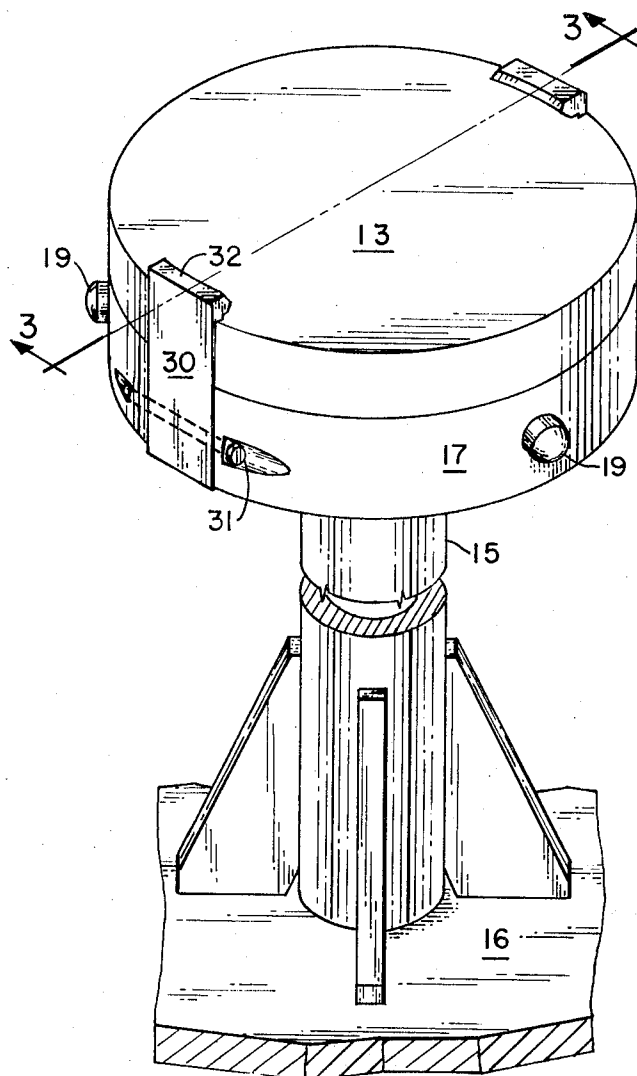


FIG. 2

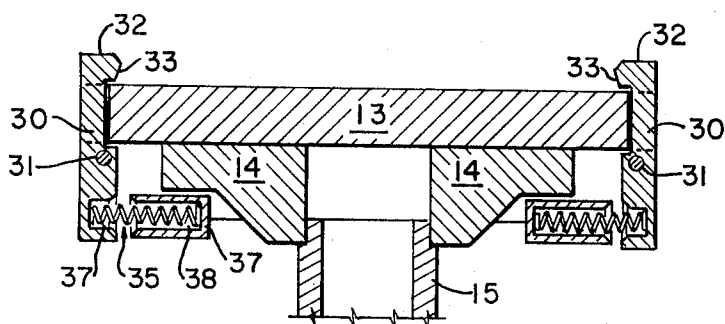


FIG. 3

SELF-CENTERING BOTTOM BLOCK ASSEMBLY

BACKGROUND OF THE INVENTION

This invention relates to a bottom block assembly for use in the vertical direct chill (D.C.) casting of metal particularly light metals, such as aluminum.

In the D.C. casting of metals, molten metal is poured into an open-ended tubular mold and begins to solidify into an ingot. Water is sprayed onto the outside surfaces of the mold and the ingot as it emerges from the mold to further cool the ingot and to assist in solidifying the molten metal above the solidified portion of the ingot. At the start of the casting operations, a bottom block or starter block is inserted into the mold bore to seal the discharge end of the tubular mold and to initiate the solidification of the molten metal to form the ingot. Once solidification of the ingot begins, the ingot is urged out of the mold by lowering the bottom block into a pit situated below the casting apparatus. The bottom block may be lowered by hydraulic or other suitable means. In the past, there has been a continual problem with alignment of the bottom block to avoid scuffing, gouging, or other damage to the mold when the bottom block is inserted or withdrawn from the mold.

In a conventional casting station, a plurality of molds (e.g., up to 20 or more) are generally supported on a casting table which can be moved out of position to remove the cast ingots from the pit. A plurality of bottom blocks are rigidly supported on a vertically movable support table. When the support table is raised to insert the bottom blocks into the molds, the operators normally watch for mold movement to determine misalignment of the molds and bottom blocks. Due to the large number of molds at most casting stations, it is impractical for the operators to check each mold to determine if the bottom block is properly aligned. If mold movement is noticed, the raising of the bottom blocks is stopped and the operator, usually by force, repositions the mold. If the mold position cannot be easily adjusted, then the mold would be loosened from the casting table, aligned with the bottom block and refastened to the casting table. In the case of a water-jacketed mold, alignment of the mold and bottom block is more complicated because the coolant and lubricant lines are attached to the mold, and, frequently, these lines would have to be disconnected to position the mold.

Misalignment of the bottom block assembly with respect to the mold can be caused by many various factors. One of the most prevalent is the removal of the ingot from the bottom block assembly after casting. Usually, the bottom block is provided with projections, such as wires, bolt heads and the like, around which metal can solidify so that the bottom block can urge the solidifying ingot out of the mold during the initial period of casting. Shortly after the casting begins, the solidified portion of the ingot is sufficiently heavy to urge the ingot out of the mold and at this point, the bottom block functions to support and control the speed of the ingot withdrawal. When the casting is completed, a lifting device is usually employed to wrench the ingot away from the bottom block. When the ingot is wrenched away from the bottom block, frequently the bottom block would become displaced causing the subsequent misalignment of the bottom block assembly with respect to the mold bore.

Against this background, the present invention was developed.

SUMMARY OF THE INVENTION

The present invention provides an improved block assembly in which a horizontally movable bottom block is guided into the mold bore without the necessity of adjusting the horizontal position of the mold assembly. The invention comprises a bottom block which is slidably mounted onto a horizontal supporting surface. The bottom block is provided with a retaining means which loosely locks the bottom block to the supporting surface and which allows for horizontal movement of the bottom block. Guide means on the retaining means or the bottom block are adapted to slide along guide runs which are in a fixed spatial relationship with respect to the mold bore. As the bottom block assembly is raised into position, the guide extensions contact the guide runs and thereby align the bottom block with respect to the mold bore. With the bottom block assembly of the present invention, reliance upon the casting station operators for aligning the mold with the bottom block is no longer necessary because no contact between the bottom block and the mold surfaces can occur either in the insertion or removal of the bottom block from the mold bore. Moreover, because contact of the mold surfaces by the bottom block is eliminated by the present invention, a substantial increase in the operational life of the mold results. In a preferred embodiment of the present invention, the bottom block assembly is provided with a means which locks the forming ingot into position with the bottom block during the initial portion of the casting but which will readily release the ingot after the ingot is cast.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of one embodiment of the present invention.

FIG. 2 is a perspective view and FIG. 3 is a cross-sectional view of a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

With reference to FIG. 1, the bottom block assembly 10 of the present invention is generally shown in the mold bore 11 of water-jacketed mold 12. The bottom block assembly comprises a bottom block 13 having horizontal dimensions slightly less than the horizontal dimensions of the mold bore 11 to thereby seal the mold when molten metal is introduced therein. The bottom block 13 is slidably mounted on a smaller supporting member 14 which is affixed to the shaft 15. Shaft 15 is suitably supported on withdrawal or support table 16. Retainer means 17, preferably having an L-shaped cross section, is affixed to the bottom block 13 to loosely lock the bottom block to the supporting member 14 but allowing for substantial horizontal movement between the bottom block and the supporting member. The spaces 18 between the support member 14 and the vertical surfaces of the retaining means 17 allow for horizontal movement of the bottom block. A movement of from about 0.3 to 3 inches, depending upon mold size, is adequate for self-centering characteristics. Guide means 19 are provided on the outer vertical surfaces of the assembly 10, for example, on retaining means 17. Preferably, three or more guide means 19 are provided around the periphery of the as-

sembly. Although the guide means 19 are shown in the drawings as buttons, the extensions may be rollers or a projecting ridge around the periphery of the retaining means. A plurality of vertically disposed guide runs 20 are positioned in a fixed spatial relationship with respect to the bore 11 of the mold 12 and are adapted to guide the bottom block assembly 10 into the mold bore 11 by means of the guide extensions 19. As shown in the drawing, the guide runs 20 are preferably flared outward in the downward direction to provide for the smooth insertion of the bottom block assembly into the mold bore. To allow for the insertion of the bottom block into the mold, the guide surfaces are positioned no closer than the projected perimeter of the mold bore. Preferably, the guide runs 20 are made integral with the mold assembly 12, for example, as a concentric tubular extension of the water jacket.

The materials of construction for the assembly can be of any suitable materials, such as low-carbon steel, aluminum and the like. Preferably, one or both of the contact surfaces between the bottom block and the supporting surfaces are provided with a bearing material, such as bronze and the like. To facilitate movement of the bottom block, preferably the horizontal contact surfaces are smoothed by machining or the like.

Prior to casting, the bottom block assembly 10 is raised into position within the mold bore 11. The guide extensions 19 ride the vertically disposed guide runs 20 aligning the bottom block assembly with respect to the mold bore and thereby preventing any contact between the bottom block assembly 10 and the mold surfaces. Molten metal is then introduced into the mold bore by suitable means (not shown) and immediately the molten metal begins to solidify. When sufficient solidification has occurred, the bottom block assembly is slowly lowered by lowering the support table 16. As the ingot emerges from the mold, it is flooded with coolant from sprays 24 to further cool the ingot and to cause substantial solidification of the molten metal above the solidified portion of the ingot. The guide runs 20 and guide extensions 19 insure that as the bottom block is removed from the mold bore, no contact is made therewith by the bottom block.

Although only one mold assembly and bottom block assembly are shown in the drawings, in commercial practice, a plurality of molds and associated bottom block assemblies are employed at each casting station. The withdrawal table or platen 16 which is hydraulically operated for vertical movement will normally support a plurality of bottom block assemblies. Thus, the drop rate for each ingot is the same and the resultant metallurgical structure and surface characteristics of all of the ingots will be approximately the same.

In FIGS. 2 and 3, another embodiment of the invention is illustrated. The bottom block assembly is provided with means which lock the ingot into position with the bottom block during the initial solidification of the ingot but which readily disengages the ingot when the ingot is removed from the pit by conventional means. The bottom block and supporting surface are essentially the same as shown in FIG. 1. The retaining means 17 are essentially two or more semicircular or arcuate members preferably of L-shaped cross section which are affixed to the bottom block 13 and which generally lock the bottom block 13 in a loose manner to the supporting member 14 as previously discussed.

Lock links 30 are situated in vertical recesses in the periphery of the assembly and are rotatably mounted therein by means of rod 31 which is affixed to the retaining means 17 or an extension of the bottom block.

The upper portion 32 of said lock links 30 extend above and over the upper surface of the bottom block 13. The end of the inwardly extending portion of the lock link is provided with a vertical surface 33 which is inclined in the direction of the bottom block away from the axis of the bottom block. The surface 33 is inclined sufficiently to insure contact with the shrinking ingot as it solidifies. Means 35 are provided to urge the upper portion 32 of the lock link 30 to rotate into engagement with the bottom block 13. The urging means must exert enough force to prevent disengagement of the lock link 30 with the solidifying ingot when the ingot is being urged out of the mold but also allow the ingot to be easily removed after the ingot is cast. A suitable means is shown in the drawing as a spring 36 which is positioned in the recess 37 in the lock link and recess 38 of member 39 to urge the lock link into engagement with the bottom block. Member 39 is suitably supported, for example, to support member 14.

As the molten metal begins to solidify during the initial periods of the casting operation, the inclined surfaces 33 of the lock link 30 insure contact with the shrinking metal. As the bottom block is lowered, the lock link mechanisms urge the forming ingot out of the mold. When the ingot is completely cast, it is readily disengaged from the bottom block assembly by the conventional ingot removal means without damage to the bottom block.

Although the invention has been described in terms of casting apparatus for casting circular ingots, the present invention is fully applicable to ingots of any shape. Moreover, it is obvious that various modifications and improvements can be made to the invention without departing from the spirit thereof and the scope of the appended claims.

What is claimed is:

1. In a vertical D.C. casting apparatus for light metals comprising an open-ended D.C. mold and a bottom block assembly adapted to be inserted into said mold prior to casting the improvement comprising
 - a. a bottom block adapted to be inserted into said mold and having sufficient dimensions to thereby seal the discharge end of said mold;
 - b. a vertically movable member smaller than the bottom block upon which the bottom block is supported, the upper horizontal surfaces of said member adapted for slidable contact with said bottom block;
 - c. retaining means to loosely lock said bottom block to said support member so as to allow horizontal movement of said bottom block;
 - d. a plurality of vertically disposed guide surfaces below the bore of said mold and separate therefrom and in a fixed spatial relationship therewith, said guide surfaces being positioned no closer than the projected perimeter of the mold bore and thereby adapted to guide said bottom block into said mold bore; and
 - e. a plurality of guide means associated with said bottom block which are adapted to ride on said guide surfaces as the bottom block is raised into position within the mold or withdrawn therefrom for aligning said bottom block with respect to said mold and

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preventing contact between said bottom block and said bore.

2. The casting apparatus of claim 1 wherein the cross section of said retaining means is generally L-shaped, the vertically extending leg attached to the bottom surfaces of said bottom block and the horizontally extending leg engaging the bottom surfaces of said support member.

3. The casting apparatus of claim 2 wherein the horizontal dimensions of the support member allow a horizontal movement of the bottom block of from about 0.3 to 3 inches.

4. The vertical D.C. casting apparatus of claim 1 comprising

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- a. A plurality of vertically disposed, rotatable lock links mounted in recesses in the periphery of said bottom block, the upper portion of said lock link extending above the upper surface of said bottom block and inwardly over a portion of said upper surface, the end of said inwardly extending portion of the lock link provided with a vertically disposed surface which is inclined in the direction of the bottom block away from the vertical axis of the bottom block; and
- b. Means of urging the upper portion of said lock link into engagement with said bottom block.

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