METHOD OF BOTTOM-CASTING INGOTS

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References Cited

UNITED STATES PATENTS

3,032,841 5/1962 Sylvester 164/137 X
3,263,283 8/1966 Allard 164/49
3,653,426 4/1972 Groteke et al. 164/133 X
3,695,334 10/1972 Khrizov et al. 164/49
3,700,025 10/1972 Tenner 164/133 X

FOREIGN PATENTS OR APPLICATIONS

661,514 3/1964 Italy 164/363

ABSTRACT

A method and system for bottom-casting ingots, slabs and the like, in which the moulds are positioned above the discharge orifices of runners extending vertically from communicating mould supply channels extending horizontally within a casting platform. The mould supply channels communicate with a teeming gate arrangement provided with means for selectively cutting off the supply of molten casting metal to the mould supply channels. Further selectively operable closure means are also arranged to co-act with the discharge orifices of the runners, to prevent molten casting metal from rising above the level of said orifices when not covered by a mould.

1 Claim, 4 Drawing Figures
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METHOD OF BOTTOM-CASTING INGOTS

The present invention relates to a method and system for the bottom-casting of ingots, slabs and the like, in which casting is effected in moulds positioned on a casting platform with respective mould gates located above and in communication with outlet openings opening out in the casting platform, which outlet openings communicate via distributing channels with a vertically extending teeming gate arrangement, from which the moulds are filled gravitationally with molten metal, i.e., with the metal subjected only to atmospheric pressure, to the desired level by free communication with said arrangement in accordance with the principle of communicating vessels.

Known methods and apparatus for casting ingots, slabs and the like require excessive space and, moreover, produces a relatively large quantity of spillage, commonly known as return metal, which reduces the capacity of such apparatus. According to one conventional bottom-casting method, there is first arranged a system of molten metal supply channels, whereafter moulds intended to receive the molten metal are placed over the outlet openings of the supply channels in register with the mould gates. Centrally of the system of supply channels there is normally arranged a teeming gate, to which the molten metal is charged from a ladle or teemer. The molten metal teemed into the gate passes through the gate and into the system of supply channels, up into the moulds through the mould gates.

When the desired level of molten metal in the moulds is reached, teeming of the metal into the central gate is interrupted, the level of molten metal in the central gate then coinciding with the level of the metal in the moulds in accordance with the law of communicating vessels, and the molten metal caused to solidify both in the moulds and in the system of channels and the central teeming gate. When the metal in the moulds and the supply channels has solidified, the sprues connecting the solidified castings is broken, e.g., by twisting off the sprues in the mould gates, whereafter the castings are removed from the moulds, by applying one of the well known stripping methods.

Before it is possible to carry out a new casting process, however, it is first necessary to remove the solidified metal from the system of supply channels and the central teeming gate, which is an unpleasant and tedious task. Since the quantity of metal solidifying in the channels and the teeming gate is quite considerable, such metal represents a further economic loss, since the whole of this material must be re-smelted before it can be used again. As will readily be perceived, in order to remove the solidified metal from the supply channels, it is necessary to destroy the entire channel system and to rebuild a completely new system before a new casting process can be undertaken, which is naturally both time-consuming and expensive.

With bottom-casting methods known hitherto it is necessary when producing ingots having a weight of, for example, 250 kg from a furnace charge of approximately 20 tons, to use groups comprising four moulding platforms, owing to the fact that it is necessary to restrict the length of the channels in order to avoid blockages therein as a result of metal freezing in the channels during a casting operation. So that the different auxiliary equipment employed to effect a casting operation can be utilized efficiently in the manner intended, it is normally necessary to operate with two groups of casting platforms each with their array of moulds and supply channels etc., i.e. in the aforesaided example, a total of eight casting platforms, of which one group of casting platforms is used for casting purposes, and one group is being prepared for a subsequent casting operation.

The work involved in preparing the casting platforms is both heavy and irksome, among other things because of the heat created by the casting process and the heat emitted from the still hot casting platform on which the task of removing old supply channels and constructing new ones is being carried out.

Another disadvantage associated with such bottom-casting processes is that a heavy traverse is required to support the ladle during the entire teeming process, which may give rise to troublesome waiting periods for other, heavy transport equipment being used within the plant area in question.

These and other disadvantages are eliminated, however, by means of the present invention, which is mainly characterized in that the gate of each mould is closed subsequent to the mould being filled, and that before the moulds are removed from the outlet openings the molten metal located in the distributing channels is prevented from being raised to a level above the level of the outlet openings, at least until all moulds filled with molten metal have been exchanged for empty moulds.

The novel method and associated apparatus of the invention enables auxiliary bottom-casting equipment to be used more efficiently. For example, the ladle containing the molten metal may be placed stationarily over the central teeming gate and thus obviate the use of a traverse for supporting the ladle during the teeming period. The casting operation is also simplified because no special equipment is required to separate each mould and casting from the solidified mass of metal located in the supply channels.

The invention also affords the advantage whereby the area of flooring required for the casting site is reduced, since, when practising the method of the invention, it is necessary to use only one casting platform for casting a desired quantity of molten metal. Further, the method and apparatus of the present invention greatly reduce the amount of work required in the aforesaid preparation of the system of channels.

As previously mentioned, the invention also relates to an apparatus for carrying out the method, the apparatus being mainly characterized by first closure means arranged to break communication of the mould gates with the outlet openings and runners, and thus also with the distributing channels, and by level control means arranged to prevent the molten metal in the supply lines to the moulds from reaching a level above the outlet openings, at least until all filled moulds have been replaced with fresh, empty moulds.

The invention will now be described in detail with reference to the accompanying drawing, further features of the invention being described in connection therewith. In the drawing,

FIG. 1 illustrates diagrammatically and in plan view a casting platform with a number of moulds according to the invention disposed thereon,

FIG. 2 is a vertical section taken along the line II—II in FIG. 1 of the casting platform and moulds illustrated therein,
FIG. 3 is a vertical section taken along the line III—III in FIG. 1 of the casting platform illustrated therein, and FIG. 4 illustrates a variation of the embodiment illustrated in FIG. 2. The elements illustrated in the separate FIGS. 1–4 are identified by the same reference numerals. Thus, the reference numeral 10 identifies a casting platform with which the method of the present invention is carried out, the platform being provided with a substantially horizontally extending system of molten metal supply channels 11 communicating with branch lines or runners 12 which extend vertically to the moulds 14 placed over outlet openings 13. The horizontally extending supply channel system 11 is connected with a teeming gate, shown generally at 15, which extends vertically substantially above the casting platform and which suitably communicates with the horizontal system of channels 11 via a chamber 16, in which the vertically extending teeming gate 15 protrudes via a tubular portion 17, which in the illustrated and described embodiment extends down into the chamber 16 to a level below the lowest portion of the channel system 11. The upper portion of the gate 15 comprises a container 18, the upper edge 19 of which is located substantially on the same level as the upper surface of the moulds 14, or may be located above said level. In the illustrated embodiment, there is arranged in the chamber of the container 18 a first closure means, shown generally at 20, which is operative to prevent molten metal from leaving the container 18. Prior to carrying out a casting process, a group of prepared moulds 14 are placed over the outlet openings 13 of the runners 12 in the casting platform 10. A ladle or teemer 21 containing molten metal is positioned over the container 18 of the teeming gate 15. To limit the time during which the ladle conveying metal is not covered by the metal, need be kept in use, the ladle 21 is conveniently placed on a frame 22. The teeming hole 23 of the ladle 21 is opened by means of a valve arrangement 24, suitably comprising an elevatable refractory member, wherewith the molten metal flows down into the container 18 of the teeming gate and passes through the tubular portion 17 into the chamber 16, from which it is distributed by the system of channels 11 to the vertically extending runners 12 and caused to rise up therethrough into the outlet openings 13 and the moulds 14. The moulds 14 are provided at the bottom portion 25 thereof with second closure means 26, which in the illustrated embodiment consists of a bar or plate 27 made of a suitable material, e.g., graphite, ceramic material, a heat resistant metal alloy, or metal plate provided with a ceramic lining. When positioning the mould 14 onto the casting platform 10, the plate 27 is moved to one side to expose the mould gate to the outlet opening 13 of the runners 12, thereby enabling molten metal to flow from the teeming gate, through the channels 11 and into the moulds 14. The plate 27, for example, is so constructed and dimensioned that, when occupying its position in which molten metal is able to flow into the moulds, the plate is located completely within the surface contours of the moulds 14. Alternatively, closing of the moulds can be effected by moving the moulds on the casting platform, thereby obviating the use of separate closure means.

When the molten metal has reached the desired level in the moulds 14, passage of the molten metal to the tubular portion 17 is cut off by actuating the closure means 20 to close the mouth of the tubular portion 17, whereupon the molten metal in the moulds 14 is maintained at the desired level even though ejection of the metal from the ladle 21 in the container 18 should be continued until shortly after the desired level has been reached. Teeming of the metal from the ladle 21 is interrupted by closing the teeming hole 23, by means of the valve arrangement 24, or by any other suitable means. Subsequent to interrupting the supply of the molten metal to the moulds 14, the mould closure means 26 is operated to close the passages through the lower portions of the moulds 14. In the illustrated embodiment, the plates 27, which are perforated to permit molten metal to pass therethrough, are actuated to closing position by mechanical drive means 28, suitably a hydraulic motor. The moulds 14 are suitably located in a manner such that the lower surfaces 29 of the moulds are in contact with each other. By adjusting the length of each plate 27 to coincide with the width of the mould 14 across the portion 29, the same degree of movement can be obtained with all plates 27 located in the row of moulds, by transmission of the movement of one plate to the next, and so on throughout the row. Subsequent to the plates 27 having been moved to their closing position and a traverse (not shown) having conveyed fresh, empty moulds 14 to an erecting station 30, a pusher system 31, consisting for example of a hydraulic motor 32 and a system of links 33, can be actuated to push fresh, empty moulds 14 to the filling station, at the same time as the filled moulds are moved from respective casting positions over the runner outlet openings 13 to a flat surface 34, from which the filled moulds 14 are removed by means of conventional conveying apparatus to a suitable site, where the molten metal is allowed to solidify in the moulds. Removal of the filled moulds 14 before the molten metal has solidified is enabled in the illustrated embodiment in FIGS. 1–3 by the closure means 20 arranged in the teeming gate 15, which when occupying its closed position (FIG. 2) interrupts the supply of molten metal to the system of channels 11. When the moulds have been filled to the extent desired, the mould gates are closed and the moulds removed from the platform. In accordance with the novel method, measures are taken to prevent the molten metal from rising above the level of the outlet openings when the moulds are removed and the outlet openings consequently exposed. One such measure involves maintaining the molten metal in the upper mouth portion of the outlet openings at the same level as before removing the moulds, although this will involve the risk of the molten metal freezing in the outlet openings. Alternatively, the level of the molten metal can be lowered to at least the level of the vertically extending runners 12. The described embodiment constitutes an example of this latter alternative, and to this end is provided with means for lowering the level of the molten metal at least in the runners 12 to the under the hotter zones, where risk of the metal freezing is less. This is achieved in the illustrated embodiment by introducing to the upper chamber portion 36 located above the orifices of the channels 11 in the chamber 16 a pressurized gas, preferably an inert gas. The body of gas located in the upper por-
tion 36 of the chamber 16 communicates with a gas container (not shown) via a pipe 37, control means 38 and an additional pipe 39.

When pouring the molten metal into the teeming gate 15, the pressure of the gas in the chamber 16 is regulated so that the space 36 is predominantly filled with gas. Subsequent to pouring the molten metal and closing the closure means 20 and 26 to prevent passage of molten metal through the system, the pressure of the gas is reduced, wherewith the molten metal enclosed between the teeming gate 15 and the closure means 26 will flow back and collect in the chamber 16. This means that when the chamber 16 is correctly dimensioned, the level of the molten metal in the channels 11 will fall to beneath the level of the outlet openings 13, thereby reducing the risk of the metal freezing in the runners 12 while the filled moulds 14 are being changed for fresh empty moulds and the fresh moulds placed over the outlet openings 13. Subsequent to changing the moulds, a new casting process can be commenced by opening the closure means 20.

The closing valve used with the continuous casting system described and illustrated in FIGS. 1-3 is of particularly simple construction, and comprises the movable valve body 20 and a valve seating formed in the upper mouth portion of the tubular portion 17 and receiving the lower end of the valve body. Although the valve seating is illustrated as being located a relatively short distance above the casting platform, it will be understood that the seating may alternatively be placed closer to the platform, substantially within the platform or even beneath the same.

FIG. 4 illustrates a system coinciding substantially with the system illustrated in FIG. 1, except that the closure means 20 and the gas body in the upper portion 36 of the chamber 16 have been replaced with a permanently open closure means 35 of known type which balances a static column of molten metal by an electromagnetic force field, thereby fulfilling the same purpose as a mechanical closing valve. Thus, the embodiment illustrated in FIG. 4 permits the arrangement of mechanical closure means for preventing the flow of molten metal from the container 18 to the channels 11 to be omitted if desired. The closure means 34 of the embodiment illustrated in FIG. 4 is of well known construction and does not form part of the present invention, and will not therefore be illustrated or described in detail. In addition to fulfilling its function as a closure means, the means 35 can also be caused to exert and maintain a certain suction effect on the molten metal present in the chamber 16, in a direction towards the container 18. Thus, subsequent to actuating means 26 to its closing position, it is possible to lower the level of the molten metal in the outlet openings 13 by means of the closure means 35, thereby eliminating the risk of molten metal freezing in the runners 12.

In accordance with the present invention, instead of a body of gas in chamber 16, the chamber may be connected via a simple closing valve to a separate drainage chamber, e.g., in the form of an elevatable mould capable of accommodating the quantity of molten metal needed to lower the level of said metal in the aforesaid manner.

The invention is not restricted to the illustrated and described embodiments, but can be modified within the scope of the accompanying claims.

We claim:
1. In a method of bottom-casting ingots, slabs and the like in moulds located on a casting platform with mold gates in register with and communicating with outlet openings discharging in the casting platform, said casting platform including a chamber communicating through runners and distributing channels with a vertically extending teeming gate arrangement from which the molds are gravitationally filled with molten metal to the desired level, comprising the steps of: filling said molds with said molten metal to a desired level; concurrently introducing a quantity of a pressurized inert gas into said chamber above the molten metal conveyed therethrough so as to form an inert gas cushion above the molten metal in said chamber during casting thereof; closing said teeming gate arrangement; closing the gates of respective of said filled molds so as to isolate said distributing channels, said runners and said chamber from the surrounding atmosphere; and upon closing of said teeming and mold gates reducing the pressure of said inert gas above the molten metal in said chamber to effect a return flow of molten metal from said runners and distributing channels into said chamber for preventing the level of molten metal remaining in said chamber, runners and distributing channels from reaching a point above the level of the outlet openings prior to removing the filled molds and replacement thereof with empty molds.

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