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Tenner

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[54] **APPARATUS FOR CASTING MOLTEN METAL IN BOTTOM-POURING MOLDS**

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[58] **Field of Search** 249/109, 110; 164/363, 337, 164/129, 304, 133, 266, 154–156; 266/38; 222/559

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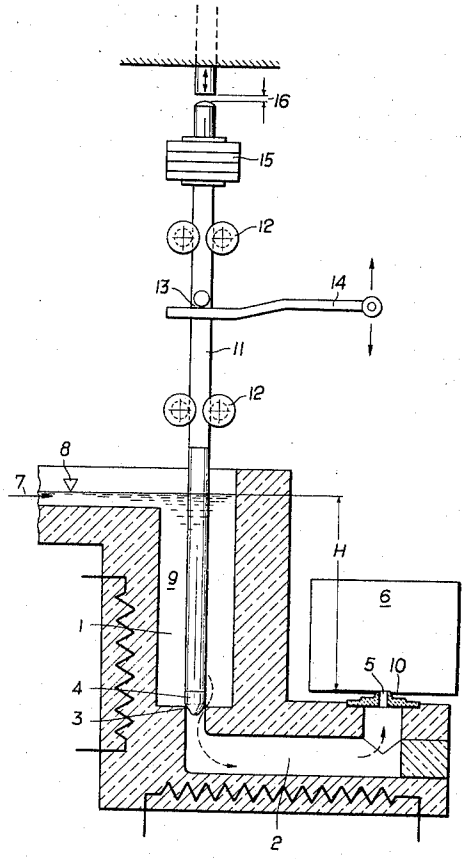
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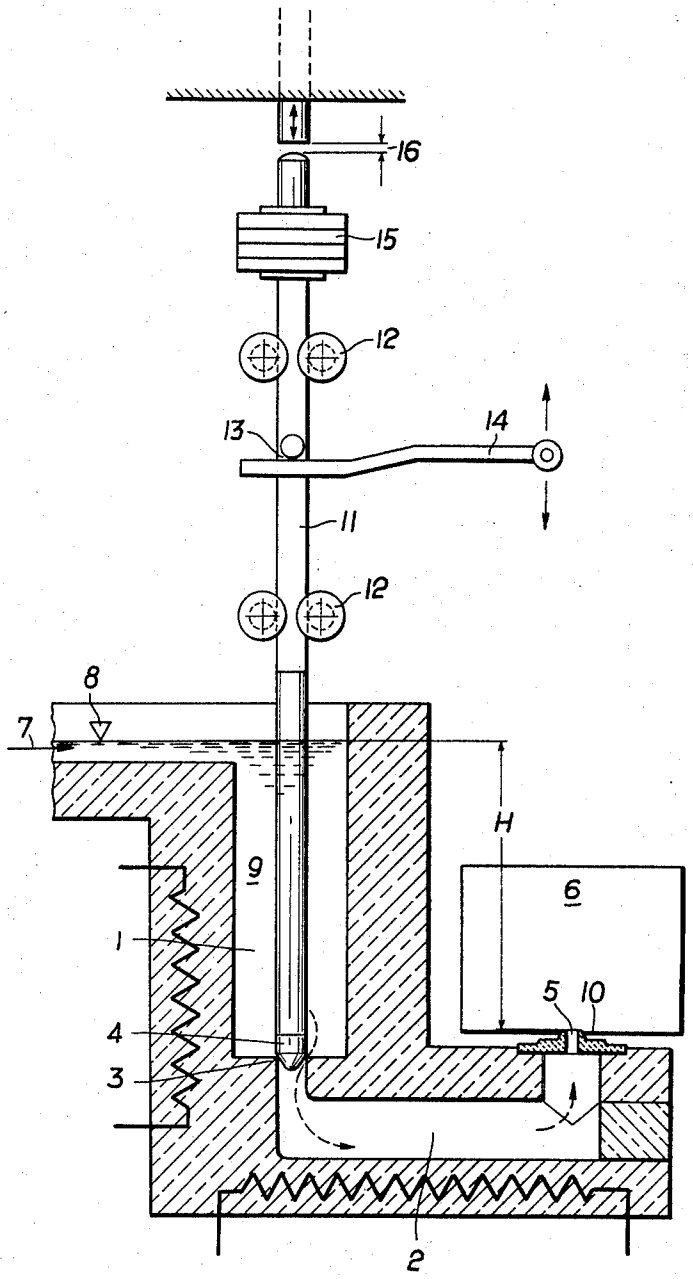
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[57] **ABSTRACT**

First chamber means define a vertically elongated first chamber and have a bottom formed with a bottom opening communicating with said first chamber. The first chamber means are provided with an overflow inlet communicating with said first chamber on a predetermined intermediate level thereof. Second chamber means define a horizontally elongated second chamber, which is smaller in cross-sectional area than said first chamber and has one end portion communicating with said bottom opening and an opposite end portion formed with an upwardly directed opening adapted to communicate with a bottom-pouring ingot mold. A plug is operable to selectively close and open said bottom opening.

10 Claims, 1 Drawing Figure





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APPARATUS FOR CASTING MOLTEN METAL IN BOTTOM-POURING MOLDS

The present invention relates to an apparatus for casting molten metal in ingot molds, in which apparatus molten metal flows from a ladle or melting furnace through two chambers into runners, from which the molten metal rises from bottom to top into the mold cavities of the ingot mold.

It is known to apply pressure to the surface of a molten bath in a crucible or other vessel, so that the molten material is forced through a riser into a casting mold, such as an ingot mold. In the known low-pressure process, the required pressure is applied to the surface of the molten bath by a gas under low pressure, which gas may consist, e.g., of air or nitrogen or a rare gas.

A development of the low-pressure process is known as the Alumasc process, in which a small superatmospheric pressure is applied to the molten metal to force the latter through a riser into the mold. When the casting has solidified, the superatmospheric pressure is removed, so that the molten metal is torn at the outlet end of the riser.

The known casting processes of that kind for a mechanical charging of casting molds have various disadvantages, so that they cannot be used to produce large numbers of castings per unit of time. In the casting of brass in ingot molds or of aluminum alloys and generally of molten materials tending to oxidize, these processes have the disadvantage that oxide films form on the surface of the molten bath and in the riser of the system and may be entrained to enter the casting mold during each casting operation, so that the quality of the casting is adversely affected. Whereas the formation of such oxide films can be restricted or avoided by the use of a non-reactive gas, such as nitrogen, or even a rare gas, rather than of atmospheric air, it will be understood that the use of such gas will increase the manufacturing costs, so that the economy of the casting process will be adversely affected. Also in the known processes the cycle times are too long in view of the large numbers of castings which are desired per hour because a gradually increasing pressure must be applied to the surface of the molten bath, the molten metal must then be forced into the mold through the riser (charging step) and, when the charging step has been completed, the pressure applied to the surface of the molten bath must be sufficiently reduced, so that the molten metal can separate from the mold inlet and fall in the riser to the level of the surface of the molten bath.

The riser leading to the mold extends into the soaking vessel or crucible and the level of the surface of the molten bath in said vessel or crucible necessarily changes widely during operation because the surface is lowered to a predetermined extent after each charging of the mold. As a result, the level of the surface of the molten bath varies continually between an upper limit, which is attained when the soaking vessel has been refilled with molten metal from the melting furnace, and a lower limit, which is reached when the level of the bath surface has been lowered toward the end of the casting operations. This will result in different cycle times, which will be a minimum when the vessel has been refilled with molten metal to the upper limit of the surface level and which will be a maximum when refilling is required. It will be understood that the flow

of molten metal from the transport vessel into the soaking crucible during the refilling of the latter with molten metal tending to oxidize will result in an entrainment of air, particularly when atmospheric air is used as a fluid for applying pressure to the molten material. This results again in a formation of oxide skins and, to some extent, of oxide foam.

It is also known to cast in top-pouring molds. In this case, the molten material flowing from the ladle is cast directly into the mold which stands on a plate and the nozzle of the ladle is closed by means of a plug.

This process has the additional disadvantage that the fall of the molten material through the atmosphere results in the formation of an oxide layer in an amount which is even larger than in the above-mentioned low-pressure process because a large amount of air is entrained. Another disadvantage resides in that the velocity at which the molten metal enters the mold cannot be controlled.

It is one object of the present invention to provide an apparatus for casting metal in removable molds, wherein these disadvantages are avoided by the apparatus provided according to the present invention for casting molten metal.

It is another object of the present invention to provide an apparatus for casting metal in molds, wherein the essential feature of the present invention resides in that a ladle or melting furnace is connected by a connecting pipe or an overflow to a vertically elongated housing defining a chamber for receiving the molten metal, a bath surface is maintained on a constant level in the chamber, the latter having a bottom opening, which can be closed by a conventional plug and communicates with one end of a horizontally elongated, second chamber, which is smaller in diameter than the first-mentioned chamber and forms a duct having at its opposite end an upwardly directed opening, and a casting mold is adapted to be fitted onto the latter opening, so that said mold is disposed below the level of the bath surface.

In an embodiment of the present invention, the plug may be connected in known manner to a guided stopper rod, which extends freely into the molten metal from above and is adapted to be controlled by hand or by electric or electronic means.

The two chambers may be electrically heated by conventional means which are not part of the present invention. The cross-sectional areas of the two chambers and the ratio of said areas will depend on the expected rate of molten metal.

The arrangement according to the present invention will result in the advantage that the level of the bath surface and with it the static pressure in the chamber can be held constant. Besides, the oxidation is much reduced because the contact area between air and molten metal is minimized. The molten metal is continually made up by the overflow which has been provided so that a re-pouring is not required and there is no entrainment of air.

With these and other objects in view which will become apparent in the following detailed description, the present invention, which is shown by example only, will be clearly understood, in connection with the accompanying drawing, in which the only FIGURE is an axial section of the apparatus designed in accordance with the present invention.

Referring now to the drawing the apparatus, according to the present invention, comprises an ingot mold set defining a chamber **1**, which receives molten metal from a connecting duct or an overflow **7**. The surface of the molten metal **9** in chamber **1** is maintained on a constant level determined by level detector **8**. The chamber **1** is provided at its lower end with a bottom opening **3** and is connected by said opening in an L-shaped arrangement to a bottom runner defining a second chamber **2**. At its end opposite to the bottom opening **3**, the second chamber **2** has an outlet opening **5** communicating with a removable mold **6**. The distance H from the bottom **10** of the removable mold **6** to the bath level determined by level detector **8** is automatically held constant during the casting operation by the provision of the overflow **7** according to the present invention.

A plug **4** is inserted into the bottom opening **3**, and is connected to a guided stopper rod **11**, which extends into the melt **9** freely from above. By means of a control lever **14**, a mechanical control mechanism **13** and the guided stopper rod **11**, the plug **4** is raised or lowered as may be required, thereby closing or opening the bottom opening **3**. The guided stopper rod **11** extends through the nips between two pairs of guide rollers **12** and above said rollers carries a weight **15**. There is an adjustable vertical gap over the guided stopper rod **11**.

When the molten metal flows from the melting chamber or ladle through the connecting pipe or overflow **7** into the chamber **1**, the chamber will fill while the plug **4** is seated at the bottom opening **3**. When the plug **4** has been lifted from its seat, the chambers **1** and **2** communicate and the molten metal in the chamber **2** is under the static pressure which prevails at the bottom of the chamber **1** and depends on the head H and the density of the molten metal. That pressure causes the molten metal to rise into the removable mold **10** through the outlet opening **5**. In the mold **10**, the molten metal flows through runners to several mold cavities and through gates at the end of the runners into the mold cavities, which are filled by the molten metal in a bottom-pouring operation. When the molten metal has entered the mold cavities, the bottom opening **3** of the chamber **1** can be closed by means of the plug **4**, which is controlled by hand or automatically by a relay (not shown), which may be remotely controlled in response to a contact which is closed as the rising molten metal enters a sensing riser of the casting system.

The apparatus according to the present invention is generally used in casting operations and may be used for casting virtually any molten metal. The advantages of the apparatus according to the present invention will become particularly apparent where molten metals are used which are easily oxidized.

The subject matter of the present invention is not restricted to the embodiment which has been shown and described by way of example to facilitate the understanding of the invention, because said embodiment may be modified within the scope of the present invention.

While I have disclosed one embodiment of the present invention, it is to be understood that this embodiment is given by example only and not in a limiting sense.

I claim:

1. An apparatus for casting molten metal, which comprises

a housing defining a vertically elongated first chamber,

said first chamber having a bottom formed with a bottom opening communicating with said first chamber,

said housing being provided with inlet means communicating with said first chamber on a predetermined intermediate level thereof and including means for automatically maintaining constant the level of said molten metal in said first chamber during the casting operation,

said housing defining a horizontally elongated second chamber, the latter being smaller in cross-sectional area than said first chamber and has one end portion communicating with said bottom opening and an opposite end portion formed with an upwardly directed exit opening, adapted to communicate with a bottom-pouring removable mold which is separate from said housing and disposed below said constant level of molten metal,

a plug operable to selectively close and open said bottom opening, and

means for heating the molten metal in said first and second chambers.

2. The apparatus, as set forth in claim **1**, in which said inlet means comprises an overflow inlet.

3. The apparatus, as set forth in claim **2**, in which said overflow inlet comprises

an overflow inlet pipe connected to said housing.

4. The apparatus, as set forth in claim **1**, which comprises

a bottom-pouring mold, which is mounted to communicate with said upwardly directed exit opening and has a mold cavity disposed below said intermediate level.

5. The apparatus, as set forth in claim **1**, which comprises

a stopper rod connected to and extending upwardly from said plug in said first chamber and above said level of molten metal and

guiding means disposed above said level of molten metal and in guiding engagement with said stopper rod.

6. The apparatus, as set forth in claim **5**, which comprises

manually operable means for operating said stopper rod to open and close said bottom opening.

7. The apparatus, as set forth in claim **5**, which comprises

electrically controlled means for operating said stopper rod to open and close said bottom opening.

8. The apparatus, as set forth in claim **1**, which comprises

a source of molten metal in communication with said inlet means.

9. The apparatus, as set forth in claim **8**, in which said source comprises a melting furnace.

10. The apparatus, as set forth in claim **8**, in which said source comprises a ladle.

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