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WITHDRAWAL HEAD FOR CONTINUOUS-CASTING MOULDS AND METHOD OF USING SAME

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FIG.1

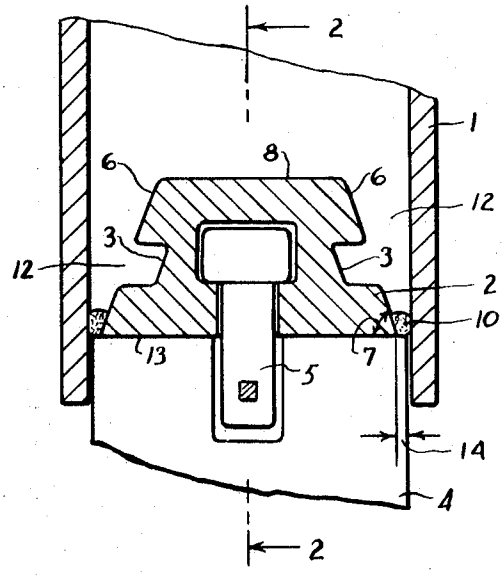


FIG.2

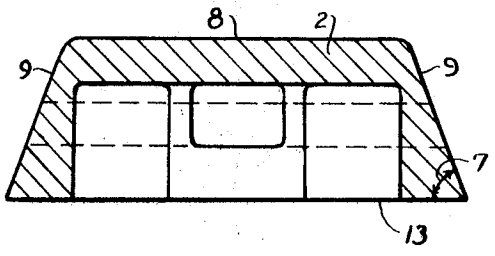
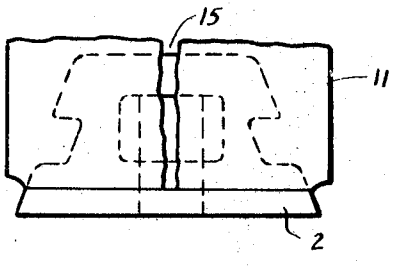


FIG.3



INVENTORS
FREDERICK J. LEESE
WILLIAM H. SUMMERS

BY Sandoe, Neill
Echotter & Wikstrom

ATTORNEYS

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WITHDRAWAL HEAD FOR CONTINUOUS-CASTING MOULDS AND METHOD OF USING SAME

Frederick John Leese, Stoke-on-Trent, and William H. Summers, Hampton Hall, near Malpas, England, assignors to Concast AG, Zurich, Switzerland

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ABSTRACT OF THE DISCLOSURE

A withdrawing head for plugging a rectangular continuous-casting mould at the start of casting is in the form of a truncated pyramid having four inclined sides with transverse recesses formed in opposite side faces. The base is slightly smaller than the cross section of the mould and is placed in the mould with the inclined sides extending up into the mould, suitable sealing material being packed around the base.

The invention relates to the continuous casting of metals, particularly steel, by pouring liquid metal into a cooled open-ended mould and withdrawing the casting, when this has formed a solidified skin, by means of a dummy casting attached to a withdrawing head.

In a continuous-casting plant comprising an open-ended mould it is known to close the bottom end of the mould by a dummy casting attached to a withdrawing head before casting begins. The stopper thus formed retains the inflowing liquid metal until the mould has been filled, when the casting formed can be continuously withdrawn from the mould by starting up a set of withdrawing rollers.

From transmitting the pull during withdrawal it has been proposed to provide a mushroom-shaped withdrawing head. In order to facilitate the subsequent separation of the head from the solidified casting, refractory plates are inserted which divide the mould interior to the top of the withdrawing head into two cavities. Moreover, the withdrawing head is provided with a coating to prevent the metal from welding onto the head. Although the area of such a withdrawing head is arranged to exceed half the cross-sectional area of the mould, it is still impossible to prevent the creation of major gaps between the round withdrawing head and the sides of the mould. Apart from the lengthy time it takes for the steel to freeze in these large cavities, the moments that are applied to the metal that has solidified above the withdrawing head in the hottest and therefore weakest zone in the casting cross section is a drawback which frequently leads to a premature break-away of the withdrawing head from the solidifying casting. Moreover, despite the presence of the coating, the metal cannot be prevented from welding onto the withdrawing head. Moreover, the base of the withdrawing head must be protected from the liquid metal by a covering of chips. As a matter of experience these chips do not fuse completely and they then score and scratch the mould walls and any following cooling plates that may be provided.

It is therefore an object of the present invention to eliminate the above described difficulties by providing a method of positively coupling the continuous casting to the dummy by means of a withdrawing head which can subsequently be easily detached from the casting and which is so contrived that the continuous casting will not be stressed by the withdrawing pull at points where this is undesirable.

The invention therefore proposes a method as well as apparatus which permit the casting to be satisfactorily withdrawn from the mould and detached from the withdrawing head. The proposed method consists in providing a withdrawing head having the general form of a truncated pyramid with recesses formed in opposite sides and a base substantially filling the entire cross section of the mould, thereby to form a cavity which tapers between the wall of the mould and the withdrawing head towards the dummy casting, in sealing this cavity to prevent metal from penetrating to the dummy casting, and in abstracting through the walls of the cavity sufficient heat from the cast metal to establish coupling engagement with the withdrawing head without forming a weld, in such manner that the pull of withdrawal is transmitted substantially in the axial direction of the casting through the outer solidified skin without applying undesirable bending loads to the solidifying metal.

The preferred form of withdrawing head is a truncated pyramid having a base and four sides inclined at an angle towards the casting axis, the base is slightly smaller than the cross section of the casting, and a transverse recess is formed in each of two opposite sides.

In order that the invention may be more readily understood an embodiment and other features thereof will be hereunder described, by way of example, reference being made to the accompanying drawing, in which:

FIG. 1 is a sectional view of the bottom end of a continuous casting mould containing an inserted dummy casting,

FIG. 2 is a sectional view of the withdrawing head of the dummy casting, taken on the line II—II in FIG. 1, and

FIG. 3 is an elevation of the withdrawing head and the surrounding metal after having been cut off the casting and detached from the dummy.

A withdrawing head **2** having transverse recesses **3** in two opposite sides **6** is inserted into a mould **1** of rectangular cross section. For casting cross sections with unequal sides the two recesses should preferably extend across the longer sides. The underside of the withdrawing head **2** is attached to a dummy casting **4**, for instance by means of a T-shaped anchoring pin **5** adapted to provide a push-and-turn coupling. The two sides **6**, as well as the remaining two sides **9** of the withdrawing head **2**, are inclined towards the casting axis. The withdrawing head, having an upper flat surface **8**, thus has the overall shape of a truncated pyramid. The size of the base is so chosen that it substantially fills the cross section of the mould. A sealing material **10**, such as asbestos, is packed between the mould wall and the base of the withdrawing head **2** to form a tight joint. Owing to the downwardly diminishing width of the gap between the wall and the sides of the head this joint effectively prevents the liquid metal, e.g. steel, from penetrating downwards to the dummy casting. The described configuration of the withdrawing head creates spaces **12**, between the mould wall and the sides **6** of the withdrawing head, which narrow in the direction down towards the base **13** of the withdrawing head; in this narrowing space the quenching effect of the mould wall and the withdrawing head rapidly abstracts heat from the poured metal so as to prevent the withdrawing head from being fused and welding to the metal of the casting. Nevertheless, the liquid and rapidly solidifying metal which fills the lateral transverse recesses **3** in the withdrawing head creates a positive coupling connection, permitting the withdrawing pull to be reliably transmitted to the casting. The forces which are engendered during the process of withdrawal are transmitted by this coupling connection in such a way that downward pulling force applies substantially in the

axial direction of the casting through the surface layer which has already solidified, so that no major bending moments, are applied to the hot solidified metal layer, which, above the top of the withdrawing head, still lacks mechanical cohesion and strength.

The continuous casting that is withdrawn from the mould—by withdrawing rollers—is separated from the withdrawing head **2** by a suitable cutting tool (not shown) which cuts it off directly above the withdrawing head, for example, at a distance of 1 to 2 cms. therefrom. The withdrawing head can then be removed from the dummy casting **4** by releasing the coupling pin **5**.

It will be understood from FIG. 3 that the metal **11** enclosing the withdrawing head **2** can be divided into two halves by two substantially vertical cuts, as indicated at **15**. The two pieces can then be pulled away from the recesses to free the withdrawing head from the surrounding metal without damaging the withdrawing head, which thus can be reused repeatedly. The economy of the process can be even further improved by using the undamaged withdrawing head repeatedly without detaching it from the dummy. The time needed for preparatory work preceding a casting operation can thus be reduced to less than 3 minutes. This affords a considerable saving in time compared with conventional methods.

For casting steel, the withdrawing head is preferably made of cast iron. It has also been found that for achieving satisfactory results the angle **7** which each side makes with the base should preferably be about 70°. The height of the withdrawing head should not be less than 100 mm. to ensure a sufficiently rapid withdrawal of heat. Furthermore, the distance of **14** of the base **13** from the mould walls should be as small as possible and preferably less than 10 mm., since this facilitates the creation of a tight seal.

Its rapid solidification prevents the molten metal from welding to the withdrawing head, thus permitting the latter to be reused after it has been extracted from the surrounding metal. Since cooling chips need not be packed around the withdrawing head the risk of scoring the wall of the mould is also eliminated. Experience has shown that a withdrawing head can thus be used for about 10 castings in the continuous casting of steel. By covering the upper surface **8** of the head with a plate before the steel is poured into the mould, the life of the head can be extended to more than 25 castings. Conveniently, such a covering plate may consist of a material of the same quality as that which is to be cast.

What we claim is:

1. A method of continuously casting metals, comprising closing the open end of a cooled, open-ended permanent mould by a withdrawing head having a dummy casting attached thereto, the withdrawing head having the general form of a truncated pyramid with recesses formed in opposite sides and a base substantially filling the entire cross section of the mould, said withdrawing head thus forming a cavity which tapers between the mould wall and the withdrawing head towards the dummy casting, sealing said cavity to prevent liquid metal from penetrating to the dummy casting, pouring liquid metal into the mould and abstracting sufficient heat from the cast metal between the walls of the cavity to establish coupling engagement with the withdrawing head without the formation of a welded bend, and withdrawing the resultant continuous casting, when this has formed a solidified skin, by means of the dummy casting whereby the pull of withdrawal is transmitted substantially in the axial direction of the casting through the outer solidified skin without applying undesirable bending loads to the solidifying metal.

2. A method according to claim **1**, further comprising cutting the resultant continuous casting adjacent the withdrawing head and subsequently separating the metal enveloping the head into two parts and pulling them away from the recessed sides of the withdrawing head.

3. A method according to claim **1**, comprising placing a cover plate over the top of the withdrawing head before pouring the metal into the mould.

4. A method according to claim **1**, comprising reusing the withdrawing head for a subsequent casting operation without detaching it from the dummy casting.

5. A method according to claim **1** for casting steel, wherein a withdrawing head consisting of cast iron is used.

6. A method according to claim **1**, wherein the gap between the base and the mould wall is 10 mm. or less.

7. A withdrawing head for continuous casting apparatus comprising an open-ended mould of rectangular cross section, said withdrawing head comprising a truncated pyramid having a base and four sides which are inclined towards the casting axis, the base being only slightly smaller than the cross section of the continuous casting, and transverse recesses being formed in opposite side faces.

8. A withdrawing head according to claim **7**, wherein a said recess is formed in each of two opposite sides.

9. A withdrawing head according to claim **7** having a height of at least 100 mm.

10. A withdrawing head according to claim **7** which, for use in the casting of steel, consists of cast iron.

11. A withdrawing head according to claim **7**, wherein the angle that the four sides make with the base is about 70°.

12. A withdrawing head according to claim **7**, comprising two longer and two shorter sides wherein the recesses are formed in the two longer sides.

13. A withdrawing head according to claim **7** in combination with a mould wherein the base is dimensioned so that the gap between it and the mould wall is 10 mm. or less.

14. A withdrawing head according to claim **7** comprising means for releasably coupling to a dummy casting.

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J. SPENCER OVERHOLSER, Primary Examiner

J. E. ROETHEL, Assistant Examiner

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