The present invention relates to an apparatus for continuous casting of metal and particularly refers to a means for guiding the cast ingot or slab immediately after the latter leaves the die in the so-called secondary cooling zone.

In the continuous casting of ingots or slabs these are cooled down in the secondary cooling zone shortly after they emerge from the die by spraying water against them to such an extent that when leaving this zone the slabs or ingots are approximately solidified over their whole cross-section. In order to obtain metallurgically perfect quality of the cast slab it is of great importance that the spraying is adaptable to changing working conditions and that this spraying, while being precisely adjustable, is also perfectly uniform. Since at least in the zone adjacent the die the solidified external zone or skin of the slab is still thin and thus may take up only limited pulling and compressing strains it has been advisable to provide means which contact the wall surface of the ingot or slab directly after it is withdrawn from the die for a distance which allows the walls or skin to acquire such a thickness as to continue to be self-supporting.

Such means for supporting and guiding the slab as it emerges from the die and before entering the withdrawal apparatus are described and illustrated in detail in the US-patent specification No. 2,284,503 for "Apparatus for Continuous Casting" filed September 14, 1939. In this patent there are shown guiding rolls or plates assembled with spraying pipes in a common frame. This slab guiding or supporting means is arranged in the spray chamber in such a manner that a separate roller guiding may be mounted for each slab or ingot or thereat least the spaces between the rollers may be adjusted and that in the case of a breaking out of fluid steel through the solidified external zone or skin the slab guiding may be cleaned. Also the possibility of an easy checking, replacement or readjustment of the spray nozzles during interruptions of the working must be provided.

In vertical continuous casting apparatus the slab guiding means have up to now been mounted below the die in such manner that for the interchanging of this guiding means it was necessary either to remove the die in order to remove the guiding upwardly or then the guiding had to be released from its securing which was rather cumbersome and then it had to be taken out of the machine through an appropriate opening in the spray chamber. Obviously great time losses were involved with these working steps. It is a prime object of the present invention to render possible the exchange of the guiding means for the slab or ingot in substantially shorter time than it was possible before and thereby to notably improve the yield and the commercial efficiency of the plant. This is obtained according to the present invention by making the guiding means for the slab or ingot and the support therefor withdrawable in direction transversely to the axis of the slab or ingot.

Other features and advantages of the invention will become apparent from the description now to follow, of preferred embodiments thereof, given by way of example only, and in which reference will be made to the accompanying drawings, in which:

FIGURE 1 is a diagrammatical view of the upper portion of a vertical continuous casting unit.

FIGURE 2 is a top view on to the unit of FIGURE 1.

FIGURE 3 is a detail of FIGURE 1.

FIGURE 4 shows a slab guiding means with stationary support.

FIGURE 5 is a top view illustrating a slab guiding means having a movable support.

FIGURE 6a and 6b illustrate in a diagrammatical front and side view respectively, sections of slab guiding means interconnected with each other by links.

FIGURE 7a shows the upper part of a continuous casting unit in sectional view, with the slab guiding means in form of a set of guiding rolls in casting position.

FIGURE 7b shows the continuation of the rails shown in FIGURE 7a with a second truck carrying mounted thereon a second set of guiding rolls ready to be put in operation.

FIGURE 8 shows a truck having guiding rolls suspended therefrom only the suspension thereof being represented.

FIGURE 9 is a top view to FIGURE 8, and

FIGURE 10 is a side view to FIGURE 8.

The continuous casting unit diagrammatically represented in FIGURES 1–3 is of known operation and according to conventional construction of such machines comprises a die or mold 1, a cooling or spray chamber 3 and lowered or withdrawing rolls 3 for a strand or slab A. Moreover a slab guiding truck 4 running on rails 6 and carrying a slab guiding or supporting means 5 is represented in position for casting. The slab guiding means 5 is a unit consisting of means for supporting and guiding the thin skin of the strand formed by the mold 1 and issuing from the mold 1 and through the unit 5.

The unit 5 may, thus, consist of a plurality of roller guides or a roller apron and includes cooling apparatus such as plurality of nozzles arranged in the unit to spray cooling water onto the strand as the strand passes through the unit as will be described and shown in detail hereinafter and as is shown in detail in U.S. Patent No. 2,284,503. The slab guiding is connected with the truck 4 through supports 7 and 8. It may be withdrawn from the casting position represented in full lines through an opening in the wall 9 of the cooling chamber into a position 11 shown in dot-and-dash lines for checking purposes. Also from this position 11 the whole slab guiding may be removed by a crane indicated by a hook 12, while a duplicate or spare slab guiding means 13 or a slab guiding means of another type may in a very expedient manner be brought into casting position on a further truck 14, by moving the latter through an opening in the cooling chamber wall 10 in direction to the right into the cooling chamber 2 (FIGURE 1).

In order to make possible precise adjustment of the position of the guiding means 5 with respect to the die opening 1 and to the lowering rolls 3 it is advantageous to provide, as shown in FIGURE 2, an adjusting device 20 for horizontal adjustment transversely to the direction of moving of the truck 4 and further adjusting devices 21 for vertical adjusting movements. These adjusting devices include threaded spindles 23 and 24. The spindles 23 carry hand wheels 22 and the spindles 24 have square ends for receiving a ratchet tool, for example the one shown in FIGURE 7a, where this tool is designated by reference numeral 85. The possibility of adjustment in direction of movement of the truck 4 may be combined with a locking device for the truck, A U-profile 25, secured to the frame of the continuous casting unit has welded thereto a nut 26 receiving a threaded spindle 28 provided with a hand wheel 27. At the side of the hand wheel 27 the spindle 28 is pivotally mounted in an eyelet of a bearing 29. This bearing may be locked by means of a locking bolt 30 over an arm 31 welded to the truck 4. The above-mentioned adjusting means highly facilitate
the handling and the operation of the unit inasmuch as the truck, which may weigh several tons, must be displaced on the rails 6 only approximately by casting the casting while the fine adjustment may then be effected by means of the said adjusting means.

Should the construction of die oscillating means, for example the hydraulically operated cylinders 35 shown in Figure 3, hinder lateral withdrawal of the slab guiding truck 4, it may be possible, to lower the guiding means 5 by a lifting device, for example by means of hydraulically or pneumatically operated lifting cylinders 36, into a position 37 shown in dot-and-dash lines from which it may then be moved out laterally. With the same device the slab guiding means may be lifted into the casting position afterwards.

Variations of temperature in the ingot or slab may lead to a deflection or warping of the latter out of the desired path. Such deflection in the lower portion of the cooling chamber 2 may result in a displacement of the uppermost portion of the slab guiding means 5 with respect to the die 1 leading to undesirable stresses of the solidified marginal zone of the slab in the thinnest part thereof and even to break out. In order to prevent this according to the present invention the supports of the slab guiding means are arranged as near as possible of the bottom of the die 1 so that the actual guiding is suspended from such support so that its lower free end may follow within its elastic limit the deflections of the slab. Such a support of the slab guiding means near the die is indicated diagrammatically at 38 in Figure 4.

If however deflections of the slab are expected that may not be followed by the guiding 5 without permanent deformation thereof, it may be advantageous to replace the guiding means rigidly connected with the truck 4 as shown in Figure 4 by the modification shown in Figure 5. In the latter the guiding means is cardanically linked with respect to the truck, i.e. the guiding means may effect pivotal movements to all sides with respect to the truck. In this modification the truck 4 is provided with bearing plates 40, 41 having in their upper portions bearings 42 and 43 rotatably receiving bolts 44 which in turn are rigidly connected with a frame 45. The latter carries bearings 46 and 47 also rotatably receiving bolts 49 rigidly connected with a further frame 48.

The latter then carries the guiding means 5. The arrangement of the two movably arranged frames 45 and 48 renders possible pivotal movements of the guiding means 5 to any side whereby abutments (not represented) are provided in the lower end of guiding 5 which limit such movements to a permissible extent.

If the guiding means 5 is rigidly mounted on the truck 4 permanent deformations of the guiding means owing to deflections of the slab may also be prevented by dividing the guiding means 5 into at least two sections 56 as shown, by way of example diagrammatically in Figures 6a and 6b in which such sections are articulated to each other by links 55. Thereby the greatest possible number of such sections should advantageously be of identical construction in order to permit interchangeability of these sections and to limit the number of spare parts to be stored.

The Figures 7 to 10 show an example of a slab guiding means in form of a roller guiding rigidly suspended from the truck. Guiding rolls 60 are arranged in a frame work 61 which simultaneously receives the apparatus for the setting of the cooling of the slab and spray nozzles 63. These elements form the so-called guide roll cage. The suspension of this cage is effected through webs 64 welded to the frame 61. Vertical adjustment of the cage may be effected through four annular screws 65 screwed into bores of the webs 64 and having been led out at both ends. When the screws 65 are supported on slide pieces 66 thereby affording for an easily adjustable four point support of the cage. Subsequent to such vertical adjustment of the cage the screws 65 are secured by nuts 65a. The slide pieces 66 are loosely placed on plates 67 welded to jacks 68.

Adjustment of thequire said roll cage transversally to the rail axis is effected by means of adjusting the 69 means in threaded blocks 69a and engaging slide pieces 66. (Figure 10). A traverse 70 arranged above the webs 64 serves to rigidly mount the roll cage after the adjustment thereof onto a truck 72 by means of a pull anchor 71. The truck is provided with wheels 73 running on the rail 6. For adjustment of the roll cage in running direction of the truck 72 the latter has welded thereto a bearing eyelet 80 in which is pivotally mounted a link 81 (Figure 9). The other end of said link may be connected by a locking bolt 82 and a nut 83 threaded onto a spindle 84. This spindle 84 is rotatably fixed in a housing 85 fixed to an I beam 89 of the machine frame and may be engaged by a ratchet 85. Thereby the nut 83 may be axially displaced and the truck 72 moved. After such adjustment of the truck the latter may be clamped to the rail axis by means of four clamping devices 90.

Should an exchange of the guide roll cage be necessary the connections of the cooling water pipes must be released, the locking bolt 82 must be pulled out of its bearing and the clamping devices 90 must be released. Subsequent to these operations the truck with the roll cage 60 which just was in operation may be withdrawn and another truck with another cage may be moved into casting position. The adjustment of the new truck in the casting position is effected as described for the first truck.

Of course the invention is not limited to the embodiment represented and described herebefore. Several modifications may be possible, for example the arrangement of the slab guiding sets on a turntable, without departing from the essence of the invention.

Also in plural slab plants it may be desirable for economic reasons and more particularly when similar profiles are to be cast in operation may be withdrawn another truck with another cage may be moved into casting position. The adjustment of the new truck in the casting position is effected as described for the first truck.

By an appropriate bearing of the guiding means it is also possible to apply the principle of the present invention to horizontal continuous casting units. Thereby the guiding means is preferably made removable from the slab in horizontal direction and perpendicularly to the slab axis.

Owing to the possibility of withdrawing the slab guiding means and of a rapid and precise adjustment thereof in casting position as provided by the present invention it is possible to improve the efficiency of any plant.

We claim:

1. Apparatus for use in a continuous casting plant having a continuous casting mold to solidify the surface of molten material poured therein into a strand issuing therefrom and drawn therefrom by lowering rolls which comprise guiding means positioned between said mold and said rolls and adjacent said mold to receive the strand issuing from said mold and to guide and support the surface of said strand as it leaves the mold, cooling means for cooling said strand as the strand passes through and is supported by said guiding means, said guiding means and said cooling means being arranged in such a manner as to provide means for moving said common frame including said guiding and cooling means transversely to the longitudinal axis of the issuing strand to a position giving access to said unit, and means for precisely adjusting the alignment of said unit with respect to said mold, said last named means comprising said shafts extending transversely of the longitudinal axis of said issuing strand, a truck being mounted on said rails and moveable thereon, said unit being supportably coupled to said truck, and means for adjusting said unit by movement in the direction of said rails, and by movement...
vent in a direction transverse both to the axis of said strand and to the direction of said rails to precisely adjust the alignment of said unit with respect to said mold.

2. Apparatus for use in a continuous casting plant having a continuous casting mold to solidify the surface of molten material poured therein into a strand issuing therefrom and drawn therefrom by lowering rolls which comprise guiding means positioned between said mold and said rolls and adjacent said mold to receive the strand issuing from said mold and to guide and support the surface of said strand as it leaves the mold, cooling means for cooling said strand as the strand passes through and is supported by said guiding means, said guiding means and said cooling means being assembled as a unit on a common frame, means for moving said common frame including said guiding and cooling means transversely to the longitudinal axis of the issuing strand to a position giving access to said unit, and rails extending transversely of the longitudinal axis of said issuing strand, a truck mounted on said rails and being movable thereby, said unit being supportably coupled to said truck, and means for precisely adjusting the alignment of said unit with respect to said mold which comprises means for adjusting the position of said truck along said rails and means for adjusting the unit with respect to said truck in a direction transverse both to the axis of said strand and to the direction of said rails.

3. Apparatus for use in a continuous casting plant having a continuous casting mold to solidify the surface of molten material poured therein into a strand issuing therefrom and drawn therefrom by lowering rolls which comprise guiding means positioned between said mold and said rolls and adjacent said mold to receive the strand issuing from said mold and to guide and support the surface of said strand as it leaves the mold, cooling means for cooling said strand as the strand passes through and is supported by said guiding means, said guiding means and said cooling means being assembled as a unit on a common frame, means for moving said common frame including said guiding and cooling means transversely to the longitudinal axis of the issuing strand to a position giving access to said unit, and means for moving said unit in a direction of the longitudinal axis of said strand thereby to enable positioning of said unit in close proximity to said mold during strand casting and to lower said unit away from said mold when it is desired to move said unit transversely.

4. Apparatus for use in a continuous casting plant having a continuous casting mold to solidify the surface of molten material poured therein into a strand issuing therefrom and drawn therefrom by lowering rolls which comprise guiding means positioned between said mold and said rolls and adjacent said mold to receive the strand issuing from said mold and to guide and support the surface of said strand as it leaves the mold, cooling means for cooling said strand as the strand passes through and is supported by said guiding means, said guiding means and said cooling means being assembled as a unit on a common frame, means for moving said common frame including said guiding and cooling means transversely to the longitudinal axis of the issuing strand to a position giving access to said unit, being coupled to said moving means at a position close to said mold thereby to ensure alignment of said unit and said mold so that said unit can receive said strand even during deflection of the guiding means by distortion of said issuing strand passing therethrough.

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