METHOD FOR STARTING AND MAINTAINING THE SUPPLY OF METAL TO A DOWNWARD OPERATING CONTINUOUS CASTING MOLD
2 Claims, 1 Drawing Fig.

ABSTRACT: A method for starting and maintaining the supply of metal to a downward operating continuous casting mold has the steps of sucking metal from a reservoir up through a riser into a launder above the reservoir, then closing the riser and keeping closed the downcomer to the mold, thereafter letting the pressure rise in the launder and subsequently opening the downcomer; then letting the metal flow and starting the casting, thereafter rarefying the air pressure in the launder, and then opening the riser again.
METHOD FOR STARTING AND MAINTAINING THE SUPPLY OF METAL TO A DOWNWARD OPERATING CONTINUOUS CASTING MOLD

The present invention relates to a method of starting and maintaining the metal supply to a downward operating continuous casting mold, for instance to a casting machine with caterpillar mold, especially for casting strips of nonferrous metals, chiefly of aluminum and aluminum alloys.

Several machines have been developed for the continuous casting of strips. In one machine the mold cavity is defined by a cooperating pair of endless chains of articulated mold blocks, and means are provided for revolving each of said chains about its own center. The chains are mounted so that over a part of their own length they engage with each other and define between them a mold cavity having walls which move continuously as the respective chains are revolved together at the same linear speed. Machines of this kind have been named "machines with caterpillar mold." In one of the said machines the mold blocks of one row are not connected but are moved separately in a guide system and maintained in circuit in such a way that they meet again at the pouring end of the mold cavity to form a closed mold with the blocks of the other row.

In the book "Handbuch des Stranggiessens" by E. Herrmann published in 1958 by the Aluminium-Verlag GmbH in Dusseldorf (Western Germany), the casting in caterpillar molds is described on pages 51 to 63.

When casting downward in caterpillar molds the metal supply presents especially difficult problems as the ducts for the metal supply must project into the closed part of the mold and must be relatively long because of the special path followed by the mold blocks; it follows that the column of molten metal in the supplying ducts must be high and therefore it exerts a high hydrostatic pressure. It is therefore difficult to obtain the necessary tightness between the supply ducts and the walls of the mold and to prevent leakage of molten metal at the joints.

During casting the molten metal, a head must be maintained under the upper end of the closed mold, as otherwise molten metal would infiltrate into the gaps where the mold blocks are nearly in contact with one another, and would stop and possibly damage the machine. Pouring the molten metal in a free fall into the mold, which should be possible when casting, does not come practically into question because of splashing and turbulence in the head. One must use special devices, for instance several tubes disposed side by side discharging into a slit nozzle fitted on the cross section of the mold.

In any case one has to take care during casting that the head of molten metal in the mold be maintained at a level as constant as possible. The float valves in the molds, that are usually used with direct casting, can practically not be utilized in the present case for reason of restricted space. A control by changing the flow-in or flow-out section of the supply tubes with simultaneous measure of the level of the molten metal head in the mold (that is to say, the level at which the molten metal makes contact for the first time with the walls of the mold) is excessively difficult, the difficulties increasing with the decrease of the thickness of the casting; moreover, the level of the molten metal head in the mold and as a consequence the quality of the casting would be subjected to disturbing variations.

It is accordingly among the principal objects of the invention to provide means for and methods to avoid the pitfalls of the prior art.

Further objects and advantages of the invention will be set forth in the following specification and in part will be obvious therefrom without being specifically referred to, the same being realized and attained as pointed out in the claims hereof.

The mentioned difficulties of the prior art are avoided by the method of the present invention, which method enables to maintain constant the level of the molten metal head in the mold.

According to the invention a siphon is used. The molten metal is sucked from a reservoir into a closed launder disposed above and connected to an air suction device, the outlets through which the melt enters the supply duct or ducts to the mold being closed; one allows more melt to rise in the launder than necessary for forming a molten metal head on the dummy bar of the mold. As soon as there is enough metal in the launder, one interrupts the sucking of melt, lets the pressure rise in the launder, for instance up to atmospheric (which is the simplest method), and opens the metal-supply ducts. As soon as melt has flowed through the ducts and the molten metal head has been formed in the mold, one starts the lowering of the dummy bar and therefore of the casting, the metal supply being continued, possibly puts into motion the chains of articulated mold blocks, and produces again rarefied pressure in the launder. Once the desired rarefication has been attained, one opens the suction pipe and the siphoning begins. From that time onward the control of the level of the molten metal head in the mold takes place automatically by controlling the level of the metal in the reservoir from which the melt is being siphoned for the supply of the mold.

As a result of the friction of the flow in the siphon, the level of the molten metal in the reservoir is somewhat higher than in the mold; for instance, with a casting speed of 3 meters per minute during operation the level difference may be 30 to 50 mm. However, when starting it is recommendable to choose for safety a greater level difference, of 200 mm, for instance, the said difference being afterwards diminished to about 30 to 50 mm.

In the accompanying drawing, the single FIG. is a schematic fragmentary vertical sectional view and shows schematically the principle of a device for carrying out the method according to the invention in a machine with a caterpillar mold.

The siphon comprises a suction pipe 11, a launder 12 and a supply tube 13 (of course, one may use several supply tubes, with or without slit nozzle). A reservoir 14 for the molten casting metal is provided, and the upper part 15 of a caterpillar mold. Valves 16 and 17 are provided, and a suction socket 18. When starting the metal supply, one closes the supply tube 13 by means of the valve 17, opens the valve 16 and sucks air out of the launder 12, by means of a suction device that is connected to the socket 18. The molten metal 19 rises through the pipe 11 into the launder 12 and fills the same up to the level 20. Then one shuts the valve 16, lets the air pressure rise in the launder 12 (suitably up to atmospheric pressure) and opens the valve 17. The result is that molten metal flows from the launder 12 through the supply tube 13 into the closed part of the mold 15 and forms a head 22 on the dummy bar 21. The molten metal level in the launder lowers to the height 24 according to the amount of melt flown out. At that moment, without shutting the valve 17, one puts into motion the mold blocks, lowers the dummy bar according to the casting speed, produces again an underpressure in the launder 12 by sucking air through the socket 18 and opens thereafter the valve 16, thereby putting the siphon 10 into operation. In the launder 12, a rarefied pressure of 110 mm. for instance (760 mm. Hg = 110 mm. Hg = 650 mm. Hg) may be sufficient. After reaching the underpressure necessary to prevent melt from running out of the launder 12 through the suction pipe 11 into the reservoir 14, the valve 16 may be opened immediately, for instance one second thereafter.

By controlling the level 25 of the molten metal in the reservoir 14, the level 23 of the molten metal head in the caterpillar mold is controlled at the same time. It is therefore not necessary to dispose regulating devices in the molten metal head 22.

The metal level 25 in the reservoir 14, which reservoir may be fed from a melting or a holding furnace, may be controlled for instance by means of a floating valve.

Besides the advantages mentioned in the foregoing description, the method according to the invention offers the further advantage that it is in a great measure independent of the casting speed. One may for instance change considerably the casting speed without changing the flow cross section. The regulation takes place automatically.
The method is especially advantageous with continuous casting in a caterpillar mold. However, it may also be used suitably with other downward continuous casting methods, for instance with the casting between rolls, the strip casting between spaced parallel portions of a pair of flexible metal belts which are moved along with opposite surfaces of the strip being cast (Hazelett), the casting in rotary strip casting machines as well as with the DC casting, and that not only for casting thin plates, but also for casting thick sections, for instance slabs and billets.

Siphon-like tubes used in continuous casting are known; however, as distinguished from the method according to the invention, they necessitate a pressure vessel as molten metal reservoir, which makes the device much more expensive and its operation difficult; moreover, they do not render possible the automatic control of the level of the molten metal head in the mold during the whole duration of the casting operation. To this must be added that the use of pressure gas in the known devices increases the gas content of the melt, whereas with the method according to the invention a degassing takes place.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. A method for starting and maintaining the supply of metal to a downward operating continuous casting mold, provided with a dummy bar, comprising sucking molten metal through a suction pipe from a reservoir into a closed launder disposed above and connected to an air suction device, the outlet means through which the melt enters at least one supply duct to deliver melt to the mold being closed; then interrupting the sucking of melt by closing the suction pipe, thereafter letting the pressure rise in the launder, and then letting molten metal flow through said outlet means and supply duct into the mold; thereafter, as soon as a molten metal head has been formed in the mold, beginning to lower the dummy bar, the metal supply being continued through said supply duct, producing again a rarefied air pressure in the launder, and finally opening again the suction pipe.

2. A method according to claim 1 applied to the casting in caterpillar mold, comprising putting the chains of articulated mold blocks into motion simultaneously with the beginning of the lowering of the dummy bar.