METHOD OF AND APPARATUS FOR CONTINUOUS CASTING WITH IMMERSION-TYPE LONG NOZZLES
2 Claims, 1 Drawing Fig.

ABSTRACT: A single tundish is used provided with two or more immersion-type long (submerged extended) nozzles of different length. The tundish is lowered to immerse the longest immersion-type nozzle to a predetermined depth below the surface of the molten steel in a casting mold, the tundish is elevated to cut off the longest nozzle before it is subjected to erosion, and again the tundish is lowered to immerse the next longest immersion-type nozzle to said predetermined depth to continue the casting operation.
METHOD OF AND APPARATUS FOR CONTINUOUS CASTING WITH IMMERSION-TYPE LONG NOZZLES

BACKGROUND OF THE INVENTION

This invention relates to a method of continuously casting a large quantity of molten metal, e.g. steel with an immersion-type long (submerged extended) nozzle over an extended period of time.

In the method of continuous casting with the immersion-type long nozzle, as the lower part thereof is immersed into the molten steel contained in a casting mold and since nozzle length is considerably long, cleaning and washing of nozzle is not easy. Consequently, in case of a kind of steel having a higher erosion rate of nozzle, such as high Mn steel, or when longer casting time is required such as when continuously casting with the same tundish from two or more ladles, there were difficulties of not being able to go on casting, due to such factors as nozzle clogging, erosion and the like.

For this reason, it is the practice in conventional continuous casting that two or more tundishes, each having an immersion-type nozzle, are provided and those are replaced one after another at a predetermined interval. Although the casting operation can be continued relatively smoothly, employment of two or more tundishes results in the increase of the number of their shifting apparatus and the cost of installation.

SUMMARY OF THE INVENTION

Accordingly, it is an object of this invention to provide a novel method of continuous casting with immersion-type long nozzles in a single tundish.

Another object of this invention is to provide a simple and inexpensive casting apparatus for effecting continuous casting operation.

According to this invention, two or more immersion-type nozzles each having a suitable outflow hole at different heights, respectively, are arranged on a single tundish. In the first place, the tundish is lowered to immerse the longest nozzle to a predetermined depth below the surface of molten steel in a casting mold after casting of a predetermined period, said tundish is elevated to cut down the longest nozzle, and again, it is lowered to immerse the next longest nozzle to said predetermined depth to continue the casting operation. Thus, continuous casting process extending over a period of time is carried out by repeating the above-mentioned steps.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, a single FIGURE shows a diagrammatic front view of a continuous casting apparatus utilized to carry out the novel method of continuous casting.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the accompanying drawing, there is provided a tundish 1 having immersion-type nozzles 3 and 4 of different lengths at its bottom. At the base of these immersion-type nozzles 3 and 4, a stopper (not shown) is arranged respectively. While two nozzles have been shown in this embodiment, the number thereof may be increased to three or more as desired. Again, the length of nozzle or the height of the outflow holes are different. To move the tundish 1 to both vertical and horizontal directions, suitable vertical and horizontal shifting apparatus are provided. The elevating apparatus may comprise two or more hydraulic cylinders 7 to receive piston rods 6 and cradle 15 mounted on the upper end of piston rods 6 to support projecting shafts 5 projecting from the sidewalls of tundish 1, as shown in the accompanying drawing. The horizontal shifting mechanism may comprise carriage 8 to support cylinders 7 and is arranged to be slidable along the upper surface of vase 14 by means of piston rods 9 of hydraulic cylinders 10 secured to the base. Molten steel is poured into the tundish from a ladle 2, thence into a water-cooled casting mold made of copper 11, reference numeral 12 representing solidified steel ingot.

In carrying out the method of continuous casting of this invention by utilizing the casting apparatus described above, the tundish 1 which has been supplied with molten steel from ladle 2 is lowered toward the water-cooled casting mold 11 by operating the hydraulic cylinder 7 until an outflow hole of the longest nozzle is immersed to a predetermined depth below the surface of the molten steel in the mold. Before occurrence of clogging or erosion of said nozzle, the flow of the molten steel through nozzle 3 is interrupted by a stopper, not shown, then the hydraulic cylinders 7 are operated to rapidly elevate the tundish 1 to cut the nozzle 3. Thereafter, the tundish 1 is again lowered to bring the lowest flow hole of the immersion-type nozzle 4 to said definite level below the surface of the molten steel in the casting mold to continue casting operation. Where there are more than three immersion-type nozzles, the same process steps are repeated to effect continuous casting. In this manner, casting operation can be continuously extended over a long time. In order to place an immersion-type nozzle in a position of about center of the casting mold 11, the tundish 1 is moved horizontally by operating hydraulic cylinder 10.

As can be clearly seen from the foregoing description, according to this invention continuous casting operation is performed by elevating or lowering a single tundish having two or more immersion-type nozzles each with outflow hole at a different height so that the cost of installation can be greatly reduced when compared with the conventional casting method wherein two or more tundish are employed alternatively. Moreover, by means of this invention the surface of the molten metal in the tundish is continuously shifted by moving outflow holes at different depths, molten steel cannot accumulate at the peripheral area of tundish and thus to the tundish is moved horizontally by operating hydraulic cylinder 10.

While the invention has been shown and described in terms of a preferred embodiment, it should be understood that many changes and modifications may be made within the true spirit and scope of the invention as defined in the appended claims.

We claim:

1. A method of continuous casting characterized by the steps of lowering a single tundish provided with two or more submerged extended nozzles each having an outflow hole at a different height to immerse the longest nozzle to a predetermined depth below the surface of the molten steel in a casting mold, elevating said tundish after a predetermined time interval, severing said longest nozzle, and again lowering said tundish to immerse the next longest submerged extended nozzle to said predetermined depth to continue the casting operation.

2. A continuous casting apparatus comprising a casting mold, a single tundish provided with two or more submerged extended nozzles each having an outflow hole at a different height, means to supply molten metal to said tundish, means to elevate and lower said tundish and means to shift said tundish in the horizontal direction.