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[54] RECIPROCATING MOLD CONTINUOUS CASTING APPARATUS

[72] Inventors: **Shigeki Soeda; Hidetaro Nemoto,**
both of Kawasaki, Japan

[73] Assignee: **Nippon Kokan Kabushiki Kaisha**

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[51] Int. Cl.B22d 11/10

[58] Field of Search164/82, 260, 273 R, 281, 283

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Primary Examiner—R. Spencer Annear

Attorney—Flynn & Frishauf

[57] ABSTRACT

Continuously casting molten metal into a mould through an opening of a tundish, the mould is directly connected to the tundish through a refractory coupling piece secured to the tundish around the opening, reinforcing members are secured to the side surfaces of the tundish to reinforce the connection between the same and the mould and an oscillating mechanism is connected to the reinforcing members to oscillate in the vertical direction the tundish together with the mould.

7 Claims, 3 Drawing Figures

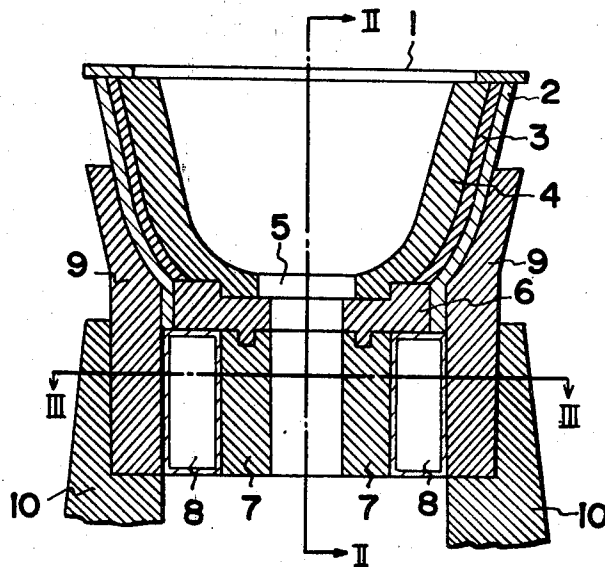


FIG. 2

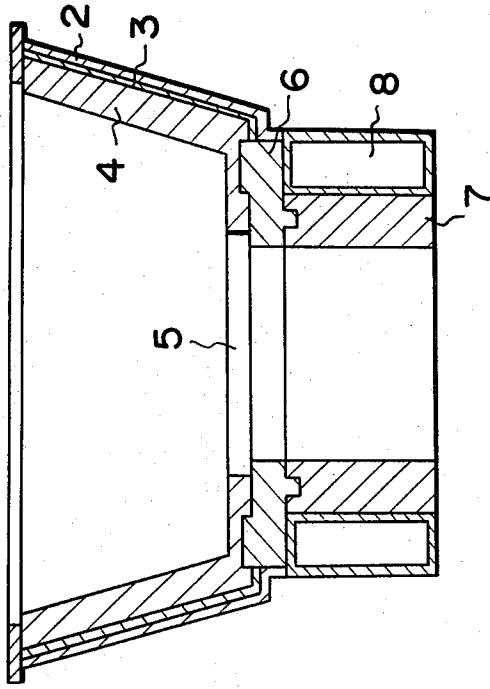


FIG. 3

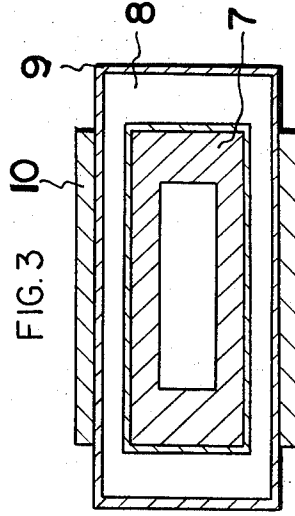
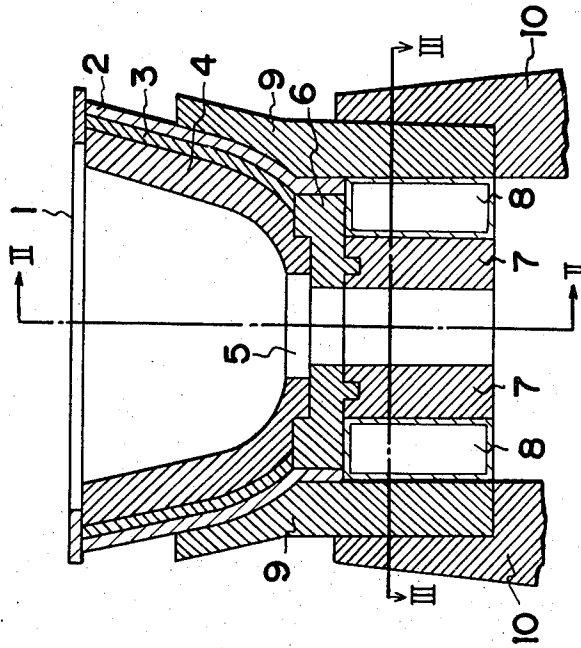


FIG. 1



RECIPROCATING MOLD CONTINUOUS CASTING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to a method and apparatus for continuous casting metal wherein a tundish is employed to perform continuous casting operation by directly connecting the tundish with moulds without the necessity of utilizing a nozzle, thus enabling continuous operation over a long period of time without being damaged by the molten metal.

In the prior method of casting metal utilizing a tundish a mould is connected to the tundish through a nozzle secured thereto so as to pour the molten metal, steel for example, into the mould. There are two types of nozzle, namely an open nozzle and an immersed nozzle. The latter type of nozzle is advantageous in that the stream of the molten steel poured into the mould through the nozzle is not exposed to the atmosphere and hence is not oxidized. It is also well known to incorporate so-called powder into the mould to prevent oxidation of the molten steel in the mould and to prevent cooling thereof.

Irrespective of the type of the nozzle, where a large quantity of molten steel is to be poured, the inner wall of the nozzle is damaged by the stream of the molten steel so that the wall thickness decreases gradually. For this reason, it is necessary to provide a number of nozzles in order to switch from a worn out nozzle to a new one. When the wall thickness is extremely decreased and hence the diameter of the nozzle is increased, the flow of the molten steel becomes turbulent thus affecting the surface condition of the casting.

It is, therefore, the principal object of this invention to provide a novel method and apparatus for continuous casting without the necessity of utilizing any nozzle.

Another object of this invention is to provide a novel method and apparatus for continuously casting molten metal capable of eliminating prior art difficulties inherent to the use of nozzles.

SUMMARY OF THE INVENTION

According to one aspect of this invention, there is provided a method of casting molten metal into a mould through an opening of a tundish characterized by directly coupling the mould to the opening through a refractory coupling piece thus pouring the molten metal into the mould from the opening through the coupling piece while the mould is oscillated vertically together with the tundish.

According to another aspect of this invention, there is provided apparatus for casting molten metal into a mould through an opening of a tundish characterized by comprising a refractory coupling piece secured to the tundish around the opening, the lower surface of the coupling piece being directly connected to the mould, reinforcing members secured to the side surfaces of the tundish to reinforce the connection between the same and the mould, and an oscillating mechanism connected to the reinforcing members to oscillate in the vertical direction the tundish together with the mould.

According to further features of this invention, cooling boxes are interposed between the side surfaces of the mould and the reinforcing members.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be better understood from the following description, reference being made to the accompanying drawing in which:

FIG. 1 shows a vertical section of the moulding apparatus embodying this invention;

FIG. 2 shows a longitudinal section taken along a line II — II in FIG. 1; and

FIG. 3 shows a cross-sectional view taken along a line III — III in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The moulding apparatus illustrated in the accompanying drawing comprises a tundish 1 including a steel casing 2 lined with a refractory lining consisting of a permanent brick lining 3 and a brick lining or working lining 4 which is contacted by molten steel. The working lining 4 may be formed by stamping of a powdered refractory material. An opening 5 is formed at the bottom of the tundish 1 to pour the molten steel and a coupling piece 6 of refractory material is connected to the linings 3 and 4 around the periphery of opening 5 by means of a suitable mortar such as an air set mortar.

The upper portion of a mould 7 is fitted to the coupling piece 6 whereby to unitarily interconnect the mould 7 and the tundish 1. To reinforce this connection, back-up metal pieces 9 are disposed on both sides of the tundish 1, the bottom of the back-up metal pieces 9 being supported by pedestals 10 oscillating in the vertical direction. Mould cooling boxes 8 are interposed between side surfaces of mould 7 and back-up metal pieces 9. Another pair of cooling boxes 8 are also attached to the shorter sides of the mould 7 thus cooling the same from four sides. Cooling water is circulated through the cooling boxes. Thus, unitary connected mould 1, coupling piece 6, mould 7, cooling boxes 8 and back-up metal pieces 9 are oscillated as a unit in the vertical direction by the oscillating pedestals 10.

In operation, the molten metal in the tundish 1 is poured directly into the mould 7 through opening 5 without the intervention of a nozzle or the like.

According to this invention, since no nozzle is used, it is possible to eliminate the above-described problems inherent due to the damage of the nozzle so that the novel casting apparatus is suitable for the continuous casting operation of a large quantity of molten steel. In addition, as the molten metal is directly poured into the mould, it is possible to prevent oxidation of the molten metal by the atmosphere, while the molten metal flows from the tundish into the mould. It is also possible to improve the quality of the casting without the necessity of considering the fluidity of the metal on the upper surface of the mould.

What is claimed is:

1. In a nozzle-less apparatus for casting molten metal into a mould (7) through an opening (5) of a tundish (1), the improvement which comprises: a refractory coupling piece (6) secured to said tundish around said opening (5), the lower surface of said coupling piece being directly connected to said mould (7);

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reinforcing means (9) secured to the side surfaces of said tundish (1) and extending around a substantial portion of the interconnection of said mould (7) to said tundish (1) via said refractory coupling piece (6) to reinforce the connection between said tundish (1) and said mould (7);

cooling means (8) interposed between the side surfaces of said mould (7), and said reinforcing means (9), whereby said tundish, said coupling piece, said reinforcing means, said cooling means and said mould form a unitary assembly; and

an oscillating mechanism (10) connected to said reinforcing means (9) to oscillate said unitary assembly in the vertical direction.

2. Apparatus according to claim 1 wherein said cooling means completely surrounds and contacts the portion of said mould adjacent said tundish and refractory coupling piece.

3. Apparatus according to claim 2 wherein said cooling means further contacts at least a portion of said

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refractory coupling means to cool said refractory coupling means.

4. Apparatus according to claim 2 wherein said cooling means contacts the inner surfaces of said reinforcing means to cool same.

5. Apparatus according to claim 1 wherein said mould has a notch formed in the upper surface thereof for receiving a protrusion of said refractory coupling piece, so that said refractory coupling piece firmly couples to, and contacts, said mould.

6. Apparatus according to claim 1 wherein said tundish has a notch formed therein to receive a protrusion of said refractory coupling piece, so that said refractory coupling piece firmly couples to, and contacts, said tundish.

7. Apparatus according to claim 1 wherein said reinforcing means (9) extends completely around said interconnection.

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