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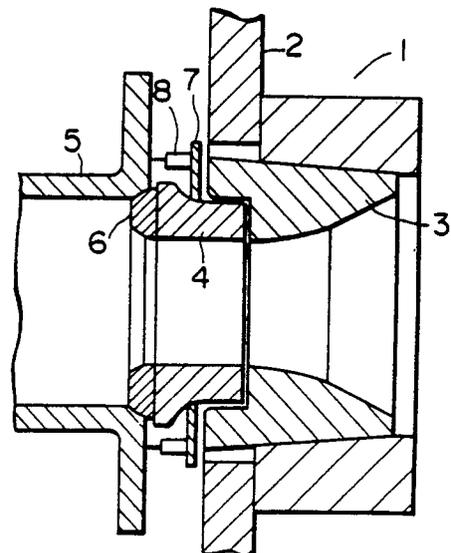

**Method for fitting a break ring to mold in horizontal type continuous casting and apparatus therefor.**


 A method for fitting a break ring (6) between a mold (5) and a feed nozzle (4), the molding being horizontally fitted to the lower part of the side wall of a tundish (1) of a horizontally type continuous casting apparatus through a front nozzle (3) and the feed nozzle, which comprises the steps of:

allowing a movement of a break ring in horizontal direction by a thermal expansion in a beginning stage of horizontal continuous casting; and

imparting a compressive stress to the outer peripheral portion of said break ring for reducing a tensile stress during casting. The compressed force is added by a pull cylinders connected to the mold through piston rod.

**FIG. 1**



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**METHOD FOR FITTING A BREAK RING TO MOLD IN HORIZONTAL TYPE CONTINUOUS CASTING AND APPARATUS THEREFOR**

The present invention relates to a horizontal type continuous casting, and more particularly to a method for fitting a break ring and an apparatus therefor.

In horizontal type continuous casting, a mold is connected to a tundish through a feed nozzle. More precisely, a front nozzle is horizontally fitted to the tundish, and a break ring which promotes the formation of a solidification shell is fitted in an end of the mold. The mold is connected to the tundish through the feed nozzle.

The outer peripheral portion of the break ring is cooled by contacting with the water cooled mold, whereas the inner peripheral portion is heated to the melting temperature of molten steel. As a result, temperature changes of the inner break ring become very large and a circumferential tensile stress occurs in the outer peripheral portion of the break ring. When a large tensile stress as mentioned occurs, cracks are caused in the break ring, and the break ring is broken.

Some methods have already been reported as countermeasures. For example, Japanese Patent Application Laid Open (KOKAI) No. 11164/81 discloses a method wherein:

compressive stress to the outer peripheral portion of the break ring for reducing a tensile stress is imparted in advance of a continuous casting, thereby preventing breakage of the break ring.

However, a problem that crack and breakage of break ring occurs in the beginning of the casting remains unsolved in this method.

It is an object of the present invention to provide a method for preventing a crack and a breakage in the beginning of a continuous casting and an apparatus therefor.

In accordance with the present invention, a method is provided for fitting a break ring between a mold and a feed nozzle, the mold being horizontally fitted to the lower part of the side wall of a tundish of a horizontally type continuous casting apparatus through a front nozzle and the feed nozzle, which comprises the steps of:

allowing a movement of a break ring in horizontal direction by a thermal expansion in a beginning stage of horizontal continuous casting; and

imparting a compressive stress to the outer peripheral portion of said break ring for reducing a tensile stress during casting.

Furthermore, an apparatus is provided for fitting a break ring between a mold and a feed nozzle, the mold being horizontally fitted to the lower part of the side wall of a horizontally type continuous casting apparatus through a

front nozzle and the feed nozzle, which comprise:

a bracket fitted on the feed nozzle; and

a pull cylinder set on the bracket, said cylinder having a piston rod whose end is connected to said mold.

Fig. 1 is a longitudinally sectional view illustrating an embodiment of an apparatus for fitting a break ring to a mold of the present invention;

Fig. 2 is a hydraulic pressure circuit diagram of the present invention; and

Fig. 3 is a figure showing an axial movement of a break ring in a beginning of horizontal continuous casting in a conventional method.

The method for fitting a break ring to a mold in an horizontal type continuous casting apparatus of the present invention is described in detail with reference to the drawings. Fig. 1 is a longitudinally sectional view illustrating an embodiment of the present invention. In Fig. 1, 1 is a tundish; 2 is a steel shell of the tundish 1; 3 is a front nozzle connected horizontally to the lower part of the steel shell 2; 4 is a feed nozzle connected horizontally to the top of the front nozzle 3; 5 is a mold connected horizontally to the top of the feed nozzle 4 through a break ring 6 described later; 6 is a break ring provided between the feed nozzle 4 and the mold 5; 7 is plurality of brackets fitted on the outside of the feed nozzle 4; and 8 is pull cylinders connected to the mold 5 through piston rod of pull cylinders 8.

Fig. 2 is a hydraulic pressure circuit diagram of a present invention. Working oil is introduced to the pull cylinders 8 through the hydraulic pressure circuit diagram.

The hydraulic pressure circuit diagram has a pressure reduction valve 9 setting the pressure of working oil, a change-over valve 10, a switch valve 11, and an accumulator 12. Before casting, cylinders 8 are under a low pressure, the change-over valve 10 being shut and the switch valve being opened.

Casting being started under this condition, break ring 6 is movable axially because the cylinders 8 are under a low pressure. Consequently, crack and breakage of the break ring 6, which can occur by thermal expansion in the beginning of casting, is prevented. The beginning stage is the interval from the start of pouring the molten steel in the tundish to the start of pulling out the molten steel. In the beginning stage of casting, the compressive stress of 250-450 kg $\cdot$ f is preferable. If the compressing stress is less than 250 kg $\cdot$ f, the break ring is not fitted to the mold. If the compressing stress is more than 450 kg $\cdot$ f, the break ring does

not move fully.

At the time of the beginning expansion of the break ring 6 being finished, the break ring 6 is pressed to the mold 5 through the feed nozzle 4, working oil being introduced to the cylinders 8 by means of the switch valve 11 being shut and the change-over valve 10 being changed. In this case, impact produced when the cylinders 8 are operated is alleviated by the accumulator 12 equipped in the hydraulic pressure unit.

Compressive stress to the outer peripheral portion of the break ring for reducing a tensile stress is imparted during casting, thereby breakage of break ring being prevented. The compressive stress of 1150-1500 kg $\cdot$ f is desirable. If the compressive stress is less than 1150 kg $\cdot$ f, the break ring is cracked and broken by the thermal stress. If the compressive stress is more than 1500 kg $\cdot$ f, the break ring is cracked and broken by the compressive stress.

The axial movement of break ring 6 against the mold 5 in a beginning stage of casting was investigated to grasp the problem that crack and breakage are easy to occur in the beginning of the conventional casting. Compressive stress for reducing a tensile stress is imparted before pre-heating.

The investigation result of axial movement of break ring 6 is shown in Fig. 3.

A symbol (+) in Fig. 3 shows a movement of the break ring 6 to the side of the tundish 1. A symbol (-) in Fig. 3 shows a movement of the break ring 6 to the side of the mold 5. A solid line is in the case that a round mold and a round break ring are combined. In pre-heating, the break ring is thrust into the (-) side by the compressive force. But with pouring molten steel in the mold, the break ring 6 expands thermally and moves to the (+) side against the compressive force. The tensile stress to the peripheral portion of the break ring 6 by thermal expansion is alleviated by the compressive stress.

A dotted line is in the case that a square mold and a square break ring are combined. The movement of the break ring is small in the period when molten steel is poured in the mold. The reason for the small movement is considered as follows:

(a) In the case of the square break ring, the outer surface of the break ring is not uniformly compressed to a tapered part of the mold. A high rigid corner is mainly compressed to the mold. Accordingly the break ring does not move so smoothly in the axial direction as in the case of the round break ring.

(b) The break ring is hard to move axially because the break ring is compressed axially from the beginning of casting.

As the mentioned above, the axial movement

of break ring is restrained. As the result of this restraint, the outer surface of the break ring is compressed too much and the corner of break ring buckles to cause crack and breakage. In this invention for solving this problem, the break ring is allowed to move easily in axial direction without being compressed strongly from the beginning stage and is compressed strongly after molten steel is poured in the tundish, and then initial expansion is allowed.

The method in this invention is particularly effective in the case of the break ring used in a large and square mold. This method is also applied to a small-square mold and large-round mold.

### Claims

1. A method for fitting break ring (6) between a mold (5) and a feed nozzle, the mold being horizontally fitted to the lower part of the side wall of a tundish (1) of an horizontally type continuous casting apparatus through a front nozzle (3) and the feed nozzle, which comprises the step of imparting a compressive stress to the outer peripheral portion of said break ring for reducing a tensile stress during casting,

characterized by comprising the step of allowing a movement of said break ring in an horizontal direction by a thermal expansion in a beginning stage of horizontal continuous casting.

2. A method according to claim 1, characterized in that said compressive stress includes the compressive stress added by pull cylinders (8) operated by hydrostatic pressure.

3. A method according to claim 2, characterized in that said pull cylinder includes being equipped on brackets (7) fitted on the outside of the feed nozzle and being connected to the mold through piston rods.

4. A method according to claim 1, 2 or 3, characterized in that said compressive stress includes being 1150-1500 Kg $\cdot$ f.

5. A method according to any one of claims 1 to 4, characterized in that said break ring includes large-square mold and small-square mold.

6. An apparatus for fitting a break ring (6) between a mold (5) and a feed nozzle (4), the mold being horizontally fitted to the lower part of the side wall of a tundish (1) of a horizontally type continuous casting apparatus through a front nozzle (3) and said feed nozzle, which comprises of a bracket (7) fitted on the feed nozzle,

characterized by comprising of a pull cylinder (8) set on the bracket, said cylinder having a piston rod whose end is connected to said mold.

FIG. 1

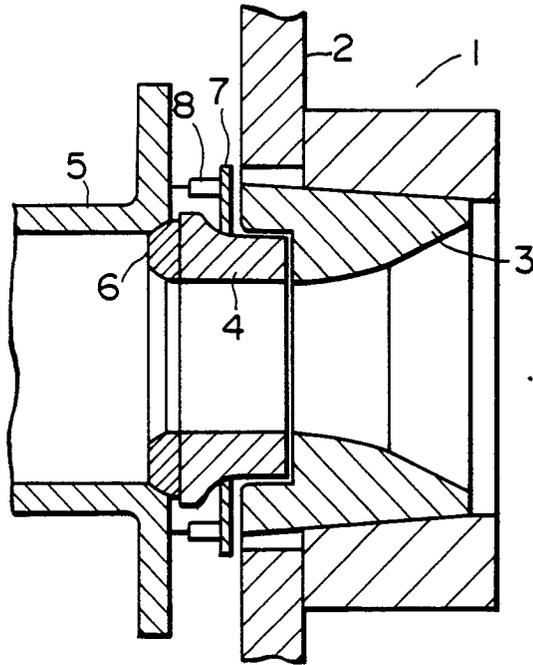


FIG. 2

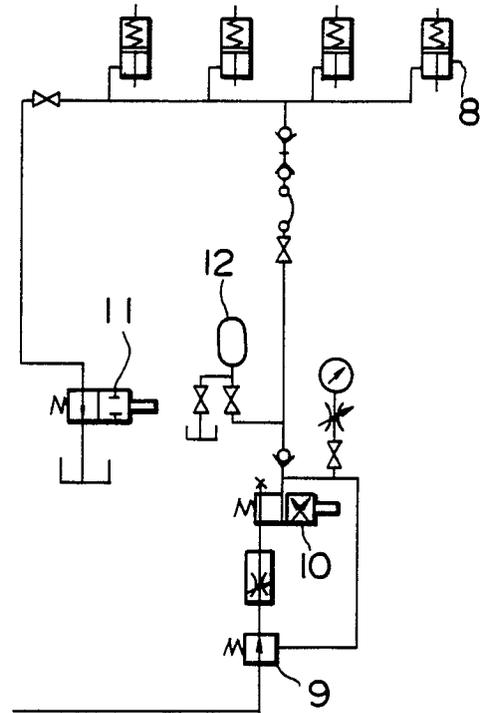


FIG. 3

