CONTINUOUS CASTING APPARATUS WITH SHROUD ARRANGEMENT

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ABSTRACT

Two one-half cylindrical tubular elements, held in mating relationship by magnets, surround a nozzle plate retainer which is secured to the bottom of a tundish by wedge keys cooperating with slotted studs projecting through openings in the nozzle plate retainer.

8 Claims, 5 Drawing Figures
CONTINUOUS CASTING APPARATUS WITH
SHROUD ARRANGEMENT

BACKGROUND OF THE INVENTION

With the steady increase in the use of continuous casting apparatus in the steel industry, many efforts have been made to protect the molten metal, teeming from the tundish into the casting mold, from oxidation, and to prevent the accumulation of undesirable oxide inclusions in the cast strand.

Various types of shrouds have been developed heretofore, and some have been used to some extent that are comprised of refractory material in the form of down spouts or "snorkels." These are submerged under the molten metal surface in the mold and they are either attached to the bottom of the tundish by means of screws or they are provided with an internal thread and are screwed on an extended threaded end of the pouring nozzle. Other shrouds are flexible, acting like a bellows, and are disposed between the vertically oscillating mold and the fixed tundish.

However, all of these various shrouds have not proved to be entirely satisfactory because they do not afford ready access to the tundish nozzle which feature is desirable and is necessary sometimes for the repair and replacement of the nozzle. Because it is virtually impossible for an operator to insert a copper chill plug into the tundish nozzle to stop the flow of molten metal in case of an emergency, these prior art shrouds leave something to be desired.

In another prior art apparatus, a slide gate is associated with a bellows-type shroud. In this instance, it is possible in case of an emergency to stop the flow of metal, but, after the gate is closed, it is not possible to reopen the gate, and the operation of that particular strand is terminated.

Those skilled in the art will know from the following description how the present invention overcomes the disadvantages of the prior art devices.

SUMMARY OF THE INVENTION

A shroud arrangement for a tundish, from which molten metal teems into a vertically reciprocable mold, includes two one-half tubular sections held together by magnets and mounted to a vertically reciprocable mold. The tubular sections surround a tubular nozzle-retainer mounted to a plate which is releasably secured to the tundish and which carries an internal circular ring. A removable teeming nozzle is disposed in the tube and supported by the annular ring.

For a further understanding of the invention and for features and advantages thereof reference may be made to the following description and the drawing which illustrates a preferred embodiment of equipment in accordance with the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an elevational view of a shroud and nozzle arrangement in accordance with the invention;

FIG. 2 is a view along line II—II of FIG. 1;

FIG. 3 is a view along line III—III of FIG. 1; and

FIG. 4 is a view similar to that of FIG. 2; but showing a modification of the invention of FIG. 2; and FIG. 5 is a modification of a portion of the embodiment of the invention shown in FIG. 1.
tally extending tube and elbow combination 54 which is used to conduct argon, or any other suitable inert gas, into the interior of the shroud arrangement 15. The argon or other inert gas is conducted from the shroud arrangement by means of another conduit 56, shown in FIG. 2.

The top edge of the semi-cylindrical shell portion 47 is attached to a cover 55 which is provided with a relatively short semi-cylindrical shell element 57 disposed coaxially with the semi-cylindrical shell portion 47. The internal surface of the semi-cylindrical shell element 57 is spaced only a small distance away from the outer surface of the cylindrical tube 23, as suggested in FIG. 2.

The second one-half cylindrical tube 45 comprises a semi-cylindrical shell portion 59 which, like the semi-cylindrical shell portion 47, is provided with a pair of vertical flanges 61. The tube 45, like the shell portion 47, is lined with material 53a, which is the same as the insulation substance 53.

The insulating material 53a covers, and is secured to, the inside surface of the semi-cylindrical shell portion 59, but the terminal edge portions of the insulating material 53a extend inside of the semi-cylindrical shell portion 47, as shown in FIG. 3. Also, the vertical edge portions of the material 53a are recessed to receive vertical seating strips 63, which may be secured to the shell portion 59 in any suitable manner. Thus, the insulating material 53a and the sealing strip 63 that covers the joint between the two one-half tubular portions 45, 47 provide an effective seal along both vertical joints that keeps the inert gas within and air from entering the shroud arrangement 15.

From FIGS. 1-3, it is seen that a plurality of small magnets 65, or a single elongate strip magnet 83 (FIG. 5), are secured by suitable cap screw fasteners 67 in spaced apart relation to each one of the flanges 61 so that the magnets 65 coact with and hold the one semi-cylindrical shell portion 47 in operative relation to the other semi-cylindrical shell portion 45.

The semi-cylindrical shell portion 57 is also provided with a cover 69 like the cover 55, and the cover 69 is provided with a relatively short semi-cylindrical shell element 71 which is like the element 57 and which is disposed coaxially with the shell portion 57.

FIG. 4 illustrates a modified form of nozzle retainer plate 73 and shroud arrangements 75 which is similar to the nozzle retainer plate 19 and shroud arrangement 15 described herein before except for the following differences.

The nozzle retainer plate 73 includes a cylindrical tubular member 77 which is provided with an internal annular ring 79. A nozzle 81 is disposed inside the cylindrical tubular member 77 and coacts with the annular ring 79, as shown in FIG. 4. Between the nozzle 81 and the inner surface of the cylindrical tubular member 77, there is a suitable insulating material 83.

In some applications it may be desirable to install the elongate strip magnet 83 on the flanges 61, as is suggested in FIG. 5. Three suitable cap screws 67 or the like can be used as fasteners for the strip magnet 83, if desired, or any other means may be used to secure the strip magnets.

In operation, a replaceable nozzle 17 or 81 is inserted into the cylindrical tube 23 and, after the refractory sealing material 33 is placed on top of the replaceable nozzle 17, the nozzle retainer plate 19 is installed as shown in FIG. 2.

That is, the slotted studs 39 project beyond the surface of the plate 19 and the wedge keys 41 are inserted into the slots in the studs 39, thereby securing the nozzle retainer plate 19 in place.

Next, an asbestos cloth gasket 84, or any other suitable gasket material may be used if preferred, is installed on top of the casting mold 13; the asbestos cloth gasket 84 having a central opening 85 that is the same or substantially the same size as the opening in the mold 13.

Then, the two one-half tubular members 43, 45 are placed around the cylindrical tube 23 so that the permanent magnets 65 attract and hold the two pairs of flanges 51, 61 in matching relationship. It will be noted from FIG. 2, that the narrow space between the tubular elements 23 and 57 provide just enough clearance to allow the mold and the shroud assembly to reciprocate vertically. An inert gas such as argon flows into the space within the shroud arrangements under a slight superatmospheric pressure, and this gas escapes through the conduit provided and through the aforementioned narrow space, so that no oxidizing air enters the shroud arrangements.

From the foregoing description of a preferred embodiment of the invention, one skilled in the art will recognize many features and advantages among which the following are more significant:

That the split shroud arrangement can be separated quickly and easily by manually grasping the handle provided and pulling on that one-half tubular portion. This provides access to the nozzle for inserting a chill plug therein to if an emergency requires such action;

That the flow of molten metal may be resumed by melting the chill plug with a suitable lance, whereupon the one-half tubular portion can be replaced and casting under normal conditions resumed; and

That the shroud arrangements can be removed quickly, allowing the nozzle plate to be readily separated from the tundish and quickly replaced with a new nozzle whenever such action is desirable. The shroud arrangement is quickly and easily reinstalled and casting is resumed with a minimum of down time.

Although the invention has been described herein with a certain degree of particularity it is understood that the present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

What is claimed is:

1. A shroud arrangement for a tundish having an orifice from which molten metal teems into a vertically reciprocable casting mold comprising:

a. a first one-half tubular element disposed on top of said mold and having a pair of first flange members along the longitudinal edges of said first element;

b. a second one-half tubular element disposed on top of said mold and having a pair of second flange members along the longitudinal edges of said second element;

c. means releasably securing said first and second flange members in matching relationship;

d. a plurality of slotted studs secured to the bottom of said tundish;

e. a perforated plate carrying a nozzle retainer tube and disposed coaxially with one such perforation, with said other perforations cooperating with said studs and with said plate being in contact with the bottom of said tundish;
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5 f. wedge means coacting with said slots in said studs for securing said plate to said studs;
g. means in said retainer tube supporting a nozzle therein; and
h. means carried by each of said first and second one-half tubular elements which, when said tubular elements are placed in edge and flange matching relation, surround in close proximity said nozzle tube and close the top of said shroud arrangement.

2. The apparatus of claim 1 wherein:
a. said means releasably securing said flange members is a plurality of magnets mounted to the flange members of one of the one-half tubular elements, said magnets attracting and holding the other flange members in position when the flanges and half-tubular elements are in an operative position.

3. The apparatus of claim 1 including:
a. insulating means lining the inside surface of each one-half tubular element, with one insulating means overlapping the matching edges of said one-half tubular elements when they are in position and form the whole tubular element.

4. The apparatus of claim 3 including:
a. a sealing strip disposed between said insulating means and the matching edges of said one-half tubular elements.

5. The apparatus of claim 1 wherein:
a. said means releasably securing said flange members is a strip magnet secured to each of the flange members of one of the one-half tubular elements, said magnets attracting and holding the other one-half tubular element in operative position.

6. The apparatus of claim 4 including:
a. means for grasping one of said one-half tubular elements whereby it may be separated from the other one-half tubular element; and wherein
b. said means securing said plate to said studs includes a wedge key that coacts with the slot in said stud and with said plate.

7. A shroud arrangement for a tundish having an orifice from which molten metal teems into a vertically reciprocable casting mold comprising:
a. a first one-half tubular element having a pair of first flange members disposed adjacent the longitudinal edges of said first element;
b. a second one-half tubular element having a pair of second flange members disposed adjacent the longitudinal edges of said second element;
c. magnets mounted to the flanges of one one-half tubular element;
d. a plurality of slotted studs mounted to and projecting from the bottom of said tundish;
e. a perforated plate carrying a nozzle retainer tube and disposed coaxially with one such perforation, with said other perforations cooperating with said studs and with said plate being in contact with the bottom of said tundish;
f. wedge means coacting with said slotted studs for holding said perforated plate in position;
g. an annular ring in said retainer tube for supporting a nozzle therein;
h. insulating means disposed around said nozzle and within said retainer tube;
i. insulating means lining the inside surface of each one-half tubular element, with one insulating means overlapping the matching edges of said one-half tubular elements when they are in position and form the whole tubular element;
j. a sealing strip disposed between said insulating means and the matching edges of said one-half tubular elements;
k. means covering one end of each one-half tubular element and carrying a one-half tube which is positionable in close proximity to said nozzle retainer tube when said one-half tubular elements are placed in operative position;
l. a handle on at least one-half tubular element for separating said one-half tubular elements when they are in operative flange matching position; and
m. a gasket disposed between said shroud arrangement and the top of said mold with the one-half tubular elements contacting said gasket.

8. The structure of claim 7 wherein:
a. said magnets comprise a strip magnet fastened to each flange of the one one-half tubular element.