ABSTRACT

Device for lifting and pivoting a metallurgical vessel, in particular a tundish arranged above the mold in a continuous casting plant. The device has a hollow vertical column, which is liftable and lowerable, and rotatable about its axis, to which column the metallurgical vessel is secured and on which there acts a swivel drive, actuated by a pressure medium. When lifting and lowering the vessel the pivot movement is fully compensated and thus disturbances of the casting procedure are eliminated.

2 Claims, 4 Drawing Figures
DEVICE FOR LIFTING AND PIVOTING A METALLURGICAL VESSEL

BACKGROUND OF THE INVENTION

The invention relates to a device for lifting and pivoting a metallurgical vessel, in particular a tundish arranged above a mold in a continuous casting plant, said device having a hollow vertical column, being liftable, lowerable and rotatable about its axis, to which column the vessel is secured and on which there acts a pivot drive actuated by a pressure medium.

U.S. Patent No. 3,552,902 and the corresponding U.K. Patent No. 1,212,918 describe a plant for the continuous casting of metals which is provided with casting ladles and tundishes pivotable about vertical axes. The tundishes are carried by liftable and lowerable hollow shafts or bushings and are additionally, in the direction perpendicular to the pivot axis of the columns, displaceable horizontally, so that the outlet of the tundishes may be adjusted above the mold. It is important in continuous casting that the axis of the outlet should be in alignment with the mold axis.

Modern continuous steel casting plants are provided with tundishes, into whose outlet a refractory casting tube is fitted. In the operating position, the casting tube projects into the mold cavity as far as below the casting level, so that the steel, while being cast cannot get into contact with air. Since, as a rule, the mold cavity is relatively narrow and the casting capacity is very high, casting tubes with a relatively large diameter have to be used, so that the gap that is left between the exterior wall of the casting tube and the interior wall of the mold is relatively small, measuring in some cases only a few cm. It is important that the width of the gap remains the same when the tundish is being lifted and lowered, i.e. when the casting tube is moved upward and downward in the mold cavity for adjustment to casting levels of different height and when the tundish is lifted up to such a height that it is pivoted from the operating position to a reserve position. In the latter case, i.e., when the tundish is lifted to the maximum lifting height, it is of particular importance that no deviation of the casting tube from the mold axis occurs, because otherwise the casting tube will break. It has been shown that in known plants in which the vertical hollow column carrying the tundish is actuated by means of a hydraulic swivel drive, a deviation of up to 35 mm occurs, when the column is being lifted. This deviation occurs as a consequence of the constant distance between the fastening points of the swivel cylinder.

SUMMARY OF THE INVENTION

It is the object of the invention to avoid the above mentioned disadvantages and difficulties and to improve the drive mechanism of a pivotable column in a plant of the described type in such a way that when lifting and lowering the vessel, the pivot movement is fully compensated, i.e. the adjustment of the vessel outlet and of the casting tube, respectively, is always kept in alignment with the mold axis and damages to the casting tube as well as disturbances of the casting procedure resulting therefrom are eliminated.

In a plant of the above described type the invention consists in that a swivel drive comprises a cylinder and a piston hinged to two levers. One of the levers is rigidly fastened to the column and the other lever is pivotable about a stationary axis. The other lever has a guide rod hinged to it, which is pivotably secured to a follower that is rotatable relative to the column.

The hollow column may have the form of a cylinder with a pressure chamber and a piston forming the axis of the rotatable column.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by way of examples with reference to the accompanying drawings:

FIG. 1 is a schematic side view of a liftable and lowerable, as well as pivotable, tundish of a continuous casting plant.

FIGS. 2 and 3 illustrate details of the lifting and swivel drive according to a first embodiment, i.e. FIG. 2 is a vertical section and a side view, respectively, and FIG. 3 is a pertaining horizontal section along line III-III of FIG. 2.

FIG. 4 is an illustration similar to FIG. 2 for a second embodiment of the invention.

DESCRIPTION OF AN EXEMPLARY EMBODIMENT

In FIGS. 1, 2 and 3 a liftable and lowerable hollow column 1 is rotatable in a bearing 6 of a casting platform 7. It carries a refractorily lined tundish 2 with a casting tube 3. The tundish is also displaceable horizontally by means of a mechanism not illustrated in detail. In the operating position the axis of the casting tube 3 is in alignment with the axis of a water-cooled continuous casting mold 4 oscillating in the vertical direction, and having a cavity or opening 5. In the interior of the column 1, a cylindrical cavity or pressure chamber 10, that is closed on the top and open on the bottom, receives a stationary piston and rod 8, whose lower end is supported against a supporting plate 9. The column 1 is lifted when the pressure chamber 10 (FIG. 2) is actuated by the injection of a hydraulic medium that applies a force between a pressure face 23 of the piston and an upper surface 24 of the pressure chamber. To the lower end of the column 1 a lever is secured, to which the piston rod 13 of a hydraulic cylinder 14 is hinged; the hinge bearing is denoted with 12. The cylinder 14 is connected with a horizontal lever 16 via a further hinge bearing 15 and the lever 16 is pivotable about a vertical trunnion 17. On the lever 16, a hinge bearing 18—slightly offset—is provided for a guide rod 19. The guide rod 19 is connected via a swivel bearing 20 with a follower ring 21, which is freely rotatable about the column 1. In the operating position according to FIG. 3, the axes of the guide rod 19 and of the lever 11, on to which the piston rod 13 is hinged, together form an angle of 150°. In order to be able to pivot the tundish from the operating position into a reserve position, the hydraulic cylinder 14 is actuated, so that the lever 11 may be pivotable about an angle of approx. 135° in direction of the arrow 22.

The function of the device according to the invention results from the drawings as follows. The tundish is to be lifted by the distance A, e.g. by 400 mm, from the operating position illustrated in FIGS. 2 and 3 by actuating the pressure chamber 10 with a pressure liquid. If the lever 16 were rigidly secured to the platform and no guide rod 19 were present, a pivot movement of the lever 11 would occur during the lifting phase, first in the direction of the arrow 22 and then in the direction of the arrow 22', back into the original position, whereby the casting tube 3 would move in direction of the wall of the mold 4 and back again. Due to the fact
that, according to the invention, the lever 16 is arranged to be pivoted about the vertical axis 17 and due to the arrangement of the guide rod 19, this pivot movement is, however, fully compensated. Thus, when changing the height of the tundish, the casting tube 3 does not change its position in relation to the mold walls and eccentric casting and/or breaking of the casting tube, while the tundish is being changed, is eliminated. During all lifting and lowering movements, the axis of the guide rod 19 remains in a plane laid through the vertical axis of the column 1. Only the position of this plane changes slightly.

FIG. 4 is a schematic illustration of another solution according to the invention, which consists in that the lever 16' is arranged in a substantially vertical position and is pivotable about a horizontal axis 17', wherein the hydraulic swivel device (14', 13') is arranged above the guide rod 19'. Reference numerals 12', 15' and, 18' denote hinge bearings and 20' denotes a swivel bearing. The lever fastened rigidly to the column 1', on to which the swivel device (14', 13') is hinged, is denoted with 11' and the follower ring, freely rotatable about the column 1', is denoted with 21'. Therefore, with this embodiment the pivot movements are also fully compensated, i.e. a deviation of the casting tube 3 is impossible.

The practising of the invention is of value not only in continuous casting plants, but also everywhere, where it is important to move pivotable construction units or vessels in an exactly vertical direction without actuating the swivel device.

What we claim is:

1. A device for lifting and pivoting a metallurgical vessel, in particular a tundish arranged above a mold in a continuous casting plant, said device comprising:
   a. a hollow vertical column secured to the metallurgical vessel;
   b. means for lifting and lowering said vertical column;
   c. a stationary member;
   d. a first lever with one end rigidly secured to said vertical column;
   e. a second lever with one end pivotally fixed to said stationary member;
   f. a swivel drive for rotating said vertical column about its axis, said swivel drive comprising a cylinder and a piston actuated by a pressure medium, one end of said swivel drive being hingely connected to the other end of said first lever and the other end of said swivel drive being hingely connected to the other end of said second lever;
   g. a follower rotatably secured about said vertical column; and
   h. a guide rod with one end hingely connected to said second lever and the other end pivotally secured to said follower.

2. A device as claimed in claim 1, wherein the vertical column contains a cylindrical pressure chamber that is closed at the top and open at the bottom, and wherein said means for lifting and lowering comprises a stationary piston and rod extending into the open bottom of the pressure chamber and means for injecting a hydraulic medium into said pressure chamber.

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