United States Patent Office 3,284,859 Patented Nov. 15, 1966

3,284,859

CIRCULAR TROUGH CASTING APPARATUS

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Filed Oct. 14, 1963, Ser. No. 315,754
8 Claims. (Cl. 22—57.3)

This invention relates to casting apparatus of the type in which the molten metal is continuously fed from a supply station into a mold consisting essentially of a circular trough rotating about a generally vertical axis of the circle, whereby the metal solidifies as it is carried by the rotating trough to a discharge station which removes the metal continuously as a rod, or the like.

The above-mentioned type of continuous casting apparatus has long been known in the art and is disclosed, for example, in U.S. Patent No. 359,349, dated March 15, 1887. Basically, it offers the advantage that the speed of casting is substantially unlimited, unlike casting with the use of a relatively short die (as in vertical casting) wherein dangerous and costly "run-outs" occur if the metal is drawn too rapidly from the restraining and supporting walls of the die. It also offers the advantage that the mold may be made of metal and will therefore have a much longer useful life than the ceramic or graphite dies conventionally used for continuous casting.

Despite its potential advantages, casting apparatus of the horizontal, circular trough type has not gone into significant use in practice. This has been due largely to the fact that such apparatus, as proposed heretofore, is incapable of adequately controlling the various factors which are involved in continuously casting rods, or the like, of good quality at high speed on a commercial scale. These factors include turbulence in the molten metal fed into the mold, the rate of solidification of the metal in the mold, cooling of the free upper surface of the solidifying metal, the tendency of this upper surface to oxidize during solidification, and other factors tending to impair the surface of the casting.

The principal object of the present invention is to provide an apparatus of the type described which overcomes the above-noted failings in prior apparatus of that type.

A continuous casting apparatus made according to the present invention comprises (a) a generally horizontal annular trough rotatable about a generally vertical axis and forming an endless mold open at the top, (b) a supply station including a container for molten metal having an outlet overlying the trough for delivering molten metal thereto, (c) means for rotating the trough about its axis in one direction for moving the delivered molten metal from the supply station, (d) a dam relative to which the trough is movable by the rotating means and disposed in the trough adjacent the region where the molten metal is delivered from the supply station, the dam being operable to limit flow of the molten metal in the trough in the direction opposite to its direction of rotation, (e) a cooling station extending along the trough in the direction of its rotation from a point adjacent the supply station and including cooling means located below the level of the top of the trough for cooling the latter and the molten metal therein, and (f) a discharge station located adjacent the trough and including means for continuously removing solidified metal from the rotating trough so that the latter is emptied before it reaches the molten metal supply station.

According to one feature of the invention, the apparatus also includes a gas-applying station overlying at least part of the cooling station and relative to which the trough is moved by the rotating means, this gas-applying station

including means for maintaining a non-oxidizing atmosphere at the open top of the mold so as to prevent or at least substantially reduce oxidation of the free upper surface of the metal as it solidifies in the mold.

According to another feature of the invention, the apparatus also includes a dressing station located adjacent the rotating mold in advance of the molten metal supply station and including means for continuously applying to the previously emptied portion of the mold a material for resisting adhesion of the metal to be supplied to the mold. Preferably, a pre-heating station is provided between the discharge and dressing stations, whereby the mold surface is preheated to prevent sudden formation of surface skin incident to turbulent flow of molten metal into the mold at the supply station.

Still another feature of the invention resides in the provision of means for effecting a controlled cooling of the free upper surface of the solidifying metal in the mold, through a cooling surface engaging this free upper surface and moving therewith as the trough rotates, thereby increasing the rate of solidification of the metal and improving the surface properties of the cast rod or bar.

These and other features of the invention may be better understood from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view of a preferred form of the new apparatus, with parts broken away;

FIG. 2 is an enlarged sectional view on the line **2—2** in FIG. 1, showing details of the molten metal supply station;

FIG. 3 is an enlarged sectional view on line **3—3** in FIG. 1, showing details of the cooling and gas-applying stations;

FIG. 4 is an enlarged sectional view on line **4—4** in FIG. 1, showing details of the discharge station;

FIG. 5 is an enlarged sectional view on line **5—5** in FIG. 1, showing details of the mold dressing station;

FIG. 6 is an enlarged sectional view on line **6—6** in FIG. 1, showing details of the means for direct cooling of the upper or free surface of the solidifying metal in the mold;

FIG. 7 is an enlarged sectional view on line **7—7** in FIG. 2, showing details of the lower end of the pouring spout which feeds the molten metal from the supply station, and

FIG. 8 is an enlarged sectional view, somewhat schematic, on the line **8—8** in FIG. 1, showing details of the pre-heating station.

The apparatus as illustrated comprises a stationary vertical post or axle **20** extending through a hub **21** having a close rotating fit on the axle (FIG. 1). Hub **21** is adapted to be rotated on the axle at constant speed by a motor **22** connected through a variable speed transmission **23** and shaft **24** to a bevel gear **25** meshing with a large bevel gear **26**, the latter being secured to hub **21**.

The hub **21** has radiating spokes **28** secured at their outer ends, as by welding, to a flat ring **29** of large diameter, for example, fifteen feet. Ring **29** is supported on horizontal rollers **30** spaced around the vertical axle **20** and mounted on stationary posts **31** (FIGS. 2 and 3). A second flat ring **29*a*** surrounds the ring **29** with a clearance and is supported on similar horizontal rollers **30*a*** mounted on stationary posts **31*a***.

A mold in the form of circular trough **33** is located in the annular clearance between rings **29** and **29*a***, where it is supported at its inner and outer portions by the respective rings. As shown, the mold **33** is open at the top and has inwardly and outwardly extending flanges **34** and **34*a*** resting on the rings **29** and **29*a***, respectively. These flanges are secured to the underlying rings by machine screws **35** (FIGS. 2 and 3) extending loosely through holes