United States Patent

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[31] **1,508,976**

[54] **COOLING SYSTEM FOR CONTINUOUS CASTING MACHINE**
6 Claims, 2 Drawing Figs.

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[51] **Int. Cl.** **B22d 11/12**
[50] **Field of Search** 164/82, 89, 282, 283; 134/64, 122, 199; 193/11

[56] **References Cited**

UNITED STATES PATENTS

2,284,503	5/1942	Williams	164/282
2,895,190	7/1959	Bungeroth et al.	164/282
3,190,793	6/1965	Starke	134/122X
3,399,716	9/1968	Rossi et al.	164/89

FOREIGN PATENTS

1,399,695	4/1965	France	164/282
749,544	5/1956	Great Britain	164/89

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ABSTRACT: Guide rollers for a casting emerging from a continuous casting mold are hollow and have spray nozzles in their circumferential surfaces. Coolant fed into the interior of each roller thus sprays out through the nozzles to cool the casting.

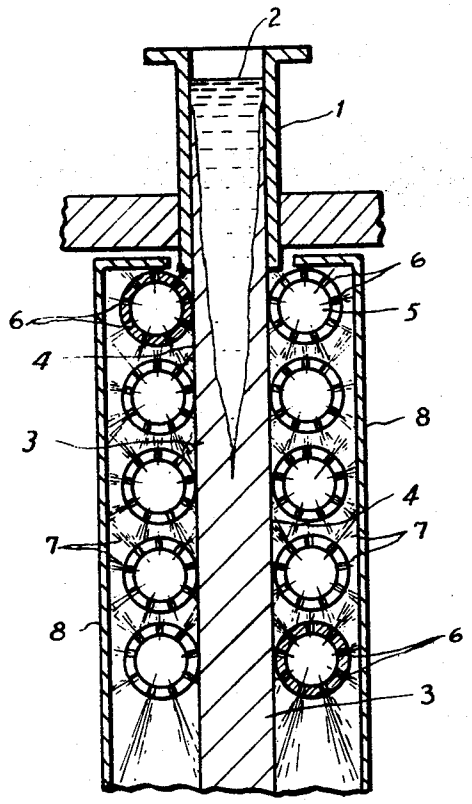
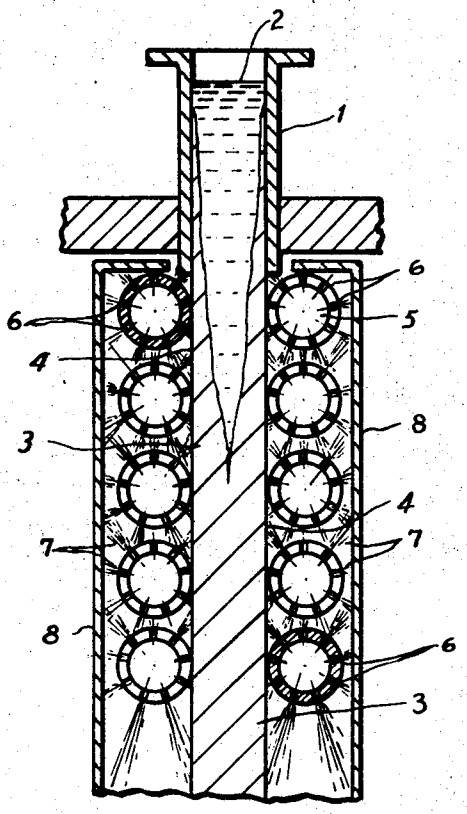


FIG. 1



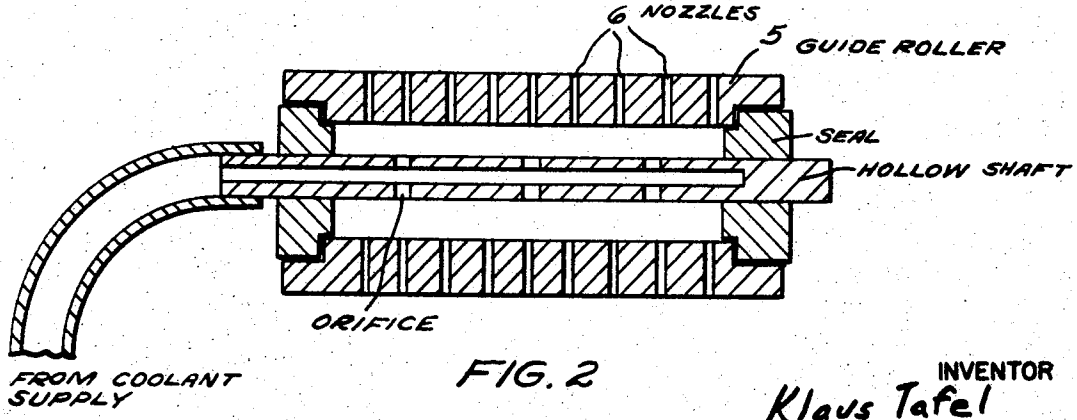


FIG. 2

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COOLING SYSTEM FOR CONTINUOUS CASTING MACHINE

The invention relates to a cooling system for continuous casting machines in which the casting emerging from the mold is guided by rollers and cooled through nozzles to which a coolant is fed.

As is known, guide rollers disposed below the bottom of the mold on either side of the strand guide the casting coming from the mold into the machine sections following the mold and at the same time center it within the mold to prevent cross-sectional distortion due to differential local cooling conditions. Now the casting must also be cooled as it leaves the mold because at that point only its skin is solidified while its core is still liquid. Thus the skin of the casting is still deformable over this region, and the specific pinching pressure exerted by the guide rollers on the surface of the casting must therefore be kept relatively low. One way of accomplishing this is to provide a great many close-spaced guide rollers. In that case, however, there is not enough room between the individual guide rollers to accommodate the coolant-fed nozzles, and effective cooling cannot then be achieved.

One attempt at solving this problem consists in disposing directly at the lower end of the open-ended mold platelike guide members which participate in the downstroke of the oscillating mold and in so doing are in close contact with the surface of the casting. During the upstroke the guide members come away from the casting surface to be able to follow the ascending movement of the mold, laterally spaced therefrom. In the upper extreme position the guide members are then again pressed against the surface of the casting. These guide members may be cooled in any desired manner and thus serve to both guide and cool the continuous casting. As a result, however, the casting is cooled more intensively in the regions where the movements of the guide members overlap and is not guided during the upstroke.

The invention has as its object to improve cooling systems of the type described at the outset in such a way that on the one hand a minimum of pressure per unit area is exerted on the surface of the casting while more heat is abstracted therefrom by means of a coolant, and considerably more uniformly, than has hitherto been the case. In accordance with the invention, this is accomplished essentially by constructing the guide rollers hollow, by providing them with nozzles distributed over their circumference, and by supplying them with a coolant through their ends. With this arrangement the spray nozzeles heretofore provided between the guide rollers may be dispensed with. This, in turn, makes it possible to dispose the guide rollers so as to begin directly at the bottom of the mold and to space them very closely. In this way, an enlarged contact area is obtained between the guide rollers and the surface of the casting, the pressure per unit area being correspondingly reduced with constant lateral forces. Deformation of the solidified skin of the casting is thus largely prevented, especially since the skin is thicker because of the improved cooling action. Moreover, this arrangement permits the guide rollers to be made considerably larger than heretofore, which also results in an increased contact area. By providing for improved strand guidance and cooling action, the invention further makes it possible to increase the casting speed and hence the capacity of the continuous casting machine, which is a factor particularly from the standpoint of its adaptation to a steelmaking shop preceding it.

The invention may be used to advantage both in continuous casting machines with curved molds and curved roller aprons and in continuous casting machines with vertical molds and associated vertical roller aprons. Also, the advantages offered by the invention will accrue both in the case of billet and of slab continuous casting machines.

The invention will now be described in greater detail with reference to the accompanying drawing, which is a diagrammatic representation of the novel cooling system.

FIG. 1 is an elevational sectional view of the apparatus of the invention.

FIG. 2 is a sectional view through one of the rolls.

The mold 1 is conventionally mounted in a mold table and is oscillated with the latter. It is supplied with coolant, in a manner not novel in itself, from either a recirculating or a once-through system. The level of metal 2 in the mold 1 is maintained by a constant flow of metal from a tundish while below the metal level 2 a skin forms in known manner whose thickness gradually increases under the influence of the coolant until the casting solidifies over its entire cross section some distance below the bottom of the mold. At the lower end of the mold 1, the skin of the casting 3 thus is still relatively thin and easily deformed under the influence of the forces acting upon it, and intensive cooling is required to enable it to thicken sufficiently to develop adequate resistance to both external deforming forces and the internal pressure of the liquid metal.

The guide rollers 5 begin directly at the botom end of the mold 1. They are spaced very closely especially at the beginning to support the solidified skin of the casting adequately without deforming it. As pointed out earlier, the guide rollers 5 are hollow and are provided with nozzles 6. Through these the coolant emerges in jets, as shown schematically, impinging upon the surface 4 of the casting uniformly and at high pressure. The coolant employed is preferably water at a pressure exceeding the vapor pressure of the steam envelope forming on the casting surface 4. Since the nozzles 6 are distributed over the entire circumference of the rollers and the latter follow the movement of the casting, the coolant is actually applied perfectly uniformly. In the gaps between two adjacent guide rollers the coolant jets strike the casting surface 4 obliquely while at the point of contact between a guide roller 5 and the casting surface 4 they strike the latter nearly perpendicularly. The cooling action will not be impaired by any accumulation of coolant which may occur in the space bounded by the lines of contact of two adjacent guide rollers 5 and the corresponding portion of the casting surface 4 because the emerging coolant jets 7 will act upon the casting even through the accumulation and displace the spent coolant outwardly.

The coolant supplied to the guide rollers may advantageously come from the same loop as the cooling medium for the mold 1. To minimize coolant losses and to prevent damage in the vicinity of the roller apron, a baffle plate 8 is provided on the side of the guide rollers 5 which is remote from the casting surface. Said baffle plate may be constructed with a drain channel at its lower end, in a manner not shown in the drawing, through which the spent coolant is discharged continuously.

Since the casting surface 4 is often contaminated with lubricant residues, oxide films or other impurities adhering to it, and since the nozzles 6 come into direct contact with the casting surface as the guide rollers 5 turn, it is advisable to incorporate means adapted to prevent clogging of the nozzles 6. To this end, scraper brushes may be provided on the side of the guide rollers which is remote from the casting surface 4, with said brushes wiping against the guide rollers, and with the impurities so loosened being flushed into the drain channel along with the coolant. Or the guide rollers 5 and their nozzles 6 may be kept clean by means of scraper blades disposed at that point. Moreover, compressed air nozzles might be provided on the side of the guide rollers which is remote from the casting surface, either in combination with the aforesaid arrangements or independently, said nozzles being aimed at the circumference of the guide rollers, with the impurities on the surface of the guide rollers and on the nozzles then being blown off by blasts of compressed air.

In the arrangement shown diagrammatically, pressure-energy losses will occur because some of the coolant jets will impinge upon the baffle plate 8. To prevent the coolant from exiting on the side of the guide rollers which is remote from the casting surface 4 and the resultant pressure loss, the respective halves of the guide rollers 5 may be provided with semicircular shells in slightly spaced relation thereto. The longitudinal edges of these shells may then likewise be provided with scraper brushes, scraper blades, etc., in order to keep the nozzles 6 clean.

The simplest way of supplying the guide rollers with coolant, preferably water, is to mount them on hollow shafts or studs, seals being interposed where the latter penetrate the two ends of the rollers, and their inside portions being orificed. The coolant can then be fed in through connections disposed at the outer shaft ends.

The novel guide rollers may be arranged in any desired manner below the mold 1. In a particularly advantageous arrangement, they are disposed so as to guide the casting 3 centered within the mold 1. Moreover, provision may be made for varying their lateral spacing to permit them to be adjusted to different casting sizes.

Even in cases where the guide rollers are disposed so as to oscillate with the mold, the space saving made possible by using them will permit them to be closely spaced in the direction of the strand, in addition to being close-spaced radially therefrom. In the event of a rupture of the skin, the arrangement offers further advantages with respect to disassembly since the rollers may be withdrawn from the top with the mold.

The water consumption exceeds that of conventional spray nozzles. But since the cooling action is more intense and more uniform, the water consumption may be reduced by limiting the nozzled guide rollers to the section located directly below the mold rather than placing them over the entire length of the cooling apron.

I claim:

1. A continuous casting machine wherein a continuous strand of partially solidified metal is cast by and emerges from a mold including means for guiding and cooling a strand emerging from the mold comprising a plurality of rotatably supported guide rollers disposed at the exit end of the mold for engaging and guiding the strand, said rollers having hollow interiors and spray nozzles opening from said hollow interiors through the circumferential surfaces of the rolls at points distributed around said circumferences, and means for supplying liquid coolant to the hollow interiors of the rollers to flow out through the nozzles and into contact with the strand.

2. The continuous casting machine of claim 1 in which said guide rollers are mounted on hollow shafts having orifices opening from the hollow interiors of the shafts into the hollow interiors of the guide rollers and conduits connected to supply liquid coolant to the hollow interiors of said shafts.

3. The continuous casting machine of claim 1 in which said guide rollers are arranged to be along a strand emerging from said mold, respectively at opposite sides of said strand.

4. The continuous casting machine of claim 3 in which a plurality of the guide rollers are arranged along each of said opposite sides of said strand beginning adjacent the end of the mold from which the strand emerges.

5. The continuous casting machine of claim 4 in which the guide rollers are close together along the direction of movement of the strand.

6. The continuous casting machine of claim 1 including a baffle plate at the sides of the guide rollers away from said strand.