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(54) CONTINUOUS CASTING MACHINE

(71) We, GEORGETOWN TEXAS STEEL CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of P.O. Box 2390, Beaumont, Texas 77704, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the continuous casting of metal such as steel, and more particularly to apparatus for spraying cooling water on all faces of a descending, at least partially solidified casting, on its emergence from a tubular flow-through mold.

According to the invention, there is provided a continuous casting machine which includes a tubular mold with a number of faces, a support for said mold, and a roller means beneath said mold for withdrawing a casting therefrom, and an arrangement for delivering spray water to all faces of a casting as it emerges from the bottom of said mold, said arrangement comprising: a water supply pipe depending from the mold support, a water distribution pipe connected to the first pipe and extending generally in a horizontal plane around each face of the mold, a multiplicity of down pipes each downwardly extending and each communicating with the distribution pipe, each down pipe terminating beneath said mold and carrying a nozzle at its lower extremity, said nozzles being directed inwardly whereby spray water delivered through said nozzles will contact the entire perimeter of a casting during withdrawal from said mold, and the entire spray mechanism with the exception of the nozzles is insulated from the casting by vertical walls of the mold.

It will be seen that the machine illustrated herein has water piping to a mold, and detachable spray nozzles beneath the bottom of the mold directed toward the emerging solidifying casting. The spray nozzles form the lower terminus of the spray apparatus. The entire spray apparatus, with the sole exception of the spray nozzles, is protected from damage from heat and molten metal splash by its location adjacent the mold walls.

Heretofore, a spray ring for initially cooling a casting as it emerges from a water-cooled mold has been located at an elevation between the bottom of the mold and the foot rolls which are the first conducting rolls or pinch rolls beneath the mold. The entire width of each face of the casting must, of course, be contacted by cooling water spray to continue solidification of the casting.

In the continuous casting operation, molten metal is poured into the upper end of a tubular, vertically reciprocating mold to a predetermined level. The mold is closed at its lower end by a removable block called a chill plate which is connected to a starter bar. After initial solidification of the casting faces in the mold, the casting is moved downward under the control of pinch rolls, which engage first a starter bar and then the casting. The upper-most section of the casting emerging from the mold has only a thin solidified skin. Turbulent action of the molten metal within the casting, particularly when a solid inclusion is present, can remelt or rupture the skin causing what is termed a "breakout" whereby molten metal flows through an opening in the solidified skin, usually with catastrophic results, both damaging adjacent machinery and endangering human beings in the vicinity. When a breakout occurs, the most frequently damaged item is the spray ring beneath the mold jacket and above the pinch rolls. This spray ring includes a specially machined spray nozzle for distributing spray water evenly across the face of the casting.

The invention will be better understood from the following description of part of a continuous casting machine according to the invention given with reference to the accompanying drawings, in which:—

Figure 1 is a partially cut-away isometric view of a tubular, flow-through mold including a spray ring and showing the front and right-hand side of the mold.

Figure 2 is a horizontal section, partly broken away, and also showing the spray ring;

Figure 3 is a front elevation view of the spray ring; and

Figure 4 is a right side view of the spray ring of our invention.

In the preferred embodiment of our invention, a vertically oscillatable mold 10 (Figure 1) has a mold support plate 12 carrying a water supply pipe 14. A casting withdrawal unit fastened to the mold by mold flanges 16 includes a pair of pinch rolls 20*a* and 20*b*. A water supply pipe 24 connects a water distribution pipe 26 to the pipe 14 through a mold support plate 12 and depends downwardly therefrom. Water distribution pipe 26 consisting of pipe segments 28, 30 and 32, best seen in Figure 2, extends generally horizontally around the mold 10 at an elevation above the bottom flange 16 of mold 10. From approximately the center of each mold face a down pipe 34*a*, 34*b*, 34*c*, 34*d*, extends downwardly and carries at its end an inwardly directed spray nozzle 40, Figure 2.

In case of a breakout, only the damaged spray nozzle need be replaced. All other portions of the spray ring water distribution system remain operable because all components are protected from heat and molten metal by their location on the mold walls. The spray nozzles, which are usually V-Jet nozzles that emit a flat stream of spray water, are readily replaceable items and are each readily disconnectable from the spray apparatus either at a distributor pipe connection 44 adjacent the pipe 26, or at a spray nozzle connection 46, at which point spray nozzle 40 is attached to distributor pipe 34. The pipe and nozzle attachments may be by threaded connectors or any other suitable type of fitting or disconnectable mounting.

It should be clear that the invented arrangement is adaptable to slab casters by merely increasing the number of downwardly extending distributor pipes 34 and nozzles 40 to that required to spray the entire perimeter of a cross-section of the casting.

By installing the invented apparatus on a continuous caster, we have effected a 98 percent savings in the cost of required replacement items in the spray apparatus when a catastrophic breakout occurs. Additionally, fewer man-hours of labor are required to replace spray heads when using our invention than with prior spray rings.

From the foregoing, it is readily apparent that the arrangement particularly described and illustrated affords a mold spray quench system for causing quenching spray to impinge upon each face of a continuously cast metal casting as it emerges from the mold, yet all of its components other than the spray nozzles are protected from damage caused by breakout, and replacement or maintenance is simplified.

WHAT WE CLAIM IS:—

1. A continuous casting machine which includes a tubular mold with a number of faces, a support for said mold, roller means beneath said mold for withdrawing a casting therefrom, and an arrangement for delivering spray water to all faces of a casting as it emerges from the bottom of said mold, said arrangement comprising: a water supply pipe depending from the mold support, a water distribution pipe connected to the first pipe and extending generally in a horizontal plane around each face of the mold, a multiplicity of down pipes each downwardly extending and each communicating with the distribution pipe, each down pipe terminating beneath said mold and carrying a nozzle at its lower extremity, said nozzles being directed inwardly whereby spray water delivered through said nozzles will contact the entire perimeter of a casting during withdrawal from said mold, and the entire spray mechanism with the exception of the nozzles is insulated from the casting by vertical walls of the mold.

2. A machine according to Claim 1 in which said nozzles are positioned as horizontally opposed pairs.

3. A machine according to Claim 1 or 2 wherein said downwardly extending pipes are removably connected to said water distribution pipes.

4. A continuous casting machine including a mold and support therefor and a spray arrangement, substantially as herein described with reference to and as illustrated in the accompanying drawings.

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Sheet 1

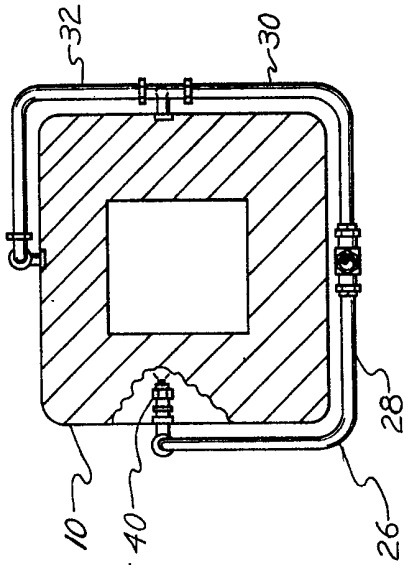

Fig. 2

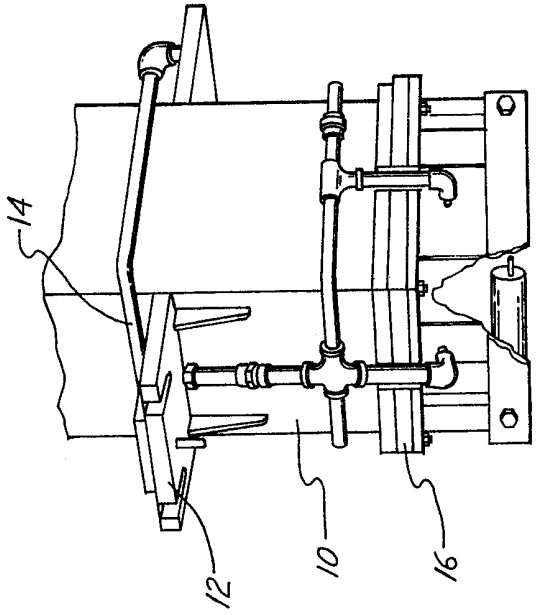

Fig. 1

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Sheet 2

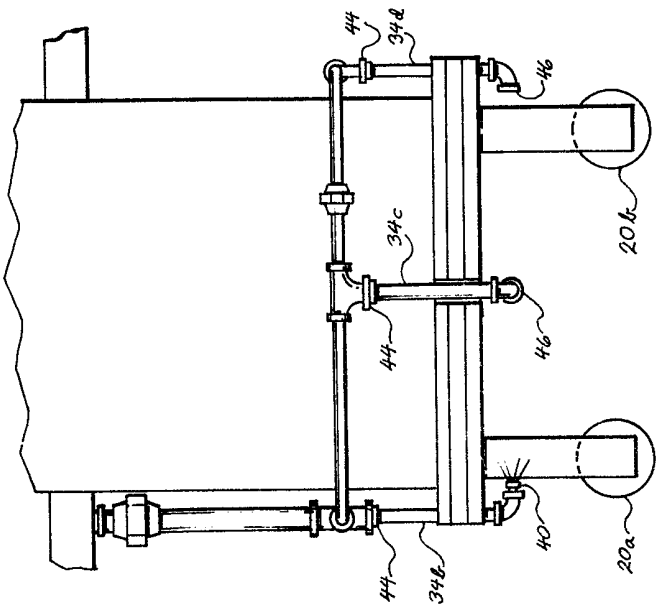

Fig. 4

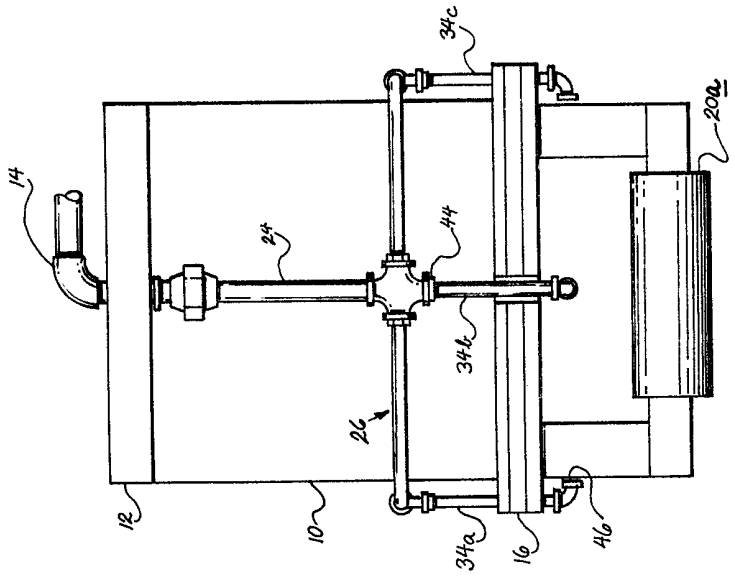

Fig. 3