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[54] **CONTINUOUS CASTING PLANT FOR SLABS**

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[51] **Int. Cl.** **B22d 11/12**

[58] **Field of Search** ..... 164/82, 89, 273 R, 164/282, 283

[56] **References Cited**

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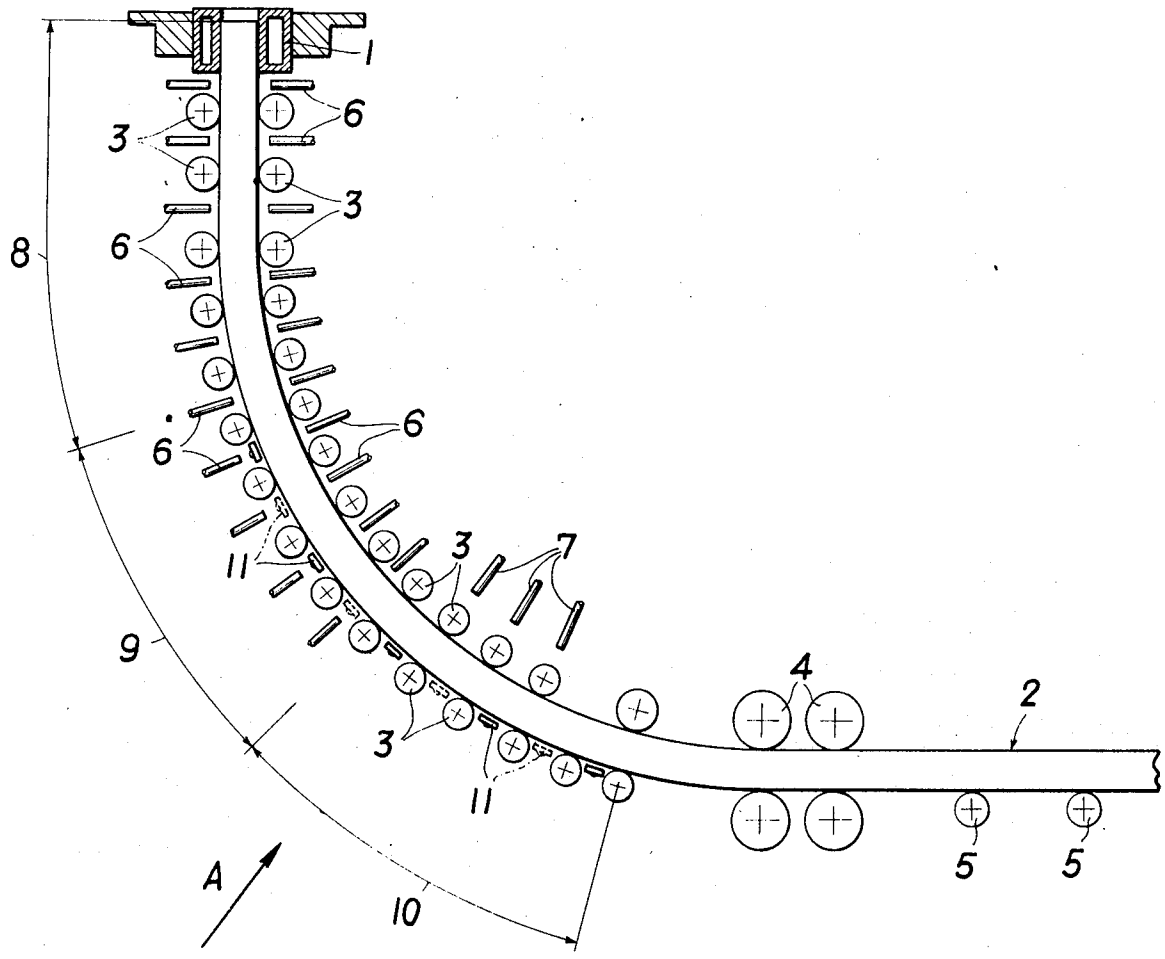
[57] **ABSTRACT**

The invention relates to a continuous casting plant wherein a cooling means is provided which includes, apart from customary nozzles, flat ray nozzles which are arranged at a distance of the slab guided in a supporting and guiding structure between rollers so as to be parallel to the width of said slab, the longitudinal axes of said flat ray nozzles extending parallel to the axes of the rollers. By means of these flat ray nozzles it becomes possible to spray the underside of the bar and the rollers in a uniform and plane manner. A satisfactory cooling is acheived also when the bar owing to skrinkage lifts off the rollers.

5 Claims, 3 Drawing Figures



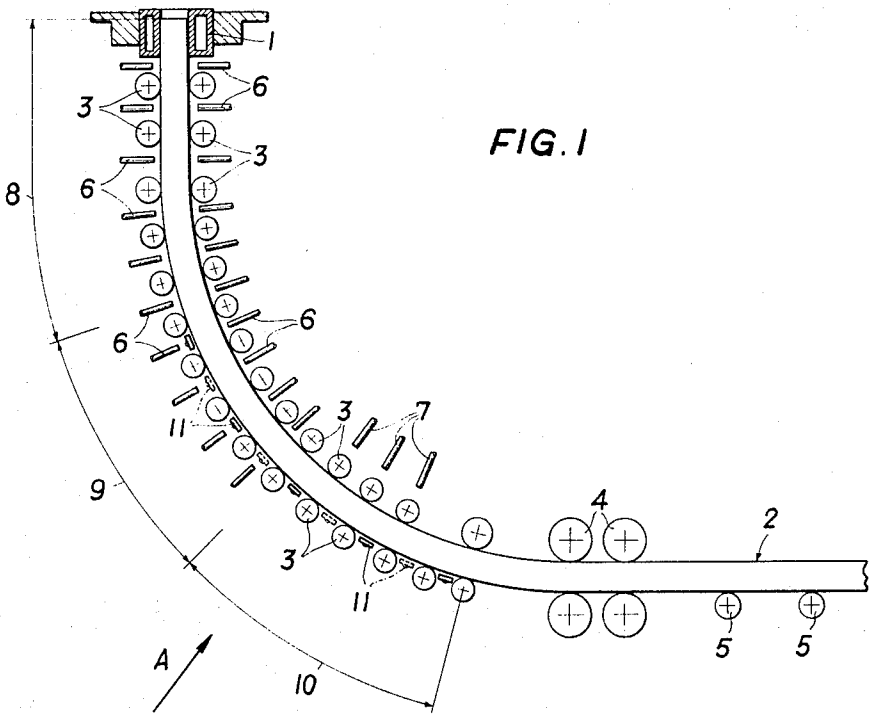


FIG. 1

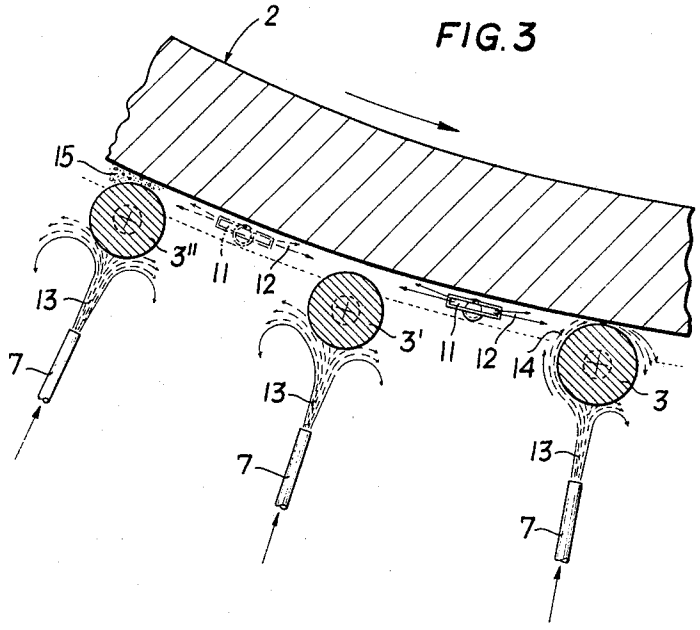
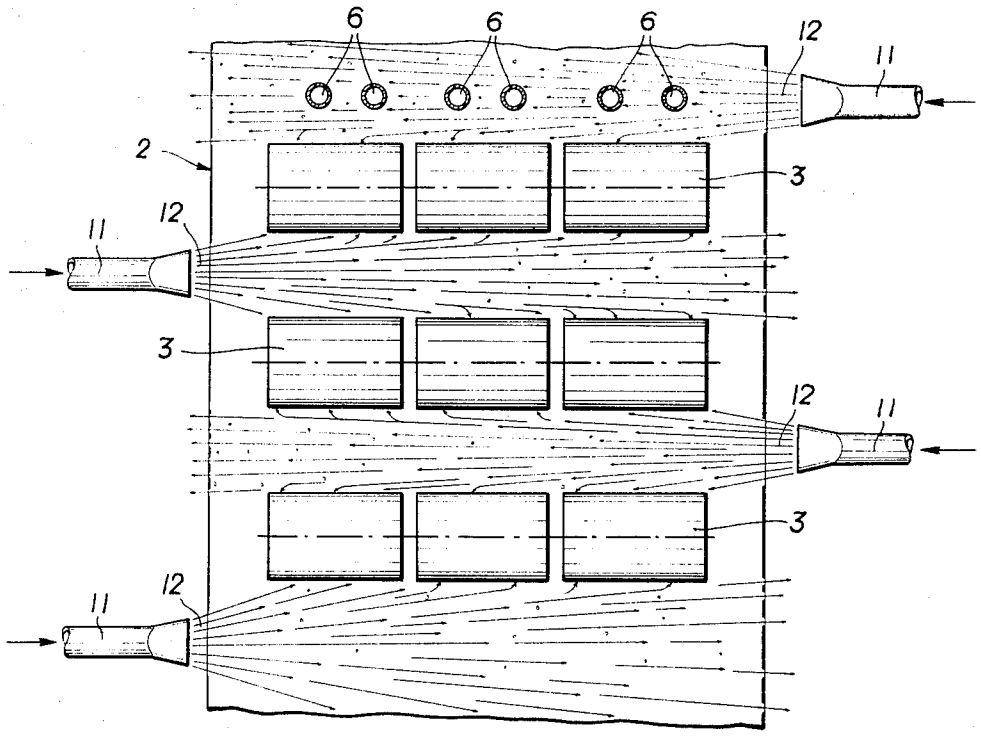


FIG. 3

FIG. 2



CONTINUOUS CASTING PLANT FOR SLABS

The invention relates to a continuous casting plant for slabs comprising a water-cooled mould from which the bar is continuously drawn out, a supporting and guiding structure including rollers between which the bar is guided, and a cooling means comprising nozzles through which a coolant, in particular water, is sprayed onto the bar and the rollers.

Various cooling arrangements for continuous casting plants have become known. E.g. in the Austrian Patent specification No. 233 186 a device is described comprising nozzles through which a liquid is atomized; the nozzles are assigned to zones which are subjected to the liquid in groups, and the nozzles are arranged side by side and vertically to the bar surface at a distance therefrom. It is attempted to uniformly apply the coolant by means of a plurality of nozzles so that the course of the temperature is rendered as uniform as possible in a direction transverse to the longitudinal axis of the bar. As a rule the nozzles have a relatively small bore with a diameter of about 1.1 to 1.3 mm; the bore widens at its mouth so that the nozzle obtains a flat characteristic. As a rule in continuous casting plants for slabs on which cast bars with a width of about 1000 to 2000 mm and a thickness of about 150 to 350 mm are produced, about six such nozzles are arranged side by side and between the individual rollers of the supporting and guiding stand. In continuous casting plants for slabs the rollers are made of several parts and they are supported at several places, as described e.g. in the Austrian Patent specification No. 257 074. In particular in continuous casting plants in which the bar is guided from the vertical line into the horizontal line in an arcuate supporting and guiding structure, the cooling of the rollers on the underside of the arch in the area of the transition to the horizontal line presents difficulties. The more acute the angle between the arch tangent and the horizontal line, the easier the water sprayed onto the bar surface is reflected therefrom or deflected by gravity, so that it is not possible to spray the under- and outer side of the slab and of the rollers in a uniform and plane manner. Thus, in particular the rollers are endangered for an insufficient cooling leads to a local overheating and to seizure of the roller bearings. When the rollers can no longer run freely, between them and the bar surface scale and other deposits, such as slag, are baked in, so that the surface of the bar is greatly impaired. The relatively small diameter of the spraying nozzles may also easily lead to clogging and obstructions of the nozzle bores although cleaned water is used for cooling the bar.

When the cast bar runs through the supporting and guiding structure below the mould it still has a liquid core; with increasing solidification the bar shrinks so that the bar occasionally is lifted from the rollers locally, i.e. between the bar and the rollers a play is created so that individual rollers come to a standstill. The surface area of the rollers turned towards the bar surface is thereby exposed to a particularly intensive heat radiation; as a result, although the surface area of the rollers turned away from the bar surface is cooled, the roller bearings may seize. The supporting and guiding rollers of continuous casting plants therefore are primarily endangered by non-uniform or occasional thermal stress and have to be exchanged frequently. This exchange cannot take place at the site, but as a rule it is necessary to remove the whole supporting and guiding structure, which results in prolonged periods in which casting has to be interrupted.

The invention pursues the task of overcoming these difficulties and disadvantages. In a continuous casting plant of the kind defined in the introduction it resides in that the cooling means comprises flat ray nozzles which are arranged at a distance of the bar so as to be parallel to the surface of the bar, i.e. to the width of the slab, the longitudinal axes of said nozzles running parallel to the axes of the rollers.

According to a further feature of the invention the flat ray nozzles are arranged in the area of the slab edge, preferably at both slab edges in a staggered manner opposite each other.

In a continuous casting plant with an arcuate supporting and guiding structure for deflecting the bar from an essentially vertical direction into an essentially horizontal direction, the cooling means comprises advantageously flat ray nozzles in the area of the deflection, i.e. along one to two thirds of the longitudinal extension of the supporting and guiding structure.

The invention may also be applied in horizontal continuous casting plants. In horizontal plants the bar issues from a water-cooled mould in horizontal direction, or, possibly, slightly slanting and is likewise supported against the ferrostatic pressure by rollers arranged on both sides of the bar and guided by these rollers. In horizontal plants suitably at least the nozzles on the underside of the bar are designed as flat ray nozzles according to the invention.

In order that the invention may be more fully understood, an embodiment thereof shall now be explained with reference to the accompanying drawings.

FIG. 1 is a schematical lateral view of a continuous casting plant for producing wide steel slabs.

FIG. 2 is a schematical top view on a greater scale in direction of the arrow A of FIG. 1.

FIG. 3 is a vertical sectional view of the cast bar and the supporting structure and illustrates how the cooling means according to the invention functions in comparison with known cooling means.

In FIG. 1 numeral 1 denotes a water-cooled mould which oscillates in vertical direction. From the mould a cast bar (slab) 2 having a liquid core still, is drawn out. Supporting and guiding rollers 3 are arranged in the arcuate supporting stand (which is not shown in detail) on both sides of the slab. These rollers 3 are designed to comprise several parts in longitudinal direction (FIG. 2) and they have several bearings. The arcuate supporting and guiding structure may comprise a stationary part on the arch outside and an adjustable part on the arch inside so that the distance between the supporting and guiding rollers 3 may be adjusted to different thicknesses of the slabs. By means of the supporting and guiding arch the cast bar is deflected from the vertical line into the horizontal line; after the arcute supporting and guiding structure a combined driving, straightening and rolling stand 4 is arranged from which the slab 2 runs out horizontally on rollers and is severed to pieces in known manner.

The arcuate supporting and guiding structure containing the rollers 3 is provided with a cooling means serving for a secondary cooling of the slab 2 until it is completely solidified, which solidification ordinarily is ended in the area of the drawing, straightening and rolling stand 4. The cooling means comprises a plurality of spraying nozzles 6 which are arranged between the roll-

ers 3 side by side and vertically to the bar surface. The water leaving the spraying nozzles 6 with a pressure of three to eight atm. gauge cools not only the bar 2 but also the rollers 3. At the end of the supporting and guiding arch, i.e. at the transition to the horizontal line, it is suitable to cool the rollers 3 at the arch inside by means of fog nozzles 7 directed against the surface area of the rollers; the fog nozzles are operated by means of a mixture of water and pressurized air. There is no problem in cooling the rollers 3 at the arch inside since they are continuously subjected to the coolant which owing to gravity runs onto the surface of the bar 2 and on to the rollers lying below.

The situation is different, however, at the outside of the arcuate structure: in the zone 8, joining to the mould 1, cooling may satisfactorily be carried out with traditional spraying nozzles, but in the adjoining zones 9 and 10 they no longer suffice because there the cooling water, which is sprayed vertically against the bar surface, is reflected and drops off owing to gravity. Therefore, according to the invention in these zones laterally of the bar 2 and parallel to its surface (outside) flat ray nozzles 11 are provided. These flat ray nozzles may be produced in simple manner by pressing together a water supply tube; a mouth having an about rectangular or oval cross section of about 10 × 4 mm which cannot easily be obstructed is obtained. In the zone 9 suitably both, spray nozzles 6 directed to be vertical to the bar surface, and flat ray nozzles 11 directed to work parallel to the surface of the slab, may be provided as this may be derived from FIG. 1. In an arcuate continuous casting plant for wide steel slabs, suitably the longitudinal extension of the zones 9 and 10 amounts each to one third of the total outside of the arcuate supporting and guiding structure. In continuous casting plants with a high casting output the supporting and guiding portion extends up to several meters into the horizontal line, so that in such a plant also below the horizontal bar portion flat ray nozzles 11 should be arranged.

The arrangement of the nozzles may be derived from FIG. 2. The flat ray nozzles 11 are arranged in a staggered manner to lie opposite each other between the supporting and guiding rollers 3, which are designed to comprise e.g. three parts, and in parallel to their longitudinal axes. These nozzles are subjected to a pressure of about 10 atm. gauge so that a broad, flat water ray 12 is created; its direction of flowing is illustrated by arrows. The flat, highpressure water stream covers the total area between two rollers 3 lying side by side, but only part of the cooling water takes actively part in cooling the bar; thus, the bar surface is not excessively cooled, as this would for example be the case if the same amount of water were sprayed vertically onto the bar surface by means of a plurality of nozzles. The broad water ray 12 has to remove scale, slag and other impurities from the bar surface, as this may be seen from the schematic drawing of FIG. 3.

FIG. 3 schematically illustrates how the cooling means according to the invention functions as compared with a known cooling means. Numerals 3, 3', 3'' denote three supporting and guiding rollers arranged side by side on the arcuate under side of the slab 2; the roller 3 turns owing to the contact with the bar, while a play has been formed between the rollers 3' and 3'' and the bar surface so that these rollers stand still because the bar 2 has lifted owing to its shrinking. Until now the fog nozzles 7 have been used also on the under side of the arcuate structure for cooling the rollers, as shown in FIG. 3. This mode of cooling, however, has remained without result because the coolant stream 13 issuing from these nozzles is directed only against that part of the surface area of the rollers which is turned away from the bar surface so that the heat exposed surface area of the rollers turned towards the bar surface is overheated and the roller bearings are blocked. Only the roller 3 which is still turning takes up a coolant film 14 in direction of the arrow; with this cooling arrangement cooling is satisfactory as long as the bar 2 does not lift off that roller. Numeral 15 denotes schematically a deposit of scale and slag on the standing and on one side overheated roll 3'' which has an abrasive effect on the bar surface. Compared to this known cooling means the cooling means according to the invention, which is also shown in FIG. 3, functions also when the rollers come to a standstill. The flat ray nozzles 11 according to the invention and the broad water stream 12 issuing from it are illustrated in FIG. 3; the cross current within the water stream parallel to the bar surface and in direction towards the rollers is characterized by arrows. It may be seen that such a broad water stream emitted with high pressure transversely to the longitudinal axis of the bar 2 and parallel to its broad side does not only effect the necessary cooling of the bar and of the rollers but also can rinse away scale and slag rests; when the bar is lifted from the rollers the roller bearings will not seize or bake with solids.

What we claim is:

1. A continuous casting plant for slabs comprising a water-cooled mould from which the slab is continuously drawn out, a supporting and guiding structure including rollers between which the slab is guided, and a cooling means comprising nozzles through which a coolant is sprayed onto the slab and the rollers, and further comprising flat ray nozzles which are arranged at a distance of the slab so as to be parallel to the width of the slab for cooling the slab and the rollers, the longitudinal axes of said flat ray nozzles extending parallel to the axes of the rollers.

2. The continuous casting plant set forth in claim 1, wherein the flat ray nozzles are arranged in the area of the slab edge.

3. The continuous casting plant set forth in claim 2, wherein said flat ray nozzles are arranged at both slab edges in a staggered manner opposite each other.

4. The continuous casting plant set forth in claim 1, wherein said supporting and guiding structure is an arcuate structure for deflecting the slab from an essentially vertical direction into an essentially horizontal direction, and wherein said flat ray nozzles are arranged in the area of the deflection which is regarded to amount to from one to two thirds of the longitudinal extension of the arcuate supporting and guiding structure.

5. The continuous casting plant set forth in claim 1, wherein said supporting and guiding structure is a horizontal structure and said flat ray nozzles are arranged at the under side of the slab.

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