Oct. 22, 1968 H. W. BRAND 3,406,739

VARIABLE DEPTH GROOVE ROTARY CONTINUOUS CASTING MACHINE

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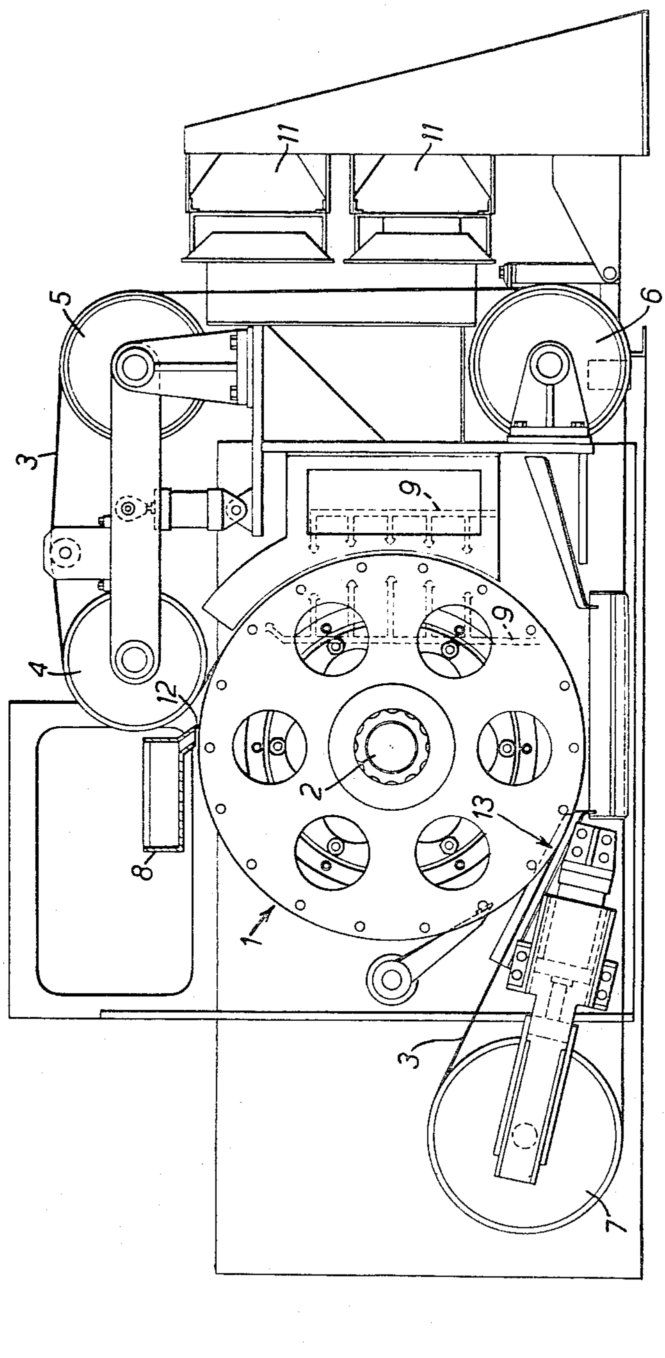

FIG. 1.

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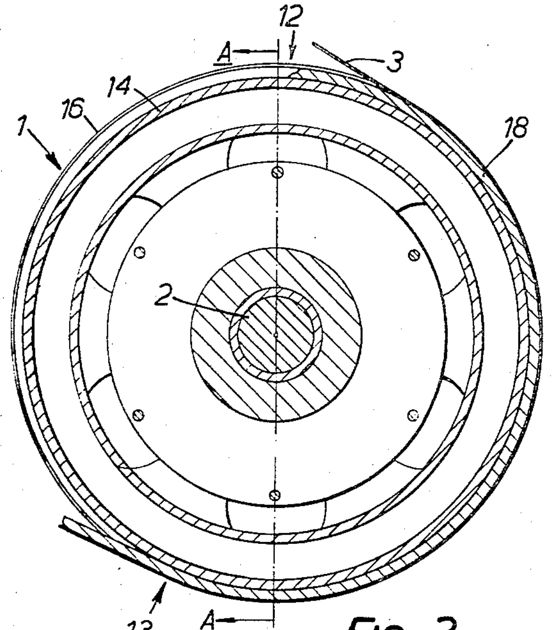

FIG. 2.

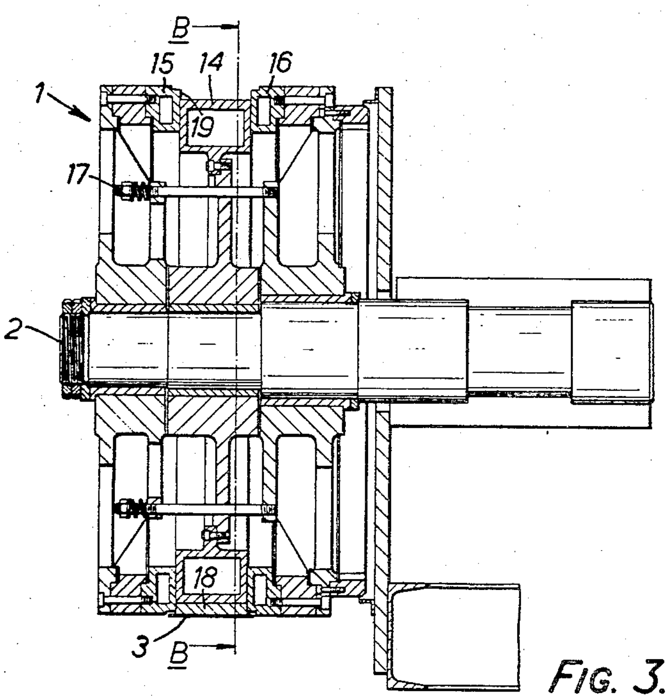

FIG. 3.

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VARIABLE DEPTH GROOVE ROTARY CONTINUOUS CASTING MACHINE

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7 Claims. (Cl. 164—278)

ABSTRACT OF THE DISCLOSURE

A mould wheel for a rotary continuous casting machine, in which the mould is formed by a groove which extends around the circumference of the wheel and a continuous belt which closes the groove over part of its length. The depth of the groove varies progressively around the circumference of the wheel, but the floor of the groove is movable relative to the sides of the groove so that the depth, at any fixed point, remains constant during rotation of the wheel. During casting the wheel rotates and the material being cast is carried round in the mould, the wheel being so arranged that the depth of the mould decreases, in the direction of rotation, so that contact between the groove, the belt and the material being cast can be maintained as the material solidifies and shrinks.

This invention relates to rotary continuous casting machines and in particular to mould wheels for such machines.

Normally, such machines include a mould wheel having a grooved rim, the groove being of uniform depth and extending around the circumference of the wheel. The mould is formed from this groove closed by a belt which is wrapped around part of the rim of the wheel. This results in a mould having uniform depth throughout the casting process and it has been observed that the quality of the resultant cast article can be short of that sometimes desired.

It is an object of this invention to provide a mould wheel for use in a rotary continuous casting machine which makes it possible to cast an improved quality article.

According to the present invention, a mould wheel for a rotary continuous casting machine has a circumferentially grooved rim, the depth of the groove varying progressively around at least part of the circumference of the wheel.

A rotary casting machine constructed in accordance with the invention includes a rotary mould wheel having a circumferentially grooved rim and an endless belt closing the groove over part of the circumference of the mould wheel in such manner that the distance between the belt and the floor of the groove progressively decreases in the intended direction of rotation of the wheel.

The mould wheel can be constructed in several ways. In a preferred construction, the mould wheel comprises an inner cylindrical member sandwiched between two outer cylindrical portions, the facing sides of which together with the rim of the inner portion define the groove. The inner and outer cylindrical portions have circular cross-sections, the outer portions having a common axis offset from the axis of the inner portion. The outer sections can be spring-loaded or preloaded into contact with the inner section.

In a rotary continuous casting machine embodying the invention, the degree of depth variation between the floor of the groove and the continuous belt can be so

arranged that contact between the casting and both the belt and the floor of the groove is maintained during solidification of the casting, during which shrinkage of the casting occurs. This maintained contact results in a casting having an improved surface quality, since the possibility of air bubble formation between the casting and either the belt or the floor of the groove has been eliminated.

In a rotary continuous casting machine, embodying the preferred construction of the mould wheel, the mould wheel is mounted for rotation on a stationary supporting shaft. The position of minimum depth of the grooves in a casting cycle can then be altered in dependence on the prevalent conditions by adjustment of the wheel and shaft to move the axis of the inner cylindrical portion around the common axis of the outer cylindrical portions or vice versa. The variation in the depth of the groove can be altered by adjustment of the wheel and shaft to alter the degree of offset of the axis of the inner cylindrical portion from the common axis of the outer cylindrical portions. The mould wheel can incorporate cooling arrangements, internal and/or external.

By way of example, an embodiment of the invention will be described in greater detail with reference to the accompanying drawings of which:

FIG. 1 is a diagram of a rotary casting machine embodying the invention

FIG. 2 is a view of a cross-section of a mould wheel according to the invention, taken along the line BB in FIG. 3, showing the casting belt and a strip of material being cast

FIG. 3 is a view of a cross section of the mould wheel taken along the line AA in FIG. 2.

The rotary casting machine shown in FIG. 1 has a mould wheel, indicated generally at **1** mounted for rotation on a stationary supporting shaft **2**, in a clockwise direction, as seen in the diagram. The mould wheel has a grooved rim, and the mould is formed from the groove closed by a continuous mild steel belt **3** that wraps around approximately half of the wheel's circumference. This belt is carried on four jockey pulleys, **4**, **5**, **6** and **7**, two of which have pneumatic or hydraulic tensioning devices to ensure that the belt is pressed hard against the wheel at the upper point of contact. The molten material to be cast is contained in a launder **8**. Water sprays **9** within and outside the mould wheel **1** are provided to cool the wheel and the steel belt **3** during casting, and dryers **11** are located behind the wheel to dry the belt as it passes in front of them. The belt is coated with colloidal graphite to prevent it sticking to the material being cast.

When casting is taking place, molten material is poured from the launder **8** into the mould at a point **12**, at, or just beyond the top center point of the wheel (in the direction of rotation of the wheel). The wheel **1** and the belt **3** rotate, carrying the material around in the mould where it is cooled by the water sprays **9** and solidifies and shrinks, there being typically a reduction of 6% in the thickness of the strip at a point about 60° of rotation from the feed point **12**. The resulting strip of solidified material leaves the wheel at a point **13** almost diametrically opposite that at which the molten material enters, and is then ready for further processing.

An end view and a cross sectional view of the mould wheel are shown in FIGS. 2 and 3 respectively. The wheel is constructed from three sections, a central section **14** and two outer sections **15** and **16**, all of cylindrical shape with a circular cross section, the outer sections **15** and **16** having a greater diameter than the central section **14**. The outer sections **15** and **16** are spring loaded or preloaded at 17 into contact with the central section 14 so that the principal axes of the outer sections are coincident, and are parallel to, but offset from the principal axis of the central section. In this way, a groove 19 is formed in the rim of the wheel (the central section 14 defining the floor of the groove and the outer sections 15 and 16 defining the side walls) and the depth of the groove varies progressively around the whole circumference of the wheel. The length of the central cylindrical section 14 depends on the required width of the cast strip.

The wheel is so mounted on the casting machine shaft 2 that each section 14, 15, 16 is rotatable about its own principal axis. The tie bars 17 ensure that the three sections rotate about the shaft 2 at the same speed, but the eccentricity of the central section 14 with respect to the outer sections 15, 16 causes a degree of relative movement, between the central and outer sections, in a direction radially of the central section. This relative movement is accommodated by a suitable clearance between each tie bar 17 and the wall of the aperture in the central section through which the tie bar passes, which is too small to show to scale on FIGURE 3. The wheel is so arranged that, when it is stationary, the depth of the groove 19 progressively decreases in the intended direction of rotation of the wheel. When the wheel is rotated, the relative movement between the central and outer sections 14, 15 and 16 ensures that the depth of the groove at any hypothetical fixed point remains constant. In this way, when a strip which is being cast begins to solidify and therefore to shrink, so the depth of the mould in which it is being cast decreases. By moving the principal axis of the center section 14 around the common axis of the outer sections 15, 16 prior to casting, the position of minimum depth of the groove 19 in a casting cycle can be varied and by varying in addition the degree of offset of the center section 14, it can be arranged that during casting the depth of the groove decreases more rapidly than the thickness of the strip being cast, so that the strip is gradually pushed out of the groove. This situation usually commences at a point between 30° and 60° of rotation from the point 12 at which molten metal enters the wheel. The tension of the steel belt 3, however, ensures that contact between it and the strip, and between the strip and the central section 14 of the wheel is maintained. The positions of the strip and the steel belt 3 in relation to the wheel are shown in FIG. 2, the strip being indicated generally at 18.

Thus, during about the initial 60° of rotation of the mould wheel from the feed point 12 the belt 3 is in contact with both the strip 18 and the wheel rim (defined by the outer curved surfaces of the sections 15 and 16). After about 60° of rotation, however, the strip 18 begins to be pushed out of the groove 19 of the mould wheel and commences to lift the belt 3 from the rim of the wheel, contact of the strip 18 with the floor of the groove 19 and the belt 3 being maintained because of the tension of the belt until the strip is lifted clear of the mould wheel as best seen at point 13 in FIG. 2. This maintained contact between the strip and both the belt and the wheel eliminates the possibility of air bubble formation in the mould, and results in the cast strip having an improved surface quality and gain structure.

I claim:

1. A rotary continuous casting machine including an operably stationary shaft, first, second and third cylindrical members, said first member having a smaller diameter than and disposed between said second and third members, resilient means operably engaging the said first member with each of said second and third members such that said second and third members have a common principal axis parallel to and offset from the principal axis of said first member, said operably engaged first, second and third members defining a mould wheel with a circumferential groove having a floor defined by said first member and side walls defined by the respective second and third members, means mounting said first, second and third cyindrical members on said shaft for rotation about their respective principal axes, an endless belt engaging the said first and second members to close said groove over part of the crcumeference of the said mould wheel with a progressively decreasing distance between the belt and the floor of said groove in the intended direction of rotation of said wheel to form a mould having a progressively decreasing depth, means for pouring molten metal into said mould, and means for supplying coolant to the said wheel in the region of the groove therein to assist cooling of molten metal in the said mould.

2. A machine according to claim 1, in which the depth of said mould decreases at a rate adequate to maintain the molten metal in said mould in contact with said belt and the floor of said groove at least over 60° of rotation of said mould wheel following pouring of the molten metal into said mould.

3. A mould wheel for a rotary continuous casting machine, said mould wheel having a rim portion, a groove in the rim portion extending around the circumference of the wheel and having a depth which changes progressively around the circumference of the wheel, the groove having a floor and side walls, the side walls being movable, relative to the floor, during rotation of the mould wheel to maintain a constant groove depth at any hypothetical point during rotation of the wheel.

4. A mould wheel as claimed in claim 3, which includes two outer cylindrical portions and an intermediate cylindrical portion sandwiched between the two outer portions, the facing ends of the two outer portions constituting the said side walls of the groove and the rim of the intermediate portion constituting the said floor of the groove, each of the cylindrical portions being rotatable about its respective principal axis, the principal axes of the outer cylindrical portions being coincident and parallel to but off-set from the principal axis of the intermediate cylindrical portion.

5. A mould wheel as claimed in claim 4, which includes resilient means loading the said outer cylindrical portions into engagement with the said intermediate cylindrical portion.

6. A rotary continuous casting machine which includes a mould wheel as claimed in claim 3, an endless belt engaging said rim portion of the mould wheel to close said groove around part of the circumference of the wheel, the depth of the groove around said part of the circumference of the wheel decreasing progressively in the intended direction of rotation of the wheel.

7. A casting machine as claimed in claim 6, including an operably stationary shaft on which the mould wheel is rotatable.

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