United States Patent

Petit

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[54] **CONTINUOUS CASTING MACHINE WITH CONTROLLED EXTRACTOR MOVEMENT**

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[51] **Int. Cl.** **B22d 11/06**

[58] **Field of Search**.....164/73, 76, 158, 268, 278, 164/344

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[57] **ABSTRACT**

A casting machine includes a casting wheel (1), which continually rotates in the direction of the arrow F, and which has a groove (2) about its periphery. The groove (2) is surrounded by a moving belt (3) which forms a moving casting chamber into the upstream end of which molten metal is injected by a nozzle (4). A continuous cast product (7) is freed from the end of the casting chamber by an extractor wedge (22) mounted for pivoted movement about an axis parallel to the axis of the casting wheel. Nozzles (10) and (11) spray lubricant into the groove (2) to cool it and rotating brushes 14) engage the periphery of the casting wheel (1) to remove deposits of lubricant from the exterior of the wheel to prevent scale formation.

24 Claims, 5 Drawing Figures

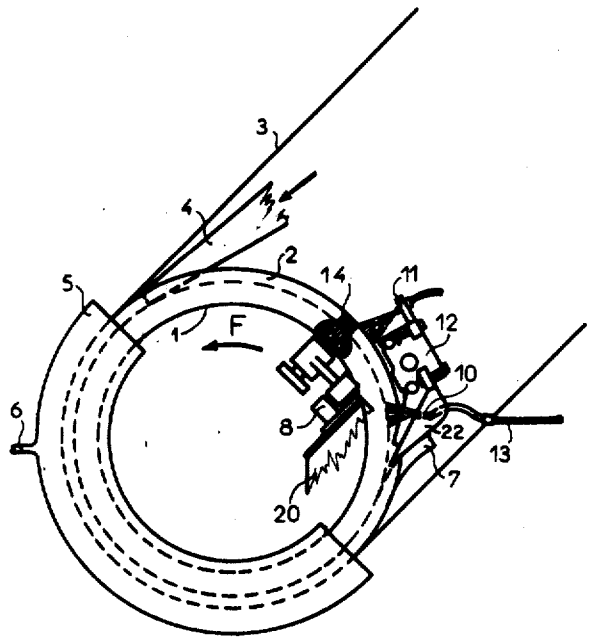


FIG.1

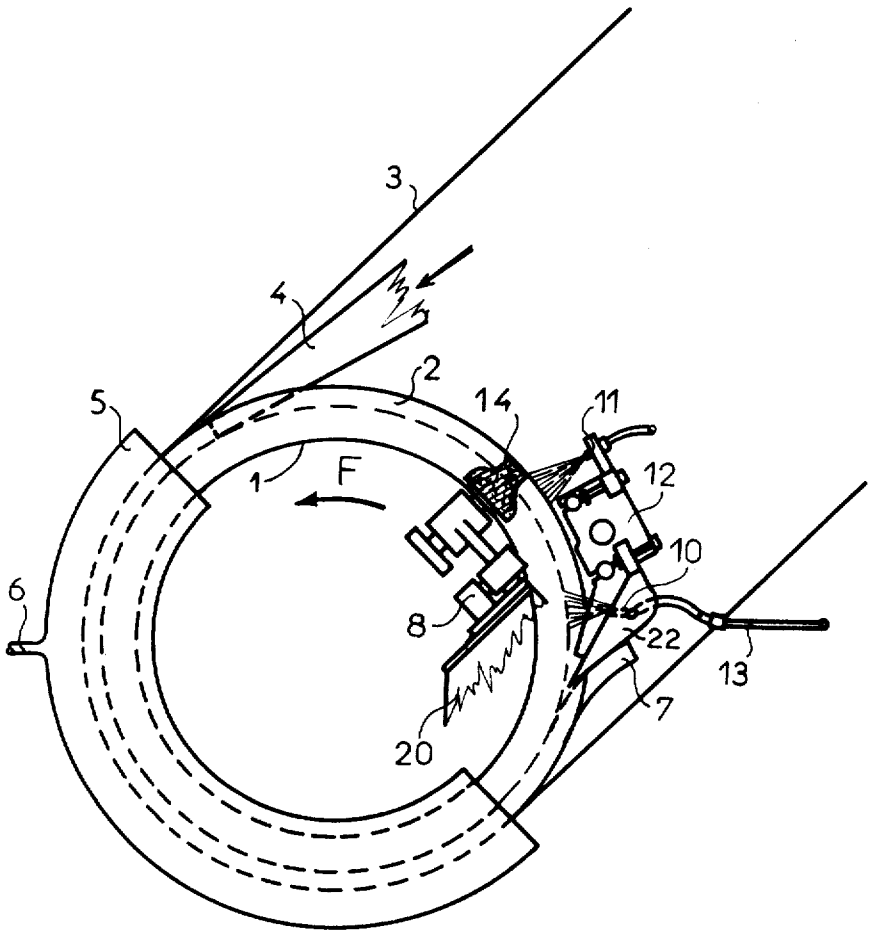


FIG. 2

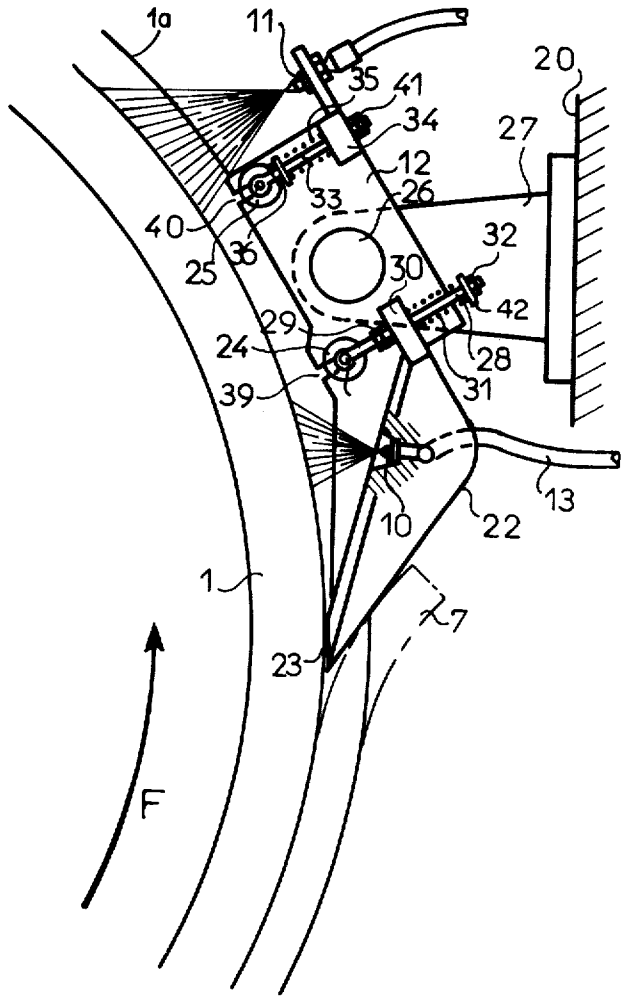

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FIG. 3

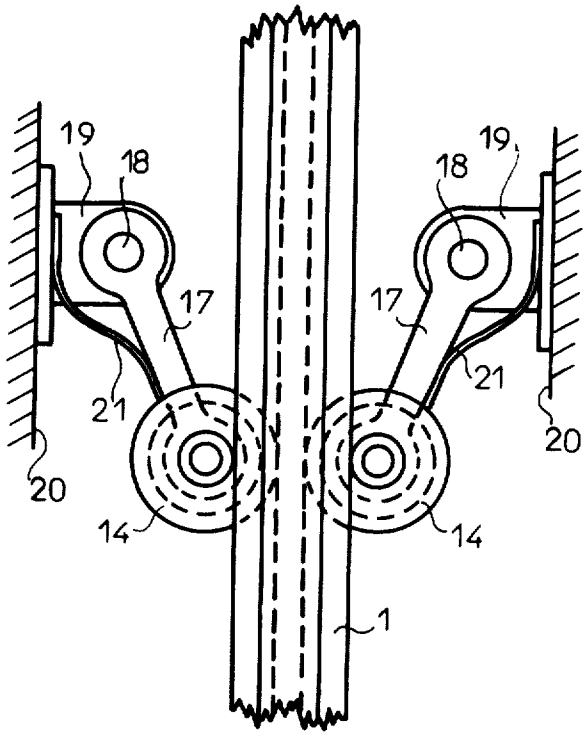


FIG. 4

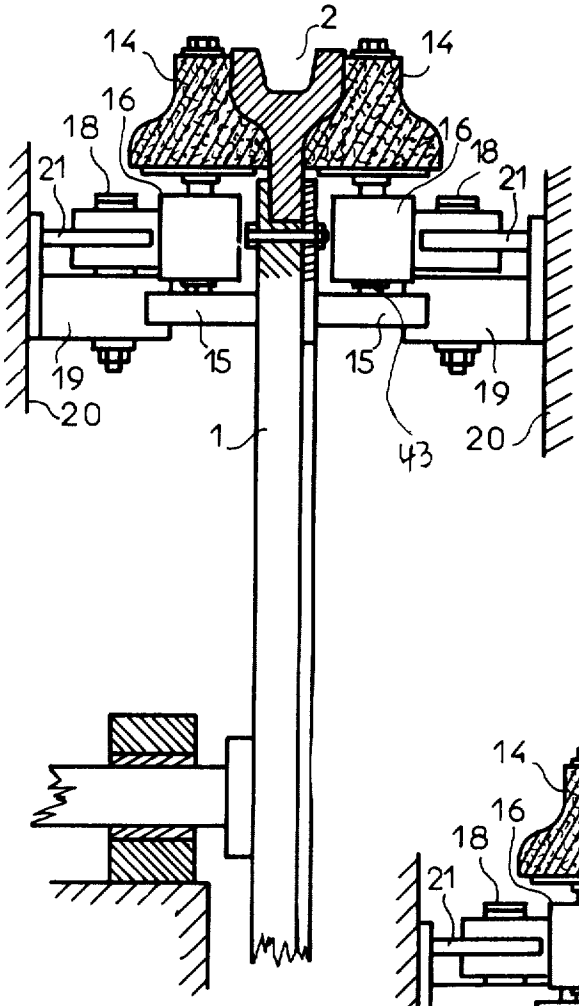
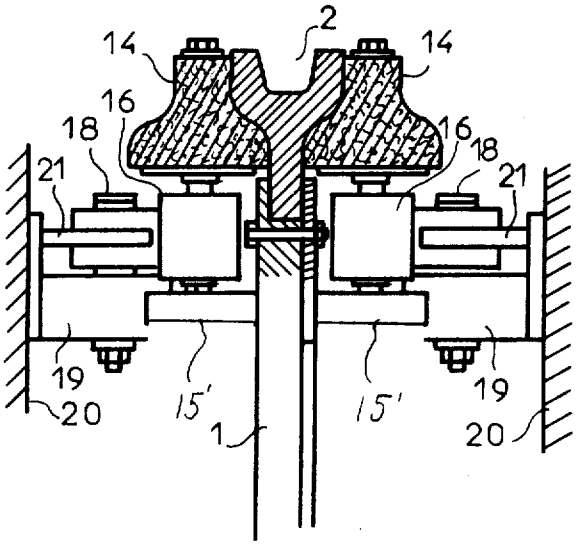

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FIG. 5.


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1

CONTINUOUS CASTING MACHINE WITH CONTROLLED EXTRACTOR MOVEMENT

BACKGROUND OF THE INVENTION

This invention relates to continuous casting, and more particularly to an arrangement for continuously extracting the cast product from the casting apparatus and for cooling and cleaning the apparatus.

There are known a number of arrangements for continuous casting which utilize, in general, a wheel called a casting wheel having a groove formed in its periphery which is closed by means of a tight belt entrained about it to engage the edges of the groove so as to constitute with the groove a casting chamber into which the material to be formed is progressively injected as a molten liquid. The wheel and the belt move together and during the movement the liquid solidifies so as to form an elongated product which is susceptible of further treatment, for example, by a series of rolling mills.

Such arrangements normally include an arrangement for cooling the casting apparatus in order to remove the heat added by the melted material and to permit this material to solidify at a sufficiently rapid rate, and to reduce the amount of time during which the said material must remain within the mold.

It is practically inevitable, however, that a certain number of complications will arise with different known types of installations, which cause the operator problems and often hinder the correct functioning of the installation.

If such a casting arrangement is to function continuously, it is necessary that it arrive at a state of equilibrium at which, during each point of the circuit of the moving apparatus, the temperature gradient should be approximately constant or at least such that the variations are sufficiently low and regulated. This stability of temperature should be realized not only within the part of the wheel which forms the casting chamber itself but equally in the remaining part where each region of the wheel, after having traveled through the zone in which it is utilized as part of the casting chamber, is progressively brought back to its initial thermal state. It is only under these conditions that the machine is susceptible of assuring regular and continuous circulation of the product so that it will, in consequence, have regular predictable characteristics.

Besides the problem of removing the heat introduced by the liquid introduced into the mold which makes necessary the provision of an appropriate cooling system, there also appear phenomena which are accessory to the expansion and deformation generated by the friction of the different parts in consequence of the changing temperatures of the parts.

Phenomena of this type cause particular trouble at the time when the product is extracted from the mold. The said product adheres more or less strongly to the inner surface of the groove and particularly against the bottom of it. It is obviously desirable to avoid as much as possible the necessity of intervening manually in the operation. For this reason it is desirable that the apparatus should be able to operate as much as possible in an automatic manner.

Accordingly, there is placed against the periphery of the wheel, immediately downstream of the point where the product should leave the mold, a wedge-shaped extractor, the point of which is directed towards the

downstream end and which comes to rest tangentially to the generally cylindrical surface which represents the bottom of the groove of the wheel. This wedge penetrates also under the product and has its point of tangency at the point at which it is desired to separate the product from the mold.

Previously known arrangements of this type present difficulties in that the casting wheel may bind against the extractor due to the expansion to which it is subjected. At times there may result the formation of casting burrs owing to an upsetting of the product which may obstruct completely the groove while totally blocking the extraction of the product. In addition, the same phenomena of expansion can cause scratches to originate which will finally cover completely the periphery of the bottom of the groove and the interior surfaces. These scratches are caused by the action of the extractor wedge against the interior of the wheel. Under these conditions it is necessary to stop the manufacture of the product from time to time in order to clean the wheel and to restore the surface of the groove by removing the scratches.

In order to avoid such scratch formation, the extractor wedge is held against the downstream end of the wheel by a support block which is capable of pivoting around an axis carried by the support structure of the machine. This axis is perpendicular to the plane of the casting wheel in order to permit the extractor wedge to rest within the plane in question while being able to pivot around the axis of the support block.

The said support block includes, on each side of its axis, a roller which, in operation, permanently runs on the borders of the groove of the wheel. Sometimes in place of being entirely solid with the said block support, the axis of the two rollers are mounted freely in translation within a plane approximately perpendicular to the circular trackway constituted by the said borders of the groove and on which the rollers are arranged to travel. In addition, each axle of the rollers is submitted to the action of resilient means which tend to keep the rollers in engagement with the rim.

Scale is sometimes formed on the extractor of prior art casting wheels. The scale includes solid deposits which are produced as a result of the reaction of heat on deposits of cooling liquids which accumulate on the exterior periphery of the wheel, particularly in the vicinity of the flanges which form each side of the peripheral groove.

Among the objects of the present invention are the elimination of interference with the turning of a casting wheel by an extractor wedge used to extract the product from the casting chamber formed by the wheel.

A further object of the invention is to minimize the formation of scratches formed by such extractor blocks.

A still further object of the invention is the prevention of the formation of a scale on the exterior surface of a casting wheel, which scale, in prior art casting devices, is formed by the action of cooling liquids which are sprayed upon the casting wheel.

A still further object of the invention is the elimination of shutdown time of continuous casting apparatus by minimizing the frictional binding and the formation of scratches and scale upon the casting wheel which

have necessitated periodic shutdown of continuous casting.

Briefly stated, these and other objects of the invention are achieved by providing a continuous casting wheel having a groove in its outer periphery about which a belt is entrained. An extractor wedge is mounted for movement about an axis parallel to the axis of the casting wheel. This extractor wedge is mounted on a support block which carries the axles of two rollers which are mounted freely for translation and which engage upon a circular trackway formed by the flanges of the groove on which the rollers are arranged to travel. In addition, each axis of the rollers is submitted to the action of a resilient means, a spring for example, which acts against a boss which is part of the support block and has the effect of biasing the rollers permanently against the trackway at a point which is downstream of the support block. This spring action has the effect of maintaining the roller in simple contact with the trackway on which it rolls.

Under these circumstances, under the influence of expansion of the wheel, the extractor wedge is slightly raised by an amount which is just sufficient to avoid hinderance of the extractor wedge with the rotation of the wheel. This effect is obtained because of the interconnection action of two controlled means of compression which act upon each roller and permit it to effect a translation corresponding to the increase in diameter of the wheel and to bring about by the play of the said means of compression on the bosses of the support block, a pivoting of the apparatus in the desired sense.

In addition, there is provided a means for spraying a cooling liquid for lubrication purposes into the bottom of the groove. In addition, the formation of scale on the exterior of the casting wheel is eliminated by providing means for removing the deposits of cooling liquid from the external periphery of the wheel, notably in the vicinity of the exterior of the flanges of said wheel. A system of brushes or shoes fitting tightly against the exterior periphery of the flanges of the wheel is proposed. These brushes are exposed, for example, in pairs, symmetrically. Each is moved more or less regularly with the rotation and in the same sense or in a sense contrary to the regulation of the wheel. The said shoes or brushes are, by resilient means, a spring for example, biased against the wheel.

Other objects and advantages of the invention will be apparent from an inspection of the following detailed description and of the following drawing figures:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of the apparatus according to the present invention connected to a continuous casting arrangement of known type;

FIG. 2 is a view, to a larger scale than FIG. 1, of a portion of the inventive structure showing the mounting of the extractor wedge and of the lubricant spray nozzles;

FIG. 3 is a plan view, taken from above, of a pair of brushes or shoes rotating so as to prevent the formation of solid deposits or scale;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3, and

FIG. 5 is a sectional view similar to FIG. 4 showing a modified form of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As can be seen from FIG. 1, a casting arrangement according to the present invention includes a casting wheel 1 having a groove 2 formed around its periphery which is closed by a belt 3. The arrow F indicates the direction of rotation of the wheel and of movement of the belt which moves at the same speed as the periphery of the wheel. The belt and the wheel together form a continuous casting chamber. A nozzle 4 at the beginning of this chamber injects a melted liquid product for casting.

A cooling casing 5 carrying a water inlet 6 surrounds the part of the wheel forming the closed casting chamber. At the exterior of the casting chamber a cast product 7 leaves the mold.

An extractor wedge 22 is mounted so that its forward end projects beneath the product and constantly grips it from the end of the casting chamber. Nozzles 10 and 11 spray a liquid into the interior of the mold. A brush 14 continuously rotates against the exterior of the casting wheel so as to remove sprayed liquid deposits which might cause the formation of scale on the exterior of the casting wheel. Brush 14 is part of the cleaning apparatus 8 which is mounted on the machine frame structure 20, only a portion of which is shown in any particular drawing figure.

The details of the mounting of the extractor wedge and of the lubricant spray mechanism can be seen in greater detail in FIG. 2. The extractor wedge 22 is integral with a holder block 12 which is mounted for rotation about an axis 26 on a support arm 27 which is fixed to the machine frame 20.

The holding block 12 carries rollers 24, 25 which both engage against the same one of the flanges 1a formed by that portion of the casting wheel which is to the side of the groove 2. The rollers 24, 25 are mounted on axles which are carried on the inner end of rods 28 and 33, respectively. These rods are arranged so as to be parallel with a radius of the casting wheel 1 which passes through the center of the pivot 26 for the support block 12. One roller is upstream of the radius, the other downstream. The shaft 28 on the downstream end of pivot 26 is mounted in an opening which passes through a boss 30 which projects from the exterior of block 26. An adjustable nut 29 is threaded about that end of rod 28 which is inward of boss 30 to serve as an adjustable abutment. A coil spring 31 surrounds rod 28 and abuts at one end with boss 30 and at the opposite end against a washer 42 held in position by a nut 32 which is threaded onto the exterior end of rod 28.

Rod 33 is mounted in an opening which passes through a boss 34 which projects from support block 12. A coil spring 35 held in position by an adjustable nut 36 is fixed on that portion of rod 33 which is radially inward of the boss. An adjustable nut 41 is threaded on the portion of the rod which is exterior of the boss.

Each of the roller axles is mounted for movement in an elongated slot 39 or 40 which extends in a direction parallel to the rods 31 or 33, respectively.

A second pair of rollers, identically mounted, can be provided to engage the other flange 1a of the casting wheel.

The function of the mounting arrangement for the extractor wedge above-described is as follows:

Initially, the desired position of the extractor wedge is regulated with the aid of the threaded abutment **29** which is on the downstream side of pivot **26**. The desired amount of play is equal to the amount by which casting wheel **1** will expand during continuous casting. When the casting wheel expands under the influence of heat, the action of nut **29** on boss **30** tends to rotate the holder block in a counterclockwise direction as seen in FIG. **2**. The maximum inward movement of the tip **23** of the extractor wedge **22** is determined by the position of the roller **24** on the flange **1a** of the wheel, this being determined by the position of the adjustable nut **29**.

Under the influence of expansion of the casting wheel due to heat, the spring **35** is compressed. This tends to rotate the holding block **12** and the extractor **22** in a clockwise direction. The combination of the adjustments on each of the rods has the effect of balancing the two contrary pivoting movements and serves always to maintain a proper distance of the wheel from the tip of the extractor wedge when the wheel undergoes expansion under the influence of heat. It is desirable to regulate the arrangement of the two rollers **24** and **25** on the periphery of the wheel with a pressure which is as light as possible.

Nozzle **10** is mounted in an opening which passes through the extractor wedge **22** on the downstream side of the pivot, while nozzle **11** is arranged on the upstream side of pivot **26** so as to spray lubricant within the groove.

Referring to FIGS. **3** and **4**, it will be seen that brushes or shoes **14** are arranged which have the shape of figures of revolution, the cross section of which has an exterior periphery which corresponds to the cross section of the external periphery of the casting wheel **1**. Each of the brushes **14** is mounted for rotation on an arm **17** which is pivoted at its one end **18** to a support **19** which extends from the machine frame **20**. A leaf spring **21** biases each of the arms **17** so as to force the brushes or shoes **14** into tight engagement with the exterior of the casting wheel periphery. Friction rollers **15** are carried by the lower ends of the shafts **43** about which the brushes or shoes **14** rotate.

If desired, as shown in FIG. **5**, the friction wheels **15** may be replaced by individual motors **15'** which permit the brushes or shoes **14** to be rotated in either the same direction as the casting wheel's periphery moves or in the contrary direction.

In operation the brushes or shoes **14** remove any liquid which is sprayed by the lubricant nozzles **10** or **11** on the external surface of the casting wheel, particularly the flanges. In addition, if any of the material which is being cast comes to rest on the outside, this will tend to be removed. As a result of the removal of these impurities it is less likely that scale will be formed on the external surface of the casting wheel.

It will be apparent that there has been provided a mounting for a casting wedge in which the tip of the extractor wedge is given sufficient play so as to accommodate expansion of the casting wheel under the influence of heat during continuous casting operations so as to avoid either binding of the casting wheel or scratches of the grooved periphery. It will also be evident that a device has been provided which will remove sprayed cooling liquid from the external flanges of the casting wheel. It will also be evident that, since the binding, scratching, and scale formation which, in the prior art, has been a cause of the necessary stopping of casting operation, a more automatic casting operation has been provided.

Although only one embodiment of the device has been depicted and described, it will be apparent that this embodiment is illustrative in nature and that a number of modifications in the apparatus and variations in its end use may be effected without departing from the spirit or scope of the invention as defined in the appended claims.

I claim:

1. A continuous casting arrangement, comprising, in combination:

A. a support structure,

B. a casting wheel rotatably mounted on said support structure and having a groove of constant cross section formed continuously about its periphery,

C. an endless belt mounted for movement on said support structure and entrained about a portion of said wheel to form therewith a moving casting chamber into the upstream end of which molten material may be supplied, and from the downstream end of which a continuous cast article will issue,

D. a wedge member for extracting the continuously cast product from the groove of said wheel,

E. a holder block carrying said wedge member and mounted on the support structure for movement about an axis perpendicular to the plane of the wheel with the point of minimum thickness of said wedge member positioned within said wheel groove to penetrate beneath a product emerging from said casting chamber,

F. means for maintaining a continuous clearance between said wedge member and said groove during the rotation of said wheel and

G. means for moving said wedge member about its pivotal axis in response to the radial expansions of said wheel for maintaining said clearance between said wedge member and said groove independently of said radial expansions.

2. The combination of claim **1**, wherein said means defined in (F) and (G) include a mechanism mounted on said holder block and being in continuous contact with a track integral with said casting wheel for automatically adjusting the position of said holder block and said wedge member in response to radial changes in the course of said track.

3. The combination of claim **1** including nozzle means mounted on said holder block for directing lubricant means for cooling said wheel into said groove at a point downstream of the point at which said product is extracted from said mold by said wedge member.

4. The combination of claim **3** including a second nozzle means for directing lubricant into said groove, said second nozzle means being mounted on support means downstream of said first nozzle means.

5. A continuous casting arrangement, comprising, in combination:

A. a support structure,

B. a casting wheel rotatably mounted on said support structure and having a groove of constant cross section formed continuously about its periphery,

C. an endless belt mounted for movement on said support structure and entrained about a portion of said wheel to form therewith a moving casting chamber into the upstream end of which molten material may be supplied, and from the downstream end of which a continuous cast article will issue,

D. a wedge member for extracting the continuously cast product from the groove of said wheel,

E. a holder block carrying said wedge member and mounted on the support structure for movement about an axis perpendicular to the plane of the wheel with the point of minimum thickness of said wedge member positioned within said wheel groove to penetrate beneath a product emerging from said casting chamber and

F. a mechanism carried by said holder block and including a pair of rollers mounted to engage one of the rims formed by the portion of said wheel outwardly of said groove and rotating about an axis parallel to the casting wheel axis, one of said rollers being upstream of the pivotal axis of said holder block and the other being downstream of said axis.

6. The combination of claim **5**, wherein the means for mounting each of said rollers on said holder block includes a rod mounted for movement on said holder block in a plane parallel to the plane containing the rim on which said rollers roll, one of said rollers is mounted for rotation.

7. The combination of claim **6**, wherein said mounting means for each of said rollers includes an elongated slot formed in said holder block, each of said rollers being mounted for rotation on an axle mounted in one of said slots, and said slots being elongated in a direction parallel to said rods.

8. The combination of claim **6**, wherein at least one of said rods includes an abutment extending from the side thereof, and resilient means acting between said holder block and said abutment.

9. The combination of claim **8**, wherein said abutment means is adjustable in position to vary the force on said resilient means.

10. The combination of claim **8**, wherein said rod on the downstream side of said axis is mounted in an opening on a boss which is integral with said holding block and projects therefrom, and engages one side of said resilient means, and the abutment on the other side of said resilient means is mounted for adjustment.

11. The combination of claim **8**, wherein said resilient means is a compressed spring.

12. The combination of claim **8**, wherein said holder block includes a pair of integral bosses projecting outwardly therefrom, each of said rods being mounted for movement within an opening in one of said bosses, and each of said rods having an abutment fixed at an end of said rod and wherein said resilient means act between one of said bosses and one of said abutments.

13. The combination of claim **12**, wherein each of said rods has an abutment on each side of the boss mounting the said rod, and wherein resilient means are mounted between each abutment and the boss mounting the said rod.

14. A continuous casting arrangement, comprising, in combination:

A. a support structure,

B. a casting wheel rotatably mounted on said support structure and having a groove of constant cross section formed continuously about its periphery,

C. an endless belt mounted for movement on said support structure and entrained about a portion of said wheel to form therewith a moving casting chamber into the upstream end of which molten material may be supplied, and from the downstream end of which a continuous cast article will issue,

D. a wedge member for extracting the continuously cast product from the groove of said wheel,

E. a holder block carrying said wedge member and mounted on the support structure for movement about an axis perpendicular to the plane of the wheel with the point of minimum thickness of said wedge member positioned within said wheel groove to penetrate beneath a product emerging from said casting chamber,

F. nozzle means mounted on said holder block for directing a lubricant, for cooling said wheel, into said groove at a point downstream of the point at which said product is extracted from said mold by said wedge member and

G. means for removing deposits due to liquid sprayed by said nozzle means from the exterior of said casting wheel.

15. The combination of claim **14**, wherein said means for removing lubricant comprises a pair of members, one on each side of said casting wheel, each being mounted on the support means for rotation about an axis parallel to a radius of said casting wheel.

16. The combination of claim **15**, wherein each of said revolving members has its outer periphery formed into a profile which is complementary in cross section to, and engages, the exterior of the flanges formed by the portion of said casting wheel which is outward of its circumferential groove, and which is mounted to engage said exterior.

17. The combination of claim **15**, wherein each of said rotatable members has connected thereto an individual motor means for rotating it.

18. The combination of claim **15** including friction roller means connected for rotation with said rotatable members and engaging the side of said casting wheel to be rotated thereby.

19. The combination of claim **18** wherein:

A. said deposit removing means are mounted on a holder block pivoted to said support means and said lubricant spray means and a second lubricant spray means are mounted on said holder block,

B. said extractor wedge member is mounted on said holder block,

C. a pair of elongated slots formed in said holder block, each being generally parallel to a radius of said casting wheel, one being upstream of the point of extraction of said cast structure and the other being downstream thereof,

D. a pair of rollers, each being mounted for rotation about an axle positioned for sliding movement within said slots,

E. a rod connected to each of said axles and mounted generally parallel to the slots in an opening in a boss projecting from said holder block,

F. an adjustable nut threaded about each end of said rods, and

G. spring means mounted on each rod between one of said nuts and said boss, the spring means on the downstream rod being on the side of the boss facing away from said casting wheel and the spring means on the upstream rod being on the side facing toward said casting wheel.

20. The combination of claim **14**, wherein said means for removing deposits are brushes.

21. The combination of claim **14**, wherein said means for removing deposits are shoes.

22. The combination of claim **14**, wherein each of said means for removing deposits is mounted on an arm, and each of said arms is pivoted to said support means.

23. The combination of claim **22** including spring means engaging each of said arms to bias it against said casting wheel.

24. The combination of claim **23**, wherein said spring means is a leaf spring.

* * * * *