United States Patent

Petersen

[15] **3,700,027**

[45] **Oct. 24, 1972**

[54] **CONTINUOUS CASTING MACHINE**

[72] Inventor: **Ulrich Petersen,** Dusseldorf-Lohausen, Germany

[73] Assignee: **Maanesmann Aktiengesellschaft,** Dusseldorf, Germany

[22] Filed: **Sept. 13, 1971**

[21] Appl. No.: **179,957**

[30] **Foreign Application Priority Data**

Sept. 16, 1970 Germany.....P 20 46 645.9

[52] **U.S. Cl.** **164/282,** 164/283, 164/89

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

[58] **Field of Search**.....164/282, 283, 278 US, 89

[56] **References Cited**

UNITED STATES PATENTS

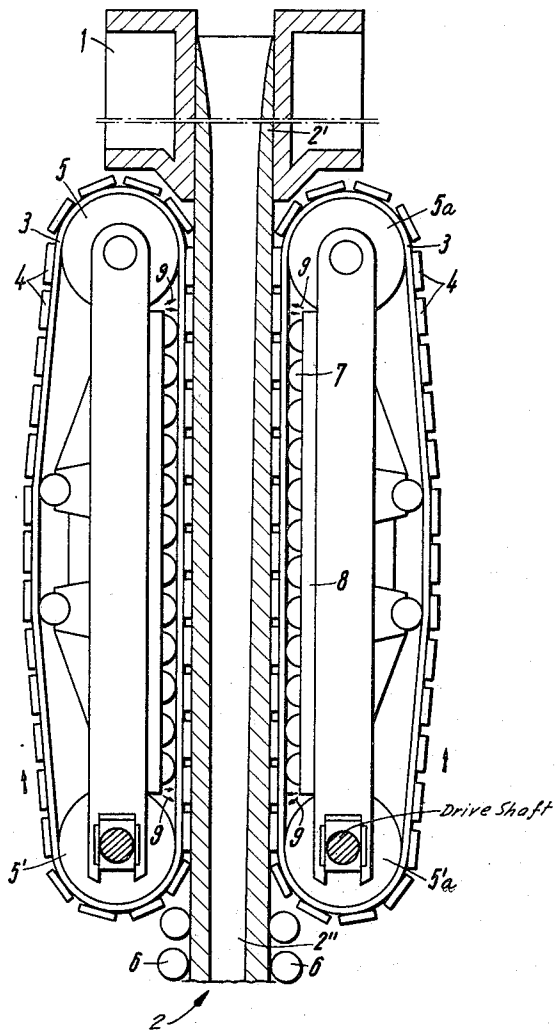
1,690,887	11/1928	Davis	164/283 X
3,110,941	11/1963	Fagg	164/283 X
3,167,830	2/1965	Hazelett et al.	164/283 X
3,283,368	11/1966	Homan	164/283 X
3,468,362	9/1969	Burkhardt et al.	164/283 X
3,625,498	12/1971	Adamec et al.	164/283
3,446,270	5/1969	Michelson	164/282

Primary Examiner—J. Spencer Overholser
Assistant Examiner—V. K. Rising
Attorney—Ralf H. Siegemund et al.

[57] **ABSTRACT**

In a continuous casting machine, having a mold and means for withdrawing and guiding a casting emerging and lowered from the mold, a pair of endless belts or chains carrying plates and disposed on opposite sides of and along and urged against the casting for the plates to engage the casting, the belts running in synchronism with the lowered casting; the plates having relief profile to engage the casting with less than the entire surface area of a plate, preferably with about 10 to 30 percent thereof, there being protrusions and indentations for a coolant to flow around the protrusions in contact with the casting.

10 Claims, 7 Drawing Figures



PATENTED OCT 24 1972 3,700,027

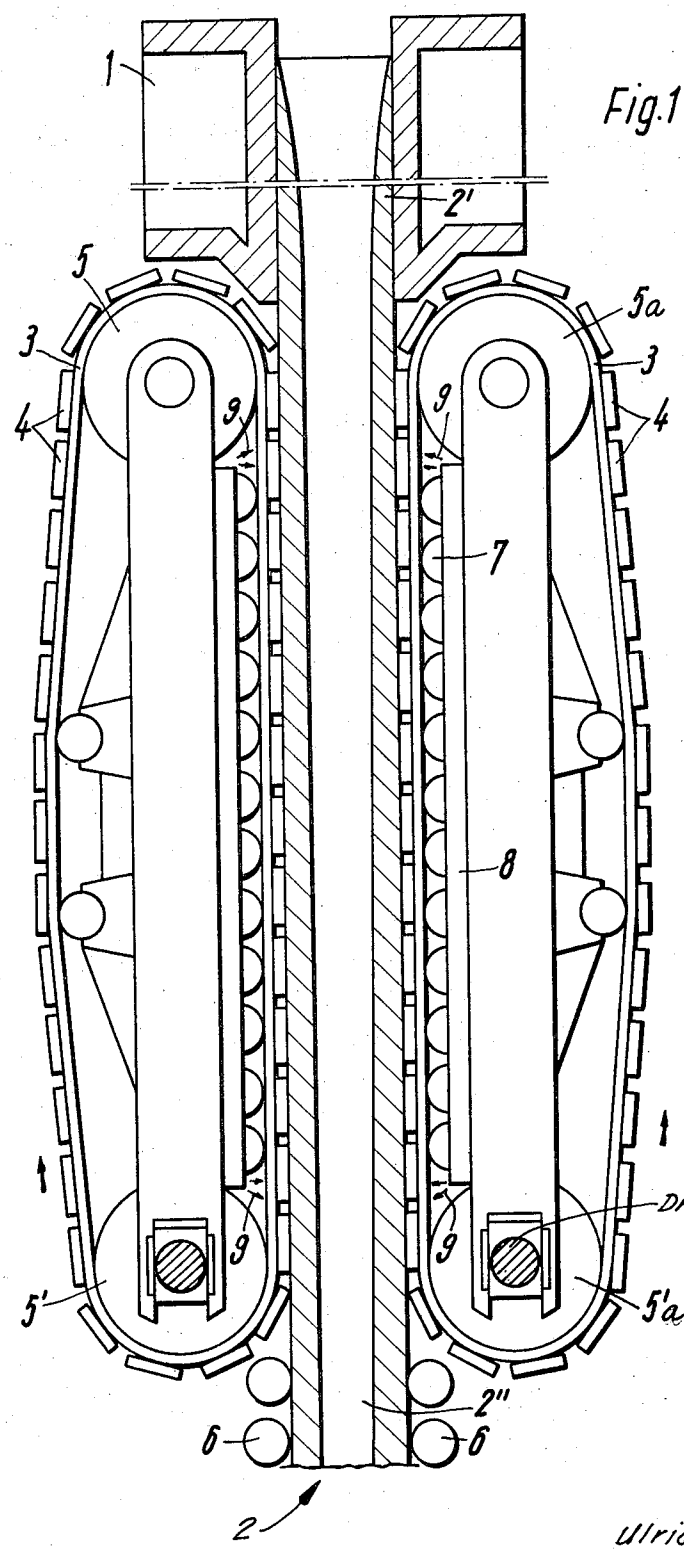


Fig.1

Inventor:
Ulrich Petersen
Smyth, Roston & Pavitt
By Percy N. Siegmund
ATTORNEYS

Fig. 2

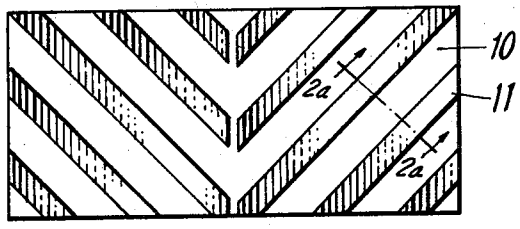


Fig. 2a

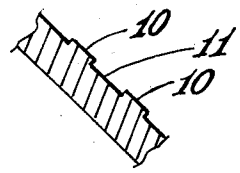


Fig. 3

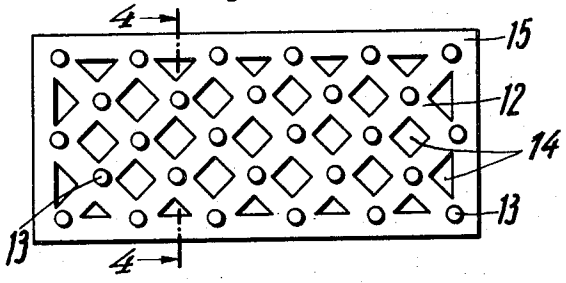


Fig. 4

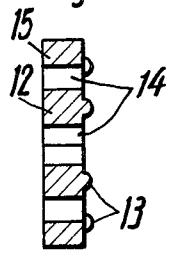


Fig. 5

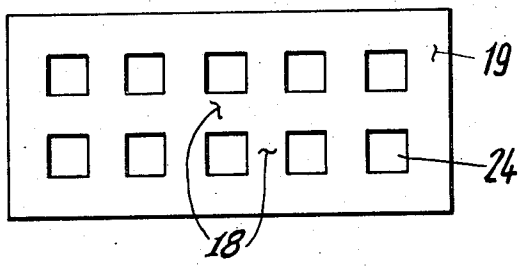
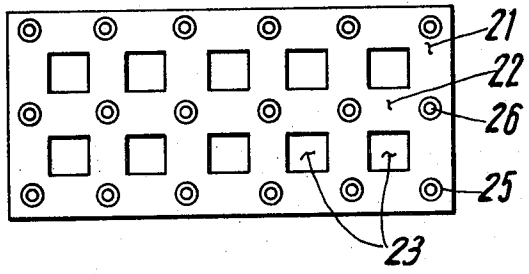


Fig. 6



Inventor:
Ulrich Petersen
Smyth, Roston & Pavitt
By Ralf H. Siegemund
ATTORNEYS

CONTINUOUS CASTING MACHINE

The present invention relates to improvements in continuous casting machines, particularly as to guiding and supporting a continuously cast ingot, using plates mounted on an endless belt.

Endless belts or chains have been used for supporting a casting upon withdrawal from the mold. Herein plates or plate-like chain elements have smooth surface that engage the casting. However, the casting requires also cooling, and it was found otherwise that direct cooling is much more effective than indirect cooling, at least right below the mold. Covering the casting by means of such plates reduces, therefor, cooling in the zones to what is now secondary cooling. This disadvantage is particularly noticeable for a high production rate and high withdrawal speed of the casting as lowered from the mold.

The usually employed rolls or stationary plates are also no longer usable in high speed machines. As the skin of the casting is quite thin at one location or another — the thinner, the higher the withdrawal speed — the skin will bulge between two rolls and is no longer adequately supported. The providing of stationary support plates directly underneath the mold does not solve that problem, as sliding friction is exerted to a significant extent upon the skin, which may easily rupture. Also, these plates wear out quite fast.

It is an object of the present invention to avoid these difficulties and disadvantages and to provide for support of a casting that is withdrawn from the mold at a high speed, without detriment to cooling.

It is another object of the invention to improve endless chain or belt construction to be used for supporting a withdrawn ingot. These belts or chains are to have plates that are urged towards the casting from opposite sides and run therewith at casting withdrawal speed. It is a particular feature of the present invention that the plates have relief profile to engage the casting with less than the entire surface of a plate as facing the casting. The protrusions, elevations, projections etc. that engage the casting and establish the relief are to cover not more than 50 percent of the plate surface; preferably they cover only 10 to 30 percent.

The type of protrusions that form the relief may differ. It was found of advantage to use dot-like or circular-like protrusions. Annular protrusions should have diameter of about 10 to 40 mm. Alternatively, the protrusion may set up a line pattern, the "lines" having width of about 10 to 40 mm. Still alternatively, the protrusions may constitute a grid or lattice structure disposed on or being part of a perforated base. The lattice type protrusions may be rhombic, rectangular or, preferably, they may be constituted by a network of annular bosses. The plates are arranged on an endless belt or chain or chains driven by pulleys as is known per se.

Water for cooling is sprayed in between the plates, laterally therefrom and through perforations in the plates, whereby the cooling water is distributed in the channels formed around or along the protrusions between the corresponding indentations of the plate and the adjacent casting skin.

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention, it is believed that the invention, the objects and features of the invention and further objects, features and advantages

thereof will be better understood from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a side elevation with section through the casting and mold and showing additionally the novel withdrawal arrangement in accordance with the preferred embodiment of the invention; and

FIGS. 2, 3, 5 and 6 show side views of plates with different surface relief profile;

FIGS. 2*a* and 4 being respectively sections through lines 2*a*—2*a* and 4—4 in FIGS. 2 and 3.

Proceeding now to the detailed description of the drawing, in FIG. 1 is shown a mold 1 for continuous casting. Liquid metal is poured into the mold and a casting 2 is lowered and withdrawn from below. The casting has a solidified skin 2' which is quite thin immediately below the mold, most of the interior of the casting being occupied by a downward extension of the liquidous pool 2'' in the mold. The skin 2' grows with distance from the mold.

Immediately upon leaving the mold, the casting is engaged and supported by plates 4. These plates are disposed on endless belts 3 and 3*a*. Belt 3 runs around pulleys 5 and 5', belt 3*a* runs around pulleys 5*a* and 5'*a*. At least, the two lower pulleys 5' and 5'*a* are driven, so that the endless belts run in synchronism with the lowering speed of the casting.

Farther down along the withdrawal path for the casting there will be provided the usual withdrawing rolls (not shown) which are driven and which provide the necessary torque and power for casting withdrawal. As that withdrawal drive determines the withdrawing speed, the belt drives will be synchronized to the withdrawing drive so that the belts move at the lowering speed of the casting. The belts are tensioned and guided by idler pulleys and by rolls 7 mounted on a support frame 8. Rolls 7 provide a particular force for urging plates 4 against the casting. Below the belts, it is presumed that the skin 2' has attained sufficient thickness so that regular rolls such as 6 suffice to support the casting.

As schematically indicated at 9, water is sprayed from the interior of the belt system, the coolant being fed laterally thereto. The water is sprayed onto the belts from the respective rear to pass through perforations therein as well as through perforations in the plates 4 and in between adjacent plates.

The belts are arranged in pairs, one pair being shown to engage opposite sides of a slab ingot. The two sides transverse thereto may be engaged and supported by a similar pair of belts with plates.

Proceeding now to FIGS. 2 to 6, various configurations for the plates' surfaces will be described. In FIGS. 2 and 2*a* a plate is shown with a plate base 10 proper having protrusions 11 in form of ridges, arranged in a herring-bone pattern, the inclination being in direction of casting (arrow A). The space between the protrusions form cooling channels so that water sprayed transversely to the plane of the drawing runs readily into these channels from above and down along the casting. It is also for this reason that the ridges should not be wider than about 40 mm, to minimize the local areas of indirect cooling.

In FIGS. 3 and 4, the plate is established by a frame 15 and bars 12 to provide a lattice or grid structure and

configuration, leaving perforations **14**, through which water is sprayed from behind. Circular bosses **13** are provided on the bars **12**, for engagement with the casting. The bosses are quite large in number, so that there is a dense network of support points for the casting over the entire plate surface, but minimizing areas of contiguous contact.

The plate of FIG. **5** is somewhat simplified; the plate **19** is flat and is provided with perforations **24**, the remaining sections **18** between the perforations establish the profile.

FIG. **6** shows a plate that has also a frame **21** with cross bars or struts **12** leaving perforations **23**. The frame as well as the cross bars carry protrusions **25**. These protrusions are circular, preferably annular, each having a central opening **26**. Spray water may, thus, pass through the perforations **23** as well as through openings **26**.

It can, thus, be seen that in each case, with the providing of plural plates on the endless belts, the casting is supported over a very large area, by a multitude of densely placed but small support elements. As the plates are mounted on the belts with little space between them, there are no large unsupported areas of the casting as is the case upon using rolls. As the plates run with the casting, little or no friction occurs between them, and the channels between the protrusions permit ready cooling. The belts themselves should be perforated to permit ready passage of cooling water, or there could be plural, narrow width belts or chains, permitting water to be sprayed against the rear of plates **4** in between the belts or chain elements.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

I claim:

1. In a continuous casting machine, having a mold and means for withdrawing and guiding a casting emerging and lowered from the mold, the improvement comprising:

a pair of endless belts or chains below the mold and carrying plates and disposed on opposite sides of and along the casting for the plates to engage the casting, the belts running in synchronism with the lower casting as the casting is lowered;

the plates where engaging the casting having relief profile to engage the casting with less than the entire surface area of a plate facing the casting, there being protrusions and indentations in the plates to define the relief profile;

means for providing coolant to the casting to flow around the protrusions in contact with the casting; and

means for urging the plates into contact with the casting.

2. The improvement as in claim **1**, the protrusions of a plate covering less than about 50 percent of the surface of a plate as facing a casting.

3. The improvement as in claim **2**, the protrusions covering about 10 to 30 percent of said plate surface.

4. The improvement as in claim **1**, the protrusions being a multitude of individual bosses, there being perforations in the plate for passage of coolant.

5. The improvement as in claim **1**, the protrusion having circular configuration.

6. The improvement as in claim **5**, the protrusions having annular configuration with a central opening for passage of coolant.

7. The improvement as in claim **5**, the plate having perforations between the protrusions for passage of coolant.

8. The improvement as in claim **1**, the protrusions being ridges disposed at an angle to the direction of casting to permit flow of coolant there along.

9. The improvement as in claim **8**, the ridges being about 10 to 40 mm wide.

10. The improvement as in claim **1**, the plate having grid-like configuration.

* * * * *