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METHOD OF ROLLING BARS CAST IN CONTINUOUS CASTING PLANTS

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FIG. 1

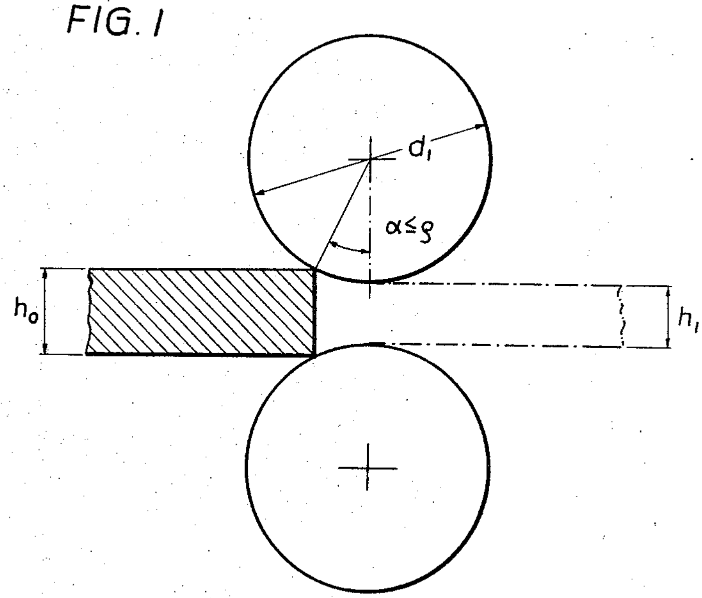
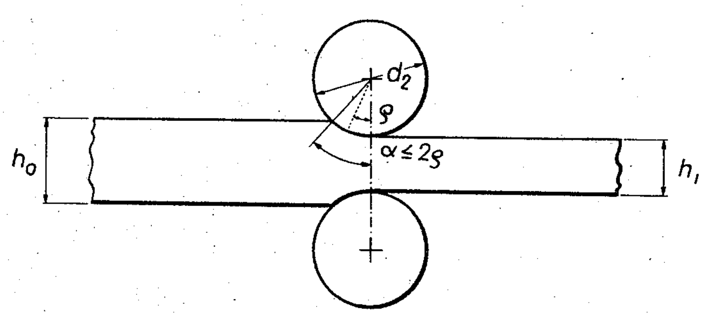


FIG. 2



INVENTOR.
RUDOLF SCHÖFFMANN
BY
Brumbaugh, Graves, Donohue & Raymond
HIS ATTORNEYS

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METHOD OF ROLLING BARS CAST IN CONTINUOUS CASTING PLANTS

Rudolf Schöffmann, Linz, Austria, assignor to Vereinigte Österreichische Eisen- und Stahlwerke Aktiengesellschaft, Linz, Austria, a company of Austria

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U.S. Cl. 72—226 1 Claim

ABSTRACT OF THE DISCLOSURE

The present invention relates to a method of rolling bars produced in continuous casting plants and comprises the use of rolls having diameters which are smaller than necessary for fulfilling the bite condition, but as great as or greater than the minimum necessary for fulfilling the haul condition of roll and bar engagement.

The present invention relates to a method of rolling bars cast in continuous casting plants.

According to a recent, hitherto unpublished, proposal, bars produced in continuous casting plants are cogged-down in a rolling mill immediately following the continuous casting plant and containing a number of two-high rolling stands. Prior to its entering the rolling mill the bar usually still has a liquid core, which is forced back by the rolls of the first stand. In order that the bar is gripped by the rolls the bar is allowed to enter while the roll gap is open, whereupon the rolls are adjusted. The mode of operation described entails various advantages as to the quality of the product and secures, in particular, a substantial avoidance of interior flaws.

If no additional driving or drawing stands are used, the diameters of rolls in rolling mills are conventionally dimensioned so as to meet the bite condition. The bite condition is dependent upon the friction coefficient prevailing between roll and rolling stock and upon the geometric components determining the angle of rolling α. There exists the following relationship between the angle of rolling and the reduction in thickness:

$$\cos \alpha = 1 - \frac{\Delta h}{d}$$

Δh being the reduction in thickness of the rolling stock between two rolls and d being the roll diameter. The bite condition is met, if the angle of rolling α is smaller than the angle of friction s.

These values known for ordinary rolling mills have so far also been used when dimensioning rolling mills serving for cogging-down operations following the continuous casting of a bar. This involves the disadvantage that, as a consequence of the relatively low casting rate in continuous casting plants, it is necessary to use similarly low rolling velocities in the roll stands following the continuous casting plant. Owing to these low rolling velocities both the duration of roll-and-stock contact and the times between subsequent passes are relatively long and consequently the bars, particularly the edges thereof, are cooled-down to a greater degree than desired, which in turn entails a limitation in the number of possible passes as well as a tendency to edge cracking.

The invention has as its object to avoid these disadvantages and difficulties and in a method of rolling bars cast in continuous casting plants comprises the use of rolls having diameters which are smaller than necessary for fulfilling the bite condition, but as great as or greater than necessary for fulfilling the haul condition.

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According to the haul condition the angle of rolling α is smaller than twice the angle of friction s, the latter being a constant of material and dependent upon the coefficient of friction according to the formula:

$$\mu = \tan s$$

Given an equal rolling stock and an equal degree of shaping the proposal of the invention resides in using rolls with diameters substantially smaller than those of conventional rolling mills. The invention will now be illustrated by way of figures in the following examples.

EXAMPLE 1

Given a coefficient of friction of $\mu=0.2$ and a desired reduction in thickness of $\Delta h=20$ mm., the necessary minimum roll diameter is calculated as follows: according to $\tan s=\mu=0.2$ the angle of friction s equals 11.4°, which means that in conventional rolling mills the angle of rolling must be $\alpha \leq 11.4°$. According to the formula

$$\cos \alpha = 1 - \frac{\Delta h}{d}$$

there follows a minimum roll diameter of 1000 mm. According to the method of the invention the angle of the rolling is $\alpha \leq 2s$, hence follows a minimum roll diameter of 250 mm. according to the above formula.

EXAMPLE 2

Given a coefficient of friction of $\mu=0.4$ and a desired reduction in thickness of $\Delta h=40$ mm. the angle of friction is $s=22°$. According to the above formula the minimum roll diameter for conventional rolling mills is calculated with 570 mm., that for the rolls used according to the invention with 140 mm.

Thus, according to the invention rolls may be used the diameters of which are only ⅕ to ½ of the diameters of rolls used in conventional rolling mills. In this manner the former difficulties are avoided. Owing to the smaller roll diameters used, the lengths of contact and consequently the durations of contact between rolls and rolling stock are reduced considerably, and thus the degree of cooling-down of the bar is considerably lower. Moreover, the geometric dimensions of the roll stands may be smaller than those of conventional roll stands; consequently the distance between individual stands may be smaller.

In order that the invention may be more fully understood it will now be described with reference to the accompanying drawings in which:

FIG. 1 illustrates diagrammatically the bite condition with rolls of the diameter d_1, if a bar of the thickness h_0 is reduced to h_1. α is the angle of rolling, which is as great as or smaller than the angle of friction s;

FIG. 2 illustrates that upon use of rolls with a smaller diameter d_2, while the other components are the same, the bite condition is no longer fulfilled, whereas the haul condition is met. In this case the angle of rolling α is greater than s, yet as great as or smaller than $2s$.

The method of the invention is carried out by leading the dummy bar through the open roll gaps of the stands in tandem, upon which the rolls of the individual stands, starting with the first stand, are adjusted. Thus, the rolling procedure is initiated after the head of the dummy bar has passed through; the head of the bar remains unshaped. In this manner it is possible to dispense with the bite condition and to have the haul condition fulfilled with smaller rolls than the conventional ones. Consequently the duration of contact between rolls and bar is shortened and the temperature behavior of the bar is improved. The roll pressures and roll momentums necessary are also smaller and, therefore, the stands may be lighter and smaller.

What I claim is:

1. In a method of rolling a bar cast in a continuous casting plant by passing it through a multistand two-high rolling mill immediately following said plant and comprising pairs of adjustable rolls having variable roll gaps, first introducing said bar into the several stands while said roll gaps are open, then adjusting said rolls to engage said bar, using rolls whose diameters are smaller than that required for establishing a bite condition, but at least equal to that required for establishing a haul condition of roll and bar engagement.

References Cited

UNITED STATES PATENTS

3,317,994	5/1967	Cofer et al.	164—76
3,491,823	1/1970	Tarmann et al.	164—82X

MILTON S. MEHR, Primary Examiner

U.S. Cl. X.R.

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