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D E C I S I O N
of 19 November 2004

Case Number: T 0056/02 - 3.2.1

Application Number: 95109638.7

Publication Number: 0689883

IPC: B21B 28/04, B21B 28/02, B23B 5/08

Language of the proceedings: EN

Title of invention:
Roller cutting method and apparatus for a plural-roll rolling mill

Patentee:
JFE Steel Corporation

Opponent:
SMS Demag AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0056/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 19 November 2004

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 14 November 2001 concerning maintenance of European patent No. 0689883 in amended form.**

Composition of the Board:

Chairman: M. Ceyte
Members: J. Osborne
S. Hoffmann

Summary of Facts and Submissions

I. The opponent's appeal is directed against the interlocutory decision posted 14 November 2001 in which it was found that, account being taken of the amendments made by the patent proprietor during the opposition proceedings, the European patent No. 0 689 883 and the invention to which it relates meet the requirements of the EPC. The positive finding of the Opposition Division was based on claims 1 to 4 as granted and claims 5 to 13 received on 2 April 2001.

II. The following prior art which was cited during the opposition proceedings in support of the ground of lack of inventive step played a role during appeal:

D1: DE-U-1 977 661

D2: EP-B-0 300 230.

III. The independent claims 1, 5 read as follows:

"1. A roll cutting method for cutting calibers (6) into peripheral surface portions (5) of at least two substantially aligned rotatable rolls (3;4) wherein a substantially centrally positioned pass line is arranged by disposing said peripheral surface portions (5) of said rolls (3;4) close to each other, the method comprising the steps of:

(a) positioning said rolls (3;4) without removing said rolls from their rolling mill;

(b) fixing said mill (1) at a first predetermined position;

(c) aligning a cutting tool (13) of a cutting machine (8) so that said cutting tool (13) is disposed at a second predetermined position with respect to said mill; and

(d) cutting said calibers (6) of said rolls (3;4) with said cutting tool (13) while abutting said surfaces of said rolls (3;4) against each other, and pushing said rolls (3;4) toward said pass line (2)."

"5. A roll cutting apparatus for cutting concave roll edge calibers (6) into the outside peripheral surfaces (5) of two horizontal rolls (3) and two vertical rolls (4) wherein a pass line (2) is arrangeable by disposing said horizontal and vertical rolls so that their peripheral surfaces (5) are close to each other, said cutting apparatus comprising:

(a) a base table (7), on which said mill is fixed at a predetermined position;

(b) a cutting machine (8), having a cutting tool (13) for cutting the calibers (6) of said rolls, movably connected to said base table (7);

(c) a position alignment sensor, attached to said cutting apparatus, for aligning said cutting tool (13) with said mill (1);

(d) a position adjusting device (9), connected to said base table (7), for adjusting the relative positions of said mill (1) and said cutting tool (8);

(e) drive units, detachably connected to said rolls, for rotating said rolls; and

(f) a pusher (16) connected for pushing said rolls toward said pass line (2) such that backlash of said rolls is removed when said rolls are cut."

IV. The arguments of the appellant (opponent) can be summarised as follows:

The closest prior art for consideration of the subject-matter of claim 1 is the roll cutting method acknowledged in the disclosure of D1 as being previously known. According to that prior art calibers are cut into peripheral surface portions of three rotatable rolls arranged at 120° to each other without the need to remove the rolls from the mill. The rolls are slowly rotated by a drive mechanism and the cutter is brought into the area between the rolls and rotated, thereby creating a round caliber. Although figure 1 of D1, which relates to that prior art process, shows gaps between the adjacent surfaces of the rolls, figures 3 and 5 teach the skilled person that the rolls must touch each other under the application of a certain level of pressure in order to ensure that the caliber receives the desired form. The mill according to D1 would comprise roll position adjustment means suitable for applying a pre-load to the rolls in the direction of the workpiece and according to D2, claim 2, it is

preferred to remove radial play when cutting the caliber. The skilled person would apply this teaching of D2 to the process according to D1 by using the available means for adjusting the roll position and so remove play from the bearings during the cutting operation.

As regards the subject-matter of claim 5, it is proposed in D2, claims 1 and 2, that the rolls should be pre-loaded in both axial and radial directions in order to remove play during the cutting operation. Although according to D2 this radial pre-load is in the direction of the cutting tool the essential teaching is that the radial play is removed by a radially directed pusher device. An adjustment device operating orthogonally to the pass line and which could serve the same purpose is present in every rolling mill. In the light of the teaching of D2 it would be obvious for the skilled person to use the known adjustment device and thereby arrive at the subject-matter of claim 5.

V. The respondent countered essentially as follows:

The essential feature as regards inventive step of the subject-matter of claim 1 is the wording "while abutting said surfaces of said rolls against each other". This avoids any backlash and elastic deformation resulting in a gap between the rolls during the cutting process, thereby improving the cutting precision. Contrary to the arguments of the appellant, figures 3 and 5 of D1 do not disclose abutting surfaces, particularly since these figures are primarily intended to illustrate that, unlike the prior art shown in figure 1, the invention of D1 permits the

achievement of non-circular calibers. Furthermore, D1 is silent as regards the feature of present claim 1 of "cutting said calibers ... while ... pushing said rolls toward said pass line", as also is D2. The radial direction in which D2 teaches to apply the pre-load is not in the direction of the pass line. The skilled person would not have been led by the cited prior art to use the existing roll adjustment mechanism to eliminate play in the location of the roll whilst it is being machined.

As regards the subject-matter of claim 5, D2 neither discloses "a pusher connected for pushing said rolls toward said pass line" nor gives any hint to combine its teaching with that of D1.

VI. With a communication of 22 December 2003 pursuant to Article 110(2) EPC the Board observed that since according to claim 6 the pusher formed part of the mill it was not a feature of the cutting apparatus, rendering the claim independent, and that the claimed subject-matter differed from that of D2 only in that it was for cutting concave roll edge calibers into the outside peripheral surfaces of two horizontal rolls and two vertical rolls.

VII. The appellant (opponent) requests that the impugned decision be set aside and that the patent be revoked in its entirety. The respondent (patent proprietor) requests that the patent be maintained on the basis of claims 1 to 4 as granted, claims 5 and 7 to 13 received 2 April 2001 which formed the basis of the impugned decision and claim 6 filed with a letter dated 29 March 2004. Claim 6 reads:

"6. A roll cutting apparatus according to claim 5, wherein said pusher (16) is adapted to act on a draft device of said mill."

Reasons for the Decision

1. D1 relates to a method of machining the calibers into the peripheral surface portions of rolls. The teaching according to D1 starts from a prior art illustrated in figure 1 and having three rolls arranged at 120° mutual spacing around the pass line. In figure 1 the three rolls are shown as having outer peripheral surfaces, adjacent ones of which are oriented generally mutually parallel and spaced from each other. As shown in the side elevation of figure 2, the cutting tool is mounted on a horizontal arm which passes the tool into the rolling gap and rotates about an axis co-axial with the pass line, thereby to provide a round caliber.

1.1 The aim of the invention according to D1 as shown in figures 3 to 6 is to provide a multi-cornered caliber, whereby it is possible to roll material having, for instance, a square cross-section. In order to nevertheless permit the calibers to be cut without removing the rolls from the mill the cutting tool is mounted on a vertical arm and contacts the roll at a position located approximately 90° from the pass line, as shown in figures 4 and 6 which correspond to the view of figure 2, and the fore-and-aft and lateral motions of the tool are synchronised in order to provide the required form of caliber. Figures 3 and 5 illustrate two arrangements, each having a four-cornered caliber created by four rolls. Unlike figure 1,

figures 3 and 5 show neither any detail of the outer peripheral surfaces of the rolls nor spaces between them.

1.2 Whereas the content of figure 1 is described in D1 as being a known arrangement, both of figures 3 and 5 are stated to show "schematic" arrangements and the essential teaching of these figures is the arrangement of four rolls to provide the multi-cornered calibers. Although these figures differ from figure 1 in as far as they do not show the spaces between the rolls, there is no reference in the text to any of the figures in this respect and the Board concludes that there is no teaching to the skilled person to arrange the rolls in abutment during the cutting operation. Moreover, D1 is silent as regards pushing the rolls towards the pass line during the cutting operation. Even if the skilled person would learn from D1 figures 4 and 6 that abutment of the rolls during the cutting operation were possible, in view of the location of the cutting tool according to the invention of D1 at 90° from the pass line there would be no implicit teaching to him that pushing the rolls in abutment would be desirable in order to increase the accuracy of the cutting operation.

1.3 It is undisputed between the parties that features (a) to (c) of claim 1 are known from D1 and the subject-matter of claim 1 differs from that disclosure by the following:

– the cutting of the calibers with the cutting tool takes place while abutting the surfaces of the rolls against each other and pushing the rolls toward the pass line.

By bringing the rolls into abutment during the cutting operation the backlash of the rolls in the pass line direction is removed. According to the patent specification the distinguishing feature has the effect of increasing machining accuracy [paragraph 0033].

1.4 D2 concerns a method of repairing rolls of a rolling mill in which a two-roll stand is mounted on a base table with the roll axes arranged parallel to the table surface and with the plane passing through the axes of the rolls being arranged perpendicular thereto. The tool approaches each roll from the lateral direction and cuts it at the level of the roll axis. According to D2 the rolls are pushed axially to remove any end-play in the bearings. This has the effect of placing the rolls in the same position as during the rolling operation and increases the cutting accuracy. There is also a mechanism to provide compensation for the force exerted in the radial direction by the cutting tool. However, this does not place the roll in the same position as during the rolling operation. Moreover, according to the disclosure of D2 and contrary to its teaching in respect of axial pre-load, the radial pre-load has the effect only of preventing radial displacement (column 7, lines 48 to 52); there is no mention of the removal of backlash. Additionally, since the cutting tool is spaced from the pass line the application of the radial pre-load does not result in pushing the rolls towards the pass line and there is no disclosure of abutting the surfaces of the rolls against each other during the cutting operation.

1.5 From the totality of the disclosure of D1 and D2 there is no teaching to encourage the skilled person to abut the surfaces of the rolls against each other and to push the rolls towards the pass line whilst cutting the calibers. Even if the skilled person were to apply the teaching of D2 to the prior art arrangement shown in D1 and thereby push the rolls towards the pass line, there still would be nothing to cause him to abut the rolls during the machining operation. Indeed, elastic deformation of the rolls during rolling is such that surfaces of the rolls which in a static condition are in abutment will separate during rolling, thereby changing the effective shape formed between the calibers of the rolls. The simple rotating cutting tool of the prior art acknowledged in D1 is unable to compensate for such a change and when used together with rolls which are in abutment would not result in the desired shape of the caliber.

The Board concludes that it would not be obvious for the skilled person when faced with either D1 alone or D1 in combination with D2 to arrive at the subject-matter of claim 1 which therefore involves an inventive step (Article 56 EPC). Since claims 2 to 4 contain all features of claim 1 this conclusion applies equally to those claims.

2. Whereas the subject-matter of claim 1 is a method of cutting the rolls, that of claim 5 relates to an apparatus and the closest prior art for consideration of the latter claim is that represented by D2.

2.1 The teaching of D2 is primarily directed towards biasing the rolls in a longitudinal direction during the cutting process in order to eliminate axial play and thereby bring the rolls into the position which they occupy during rolling. Preferably, the roll cutting machine additionally comprises a radial pre-load mechanism and the roll stand is positioned between this and the tool operation mechanism. The stand contains two rolls mounted in a housing having a passage through which material to be rolled travels along the pass line. During the cutting operation the tool passes into the entrance of the passage and successively engages each roll approximately on its horizontal diameter in a position similar to that according to the invention of D1 whilst the radial pre-load mechanism exerts a counter-force by means of a pusher at a corresponding position on the opposite side of the respective roll. The effect of the pusher device according to D2 therefore is to bias each roll in a direction parallel to the pass line.

2.2 It is undisputed between the parties that all features of claim 5 are disclosed by D2 with the exception of:

- the apparatus being suitable for cutting the concave roll edge calibers into the outside peripheral surfaces of two horizontal rolls and two vertical rolls; and

- the apparatus comprising a pusher connected for pushing the rolls toward the pass line such that backlash of the rolls is removed when the rolls are cut.

2.3 As set out under 1.4 above, it is merely stated in D2 that the radial pre-load mechanism applies a counter-force which prevents the roll from displacing radially against the housing. There is no mention of the removal of backlash and this reason alone is sufficient to render the subject-matter of claim 5 not obvious. Furthermore, whilst the prior art acknowledged in D1 is a teaching in itself, D1 proposes an improvement which is more versatile in that it can be used to produce both round and angular calibers. It would seem unlikely that the skilled person aware of D2 would opt to combine the latter with the prior art acknowledged in D1 which not only exhibits less commonality with the device according to D2 but is less versatile than the newly proposed device of D1. Additionally, whereas D1 relates to apparatus for cutting three or more rolls, that according to D2 is limited to two and there is no disclosure in D2 as regards how that machine may be used in conjunction with a four-roll stand having two horizontal and two vertical rolls.

2.4 In the appellant's view the skilled person would derive from the disclosure according to D2 a general teaching to bias the rolls in the direction of application of force during the cutting operation and this together with the knowledge that every rolling mill comprises an adjustment means suitable to apply such a force, in combination with the acknowledgment of prior art in D1 would lead to the subject-matter of claim 5 in an obvious way. In the Board's view the skilled person would not derive such a general teaching from D2. Firstly, its primary teaching relates not to radial but to axial biasing of the rolls and the former is only disclosed as preferable in combination with the latter.

Secondly, it does not relate to methods of cutting rolls in general but to a specific machine for use with a two-roll mill whose stand offers no access for the pusher device to act in a direction towards the pass line. Finally, there is no suggestion anywhere in either D1 or D2 to utilise the roll adjustment device to apply a pre-load to the rolls during the cutting operation and any presumption that this would readily occur to the skilled person results from an *ex post* consideration of the facts.

2.5 The Board therefore concludes that the subject-matter of claim 5 also involves an inventive step (Article 56 EPC). Since claims 6 to 13 contain all features of claim 5 this conclusion applies equally to those claims.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

   - claims 1 to 4 as granted;
   - claims 5 and 7 to 13 filed with a letter dated 2 April 2001;
   - claim 6 filed with a letter dated 29 March 2004;
   - description columns 3 to 7 as granted;
   - description columns 1 and 2 filed with a letter dated 2 April 2001;
   - drawings figures 1 to 7 as granted.

The Registrar: The Chairman:

A. Vottner M. Ceyte