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D E C I S I O N
of 27 February 2004

Case Number: T 0786/01 - 3.2.1

Application Number: 92910178.0

Publication Number: 0543014

IPC: B21B 13/14

Language of the proceedings: EN

Title of invention:
Six-stage rolling mill

Patentee:
JFE Steel Corporation

Opponent:
SMS Schloemann-Siemag AG

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0786/01 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 27 February 2004

Appellant: (Opponent)
SMS Schloemann-Siemag AG
Eduard-Schloemann-Strasse 4
D-40237 Düsseldorf (DE)

Representative:
Grosse, W.-D. Dipl.-Ing.
Patentanwälte,
Müller-Grosse-Pollmeier-
Valentin-Gihske
Hammerstrasse 2
D-57072 Siegen (DE)

Respondent: (Proprietor of the patent)
JFE Steel Corporation
2-3, Uchisaiwai-cho 2-chome
Chiyoda-ku
Tokyo (JP)

Representative:
Overbury, Richard Douglas
Haseltine Lake & Co,
Imperial House,
15-19 Kingsway
London WC2B 6UD (GB)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 7 May 2001 rejecting the opposition filed against European patent No. 0543014 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: S. Crane
Members: M. Ceyte
S. Hoffmann

Summary of Facts and Submissions

I. The respondent is proprietor of European patent No. 0 543 014 (application No. 92 910 178.0).

II. The patent was opposed by the appellant on the grounds that its subject-matter lacked inventive step.

The following state of the art was *inter alia* cited:

D1: DE-A-3 712 043

D2: SMS company publication "High-Tech Rolling: Verbesserung und Produktqualität in Warmband- und Kaltbandwalzwerken"

D3: DE-A-3 638 331

III. By its decision posted on 7 May 2001 the opposition division rejected the opposition.

IV. On 11 July 2001 the appellant (opponent) lodged an appeal against that decision and paid the prescribed appeal fee.

The statement of grounds of appeal was filed on 14 September 2001.

V. Oral proceedings before the Board were held on 27 February 2004.

The appellant (opponent) requested that the decision under appeal be set aside and the European patent be revoked.

The respondent requested that the appeal be dismissed and the European patent be maintained on the basis of claims 1 to 3 filed during the oral proceedings.

Claim 1 reads as follows:

1. A six high rolling mill comprising upper and lower work rolls (2), a pair of intermediate rolls (3) and a pair of backup rolls (4) wherein at least the intermediate rolls and the work rolls are adapted to be shifted in their axial directions, said intermediate rolls are provided with roll crowns which are in a point symmetrical relationship with reference to the centre point of the mill, and said work rolls have roll profiles which are in a point symmetrical relationship with reference to the centre point of the mill characterised in that

the roll profile of one of the intermediate rolls (3) is expressed by the following ternary equation (1):

$$y_1(x) = -a[\{x+(\delta+OF)\}/L]^3 + b(x/L)$$

where Y_1 is the generating line of the crown of the roll,
a is a coefficient of the third order,
b is a coefficient of the first order,
x is the coordinate of the barrel center,
L is 1/2 of the barrel length of the intermediate roll,

δ is the shift amount of the intermediate roll relative to a start point where $x=L_B$ and OF is the offset amount in the axial direction; in that the roll profile of the other of the intermediate rolls is expressed by the following ternary equation (2):

$$y_2(x)=-a[\{x+(\delta+OF)\}/L]^3+b(x/L)$$

where Y_2 is the generating line of the crown of the roll; and in that each of the intermediate rolls has a barrel length 1.5 times as long as that of its backup roll such that the intermediate rolls always contact the backup rolls over the full length thereof at the maximum and minimum shifted positions of the intermediate rolls."

VI. In support of its request the appellant made essentially the following submissions:

(i) D1 which represents the closest prior art discloses a six high rolling mill of the type stated in the pre-characterising part of claim 1.

In this known rolling mill, the intermediate rolls are provided with a S-shaped profile which may be defined by a third order polynomial.

The claimed rolling mill is *inter alia* characterised by the S-shaped profile of the intermediate rolls which is defined by the ternary equations (1) and (2). The ternary equations comprise a third order coefficient "a" and a first order coefficient "b". In the description, the

coefficient "a" is said to be made minimum. However, the European patent under appeal did not contain any disclosure enabling the skilled person to solve these two equations in the absence of any indication of the possible values for the coefficient "b". It is not disputed that the specified ternary equations may be converted into third order polynomials and vice versa. However, these converted third order polynomials are nothing else than third order polynomials generating the well known "CVC" roll profile (for continuously variable crown) referred to in D2.

The various third order polynomials of D2 are said to differ from each other only by their polynomial coefficients whose values directly result from the desired adjustment range (see D2, page 8 right hand column, third paragraph). Consequently, the ternary equations defined in claim 1 are, after conversion into third order polynomials, undistinguishable from the third order polynomials defining the "CVC" profile referred to in D2.

(ii) Claim 1 further requires the barrel length of the intermediate roll to be 1.5 times as long as that of its backup roll, such that the intermediate rolls always contact the backup rolls over the full length thereof at the maximum and minimum shifted positions of the intermediate rolls.

Since the claimed intermediate rolls have a S-shaped profile defined by a third order polynomial, non-contact regions between an intermediate roll and its backup roll can only be

avoided if a sufficiently high pressure is applied, which in turn depends upon the maximum an minimum diameter differences of the intermediate roll. Insofar as claim 1 omits to include this essential feature, it is not a definition of the invention actually described in the body of the description of the European patent.

As already stated, D2 teaches that these third order polynomials defining the "CVC" roll profile merely differ from each other by the value of their polynomial coefficients and that the appropriate values of these coefficients directly result from the desired adjustment range, that is eg from the relative axial displacement of the rolls and the bending forces to be applied. The claimed value of the barrel length ratio can thus be determined in a routine manner by the skilled person. Therefore the subject-matter of claim 1 does not involve an inventive step with respect to the cited prior art and general knowledge in this technical field.

VII. The respondent (patentee) rejected the arguments brought forward by the appellant. It submitted the reasons for which the subject-matter of claim 1 was inventive over the cited prior art documents.

Reasons for the Decision

1. The appeal is admissible

2. *Article 123*

Claim 1 as granted relates to a selected range of the barrel length of the intermediate rolls which is 1.2 to 2.5 times longer than that of its backup roll. Claim 1 as amended requires the barrel length to be 1.5 times as long as that of its backup roll. Since this value falls within the range defined in claim 1 as granted, the amendment made is a restriction which does not extend the protection conferred and thus meets the requirements of Article 123(3) EPC.

The claimed value 1.5 is also clearly supported by the application as filed, see page 8, lines 1 to 30 of the published "A" document, and thus meets the requirements of Article 123(2) EPC.

3. *Inventive step*

3.1 It is not in dispute that prior art document D1 (i) represents the closest prior art and (ii) discloses a six high rolling mill of the type stated on the pre-characterising part of claim 1.

The parties also accepted that this citation discloses intermediate rolls having a profile defined by a ternary equation, since a third order polynomial disclosed in D1 can be converted into a ternary equation and vice versa. However the respondent argued that the ternary equations (1) and (2) set out in

claim 1 are very specific and are not anticipated by the generic disclosure in D1.

The Board is unable to follow such reasoning since the claimed ternary equations (1) and (2) are not more narrowly defined or identified than those disclosed in D1. If the coefficient "a" is said to be made minimum, coefficient "b" is not defined in the European patent specification. Moreover, the skilled person would realise that these ternary equations (1) and (2) may be converted into third order polynomials which generate the well known "CVC" roll profile referred to in D2.

It follows that the rolling mill according to claim 1 differs in essence from that disclosed in D1 by virtue of the barrel length of the intermediate roll which is 1.5 times as long as the barrel length of the back up roll, such that the intermediate rolls always contact the backup rolls over the full length thereof at the maximum and minimum shifted positions of the intermediate rolls.

3.2 According to the European patent (page 6, lines 31 to 36) "when the barrel length of the intermediate rolls is made 1.5 times as long as that of the backup rolls, the maximum and minimum diameter differences of the intermediate rolls can be made small, that is, when an S-shaped roll crown is formed on the intermediate roll, the grinding amount can be reduced, so that the life of the intermediate roll can be lengthened in the process of roll grinding".

Moreover as shown in Table 1 on page 6, it is apparent that the maximum pressure is smaller when the barrel

length of the intermediate roll is 1.5 times as long as that of the back up roll as compared with a case in which the barrel length is 1.1, so that it contributes to improving the roll life.

Finally, since the intermediate rolls are always maintained in contact with the backup rolls over their full length at the maximum and minimum shifted positions, there are no non-contact regions between the intermediate rolls and the backup rolls and thus the rigidity of the mill is enhanced.

3.3 Therefore, starting from D1 the technical problem to be solved by the present invention may be seen in minimising the amount of grinding required when producing the profiles of the intermediate roll, improving the working life of the intermediate rolls and increasing the rigidity of the mill.

3.4 In the cited prior art documents there is no suggestion that the intermediate rolls should have a length which is 1.5 times the length of the backup rolls and that the intermediate rolls should always be maintained in contact with the backup rolls at the maximum and minimum shifted positions, in order to increase the working life of the intermediate rolls and the rigidity of the mill.

The appellant refers to document D3 as showing a mill where the intermediate rolls have a barrel length which is longer than the length of its backup roll. He also refers to Figure 24 of D2 as showing typical shift paths of ± 400 mm and calculates that, when used with rolls having a length of 2000 mm, this would result in

a barrel ratio which is from 1 to 1.4 times the length of the backup rolls. Thus the barrel length ratio of 1.5 required by claim 1 of the opposed patent is not taught by documents D3 or D2 either alone or in combination.

3.5 Furthermore the advantageous effects obtained by the claimed invention cannot be at least fully achieved by a barrel length ratio extending from 1 to 1.4. As evidenced by at page 6, Table 1 of the European patent specification, the line pressure between intermediate and backup rolls is smaller when the barrel length ratio is 1.5 as compared with a case in which the barrel length ratio is 1.1; reduced line pressure contributes to improve the roll working life.

3.6 Accordingly in the Board's judgement, the subject-matter of claim 1 involves an inventive step (Article 56 EPC).

4. The appellant submits that the claimed contact between the intermediate roll and its backup roll which extends along the whole length of the backup roll is only achieved if an appropriate pressure range is applied. Thus claim 1 would not define the claimed subject-matter by reference to all its essential features.

The appellant further alleges that the skilled person would not be able to determine the first order coefficient "b" of the claimed ternary equations (1) and (2).

Those submissions relate to the requirements of Article 84 and/or 83 EPC. An objection based upon

Article 84 is in the present case not admissible since it does not arise out of the amendment made. The objection of insufficiency of disclosure pursuant to Article 83 EPC was not raised in the notice of opposition and thus constitutes a fresh ground for opposition which accordingly may not be introduced in the appeal proceedings without the agreement of the respondent (patentee).

For completeness the Board would add that it in any case cannot agree with those submissions, since the skilled person would be able to establish by routine experimentation the desired pressure values necessary to avoid a non-contact region between the intermediate roll and its backup roll and determine the required value of the coefficient "b" by using standard methods. In the latter context reference is made to the teaching of D2 at page 8 third column, where it said that the third order polynomials generating the CVC profiles differ from each other only by their polynomial coefficients, whose values directly result from the desired adjustment rate.

5. Dependent claims 2 and 3 relate to particular embodiments of the invention claimed in claim 1 and are likewise allowable.

The opposition grounds thus do not prejudice the maintenance of the patent as amended.

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 3,

   - description and drawings (Figures 1 to 13) presented at the oral proceedings.

The Registrar: The Chairman:

S. Fabiani S. Crane