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File Number: T 770/89 - 3.2.3

Application No.: 80 105 897.5

Publication No.: 0 026 903

Title of invention: Rolling mill

Classification: B21B 31/18, B21B 37/08, B21B 29/00

DECISION
of 16 October 1991

Proprietor of the patent: Hitachi Ltd

Opponent: SMS Schloemann-Siemag AG

Headword:

EPC Article 56 EPC

Keyword: - First auxiliary request disregarded because filed late and not
clearly allowable
- Inventive step (no)

Headnote



Case Number : T 770/89 - 3.2.3

DECISION
of the Technical Board of Appeal 3.2.3
of 16 October 1991

Appellant : SMS Schloemann-Siemag AG
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Decision under appeal : Interlocutory decision of the Opposition Division
of the European Patent Office dated
16 October 1989 concerning maintenance of
European patent No. 0 026 903 in amended form.

Composition of the Board :

Chairman : C.T. Wilson
Members : R.E. Gryc
W. Moser

Summary of Facts and Submissions

- I. European patent No. 0 026 903 comprising three claims was granted to the Respondent on 2 January 1986 on the basis of European patent application No. 80 105 897.5 filed on 29 September 1980 claiming priority of 4 October 1979.

Claim 1 as granted reads as follows:

"1. A rolling mill comprising a pair of work rolls (1,2) brought into contact with a material (3) to be rolled, a pair of intermediate rolls (13, 14) positioned vertically outwardly of the respective work rolls to contact therewith, a pair of backup rolls (28,29) for supporting the respective intermediate rolls,

the diameters of the work rolls being smaller than the diameters of the intermediate rolls and the diameters of the intermediate rolls being smaller than the diameters of the backup rolls,

wherein the following four features for influencing the shape of the rolled material are realized:

a) the diameters of the work rolls (1,2) are smaller than 25% of the maximum width of the rolled material (3);

b) means (17,26) for axially displacing the intermediate rolls (13,14) to position the end portions of the roll barrel thereof on or near vertical lateral end surfaces of the rolled material (3);

c) means (11,12) for applying a roll bending to the work rolls (1,2); and

d) bending means acting on the intermediate rolls (13,14) are provided."

- II. An opposition was filed by the Appellant (Opponent) on 30 September 1986 and by a decision of 16 October 1989, the Opposition Division maintained the patent in an

amended form according to a second auxiliary request. The main claim accepted by the Opposition Division corresponds to the granted Claim 1 amended with an additional feature e) which reads as follows:

"e) the two metal chocks (15,15';16) supporting each of the intermediate rolls (13,14) are disposed inside of a block (17,18), which is movable disposed on the roll housing (6) and engaged with the bending means (19 to 22)."

III. The Appellant lodged an appeal on 8 December 1989 and, simultaneously, paid the relevant fee. The written Statement setting out the Grounds of Appeal was filed on 20 February 1990.

The Appellant requested the revocation of the patent in its amended form on the ground of lack of an inventive step of its subject-matter mainly in comparison with the disclosures of the following documents considered in combination:

D1 : BR-A-7 608 285 (corresponding to CA-A-1 101 702)
D2 : US-A-3 818 743
D6 : JP-B-50 12385

and also in view of document DE-A-2 335 809 cited in the search report.

IV. In his Statement of Grounds the Appellant argued mainly the following:

- the addition of feature e) to Claim 1 as granted is not admissible because it has already been claimed in a divisional application;

- the possibility of displacing axially the intermediate-rolls during the rolling operation, i.e. under the rolling load, cannot be taken into consideration in favour of the invention because this feature is not disclosed in the application as originally filed;
- D2 already discloses the possibility of displacing the intermediate rolls during the rolling operation;
- at the priority date, it was common knowledge for the skilled man to combine bending of the work rolls with axially displacing the backing rolls of said work rolls in order to compensate deformations;
- feature e) just specifies the means for axially displacing the rolls stated under b); and,
- D6 discloses such means and gives a hint for using them on a rolling mill according to D2.

V. In his reply of 30 August 1990 the Respondent (Patentee) requested the maintenance of the patent as granted and auxiliarily the maintenance of the patent as accepted by the Opposition Division.

He argued that when work rolls of a small diameter are adopted on rolling mills according to either document D2 or D3 (DE-A-2 752 750), a flat shape of the rolled material cannot be realised, composite elongation such as quarter buckle occurs and it is impossible to correct positively the composite control whereas the mill according to Claim 1 as granted enables such a control.

Concerning the rolling mill according to Claim 1 of the auxiliary request, the Respondent contended that it

comprises a structure suitable for effecting composite control following the variation in factors during the rolling operation. According to the Respondent, the rolling mill known from D6 would not allow the use of small diameter work rolls and would not permit to effect shape control following the thermal crown.

VI. In a communication sent to the parties for preparing the requested oral proceedings, the Board expressed a provisional negative opinion with regard to the patentability of the main claim of the impugned patent either as granted or as maintained by the Opposition Division, in the light of the teaching of document D2 taken in combination with the disclosure of respectively documents D3 or D6.

VII. With his reply dated 30 September 1991, the Respondent filed three new auxiliary requests respectively based on the three following amended claims:

A. Claim 1 according to auxiliary request III:

It corresponds to Claim 1 as granted amended to read additionally after feature c):

- "d) bending means (19 to 22) acting on the intermediate rolls (13,14) are provided for applying an increased bending or a decreased bending to the intermediate rolls (13,14);
- e) the two metal chocks (15,15';16) supporting each of the intermediate rolls (13,14) are disposed inside of a block (17,18), which is engaged with the bending means (19 to 22) and movable disposed on the roll housing (6) under the action of an hydraulic cylinder (26); and

f) mechanisms (23,24) are provided for connecting and disconnecting the metal chocks (15,15';16) of the intermediate rolls (13,14) with the movable blocks (17,18)."

B. Claim 1 according to auxiliary request IV:

It corresponds to Claim 1 according to request III with features c) and d) amended as follows:

"c) means (11,12) for applying a roll bending to the work rolls (1,2) for controlling the shape of the lateral end portions of the rolled material (3);

d) bending means (19 to 22) acting on the intermediate rolls (13,14) are provided for applying an increased bending or a decreased bending to the intermediate rolls (13,14) and are controlled in interlocking relation to the control of the work roll bending and in conformity with the rolling load."

C. Claim 1 according to auxiliary request V:

It corresponds to Claim 1 according to request IV amended so as to incorporate as feature g) the content of Claim 2 as granted i.e.:

"g) the work rolls (1,2) are supported by metal chocks (4,5) including bearings (50) for mainly supporting radial loads and mechanisms (54 to 60) for directly supporting the work rolls (1,2) to support thrust loads acting on the work rolls."

Moreover, the Respondent also filed three technical articles (Enclosures I to III) to illustrate the state of the art at the priority date and the use of the invention and he contended mainly that:

- it was not obvious to combine the teachings of D2 and D3;
- it appears from Claim 8 of the European patent application as originally filed that the axial movements of the intermediate rolls can be performed during the rolling operation;
- there is no hint in D6 that the described device for moving axially the rolls can be employed in a mill according to D2, and, even if it would, the idea of bending the displaceable intermediate rolls would not be present; and,
- even more, the feature of using thin and thus flexible work rolls in combination with the other three control parameters would also not be envisaged.

VIII. The day before the oral proceedings, the Respondent filed a new Claim 1 to be considered as the basis for auxiliary request number 1; this new auxiliary main claim corresponds to Claim 1 as granted amended to read additionally after feature b):

"c) means (11,12) for applying a roll bending to the work rolls (1,2) for controlling the shape of the lateral end portions of the rolled material (3);

- d) bending means (19 to 22) acting on the intermediate rolls (13,14) are provided for applying an increased bending or a decreased bending to the intermediate rolls (13,14) and are controlled in interlocking relation to the control of the work roll bending and in conformity with the rolling load;

so that the shape or crown of the rolled material can be controlled by controlling the axial movement of the intermediate rolls, work roll bending action and intermediate roll bending action in combination in such a manner that control of the shape or crown of the rolled material across the width thereof is mainly effected by the intermediate roll bending and control of the edge portions of the rolled material is mainly effected by work roll bending."

IX. The oral proceedings were held on 16 October 1991 and the discussion took place in German by common consent of the parties.

A. The Appellant requested first that the last petition of the Respondent filed the day before as first auxiliary request be rejected since:

- it was filed much too late;
- the protection conferred by the corresponding Claim 1 is extended in comparison with the one of the claim accepted by the Opposition Division because feature e) has been omitted;
- the new paragraph added at the end of the claim does not bring anything more and results already from the combination of the features described in Claim 1 as granted.

The Appellant also requested that the decision under appeal be set aside and that the impugned patent, whether as granted or in its various auxiliary amended forms be revoked on the ground of lack of an inventive step of its subject-matter. To support his request, the Appellant contended essentially the following with regard to Claim 1 according to:

A1. The main request (as granted):

- At the priority date, the skilled technician knew exactly all of the limited number of possibilities he had at his disposal to control the shape of the rolled material, i.e. rigidity and profile of the rolls, roll bending, axial moving, cooling etc. ... (cf. D3, Figure 5 and pages 17, 18 and 20), and according to the needs, he would have combined these different parameters at will.
- Since D2 already describes a mill provided with small diameter work rolls (15/18% of the length of the rolling surface), benders for these rolls and also means for axially shifting the intermediate rolls, no inventive step should be acknowledged in the simple fact of providing additional bending means to said intermediate rolls to obtain a foreseeable effect on the rolled material.
- Displacing the rolls during the rolling operation, i.e. under load, is disclosed neither in Claim 1 of the impugned patent nor in its description.

- A2. Auxiliary request II (as accepted by the Opposition Division):

The Appellant referred to his written Statement of Grounds (cf. paragraph IV above).

- A3. Auxiliary request III:

To increase or decrease the bending of intermediate rolls according to feature d) is known per se from D3. As far as amended feature e) and new feature f) are concerned, D1 discloses in Figure 5 hydraulic cylinders and mechanisms provided for the same purpose as according to the invention.

- A4. Auxiliary request IV:

To bend the work rolls according to feature c) for controlling the edges of the strip to be rolled is common use as disclosed in D2 and D3. The measure according to amended feature d) is also known per se from D3 and to control the forces in combination stands to reason for the skilled man.

- A5. Auxiliary request V:

During rolling, the rolls are submitted to a "screw effect"; consequently radial and axial supports cannot be avoided, as represented in Figure 2 of D2.

- B. In reply, the Respondent requested that the appeal be dismissed and the patent be maintained as granted or in an amended form according to one of the auxiliary requests.

- B1. With regard to the main request:

He maintained that since D2 and D3 teach completely different solutions (displaceable rolls or rolls of different lengths) to solve the same problem of edge waves on a rolled strip, the skilled technician would never envisage to combine the opposite teachings of these documents, more especially as no hint can be found in any of the anticipations so to do.

The Respondent argued further that neither D2 nor D3 would recommend the use of flexible work rolls on six-high rolling mills and that D2 teaches that the work rolls must have a high rigidity in order to influence the shape of the central portion of the rolled strip and to avoid the "quarter buckles".

In his opinion, the essential teaching of D3 should be the use of non-displaceable intermediate rolls having a working surface longer than that of the backup-rolls but shorter than the work rolls as shown in Figure 4. Consequently, among the six embodiments described in D3, the skilled man would have no reason to consider the one represented in Figure 5 rather than the one shown in Figure 4. Moreover, D3 shows at the end of page 7 that the heating effect on the rolls was not correctly understood, unlike in the present invention which has been immediately taken up in industry.

B2. With regard to auxiliary request II:

The Respondent contended that in the German translation of D6, the passage of page 2 relating to the six-high mill does not make sense and he supplied the Board with a new translation in English.

According to the Respondent the Japanese document concerns only a four-high mill and no indication is given of the use of small diameter work rolls.

Even the percentages cited in D2 (15-18%) could not lead the skilled person to the use of rolls having diameters as small as according to the invention since D2 refers to percentages of the length of the rolling surface of the rolls that is generally larger than the maximum width of the rolled material.

According to the Patentee, there is no incentive for combining D6 with D2 and using flexible work rolls; and new feature e) added to Claim 1 as granted specifies the means for allowing the intermediate rolls to move under load which appears from Claim 8 of the application as originally filed and such a feature cannot be found in any anticipation.

B3. With regard to auxiliary requests III, IV and V:

The Respondent argued that nowhere could be found a mechanism that would be strong enough to move axially the rolls and D1 and D6 were concerned with something else. Also, there was no disclosure in the state of the art of such a reciprocal effect between the bending of the rolls and the rolling load, as in accordance with the invention.

As far as the thrust supporting mechanisms referred to in feature g) of auxiliary request V are concerned, it should be considered that the invention relates to a special case where very high thrust loads are involved, such a case being not considered on a six-high mill of the state of the art.

At the end of the oral proceedings both parties maintained their requests unamended.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rule 64 EPC; it is admissible.

2. Late-filed auxiliary request I

Claim 1 according to this request was filed the day before the oral proceedings and is not clearly allowable, since in the opinion of the Board it does not bring anything inventive to Claim 1 as granted which, as explained below, is itself not allowable.

For these reasons and in compliance with decisions T 153/85, OJ EPO 1988, 1 and T 406/86, OJ EPO 1989, 302 the Board has decided to disregard the request.

3. Main request (Claim 1 as granted)

Since the Respondent has been adversely affected by the interlocutory decision of the first instance that rejected the maintenance of the patent as granted and since he never explicitly abandoned such a request, he has the right now to request grant on the basis of the granted Claim 1.

3.1 Novelty

None of the citations covered by the Search Report or introduced in the course of the further proceedings discloses a six-high rolling mill of the type as described in Claim 1 as granted. Since the Appellant did not dispute

novelty, there is no need for further detailed substantiation of this matter and the rolling mill as set forth in Claim 1 as granted is to be considered as novel within the meaning of Article 54 EPC.

3.2 The state of the art closest to the invention

As acknowledged in enclosure II of the Respondent's reply of 30 September 1991 (cf. article "Universal Crown Control Mills" of Hitachi Review, Vol. 34, 1985, page 169) the design of the rolling mill according to the invention basically came from a high crown control mill of the type described in D2 or in US-A-3 902 345 both cited in the search report and in the patent specification. Such a known mill comprises all the features stated in the first part of Claim 1 as granted, i.e. before "wherein".

In addition, D2 discloses the possible use of work rolls having a diameter of 15 per cent of the length of the rolling surface (cf. columns 6 and 12, lines 37, 38) and it also relates to a rolling operation carried out on material having a width of 1220 mm by work rolls of 250 mm diameter (cf. column 10, lines 45 to 50 and Figure 9) i.e. rolls having a diameter smaller than 25% of the width of the rolled material as in feature a) of Claim 1. Moreover, D2 also discloses axial displacement of the intermediate rolls and bending of the work rolls, as in features b) and c) of Claim 1.

Therefore, the state of the art closest to the invention appears to be found in D2 and the subject-matter of Claim 1 as granted differs therefrom only by feature d) i.e. the provision of bending means acting on the intermediate rolls.

3.3 The problem and its solution

On a six-high crown control mill having axially adjustable intermediate rolls and work roll bending means according to D2, the unevenness in the thickness of the rolled product can be improved according to that patent as compared with a conventional four-high mill by the use of work rolls having a high rigidity (cf. D2, column 2, lines 42 to 45 and column 6, lines 26 to 34) and having their deformation compensated by the roll bending force over the width range of the material (cf. D2, column 11, lines 4 to 8). The problem according to the contested patent (see column 2, lines 9 to 13) is therefore to improve this known rolling mill so that when more flexible work rolls are used, an improved shape control of the rolled material over the whole width thereof is achieved.

However, as pointed out in paragraph 3.2 above, the work rolls of D2, although on the one hand being described as having a "high rigidity", are also described in column 6, lines 35 to 38 as having diameters "substantially larger than 18 percent and at least 15 percent and usually 25 percent of the length of the rolling surfaces thereof", i.e. in essentially the same terms as feature a) of the present Claim 1, which refers to the "more flexible rolls" of the present European patent description (cf. column 8, line 11). Clearly, the known "rigid" rolls of D2 do not differ essentially from the "flexible" rolls of the present invention, so that the objective problem to be solved cannot include this aspect.

As set out above, the only difference between the subject-matter of Claim 1 and the disclosure of D2 is feature d), i.e. the bending means acting on the intermediate rolls.

The objective problem to be solved by the present invention is therefore more generally to improve shape

control of the rolled material over the whole width thereof.

This problem is solved by the provision of an additional control parameter i.e. bending of the intermediate rolls, in combination with the two other existing parameters of bending the work rolls and displacing axially the intermediate rolls.

3.4 Inventive step

3.4.1 At the priority date of the impugned patent, the person skilled in the art learned from D2 that in order to improve the thickness unevenness in the widthwise direction of a rolled material, the most important aspect is to minimise the influence of the bending moments occurring in the work rolls under rolling load and to increase the flatness correcting capacity by roll bending (cf. D2, column 1, lines 34 to 41). D2 teaches further that while the adjustment of the relative position of the intermediate roll and work roll already permitted controlling with sufficient accuracy the evenness of the rolled product, an additionally applied roll bending force could help in lessening the deformation of the work rolls under rolling load (cf. D2, column 8, lines 41 to 51 and Figures 10b and 10c). These general hints all served to emphasise the importance of the bending effect for compensating the deformation of rolls under rolling pressure.

3.4.2 Keeping that in mind, the skilled person who was starting from the mill according to D2 and looking for additional means for improving its flatness correcting capacity when using small diameter work rolls backed up by intermediate rolls of higher rigidity, would have consulted, at least in the same technical field, the relevant prior art for

rolling mills which perform the same function. Such a consultation would have revealed D3 (DE-A-2 752 750) concerned with the same problem where the skilled person would have found corroboration that:

- The shape control can be satisfactorily accomplished by applying bending forces on rolls which backup small diameter work rolls (cf. D3, page 11, lines 1 to 5), and
- The addition of benders to intermediate rolls already having a high degree of freeness enhances the total bending effect (cf. D3, page 18, lines 20 to 23; page 20, lines 5 to 13 and Figure 5).

3.4.3 Consequently, since no surprising effect results from the provision of bending means acting on the intermediate rolls of the mill according to D2 and since, furthermore, a fairly limited number of options for lessening the deformations of the work rolls is available, the adoption of such a measure known per se from D3 (i.e. feature d) of Claim 1) in combination with the other features of Claim 1 already known from D2 does not involve the exercise of any skill or ability beyond that to be expected of the skilled person.

For the foregoing reasons, the subject-matter of Claim 1 cannot be considered as implying an inventive step in the meaning of Article 56 EPC.

4. Auxiliary request II (Claim 1 as maintained)

4.1 Claim 1 according to this auxiliary request concerns a rolling mill whereas the subject-matter of the divisional application referred to by the Appellant in their Statement of Grounds relates to a device for moving

axially the rolls of a rolling mill. Consequently, no double patenting can take place and, with regard to this point, Claim 1 according to this request is allowable.

- 4.2 Moreover, in spite of the abandonment in the letter of 26 March 1985 of Claims 2 and 3 filed on 19 November 1984, the subject-matter of which claims corresponds essentially to that of feature e) of the present auxiliary Claim 1, the Board considers that this subject-matter may be re-introduced into the claims.

In this respect it is noted both that the corresponding part of the description supporting the claims was maintained (contrary to what happened in case T 61/85 dated 30 September 1987, not to be published in the OJ), and that it became manifest that the clearly stated assumption of the Respondent, namely that the abandonment was necessary to avoid double-patenting, was incorrect, as concluded by the Opposition Division.

- 4.3 Although it is not immediately understandable from Claim 1 that feature e) describes only a particular way of embodying the means cited in feature b), this appears from the description and the drawings (cf. Figure 2) and also in Claim 1, from the reference sign 17 which follows both the means for displacing the rolls of feature b) and the movable block of feature e).

- 4.3.1 At the priority date such a special embodiment which permits to displace axially the rolls of a rolling mill was already known per se from D6 and even if, in this document, said embodiment is only exemplified on a four-high mill, D6 also refers to a rolling mill having axially movable intermediate rolls (cf. page 3, lines 7 to 13 of the English translation of D6 supplied by the Respondent during the oral proceedings) and does not limit the use of

this embodiment to a quarto (cf. the claims of this anticipation).

- 4.3.2 Moreover, it should be observed that the movable frames disclosed in D6 also comprise hydraulic means 15-18 for effecting "roll profile control" (cf. page 4, lines 29 to 31 of the English translation), i.e. roll bending means.
- 4.3.3 With regards to the argument of the Respondent that, according to the invention, feature e) of Claim 1 does not merely describe some general means for moving axially the rolls but rather specifies special means for moving them during rolling operation, i.e. under load, the following should be observed:
- whether the intermediate rolls can or cannot be moved under load is clearly specified neither in Claim 1 nor in the description of the patent amended according to auxiliary request II and thus cannot be taken into consideration in the appreciation of the inventiveness, and,
 - even if Claim 8 as originally filed could possibly be interpreted as describing the possibility of moving the rolls during rolling, the same possibility could also be found in D2 when interpreting the expressions: "the material being rolled" cited in column 2, lines 59 and 60 or column 3, lines 30 and 31 or column 6, lines 53 to 55 and "during the rolling operation" cited in column 14, lines 10 to 15.
- 4.3.4 Consequently, for the foregoing reasons, the simple addition of feature e) known per se from D6 to the other features of Claim 1 as granted cannot be considered as inventive for the skilled practitioner.

5. Auxiliary request-III

At the priority date, the measure consisting of applying an increased or a decreased bending to the intermediate rolls was already known per se from D3 (cf. Figure 5) and the use of a hydraulic cylinder for moving axially the intermediate rolls was also already known per se from D1 (cf. Figure 5) as well as mechanisms for connecting and disconnecting the metal chocks.

Since no combinatory or surprising effect results from the provision of these above-mentioned known features on a rolling mill according to Claim 1 of auxiliary request II, no inventive step is implied just by the fact of adding all these characteristics together.

6. Auxiliary request IV

At the priority date, the skilled practitioner knew perfectly that bending of the work rolls under rolling pressure naturally causes a thickness unevenness in particular at the opposite edge portions of the rolled plate and that this effect could be counter-balanced and minimised in particular by applying roll bending forces to the extremities of the work rolls (cf. for example D2, Figures 10b and 10c or D3, page 9, paragraph 2). Moreover, since the bending forces are normally applied on the work rolls and/or the intermediate rolls in order to compensate the influence of the bending movements occurring in the work rolls under rolling load, all the bending means acting on the rolls should obviously be reciprocally controlled in interlocking relation and in conformity with the rolling pressure otherwise the deformations of the work rolls could not be counter-balanced satisfactorily.

Consequently, the amendments brought to features c) and d) of Claim 1 according to auxiliary request IV do not go beyond the ordinary skill of the person skilled in the art and no inventive step can be acknowledged.

7. Auxiliary request V

Since it is usual to support the rolls of a mill radially and also axially in particular to counter-balance the screw effect acting on the rolls during the rolling operation, the same conclusion as under point 6 is to be drawn with regard to added feature g) of Claim 1 according to auxiliary request V.

8. For the foregoing reasons, the Board considers that the subject-matter of none of the main claims presented by the Respondent in the course of the appeal procedure meets the requirements of the Convention as far as Articles 52 and 56 EPC are concerned.

Order

For these reasons, it is decided that:

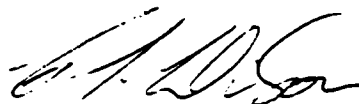
1. The decision under appeal is set aside.
2. The European patent No. 0 026 903 is revoked.

The Registrar:



N. Maslin

The Chairman:



C.T. Wilson

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R.G.
W. Moser