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D E C I S I O N
of 27 July 1995

Case Number: T 0582/92 - 3.2.1

Application Number: 82302863.4

Publication Number: 0067040

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Language of the proceedings: EN

Title of invention:
Rolling mill

Patentee:
Hitachi, Ltd.

Opponent:
SMS Schloemann-Siemag AG
Davy McKee (Sheffield) Limited
Société Clecim

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0582/92 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 27 July 1995

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office given on 13 March 1992 and issued in writing on 23 April 1992 revoking European patent No. 0 067 040 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: F. Pröls
Members: S. Crane
B. Schachenmann

Summary of Facts and Submissions

I. European patent No. 0 067 040 was granted on 10 September 1986 on the basis of European patent application No. 82 302 863.4.

II. The patent was opposed by the present Respondents (Opponents 01 to 03) on the grounds that its subject-matter lacked inventive step.

Of the prior art documents relied upon in the opposition proceedings only the following have played any role in the appeal proceedings:

(D1) EP-A-0 026 903,
(D3) US-A-3 943 742 and
(D14) JP-A-50/12385

(Translations into German and English of document D14 have been filed by Opponents 01 and 02 respectively).

III. The patent was revoked by a decision of the Opposition Division given at oral proceedings on 13 March 1992, and issued in written form on 23 April 1992.

IV. An appeal against this decision was filed on 25 June 1992 and the fee for appeal paid at the same time. The Statement of Grounds of Appeal was filed on 2 September 1992.

V. Oral proceedings before the Board were held on 27 July 1995.

At the oral proceedings the Appellants (Proprietors of the patent) submitted an amended Claim 1 and amended description and requested that the patent be maintained

in amended form on the basis of these documents together with dependent Claims 2 and 3 filed on 2 September 1992 and sheets 1, 3 and 4 of the drawings as granted and sheet 2 filed on 20 June 1991.

Claim 1 reads as follows:

"A four-high rolling mill

- comprising a roll housing (131 to 134) in which are mounted a pair of working rolls (5, 8) and a pair of backup rolls (2, 12) therefor,

- said working rolls (5, 8) supported in roll chocks (4, 6, 7, 10) at their opposite ends being provided with drive means (26), with roll bending means (29) and with means (25) for relative axial displacement disposed on the driving side of the rolling mill,

- supports (141, 142, 231, 232) are fixed in the roll housing for slidably supporting a plurality of beams (18, 19, 30, 31) extending parallel to the working rolls (5, 8) and having vertical flat faces (161) for vertical guiding the working roll chocks (4, 6, 7, 10),

- said supports (141, 142, 231, 232) comprise central projections (153) extending generally horizontally towards the working rolls and having a vertical flat endface (156), and also upper and lower projections (151, 152) equally spaced vertically from said central projections (153),

- each central projection (153) is provided at its end (155) with a small downward extension for engaging in a recess (162) formed in the face of the respective beam (30, 31) contacting the central projection (53) and

each upper projection (151) is provided with a recess (154) engaged by a small projection (163) formed on the contacting face of the respective beam (18, 19),

- said roll bending means (29) are disposed in said beams (18, 19, 30, 31) to engage the working roll chocks (4, 6, 7, 10) and are located symmetrically with respect to the axis of the central projection (53) of the support,

c h a r a c t e r i z e d in that

- each central projection (153) is provided at its end (155) also with a small upward extension for engaging in a recess (162) formed in the face of the respective beam (18, 19) contacting the central projection (153) and each lower projection (152) is provided with a recess (154) engaged by a small projection (163) formed on the contacting face of the respective beam (30, 31), so that the supports (141, 142) wrap or surround the beams,

- the roll bending means (29) are disposed in said beams (18, 19, 30, 31) wholly within the width of the respective central projections (153),

- the vertical flat faces (161) of the beams (18, 19, 30, 31) are aligned with the vertical flat endfaces (156) of the central projections (153) so that guide faces are formed for both of the roll chocks (6, 7),

- said means for relative axial displacement of the working rolls (5, 8) comprising a plurality of actuators (25) connected to the roll housing (131 to 134) and to the beams (18, 19, 30, 31) independently of each other

for sliding the beams axially, the axis of each actuator (25) being laterally spaced from the axis of the respective beam."

Claims 2 and 3 relate to preferred embodiments of the rolling mill according to Claim 1.

VI. In support of their request the Appellants argued substantially as follows:

The basic principle of axially displacing the rolls of a rolling mill in accordance with the width of the strip being rolled was well-known. In a four-high rolling mill of the type claimed the roll bending means also served to urge the working rolls against the backup rolls when strip was not being rolled in order to maintain the drive from the working rolls to the backup rolls. In order to effect axial displacement of the working rolls it had conventionally been necessary to remove the load between the working rolls and the backup rolls, the latter, which were of great mass, consequently slowing down. Before a new rolling pass could begin these backup rolls had therefore to be brought back to their normal speed. This was wasteful of operating time. The claimed invention proposed means whereby the working rolls could be axially displaced under load so that drive from the working rolls to the backup rolls could be maintained. This was a significant advance. Moreover the means involved were simple and rugged and did not bring with them any attendant difficulties requiring higher maintenance or roll changing times.

The Opposition Division had been wrong in treating the features of the characterising clause of Claim 1 as being a mere aggregation since those features had a genuine functional and structural interrelationship.

There was nothing in the state of the art which could lead the skilled person to the combination of features claimed.

VII. In support of their requests that the appeal be dismissed the Respondents argued substantially as follows:

Although document D14, which indisputably represented the closest state of the art, stemmed from the present Appellants they had not referred to it in the evaluation of the background art made in the originally filed application. Instead there the invention was presented as being a development from a significantly more remote starting point. In fact all of the technical problems which the claimed invention was alleged to solve when seen from that starting point had already been solved by the arrangement proposed in document D14.

Once document D14 had been introduced into the proceedings the Appellants had recognised that granted Claim 1 was no longer sustainable and had amended it. The features introduced into the claim were however of a trivial nature which were either known to the skilled person from documents D1 or D3 or would follow as a simple matter of engineering logic as a consequence of putting the schematic teachings of document D14 into real, practical effect. Furthermore, each of the features had to be considered individually as to its potential inventive merit as the features had no genuine combinatorial effect.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is therefore admissible.

2. *Amendments*

2.1 Present Claim 1 has been derived from granted Claim 1 by the addition of features specifying more precisely the form and arrangement of the supports and slidable beams, the disposition of the roll bending means and the disposition of the actuators. The rolling mill claimed has also been explicitly restricted to a four-high rolling mill. There is a clear and unambiguous basis in the original disclosure for all of the features added to Claim 1. Since this has not been disputed by the Respondents it is not necessary here to go into further details on this question.

Present dependent Claims 2 and 3 correspond to dependent Claims 5 and 6 as granted.

The amendments made to the description do not go beyond those necessary to adapt thus to the terms of the claims and to refer to the most relevant state of the art.

There are therefore no objections under Articles 123(2) and (3) to the amendments made.

2.2 In comparison with granted Claim 1 the two-part form of present Claim 1 has also been revised to reflect the state of the art known from document D14 in its preamble.

In this respect the Respondents objected to the feature that the roll bending means are disposed in the beams wholly within the width of the respective central projection appearing in the characterising clause of the claim. The basis for this objection was that according to document D14 the roll bending means were already disposed in such a way that they were partially within the width of the central projection, and more importantly, the central axis of the roll bending means, along which the force generated by them could be assumed to act, lay within that width. In their view this situation should have been reflected by the inclusion of an appropriate statement in the preamble of the claim.

The Board is not persuaded by the arguments of the Respondents that further amendment of Claim 1 in this respect is necessary and appropriate having regard to Rule 29(1) EPC. That the roll bending means "are disposed in the beams wholly within the width of the respective central projection" can be seen as a single, integral feature which is certainly not disclosed in document D14 and therefore rightly has its place in the characterising clause of the claim. Although it might in theory be possibly to find some suitably generalised description applicable to both the claimed subject-matter and the state of the art, which could then be placed in the preamble of the claim, any benefit in doing this would, in the opinion of the Board, be outweighed by the claim becoming less concise and potentially less clear. The Board instead takes the view that the proper place for determining what is disclosed in document D14 in this respect and what distinguishes the claimed feature from that state of the art, together with any technical effect achieved by that feature, is in the investigation of inventive step.

3. *State of the art*

3.1 Document D14 discloses a four-high rolling mill with working rolls that can be displaced axially in accordance with the width of the material to be rolled. The rolling mill also comprises roll bending means (hydraulic piston/cylinder devices) for adjusting the shape of the working rolls. The roll bending means are disposed in transversely extending beams arranged in pairs on opposite sides of each work roll, the beams being supported for axial movement in the roll housing by special support members. The face of each beam facing the respective roll is formed as a vertical bearing surface for supporting the respective roll chock for vertical movement. Each support member is essentially E-shaped with an upper, a central and a lower projection. The upper projection has a small downwards extension which engages in a corresponding recess in the upper face of the upper beam. The central projection has a similar extension which engages in a recess in the upper face of the lower beam. The central projection does not extend as far as the inner faces of the beams. The axes of the piston/cylinder roll bending devices appear from the drawings to lie somewhat within the width of the central projection, part of the cross-sectional area of these devices lies however beyond the corresponding end face of that projection. According to the English translation of document D14 (sentence bridging pages 4 and 5) the support members have a width such that they can always support the beams on axial movement of the working rolls "during rolling". (The equivalent passage in the German translation at page 6, lines 4 to 9 refers to "Verschiebung ... der Arbeitswalzen ... beim Walzen".) The axial displacement of the working rolls is introduced via the drive shafts and transferred from the rolls to the beams via keeper plates. Bearing liners are provided on the support

members for the beams to facilitate their axial movement. As shown in the drawings those liners contact the outer and lower face of each beam.

3.2 Documents D1 relates to a six-high rolling mill for rolling very thin and very hard sheet materials to a high degree of accuracy. The working rolls are of small diameter and are provided with roll bending means. The intermediate rolls disposed between the working rolls and the backup rolls are also provided with roll bending means and are arranged to be axially displaceable in accordance with the width of the material being rolled. To this end respective frames comprising two beams disposed on respective opposite sides of the corresponding working roll and joined together at one end by a crosshead are supported for axial movement in the roll housing with each beam located in a slideway groove formed in a corresponding support member mounted in a window of the roll housing. The inner faces of the beams support the intermediate roll chocks for vertical movement and the roll bending means are disposed within the beams to act on the chocks. The support members also have inwardly facing central projections for supporting and guiding the working roll chocks. Axial displacement of each intermediate roll is performed by a pair of hydraulic actuators which act on respective ends of the crosshead of the frame, the crosshead having hydraulically operated releasable coupling means for connecting it to the adjacent roll chock. It is stated in paragraph 2 of page 9 of document D1 that since it is not permissible to drive the working rolls in view of their low structural strength then it is desirable to adopt an intermediate or backup roll driving system.

3.3 Document D3 relates generally to means for axially displacing the rolls (working, intermediate or backup) of a rolling mill and comprising a pair of hydraulic actuators located one to either side of the associated roll and acting between the roll housing and a respective sideways extension of the roll chock. In the embodiment of Figure 6 the axially displaced rolls are the working rolls of a four-high rolling mill.

4. *Novelty and inventive step*

The novelty of the subject-matter of Claim 1 has not been in dispute during the opposition or appeal proceedings. It is distinguished from the closest prior art according to document D14 by the features set out in the characterising clause of the claim (see point 2.2 above).

For ease of discussion these features are repeated here and designated (a) to (d). They are:

(a) Each central projection (153) is provided at its end also with a small upward extension for engaging in a recess formed in the face of the respective beam contacting the central projection and each lower projection is provided with a recess engaged by a small projection formed on the contacting face of the respective beam so that the supports wrap or surround the beams.

(b) The roll bending means are disposed in said beams wholly within the width of the respective central projections.

(c) The vertical flat faces of the beams are aligned with the vertical flat endfaces of the central projections so that guide faces are formed for both of the roll chocks.

(d) The means for relative axial displacement of the working rolls comprise a plurality of actuators (25) connected to the roll housing and to the beams independently of each other for sliding the beams axially, the axis of each actuator (25) being laterally spaced from the axis of the respective beam.

An analysis of the technical effects achieved by those features in comparison with the state of the art disclosed in document D14 can best be begun by considering feature (d), which is seminal to the claimed invention.

It had been a matter of considerable contention between the parties whether the introduction of the axial displacement force by means of actuators acting on the beams rather than via the drive shaft and drive coupling was disclosed in the original application as allowing displacement of the working rolls under operating (i.e. rolling) load. At the oral proceedings, however, the Appellants clarified their position on this to the extent that they referred to axial displacement under the load applied by the roll bending means to maintain frictional drive between the working roll and the backup roll when material is not being rolled. There is a clear and unambiguous disclosure of this in the original application, as was conceded by the Respondents. There is a significant time saving in being able to displace the working rolls in this way.

A further highly contentious issue was whether document D14 also disclosed a displacement of the working roll under load. The Respondents based themselves in this respect on the passages of the translations quoted in point 3.1 above. They argued that the references to axial movement "during rolling" ("beim Walzen") could only be understood in this way. The Appellants argued on the other hand that this passage could equally well refer to the overall operation of the rolling mill and not specifically to the point in time when material is being rolled. When account is taken of the totality of the disclosure of document D14 and the relevant knowledge of the skilled person the Board comes down on balance on the side of the Appellants. A drive coupling capable of transferring simultaneously the very high axial loads and torques involved would be a significant departure from those conventionally used in this context, but all the indications in document D14 are that the drive coupling used is indeed conventional. Furthermore, the bearing liners provided on the support members appear to be arranged in such a way that they can only facilitate sliding of the lower beams when these are not under an upward reaction load from the roll bending means. This tends to suggest that axial displacement of the working rolls takes place when they are resting under their own weight on the support members. In any case, as can be seen from what is said below, this question is not critical to the determination of inventive step.

In order to allow adequate space to accommodate the drive coupling the actuators are spaced laterally from the axis of the respective beam, as is stated in feature (d). This arrangement leads however to the actuators imposing bending moments on the beams the resultant distortion of which could lead to jamming of the chocks which are supported on them for vertical movement.

Therefore, according to feature (a) the form of the support and the degree of engagement between it and the beams is increased in such a way as to resist distortion of the beam.

Feature (b) is also provided to reduce distortion of the beam, in this case as a result of the roll bending means, and also contributes to ensuring proper free movement of the roll chocks during operation of the rolling mill. It must however be noted in this respect that since in document D14 the axes of the roll bending piston/cylinder devices lie within the width of the central projection shown there the relative gain in having the whole of these devices disposed within that width will be small.

In fact, feature (b) can be seen as a corollary of feature (c) according to which the flat end face of the central projection is aligned with the flat faces of the beams which vertically guide the working roll chocks. This arrangement serves not only to provide improved resistance against distortion of the support and beam but also, by virtue of the fact that the flat end face of the central projection also guides the roll chocks, ensures guide surfaces for the roll chocks which are fixed relative to the roll housing and independent of the movement and possible distortion of the beams.

In the opinion of the Board it can be seen from the above that the features (a) to (d) are structurally and conceptually closely linked to each other and all contribute to the provision of a rolling mill in which the working rolls can move smoothly in the vertical direction and which can be operated in an efficient manner with idle times kept to a minimum. It would

therefore not do justice to the character of the present invention to consider each of the features (a) to (d) in isolation as if they were a mere aggregation.

The basic standpoint of the Appellants is that the skilled person, starting from the state of the art according to document D14, would not have been induced by documents D1 or D3 to consider axially displacing the working rolls by acting on the beams rather than on the rolls themselves since he would recognise that this approach would lead to unacceptable distortion of the beams and consequent loss of proper guidance for the roll chocks. In particular, the Appellants point out that in the arrangement shown in document D1 the crosshead connecting the beams substantially eliminates any bending moment on the beams. The provision of such a crosshead is however impossible if the rolls are to be driven from the side on which the actuators are disposed, as in the claimed invention. As for document D3, the actuators act directly on the roll chocks, there being no beams present, so again this teaching is not relevant. The Respondent on the other hand argued that the skilled person would recognise from documents D1 and D3 the advantages of using actuators for shifting the rolls and would know what measures he needed to adopt to prevent distortion of the beams.

The Board does not find it necessary to decide this issue since in its view the skilled person would not, even if he did choose to investigate the use of actuators in the arrangement known from document D14, arrive at the combination of features (a) to (c) specified in Claim 1 in order to ensure free and smooth vertical movement of the roll chocks with respect to the beams. Of particular relevance in this respect is feature (c) by virtue of which the roll chocks are no longer guided by the faces of the beams alone but by end

surfaces of the central projections of the support, which surfaces are essentially fixed with respect to the roll housing. Thus here it is not merely a question of quantitatively increasing the guide surface area for the roll chocks, as suggested by the Respondents, but instead of providing a qualitatively different guiding arrangement. There is nothing which corresponds to such a guiding arrangement in the state of the art. Although the Respondents made reference in this respect to the central projections of the support members shown in document D1 those central projections merely provide guiding surfaces for the chocks of the working rolls of the six-high rolling mill disclosed there, which working rolls are not axially displaceable, and so the form and purpose of these central projections is in no way comparable with those of the claimed invention.

As a result of the above the Board comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the state of the art and therefore involves an inventive step (Article 56 EPC). This claim together with its dependent Claims 2 and 3 and the revised description therefore form a suitable basis for maintenance of the patent in amended form.

Order

For these reasons it is decided that:

1. The contested decision 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:

   Claim 1 as submitted at the oral proceedings;
   Claims 2 and 3 as filed on 2 September 1992;
   Pages 1 to 5 of the description submitted at the oral proceedings;
   Sheets 1, 3 and 4 of the drawings as granted; and
   Sheets 2 of the drawings as filed on 20 June 1991.

The Registrar: The Chairman:

S. Fabiani F. Prols