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Datasheet for the decision of 9 September 2015

Case Number: T 0065/12 - 3.2.03

Application Number: 06809087.7

Publication Number: 1945383

IPC: B21B1/46, B22D11/12, B22D11/14

Language of the proceedings: EN

Title of invention:
PROCESS AND PLANT FOR PRODUCING METAL STRIP

Patent Proprietor:
DANIELI & C. OFFICINE MECCANICHE S.p.A.

Opponent:
SMS Siemag AG

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step (yes)

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Catchword:

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Case Number: T 0065/12 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 9 September 2015

Appellant: (Opponent)	SMS Siemag AG Eduard-Schloemann-Strasse 4 40237 Düsseldorf (DE)
Representative:	Klüppel, Walter Hemmerich & Kollegen Patentanwälte Hammerstraße 2 57072 Siegen (DE)
Respondent: (Patent Proprietor)	DANIELI & C. OFFICINE MECCANICHE S.p.A. Via Nazionale, 41 33042 Buttrio (UD) (IT)
Representative:	Cinquantini, Bruno Notarbartolo & Gervasi S.p.A. Corso di Porta Vittoria, 9 20122 Milano (IT)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 14 November 2011 rejecting the opposition filed against European patent No. 1945383 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	G. Ashley
Members:	C. Donnelly
	E. Kossonakou

Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division rejecting the opposition against the European Patent No. EP-B-1 945 383.

The opponent (hereinafter: the "appellant") filed a notice and grounds of appeal against this decision in due form and time.

II. State of the art

In support of its case for revocation of the patent the appellant relied on the following documents:

D1: US 5 634 257;
D3: EP 0 286 862 B1;
D6: US 4 953 615;
D8: US 5 479 982;
D10: EP 0 743 116 A;
D11: EP 0 535 368 B1;

The appellant also cited:
D12: G. Flemming, P. Kappes, W. Rohde and L. Vogtmann,"Walzen von stranggegossenen Vorbändern - Anlagetechnische Konsequenzen für den Bau von Warmband-Produktionsanlagen", Fachbericht Stranggießund Walzanlagen, Sonderdruck aus Stahl und Eisen (Verlag Staheisen, Düsseldorf) 108 (1988), Nr. 3, Seite 5 bis 12 und letzte Seite.

III. During the oral proceedings before the board the respondent (patent proprietor) also referred for background information purposes to an extract of a company brochure from Universal Engineers detailing various types of rolls used in the continuous production

of hot rolled metal strips in rolling mills and an information sheet entitled "Reforming steel" by U. Huff (as attached to the minutes of the oral proceedings and numbered by the Board as D13).

IV. The board informed the parties of its provisional opinion in a communication dated 11 August 2015 pursuant to Articles 15(1) and 17(2) RPBA.

V. At the close of the debate in the oral proceedings held on 9 September 2015, the parties made the following requests:

The appellant requested that the decision under appeal be set aside and that the European patent No. 194583 be revoked.

The respondent requested that the appeal be dismissed.

VI. Both parties referred to the following feature analysis of independent method claim 1 as granted:

1. A continuous production process of hot rolled metal strips which includes
2. an ingot mould 15),
3. with a built-in crystallizer (15'),
4. a liquid core pre-rolling device (16), located near the exit section of the crystallizer (15'),
5. a first pinch roll (17),
6. a path deflecting and guiding device (18) which can be operated at least during predetermined periods of time,
7. a second pinch roll (22'),
8. a third pinch roll
9. and straightening device (22"),

10. heating devices and/or devices to keep the heat constant (50),
11. a descaling device (19)
12. and at least three rolling stands (20', 20", 20"'),
13. wherein the process comprises the following stages without intermediate interruptions:
a) casting of a thin slab exiting the crystallizer (15') at a speed of 4 - 16 m/min, with narrow sides between 15 and 50 mm and a core in which the steel is in a liquid state,
14. b) implementation of a soft reduction of the slab through said pre-rolling device (16) so as to obtain a completely solidified cast product with thickness between 15 and 40 mm,
15. c) formation on the cast product of a free curve (53) located between said first (17) and said second (22') pinch roll,
16. d) implementation of a descaling operation on the cast product by means of said descaling device (19),
17. e) implementation in succession of a plurality of rolling operations through said rolling stands (20', 20", 20"') on the cast product, thus eventually defining a strip with thickness between 0,8 and 12 mm.

Independent apparatus claim 17 as granted reads as follows:

"Continuous production plant of hot rolled metal strips which includes an ingot mould (15), with a built-in crystallizer (15') capable of producing a thin liquid core slab (between 15 - 50 mm), a liquid core pre-rolling device (16), located near the exit section of the crystallizer (15'), a first pinch roll (17), a second pinch roll (22'), a third pinch roll and straightening device (22"), heating devices and/or

devices to keep the heat constant (50), a descaling device (19) and at least three rolling stands (20', 20", 20'"), wherein, between said first (17) and second pinch roll (22'), there is a deflecting and guiding device (18) of the cast product which can be operated at least during predetermined periods of time, from a vertical path to a horizontal path, able to disengage the cast product under normal operating conditions so as to allow the formation of a free curve (53) of the cast product between said first (17) and second (22') pinch-roll."

VII. The arguments of the parties relevant to the decision can be summarised as follows:

a) Consideration of late filed documents D11 and D12

The respondent argued that D11 and D12 should not be admitted into the proceedings since they were filed for the first time with the grounds of appeal and are no more relevant than the documents already filed.

The appellant accepted that D12 had not been used in any detailed arguments and that D11 was no more relevant than D8.

b) Inventive step

Appellant's case

The appellant submitted that the subject-matter of claim 1 lacked an inventive step in view of the following combinations of documents:

(i) D1 and D8;

(ii) D8 and D1;

(iii) D8 with D6 and D3;
(iv) D1 and D10;

and that the subject-matter of claim 17 lacked an inventive step in view of a combination of:

(i) D8 and D1;
(ii) D1 and D6;
(iii) D1 and D10

In its view the term "pinch roll" covers a much broader range of rolls than the narrow interpretation suggested by the respondent. This is borne out by the fact that the material used to make the pinch rolls is the same as that used for the other types of rolls specified in D13. Thus, all of these rolls would function as a "pinch roll".

(i) D1 and D8

Bearing this in mind, and taking D1 as the most relevant prior art, the subject-matter of claim 1 only differs in that there is no explicit disclosure that the thin slab exiting the crystallizer has a core in which the steel is in a liquid state. Hence, there is no disclosure of the implementation of a soft reduction of the slab through a pre-rolling device so as to obtain a completely solidified cast product. Thus, only features 4, 13 and 14 are not disclosed in D1.

The objective technical problem can be seen to be one of improving the quality of strip produced by hot-rolling with a thickness from 0,8 to 12mm.

D8 discloses all the subject-matter of claim 1 except for features 11, 12 and 16. In particular, D8 discloses hot-rolled strip within this thickness range which is produced by a method in which there is soft reduction by pre-rollers 3a, 3b of a thin slab exiting the crystallizer with a liquid core (see D8, figure 1). Faced with the above problem it would be obvious for the skilled person to modify the process of D1 by implementing these features known from D8 and to obtain the subject-matter of claim 1 without exercising an inventive step.

(ii) D8 in combination with D1

As stated above, only features 11, 12 and 16 distinguish the subject-matter of claim 1 when taking D8 as the most promising starting point. The objective technical problem is to improve the quality of the hot-rolled strip. Faced with this problem the skilled person is given a hint in D8 itself at col. 4, lines 3 and 4 that a plurality of roll-stands may be provided. The provision of a descaling device is merely a conventional measure which the skilled person would apply in such hot-rolling operations as a matter of course.

(iii) D8 in combination with D6 and D3

D6 discloses a similar process to D8 in which a slab with a molten core exits the crystallizer (see figure 4 and col. 6, lines 31 to 36). Additionally, D6 discloses three roll-stands 7 (see figure 1) and, as stated above, the provision of a descaling device is merely a conventional measure which the skilled person would apply in such hot-rolling operations as a matter of course. Feature 6 is disclosed in D3 which also concerns

a casting method in which there is soft reduction of the strip by means of a pre-rolling device.

(iv) D1 in combination with D10

As laid out in (i), only features 4, 13 and 14 are not disclosed in D1.

Faced with the objective technical problem of improving the quality of strip produced by hot-rolling with a thickness from 0,8 to 12mm, the skilled person would also take into consideration D10, since it lies in exactly the same technical field. This document discloses a hot-rolled strip produced by a method in which there is soft reduction by pre-rollers 13, 14 (see fig. 2 and col. 4, lines 45 to 50) of a thin slab exiting the crystallizer with a liquid core.

Thus, the subject-matter of claim 1 does not involve an inventive step with respect to a combination of D1 with D10.

Respondent's case

The respondent submitted that pinch rolls were a fundamentally different group of rolls, which were primarily intended to direct and maintain tension in the strip rather than produce any reduction in its thickness. A key point in the invention is the realisation that suitably positioned pinch rolls produce a limited reduction in strip thickness. This contributes to an increase in strip quality by refining the grain structure before the main reduction is carried out in the much bigger rolling stands (see the patent, col. 4, line 52 to col. 5, line 11). Also, by so doing, the length of the installation can be shortened, since there

is no need for a roughing mill (as is the case in the prior art, see for example D1, fig. 1, ref. sign 7) and the strip can go straight to the finishing mill.

Furthermore, the formation of a free curve between the pinch rolls, after the crystallizer, decouples to a certain extent the casting process from the rolling process, since the strip is still very ductile at this point. Hence, the strip can rise and fall to compensate for variations in speed between the two sides.

Thus, the positioning of the pinch rolls is important, and cannot be dismissed as something the skilled person would do as a matter of routine.

The respondent argued that D1 does not disclose features 6, 7 ,8 and 15 in addition to features 4, 13 and 14 which the appellant accepts as not being disclosed. In its view the only pinch roll shown in D1 is that indicated by reference sign 15. The rolls indicated by the reference sign 2 could be rolls of another type, and those indicated by reference 3 are straightener rolls. Furthermore, roll 15 of D1 is positioned at the end of the rolling line, whereas the three pinch rolls of claim 1 are located after the liquid core pre-rolling device and before the first rolling stand.

In the method of D8 the liquid core squeezing rolls are located near the exit section of the crystallizer. Subsequently soft reduction is carried out by rolls 3a and 3b, and then the strand 5 is hard-rolled by stand 4a, 4b before becoming a freely guided arc and passing over guide rolls 6a, 6b. Thus, in D8 the hard rolling starts before the free curve and not after it. This means that the strand in the free curve has a different

structure and requires a specific control of the curve radius.

D6 discloses a casting plant with two moulds. The second mould is not a liquid core pre-rolling device. The skilled person faced with the problem of providing a compact plant able to produce high quality strips at high speeds would not consider combining selected elements from each of the plants disclosed in D6 or D8 without the benefit of hindsight. D10 fails to disclose a free curve situated between two sets of pinch rolls. As regards D3, the appellant has failed to explain how or why the skilled person would combine this document with D8 and D6.

Thus, a combination of either D1 with D8 or D10, or D8 with D1 or D6 and/or D3 respectively would not lead the skilled person, faced with the problem of shortening the length of the plant and improving the quality of the product, to the subject-matter of claim 1 without the need to exercise an inventive step.

c) Inventive step, Claim 17

Appellant's case

Similar arguments applied to the subject-matter of claim 17.

In particular D8 discloses:

Continuous production plant of hot rolled metal strips which includes an ingot mould (1), with a built-in crystallizer capable of producing a thin liquid core slab between 15 and 50 mm (see col. 4, lines 7 to 9), a liquid core pre-rolling device (3a, 3b), located near

the exit section of the crystallizer, a first pinch roll (4a, 4b), a second pinch roll (8a, 8b), a third pinch roll and straightening device (6a, 6b), heating devices and/or devices to keep the heat constant (7).

A deflecting and guiding device of the cast product which can be operated at least during predetermined periods of time, from a vertical path to a horizontal path, able to disengage the cast product under normal operating conditions, so as to allow the formation of a free curve of the cast product between said first and second pinch-roll, is implicitly disclosed since the strip must be fed into the third pinch roll 6a, 6b at least at the start of the process.

The employment of a descaling device and at least three rolling stands is conventional practice in the art and are shown for example in D1.

Thus, the subject-matter of claim 17 does not involve an inventive step in view of D8 in combination with D1.

A deflecting and guiding device for forming a free curve is also known from D6 (see "straightening ram" 9) and through the device 17a disclosed in D10. Thus, the subject-matter of claim 17 also does not involve an inventive step with respect to D1 in combination with D6 or D10.

Respondent's case

The subject-matter of claim 17 also involves an inventive step, since it comprises the equivalent feature to that of claim 1, in that it is designed to

allow the formation of a free curve of the cast product between the first and second pinch-rolls positioned after the crystallizer. As explained above this contributes to reducing the length of the installation since the roughing mill may be dispensed with.

Reasons for the Decision

1. Documents D11 and D12

Documents D11 and D12 were filed for the first time with the grounds of appeal. The appellant accepted that the disclosure of D11 is no more relevant than that of D8 and has been used in a similar manner, namely in combination with D1 to attack inventive step. The appellant has not referred to D12 in any of its detailed arguments concerning inventive step. Its relevance is not immediately apparent to the board. Consequently, these documents are not considered further in these appeal proceedings.

2. Inventive step

2.1 In the board's view, the skilled person would see D8 as the most promising starting point, since it discloses a continuous production process for producing hot rolled metal strips of similar thickness at the same production speeds using a soft reduction technique.

D1 is not so relevant as D8 since, as pointed out by the opposition division in its decision (see section 2.3.1), it fails to describe in detail the type of rolls employed on either side of the free curve. Also, it is not clear from the disclosure of D1 whether any soft reduction takes place, since neither an indication of a molten core nor a description of the strip processing

immediately after it leaves the continuous casting machine is given.

2.2 It is important to establish what exactly is meant by the term "pinch roll" within the context of the patent, since the parties had widely differing opinions on this matter. The board considers that pinch rolls are used to provide and maintain the tension of a strip mill product, which is necessary to ensure its correct passage through the plant. As the name suggests, pinch rolls must exert a limited compression force (i.e. "pinch") on the strip in order to be able to produce the required traction.

Whilst pinch-rolls are not primarily intended to produce any reduction in strip thickness, the board accepts the respondent's argument that a limited thickness reduction can be expected on solidified, but still very hot products, even with the low compression forces produced by such rolls.

Roll-stands that are specifically intended to produce large reductions in the strip thickness are fundamentally different both in size and in the forces they bring to bear upon the strip. In particular, pinch-rolls do not require back-up rolls or to be placed in a sturdy frame in order to carry out their main function. These differences can be clearly seen in the figures of the patent when comparing the pinch-rolls 17, 22' with the rolling stands 20', 20'', 20'''.

The appellant argues that according to D13 the same materials are used to make pinch rolls and other types of rolls. Hence, different types of rolls may be considered as carrying out the function of a pinch roll. However, this argument is not persuasive, as D13

describes distinct classes of rolls including pinch rolls, work rolls, straightener rolls, leveler rolls and intermediate rolls. Of these, only the material specification of the intermediate rolls overlaps with that given for pinch roll manufacture. Further, roll properties are determined by more than just the material, since roll geometry, size and support system also play a crucial role.

In D8, the strip follows a curved path between the rolls 4a, 4b and 6a, 6b. Rolls 6a, 6b are described at col. 4, line 2 of D8 as "guide rolls", and are not immediately identifiable as belonging to the category of pinch rolls, since it is not clear whether they provide any tractive force. Rolls 4a, 4b are described as a "roll stand" and are used to produce a degree of deformation of at least 20% (see col. 4, lines 11 to 13). Clearly these rolls are also not pinch rolls since their function is to provide a large amount of reduction and working of the strip before it enters the curve. Also, the curve between the rolls 4a, 4b and 6a, 6b in D8 is not strictly speaking a "free curve" since a check is made on whether the strip 5 is running askew and a correction performed by a control unit 9 acting on the the rolls 3a, 3b feeding the rolls 4a, 4b (see D8, col. 4, lines 13 to 25). Hence, the velocities are connected at each side of the curve.

2.3 In view of this the board considers D8 to disclose the following features of claim 1:

A continuous production process of hot rolled metal strips which includes
2. an ingot mould (1),
3. with a built-in crystallizer (inherently present),

4. a liquid core pre-rolling device (3a, 3b), located near
the exit section of the crystallizer,
10. heating devices and/or devices (7) to keep the heat constant,
13. wherein the process comprises the following stages without intermediate interruptions:
a) casting of a thin slab exiting the crystallizer at a speed of 2 to 20m/min (cf. claimed 4 to 16 m/min, see col. 4, lines 7 to 9), with narrow sides between 40 to 50mm (cf. claimed 15 to 50 mm, see col. 4, lines 7 to 9) and a core (2c) in which the steel is in a liquid state,
14. b) implementation of a soft reduction of the slab through said pre-rolling device (3a, 3b) so as to obtain a completely solidified cast product with thickness between 15 and 40 mm,
15. c) formation on the cast product of a curve (R1, R2, see col. 4, lines 1 to 2);

The subject-matter of claim 1 differs therefrom in that the process includes:

5. a first pinch roll;
6. a path deflecting and guiding device which can be operated at least during predetermined periods of time,
7. a second pinch roll (22')
8. a third pinch roll
9. and straightening device (22"),
11. a descaling device (19)
12. and at least three rolling stands (20', 20", 20"')

for carrying out the following stages:

(c) - formation on the cast product of a free curve located between first and said second pinch rolls,

(d) - a descaling operation on the cast product by means of the descaling device, and

(e) - a succession of a plurality of rolling operations through the rolling stands on the cast product, thus eventually defining a strip with thickness between 0,8 and 12mm.

2.4 The board agrees with the appellant that the presence of a descaling device and the execution of descaling operations is conventional in such installations and processes. The provision of three rolling stands is also considered to be a standard measure which would fall into the category of "further processing" mentioned at col. 2 lines 18 to 19 of D8. Continuous production plants for processing hot rolled metal strips employing three rolling stands are also shown for example in D1 and D6. Further, although D8 does not explicitly disclose a path deflecting and guiding device, it can be assumed that some kind of device must have been used to guide and provide the initial deflection of the strip to form the curve.

2.5 Thus, the critical difference between the subject-matter of claim 1 and that of D8 lies in the formation on the cast product of a free curve located between first and second pinch rolls.

The formation on the cast product of a free curve after the ingot mould and before the rolling stands will to some extent decouple the casting and rolling sides of the process, thus increasing flexibility. In particular, this means that the control system can be simplified since the speeds of the pinch rolls do not need to be exactly matched. The board also accepts the respondent's argument that since the free curve is located between first and second pinch rolls, a limited thickness

reduction of the strip can be obtained with different metallurgical effects. This applies primarily to the pinch-roll located at the vertical end of the curve where the strip is still very hot and therefore ductile and workable. It can also be accepted that this could plausibly lead to an improvement in the quality of the product by closing interdendritic paths between the grains by compacting the structure and preventing precipitation of aluminium compounds on the grain boundary (see the patent, col. 4, line 52 to col. 5, line 11).

2.6 Thus, the objective technical problem to be solved can be seen as one of improving the quality of the strip product and maintaining a compact installation.

The skilled person faced with this problem would not find a suggestion towards this solution in any of the documents D1, D3, D6 or D10.

The plant of D6 comprises two moulds. The second mould 3 (see figures 1 and 4) cannot be construed as a liquid core pre-rolling device since the rollers 36 are primarily intended to reduce friction between the beams 33 and the strand S_5 moving through the mould. A type of soft reduction, in which the shell portions are forced against each other and joined by a pressure weld, is carried out by the squeeze roll set 5 (see col. 6, lines 37 to 42). Thus, the roll set 5 is not a pinch roll. There is also no free curve as such in the installation of D6, since the strip is shown in figure 1 as being supported by rolls between the squeeze rolls 5 and the guiding and backing rolls 6 (see figure 1) before passing over further supporting rolls on its passage to the roll stands 7.

As already discussed, in the various embodiments of the plant shown in D1, the rolls are not clearly identified and it is left open to speculation to determine what the function of each might be.

D10 is primarily concerned with an arrangement for adjusting the position of the kissing point during the continuous casting operation to improve product quality (see col. 3, lines 31 to 35 and col. 3, line 54 to col. 4, line 2) and does not disclose a free curve. In the embodiment shown in figure 2, the strip leaving the casting machine 10a is largely supported along the curve from the vertical to horizontal by the extraction assembly 15 (see col. 5, lines 16 to 20) and the drawing assembly 16 (see col. 5, lines 48 to 50). In the embodiment shown in figure 3, for the strip leaving the casting machine 10b it is disclosed that a plurality of containing and guiding assemblies 13b "accompany the slab 18 along the whole arc of the circumference travelled to reach the horizontal position." (see column 5, lines 52 to 55). Hence, D10 teaches away from the formation of a free curve.

D3 also does not disclose a free curve between two pinch rolls, since the strip is fully supported by the guide roll device 6 over the whole length of the transition from vertical to horizontal (see figure 1). Further, the rolling operations in D3 are of a different type, since cooling of the strip is carried out immediately after it leaves the ingot mould 2 and the major part of the reduction is made at the rolls 5 before the curve (see col. 6, lines 11 to 18).

Hence, none of the documents D1, D3, D6 or D10 suggest such an arrangement of pinch rolls and a free curve as

claim 1, nor would it be obvious on the basis of general knowledge alone.

Consequently, the subject-matter of claim 1 is considered to involve an inventive step.

2.7 Similar considerations also apply to the subject-matter of claim 17 which is designed to allow the formation of a free curve of the cast product between first and second pinch-rolls.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Spira G. Ashley

Decision electronically authenticated