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**Datasheet for the decision  
of 13 June 2017**

**Case Number:** T 0855/13 - 3.2.03

**Application Number:** 05732302.4

**Publication Number:** 1868748

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

**Language of the proceedings:** EN

**Title of invention:**

PROCESS AND SYSTEM FOR MANUFACTURING METAL STRIPS AND SHEETS  
WITHOUT SOLUTION OF CONTINUITY BETWEEN CONTINUOUS CASTING AND  
ROLLING

**Patent Proprietor:**

ARVEDI, Giovanni

**Opponent:**

SMS group GmbH

**Headword:**

**Relevant legal provisions:**

EPC Art. 100(a), 56, 100(b)

**Keyword:**

Inventive step - main request (yes)  
Ground for opposition under Article 100(b) EPC - not admitted  
in the appeal proceedings

**Decisions cited:**

G 0010/91

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
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Case Number: T 0855/13 - 3.2.03

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.03**  
**of 13 June 2017**

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**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office posted on 11 February 2013 rejecting the opposition filed against European patent No. 1868748 pursuant to Article 101(2) EPC.**

**Composition of the Board:**

**Chairman** G. Ashley  
**Members:** V. Bouyssy  
Y. Podbielski

## **Summary of Facts and Submissions**

- I. European patent No 1 868 748 (in the following: "the patent") concerns a process and a plant for the manufacture of steel strips or sheets, without interruption between continuous casting and rolling.
- II. The patent as a whole was opposed on the sole ground of lack of inventive step (Article 100(a) EPC).
- III. The opposition division decided to reject the opposition.
- IV. This decision was appealed by the opponent (in the following, "appellant").
- V. With the summons to oral proceedings, the Board sent a communication pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA) indicating its preliminary opinion of the case.
- VI. Oral proceedings before the Board were held on 13 June 2017.
- VII. Requests

The appellant requested that the decision under appeal be set aside and the patent be revoked.

The patent proprietor (in the following, "respondent") requested that the appeal be dismissed (main request), alternatively that the decision under appeal be set aside and the patent be maintained on the basis of one of the first to eighteenth auxiliary requests filed with letter dated 18 December 2013.

VIII. Claims of the main request

Independent method claim 1 is directed to the following subject-matter (the feature numbering is introduced by the Board for ease of reference):

- (a) A process for manufacturing metal strips of thickness in the range between 0.14 and 20 mm and metal sheets of thickness in the range between 10 and 100 mm
  - (b) from slabs having thickness comprised between 30 and 300 mm and width comprised between 600 and 4000 mm obtained through continuous casting,
  - (c) with a high quantity of material or mass flow passing in the time unit at the outlet thereof,
  - (d) wherein the continuous casting (10) is bow-shaped from a mould and
  - (e) directly connected with a rolling step (11) in a single manufacturing step without solution of continuity,
- characterised by
- (f) providing a thickness reduction, increasing step by step from its beginning in the mould and continuing in the single step of casting and rolling,
  - (g) as well as a secondary cooling for obtaining at the outlet of the continuous casting a slab with an inverted temperature gradient in its cross-section,
  - (h) with an average surface temperature of the slab  $< 1150\text{ }^{\circ}\text{C}$  and an average temperature at the core  $> 1350\text{ }^{\circ}\text{C}$ ,
  - (i) an induction heating (12) between casting and rolling,
  - (j) a cutting and withdrawal (14') of the sheets (20), upon controlled cooling, in alternative to the coil winding (15) of the rolled strip,

- (k) as well as providing a speed regulation system in cascade in the downstream direction starting from the continuous casting,
- (l) wherein said feeding speed of the casting at the rolling end is step by step increasing in correspondence with the thickness reduction of the desired end product,
- (m) with the distance between casting and rolling being the least one admissible by the process.

Independent claim 4 for a plant reads as follows:

"4. A plant for manufacturing metal strips with thickness in the range between 0.14 and 20 mm and metal sheets with thickness in the range between 10 and 100 mm from a continuous casting comprised of mould and subsequent bow caster with means for liquid core reduction starting from slabs (1) of thickness between 30 and 300 mm and width between 600 and 4000 mm, characterized in that said mould has a ratio  $\geq 1.1$  between its surface  $S_M$  at the meniscus, subtracted the area  $S_T$  interested by the submerged nozzle, and the cross-section area  $S_b$  of the slab (1) at the outlet of continuous casting, there being provided a secondary cooling system for obtaining at the outlet of continuous casting a slab having an inverted temperature gradient and a cross-section with an average surface temperature of the slab  $< 1150^\circ\text{C}$  and with an average core temperature  $> 1350^\circ\text{C}$  as well as a finishing mill (11) directly connected with the continuous casting at a maximum distance of 50 m, further comprising an induction heating furnace (12) between the continuous casting outlet and the rolling-mill (11) and at the outlet of the latter, either a cutting device (14) of coils, wound on an end reel (15), after a final cooling system (13), or a cutting

device (14') for the withdrawal of sheets (10) also cooled by said cooling system (13)."

IX. Prior art

In the statement setting out the grounds of appeal, and in the reply to it, the parties relied among others on the following prior art documents which were filed in the opposition proceedings and are cited in the decision under appeal:

D1: WO 2004/026497 A1

D2: EP 0 013 539 A1

X. The arguments of the parties, insofar as relevant for the present decision, can be summarised as follows:

(a) Main request - Inventive step

Appellant's case:

The opposition division's decision that the subject-matter of method claim 1 involved an inventive step starting from D1, was based on a wrong assessment of the teaching of D1 and of common general knowledge in the field of continuous casting.

As acknowledged by the opposition division, D1 discloses all the features of claim 1, with the exception of features (i) and (k). In particular, feature (f) is implicitly disclosed in D1 because, as is generally known in the field of continuous casting, the mould must be funnel-shaped to compensate for the natural shrinkage of the slab upon casting. Further, the two alternatives defined in feature (j) are anticipated by the teaching of D1 because it discloses

the step of coil winding of the rolled strip (see coiling stations 19 and 20 in figure 1b) as well as the alternative steps of cutting and removing plate-shaped sheets after rolling (see shearing device 10 and transverse transportation device 11 in figure 1a), upon controlled cooling (by means of tiltable cover 12), in case of a breakdown in the finishing mill 18 (see figure 1b).

With respect to distinguishing feature (i), D1 already discloses the step of heating the strip, between casting and rolling, with a compensation furnace, preferably a continuous roller furnace (see paragraph bridging pages 6 and 7 of D1). The replacement of this compensation furnace by an induction furnace would be an obvious modification, in particular because it is generally known in the art as being more compact and energy-efficient. Contrary to the respondent's view, it does not follow from the wording of claim 1 that the induction heating of feature (i) is aimed at maintaining the inverted temperature gradient defined in features (g) and (h) until the rolling starts. In practice, this effect may or may not be achieved, depending on parameters of the induction heating such as frequency and penetration depth.

With respect to distinguishing feature (k), D2 discloses a continuous casting and rolling plant similar to that of D1, and comprises a system for controlling the speed of the casting machine and of a downstream rolling stand, wherein the speed of the rolling stand is controlled on the basis of the cast strip's temperature between casting and rolling. This renders feature (k) obvious. Contrary to the respondent's view, claim 1 does not exclude that the casting speed varies while the speed of the rolling



stand is controlled in the downstream direction, as is the case in D1.

In the event that the Board decides that D1 fails to disclose that the reduction of the slab thickness begins in the mould, as is required by feature (f), this would be an obvious modification falling within the realm of routine design. The mould of D1 is implicitly funnel-shaped to compensate for slab shrinkage. Casting moulds are typically at least 900 mm long, which in light of the aim of reducing the plant length, would encourage a thickness reduction taking place already in the mould.

In conclusion, the subject-matter of method claim 1 lacks an inventive step in light of D1 and D2.

The same arguments apply, *mutatis mutandis*, to the subject-matter of independent claim 4 for a plant.

Respondent's case:

In addition to features (i) and (k) of claim 1, D1 also fails to disclose features (a), (b), (f) and (j), for the following reasons.

The ranges for the slab thickness (70 to 100 mm), the slab width (800 to 1200 mm) and the strip thickness (0.4 to 12 mm) as disclosed in D1 do not anticipate the broader ranges defined in features (a) and (b).

With respect to feature (f), D1 does not disclose that the thickness reduction begins in the mould 2, but rather downstream of it, in the roller table 3 (page 3, lines 10 to 12 and page 18, lines 7 to 9). Even though it was common practice at the filing date of the patent

(7 April 2005) to use a funnel-shaped casting mould to compensate for natural slab shrinkage, it cannot be derived from D1 that the mould 2 is shaped for actively reducing the slab thickness beyond normal shrinkage compensation.

Feature (j) defines two alternatives, namely the cutting and withdrawal of finished sheets and the coil winding of a rolled strip, whereby the user can freely choose between the two alternatives, depending on the required end product. Although D1 discloses the steps of cutting and removing sheets (page 7, lines 12 to 15), this is only an emergency measure taken in the event of a breakdown of the finishing mill 18, and is not a normal processing step in the production of finished sheets. The sheets thus obtained are of low quality, being twisted and bent since they have not passed the finishing mill 18, and hence are not finished. Further, D1 fails to disclose the steps of cutting and removing sheets "upon controlled cooling". Although the tiltable cover 12 is designed to insulate the sheets and limit temperature losses, it does not actively cool the sheets by water jetting, as is the case in the invention.

The claimed invention takes advantage of the inverted temperature gradient of the slab resulting from casting and maintains it by induction heating until rolling begins, as is required by feature (i). This is clear from the wording of features (g) to (i) and is confirmed by the teaching in paragraphs 10 and 22 of the patent specification. D1 does not disclose that the slab is heated, let alone induction heated, between casting and rolling in order to maintain the inverted temperature gradient. In contrast, D1 teaches that the distance between the casting machine 1 and the roughing

mill 5 is preferably short, e.g. between 0.5 and 4 m, whereby the slab is fed directly from the casting machine 1 to the roughing mill 5, without being reheated (page 6, lines 8 to 18). On the other hand, it is mentioned in the paragraph bridging pages 6 and 7 of D1 that, in prior art plants with a larger distance of up to 350 m between casting machine and roughing mill, a compensation furnace is used to homogenise the temperature throughout the thickness of the cast slab, and hence suppress the inverted temperature gradient.

Starting from D1, the technical problem solved by all distinguishing features is how to improve the properties of the end product, while saving energy and maintaining a compact lay-out of the plant (paragraph 11 of the patent specification).

The claimed solution to this problem is neither part of common general knowledge of the skilled person, nor is it disclosed or suggested in D2.

With respect to feature (f), the appellant has provided no evidence supporting its allegation that it was a standard design option to reduce the slab thickness in the mould itself, beyond normal shrinkage compensation.

With respect to feature (i), as explained above, D1 teaches away from heating the slab between casting and rolling to maintain the desired inverted temperature gradient defined in features (g) and (h).

D2 cannot direct the skilled person towards feature (k) for the following reasons. This feature must be construed in the sense that the casting speed is preset and the possible speed corrections have effect on the speed parameters of the downstream rolling stands. D2

discloses a plant comprising a continuous strip casting machine and a rolling mill, wherein the speed of the cast strip between casting and rolling is detected and used to control the motor driving the casting machine, thus permitting operation of the plant without any strip loop (page 5, lines 13 to 21 and claim 1). The skilled person would not consider the teaching of D2 because it concerns a different kind of plant than that disclosed in D1. Moreover, even if he were to consider the teaching of D2, it could not lead him to a speed control system in cascade in the downstream direction, as is required by feature (k), since D2 only discloses a conventional speed control system in cascade in the upstream direction. As shown in the drawing of D2, a speed measuring device 6 is used to control the speed of the casting machine 3 on the basis of the cast strip's speed between casting machine 3 and rolling mill 7. A temperature measuring device 5 is used to control the motor 10 driving the rolling mill 7 on the basis of the cast strip's temperature between casting machine 3 and rolling mill 7, to maintain the temperature within narrow limits (page 8, lines 22 to 36). This eventually also results in an upstream control of the casting speed (page 7, lines 7 to 13).

The subject-matter of claim 1 thus involves an inventive step.

The same arguments apply to claim 4 for a plant. In addition, the appellant has failed to address the specific features of claim 4 that the mould "has a ratio  $\geq 1.1$  between its surface  $S_M$  at the meniscus, subtracted the area  $S_T$  interested by the submerged nozzle, and the cross-section area  $S_b$  of the slab (1) at the outlet of continuous casting" and that "a

finishing mill [is] directly connected with the continuous casting at a maximum distance of 50 m".

(b) Main request - Insufficient disclosure

Appellant's case:

The feature of claim 1 that the slab thickness is actively and purposively reduced in the casting mould itself (see feature (f)) is insufficiently disclosed within the meaning of Articles 100(b) and 83 EPC for the invention to be carried out by the skilled person.

Respondent's case:

The ground of lack of sufficiency constitutes a fresh ground of opposition in the appeal proceedings. Since the patent proprietor does not approve the discussion of this ground, it cannot be considered in the appeal proceedings, pursuant to G 10/91.

**Reasons for the Decision**

1. Claim 1 of main request - Inventive step
  - 1.1 The Board shares the view of the parties and the opposition division that the process for the manufacture of steel strips as disclosed in D1 is the most promising starting point for the assessment of inventive step.
  - 1.2 The parties agree that D1 fails to disclose feature (i) and (k) of claim 1 but they dispute whether it discloses features (a), (b), (f) and (j) of the claim.

- 1.3 The Board takes the view that features (a), (b) and (j) cannot distinguish the claimed process from that disclosed in D1, and this for the following reasons.
  - 1.3.1 The ranges for the thickness of the strip, on the one hand, and for the thickness and width of the slab, on the other hand, as defined in features (a) and (b) cannot be seen as novel over D1 because it discloses values for the slab thickness (70 and 100 mm), the slab width (800 and 1200 mm) and the strip thickness (0.4 and 12 mm), all of which fall within the claimed ranges.
  - 1.3.2 Feature (j) defines alternatives, namely the cutting, withdrawing and cooling of sheets, on the one hand, and the coil winding of the rolled strip, on the other hand, whereby the choice between the alternatives is left open. D1 discloses at least the second alternative of coil winding of the rolled strip (see coiling stations 19 and 20 in figure 1b). This takes away the novelty of feature (j).
- 1.4 However, the Board shares the respondent's view that feature (f) is not disclosed in D1. It is common ground that the casting mould of D1 is implicitly funnel-shaped to compensate for the natural shrinkage of the cast slab. When reading feature (f) in context, it is apparent that it defines the step of actively and purposively reducing the slab thickness in the mould itself, and that this step goes beyond the compensation of the natural process of slab shrinkage. This understanding is confirmed by the teaching in the patent specification (see paragraphs 17 to 19 and figures 2 and 3). Contrary to the appellant's view, D1 does not disclose unambiguously such a thickness reduction in the mould. Instead, the reduction of the

slab thickness begins only downstream of the mould 2, in the roller table 3 (see page 3, lines 7 to 12 and page 18, lines 7 to 9 of D1).

- 1.5 The Board thus comes to the conclusion that the process defined in claim 1 differs from that disclosed in D1 in that it comprises the steps of providing
- f) "a thickness reduction ... beginning in the mould",
  - i) "an induction heating between casting and rolling", and
  - k) "a speed regulation system in cascade in the downstream direction starting from the continuous casting".
- 1.6 Starting from D1, the technical problem objectively solved by these distinguishing features is how to improve the properties of the end product, while saving energy and maintaining a compact lay-out of the plant (see paragraph 11 of the patent specification).
- 1.7 The Board agrees with the appellant that the skilled person seeking to solve this problem would arrive at features (i) and (k) in an obvious manner:
- 1.7.1 With respect to feature (i), D1 already teaches the step of heating the strip between the casting machine and the first rolling stand with a compensation furnace, preferably a continuous roller furnace (see the paragraph bridging pages 6 and 7 of D1). As argued by the appellant, for the skilled person seeking to solve the above problem, the replacement of this furnace by an induction furnace would be an obvious modification, in particular because such a furnace is generally known in the art as being more compact and energy-efficient. In doing so he would arrive at feature (i) in an obvious manner.

Contrary to the respondent's view, it cannot be derived from the wording of claim 1 that the step of induction heating in feature (i) maintains the inverted temperature gradient defined in features (g) and (h) until the rolling starts. It is explained in paragraphs 10 and 22 of the patent specification that induction heating is used to achieve this effect, but there is no reason to read this limitation into feature (i) of the claim, since it alone imparts a clear and technically sound teaching. In practice, the inverted temperature gradient of the cast slab may or may not be maintained by induction heating, depending on induction frequency and penetration depth.

- 1.7.2 In the context of claim 1, feature (k) can be construed broadly. It does not exclude that the casting speed varies while the speed is controlled in the downstream direction, as is disclosed in D2. It is explained in paragraph 32 of the patent specification that the casting speed is preset and the possible speed corrections have effect on the speed parameters of the rolling stands, but there is no reason to give feature (k) of claim 1 this narrower meaning.

D2 discloses that, to improve the properties of the end product, a continuous casting and rolling plant comprises a system for controlling the speed of the casting machine (3) and that of the first rolling stand (7), wherein the temperature measured between casting machine and rolling stand (device 5) is used to control the speed of the rolling stand (through motor 10). Hence D2 discloses a speed regulation system in the downstream direction starting from the casting. The skilled person would see the advantages of this teaching and would have no practical difficulties in



implementing such a speed regulation system in the process disclosed in D1 to control the speed of the downstream rolling stands. By doing so he would arrive at feature (k) in an obvious manner.

1.8 On the other hand, the Board is not persuaded by the appellant's argument that distinguishing feature (f) is obvious. In fact, no evidence has been provided to support the assertion that, when seeking to shorten the length of the plant of D1, the skilled person would inevitably modify the shape of the casting mould disclosed in D1 to reduce the slab thickness in the mould itself. The mere fact that a casting mould as used in D1 typically is at least 900 mm long does not inevitably imply that this modification is obvious when seeking to render the plant more compact. D1 already suggests another solution to the problem of plant compactness: it teaches that the distance between casting machine and first rolling stand can be shortened down to 4 m or less, by directly feeding the cast slab to the first rolling stand without re-heating it (page 6, lines 8 to 18). For the skilled person it would be straightforward to apply this teaching to obtain a more compact plant. In so doing he would not arrive at feature (f).

1.9 In conclusion, when starting from D1, the subject-matter of claim 1 involves an inventive step in the sense of Article 56 EPC.

2. Claim 4 of main request - Inventive step

2.1 The above reasoning applies to independent claim 4 for a plant, even though it does not require that a speed regulation system be present, contrary to claim 1.

- 2.2 In its communication pursuant to Article 15(1) RPBA the Board stressed that, as argued by the respondent, there is no indication where the cited prior art discloses the features of claim 4 that the mould "has a ratio  $\geq 1.1$  between its surface  $S_M$  at the meniscus, subtracted the area  $S_T$  interested by the submerged nozzle, and the cross-section area  $S_b$  of the slab (1) at the outlet of continuous casting" and that "a finishing mill [is] directly connected with the continuous casting at a maximum distance of 50 m". In response the appellant neither commented nor disputed this argument. The Board remains of the view that there is no disclosure in the cited prior art for these two features.
3. The Board thus shares the opposition division's view that the opposition ground of lack of inventive step does not prejudice the maintenance of the patent unamended.
4. Admissibility of the ground of lack of sufficient disclosure
- 4.1 In the oral proceedings before the Board, the appellant contended that feature (f) of claim 1 as granted is insufficiently disclosed for the invention to be carried out by the skilled person, contrary to Articles 100(b) and 83 EPC.
- 4.2 The ground of lack of sufficient disclosure is a fresh ground for opposition which cannot be considered in the appeal proceedings, without the approval of the respondent as patent proprietor (see G 10/91, OJ EPO 1993, 420, point 18 of the Reasons). Since this was not given, the issue of insufficient disclosure has not been considered.

5. In light of the above conclusions there is no need to consider the auxiliary requests of the respondent.

## Order

### For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



C. Spira

G. Ashley

Decision electronically authenticated