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Datasheet for the decision of 1 July 2020

Case Number:	T 1436/17 - 3.3.05
Application Number:	11772882.4
Publication Number:	2627790
IPC:	C21D8/00, C21D8/02, C22C38/22, C22C38/28, C22C38/38, C22C38/02, C22C38/04, C22C38/12, C22C38/14, C21D1/673, C21D9/48, C21D9/46
Language of the proceedings:	EN

Title of invention:
METHOD OF HOT FORMING A STEEL BLANK AND THE HOT FORMED PART

Patent Proprietor:
Tata Steel IJmuiden B.V.

Opponent:
ArcelorMittal

Headword:
Hot formed steel part/Tata

Relevant legal provisions:
RPBA 2020 Art. 13(1)
EPC Art. 83

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It can be changed at any time and without notic

Keyword:
Late-filed request - admitted (yes)
Late-filed evidence - admitted (yes)
Sufficiency of disclosure - (no)
Late-filed auxiliary requests - admitted (no)

Decisions cited:
T 0409/91, T 0435/91, T 1110/03

Catchword:

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Case Number: T 1436/17 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 1 July 2020

Appellant: (Opponent)	ArcelorMittal 24-26, Boulevard d'Avranches 1160 Luxembourg (LU)
Representative:	Lavoix 2, place d'Estienne d'Orves 75441 Paris Cedex 09 (FR)
Respondent: (Patent Proprietor)	Tata Steel IJmuiden B.V. Wenckebachstraat1 NL-1951 JZ VELSEN-NOORD (NL)
Representative:	Müller Schupfner & Partner Patent- und Rechtsanwaltspartnerschaft mbB Bavariaring 11 80336 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 24 April 2017 concerning maintenance of the European Patent No. 2627790 in amended form.**

Composition of the Board:

Chairman	E. Bendl
Members:	G. Glod
	O. Loizou

Summary of Facts and Submissions

I. The appeal lodged by the opponent (the appellant) lies from the opposition division's decision finding that the amended European patent EP-B-2 627 790 on the basis of the request of 30 March 2017 met the requirements of the EPC.

II. The following document cited in the impugned decision is of relevance here:

D2: H-B Ryu et al., Metallurgical and Materials Transactions A, vol. 33A, September 2002, pages 2811-2816

III. With the statement of grounds of appeal the appellant submitted the following document:

D7: S. Chen et al., Metallurgical and Materials Transactions A, vol. 45A, April 2014, pages 2209-2218

IV. In reply to the board's communication under Article 15(1) RPBA 2007 of 16 March 2020, the patent proprietor (respondent) submitted, among other requests, a second, fourth, sixth, eighth and tenth auxiliary request. Ultimately, these became the main request and first, second, third and fourth auxiliary requests at the oral proceedings on 1 July 2020.

The relevant claims of the now main request read as follows:

"*1. Method of hot forming a steel blank into an article, the method comprising the following steps:*

a) heating the steel blank to an austenitizing temperature T1 above Ac3, preferably in the range of Ac3 + 20°C - Ac3 + 60°C, preferably at a heating rate of 10 - 25°C/s;
b) soaking the steel blank in said range, preferably during a soaking time of 1-5 minutes;
c) transferring the heated and soaked blank to a hot forming press;
d) cooling the heated and soaked steel blank to form an article during hot forming, starting at a starting temperature T2 above Ar3 to an interrupt temperature T3 in the range of 400 - 550°C at a cooling rate V2 of at least 25°C/s, wherein the blank has the following composition in weight %:
C: 0.15-0.45
Si: 0.6-2.5
Mn: 1.0-3.0
Al: 0-1.5
Mo: 0-0.5
Cr: 0-1.0
P: 0.001-0.05
S: < 0.03
Ca: <0 .003
Ti: < 0.1
V: < 0.1
the balance being Fe and inevitable impurities, wherein Si + Al = 1.2 - 2.5%;
e) without holding the blank for a predetermined time at a temperature of T3 immediately further cooling the article from the interrupt temperature T3 to ambient temperature at a cooling rate V3 of 0.2 - 10°C/s, wherein the interrupt temperature T3 and cooling rate V3 are selected using the relation that the higher T3 is the lower V3 is, such that the article thus obtained has a multiphase microstructure comprising by volume fraction:

55 - 90% of bainitic ferrite
5 - 15% of retained austenite
5 - 30% martensite."

"*10. Steel article hot formed according to the method of any one of the preceding claims, wherein the steel has a microstructure comprising by volume fraction:*
55 - 90% of bainitic ferrite
5 - 15% of retained austenite
5 - 30% martensite, and
wherein the steel article has the following composition in weight %:
C: 0.15-0.45
Si: 0.6-2.5
Mn: 1.0-3.0
Al: 0-1.5
Mo: 0-0.5
Cr: 0-1.0
P: 0.001-0.05
S: < 0.03
Ca: < 0.003
Ti: < 0.1
V: < 0.1
the balance being Fe and inevitable impurities,
wherein Si + Al = 1.2 - 2.5%, and wherein the steel has an Ultimate Tensile Strength of at least 1400 MPa, advantageously at least 1500 MPa, preferably at least 1600 MPa, more preferably at least 1700 MPa and a total elongation of at least 8%, preferably at least 10%, more preferably at least 12%, most preferably at least 14%."

Claim 1 of the first auxiliary request contained the following amendments (highlighting by the board):

"*1. Method of hot forming a steel blank being produced from a cold rolled steel sheet into an article, the method comprising the following steps: [...].*"

Claim 1 of the second auxiliary request additionally contained the following amendment:

" *1. Method [...]*
c) transferring within less than 10 seconds the heated and soaked blank to a hot forming press; [...]."

Claim 1 of the third auxiliary request additionally contained the following amendment:

" *1. Method [...]*
a) heating the steel blank having a thickness of 1 to 2 mm to an austenitizing temperature T1 [...]."

In claim 1 of the fourth auxiliary request the preferred features of steps a) and b) additionally became mandatory.

V. The appellant's relevant arguments can be summarised as follows:

The main request should not be admitted into the proceedings since it could and should have been filed much earlier. It gave rise to new objections, in particular regarding the sufficiency of disclosure of claim 10 in view of D7.

There was insufficient disclosure for several reasons. The examples did not correlate with the claim since they did not include a deformation step. A comparison between the different alloys with respect to cooling was not possible in view of their different

compositions. D2 showed the impact of deformation on retained austenite. Claim 1 did not require simultaneous cooling and hot press forming. The relationship between T3 and V3 in claim 1 was comprehensible and clear, but had to be disregarded in order to rework the invention. D7 showed that the claimed microstructure was not sufficient to obtain the desired properties in claim 10. Undue burden was required to obtain said properties.

The first to fourth auxiliary requests did not overcome the problem of sufficiency and led to an additional problem under Article 123(2) EPC; they should not be admitted.

VI. The respondent's arguments relevant to the present decision can be summarised as follows:

D7 should not be admitted into the proceedings since it was no more relevant than the documents already on file and was not prior art either. Although it did have an example showing that the desired microstructure did not inevitably lead to the mechanical properties in claim 10, it also contained examples, such as alloy S2, confirming that the desired properties were obtained.

The disclosure was sufficient since the skilled person could rework the invention using the information provided in the patent. In particular, paragraph [0020] of the patent taught all the features that were essential to achieve the claimed microstructure. It explicitly indicated that during hot forming the blank was deformed while being cooled at the same time (page 4, lines 9 and 10). Hot deformation was not the most decisive factor for obtaining the desired microstructure, as confirmed by the examples submitted

on 2 August 2018. D2 (Figure 1) did not disclose cooling during hot forming. The hot deformation was conducted in the stable austenite phase field (above Ac3), where the effect of the deformation was different from that at lower temperatures as in the present invention. It also disclosed the heating and deformation of a 15-mm thick hot-rolled steel in contrast to the 1 to 2-mm cold-rolled steel used in the method of the invention. The impact of deformation on the retained austenite was only minor (Figure 6c of D2). All the steels shown in that document were outside the claimed range of 5 to 15% retained austenite.

The patent contained examples that were carried out according to the invention. Although the degree of hot deformation was not given, the CASIM simulator was used to simulate the hot press forming process, particularly the temperatures during hot press forming. Some experiments were needed to find the relationship of the degree of deformation and T3 with V3.

It was evident from alloys B and C that if the temperature (T3) was raised for a given cooling rate (V3), the amount of bainitic ferrite was raised while the amount of martensite was lowered, resulting in a final microstructure having more bainitic ferrite and less martensite, and thus lower strength and higher elongation. This was also in line with the table provided by the appellant during opposition proceedings in the letter of 23 January 2017. Alloy F was an outlier that the skilled person would recognise.

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

The respondent (patent proprietor) requested that the patent be maintained in amended form on the basis of one of the main or first to fourth auxiliary requests previously filed as second, fourth, sixth, eighth and tenth auxiliary requests by letter dated 22 April 2020.

Reasons for the Decision

Main request

1. Article 13(1) RPBA 2020

In this case, Article 13(1) RPBA 2020 applies (see Article 25 RPBA 2020).

1.1 The request in hand was submitted on 22 April 2020 in response to the board's communication of 16 March 2020. The request is based on auxiliary request 2 as filed on 2 August 2018, on which the preliminary view expressed in that communication was based. It overcomes the objections to claims 7 and 10 initially raised by the board. Product claim 10 is now a combination of claims 12 and 13 as granted, with the deletion of the "or" variant in claim 13. Although the novelty objection with respect to the product claim has been present since the beginning of the opposition proceedings, combining the two successive claims raises no new issues, *prima facie* overcomes the novelty objection and helps to streamline the proceedings. Therefore the board decided to admit the request into the proceedings.

1.2 D7, a post-published document, was filed with the grounds of appeal. In its statement of grounds of appeal the appellant mainly relied on D7 for

challenging the sufficiency of disclosure of claim 6. In later submissions (in particular those of 5 November 2018 and 17 July 2019) and during oral proceedings, the appellant put forward a further statement of facts, to which Article 13(1) RPBA 2020 applies, relating to the mechanical properties of the steel article. Therefore, D7 can be considered to be a reaction to the new product claim, which now includes the mechanical properties as an essential feature. Although D7 is not part of the state of the art, it is considered relevant evidence for the question of sufficiency of disclosure (see T 1110/03, Reasons 2.3), similar to experimental evidence. Consequently, the board decided to admit D7 into the proceedings.

2. Article 83 EPC

2.1 Under the established case law of the boards of appeal, the requirements of sufficiency of disclosure are met if a person skilled in the art can carry out the invention as defined in the independent claims over the whole scope of the claims without undue burden using their common general knowledge (e.g. T 409/91, Reasons 3.5; T 435/91, Reasons 2.2 and 2.2.1).

To make a case for insufficiency of disclosure, it is necessary to identify information gaps resulting from either limitations in the teaching or a lack of guidance in general.

The question then to be answered is whether the skilled person can remedy any such defects using common general knowledge, or whether the information gaps entail an unreasonable number of experiments.

2.2 In this case, claim 1 relates to a method of hot forming a steel blank into an article by following steps a) to d) such that at the end the article has a multiphase microstructure comprising by volume fraction 55 to 90% bainitic ferrite, 5 to 15% retained austenite and 5 to 30% martensite. Claim 1 is defined by a result to be achieved. Claim 10 further specifies that the article formed according to the method of claim 1 should have the specified mechanical properties, which means that claim 10 contains an additional result to be achieved.

2.3 The skilled person trying to reproduce the invention defined in the claims relies on the patent specification to understand the steps that are necessary to obtain the desired product. The method relates to hot forming, defined as hot pressing in step c), but the patent does not contain any information on the impact hot forming has on the multiphase structure. The steel blank to be used has to have the composition as claimed; it is described in paragraph [0018] and is preferably a cold-rolled sheet. Although the claim is not limited to such a starting product, the skilled person learns from that paragraph how to preferably choose the steel blank to start the process. This blank is then heated to a temperature T1, as explained in paragraph [0020] and illustrated in Figure 1. In the next step the soaking is performed and then the blank is transferred to a hot forming press. This should be done quickly to prevent the blank cooling too much (page 4, lines 4 to 6).

2.4 Step d) of the claimed process specifies that during the hot forming an article is formed and that cooling is maintained until a temperature T3 in the range of 400 to 550°C is reached, at a cooling rate V2. From the

wording of the claim it is not clear how the cooling is supposed to be done in relation to the hot press forming, but it appears from Figure 1 that they are executed simultaneously. This is also in line with page 4, lines 9 and 10. From the figure it is also evident that hot press forming stops well before the desired temperature T3 is reached. From the description of the figure, it is not completely clear whether the active cooling also occurs during hot press forming since it is indicated that after hot press forming the blank thus formed is cooled (page 7, lines 12 and 13). Overall the skilled person understands that cooling happens during hot press forming, but the passage relating to the figure appears to suggest that the cooling rate is not necessarily constant from T2 to T3. This means the patent does not teach that the forming is necessarily done below Ac3. Regarding the temperature T2 and the rate V2, the patent teaches that their impact on the microstructure is insignificant (page 7, lines 50 and 52).

However, the skilled person carrying out step d), which includes hot press forming, would also like to know what effect this step has on the microstructure since they have to achieve a certain microstructure at the end of the complete process. The examples in the patent are based on a CASIM simulator, which simulates the thermal effect on the steel but does not take into consideration the effect of hot press forming. As indicated above, the patent is silent on how the hot press forming affects the microstructure. Therefore, the skilled person cannot know whether the results presented in Table 2 would be the same if hot press forming were taken into consideration. This information gap is also confirmed by D2, which describes the effect of thermomechanical processing on a TRIP steel.

Although the blanks used were cylinders and thus different from the preferred ones in the process under discussion, and the deformation process may have been done at higher temperatures without cooling, it is apparent from D2 that hot deformation can have an effect on a steel that has a composition as claimed and undergoes a similar thermal treatment to that claimed. The skilled person therefore needs to fill the information gap by experimentation in order to establish the effect of hot press forming.

2.5 Step e) of claim 1 specifies that the press-formed blank is further cooled to ambient temperature from temperature T3 at a rate V3. The choice of T3 and V3 are critical for obtaining the desired result. This is evident from the description of the patent (page 4, lines 16 to 22 and page 7, lines 52 and 53). The patent teaches that the higher T3 is, the lower V3 is (page 4, lines 27 and 28); this is even stated in the claim.

2.6 The skilled person trying to rework the invention would start from the examples of the patent. Upon studying the examples, it becomes apparent that there is no clear relationship between T3 and V3. For alloy A, when T3 is 450°C V3 is 4°C/s, while for alloys B, C, D and E V3 is 1, 1, 2 and 0.5°C/s, respectively, when T3 is 450°C. The relationship does not even apply to a specific alloy since V3 was not changed for alloys B, C, E and F but T3 was. The skilled person recognises from the examples that the teaching "the higher T3 is, the lower V3 is" is most probably erroneous. There is a clear information gap in the patent concerning the correct relationship between T3 and V3 which the skilled person can only fill by experimentation. It is also evident from the examples that T3 and V3 depend on the composition of the alloy, as confirmed in the

description (paragraph [0024] and page 7, lines 53 and 54). This is also confirmed by D7 (page 2212, right-hand column, last sentence). The guidance given in the patent at issue that leads to success is very limited and erroneous. The patent teaches adapting V3 depending on the C or Mo contents (page 7, lines 54 to 57) and that, for any given alloy composition at a fixed T3, a higher cooling rate would result in less bainitic ferrite (page 7, lines 57 and 58). It also teaches that the higher T3, the relatively more bainitic ferrite in the final microstructure for a given cooling rate. This is confirmed by alloys B, C and E, but does not apply to F. There is no indication that F should be an outlier in that respect since it could also be that said relationship does not apply to a composition such as alloy F. From the indications given, the skilled person can only learn that T3, V3, the C content and the content of the alloying elements are all relevant and that a clear trend may apply to a specific alloy composition but certainly cannot be generalised for all alloys to be used in the method of claim 1.

2.7 Irrespective of the opposition division's conclusion that the skilled person can carry out the invention despite the apparent lack of information - meaning that they can obtain the desired microstructure by a reasonable amount of experimentation - it is also necessary to ensure that the obtained article has the mechanical properties as defined in claim 10. All the examples in Table 2 have an Ultimate Tensile Strength of at least 1 400 MPa and a total elongation of at least 8%. The teaching in the patent is that more martensite means higher strength (page 7, last line and Table 2), albeit only for a given alloy. Furthermore, it is indicated that more bainitic ferrite will result in higher strength but lower elongation. The skilled

person will probably realise from the results in Table 2 that this indication is incorrect and that relatively more bainitic ferrite results in lower strength and higher elongation.

2.8 However, it is evident from D7 that the microstructure of the article recited in claim 1 does not correlate with the desired mechanical properties. D7 shows an alloy that falls within the scope of claim 10, but alloy S1 in D7, which was obtained using a process according to claim 1 at a T3 of 450°C and a V3 of 1°C/s and had a multiphase microstructure comprising by volume fraction 66.8% bainitic ferrite, 12.6% retained austenite and 20.6% martensite, only had an Ultimate Tensile Strength of 1 356 MPa, i.e. lower than the required 1 400 MPa. This means that the skilled person has to conduct even more experiments to potentially arrive at the desired properties. As indicated in D7, the optimal conditions for obtaining the desired properties, in particular the interrupt temperature and cooling rate, are different depending on the composition (page 2217, left-hand column, last sentence of first paragraph). After having executed their research programme described in D7, the authors came to the conclusion that a bainite fraction within a range of 60 to 75%, which is much narrower than the 55 to 90% range in claim 1, provided the better combination of strength and ductility (page 2218, right-hand column, penultimate sentence) despite the fact that the above-cited alloy S1 did not have the mechanistic properties of claim 10. This means that the skilled person has to carry out a large number of experiments to find the optimal conditions for a specific alloy, without knowing whether these conditions are of use for the next alloy with a different composition.

2.9 This trial and error situation without reliable guidance towards success amounts to an undue burden for the skilled person, which means that the requirements of Article 83 EPC are not fulfilled.

First to fourth auxiliary requests

3. Article 13(1) RPBA 2020

These requests were also filed on 22 April 2020. All these requests contain the specification that the steel blank is "being produced from a cold rolled steel sheet". It is very questionable whether this specification is directly and unambiguously derivable from the application as filed since it discloses that a cold-rolled sheet is a preferred starting product. "Being produced from" could involve other process steps, which *prima facie* gives it a different meaning from that of the original disclosure.

In addition, the insufficient disclosure is not remedied by the further specifications in claim 1 of any of these requests. These relate to preferred options that were already taken into consideration in the reasoning given for the main request since the skilled person would depart from the preferred embodiments when trying to reproduce the invention.

Therefore, these requests do not *prima facie* overcome the lack of sufficiency and are not clearly allowable, so there is no reason to admit them into the proceedings.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated