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Title of invention:
Method of galvanising a steel strip in a continuous hot dip galvanising line

Patent Proprietor:
Tata Steel UK Limited

Opponents:
ThyssenKrupp Steel Europe AG
ArcelorMittal France
Research & Development Intellectual Property
SMS group GmbH

Headword:
Galvanising method/Tata

Relevant legal provisions:
EPC Art. 123, 84, 83, 56
RPBA Art. 13(1)

Keyword:
Main request - inventive step (no)
First auxiliary request - admissible (yes), allowable (yes)

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G 0003/14

Catchword:

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Beschwerdekammern

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Case Number: T 0097/17 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 27 November 2019

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted on 30 November 2016 concerning maintenance of the European Patent No. 2458022 in amended form.**

Composition of the Board:

Chairman E. Bendl
Members: S. Besselmann
P. Guntz

Summary of Facts and Submissions

I. The present appeal lies from the interlocutory decision of the opposition division, deciding on three oppositions, to maintain European patent No. 2458022 in amended form. The patent in suit concerns a method of galvanising a steel strip in a continuous hot dip galvanising line.

II. The opposition division maintained the patent based on the claims filed on 31 August 2016 as the first auxiliary request, having, *inter alia*, dealt with objections under Article 56 EPC.

III. Opponent II (now appellant) appealed this decision.

IV. The appellant relied, *inter alia*, on the following documents:

D9 FR 2 920 439 A1 (SIEMENS VAI METALS TECH SAS [FR]) 6 March 2009 (2009-03-06)

D10 US 2008/308191 A1 (LEUSCHNER RONNY [DE] ET AL) 18 December 2008 (2008-12-18)

D11 JP 2010 174262 A (JFE STEEL CORP) 12 August 2010 (2010-08-12) and English translation thereof

V. The patent proprietor (respondent) maintained the set of claims upheld by the opposition division as its main request and filed further auxiliary requests 1-10 on 4 October 2019. During oral proceedings, the respondent renumbered auxiliary request 7 as the first auxiliary request.

VI. Opponents I and III (parties as of right) did not submit any comments on the substance of the appeal, and did not attend the oral proceedings.

VII. Claim 1 of the main request reads as follows:

"*Method of galvanizing a steel strip in a continuous hot dip galvanising line comprising a direct fired furnace section or non oxidising furnace and a subsequent radiant tube furnace section, the method comprising injecting an oxidizing medium consisting of a gas mixture of nitrogen and air or a gas mixture of nitrogen and oxygen into the galvanising furnace by projecting the oxidizing medium onto one or both of the surfaces of the uncoated strip exiting the non-oxidising or direct fired furnace section by a nozzle system to cause one or both of the steel strip surfaces to oxidise in a controlled manner in the connection chamber between the direct fired furnace section or non-oxidising furnace and the radiant tube section, the method further comprising at least partly reducing the oxide back to iron in the radiant tube furnace section and the method further comprising hot dip galvanising the steel strip in the hot dip galvanising line, wherein the gas mixture comprises an oxygen content of 0.5 to 10% in volume.*"

VIII. Claim 1 of the first auxiliary request differs from claim 1 of the main request in the following passage to be inserted after "and the radiant tube section" (with the differences to claim 1 of the main request underlined by the board):

"*<u>wherein the nozzles are designed such as to distribute the gas mixture evenly</u>, the method further comprising at least partly reducing the oxide back to iron in the radiant tube furnace section and the method further comprising hot dip galvanizing the steel strip in the hot dip galvanizing line, wherein the gas mixture comprises an oxygen content of <u>2 to 4.5%</u> in volume,*

wherein the oxidation of the steel strip surface or surfaces takes place between 650°C and 900°C."

Dependent claims 2-3 relate to preferred embodiments.

IX. The appellant's arguments, where relevant to the present decision, may be summarised as follows.

The claimed method lacked an inventive step. Starting from D11, the objective technical problem was merely the provision of an alternative. The method of claim 1 was obvious because the skilled person would readily select the oxygen content of the oxidising gas. Mounting the nozzle system in the connection chamber did not support inventive step either, because this was already disclosed in D11 and constituted an arbitrary choice.

Auxiliary request 1 was late-filed and should not be admitted into the proceedings.

Furthermore, the following objections concerning features present in auxiliary request 1 were made and discussed.

Claim 1 combined features of two initially distinct embodiments in contravention of Article 123(2) EPC, because the feature "by projecting the oxidizing medium onto one or both of the surfaces of the uncoated strip exiting the non-oxidizing or direct fired furnace section" [emphasis added] had originally been disclosed only in relation to the embodiment regarding the injection of the oxidising medium in the direct fired furnace (DFF) section or non-oxidising furnace (NOF), and not in relation to the now claimed injection of the oxidising medium in the connection chamber.

The deletion of the feature "2. before the radiant tube section" contravened the requirements of Articles 123(2) and 123(3) EPC.

It was unclear where the injection of the oxidising medium was to be done (Article 84 EPC).

The newly introduced feature "wherein the nozzles are designed such as to distribute the gas mixture evenly" was also objected to under Articles 123(2) and 84 EPC.

The subject-matter of claim 1 of the first auxiliary request lacked inventive step (Article 56 EPC) in view of each of D11 and D10.

X. The respondent's arguments, where relevant to the present decision, may be summarised as follows.

The method of claim 1 of the main request involved an inventive step in view of D11, because D11 taught away from mounting the nozzle system in the connection chamber and did not mention a gas mixture having the claimed oxygen content. The claimed oxygen content made it possible to obtain a uniform and reproducible oxide layer with a controlled thickness which was easily reducible.

The auxiliary requests were filed in reaction to the preliminary opinion of the board. The amendments were substantiated and addressed the objections. They should therefore be admitted into the proceedings.

The method of claim 1 of the first auxiliary request was further delimited from D11 in that the nozzles were designed to distribute the gas mixture evenly, in

contrast to D11 which taught an uneven distribution. The oxygen content was now limited to the preferred narrow range and the temperature was additionally defined. It also involved an inventive step in view of D10.

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

The respondent requested that the appeal be dismissed or, alternatively, that the patent be maintained in amended form on the basis of one of auxiliary requests 1 to 10 as submitted with the letter dated 4 October 2019, whereby the former auxiliary request 7 was made the first auxiliary request after the main request.

Reasons for the Decision

Main request

1. Inventive step

1.1 The invention relates to the continuous galvanising of steel strips and aims at improving the plating properties (paragraphs [0001], [0006] and [0015] of the patent in suit).

1.2 D11 also relates to a hot dip galvanising line (paragraph [0001]), aims at improving the plating properties (paragraph [0016]) and even addresses the more specific purpose of strongly oxidising the steel strip surface and then reducing it (paragraph [0016]), which corresponds to the purpose of avoiding selective

oxidation, as addressed in the patent in suit (paragraph [0006]).

1.3 In particular D11 describes a method using a continuous annealing furnace provided with a DFF. D11 discloses an embodiment wherein a nozzle system (gas header (17), figure 2) is located in the final oxidation zone of the DFF (6), before the reducing and annealing furnace, see figure 1 and paragraphs [0032] and [0057]. The nozzle system (17) allows to inject a gas with an oxidising effect (e.g. air) and a gas with no oxidising effect (e.g. N_2). In the examples illustrating the invention of D11, the nozzles directed towards the centre of the steel strip inject air, and the nozzles directed towards the edges of the steel strip are either closed or inject nitrogen (tables 1 and 2).

1.4 D11 is therefore a suitable starting point for assessing inventive step.

1.5 Following the respondent's argumentation, the subject-matter of claim 1 differs from D11 in that

- a gas mixture is used with a defined oxygen content, and in that
- the nozzle system is mounted in the connection chamber.

1.6 The board does not regard the use of a gas "mixture" as a separate distinguishing feature, because a gas containing 0.5 to 10 vol.-% oxygen is necessarily a mixture. Thus the first distinguishing feature boils down to the use of an oxygen content within the claimed range.

1.7 There is no indication that the indicated differences interact to produce a combined effect, nor has this been argued by the respondent. Thus, in the absence of such a combined effect, these differences address separate (partial) technical problems, which are to be considered separately.

1.8 *Provision of a gas mixture having an oxygen content of 0.5 to 10% in volume*

1.8.1 The respondent views the technical problem as the provision of a method for galvanising a steel strip in a continuous hot dip galvanising line in which a uniform and reproducible oxide layer having a controlled thickness is obtained as an intermediate product which has good reducibility in the radiant tube furnace (RTF).

1.8.2 This view is in line with the patent in suit (paragraphs [0006], [0008]-[0010], [0012]). Specifically, paragraphs [0008]-[0010] of the patent in suit associate a uniform and reproducible oxide layer having a controlled thickness with using a gas mixture of oxygen and nitrogen, or of air and nitrogen, having an oxygen content between 0.5 and 10 vol.-%.

1.8.3 Nevertheless, the provision of an oxide layer followed by a reduction step is merely an intermediate step preparing the steel strip for the hot dip galvanising step. The quality of the oxide layer is linked to the quality of the final galvanised coating. The only result actually assessed in the example of the patent in suit is the strip wettability and coating adhesion after the annealing and coating, see paragraph [0015].

1.8.4 D11 already provides improved plating properties by strongly oxidising the pre-annealed steel and then reducing and annealing it before hot dip plating, see paragraph [0016]. According to D11, the plating properties are "favorable" (paragraph [0067]). This leads to the initial conclusion that D11 already solves the technical problem identified by the respondent (see point 1.8.1).

1.8.5 There is no basis to conclude that the claimed method would solve this technical problem in an improved way. No direct comparison with D11 is available. Moreover, as credibly argued by the appellant, the properties of the oxide layer and hence of the final galvanised coating are not governed by the oxygen content alone, but depend on its interaction with the other process parameters including the temperature, the gas flow rate, the steel composition etc. Claim 1 does not define any of these process parameters.

1.8.6 The objective technical problem associated with using a gas mixture having the defined oxygen content is thus simply the provision of an alternative.

1.8.7 The board is satisfied that this less ambitious technical problem is solved by the method defined in claim 1, involving an oxygen content of the oxidising gas of 0.5 to 10 vol.-%.

1.8.8 It remains to be assessed whether this solution would have been obvious.

1.8.9 D11 generally mentions that the gas introduced in the DFF can be a combination of a gas that has an oxidising effect and a gas that does not have an oxidising effect (paragraph [0024]). D11 does not impose any limitation

on the gas having an oxidising effect. It may for example be a gas containing oxygen, with air being preferred, but merely from a cost perspective (paragraph [0025]).

The teaching of D11 is therefore not limited to a specific oxygen content in the oxidising gas.

1.8.10 It falls within the normal practice of the skilled person to identify a suitable oxygen content of the oxidising gas, in accordance with the other process parameters, for instance the steel sheet temperature (paragraph [0032]) and the flow rate of the oxygen containing gas (taught to be freely adjustable, see paragraph [0047]), to obtain the desired oxidation, eventually leading to the desired plating properties.

The skilled person wishing to provide an alternative would therefore have readily arrived at an oxygen content within the claimed range.

1.9 Mounting the nozzle system in the connection chamber

1.9.1 The opposition division found that the effect of the injection of the oxidising medium taking place in the connection chamber was a more constant atmosphere, and thus better control of the oxidation step.

The respondent did not argue any (other) technical effect of mounting the nozzle system in the connection chamber (and not in the DFF), in particular no effect on the quality of the oxide layer, but maintained that this constituted a non-obvious alternative.

1.9.2 The patent in suit does not describe any advantages associated with the injection of the oxidising medium

being conducted in the connection chamber. The patent in suit does not give any preference to mounting the nozzle system in the connection chamber, but presents it as an alternative to mounting it in the DFF (paragraphs [0007], [0011]). It is not known where the nozzle system was located in the example (paragraph [0015]).

Moreover, claim 1 neither defines the atmosphere in the direct fired furnace or non-oxidising furnace, nor in the connection chamber.

1.9.3 In so far as the location of the nozzle system is concerned, the objective technical problem is therefore also merely the provision of an alternative.

1.9.4 There are no doubts that this technical problem has been solved by the subject-matter of claim 1, wherein the nozzle system is in the connection chamber between the direct fired furnace section or non-oxidising furnace and the radiant tube section.

1.9.5 The provision of the oxidising medium between the oxidising zone and the reducing zone has been explicitly considered in D11, see paragraph [0032]. It is taught not to be preferred, because with a position too close to the reducing zone, there is an increased possibility that the gas with the oxidising effect will contaminate the reducing zone. At the same time, a higher steel sheet temperature is said to cause higher oxidising power (same paragraph).

1.9.6 The skilled person, faced with the problem of providing an alternative, would also contemplate the non-preferred alternative of D11, thereby accepting a higher possibility of contamination of the reducing

zone, but possibly benefiting from a higher steel sheet temperature, as described in D11.

1.10 For these reasons, the method of claim 1 does not involve any inventive step in view of D11 (Article 56 EPC).

First Auxiliary request

2. Admissibility

2.1 The request was filed in reply to the provisional opinion of the board, about 7 weeks before the date for oral proceedings.

2.2 Claim 1 has been further limited by including features from two claims as granted and the general disclosure of the invention. These amendments are not complex. In the present case, no reason is seen why the board or the other party would be unable to deal with these amendments.

2.3 On a *prima facie* basis, the claims are clearly allowable. As is evident from the considerations below, the amendments overcome the objections raised against the main request.

2.4 The board, using its discretion under Article 13(1) RPBA, admitted this request into the proceedings.

3. Article 123 EPC

3.1 Claim 1 is based on granted claim 1, limited to one of two alternatives, which already existed in claim 1 as

originally filed, further limited by the features of granted claims 3 and 4 (corresponding to original claims 3 and 4), and finally limited to features taken from the general disclosure of the invention on page 2, line 30 to page 3, line 11 of the application as originally filed).

3.2 The appellant raised three objections under Article 123(2) EPC. Namely, the appellant objected that features from distinct embodiments had been combined, that the deletion of the term "before the radiant tube section" introduced new subject-matter, and that the newly added feature regarding the nozzle design had been isolated from a part to which it was inextricably linked.

3.3 Regarding the first of these objections, the board does not agree that features of distinct embodiments were combined. The reasons are the following.

3.3.1 The application as filed disclosed an embodiment involving the injection of the oxidising medium in the DFF section or NOF, and another embodiment involving the injection of the oxidising medium in the connection chamber between the DFF section or NOF and the radiant tube furnace section (RTF).

3.3.2 Claim 1 has been limited to the latter of these embodiments, namely the injection of the oxidising medium in the connection chamber.

3.3.3 The appellant's objection specifically concerns the last part of the sentence "by projecting the oxidizing medium onto one or both of the surfaces of the uncoated strip exiting the non-oxidizing or direct fired furnace section" [emphasis added]. According to the appellant,

this feature was originally disclosed only in relation to the embodiment in which the injection of the oxidising medium takes place in the DFF section or NOF, and not in relation to the presently claimed embodiment involving the injection of the oxidising medium in the connection chamber (page 2, line 15 - page 3, line 11 of the application as originally filed, corresponding to paragraphs [0007] and [0008] of the patent in suit).

3.3.4 However, the expression "exiting the non-oxidizing or direct fired furnace section" merely describes the uncoated strip, and thereby implies the sequence of method steps. In the context of the claim, the strip exiting the NOF or DFF is the strip in the connection chamber. The indicated expression implies neither any additional limitation, nor is it inconsistent with the injection of the oxidising medium in the connection chamber, i.e. the claim does not define the projection of the oxidising medium onto the strip at the moment when the strip is exiting the NOF or DFF section.

3.3.5 The amendment concerned thus has a basis in the application as filed, see the indicated part on pages 2-3 (in particular line 23 on page 2).

3.4 Regarding the second objection (see point 3.2), the board also does not agree that the deletion of the feature "before the radiant tube section", in comparison to original claim 1 (and claim 1 as granted), could be objected to under Article 123(2) EPC. The reasons are the following.

3.4.1 The appellant was of the opinion that original claim 1 (and granted claim 1) implied that the oxidation step had to be completed before the radiant tube section. The appellant maintained that this was an essential

feature of the originally disclosed method, and that its deletion contravened the requirements of Article 123(2) EPC.

3.4.2 The relevant part of original claim 1 states that the method comprises "injecting a gas mixture of nitrogen and air or a gas mixture of nitrogen and oxygen into the galvanising furnace by a nozzle system to cause one or both of the steel strip surfaces to oxidise in a controlled manner 1. in the direct fired furnace section or non-oxidising furnace, ... or in the connection chamber between the direct fired furnace section or non-oxidising section and radiant tube section and 2. before the radiant tube section". Original claim 1 thus merely requires that the step of injecting the oxidising mixture to cause one or both surfaces of the steel strip to oxidise takes place before the radiant tube section.

3.4.3 According to claim 1 at issue, this step takes place in the connection chamber between the DFF or NOF and the radiant tube section. It is implicit that the location of the connection chamber, and hence of the indicated step, is "before the radiant tube section". This feature was therefore superfluous and could be deleted, without infringing the requirements of Article 123(2) EPC.

3.5 Regarding the third objection (see point 3.2), the board also does not agree that the newly added feature regarding the nozzle design was isolated from a part to which it was inextricably linked. The reasons are the following.

3.5.1 The feature regarding the nozzle design is disclosed on page 3, lines 9-11 of the application as filed, where

it is stated "To that end the nozzles are designed such as to distribute the gas mixture evenly thereby causing the hot steel strip surface to oxidise evenly and reproducibly" [emphasis added].

3.5.2 The last part of this sentence (underlined) merely indicates why the even distribution of the gas mixture is desirable. This part as such constitutes no further functional definition of the nozzle design, nor of the galvanising method. It was therefore not necessary to include this part in the claim. Including only the first part of the indicated sentence regarding the nozzle design does not introduce subject-matter which extends beyond the scope of the application as originally filed.

3.6 The subject-matter of claim 1 at issue can therefore be derived directly and unambiguously from the application as originally filed and the requirements of Article 123(2) EPC are met.

3.7 It is evident from the above considerations (see point 3.1) that the scope of protection of the claims at issue has been limited in comparison to claim 1 as granted. In particular, the deletion of the indication "2. before the radiant tube section" does not affect the scope of the claim (see point 3.4.3). The requirements of Article 123(3) EPC are therefore met.

4. Clarity (Article 84 EPC)

4.1 The appellant raised objections of lack of clarity in view of the feature of the strip "exiting the non-oxidizing or direct fired furnace section", and in view

of the feature "wherein the nozzles are designed such as to distribute the gas mixture evenly".

4.2 These features were not present in the granted claims but had been introduced from the description by amendment, so that clarity may be examined in the present opposition appeal proceedings (G 3/14, Order).

4.3 The appellant construes the feature of the strip "exiting the non-oxidizing or direct fired furnace section" as defining the place of injecting the oxidising medium. The appellant concludes that the claim as a whole does not define this place in a consistent manner, leading to lack of clarity.

4.4 As is evident from the considerations regarding added matter (point 3.3.4), the board does not share the appellant's interpretation of this feature, and does not regard it as an (additional) definition of the place of injecting the oxidising medium.

4.5 The appellant also argued that it was not known how the nozzles had to be designed to achieve the desired even distribution of the gas mixture. In its opinion, it was not clear whether this even distribution referred to the spray pattern of an individual nozzle, or to the arrangement of the nozzles across the strip surface. In neither case was it clear how this could be implemented.

4.6 It is implicit in claim 1 that the nozzles are those of the nozzle system, which projects the oxidising medium (i.e. the gas mixture) onto one or both of the surfaces of the uncoated strip to cause one or both of the steel strip surfaces to oxidise in controlled manner. It is therefore clear from claim 1 as a whole that the

indication "to distribute the gas mixture evenly" can only refer to the distribution of the gas mixture across the steel strip surface, and does not necessarily require a specific spray pattern of an individual nozzle.

As argued by the respondent, in the present case of a continuous process, the even distribution can only be achieved by arranging the nozzles across the width of the steel strip surface (and not along the direction of travel of the steel strip).

This interpretation is also supported by the last sentence of paragraph [0008] of the patent in suit, as well as by figure 1 schematically depicting a suitable nozzle system (see paragraph [0011]).

4.7 The amendments therefore do not result in lack of clarity of the claim.

5. Sufficiency of disclosure (Article 83 EPC)

5.1 The appellant maintained that it should be allowed to raise an objection of lack of sufficiency of disclosure because the claim request at issue had been newly filed during the appeal proceedings, even though the relevant matter was already contained in the claims considered by the opposition division (namely in claim 1 of the current main request).

5.2 The appellant argued that the skilled person would have been unable to carry out the claimed method because they would not have known how to avoid the contamination of the RTF with oxidising gas when injecting an oxidising medium into the connection

chamber. In the appellant's view, the board had raised this objection in its preliminary opinion (point 11.2.9 of the preliminary opinion).

The appellant referred to the diverging views as to whether the deletion of the feature "before the radiant tube section" affected the scope of the claim (see 3.4-3.4.3), but stressed that the objection concerned both, methods wherein the oxidation step had to be completed within the connection chamber and thus "before the radiant tube section", and methods wherein the oxidation step might continue in the RTF.

5.3 Notwithstanding the admissibility of this objection, it is in any case not convincing, the reasons being the following.

5.3.1 In contrast to the appellant's understanding, the board in its preliminary opinion had not pointed to any potential issue of sufficiency of disclosure. It had merely, in the context of inventive step, addressed the question of whether the claimed method appeared to provide any technical effect in the form of benefits, or overcoming inconveniences, in comparison to the prior art (see point 11.2.9 of the preliminary opinion).

5.3.2 As derived from the considerations regarding added matter, the claim at issue does not mention whether the oxidation step is completed in the connection chamber or may continue in the RTF. The claimed method also does not mention a possible contamination of the RTF with oxidising medium, i.e. such a possible contamination *per se* is not excluded.

5.3.3 Avoiding the problem of contamination of the RTF with oxidising gas is consequently no feature of the claimed method and therefore irrelevant when considering sufficiency of disclosure.

6. Inventive step

6.1 Objections of lack of inventive step were raised starting from D11 and D10 as the closest prior art. As both documents are of equal relevance, both of them will be discussed in the following.

6.2 Document D11

6.2.1 Inventive step in view of D11 was considered in view of the main request (see point 1.).

6.2.2 Claim 1 at issue differs from claim 1 of the main request, *inter alia*, in that the nozzles are designed so as to distribute the gas mixture evenly.

6.2.3 Even assuming that the objective technical problem remains the same as considered in relation to the main request, namely the provision of an alternative method, document D11 no longer renders the subject-matter of claim 1 obvious.

6.2.4 It is an essential feature of the method of D11 that a gas that has an oxidising effect is blown at a steel sheet center part to promote oxidation of the steel sheet center part (claim 1 of D11; tables 1-2). A uniform distribution of the gas mixture is only employed in the comparative examples, but is shown not to lead to the desired results (for instance "abnormal oxidation" of the edges in example 3 in table 1). D11

therefore teaches away from distributing the gas mixture evenly.

6.2.5 The skilled person, even if merely faced with the technical problem of providing an alternative, would not have had any motivation to employ nozzles designed so as to distribute the gas mixture evenly. Starting with D11, the skilled person would not have arrived in an obvious manner at the method of claim 1.

6.3 Document D10

6.3.1 Document D10 (see figure 1) also relates to a method for melt coating (hot dip galvanising, see paragraph [0020]) a strip of steel. D10 also relates to the same purpose of improving the plating properties, see paragraphs [0004], [0009] and [0014], and more specifically to the formation of an oxide layer preventing further alloy constituents from diffusing to the surface, followed by a reducing treatment (paragraph [0014]).

D10 is therefore also a suitable starting point for assessing inventive step.

6.3.2 The method of D10 involves the use of an RTF system (paragraph [0009]). The furnace is divided into three zones, the first furnace zone and the final furnace zone having a reducing atmosphere (paragraphs [0010]-[0013], [0028]-[0031]). The first and the final RTF zones may therefore be seen as a non-oxidising furnace and a subsequent radiant tube furnace section within the meaning of claim 1 at issue.

The central zone forms a reaction chamber (paragraphs [0012], [0028]) and may be seen as a connection

chamber. It has a temperature of 650 to 750 °C and contains between 0.01% to 1% oxygen (paragraphs [0012], [0030]).

6.3.3 D10 does not explicitly state whether the oxygen content is defined in percent by volume. The respondent argued that it was not known whether the percentage disclosed in D11 was by mole, by mass, by atom, or by volume.

The board has no doubt that the skilled person, wishing to carry out the invention disclosed in D11, would have construed this percentage as based on the volume, as is normal for gaseous compositions. This is also reflected by the granted claims of the patent in suit, which do not specify either that the percentage is by volume. The percentage by volume is equivalent to the percentage by mole, applying the ideal gas law.

An indication of the percentage by mass would not be meaningful in the present context for a gaseous composition which is not normally weighed and wherein the remaining components are not specified. An indication of atom % would not meaningfully express the content of molecular oxygen O_2.

6.3.4 The subject-matter of claim 1 differs from D10 in that the oxidising medium is projected onto the surfaces of the strip by a nozzle system as defined in the claim, and in that the oxygen content is 2 to 4.5 vol.-%.

6.3.5 According to the respondent, using an oxygen content within the claimed range has the technical effect that it results in an oxide layer of consistent composition, thickness and homogeneity to provide a good quality galvanised coating (paragraphs [0012] and [0015]).

6.3.6 There is no indication of any improvement in comparison to D10, which already aims at an "optimally refined surface" (paragraph [0009]) and teaches adjusting the process parameters to control the thickness of the oxide layer (paragraph [0030]).

6.3.7 The objective technical problem attributed to the claimed method involving an oxygen content of 2 to 4.5 vol.-% is therefore the provision of an alternative.

6.3.8 There are no doubts that this problem is solved by the claimed method, in particular as the example of the patent in suit also shows that excellent coating properties may be obtained when using an oxygen content within the claimed range (paragraph [0015]).

6.3.9 According to the appellant, the proposed solution was obvious in view of the teaching in D10 that the oxygen content is adjustable and depends on how long the treatment time is (paragraph [0030]). It argued that the skilled person would have been motivated by this teaching to adjust the oxygen content according to circumstances and would have easily arrived at an oxygen content within the claimed range. In its opinion, the skilled person would have had no reason to adhere to the specific range of the oxygen content disclosed in D10, because it was not known why this range had been selected.

6.3.10 However, the gist of the teaching of D10 is that a sequence of process steps has been identified which provides the desired, optimally refined surface of the steel strip (paragraphs [0009]-[0013] of D10). This method involves a narrowly defined atmosphere in each of the three zones of the furnace. Selecting an oxygen

content within the range of 0.01% to 1% (by volume, see point 6.3.3) in the central zone is an essential feature of this method.

The teaching to adjust the oxygen content (paragraph [0030]) therefore has to be understood in the sense that the oxygen content is adjustable within this range.

6.3.11 Starting from D10, the skilled person faced with the technical problem of providing an alternative would therefore not have had any motivation to deviate from this essential requirement of D10, and would not have arrived in an obvious manner at the claimed method, involving an oxygen content of 2 to 4.5 vol.-%.

6.3.12 As is evident from the considerations above, the objection concerning the obviousness of the feature relating to the nozzle system in view of D9 is irrelevant for the present decision.

6.4 The subject-matter of claim 1 consequently involves an inventive step. This also applies to the subject-matter of claims 2 and 3, which depend on claim 1.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent in amended form on the basis of the claims of the 1st auxiliary request, submitted as 7th auxiliary request with the letter dated 4 October 2019, and a description to be adapted.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated