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D E C I S I O N
of 26 November 2003

Case Number: T 0783/01 - 3.2.2

Application Number: 95912541.0

Publication Number: 0804622

IPC: C21D 1/76

Language of the proceedings: EN

Title of invention:
Method for heat treatment of stainless steel

Patentee:
AGA AKTIEBOLAG, et al

Opponent:
L'AÎR LIQUIDE, Société Anonyme pour L'étude et L'exploitation des procédés Georges Claude

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0783/01 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 26 November 2003

Appellant: (Opponent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 7 June 2001 rejecting the opposition filed against European patent No. 0804622 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: W. D. Weiß
Members: R. Ries
E. J. Dufrasne

Summary of Facts and Submissions

I. European patent No. 0 804 622 was granted on 2 June 1999 on the basis of European patent application No. 95 912 541.0.

II. The granted patent was opposed by the present appellant on the grounds that its subject matter lacked novelty and did not involve an inventive step (Article 100(a) EPC), that it did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 100(b) EPC) and that its subject matter extended beyond the content of the application as filed (Article 100(c) EPC).

III. With its decision posted on 7 June 2001, the opposition division held that the patent and the invention to which it relates meet the requirements of the EPC and rejected the opposition.

IV. An appeal against this decision was filed by the opponent (appellant) on 9 July 2001, and the fee for appeal was paid on 12 July 2001. The statement of the grounds of appeal was submitted on 5 October 2001. In the appeal proceedings, i.a. the following documents have played a pertinent role:

D3: US-A-4 415 415 and

D6: EP-A-0 038 257 and

D14: Aide-Mémoire du Thermicien A_3-E_2-T_h, 1987, Editions Européennes Thermique et Industrie, 3, rue Henri-Heine, 75016 Paris, pages 1 to 5, 258 to 269, 280 to 285

V. Oral proceedings were held before the Board on 26 November 2003, at the end of which the requests were as follows:

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

- The respondent (patentee) requested that the appeal be dismissed and the patent be maintained as granted.

Claim 1 reads as follows:

"1. A method for heat treating stainless steel, primarily tubes, pipes, strip-like or rod-like material made of stainless steel, such as steel strip, steel sheet, steel rod or steel wire which have been rolled and which are heated in a heat treatment oven or furnace to a surface temperature above about 900 degrees C and thereafter cooled and normally treated by pickling, characterized in that the burners of the heat treatment oven are fired with a liquid or a gaseous fuel which is burned with the aid of a gas that contains at least 85 percent by volume oxygen and at most 10 percent by volume nitrogen."

VI. The appellant argued as follows:

Document D3 relates to the heat-treating of stainless steel parts and the removal of scale formed on the surface during this treatment by acid pickling and is, therefore, regarded as representing the closest prior art. As set out in D3, the atmosphere in the gas fired furnace during the thermal treatment has to be "oxidising" to control the oxide scale formation and thus should comprise an oxygen content ranging from 3 to 11%. This excess of oxygen in the flue gases of the furnace is the key feature which determines the type and amount of scale that forms on the surface, irrespective of whether the firing burners are fed with a fuel/air mixture or with a mixture consisting of fuel and oxygen enriched air or even pure oxygen. The essential objects underlying the opposed patent are, therefore, the improvement of the heat transfer to the metal parts in the heat-treatment furnace and the reduction of the NO_x formation. Both objects are, however, already achieved by the process disclosed in document D6 which proposes a combustion technique using a substantially closed furnace and an oxygen supply up to 100% when burning hydrocarbon fossil fuel to minimize the formation of NO_x. This process is used for heating a variety of materials including metals and in particular steel.

Apart from the teaching given in document D6, it belongs to the basic technical knowledge of a person skilled in this field of technology that the combustion of fuels (such as methane or propane) with oxygen enriched air or even pure oxygen results in a better thermal performance of the furnace, a higher heat

transfer rate to the treated parts and improved physico-chemical properties of the combustion process. This background knowledge is, for instance, disclosed in the basic textbook D14: "Aide-mémoire du thermicien", points 2.5.1 to 2.5.2.3 on pages 281 to 282. The annealing of stainless steel parts in a furnace heated by burning natural fuel with oxygen enriched air or even pure oxygen, as claimed in the opposed patent, therefore amounts to nothing more than what has been obvious to a skilled person who is confronted with the above mentioned problems.

VII. The patentee argued as follows:

It may be true that the process and burners for firing a furnace and the fuel/oxygen mixtures described in document D6 have been applied in the steel industry for annealing unalloyed steel products. As far as the patentee is aware, the combustion of fuels with oxygen enriched air has essentially been applied in the steel industry for reheating refractory materials, ladles etc, but this technology has never been used for firing furnaces to heat treat stainless steel parts as claimed in the patent. When supplying oxygen for the combustion of a hydrocarbon fuel such as propane, very high concentrations of water vapour (and carbon dioxide) form in the flue gases. Due to this specific type of atmosphere in the furnace, a skilled person would have apprehended a significantly increased formation of scale on the surface of the treated stainless steel parts. This is the decisive reason why the oxygen/fuel combustion technology has not been taken into account by those skilled in the art up to the priority date of the patent. In spite of this existing technical

prejudice, the inventors surprisingly found that, by firing a furnace with hydrocarbon fuel and a gas comprising 85% to 100% oxygen, the stainless steel parts could be very rapidly heated-up to the required temperature level and that the furnace flue gases acting on the surface promoted only the formation of a thin dense layer of scale which could be easily removed by acid pickling. The surprisingly thin and compact deposit of scale on the surface is the consequence of the increased heat transfer resulting from the high radiation of the oxygen/fuel flame and from H_2O-CO_2-containing flue gases. Moreover, the formation of harmful NO_x by-products is effectively suppressed or minimized by the claimed process since the nitrogen content in fuel/gas mixture is restricted to 10 volume percent or less. It, therefore, was by no means obvious for a skilled person to select the oxygen-enriched combustion technique - in spite of being known per se from D6 - for heat treating stainless steel parts according to the process disclosed in document D3, as alleged by the opponent. The claimed process thus involves an inventive step over the technical teaching given in documents D3 and D6 or D14.

Reasons for the Decision

1. The appeal complies with Rule 65(1) EPC and is, therefore, admissible.

2. *The closest prior art*

The patent at issue is concerned with a method for heat treating or soft annealing stainless steel, in

particular in the form of rods, wire, sheet or strips, tubes etc, and removing the oxide scale formed during the annealing step on the surface by acid pickling. Likewise, document D3 discloses a method for controlling the formation of oxide scale and of removing the scales in a pickling bath from the finished products such as flat rolled strip and sheet, bar, wire and tubular products. Although the method is adaptable to a variety of metals, in particular stainless steel types 201, 304, 316, 409 and 413 constitute the most significant embodiment thereof (cf. D3, column 1, lines 7 to 26; column 4, lines 57 to 62). As does the claimed process, the known process aims at minimizing or even eliminating the need for a subsequent acid pickling treatment and at minimizing all the environmental and the economic problems associated therewith (cf. D3, column 2, lines 53 to 56). In this respect, the problem underlying the patent at issue is the same as that addressed in document D3. Based on these considerations, it has been common ground to all parties and to the Board that document D3 represents the closest prior art.

Document D3 states that the nature of the different oxide scales formed during the annealing operation is strongly influenced by the oxidising potential of the atmosphere in the furnace and that it is, therefore, essential that the annealing be done in a controlled furnace atmosphere with a proper surplus of oxygen. In order to promote a favourable type of oxide scale which permits its complete and easy removal in the subsequent pickling step, an oxygen content ranging from 3 to 11 volume% in the flue gases of the furnace has been found to be indispensable (cf. D3, claims 1 and 4, column 6,

line 65 to column 7, line 10). It is noted in this context that in the example given in the disputed patent the flue gas generated in the annealing furnace likewise contains 4% by volume O_2 (cf. the patent, column 5, lines 41 to 49). This means that the surplus of oxygen in the furnace atmosphere according to the claimed process falls within the range postulated in document D3.

However, document D3 remains silent about the combustion technology that is applied for heating the furnace used in the annealing operation.

3. *The problem to be solved*

In the light of the closest prior art according to document D3, the problem underlying the patent at issue, therefore, resides in

- further reducing the oxide scale formed during the heat treatment and promoting a scale type which allows its easy removal by acid pickling or which even renders pickling unnecessary (cf. EB-B-0 804 622, paragraphs 0009, 0028)

- improving the heat efficiency of the furnace so that the steel parts can pass through the furnace at a higher speed (cf. the patent, paragraph 0025) and

- minimizing the emission of deleterious NO_x compounds formed by the combustion process for heating the furnace (cf. the patent, paragraph 0030).

As set out in claim 1, the solution to these problems consists in firing the burner(s) of the heat treatment furnace with a hydrocarbon fuel, e.g. propane, and a gas that contains at least 85 volume % oxygen and at most 10 volume % nitrogen.

4. *Inventive step*

4.1 When searching for technical help to solve the stated problems, a person skilled in the art would have paid particular attention to such prior art which specifically deals with one or two or all of the above mentioned objects. As set out before, the skilled person has already learnt from document D3 that controlling the oxygen content in the flue gases in the range between 3 to 11 volume % significantly reduces the amount of scale formed on the stainless steel parts and results in a type of oxide scale that could be easily removed in the final acid pickling step (cf. D3, column 7, lines 7 to 10). This part of the technical problem underlying the patent at issue, therefore, has already been successfully solved by the process disclosed in document D3.

In his search for technical information, the expert would, however, also turn to document D6 since this document relates to a process for firing industrial furnaces commonly used in steel industry for heating a metal charge, e.g. a bar reheat furnace, a soaking pit etc, by utilizing oxygen or oxygen-enriched air as the oxidant gas instead of air (cf. D6, page 1, first paragraph; page 7, lines 22 to 26). Although document D6 does not specifically address the minimization of

scale formed on the stainless steel parts during annealing, it nevertheless aims at

(a) improving the overall performance and efficiency of industrial furnaces through the use of oxygen or oxygen-enriched air while

(b) avoiding the disadvantages of a high flame temperature and a low gas momentum in the furnace which would involve high NO_x emissions and result in a non-uniform furnace temperature distribution, respectively (cf. D6, page 4, lines 4 to 14).

With particular respect to the formation of toxic NO_x compounds, document D6 teaches on page 19, lines 5 to 11 and 26 to 28, that the NO_x formation can be decreased to very low levels by selecting 90 to 100 volume % oxygen as an oxidant gas (cf. also D6, page 18, lines 25 to 30). This range corresponds to the concentration of 85 to 100 volume % oxygen in the gas for burning the fuel stipulated in claim 1 of the patent at issue. Consequently, at least in view of finding a solution to the problem of how the emission of NO_x compounds could be successfully prevented, the selected ranges for oxygen and nitrogen featuring in claim 1 of the patent at issue are obvious from document D6.

4.2 In the patentee's view a prejudice existed in the art against firing a furnace with pure oxygen/fuel mixtures for heat treating stainless steel parts since the flue gases obtained from such a process comprised high concentrations of water vapour and carbon dioxide which in turn led to the increased formation of oxide scale. Therefore, a person skilled in the art would not have

seriously contemplated using the process disclosed in document D6 for that purpose.

4.3 The patentee has, however, not produced any evidence for the existence of such a prejudice. Moreover, such a prejudice cannot be deduced from in the cited prior art either. Document D3 is completely silent about the combustion technique that has been used for heat treating stainless steel, and there is no warning nor any restriction in this document indicating that oxygen-enriched air or pure oxygen for burning the fuel to heat the furnace could be harmful when heat treating stainless steel parts.

Also with respect to D6 no information can be found anywhere in this document prompting the skilled reader to exclude stainless steel structural parts from the heat treatment proposed therein for a wide variety of materials including steel in general. An obstacle to apply this process could possibly have been that burning fossil fuel with oxygen-enriched air or pure oxygen instead of air as the oxidant entails the drawbacks of a high flame temperature and a low gas momentum (cf. D6, page 2, line 18 to page 3, line 25). These disadvantages have, however, been successfully overcome by the process disclosed in document D6. Contrary to the patentee's position it is, therefore, concluded that, in the absence of a crucial prejudice and in expectation of the advantages of an increased heat efficiency of the furnace and a decreased emission of deleterious NO_x, a skilled person would have seriously considered using the process proposed in document D6 also for heat treating stainless steel

parts in the hope of solving the remaining technical problem(s) underlying the patent at issue.

Even if some hesitance actually had existed to use an oxy-fuel burner for heat treating stainless steel parts, the prospective advantages would have been incentive enough to carry out simple experiments which inevitably would have disproved such opposing considerations.

5. The subject matter of claim 1, therefore, does not involve an inventive step in view of the combined technical teaching given in documents D3 and D6. The claims 2 to 6 fall together with claim 1 on which they are dependent.

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:

V. Commare W. D. Weiß