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Aktenzeichen / Case Number / N° du recours : T 173/85 - 3.4.1

Anmeldenummer / Filing No / N° de la demande : 80 303 035.2

Veröffentlichungs-Nr. / Publication No / N° de la publication : 0 047 346

Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : Disposal of oxides of nitrogen and heat recovery in a single self-contained structure

Klassifikation / Classification / Classement : B01D 53/34

ENTSCHEIDUNG / DECISION

vom / of / du 25 June 1988

Anmelder / Applicant / Demandeur : John Zink Company

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : "Inventive step - (yes)"

Leitsatz / Headnote / Sommaire

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Case Number : T 173/85 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 25 June 1988

Appellant : John Zink Company
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Tulsa, Oklahoma, 74103 (US)

Representative : Kerr, Simonne J. et al,
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Decision under appeal : Decision of Examining Division 031 of the European Patent Office dated 8 March 1985 refusing European patent application No. 80 303 035.2 pursuant to Article 97(1) EPC

Composition of the Board :

Chairman : K. Lederer
Members : J. Roscoe
R. Schulte

Summary of Facts and Submissions

I. European patent application No. 80 303 035.2 (publication number 0 047 346) was refused by decision of the Examining Division.

II. The reason given for the refusal was that the subject-matter of Claim 1 did not involve an inventive step within the meaning of Article 56 EPC having regard to the prior art.

III. The Applicant lodged an appeal against the decision.

IV. On 26 March 1988, following several communications of the Board in which his attention was drawn inter alia to the content of the documents US-A-3 873 671 and DE-A-2 348 909, the Appellant filed an amended single claim together with amended pages of the description. Further amendments to the description and drawings were requested in his letter dated 1 June 1988.

V. The Appellant made no formal request regarding the impugned decision, but his above mentioned submissions are interpreted by the Board as a request to set aside the decision of the Examining Division and to grant a European patent on the basis of the amended single claim as filed on 26 March 1988, which reads as follows:

"An NOx disposal and heat recovery system comprising

(a) a burner and means to supply it with NOx gases to be reduced, gaseous fuel and primary air in a less than stoichiometric amount;

(b) a reducing section (114) adjacent to the burner for combustion of the fuel in the NOx gases and primary air after they have flowed through the burner;

(c) a cooling section (118) downstream of the reducing section (114), in which the hot products of combustion leaving the reducing section (114) may be mixed with cooled effluent gases introduced into the cooling section through cooled effluent gases injection means (121);

(d) secondary air injection means (172) for injecting secondary air into the gases flowing out of the cooling section (118) in an amount such that the total amount of primary and secondary air is equal to or greater than the stoichiometric amount required for the combustion of the fuel;

(e) a reoxidation section (122) provided downstream of the secondary air injection means where the secondary air acts to complete combustion of the products of combustion leaving the cooling section (118);

(f) heat exchanging means (124) for recovering heat from the gases flowing through the reducing section (114) and from the effluent gases flowing out of the reoxidation section (122); and

(g) exhaust means for evacuating the cooled effluent gases after they have passed the heat exchanging means;

characterised in that:

(h) the cooling section (118) is immediately adjacent the reducing section (114);

(i) the reoxidation section (122) is of annular configuration and surrounds the centrally arranged cooling section (118), and the upstream end of the reoxidation section is closed by an end wall (155) spaced from the downstream end of the cooling section (118), so that the gases therefrom are diverted into the annular reoxidation section;

(j) the cooled effluent gases injection means comprises a conduit extending along the axis of the cooling section and having openings therein through which said gases are injected;

(k) the secondary air injection means comprises a plurality of openings (172) in said end wall (155); and

(l) the heat exchanging means (124) comprises at least one steam/water tube, is of annular configuration, surrounds the centrally arranged reducing section (114), and is immediately adjacent the downstream end of the annular reoxidation section (122);

so that the gases successively flow in a first direction from the burner through the centrally arranged reducing and cooling sections (114, 118) to the end wall (155), and thence in the opposite direction through the annular reoxidation section (122) and heat exchange means (124) to the exhaust means."

Reasons for the Decision

1. The appeal is admissible.

2. There is no objection to the present claim on formal grounds since it is clear and adequately supported by the application documents as originally filed.

The claim which is directed to the specific embodiment originally disclosed by reference to Figure 2, comprises in essence the features of original Claims 1, 7 and 8. These features have been rearranged and amended on the basis of the information contained in Figure 2 and the corresponding portion of the original description in order to more clearly define the mutual geometrical arrangement of the structural elements which form the claimed apparatus, and to specify the nature of certain features which were claimed originally in a broader way, such as the means to reverse the direction of gas flow and the secondary air injection means.

In addition, whereas in original Claim 1 the amount of secondary air injected into the gases flowing out of the cooling section was defined as being such that the total amount of primary and secondary air is greater than the stoichiometric amount required for the combustion of the fuel, the present claim also encompasses a total amount which is equal to said stoichiometric amount. This amendment is supported by the fact that the use of a total amount of primary and secondary air greater than the stoichiometric amount was disclosed originally with reference to the embodiment of Figures 3 to 5 only, (page 8 as filed, lines 26 to 28) which is no longer covered by the claim, while the description of the embodiment of Figure 2 as now covered by the claim referred merely to the combustion being complete (page 6 as filed, lines 26 to 35) which means that the total amount of air is at least (i.e. equal to or greater than) the stoichiometric amount required for the combustion of the fuel, as defined in the present claim.

3. The amendments made to the description and drawings serve to adapt them to the new claim and to meet the requirements of Rules 27(1)(c) and (d), 34(1)(c) (prohibition of obviously irrelevant or unnecessary matter), 35(12) (units in terms of the metric system) and 35(13) (consistency of the terminology) EPC. None of the amendments introduces matter which was not contained in the description as originally filed. Therefore no objection arises under the terms of Article 123(2) EPC.

4. Novelty.

4.1 An NOx disposal and heat recovery system as defined in the preamble of the claim and described in the specification of the present application with reference to Figure 1 is acknowledged therein as being part of the prior art.

This known system is distinguished from the claimed subject-matter essentially in that the reducing section, cooling section, reoxidation section and heat exchanging means are substantially aligned in such a way that the gases flow from the burner to the exhaust means in a single direction. In contrast therewith, the corresponding portions of the claimed device are arranged as defined in the characterising portion of the claim, so that the gases successively flow in a first direction from the burner through centrally arranged reducing and cooling sections to an end wall, and thence in the opposite direction through annular reoxidation section and heat exchanging means to the exhaust means.

4.2 Document US-A-3 873 671 discloses an installation which is similar to the prior art referred to in paragraph 4.1 above but further distinguished from the subject-matter of the claim in that the heat exchanging means 58 (Figure 2)

for recovering heat from the effluent gases flowing out of the reoxidation section is not adapted to recover heat also from the gas flowing through the reducing section as defined in feature (f) of the preamble of the claim.

4.3 Document DE-A-2 348 909 relates to an after burner installation comprising a centrally arranged combustion chamber 8 (Figure 1) and an annular heat exchanger disposed coaxially about the combustion chamber for transferring heat from the gas leaving the chamber to the raw gas to be burned. Combustion gas leaving the chamber is diverted by the end wall of the chamber through slots so as to reverse its direction of flow in the heat exchanger.

This installation comprises neither cooling and reoxidation sections, nor cooled effluent gases and secondary air injection means as defined in the claim.

4.4 The remaining documents cited in the European search report do not come closer to the claimed subject-matter.

In particular, those cited documents which relate to installations for disposal of NOx or combustion without formation of NOx, which include reducing or air-starved combustion, cooling and reoxidation sections, namely

- US-A-4 033 725
- Patent Abstracts of Japan Vol. 1, No. 1, March 1977, page 58M76, 2nd and 3rd abstracts; and
- "Thermische und katalytische Reduktion der Stickoxide aus Abgasen der Industrie", G. Kurz, CZ- Chemie-Technik, Vol. 3, No. 1, 1974;

all disclose adjacent in-line arrangements of those sections.

4.5 For these reasons the subject-matter of the claim is considered to be new within the meaning of Article 54 EPC.

5. Inventive step

5.1 Starting from the nearest prior art as described in the specification of the present application with reference to Figure 1, the principal technical problem to which the claimed subject-matter affords a solution is to provide such a system in a more compact and thermally efficient form.

This problem is solved in accordance with the present invention by the specific geometrical arrangement of the sections defined in paragraphs (h), (i) and (l) of the characterising portion of the claim and the construction and location of specific cooled effluent gases and secondary air injection means as set out in its paragraphs (j) and (k) respectively. Thus a compact unitary structure is provided which comprises a central passage constituted by immediately adjacent reducing and cooling sections through which the gases flow in a first direction from the burner to an end wall; the end wall closes the central passage and diverts the gases into an outer annular passage formed by immediately adjacent reoxidation and heat exchange sections; these sections respectively surround the cooling and the reducing sections, and the gases flow therethrough in the opposite direction to the exhaust means.

5.2 In the Board's opinion, the claimed solution was not obvious in view of the available prior art documents.

Document DE-A-2 348 909 clearly emphasises the advantage of disposing a heat exchanger coaxially about a centrally

arranged combustion chamber for reducing both the space requirements of and thermal losses in an after burner as compared with those resulting from an in-line arrangement of the heat exchanger and combustion chamber (paragraph bridging pages 1 and 2 and page 2, 3rd paragraph). Such after burner, however, does not comprise cooling and reoxidation sections downstream of the combustion chamber as known from the nearest prior art and the document cannot without hindsight be considered to suggest a similar coaxial arrangement of the sections having those functions in the prior art arrangement of Fig. 1 of the present application, nor to incite the skilled person to substitute for that arrangement a first coaxial structure including an inner combustion chamber and an outer heat exchanger disposed immediately adjacent a second such structure comprising an inner cooling section and an outer reoxidation section as defined in the claim.

In contrast with the situation disclosed in document DE-A-2 348 909 wherein heat transfer between the combustion chamber and the heat exchanger is improved by the coaxial arrangement of the latter about the central combustion chamber, in installations which also comprise cooling and reoxidation sections, those sections must obviously be thermally insulated from each other. Therefore the skilled person had no obvious reason to depart from the adjacent in-line arrangement of the cooling and reoxidation sections as disclosed in any of the cited prior art documents relating to installations comprising such sections as indicated in paragraph 4.4 above, and to relocate them in the way disclosed in document DE-A-2 348 909 with reference to different portions of the installation in order to meet completely different thermal requirements.

There is also no hint to be found in the cited prior art documents for the skilled person to replace the known coolant gases and secondary air injection means, which comprise radial passages through the walls of the corresponding apparatus sections as disclosed in any of the cited documents indicated in paragraph 4.4 above and in US-A-3 873 671, by the specific injection means defined in paragraphs (j) and (k) of the claim.

5.3 For these reasons, the subject-matter of the claim is considered to involve an inventive step within the meaning of Article 56 EPC and the claim, accordingly, is allowable under Article 52(1) EPC.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to grant a European patent on the basis of the following documents:

2.1 Description: page 1 filed 26 March 1988, with the following correction of an obvious clerical error: line 16, change "7. Chemie-Technik" into "CZ-Chemie-Technik";

pages 2 to 4 and 6 filed on 26 March 1988;

page 5 filed on 29 March 1984 with the following correction of an obvious clerical error: line 30, change "80°" into "80%";

page 7 filed on 29 March 1984 with the following amendments requested by the Applicant in his letters dated 14 January 1986 and 1 June 1988:

delete lines 17 to end of page 7.

2.2 Claim: Single claim filed on 26 March 1988.

3.3 Drawings: Sheets 1/5 and 2/5 as originally filed, renumbered 1/2 and 2/2.

The Registrar The Chairman

F. Klein K. Lederer