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**Datasheet for the decision
of 8 July 2010**

Case Number: T 1275/09 - 3.2.06

Application Number: 02702663.2

Publication Number: 1373687

IPC: F01K 21/04

Language of the proceedings: EN

Title of invention:

Integrated air separation and power generation process

Patentee:

L'AIR LIQUIDE, S.A.

Opponent:

LINDE AKTIENGESELLSCHAFT

Headword:

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Relevant legal provisions:

EPC Art. 56

Relevant legal provisions (EPC 1973):

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Keyword:

"Inventive step (no)"

Decisions cited:

-

Catchword:

-

Case Number: T 1275/09 - 3.2.06

DECISION
of the Technical Board of Appeal 3.2.06
of 8 July 2010

Appellant: L'AIR LIQUIDE, Société Anonyme pour l'Etude et
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 29 April 2009
revoking European patent No. 1373687 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: P. Alting van Geusau
Members: G. de Crignis
R. Menapace

Summary of Facts and Submissions

- I. European patent No. 1 373 687, granted on application No. 02702663.2, was revoked by the opposition division by decision announced during the oral proceedings on 2 April 2009 and posted on 29 April 2009.

Claim 1 as granted reads as follows:

"An integrated air separation and power generation process, comprising the steps of:

- a) introducing an O₂/N₂ source (24) to an air separation unit;
- b) separating the O₂/N₂ source (24) into at least an O₂-enriched gaseous stream (28) and an N₂-enriched gaseous stream (36);
- c) introducing at least a portion of the O₂-enriched gaseous stream (28), having a pressure of at least about 3 bars (300 kPa), and fuel (14) to a combustor (12) to produce a combustion mixture;
- d) burning the combustion mixture to produce at least a flue gas (18);
- e) injecting steam (16) into the combustor (12) before, during and/or after the combustion mixture burning step, to produce a modified combustion mixture of at least steam and flue gas;
- f) generating power by introducing the modified combustion mixture exiting the combustor into a first power generating means (32);
- g) heating at least a portion of the N₂-enriched gaseous stream (36), having a pressure of at least 3 bars (300 kPa); and
- h) generating power by introducing the heated N₂-enriched gaseous stream (36) into a second power generating means (42), wherein the N₂-enriched gaseous

stream (36) is heated in a heat exchanger (38) using residual heat from the flue gas-steam (FG/S) stream exiting the first power generating means (32)."

- II. The decision of the opposition division was based on the finding that the subject-matter of claim 1 was novel over the disclosure in
D1 US-A-6 148 602,
which did not include steps c), g) and h). However, the subject-matter of claim 1 did not involve an inventive step when starting from D1 and taking into account the general knowledge of the skilled person and the teaching of
D4 EP-A-1 058 074.
- III. On 16 June 2009, the appellant (patent proprietor) filed a notice of appeal against this decision and paid the appeal fee. In the statement of grounds of appeal, which was filed on 10 August 2009, the appellant requested the decision of the opposition division to be set aside and that the patent be maintained as granted. Additionally, oral proceedings were requested.
- IV. With letter of 21 January 2010, the respondent requested dismissal of the appeal and filed a number of further documents.
- V. In a communication annexed to the summons to oral proceedings according to Article 15(1) of the Rules of Procedure of the Boards of Appeal dated 8 February 2010, the Board expressed the preliminary opinion that it generally concurred with the objections specified in the decision under appeal.

VI. In reply to this communication, the appellant filed with letter of 26 May 2010 an auxiliary request, withdrew the request for oral proceedings, and announced that he would not participate in the oral proceedings.

Claim 1 of the auxiliary request differs from claim 1 as granted in that in features c) and g) the wording "at least a portion of" has been deleted.

VII. Oral proceedings were held on 8 July 2010 in the absence of the appellant.

The respondent (opponent) requested that the appeal be dismissed.

VIII. In support of his requests the appellant essentially relied upon the following written submissions:

In D1 water was introduced into the combustor. Such water injection did not correspond to claimed feature e) concerning steam injection into the combustor.

Therefore, the process according to claim 1 differed from the disclosure of D1 in four characteristics and not only in three such as concluded by the opposition division.

The problem to be solved was to improve the process disclosed in D1 with regard to the energetic efficacy.

The four distinguishing features, corresponding essentially to features c), e), g) and h) in claim 1, should not be considered in isolation but in combination because their impact on the consumption of

energy was the consequence of a functional interaction of these features. In particular the synergistic effect of features g) and e) and the antagonistic effect of features c) and g) as concerns the pressure of at least 3 bar was nowhere disclosed or suggested.

The skilled person would not consider D4 in combination with D1 because D4 was not concerned with combustion mainly using oxygen. However, when taking D4 into account, it disclosed the possibility to provide step g) as regards the heating of the nitrogen but not in combination with step e) and it did not at all disclose the combination with the pressures specified in e) and g). Therefore, as regards the process claimed, the skilled person would at least not have extended the process known from D1 by the steps c), e) et g).

The subject-matter of claim 1 of the auxiliary request stated more precisely that all the N₂- and O₂-enriched gaseous streams were concerned and hence, the corresponding objection according to which in claim 1 of the main request only a portion of the O₂- and N₂-enriched gaseous streams had to have the claimed pressure as set out in the annex to summons by the Board was addressed.

IX. The respondent essentially argued as follows:

The appellant contested the presence of the feature of steam injection in D1 but stated that irrespective of whether steam or water was introduced into the combustor, the intended use was the same, namely, to influence the temperature of the flue gas before entry into the turbine. The injection of steam represented an

injection of water, which was evident in that the subject-matter of claim 1 referred to such an injection taking place before, during and/or after the combustion mixture burning step. The prevailing temperatures at these steps immediately vaporized water, which was also acknowledged by the appellant. Moreover, no amount of water injection was specified in the claim of the patent in suit. Accordingly, D1 anticipated this part of the claimed process. The analysis of the features absent in D1 performed by the opposition division was correct.

Considering the problem of increased efficiency, itself an obvious goal for any energy production plant, the distinguishing features did not result in any combinatory effect. Furthermore it was plainly obvious to the skilled person that both flue gas and nitrogen gas should have a pressure substantially higher than atmospheric pressure. Otherwise no expansion was possible in the turbine. Using residual heat to heat up the nitrogen before expansion was shown by D4 and was a measure well known to the skilled person when trying to increase further the efficiency of an energy producing plant. Accordingly, no inventive step was involved.

The subject-matter of claim 1 of the auxiliary request included the same features as discussed above. Accordingly, the same arguments applied.

Reasons for the Decision

1. The appeal is admissible.

2. Inventive step

2.1 D1 represents the closest prior art. It discloses a process wherein an oxygen-enriched gas stream from an air separation unit is used in a combustor. The features either distinguishing claim 1 over D1 or disputed in this respect are the following:

- (a) the pressure of the O₂-enriched gaseous stream being at least about 3 bars (feature c) of claim 1);
- (b) the pressure of the N₂-enriched gaseous stream of at least about 3 bars (feature g) of claim 1);
- (c) the N₂-enriched gaseous stream is heated in a heat exchanger using residual heat from the flue gas-steam stream exiting the first power generating means (feature h) of claim 1); and
- (d) vapour is injected into the combustor before, during and/or after the combustion mixture burning step (feature e) of claim 1).

2.2 In order to define the problem to be solved, the technical effect of these features distinguishing the claimed subject-matter from the closest prior art have to be considered.

2.3 Features (a) and (b) concern the minimum pressure ratio before entry into the respective turbines. It belongs to the common knowledge of the skilled person that higher pressure ratios improve efficiency. Feature (c) is another measure improving efficiency by using residual heat to warm up the nitrogen before its entry into the turbine. The steam introduction increases the

power generated in the gas turbine by reducing the gas turbine inlet temperature and by increasing the mass flow rate through the gas turbine (see [0054] in the patent in suit). Although these features have a functional interaction in the claimed process, the Board sees no evidence of the alleged synergy provided by the combination of the distinguishing features and therefore for the reasons explained in the decision under appeal the Board agrees with the opposition division that each feature has to be examined for inventiveness independently of the others (paragraph 4.1 of the decision under appeal).

2.4 In order to assess inventive step of features (a) and (b) above, which are concerned with the pressure of the gaseous streams in the context of generally improving efficiency, the problem to be solved by these features is to define a range/lower threshold for the pressure of the gaseous streams to be used.

2.5 It is disclosed in D1 - although no specific pressure for the gaseous stream is defined therein - that at least a certain pressure has to be applied in order to obtain a minimum process efficiency when a gas turbine is used. This is disclosed with regard to the oxygen stream which is compressed in the compressor before it is passed to the combustor (col. 4, lines 31 - 34) and thus combustion takes place at a higher pressure than atmospheric pressure.

2.6 No particular advantage is disclosed for the claimed lower threshold of the pressure of at least 3 bars of either O₂- or N₂-enriched gaseous streams. With regard to the general object of the invention concerning

increased process efficiency, and when including basic thermodynamic considerations, the skilled person would inevitably apply higher pressure ratios since it is common ground for the skilled person that the higher the gas turbine entry pressure of the respective gas streams before heating-up, the higher the efficiency when they are expanded through their respective turbines.

- 2.7 Hence, the skilled person trying to improve the efficiency of the process would know that higher pressure ratios and thus elevated turbine entry pressures are more efficient and would apply them. Accordingly, the introduced features a) and b) cannot contribute an inventive step (Article 56 EPC).
- 2.8 Concerning feature (c) referring to the N₂-enriched gaseous stream being heated in a heat exchanger using residual heat from the flue gas-steam stream exiting the first power generating means, D1 can consistently be the starting point for the assessment of inventive step as it already indicates that the nitrogen-enriched gaseous stream can be used for energy recovery.
- 2.9 In order to assess inventive step of feature (c), and again in view of the general issue improving efficiency, the objective problem to be solved by this feature is that of increasing the power output efficiency of the process. In this respect the skilled person knows from basic thermodynamic considerations that increasing the temperature of the nitrogen before expansion increases the power obtainable from said expansion, thus leading to higher overall process efficiency.

2.10 Additionally, D4 suggests heating nitrogen from an air separation unit in a heat exchanger in order to raise its temperature prior to its expansion. Any heat source can be used for such purpose, and D4 directly refers to the possibility of the hot exhaust gas from the combustion being submitted to a heat exchanger. Accordingly, the skilled person is directed to such further improvement of the efficiency by the teaching of D4. Therefore feature (c) does not add any inventive measure either to the system disclosed in D1 (Article 56 EPC).

2.11 D1 refers in column 2, lines 19 to 33 and lines 60 to 63 to the addition of water to the combustor. The advantages of a reduced maximum temperature within the combustor are reported. Moreover, the water which is directed to the combustor could be separated from the turbine exhaust stream, recycled and additionally re-pressurized prior to being introduced into the combustor. In the alternative, spraying of a stream of water into the combustible gas is suggested before the filtering step in order to reduce the temperature of the combustible gas. This teaching effectively corresponds to injecting steam into the combustor before, during and/or after the combustion mixture burning step and the added water modifies the composition of the flue gas. Since the effects of injecting steam or water are substantially the same, no inventive merit can be seen in the alternative of injecting steam instead of water.

3. First auxiliary request

3.1 Claim 1 differs from claim 1 as granted in that the feature concerning the O₂- and N₂-enriched gaseous streams no longer refers to "at least a portion of" these streams.

3.2 However, neither D1 nor D4 refers to any gaseous streams used only partially. Therefore, the considerations set out above for the main request apply and the subject-matter of this claim 1 does not involve an inventive step either.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

M. Patin

P. Alting van Geusau