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File Number: T 545/90 - 3.2.3

Application No.: 82 850 254.2

Publication No.: 0 081 473

Title of invention: Improved air separation process with turbine exhaust
desuperheat

Classification: F25J 3/04

D E C I S I O N
of 18 January 1993

Appellant: UNION CARBIDE CORPORATION

Opponent: Linde Aktiengesellschaft, Wiesbaden

Headword: Air separation process/UNION CARBIDE

EPC Article 56

Keyword: "Inventive step (yes)"
"Maintenance of the patent in amended form"



Case Number : T 545/90 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 18 January 1993

Appellant :
(Proprietor of the patent)

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Danbury
Connecticut 06817 (US)

Representative :

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Respondent :
(Opponent)

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Zentrale Patentabteilung
W - 8023 Höllriegelskreuth (DE)

Decision under appeal :

Decision of the Opposition Division of the
European Patent Office dated 28 March 1990,
issued in writing on 14 May 1990, revoking
European patent No. 0 081 473 pursuant to
Article 102(1) EPC.

Composition of the Board :

Chairman : C.T. Wilson
Members : H. Andrae
J.-C. Saisset

Summary of Facts and Submissions

- I. European patent No. 0 081 473 was granted on 7 January 1988 on the basis of European patent application No. 82 850 254.2, filed on 8 December 1982.
- II. A Notice of Opposition to this patent was filed on 4 October 1988 by the Respondent (Opponent) requesting that the patent be revoked in its entirety. The opposition was based on
- D1: US-A-3 066 494
D2: DE-B-2 548 222
D3: DE-A-2 113 539
D4: US-A-3 375 673
D5: US-A-3 340 697.
- III. By its decision taken at the oral proceedings on 28 March 1990, issued in writing on 14 May 1990, the Opposition Division revoked the patent on the ground of Article 100(a) EPC. They argued that the patent had to be revoked in its totality since the subject-matter of Claim 1 was obvious having regard to the state of the art, although the Opposition Division was of the opinion that the subject-matter of Claims 9 to 12 was novel and not obvious over the disclosure of documents D1 to D5.
- IV. The Appellant (Patentee) lodged an appeal against the decision on 6 July 1990 paying the appeal fee at the same time. The Statement of Grounds of Appeal was filed on 7 September 1990. Together with the Statement of Grounds of Appeal in which reference was made to the Notice of Appeal, the Appellant filed new Claims 1 to 6, corresponding in substance to Claims 9 to 14 according to the patent as granted, and new pages 1 to 10 of the description, pointing out that the Opposition Division was

of the opinion that this subject-matter, (or more specifically the subject-matter of Claims 9 to 12 according to the "Grounds for the Decision" and the subject-matter of Claims 9 to 14 according to the "Minutes of oral proceedings"), is novel and not obvious over the documents cited by the Opponent.

V. By letter dated 5 February 1991, the Respondent (Opponent) stated that they did not intend to comment on the Appellant's Statement of Grounds of Appeal dated 3 September 1990.

VI. In a communication pursuant to Article 110(2) EPC dated 20 October 1992, the Board expressed their preliminary opinion according to which none of the prior art documents discussed in the opposition proceedings including those cited in the Search Report appeared to disclose the subject-matter of Claim 1. The documents D4 and D5 which were submitted by the Respondent only after expiry of the time limit stipulated for filing a Notice of Opposition did not seem to be more relevant than the prior art known from D1, D2 and D3 and would probably be disregarded pursuant to Article 114(2) EPC. Furthermore, objections to the claims, the description and the drawings in view of inconsistencies and of the issue of clarity were raised.

VII. In a reply to this communication filed on 1 December 1992, the Appellant submitted a new set of Claims 1 to 6, new pages 4 and 10 of the description and a new single sheet of the drawings, by implication requesting that the patent in suit be maintained on the basis of these documents.

VIII. Claim 1 amended as requested by the Appellant reads as follows:

"A process for the separation of air by rectification wherein feed air (120) at greater than atmospheric pressure is cooled substantially to its dew point and is subjected to rectification in a high pressure column (122) and a low pressure column (130), and wherein a first stream (173) having a composition substantially that of air is warmed by partial traverse (141) against said cooling feed air, said first stream (173) then sequentially being expanded and introduced into said low pressure column (130), the improvement comprising:

- (A) dividing the cooled feed air (121) into a major fraction (171) and a minor fraction (172);
- (B) introducing the major fraction (171) into the high pressure column (122);
- (C) dividing the minor fraction (172) into the first stream (173) and a second stream (174);
- (D) cooling the first stream (173) after expansion but before introduction to the low pressure column (130) by indirect heat exchange with said second stream (174); and
- (E) introducing the second stream (174) into the high pressure column (122)."

Dependent Claims 2 to 6 relate to preferred features of the process according to Claim 1.

Reasons for the Decision

- 1. The appeal complies with Articles 106 to 108 and Rules 1(1) and 64 EPC; it is admissible.
- 2. Admissibility of the amendments to the claims
 - 2.1 Claims 1 to 6 are supported by Claims 12 to 17 as originally filed.

The claims are therefore in compliance with Article 123(2) EPC.

- 2.2 Claim 1 corresponds in substance with Claim 9 as granted except for the amendment from "In a process for ..." to "A process for ...". This amendment constitutes a linguistic clarification of the term defining the category of the claim and does not extend the scope of protection conferred.

Claims 2 to 6 correspond with Claims 10 to 14 as granted.

The fact that the subject-matter of granted Claims 1 to 8 has been deleted leads to a limitation of the scope of protection as a whole.

The claims are also not objectionable under Article 123(3) EPC.

3. Novelty

In agreement with the Respondent's opinion expressed on pages 4 and 5 of the Notice of Opposition, the Board considers that DE-A-2 113 539 (D3), corresponding to US-A-3 754 406 referred to in the passage bridging pages 2 and 3 of the description, reflects the closest prior art with regard to Claim 1.

This citation describes a process for the separation of air by rectification wherein feed air at greater than atmospheric pressure is cooled substantially to its dew point and is subjected to rectification in a high pressure column (C101) and a low pressure column (C102), and wherein a first stream having a composition substantially

that of air is warmed (E102, E104) by partial traverse against said cooling feed air (cf. page 8, paragraph 2), said first stream then being sequentially expanded (K103) and introduced into said low pressure column (C102).

The subject-matter of Claim 1 is distinguished from this state of the art by the following process steps:

- (A) dividing the cooled feed air into a major fraction and a minor fraction.
- (B) introducing the major fraction into the high pressure column.
- (C) dividing the minor fraction into a first stream and a second stream.
- (D) cooling the first stream after expansion but before introduction into the low pressure column by indirect heat exchange with said second stream.
- (E) introducing the second stream into the high pressure column.

As the novelty of the process according to Claim 1 has never been disputed, further explanations on this point are superfluous.

4. Inventive step

- 4.1 In processes such as known from the closest state of the art according to document D3, in which an air fraction is employed as the unbalance stream required to control the cold end temperature difference between the cooling and warming streams of recovering heat exchangers, the air fraction can be introduced into the low pressure column

after it has been turbo expanded. Because of the superheat of this stream which would adversely affect the process in the low pressure column, temperature control of the unbalance stream is required. This could be done by exchanging some of the warm unbalance stream flow with some of the cool feed air flow which, however, would require a complex control valve arrangement. Besides, it would introduce a pressure drop on the feed air stream and lead to a thermodynamic energy loss.

The invention aims therefore to provide an improved air separation process which employs an air fraction for reversing heat exchanger cold end temperature control and for plant refrigeration while avoiding the difficulties mentioned above (cf. page 2, last paragraph to page 3, last paragraph of the subsisting description).

- 4.2 According to the solution given in Claim 1, the cooled feed air is divided into a major fraction and a minor fraction, the minor fraction being further divided into the first stream and a second stream. Due to cooling of the first stream after expansion before introduction into the low pressure column by indirect heat exchange with the second stream, the amount of superheat of the first stream when introduced into the low pressure column is relatively small as desired, without necessitating a complex control valve arrangement and giving rise to a considerable pressure drop in the feed air stream.

Thus, Claim 1 provides credibly a complete solution to the above-cited problem.

- 4.3 The Board concurs with the opinion of the Opposition Division expressed in the communication dated 6 July 1989, section 4, having regard to the appreciation of the invention vis à vis the disclosure of document D3. This

citation does not disclose the step of dividing the cooled feed air into a major fraction and a minor fraction as defined in Claim 1 according to which the major fraction is defined to be introduced into the high pressure column and the minor fraction is defined to be further divided into the first and a second stream. According to document D3, there are provided two separate streams of feed air (K101, K102) which are cooled separately. One of these streams (K101) is fed into the high pressure column, the other stream (K102) is divided (C110) into a first and a second stream, both streams being fed into the low pressure column in contrast to the invention wherein only the first stream is fed into the low pressure column and the second stream is fed into the high pressure column.

Furthermore, as taught by document D3, the first stream after leaving the turbo expander (K103) is cooled in an intermediate cooler (E105) which receives coolant in the form of nitrogen exhaust from the low pressure column (C102). Document D3 does not, therefore, provide a clue to the idea of cooling the first stream after expansion by direct or indirect heat exchange with the second stream. The system according to Claim 1 is fundamentally different in respect of several basic circuit connections and process steps in relation to the system and process disclosed in document D3 such that the latter cannot suggest the solution claimed in Claim 1.

- 4.4 US-A-3 066 494 (D1) discloses a process for the separation of air by rectification wherein feed air (10) at greater than atmospheric pressure is cooled substantially to its dew point and is subjected to rectification in a high pressure column (35) and a low pressure column (45), and wherein a first stream (58C) having a composition substantially that of air is warmed in a heat exchanger (40) by traverse against cooling air (side bleed air in

conduit (41)), said first stream then sequentially being expanded (61) and introduced into the low pressure column. A second stream of air (36, 38) from the high pressure column (35) is also warmed in the heat exchanger (40) and passed after expansion (turbine 44) to the low pressure column (45). In the heat exchanger (40), the first and second streams are warmed and are not, therefore, in heat exchange with one another.

Thus document D1 does not suggest the steps of dividing a minor fraction of the cooled feed air into the first air stream and a second stream, cooling the first stream after its expansion and introducing the second stream into the high pressure column.

In the absence of any suggestion to cool the first stream after its expansion, the basic issue of reducing the amount of superheat of the first stream before its introduction into the low pressure column is not tackled in the citation.

Thus, document D1 does not suggest the process according to Claim 1, neither in respect of the inherent problem nor of the solution as claimed.

- 4.5 DE-B-2 548 222 (D2) discloses a process for the separation of air by rectification wherein feed air (1) at greater than atmospheric pressure is cooled (heat exchanger 2) substantially to its dew point and is subjected to rectification in a high pressure column (4) and a low pressure column (5), and wherein a first stream of gas (24,25) is warmed by traverse against said cooling air. The first stream is then sequentially expanded (turbine 26) and introduced (27) into the low pressure column. A further (second) stream (12) is withdrawn from the high pressure column and is guided for indirect heat exchange

with the first stream which after expansion (turbine 26) is cooled (heat exchanger 18) by the second stream, the latter then being returned (20) to the high pressure column.

According to document D2, the cooled feed air is introduced (3) in its totality into the high pressure column (4). Thus, there is no suggestion of dividing the cooled feed air into a major fraction and a minor fraction, introducing (only) the major fraction into the high pressure column and dividing the minor fraction into a first and a second stream and treating these streams according to the further steps represented by the features D and E (cf. above section 3).

In view of the fact that the process known from document D2 does not provide a first and a second stream as defined in Claim 1, the process according to document D2 on the one hand and the process according to Claim 1 on the other hand cannot be compared with each other. Moreover, the problem underlying the process according to document D2, i.e. to provide a process which operates with an optimum of small temperature differences in particular in the cold portion of the liquefying circuit and is thus highly economical, is of a different character from that underlying the invention.

Hence, the process known from document D2 cannot suggest the teaching according to Claim 1.

- 4.6 US-A-3 375 673 (D4) was cited for the first time in the letter received on 16 May 1989 after expiry of the time limit stipulated for filing a Notice of Opposition.

Document D4 discloses an air separation process wherein feed air (10) at greater than atmospheric pressure is

cooled substantially to its dew point and is subjected to rectification in a high pressure column (24) and a low pressure column (56). Since the whole amount of feed air is introduced into the high pressure column, document D4 does not suggest dividing the cooled feed air into a major and a minor fraction, so that the considerations in preceding paragraph 4.5 in respect of document D2 apply also to document D4.

US-A-3 340 697 (D5) was cited for the first time in the letter received on 14 November 1989, i.e. also after expiry of the time limit for filing a Notice of Opposition. The examination as to its relevance reveals that document D5 discloses a process for the separation of air by rectification wherein feed air (10) at greater than atmospheric pressure is cooled substantially to its dew point and is subjected to rectification in a high pressure column (30) and a low pressure column (54). Similarly to the process known from document D4, the entire amount of feed air is introduced into the high pressure column such that no dividing of the cooled feed air into a major and a minor fraction with the major fraction of the feed air being introduced into the high pressure column takes place. The comment given in respect of document D4 is therefore equally valid with regard to document D5.

In the exercise of its discretion under Article 114(2) EPC, the Board disregards the disclosure of documents D4 and D5 because of lack of relevance as announced in the communication of the Board dated 20 October 1992.

- 4.7 Summarising, none of the documents discussed in the opposition proceedings provides either individually or in combination with one another an incentive to the solution of Claim 1.

5. In the course of the appeal proceedings, the Respondent has not forwarded any comment relating to the issue of patentability of the present claims which is in line with his announcement (cf. above section V) that he does not intend to comment on the Appellant's Statement of grounds of Appeal.

6. Summing up, the Board comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step (Articles 52(1) and 56 EPC). The patent may therefore be maintained on the basis of this Claim 1 and dependent Claims 2 to 6 which relate to preferred features of the process according to Claim 1.

The description and the drawings take account of the requirements of the EPC and are suitable for maintenance of the patent in amended form.

In the documents, the following minor amendments are necessary:

In Claims 3 and 4, reference numeral "171" should be replaced by "172".

In the description on page 9, line 14, "exhaust temperature" should be replaced by "exhaust pressure".

Order

For the above 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 maintain the patent on the basis of the following documents:

Claims: 1 to 6 filed on 1 December 1992;

Description: pages 1 to 3 and 5 to 9 filed on
7 September 1990;
pages 4 and 10 filed on 1 December 1992;

Drawings: single sheet filed on 1 December 1992;

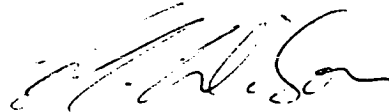
with the corrections indicated under point 6 above.

The Registrar:



N. Maslin

The Chairman:



C.T. Wilson