BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File No.: T 0965/91 - 3.2.3

Application No.: 85 304 797.5

Publication No.: 0 169 679

Classification: F25J 3/04

Title of invention: Air separation process

D E C I S I O N
of 6 July 1993

Applicant:

Proprietor of the patent: UNION CARBIDE CORPORATION

Opponent: Linde Aktiengesellschaft, Wiesbaden

Headword: Air separation process/UNION CARBIDE

EPC: Art. 56

Keyword: "Inventive step (denied)"

Headnote
Catchwords

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0965/91 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 6 July 1993

Appellant: (Proprietor of the patent)
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-

Decision under appeal:
Decision of the Opposition Division of the European Patent Office dated 27 September 1991, despatched in writing on 18 October 1991 revoking European patent No. 0 169 679 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: C.T. Wilson
Members: H. Andrä
W. Moser

Summary of Facts and Submissions

I. European patent No. 0 169 679 comprising 14 claims was granted on 14 June 1989 on the basis of the European patent application No. 85 304 797.5 filed on 5 July 1985.

II. A notice of opposition to this patent was filed on 14 March 1990 by the Respondent (Opponent) requesting that the patent be revoked in its entirety on the ground that its subject-matter lacks an inventive step particularly in the light of the following documents:

D1: DE-A-2 323 941
D2: US-A-3 210 951
D3: US-A-2 896 415
D4: US-A-3 371 496.

III. The patent was revoked by a decision of the Opposition Division dated 27 September 1991, despatched with written reasons on 18 October 1991. It was argued in the decision that the subject-matter of the independent Claim 1 according to the main request and the subsidiary requests 1 and 2 does not involve an inventive step.

IV. The Appellant (Patentee) filed a notice of appeal by telex dated 16 December 1991, confirmed by letter of 16 December 1991, received on 19 December 1991, paying the appeal fee in due time. The Statement of Grounds of Appeal was received on 18 February 1992. The Appellant requested that the patent should be maintained as granted submitting that the Opposition Division's decision was incorrect in respect of the issue of the presence of an inventive step.

V. With a communication pursuant to Article 11(2) RPBA dated 22 January 1993, the Board gave its provisional opinion about the subject-matter of granted Claim 1 emphasising that in the oral proceedings the main point of discussion would apparently be the issue of inventive step in view of the disclosure of the documents D1, D3 and D4.

VI. In response to the observations filed by the Respondent in his letter of 27 August 1992 and to the communication of the Board dated 22 January 1993, the Appellant submitted with the letter of 3 June 1993 two independent claims, designated "1" and "2", as auxiliary requests 1 and 2, respectively.

VII. With his letter dated 22 June 1993, the Respondent cited for the first time the document US-A-4 133 662 (D5). He put forward that the subject-matter of Claim 1 according to all three valid versions of the claim differs from the disclosure of document D5 only by the use of the major portion of feed air for vaporising the liquid oxygen. He pointed out that according to the patent in suit at least 50% of the feed air is conducted through the condenser-vaporiser rather than 34% pursuant to the process disclosed in document D5. At the claimed borderline of 50% feed air, any critical or even surprising phenomena could not be observed and in the process known from document D5 also partial condensing of the feed air portion used for vaporising the liquid oxygen would occur. The question of whether the minor or the major portion of feed air is used for vaporising the liquid oxygen would therefore lie within the design choice of the skilled person and could not contribute to the acknowledgement of an inventive step.

The Respondent maintains that the subject-matter of the patent in suit including the versions according to the

auxiliary requests is not based on an inventive step and requests that the appeal be rejected.

VIII. The Appellant requests that the decision under appeal be set aside and that the patent in suit be maintained on the basis of the documents as granted according to the main request or on the basis of the independent Claim "1" or "2" filed on 9 June 1993, according to the auxiliary request 1 or 2, respectively.

Claim 1 according to the main request (granted version) reads as follows:

"A process for the separation of feed air by countercurrent liquid vapour contact in a higher pressure column and a lower pressure column which are in heat exchange relation at a region where vapour from the higher pressure column cools to warm liquid from the lower pressure column and in which liquid is withdrawn from the region of heat exchange relation characterised in that:

(A) the withdrawn liquid is vaporized by indirect heat exchange with the major portion of feed air, which is at a pressure substantially the same as that of the higher pressure column, at an elevation lower than the region of heat exchange relation, to partially condense the feed air;

(B) at least some of the vapour portion of the partially condensed major portion of the feed air is introduced into the higher pressure column; and

(C) at least some of the vapour formed in step (A) is recovered at a pressure which exceeds that of the lower pressure column."

Claim 1 (numbered "1") according to auxiliary request 1 reads as follows:

"A process for the separation of feed air by countercurrent liquid vapour contact in a higher pressure column and a lower pressure column which are in heat exchange relation at a region where vapour from the higher pressure column cools to warm liquid from the lower pressure column and in which liquid is withdrawn from the region of heat exchange relation to an elevation lower than the region of heat exchange relation to create a hydrostatic head and thereby increase the pressure of the withdrawn liquid characterised in that:

(a) the withdrawn liquid is then brought into indirect heat exchange with the major portion of feed air, which is at a pressure substantially the same as that of the higher pressure column, where it is vaporised to partially condense the feed air thereby effecting a first separation of the major portion of the feed air;

(b) all of the partially condensed major portion of the feed air is introduced into the higher pressure column; and

(c) all of the vapour formed in step (a) is recovered at a pressure which exceeds that of the lower pressure column."

Claim 1 (numbered "2") according to auxiliary request 2 reads as follows:

"A process for the separation of feed air by countercurrent liquid vapour contact in a higher pressure column and a lower pressure column which are in

heat exchange relation at a region where vapour from the higher pressure column cools to warm liquid from the lower pressure column and in which liquid is withdrawn from the region of heat exchange relation to an elevation lower than the region of heat exchange relation to create a hydrostatic head and thereby increase the pressure of the withdrawn liquid characterised in that:-

(a) the withdrawn liquid is then brought into indirect heat exchange with the major portion of feed air, which is at a pressure substantially the same as that of the higher pressure column, where it is vaporised to partially condense the feed air into liquid and vapour fractions thereby effecting a first separation of the major portion of the feed air;

(b) all of the liquid and vapour fractions of the partially condensed major portion of the feed air are introduced into the higher pressure column; and

(c) all of the vapour formed in step (a) is recovered at a pressure which exceeds that of the lower pressure column."

IX. In support of his requests, the Appellant argued essentially as follows:

- All the prior art documents introduced into the proceedings and disclosing the use of feed air for vaporising liquid withdrawn from the region of heat exchange between the higher and the lower pressure column suggest that a minor portion of the feed air is used. It is the basic concept of the present invention that the major portion of the feed air

being at a pressure substantially the same as that of the higher pressure column is used for heat exchange.

- Despite the energy losses associated with passing the major portion of the feed air through the condenser against the liquid oxygen, the resulting partial condensation of the feed air initiates the air separation outside the column system. This effect reduces the number of trays necessary in the column system for a predetermined degree of separation. Due to the pressure drop within the column system resulting therefrom the column system can be operated at a higher pressure and thus the oxygen product taken off the column system is at a higher pressure.

- Whilst all the feed air in the process known from document D3 would appear to pass through the heat exchanger in which the liquid oxygen is vaporised, the feed air is clearly at a pressure substantially greater than the pressure within the high pressure column, as evidenced by the provision of the expansion valve 22 where the feed air temperature is reduced to be near or at the point of liquefaction. Preseparation, i.e. partial condensation does not, therefore, occur in this prior art construction.

- In the process according to document D4, a major portion of the feed air is passed to the heat exchangers 20,100 in order to vaporise the oxygen product produced by the column system 15, 16, the partially condensed feed air being subsequently separated into its liquid and gaseous fractions and solely the gaseous fraction is fed to the high pressure column. The advantages of the invention wherein the gaseous and the liquid fractions of the partially condensed feed air are passed to the high

pressure column cannot be achieved with the known arrangement.

- The document D5 discloses a process for the separation of feed air according to which the minor portion of the feed air is used for vaporising the oxygen product. Furthermore, the pressure of this portion of the feed air is indicated to be at least 0.7 bar higher than that of the higher pressure column which cannot be said to be substantially the same pressure. The feature concerning substantially equal pressure of the feed air portion and the higher pressure column is required for obtaining an efficient preseparation of the feed air.

Reasons for the Decision

1. The appeal is admissible

2. *Article 123 EPC*

2.1 Main request:

The subject-matter of Claims 1 to 14 corresponds in substance to that of the originally filed Claims 1 to 14.

The claims comply therefore with Article 123(2) EPC and, since they correspond with the granted version, they comply also with Article 123(3) EPC.

2.2 Auxiliary request 1:

The main claim (numbered "1") contains the following additional features:

(i) Partially condensing the feed air effects a first separation of the feed air portion;

(ii) All of the partially condensed portion of the feed air is introduced into the higher pressure column;

(iii) All of the vapour formed in step (a) is recovered at a pressure which exceeds that of the lower pressure column; and

(iv) Withdrawing liquid from the region of heat exchange relation to an elevation lower than the region of heat exchange relation creates a hydrostatic head and thereby increases the pressure of the withdrawn liquid.

Feature (i) is disclosed on page 12, lines 11 to 16 of the original description, Feature (ii) derives from page 11, paragraph 2 of the original description in combination with Figure 1 of the original drawing, feature (iii) derives from the passage bridging pages 10 and 11 of the original description and feature (iv) derives from page 10, paragraph 2 of the original description.

Features (i) and (iv) concern effects following necessarily from features which are already contained in Claim 1 as granted, i.e. partially condensing the feed air and vaporising the withdrawn liquid at an elevation lower than the region of heat exchange relation, respectively. These features do not, therefore, extend the scope of protection of granted Claim 1. The introduction of the features (ii) and (iii) leads to a limitation of the scope of granted Claim 1, i.e. to a particular amount of the partially condensed major portion of the feed air and the vapour formed in

step (a), namely "All of the partially condensed major portion of the feed air" and "All of the vapour formed in step (a)".

The main claim complies therefore with the requirements of Article 123(2) and (3) EPC. This applies also to the dependent Claims 2 to 14 which correspond with those of the granted version.

2.3 Auxiliary request 2:

The main claim (numbered "2") differs from the main Claim 1 according to auxiliary request 1 in substance by the feature that by partially condensing the feed air, liquid and vapour fractions are obtained. This feature being disclosed on page 15, lines 23 to 25 of the original description does not reflect more than the definition of the term "partially condensing" and cannot, therefore, extend the scope of the granted Claim 1.

Since the remaining features of the main claim correspond to the main claim according to auxiliary request 1, the above (section 2.2) conclusion of compliance with Article 123(2) and (3) EPC applies also to the main claim according to auxiliary request 2. This is valid also for the dependent Claims 2 to 14 which correspond with those of the granted version.

3. Novelty was not disputed by the Respondent so that this issue needs no further reasoning.

The question remaining to be decided is whether or not the subject-matter of the main claim in its versions according to the main and the auxiliary requests involves an inventive step.

4. *Main request*

4.1 In the opinion of the Board, the document D5 reflects the closest prior art in view of Claim 1.

This document discloses a process for the separation of feed air by countercurrent liquid-vapour contact in a higher pressure column (2) and a lower pressure column (3) which are in heat exchange relation at a region where vapour from the higher pressure column cools to warm liquid from the lower pressure column and in which liquid is withdrawn (15) from the region of heat exchange relation, the withdrawn liquid being vaporised by indirect heat exchange with a portion of feed air which is at a pressure substantially the same ("incrementally at least 0,7 bar", cf. column 1, lines 49 to 59 and Claim 1(b)) as that of the higher pressure column, at an elevation (4) lower than the region of heat exchange relation to partially condense the feed air (cf. column 1, lines 60 to 64 and Claim 9), at least some of the vapour portion of the partially condensed portion of the feed air (namely all of it, cf. column 3, lines 61 to 64 and Figure 1) being introduced into the higher pressure column and at least some of the vapour formed from the withdrawn liquid (i.e. all of it, cf. column 3, lines 43 to 52) being recovered at a pressure which exceeds that of the lower pressure column (substantially by the hydrostatic pressure difference between the levels of the lower pressure column (3) and the condenser - evaporator (4), cf. column 2, lines 3 to 8).

Due to the relevance of the document D5 with regard to the claimed subject-matter, the Board has admitted the citation to the proceedings even though it was late-filed.

4.2 Claim 1 differs from the disclosure of document D5 in that the portion of feed air used for vaporising the withdrawn liquid is the major portion of feed air.

In the description of the patent in suit, page 5, lines 28 to 47, the following is stated:

"The major portion of the feed air which undergoes partial condensation within condenser 11 is at a pressure which is substantially the same as that of the higher pressure column, at most 69 kPa (10 psi) ... greater than the pressure of the higher pressure column. In this way the partially condensed feed air emerging from condenser 11 may be fed directly into the higher pressure column without need for a pressure reduction ... which would be a process inefficiency .... Were a minor part of the feed air employed to carry out this function, that minor part would first require pressurization in excess of that of the higher pressure column in order to completely vaporize the liquid oxygen. This would mean that the air emerging from the condenser would have to be reduced in pressure prior to introduction into the higher pressure column resulting in a process inefficiency. Furthermore, were a minor part of the feed air employed to vaporize the liquid oxygen, it is quite likely that all of such minor part would condense. This is undesirable."

In accordance with the laws of thermodynamics vaporising a liquid by an air stream requires a given amount of heat energy to be transferred from the airstream to the liquid. The extent of cooling and the degree of condensation of the air by vaporisation of the liquid depends on the amount of the air stream in the sense that increasing of the air stream leads to a smaller extent of temperature decrease and a smaller degree of condensation of the air.

The effect of the distinguishing feature of Claim 1 is thus to be seen, in accordance with the above-cited statement of the patent in suit, in achieving that the feed air is only partially condensed.

The inherent objectively determined problem must therefore be seen in increasing the efficiency of the process, in particular avoiding that all of the feed air employed to vaporise the liquid oxygen condenses.

4.3 According to the disclosure of document D5, the partial air stream (7) employed for vaporising the product oxygen in the condenser-evaporator (4) is under a pressure of at least 0.7 bar above the pressure of the other partial air stream introduced into the higher pressure column (2).

According to Claim 1 of the patent in suit, the partial air stream which is employed for vaporising the withdrawn liquid is at a pressure substantially the same as that of the higher pressure column. In order to interpret the term "at a pressure substantially the same..." in the claim, the description and the drawing of the patent shall be used pursuant to Article 69(1) EPC.

On page 5, lines 28 to 30 of the description of the patent in suit it is indicated that the major portion of the feed air which undergoes partial condensation within condenser 11 is at a pressure which is at most 69 KPa (0.69 bar) greater than the pressure of the higher pressure column. This value of the pressure of the condenser-sided feed air is in line with the corresponding value in the process according to document D5, i.e. 0.7 bar. It must therefore be concluded that the pressure of the partial air stream employed for vaporising the product oxygen in the process disclosed

in document D5 has also to be regarded as being substantially the same as that of the higher pressure column. This conclusion is corroborated by the fact that in the process according to D5 there is no suggestion as to an intentional pressure reduction of the feed air emerging from the condenser, the feed air is rather delivered from the condenser immediately to the higher pressure column (cf. document D5, column 1, lines 42 to 48 and column 3, lines 61 to 64).

Thus, the argument of the Appellant that according to document D5 the pressure of the condenser-sided feed air portion cannot be said to be substantially the same as that of the higher pressure column and that therefore an efficient preseparation in the condenser would not occur, cannot be followed.

4.4 The skilled person faced with the problem of increasing the efficiency of the known process and in particular of avoiding that all of the feed air employed to vaporise the liquid oxygen condenses, is aware that by increasing the feed air stream through the condenser the degree of the condensation can be reduced since in this case the heat energy delivered from the feed air stream is withdrawn from an increased mass of air that undergoes a smaller degree of cooling per mass unit - subject to the same amount of heat being transferred in both cases.

Thus, the skilled person is already induced by his knowledge of thermodynamics to determine the amount of the air stream required to obtain a desired degree of condensation of the air stream emerging from the condenser which amount may be the major amount of the feed air depending upon the particular circumstances and characteristics of the process and the apparatus for carrying out the process.

4.5 On the other hand, the skilled person would also consider the disclosure of document D4 with particular reference to Figure 1. This citation discloses that liquid withdrawn (52, 53, 21) from the region of heat exchange between the higher and lower pressure columns, is vaporised by indirect heat exchange (100, 20) with a portion of the feed air (19, 19a, 19b) which is the major portion (cf. column 4, lines 1 to 51). The feed air is partially condensed in the vaporiser (100,20) and the vapour portion thereof is introduced (24a, 24b, 24) into the higher pressure column.

In this known process which deals with the basic problem of increasing the process efficiency (cf. column 1, lines 38 to 42), partial condensing of the feed air in the heat exchange with the liquid product to be vaporised effects a preseparation so that the problem of determining the appropriate degree of condensation of the feed air in view of an efficient rectification process also arises.

The skilled person would therefore be induced to envisage the solution taught in document D4, i.e. to employ a major portion of the feed air for heat exchange with the liquid product, and to substitute this solution for the employment of the minor partial airstream in the process according to document D5. He would thereby avoid the disadvantage that all of the feed air would condense and thus impair the efficiency of the separation process.

4.6 Summarising, the skilled person starting from the disclosure of document D5 and being faced with the problem of improving the efficiency of the known process, in particular avoiding that all of the feed air stream employed to vaporise the liquid oxygen condenses, would already be led by his basic knowledge of

thermodynamic processes to make use of a sufficiently great amount of the feed air stream including a major portion thereof in order to obviate condensing of all of the feed air stream in the condenser and thus a decrease of process efficiency. In the alternative, he would be taught by the disclosure of document D4 that in an air separation process comprising partial condensation of the feed air stream employed to vaporise liquid oxygen a major portion of such feed air stream is involved.

Thus, it must be concluded that the subject-matter of Claim 1 is not based on an inventive step and, consequently, the main request has to be rejected.

Claims 2 to 14 being dependent on Claim 1 can also not be maintained.

5. *Auxiliary requests*

5.1 Auxiliary request 1

Claim 1 incorporates additionally to Claim 1 according to the main request the features (i), (ii), (iii) and (iv) listed in above section 2.2. Feature (ii), i.e. all of the partially condensed portion of the feed air is introduced into the higher pressure column, is known from document D5 (cf. column 3, lines 61 to 64 and Figure 1) and feature (iii), i.e. all of the vapour formed from the withdrawn liquid is recovered at a pressure which exceeds that of the lower pressure column, is also known from document D5 (cf. column 3, lines 43 to 48).

Feature (i), i.e. "thereby effecting a first separation of the major portion of the feed air" constitutes a mere effect of a feature already present in Claim 1 of the

main request, namely that the major portion of the feed air is partially condensed.

Likewise, Feature (iv), i.e. "to create a hydrostatic head and thereby increase the pressure of the withdrawn liquid" has also to be regarded as an effect following necessarily from the feature "withdrawing liquid from the region of heat exchange relation to an elevation lower than the region of heat exchange relation" according to Claim 1 of the main request.

Thus, the further features (i) to (iv) according to Claim 1 of the first auxiliary request are also known from document D5.

5.2 Auxiliary request 2

The main claim (numbered "2") is distinguished from the main Claim 1 according to auxiliary request 1 by the feature that by partially condensing the feed air liquid and vapour fractions are obtained. This feature reflects merely the definition of the term "partial condensation" being generally known in the art.

The main claim of auxiliary request 2 does not, therefore, differ in substance from the main claim of auxiliary request 1.

5.3 It follows from the foregoing considerations that the above-cited additional features according to the independent claims of the first and second auxiliary requests as far as they do not relate to self-evident effects and generally acknowledged definitions are known from the document D5. Since this citation reflects the closest prior art from which the inherent problem has been derived, the above considerations with regard to the issue of inventive step of the subject-matter of the

main request apply also to the subject-matter of the first and second auxiliary request.

As a result of the foregoing, the independent claims of the first and second auxiliary requests can also not form a basis for maintaining the patent in suit since their subject-matter cannot be regarded as involving an inventive step (Articles 52(1) and 56 EPC).

Claims 2 to 14 of the first and second auxiliary request being dependent on their respective independent claims can also not be maintained.

Order

For these reasons, it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

N. Maslin C.T. Wilson