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D E C I S I O N
of 25 May 2004

Case Number: T 0985/02 - 3.2.3

Application Number: 95115584.5

Publication Number: 0706020

IPC: F25J 3/04

Language of the proceedings: EN

Title of invention:

Side column cryogenic rectification system for producing lower purity oxygen

Patentee:

PRAXAIR TECHNOLOGY, INC.

Opponent:

L'AIR LIQUIDE, Société Anonyme pour L'étude et L'exploitation
des procédés Georges Claude
LINDE AKTIENGESELLSCHAFT

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty - no (main request)"

"Inventive step - no (auxiliary request)"

Decisions cited:

-

Catchword:

-



Case Number: T 0985/02 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 25 May 2004

Appellant I:
(Opponent I)

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Respondent:
(Proprietor of the patent)

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Decision under appeal:

Interlocutory decision of the Opposition
Division of the European Patent Office posted
12 July 2002 concerning maintenance of European
patent No. 0706020 in amended form.

Composition of the Board:

Chairman: C. T. Wilson
Members: U. Krause
J. P. B. Seitz

Summary of Facts and Submissions

I. Appeals were lodged by Opponent I (hereinafter: Appellant I) on 12 September 2002 and by Opponent II (hereinafter: Appellant II) on 13 September 2002 against the interlocutory decision of the Opposition division dated 26 June 2002, posted on 12 July 2002, to maintain European patent No. 0 706 020 in amended form on the basis of two independent claims 1 and 2 having the following wording:

"1. A cryogenic rectification method for producing lower purity oxygen in a double column system comprising a higher pressure column (100), a lower pressure column (200), a side column (300) and a bottom reboiler (350), the method comprising:

(A) compressing (25) feed air (24);

(B) passing a major portion (3) of the compressed feed air (1) into the bottom reboiler (350), partially condensing the major portion (3) of the compressed feed air (1) within the bottom reboiler (350) and passing the resulting partially condensed, compressed major feed air portion (29) into the higher pressure column (100);

(C) turboexpanding (80) the remaining minor portion (2) of the compressed feed air (1) and passing the turboexpanded minor portion of the compressed feed air into the lower pressure column (200);

- (D) passing crude liquid oxygen (10) comprising from 50 to 88 mole percent oxygen from the lower pressure column (200) into the side column (300);
 - (E) separating the crude liquid oxygen (10) by cryogenic rectification within the side column (300) into oxygen product fluid and remaining vapor (13);
 - (F) passing remaining vapor (13) from the side column (300) into the lower pressure column (200);
 - (G) at least partially vaporizing the oxygen product fluid by indirect heat exchange with the compressed major feed air portion (3) to carry out the said partial condensation of step (B), wherein all of the vapor feed air which is passed into the higher pressure column (100) results from the partial condensation of step (B); and
 - (H) recovering oxygen product fluid as product lower purity oxygen (34,35) having an oxygen concentration which exceeds that of the crude liquid oxygen (10) and which oxygen concentration is 99 mole percent or less."
- "2. A cryogenic rectification method for producing lower purity oxygen in a double column system comprising a higher pressure column (100), a lower pressure column (200), a side column (300) and a bottom reboiler (350), the method comprising:

- (A) compressing (25) feed air (24);
- (B) passing a first portion (3) of the compressed feed air (27) into the bottom reboiler (350), partially condensing the first portion (3) of the compressed feed air within the bottom reboiler (350) and passing the resulting partially condensed, compressed first feed air portion (29) into the higher pressure column (100) of a double column system comprising a higher pressure column (100), a lower pressure column (200);
- (C) turboexpanding a second portion (2) of the compressed feed air (27) and passing the turboexpanded second portion of the compressed feed air into the lower pressure column (200);
- (D) further compressing (37) the remainder (36) of the compressed feed air (27), condensing the further compressed feed air and passing it into the higher pressure column (100) at a point above the point where the partially condensed, compressed first feed air portion (29) is passed into the higher pressure column;
- (E) passing crude liquid oxygen (10) comprising from 50 to 88 mole percent oxygen from the lower pressure column (200) into the side column (300);

- (F) separating the crude liquid oxygen (10) by cryogenic rectification within the side column (300) into oxygen product fluid (10) and remaining vapor (13);
- (G) passing remaining vapor (13) from the side column (300) into the lower pressure column (200);
- (H) at least partially vaporizing the oxygen product fluid (10) by indirect heat exchange with the compressed first feed air portion (3) to carry out the said partial condensation of step (B);
- (I) withdrawing oxygen product fluid (12) from the side column (300) as liquid, increasing said oxygen product fluid in pressure, and vaporizing the pressure-increased oxygen product fluid against the condensing further compressed feed air of step (D); and
- (J) recovering oxygen product fluid as product lower purity oxygen (34,35) having an oxygen concentration which exceeds that of the crude liquid oxygen (10) and which oxygen concentration is 99 mole percent or less."

II. The oppositions were based on the grounds of lacking novelty and/or inventive step in view of twelve documents D1 to D12. The Opposition division found that, starting from the process disclosed in D12, there was no suggestion in the prior art for having either two (claim 1) or three (claim 2) feed air streams.

III. The appeal fees were paid on 12 September 2002 (Appellant I) and on 13 September 2002 (Appellant II). The statements of the grounds of appeal were submitted on 8 November 2002 (Appellant I) and 22 November 2002 (Appellant II). In their statements, the Appellants made reference to seven further documents, D13 (Appellant I) and E13 to E18 (Appellant II).

With communication pursuant to Article 11(1) RPBA dated 12 August 2003 the Board informed the parties of its provisional opinion, drawing particular attention to documents D12 and D8. Thereafter the Proprietor of the patent (hereinafter: Respondent) submitted an amended independent claim 2 and an amended dependent claim 4 on 26 April 2004, and Appellant I advised that it would not attend the oral proceedings. During the oral proceedings which took place on 25 May 2004 in the absence of Appellant I the Respondent further amended independent claim 2 and submitted fresh dependent claims 2 and 3 of an auxiliary request. The final version of independent claim 2 is a clarified version of claim 2 as maintained by the Opposition division wherein the words "of a double column system ... a lower pressure column (200)" are deleted from step (B), the reference sign "10" for the oxygen product fluid is changed to "12" in steps (F) and (H), the reference sign "14" is added for the pressure-increased oxygen product fluid in step (I) and the reference sign "15" is substituted for the reference sign "34,35" of the product lower purity oxygen in step (J).

IV. Among the documents D1 to D13 and E13 to E18 cited during the opposition and appeal proceedings only the two documents

D8: US-A-4 704 148 and

D12: US-A-4 702 757

proved to be particularly relevant and were relied upon during the oral proceedings.

V. The Appellants I and II request that the decision under appeal be set aside and that the impugned patent be revoked.

The Respondent requests that the appeal be dismissed and that the patent be maintained either on the basis of claim 2 as filed during the oral proceedings, claims 1 and 3 as maintained by the Opposition division and claim 4 as filed with letter dated 20 April 2004 (main request), or on the basis of claim 1 as maintained by the Opposition division and claims 2 and 3 as filed during the oral proceedings (auxiliary request).

VI. The essential arguments of the parties in support of their requests can be summarized as follows:

Appellants:

Independent claims 1 and 2 did not comply with Article 123(2) because the oxygen concentration in the oxygen product fluid was originally disclosed to be in the range of 70 to 99 mole percent and, therefore, a

concentration of less than 70 mole percent, as now covered by claims 1 and 2 defining only an upper limit of 99 mole percent, was beyond the original disclosure. Further, the original application provided no basis for understanding step (D) of claim 2 in the sense that the total further compressed feed air stream was condensed.

Independent claim 2 of the main request was not new in view of document D12 taking into account that, according to the option derivable from column 2, lines 20 to 26, the entire condensed second substream leaving the vaporizer (43) could be fed to the high pressure column, resulting in merely three feed air streams (76), (28) and (44) corresponding to the first, second and third portions defined in the claims. A further compression of the second feed air stream before turboexpansion, as in expander (28) of D12, was not excluded in the claims, and the oxygen concentration of the crude liquid oxygen had to be within the range of 50 to 88 mole percent if, as in D12, the concentration of the oxygen product was 70 mole percent. Further, no difference could be seen with regard to the term "side column" in view of the fact that the term column was defined in the patent (see paragraph 0011) to include any fractionating zones, and that the fractionating zone below intermediate reboiler (112) of the lower pressure column in D12 was a fractionating zone located at the side of the higher pressure column.

Independent claim 1 of the main and auxiliary requests lacked inventive step in view of document D8 which, taking account of the options referred to in column 2, lines 23 to 25 and 38 to 45, disclosed a double

column air separation process including three feed air streams (40), (34) and (54). Since the third stream (50) served the purpose of vaporising liquid oxygen product in vaporizer (52), this stream could be omitted if the oxygen product was recovered in liquid form. Likewise, the vaporizer (52) and, consequently, the third air feed stream could be removed if the vaporization of the liquid oxygen product was effected by the bottom reboiler (42) of the side column and the vaporized product was withdrawn from above the sump of the side column in conventional manner, thereby simplifying the process.

Respondent:

Whereas no upper limit of the oxygen product purity was defined in original claim 1, independent claims 1 and 2 specified that this purity should be 99 mole percent or less. This narrowing of the originally claimed purity range was derivable from the description of the figures and, therefore, fully supported by the application as filed.

The patent was concerned with a modification of a conventional double column rectification process by producing the oxygen product fluid in a distinct side column added to the double column. This was different from the process disclosed in D12 producing the oxygen product fluid in the lower portion of the lower pressure column of the double column.

As to independent claim 2 of the main request, the high fraction of the condensed feed air stream supplied to the lower pressure column, which in the embodiment

described in D12 amounted to more than twice that supplied to the higher pressure column, was to be seen as a clear indication that the option of eliminating this feed air stream, as indicated by the word "at least" in column 2, line 21, of D12, was merely theoretical. Thus, D12 disclosed four feed air streams, as opposed to three streams defined in independent claim 2.

As to independent claim 1 of the main and auxiliary requests, the stream (40) which is partially condensed in the bottom reboiler (42) of D8 was not a "major" portion of the compressed feed air even if, optionally, the entire partially condensed stream was introduced into the high pressure column. Consequently, the remaining streams could not form "minor" portions. If in D8 the stream (50) was, optionally, passed into the high pressure column only, some vapor feed air was also passed with this stream into the high pressure column and, consequently, not all of the vapor feed to the high pressure column resulted from the partial condensation of stream (40). A skilled person would not consider omitting the vaporizer (52) and, consequently, the stream (50) in D8 because the process would not work anymore.

Reasons for the Decision

1. The appeal complies with the provisions of Articles 106 to 108 EPC and of Rules 1(1) and 64 EPC and is, therefore, admissible.

2. *Main request*

2.1 Both independent claims 1 and 2 of the main request define the oxygen product as having an oxygen concentration which exceeds that of the crude liquid oxygen and which is 99 mole percent or less (step (H) of claim 1 and step (J) of claim 2). It has to be determined whether this range, or just the narrower range of 70 to 99 mole percent, as argued by Appellant I, is derivable from the original application.

Indeed, the upper limit of 99 mole percent was disclosed in the description of figures 1 and 4 (see page 9, lines 15/16 and 31 to 33, and page 11, lines 31 to 33) in combination with a lower limit of 70 or 90 mole percent, respectively. However, the fact that original claim 1 defined the lower limit with respect to the oxygen concentration of the crude liquid oxygen ("which exceeds that of the crude liquid oxygen"), which was stated in step (C) to be within the range of 50 to 88 mole percent, is a clear indication that the lower limits of 70 or 90 mole percent are related to the particular embodiments of the process, rather than being intended to define a general lower limit of the oxygen product purity of the process which is, in original claim 1 as well as in claims 1 and 2 on file, based on the simple consideration that the side column enhances the oxygen concentration of the crude liquid oxygen.

Appellant I further argued that a condensation of the total further compressed feed air stream, as now stated in step (D) of claim 2, was not derivable from the original application. However, the description of the

embodiment of Figure 2 on page 11, lines 3 to 20 clearly states that the further compressed stream (30) is passed through the main heat exchanger into the higher pressure column, whereby this stream is condensed by heat exchange with boiling oxygen product stream (14) either in the main heat exchanger or in a separate heat exchanger located between the main heat exchanger and the liquid oxygen pump. In view of this clear disclosure of introducing the condensed further compressed stream into the high pressure column there is no room for a diverging interpretation in the sense that this stream should either be partially condensed or partially introduced into the high pressure column.

Thus, the objections of added subject-matter are not justified and the claims of the main request comply with Article 123(2) EPC. Since the amendments limit the scope of the patent as granted, the requirements of Article 123(3) are likewise met.

2.2 Concerning novelty it was found, in the impugned decision, that the subject-matter of claim 1 was distinguished from the disclosure of D12 "at least in that there are only two feed air streams", and that the subject-matter of claim 2 was distinguished from the disclosure of D12 in that it specified three feed air portions as defined in steps (B), (C) and (D). Whereas the finding on claim 1 is acceptable, the Board cannot concur with the finding on claim 2.

2.3 Comparing the feed air streams of D12 with those defined in claim 2, it is evident that feed stream (70,76) of D12 corresponds to the first portion defined in claim 2 in that it is a compressed feed air portion

passed into the higher pressure column (52) after being partially condensed in the bottom reboiler (74) of column (30).

The second portion defined in claim 2 corresponds to the combination of streams (27) and (41) which are turboexpanded in expander (28) before being introduced into the lower pressure column (30). Indeed, both streams (27) and (41) are derived from the compressed feed air in line (18) and thereby form a portion of the compressed feed air, notwithstanding any intermediate treatment such as further compression in compressor (20) or cooling in heat exchangers (26), (34) and (40).

In D12, the portion of the compressed, and further compressed, feed air which is not turboexpanded, i.e. the "remaining portion of the second substream" according to the terminology of D12, is condensed in vaporizer (43) and split, in the embodiment shown in the figure, into a portion passed into the high pressure column (52) at a point above the introduction of the first portion, and a further portion passed to the low pressure column (30). However, in view of the general description of the process in column 2, lines 20 to 25, of D12, stating that "at least" a portion of the condensed second substream is fed to the high pressure column, it is evident that the portion fed to the low pressure column, even if, as pointed out by the Respondent, in the particular embodiment shown in the figure it amounts to more than twice that fed to the high pressure column, is optional and all of the condensed second substream may be passed to the high pressure column. In this case the condensed second substream would form the third feed air stream out of

three, corresponding to the remainder of the compressed feed air defined in step (D) of claim 2.

It can, therefore, be concluded that a rectification process comprising the three feed air streams defined in steps (B), (C) and (D) of claim 2 can be derived from D12.

- 2.4 The Respondent argues that further differences between the process disclosed in D12 and the one defined in claim 2 relate to the oxygen content of the crude liquid oxygen (step (E) of claim 2) and to the separation of the crude liquid oxygen within a side column, rather than within the lower portion of the low pressure column (step (F) of claim 2).

In the patent, paragraph 0011, the terms "column" and "double column" are defined. According to this definition a double column means "a higher pressure column having its upper end in heat exchange relation with the lower end of a lower pressure column". This definition is somewhat broader than the typical arrangement of the lower pressure column on top of the higher pressure column and includes the modification disclosed in D12 whereby the lower pressure column is the part of column (30) extending from reboiler (112) upwards. If according to paragraph 0011 of the patent the term "column" is likewise understood in the broad sense to include any fractionation zone, irrespective of its physical separation from other zones or columns, in D12 the portion of column (30) below reboiler (112) and comprising bottom reboiler (74) corresponds to the side column of claim 2 as being a fractionating zone operating in the same way and being located sideways of

another zone, in this case of the high pressure column (52). The Board therefore concurs with the finding, in the impugned decision, that with regard to the term "side column" the claimed process cannot be distinguished from the process disclosed in D12.

Consequently, the crude liquid oxygen of claim 2 corresponds to the oxygen-enriched liquid descending within column (30) of D12 past reboiler (112) from the upper (lower pressure column) portion to the lower (side column) portion. The oxygen concentration of this liquid is not specified in D12, but judging from the fact that liquid product having an oxygen concentration of about 70 vol-% is withdrawn at the bottom of column (30) and from the typical oxygen concentration profile prevailing in a column of this type, the skilled person will expect the oxygen concentration of the oxygen-enriched "crude liquid oxygen" of D12 to be around 50 vol-% or somewhat higher, which will be within the range of 50 to 88 mole percent specified in step (E) of claim 2.

2.5 It is not disputed that, on the basis of the above understanding of the term "side column", the other steps of claim 2 are likewise disclosed in D12. As a consequence, the subject-matter of claim 2 lacks novelty and the main request cannot be allowed as comprising an unallowable claim.

3. *Auxiliary request*

3.1 The auxiliary request differs from the main request in that independent claim 2 is deleted and the dependent

claims are renumbered. Independent claims 1 of both requests are identical.

- 3.2 It is common ground that the subject-matter of claim 1 is novel because the documents D8 and D12, being the most relevant documents with regard to the overall process described in the appealed patent, do not disclose a process utilising only two feed air streams, a major portion which is passed into the higher pressure column after partial condensation in the bottom reboiler of the "side column", and a remaining minor portion which is turboexpanded and passed into the lower pressure column.

Further, it is not disputed that, as set out in point 6.2 of the impugned decision, the remaining cited prior art does not give a hint at a corresponding modification of the known processes. Nevertheless, the Board cannot concur with the finding that claim 1 is, therefore, not obvious.

- 3.3 The process of claim 1 differs from that defined in claim 2 of the main request, not only in the number of feed air streams, but also in that the liquid oxygen product is not pressurised before vaporization by heat exchange with the remaining feed air stream. In view of this difference document D8, disclosing a cryogenic rectification process for producing lower purity oxygen with a column arrangement similar to that of D12 but vaporizing the liquid oxygen product without preceding pressurization, is seen as the closest prior art. The embodiment depicted in the figure of D8 comprises various feed air streams to the columns. However, it is evident from the description at column 2, lines 23 to

25 and 38 to 45, that several streams are optional, corresponding to streams (28), (48) and (58) of the figure. The basic process of D8, disregarding these optional streams, comprises three feed air streams, a first feed air stream (40,46) passed to the high pressure column (56) after partial condensation in bottom reboiler (42), a second feed air stream (24,34) passed to the low pressure column after turboexpansion, and a third feed air stream (50,54) passed into the high pressure column (56) in liquid form after condensation by heat exchange with the vaporized liquid oxygen product. Considering that the second feed air stream (24) is described to comprise 9 mol-% of the total compressed feed air and the first feed air stream comprises 64.1 mol-% of the feed air stream resulting from the total compressed feed air minus the second feed air stream, the first feed air stream amounts to more than half of the total compressed feed air, thereby being a "major" portion of the compressed feed air, contrary to the corresponding argument of the Respondent. The oxygen product withdrawn at the bottom of the "side column" formed by the portion of the low pressure column (36) below intermediate reboiler (88) has a purity of 96 % by volume or less, again resulting in an oxygen concentration of the crude oxygen liquid descending within the low pressure column past the intermediate reboiler somewhere within the range of 50 to 88 mol-%.

- 3.4 The only difference between the process derivable from D8 and that of claim 1 therefore concerns the presence of the third feed air stream in D8 which is excluded in claim 1 by stating that the second feed air stream is the "remaining minor portion" of the compressed feed

air. This third feed air stream of D8 serves the purpose of vaporizing the liquid oxygen product in product vaporizer (52). Consequently, it is evident that this third feed stream is not required if the oxygen product is recovered from the bottom of column (36) in liquid form without further vaporisation, or alternatively if oxygen product is withdrawn in gaseous form from the side column above the bottom reboiler of column (36), whereby the separate vaporizer (52) can be dispensed with and the heat of vaporisation is furnished by the bottom reboiler (42). In the latter case the process is less complex but a slightly reduced purity might have to be accepted which, however, is not a crucial issue in D8.

The skilled person faced with the problem of reducing the complexity of the process of D8 or of recovering the oxygen product in liquid form will, therefore, consider omitting the third feed stream and increasing the first and second feed air streams correspondingly according to the altered heating or refrigerating requirements in bottom reboiler (42) and turboexpander (32), respectively, thereby arriving at the subject-matter of claim 1 without exerting inventive activity.

- 3.5 The Respondent argued that the process of D8 would not work if stream 50 was eliminated. The Board cannot follow this argument, on which the Respondent did not further elaborate, because the additional function of this stream in D8, after vaporizing the liquid oxygen product, to provide intermediate reflux to the high pressure column is not relevant for the operation of this column which, in a typical double column system, does the same job without such an intermediate reflux.

Omitting the third feed air stream (50,54) in D8 further results in the major first feed air stream being the only feed stream to the high pressure column and, therefore, in all of the vapor feed air to this column resulting from the partial condensation of this feed air stream in reboiler (42). It is noted, however, that this condition of step (G) of claim 1 would also be met without eliminating stream (54) which is described, in column 4, line 30, of D8, to result from total condensation of third feed air stream (50) and, therefore, has no vapor fraction to be introduced into the high pressure column.

4. In summary, the independent claims of the main and auxiliary request are not allowable and, therefore, the grounds of opposition under Article 100(a) relied on by the Appellants prejudice the maintenance of the patent.

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:

A. Counillon

C. T. Wilson