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**Datasheet for the decision
of 9 October 2007**

Case Number: T 0865/04 - 3.2.03

Application Number: 99300415.9

Publication Number: 0931999

IPC: F25J 3/04

Language of the proceedings: EN

Title of invention:

A multiple expander process to produce oxygen

Patentee:

AIR PRODUCTS AND CHEMICALS, INC.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 54(2), (3), 56, 123(2), 82

Keyword:

"Novelty (yes)"
"Inventive step (yes)"
"Unity (yes)"
"Added subject-matter (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0865/04 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 9 October 2007

Appellant: AIR PRODUCTS AND CHEMICALS, INC.
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Representative: Burford, Anthony Frederick
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 2 January 2004
refusing European application No. 99300415.9
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: U. Krause
Members: C. Donnelly
K. Garnett

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division, posted on 2 January 2004, to refuse European Patent application No. 99300 415.9. In its decision, the examining division essentially reasoned that the amendment to claim 1 of the main request filed with letter of 12 September 2003, whereby a feature of step (c) had been deleted, introduced subject-matter which extended beyond the content of the application as originally filed in breach of Article 123(2) EPC. Since the same amendment appeared in the auxiliary requests 1 to 5, it was also found that these too failed to meet the requirements of Article 123(2) EPC.

The examining division also commented that, even if the objection under Article 123(2) EPC were overcome by reintroducing the deleted feature, the requirements of Articles 84 and 56 EPC would not be fulfilled for the reasons presented in the official communication of 26 June 2002 and the summons to the oral proceedings dated 13 June 2003.

The examining division also found that the subject-matter of the independent apparatus claim 5 did not meet the requirements of Article 82, 54(3) and 56 EPC.

II. *Prior art*

The following documents were cited by the examining division:

- D1: US-A-4 796 431 (in particular figures 4 and 6);
- D2: EP-A-0 556 516 (in particular figure 7);
- D3: US-A-5 678 427 (in particular figure 4);

- D4: US-A-4 936 099 (in particular figure 2);
- D5: US-A-5 146 756
- D6: EP-A-0 902 245 (prior art under Article 54(3) EPC,
in particular figure 4).

III. The appellant (patent proprietor) filed a notice of appeal on 2 March 2004 together with the appeal fee. The grounds of appeal were filed on 4 May 2004.

The Board issued a provisional opinion in a communication under Article 110(2) EPC dated 11 May 2006 and in particular invited the appellant to file a new set of claims in the one-part form in order to simplify the language employed.

The applicant filed new sets of claims in the one-part form with letter of 15 September 2006. The Board issued a further provisional opinion in a communication pursuant to Article 11(1) RPBA annexed to the invitation to oral proceedings.

IV. The oral proceedings took place before the Board on 9 October 2007. At the end of the debate, the appellant:
(i) requested that the impugned decision be set aside and a patent be granted on the basis of claim 1 according to the sole request filed during the oral proceedings; and
(ii) confirmed that the request for reimbursement of the appeal fee had been withdrawn.

The independent method claim 1 as filed during the oral proceedings reads as follows:

"A process for the cryogenic distillation of a feed air stream (100) in a distillation column system comprising a higher pressure distillation column (196) and a lower pressure distillation column (198) wherein at least a portion (106) of the feed air (100) is fed to the higher pressure distillation column (196), product oxygen (170) with oxygen concentration less than 99.5% is produced at the bottom of the lower pressure distillation column (198) and boil-up at the bottom of the lower pressure column (198) is provided by condensing (193) a stream (152) from the higher pressure distillation column (196) whose nitrogen concentration is greater than that in the feed air stream (100), wherein:

(a) work energy which is at least ten percent (10%) of the overall refrigeration demand of the distillation column system is generated by

(1) work expanding (139) a first vapor process stream (254;538) withdrawn from the higher pressure distillation column (196) and having a nitrogen content greater than that in the feed air and then condensing at least a portion of the expanded stream (240,540) by latent heat exchange (194,394) with at least one of:

(i) a liquid at an intermediate height in the lower pressure distillation column (198) and
(ii) one of the liquid feeds (136) to the lower pressure distillation column (198), having an oxygen concentration greater than the concentration of oxygen in the feed air and being at least a portion of an

oxygen-enriched liquid (130) which is withdrawn from the higher pressure distillation column (196); or

(2) condensing (194) a second vapor process stream (154), withdrawn from the higher pressure distillation column (196) and having a nitrogen content greater than that in the feed air (100) by latent heat exchange with at least a portion (136) of an oxygen enriched liquid stream (130) which is withdrawn from the higher pressure distillation column (196) and has an oxygen concentration greater than the concentration of oxygen in the feed air (100) and which is also at a pressure greater than the pressure of the lower pressure distillation column (198) and after vaporisation of at least a portion of said liquid stream (130) into a vapor fraction (137) due to the latent heat exchange (194), work expanding (139) at least a portion (138) of the resulting vapor stream;

(b) a third process stream is work expanded (103;403;503) to produce additional work energy such that the total work generated along with step (a) exceeds the total refrigeration demand of the cryogenic distillation column system, said third process being selected from a portion (104) of feed air that is eventually fed to the lower pressure distillation column (198) and a nitrogen-rich product vapor stream (404; 504) withdrawn from the higher pressure distillation column (196) and

(c) the work energy exceeding the total refrigeration demand of the cryogenic distillation column system is used external to said system."

Reasons for the Decision

1. *Article 84 EPC*

The meaning of the expression used in step (b) of claim 1 wherein "additional work energy such that the total work generated along with step (a) exceeds the total refrigeration demand of the cryogenic distillation column system" does not necessarily mean that the system is out of equilibrium and is cooling down since it must be seen in conjunction with feature (c), which requires this excess work energy to be used external to the cryogenic distillation column system (i.e. the cold-box - see paragraph 32 of the published application) .

2. *Article 123(2) EPC.*

The examining division based its objection on the deletion of the feature of the work expansion of the third process stream under step (c) of the originally filed claim 1 reading:

"if the third process stream is the same as the first process stream in step (a)(1), at least a portion of said third process stream after work expansion is not condensed against either of the two liquid streams described in step (a)(1)".

Although this feature also does not appear in this form in claim 1 of the sole request filed during the oral proceedings, it is effectively comprised by the requirements:

(i) that in step (a) 1 the first vapor process stream withdrawn from the higher pressure distillation column has a nitrogen content greater than that in the feed air;

(ii) that in step (b) that the third process is selected from a portion of feed air that is eventually fed to the lower pressure distillation column and a nitrogen-rich product vapor stream.

Requirement (i) means that the first stream cannot be the feed air and requirement (ii) specifically states that the other alternative in step (b) is a product vapor stream i.e. it is exhausted from the system as vapor and therefore not condensed.

As a consequence of the restriction of the first vapor stream to a nitrogen-rich vapor stream, the condition deleted from original claim 1 can only refer to a case where the first and third process streams are both nitrogen rich vapor streams and is satisfied by requirement (ii).

Hence, this objection has been overcome by the amended claim.

3. *Novelty (Articles 54 (2) and (3) EPC)*

3.1 *Article 54(3)EPC - D6*

D6 constitutes prior art according to Article 54(3) EPC.

In D6, the most relevant processes of figures 4 and 5 show that nitrogen-rich vapour (62) from the HP

column (20) is work-expanded (64), thus corresponding to step a(1)(i) of claim 1. However, the nitrogen rich product stream 104 which is work-expanded in turbine (106) is taken from the LP column rather than the HP column and the feed-air (46) expanded in turbine (100) is fed to the HP rather than the LP column as required for the third process stream by step (b) of claim 1.

This distinguishing feature is also present in independent apparatus claim 14.

Hence, the subject-matter of claims 1 and 14 is new with respect to D6.

3.2 *Prior art according to Article 54(2) EPC*

The process of **figure 4 of D1** differs from that of claim 1 according to the main request in that:

- the nitrogen-rich stream described in column 5, lines 40 to 48 as being an additional option for the process is not a product vapour stream as required by step b of claim 1 since it is condensed to provide reflux to the system;
- there is no explicit indication that excess work energy is exported from the system as required by step (c).

The process of **figure 6 of D1** differs from that of claim 1 at least in that:

- the bottom boil-up of the LP column is provided by feed air.

The process of **figure 7 in D2** differs at least in that:
-the bottom boil-up of the LP column (116) is not provided by a nitrogen rich stream from the HP column but by a portion of feed air (112).

The process according to **figure 4 of D3** differs in that:

- the expanded feed air is fed to the HP column, thus if feed air is selected as the third process stream, then the requirement for feeding to the LP column is not met;
- the nitrogen-rich vapour (64) from the HP column (10) is fed (69) into the LP column after work expansion (30) and is not a product vapor stream;
- the work expansion only meets the refrigeration demand (ref col. 6, lines 7-10); hence, by implication, step (c) is also not met as there is no work energy excess.

The processes depicted in **D4 figures 1,2 and 3** all use feed air (30) to provide boil-up (32) at the bottom of the LP column (31). Further, only an oxygen-rich process stream (80) derived from the HP column is expanded; there is no mention of expanding a further stream.

D5 shows a process wherein a portion of feed air is work expanded and fed into the LP column but there is no indication of the work expansion of either of the streams defined in steps 1 or 2 of claim 1.

The remaining document of the search report, DE-A-3307181, relates to an air distillation plant in which an oxygen-rich stream from the LP column is expanded in turbine 16.

The subject-matter of claim 1 according to claim 1 of the sole request is therefore new and meets the requirements of Article 54 EPC.

4. *Inventive step (Article 56 EPC)*

Figure 4 of D1 is considered to be the nearest prior art as this shows an expansion arrangement for a double column system wherein the boil-up at the bottom of the LP column is provided by a nitrogen rich stream taken from the HP column. The process of figure 6 cannot be considered the nearest prior art since it is representative of a fundamentally different class of distillation system which uses feed air to provide boil-up in the LP column. As argued by the appellant, the skilled person knows that these two types of boil-up are not interchangeable without causing a cascade of knock-on effects in the system. In particular, using air to provide bottom boil-up has the advantage of allowing lower air pressure but comes with the associated disadvantage of lower oxygen recovery which the skilled person has to balance out. The same argument would apply to the processes according to figure 7 of D2 and figures 1,2 and 3 of D4 .

D1, in particular figure 4, describes:

a process for the cryogenic distillation of a feed air stream in a distillation column system comprising a

higher pressure distillation column (5) and a lower pressure distillation column (3) wherein at least a portion of the feed air is fed to the higher pressure distillation column (5), product oxygen with oxygen concentration less than 99.5% is produced at the bottom of the lower pressure distillation column (3) and boil-up at the bottom of the lower pressure column (3) is provided by condensing (27) a stream from the higher pressure distillation column (5) whose nitrogen concentration is greater than that in the feed air stream, wherein:

(a) work energy which is at least ten percent (10%) of the overall refrigeration demand of the distillation column system is generated by

-work expanding (E) a first vapour process stream withdrawn from the higher pressure distillation column (5) and having a nitrogen content greater than that in the feed air and then condensing at least a portion of the expanded stream by latent heat exchange (15) with a liquid at an intermediate height in the lower pressure distillation column, and

b) a third process stream is work expanded (see column 5, lines 40 to 50 "second NIPER") to produce additional work energy, such that the total work generated along with step (a) exceeds the total refrigeration demand of the cryogenic distillation column system, said third stream being a nitrogen-rich vapour stream withdrawn from the higher pressure distillation column (5).

The subject-matter of claim 1 differs therefrom in that:

- said nitrogen-rich product vapour stream withdrawn from the higher pressure distillation column and

denominated as "third process stream" in claim 1 is a product vapour stream, i.e. it is exported from the system as vapour and is neither condensed after expansion nor fed back into the system;

and

- the work energy exceeding the total refrigeration demand of the cryogenic distillation column system is used external to said system.

These distinguishing features also find expression in the corresponding independent apparatus claim 14.

By work-expanding a second stream in this manner the efficiency of the air separation process under certain operating conditions is apparently increased by reducing power consumption and main heat-exchanger requirements whilst maintaining low purity oxygen production levels. A comparison of prior art processes with that of the invention for the production of 95% purity oxygen, which backs up this assertion, is given in the application as filed from page 12, line 24 to page 15, line 18.

The objective technical problem can therefore be seen to be one of increasing efficiency of the process whilst maintaining low purity oxygen production levels. It is not considered that the skilled person faced with this problem would have modified the process according to figure 4 of D1 in the above manner since there is no hint in this direction in the available prior art. Further, the solution would prima facie appear counter-intuitive because boil-up to the LP column is reduced. Such a reduction would normally be expected to require compensation by an increase in the amount of feed air

to the plant and/or the operating pressure into the feed air expander in order to maintain oxygen production levels with the attendant increase in power requirements and a reduction in efficiency that this implies.

The particular dual expansion process specified in claim 1 apparently circumvents such limitations.

D5 is the only document which directly mentions the export of excess work energy from cryogenic installations. However, in this case the high pressure nitrogen stream is provided by the low pressure column (which operates at higher than conventional pressures) and the expansion takes place partly outside of the cold-box. Thus, it is not considered that the skilled person combining the teachings of D5 with those of D1 would arrive at the subject-matter of claim 1.

Thus, the subject-matter of claims 1 and 14 meets the requirement of Article 56 EPC.

5. *Article 82 EPC*

As argued by the appellant in letter of 8 August 2007 and during the oral proceedings, the common inventive concept is to be seen in the sacrifice of the amount of HP GAN available for bottom boil-up of the LP column. This is obtained in step (b) of claim 1 either directly by work-expanding a portion of the HP GAN leaving the HP column to a product vapor stream or indirectly by work-expanding a portion of the feed-air going to the LP column which in turn leads to a reduction in the

amount of HP GAN leaving the HP column available for reboil.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the examining division with the order to grant the patent on the basis of:
 - (a) claims 1 to 24 as filed during the oral proceedings;
 - (b) the description pages 1 to 15 as filed during the oral proceedings;
 - (c) Figures 1 to 8 as originally filed.

Registrar

Chairman

A. Counillon

U. Krause