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**D E C I S I O N**  
of 17 January 1995

**Case Number:** T 0195/92 - 3.2.3  
**Application Number:** 87101653.1  
**Publication Number:** 0231949  
**IPC:** F25J 3/02, F25J 3/08, C07C 7/04,  
C07C 9/04

**Language of the proceedings:** EN

**Title of invention:**  
Process to separate nitrogen and methane

**Patentee:**  
UNION CARBIDE CORPORATION

**Opponent:**  
LINDE AG  
KOCH Process Systems Inc.

**Headword:**

**Relevant legal provisions:**  
EPC Art. 56, 82, 84, 123  
EPC R. 29(1)

**Keyword:**  
"Inventive step (yes)"

**Decisions cited:**  
G 0001/91

**Catchword:**



Case Number: T 0195/92 - 3.2.3

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.3**  
**of 17 January 1995**

**Appellant:** UNION CARBIDE CORPORATION  
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**Respondent:** LINDE AG, Wiesbaden  
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**Respondent:** KOCH Process Systems Inc.  
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**Representative:** Myerscough, Philip Boyd  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office dated 9 December 1991 with  
written grounds sent on 30 December 1991 revoking  
European patent No. 0 231 949 pursuant to  
Article 102(1) EPC.

**Composition of the Board:**

**Chairman:** C. T. Wilson  
**Members:** J. du Pouget de Nadaillac  
L. C. Mancini

## Summary of Facts and Submissions

I. The present appeal is directed against the decision of the Opposition Division dated 9 December 1991, the written grounds having been sent on 30 December 1991. By this decision, the Opposition Division revoked the European patent No. 0 231 949 (based on European patent application No. 87 101 653.1) on the grounds that the subject-matter of Claim 1, in an amended form, lacks novelty having regard to document D1 (DE-B-2 122 707) and that Claim 2 infringes Article 123(3) EPC. Even if Claim 1 were to be amended as proposed by the Patentee during the opposition proceedings, the subject-matter of Claim 1 would not involve an inventive step in the light of the additional teaching of document D2 (EP-A-0 132 984).

II. The Appellant (Patentee) filed the appeal on 2 March 1992 and paid the appeal fee on the same date. The Statement of Grounds was filed on 30 April 1992. It was accompanied by a set of claims and new pages of the description.

By a letter dated 26 August 1992, Respondent I (Opponent I) attacked the new independent Claims 1 and 2 as lacking inventive step in view of document D1.

Respondent II (Opponent II), in a letter received on 24 November 1992, raised objections under Article 100(b) and (c) and, further, contested the patentability of the new claims, since they provide an improperly defined solution to an undefined problem.

III. Oral proceedings took place on 17 January 1995. Respondent II had previously indicated by a letter received on 12 August 1994 that he would not participate further in the appeal proceedings.

At the oral proceedings, the Appellant filed a complete set of documents, namely amended Claims 1 to 12, amended description pages 2, 3, 3a, 3b, 4, 5 and 6 and Figures 1 and 2.

IV. The two independent claims, namely Claims 1 and 2, which correspond to the embodiments of Figures 1 and 2 respectively, read as follows:

"1. A process for the separation of nitrogen and methane employing double column cryogenic rectification in a nitrogen rejection unit comprising the recovery of methane at a pressure which exceeds that of methane as it emerges from the nitrogen rejection unit by the steps of:

- (a) partially condensing incoming vapor (111) containing nitrogen and methane, separating said partially condensed incoming vapor (114) into a vapor portion (128) and a liquid portion (115), and passing said liquid portion (115) as feed into and down a high pressure stripping column (102) operating at a pressure in the range of from 13.8 to 41.4 bar (200 to 600 psia);
- (b) passing feed down the stripping column (102) against upflowing vapor to produce stripping column bottom liquid (120) having a methane concentration which exceeds that of the feed, and stripping column top vapor (133) having a nitrogen concentration which exceeds that of the feed;

- (c) partially vaporizing bottom liquid (120) to produce nitrogen-richer vapor (122) and methane-richer fluid (123);
- (d) employing the nitrogen-richer vapor (122) in the stripping column (102) as upflowing vapor;
- (e) passing at least some of the stripping column top vapor (133) to a nitrogen rejection unit (106, 108) for separation by double column cryogenic rectification into nitrogen-richer and methane-richer fractions (151 and 163, respectively);
- (f) recovering methane-richer fluid (123) from step (c) at a pressure which exceeds that of the methane-richer fraction (163) as it emerges from the double column nitrogen rejection unit (106, 108); and
- (g) passing at least some of the vapor portion (128) of step (a) to the nitrogen rejection unit (106, 108) for separation into nitrogen-richer and methane-richer fractions (151 and 163, respectively).

2. A process for the separation of nitrogen and methane employing double column cryogenic rectification in a nitrogen rejection unit comprising the recovery of methane at a pressure which exceeds that of methane as it emerges from the nitrogen rejection unit by the steps of:

- (a) partially condensing incoming vapor (211) containing nitrogen and methane, and separating said partially condensed incoming vapor (214) into a vapor portion (228) and a liquid portion (215);
- (b) liquefying at least some of the vapor portion (228) of step (a);

- (c) passing said liquid portion (215) of step (a) and the liquified stream (273) resulting from step (b) as feed into and down a high pressure stripping column (202) operating at a pressure in the range of from 13.8 to 41.4 bar (200 to 600 psia);
- (d) passing feed down the stripping column (202) against upflowing vapor to produce stripping column bottom liquid (220) having a methane concentration which exceeds that of the feed, and stripping column top vapor (233) having a nitrogen concentration which exceeds that of the feed;
- (e) partially vaporizing bottom liquid (220) to produce nitrogen-richer vapor (222) and methane-richer fluid (223);
- (f) employing the nitrogen-richer vapor (222) in the stripping column (202) as upflowing vapor;
- (g) passing at least some of the stripping column top vapor (233) to a nitrogen rejection unit (206, 208) for separation by double column cryogenic rectification into nitrogen-richer and methane-richer fractions (251 and 263, respectively); and
- (h) recovering methane-richer fluid (223) from step (e) at a pressure which exceeds that of the methane-richer fraction (263) as it emerges from the double column nitrogen rejection unit (206, 208)."

V. The Appellant submitted essentially the following arguments.

The claimed invention aims at improving the process in question, so that it works more efficiently, in particular when a lower available nitrogen concentration

is present and when a higher carbon dioxide concentration in the nitrogen-methane feed has to be tolerated.

The column (8) shown in document D1 upstream of the nitrogen rejection unit (NRU) does not correspond to the stripping column of the present invention, as defined in the description of the patent in suit. More important, however, are the two phase separations disclosed respectively in Claim 1, by features (a) and (c)-(d), and in Claim 2, by features (a)-(c) and (e)-(f). In cooperation with features (e), (g) of Claim 1 and feature (g) of Claim 2, they increase the nitrogen content of the vapour feed to the NRU. They also reduce the CO<sub>2</sub> content, in particular features (b) and (c) of Claim 2. The first phase separation also creates a difference in the energy requirement; it can be operated at high pressure so that, at the end of the process, the obtained product streams can still be at a relatively high pressure.

No hint to these process steps can be found in document D1. Having regard to document D2, it shows a quite different process, so that it cannot be combined with document D1.

VI. Respondent I expressed the opinion that if it is right that the figures of the patent in suit show two phase separations as distinguishing features vis-à-vis the teaching of document D1, the wording of the claims does not indicate clearly these differences. In fact, the features (c) and (g) of Claim 1 can be read on the figure of document D1. Moreover, the first phase separation is a choice, which can be made by the person skilled in the art according to the circumstances. It does not show a great difference, having regard to the upper part of column 8 in document D1, where a

separation takes place. To make a separation outside this column, instead of inside, cannot be considered as inventive.

Considering now the second phase separation, such a separation is well-known in the art, see in this respect document D2. It is obvious to use a reboiler as shown in this last document, instead of the one shown in document D1.

The same objections apply to Claim 2. The feeding to the top of the stripping column of the liquefied vapour portion from the phase separator fulfils the same function as the direct feed of the liquid portion of the phase separator.

VII. The Appellant requested that the decision under appeal be set aside and that the patent be maintained with the documents presented at the oral proceedings.

The Respondents requested that the appeal be dismissed.

#### **Reasons for the Decision**

1. The appeal is admissible.
2. During the oral proceedings, the parties agreed that the new claims do not infringe Article 123(2) and (3) EPC. However, Respondent II, who was not present in the oral proceedings, raised in his correspondence objections under said Article 123(2) EPC, mainly in connection with Article 84 EPC. Therefore these objections, which all concern the following words of feature (a) of Claims 1 and 2, are examined:



- (a) "... partially condensing **incoming vapor** ...":

The fact emphasised by Respondent II that this word "incoming" appears in the original disclosure of the contested patent only in connection with the now cancelled Figure 3 or that a pretreatment of the vapour is envisaged, do not seem to constitute sufficient reasons for asserting that this word is not supported by said original disclosure. Claims 1 and 2 each concern a process and the feed stream which **enters** the process **as claimed** is clearly described in the description as filed as being a vapour and, thus, can be qualified as being the incoming vapour, whatever its exact composition is. The meaning of this expression seems, therefore, to be clear (Article 84).

- (b) "... separating said partially ... and a liquid portion":

Page 8 of the original description clearly indicates that the whole stream 112 or 114 passes through the phase separator 101, so that this contested feature apparently is supported by the description as filed. The Board does not see any reason why it should be necessary to emphasise that the condensed vapour is in the meantime expanded or which liquid is separated from the vapour, as argued by Respondent II.

- (c) "... passing said liquid portion as feed":

In the Respondent's opinion, it is not the "liquid portion" of the phase separator which is fed to the stripping column since it is in the meantime expanded.

According to Rule 29(1), a claim must only indicate the features which are essential for the invention in suit. It is therefore unnecessary to detail all the steps of a process, when some of them are not essential or are obvious for the person skilled in the art. In the present case, it is known that a partially condensed vapour must be reduced to below its critical pressure before it is introduced to a stripping column, so that a two-phase stream is fed to the stripping column to render separation possible, see in this respect EP-A-0 068 587. The feed steam needs also to be throttled to a pressure compatible with the stripping column. Apparently, Claims 1 and 2, therefore, only indicate in this respect the essential feature of the invention in suit, namely that it is the liquid fraction of the separator which is fed to the stripping column.

These words of the main claims are consequently clear and well-supported by the description. Thus, the new claims are admissible having regard to Articles 84 and 123 EPC.

3. The further objection raised by Respondent II that a lack of unity of invention in the sense of Article 82 EPC exists between Claims 1 and 2 of the present invention, cannot be taken into consideration. It was established in the Enlarged Board of Appeal decision G 1/91, OJ EPO 1992, 253 that it is irrelevant in opposition proceedings that the European patent as granted **or amended** does not meet the requirement of unity of invention.

4. None of the cited documents shows all the particular features of the main Claims 1 and 2. This was no longer disputed in the oral proceedings. Therefore, the subject-matter of Claims 1 and 2 is novel in the sense of Article 54 EPC.

5. The closest state of the art is the process for the separation of nitrogen and methane employing double column cryogenic rectification in a nitrogen rejection unit (hereinafter called NRU), which is disclosed by document D1. One advantage of this known process is the recovery of methane at a pressure which exceeds that of methane as it emerges from the NRU - an advantage which is also obtained by the present invention.

This known process comprises the following steps, which can be seen in the single figure of this document:

(a) after having been pretreated in a heat exchanger and following separator (4) so as to remove higher hydrocarbons and natural gas liquids, the incoming vapour, which now contains essentially nitrogen and methane, is partially condensed by passing through heat exchangers and an expansion valve. **The resulting two-phase stream** is introduced as feed into a stripping column (8) **at an intermediate level** thereof; this column operates at a pressure of about 33 ata, thus within the range of from 13.8 to 41.4 bar of the stripping column of the present invention;

(b) said feed follows then the step (b) of Claims 1 and 2, namely the phase separation in the stripping column, resulting in a nitrogen-richer top vapour and a methane-richer bottom liquid;

- (c) **a part of the stripping column bottom liquid is partially vaporised in heat-exchanger (6), which serves as a reboiler, so as to produce nitrogen-rich vapour and methane-rich fluid;**
- (d) **the two-phase stream emerging from step (c) is returned to the stripping column, at a low level thereof, so that the nitrogen-rich vapour of this stream is employed in the stripping column as upflowing vapour;**
- (e) at least some of the stripping column top vapour is passed to the NRU for separation by double column cryogenic rectification into nitrogen-rich and methane-rich fractions;
- (f) **the other part of the stripping column methane-rich bottom liquid is recovered at a pressure of 32 ata, namely a pressure which exceeds the pressure of the methane-rich fraction which emerges from the NRU.**

## 6. *Distinguishing features*

- 6.1 Respondent I, although recognising that Figure 1 of the patent in suit clearly shows the differences, contests that the wording of Claim 1, as far as features (c) and (g) are concerned, clearly indicates the steps which are truly carried out and thus shows some differences vis-à-vis the teaching of document D1. Feature (c) of Claim 1 does not indicate a phase separation and the reboiler shown in document D1 vaporises the stripping column bottom liquid, so that feature (c) is fulfilled in this prior art. Feature (g) of Claim 1 by mentioning only that at least some of the vapour portion, and not the

whole vapour portion, is passed to the NRU, does not exclude the passage of the vapour portion inside of the stripping column, as is shown in document D1.

6.2 The Board cannot follow these arguments. A claim must be read as a whole, and it is not correct to isolate a feature without considering the other features with which it may be in relation. Moreover, if any doubt in the interpretation of a feature arises, this feature should be interpreted in the light of the description (Article 69 EPC).

6.3 In the present case, features (c), (d) and (f) clearly indicate a phase separation, since feature (c) calls for a vaporisation of the bottom liquid emerging from the stripping column, **so that** streams of **different** compositions, namely a **nitrogen-richer vapour** and a **methane-richer fluid**, are produced. According to feature (d), the nitrogen-richer vapour is used as reflux vapour for the stripping column, whereas according to feature (f) the methane-richer fluid is recovered as high pressure methane fluid. Thus, even if not explicitly mentioned, a phase separation of the stripping column bottom liquid is disclosed. In the process according to document D1, indeed a splitting of the corresponding bottom liquid occurs, but the two streams have the same compositions, and thus it is not a phase separation. Considering now only one of these two streams, namely the only one used to reboil the stripping column, it corresponds to one of both reboiling sources of the patent in suit, namely the one given in dependent Claim 12, in which it is stated that a liquid stream is removed from the stripping column, partially vaporised and returned to the stripping column. No separation of this last stream occurs. Features (c), (d) and (f) of Claim 1 of the patent in suit relate to the other reboiling source, in which only the nitrogen-richer

vapour is returned to the stripping column, as already seen above. The figures of the patent in suit each clearly show both embodiments of reboiling sources.

- 6.4 Since feature (g) clearly specifies the vapour portion **of step (a)**, it is clear that it is the vapour portion of the phase separation given in feature (a) which is concerned, and not the vapour portion of the stripping column. In document D1, only this last vapour portion is fed to the NRU.

The Board, also, does not see for which reason it should be indicated that it is the **whole** vapour portion of step (a), which is passed to the NRU. Claim 2 and Figure 2 of the patent in suit teach a different use of this vapour portion and, thus, a combination of both uses can be envisaged. Thus, the indication that the whole vapour portion is passed to the NRU, would be an excessive limitation of feature (g). Moreover, it cannot be certified that the whole vapour portion is always removed from the top of a phase separator, since a separation is not perfect.

- 6.5 Therefore, the process according to Claim 1 of the present invention differs from the process known from document D1 in that:

- The incoming vapour, once partially condensed as is the case in the known prior art process, is separated (in phase separator 101) into a vapour portion and a liquid portion; the liquid portion is fed to the stripping column, whereas at least some of the vapour portion is passed to the NRU (features (a) and (g) of Claim 1). Said separation arranged upstream from the stripping column will hereinafter be referred to as the first separation.

- A second separation, as seen above in point 6.3, is provided for the bottom liquid of the stripping column, and it is the resulting methane-richer fluid which is recovered as high pressure methane gas (features (c) and (f) of Claim 1), while it is only the resulting nitrogen-richer vapour which is used as upflowing vapour for the stripping column.

Claim 2, which concerns the embodiment shown in Figure 2 of the patent in suit, differs from Claim 1 in that the vapour portion of the first separator, instead of being passed to the NRU, is liquefied and returned to the top of the stripping column (features (a) to (c) of Claim 2).

## 7. *Problems to be solved*

7.1 Because of the separation of a nitrogen vapour stream which is obtained from the first separation and directly fed to the NRU, additionally to the nitrogen stream withdrawn from the stripping column, the NRU receives a higher content of nitrogen and a liquid better suited for the stripping column is produced. Further, the major portion of the carbon dioxide is taken to the stripping column. Thus, the NRU operates more efficiently, particularly at lower available nitrogen concentration of the incoming vapour. The need of a nitrogen recycle or of a nitrogen heat pump to keep the nitrogen concentration high enough in the NRU for an effective separation is avoided.

7.2 Respondent II objected that the partial condensation of the incoming vapour reduces the pressure of the high pressure methane-richer stream recovered from the stripping column and that the nitrogen-vapour stream of the first separation by-passes the stripping column and, thus, contains carbon dioxide, which can cause the

freezing of the NRU. In the opinion of the Board, these objections cannot be taken into consideration.

Disadvantages of an invention are not grounds under the EPC to make an invention unpatentable. Important is that this invention provides a solution for the problem as given in the description of the patent in suit.

Concerning the CO<sub>2</sub> content, it is moreover noticed that the description of the patent indicates that in the case of a significant amount of carbon dioxide, it is the process according to Claim 2 which should preferably be used and not the one of Claim 1.

7.3 By feeding back to the stripping column only a nitrogen-rich vapour portion, the second separation also increases the nitrogen content of the NRU feed stream, whereas in document D1, the sump liquid of the stripping column in its whole composition is directly fed back to said column. Thus the second separation improves the efficiency of the stripping column. The CO<sub>2</sub> concentration of the nitrogen-rich vapour withdrawn at the top of the stripping column is also decreased.

7.4 In the process of Claim 2, the additional feed of the liquefied vapour stream of the first separator to the top of the stripping column is used to wash down more of the CO<sub>2</sub> and CH<sub>4</sub> inside this column. The vapour in the stripping column is therefore more enriched in nitrogen, more especially as the vapour portion of this additional feed becomes part of the vapour stream leaving the stripping column. The first separator by splitting the incoming vapour into two streams, namely a liquid stream and a vapour stream which is then partially liquefied, reduces the energy requirement for liquefaction.



7.5 Thus, contrary to the Respondent's opinion, a functional relationship exists between feature (a) and features (c), (d), (f) and (g) of Claim 1, since all these features at least provide a vapour stream better suited for the NRU. Therefore, starting from the process known from document D1, one problem underlying the patent in suit can be seen in improving the known process so that, with respect to Claim 1, it operates more efficiently at lower available nitrogen concentrations and higher carbon dioxide concentrations.

With Claim 2, the same problems are solved, but priority is given to the second one, namely the high carbon dioxide concentration.

8. *Inventive step*

As seen above, document D1 does not suggest the first and second phase separation steps of the process.

Phase separation steps, arranged either upstream or downstream from a column, are per se well known in this technical field. Document D2, for example, shows both of them: It concerns a process for removing nitrogen from natural gases in which the incoming stream, after being partially condensed, is introduced into a phase separation so as to separate the bulk of the higher hydrocarbons and also some methane, as liquid, from nitrogen together with the rest of methane, as vapour. The vapour portion is passed to a rectification column (NRU), whereas the liquid is fed to the top of a stripping column which separates the heavy hydrocarbons from methane, both these products being then recovered as such. Thus, a first phase separation is disclosed in this prior art, upstream from a stripping column. Another phase separation is also described at the bottom of the rectification column, thus downstream from said column;

the vapour portion of this phase separation is returned to the rectification column as reflux vapour, whereas the liquid portion exists as methane product.

However, in this prior art, the stripping column has not the same function as the stripping column of the present invention. It concerns the removal of the higher hydrocarbons, which corresponds to a pretreatment of the incoming vapour of the present invention and is, therefore, not a step of the claimed process. Thus, the problems to be solved are not identical. The solutions are also different, since in document D2 the top vapour portion from the phase separator and the top vapour portion of the stripping column do not have the same destination, as is the case in the present invention.

It follows that the combination of a first phase separator upstream of a stripping column with a second phase separator downstream of this column, in order to increase the nitrogen concentration and to reduce the carbon dioxide concentration, is not suggested by document D2.

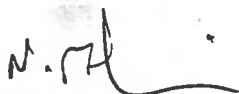
9. Therefore, the subject-matter of Claims 1 and 2 of the present invention involves an inventive step. Dependent Claims 3 to 12, which concern further embodiments of the process, are therefore also patentable.

**Order**

**For these reasons it is decided that:**

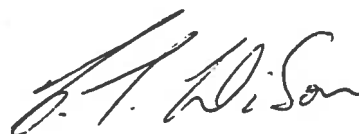
1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent on the basis of the documents, (see para. III above) presented at the oral proceedings.

The Registrar:



N. Maslin

The Chairman:



C. T. Wilson