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Bezeichnung der Erfindung: Method and apparatus for gas separation
Title of invention:
Titre de l'invention :

Klassifikation / Classification / Classement : B01D 53/22

ENTSCHEIDUNG / DECISION
vom / of / du 28 November 1990

Anmelder / Applicant / Demandeur : A/G Technology Corporation

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Einsprechender / Opponent / Opposant :

Stichwort / Headword / Référence :

EPÜ / EPC / CBE Article 56 EPC

Schlagwort / Keyword / Mot clé : "Inventive step (affirmed, after amendment)"

Leitsatz / Headnote / Sommaire

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Case Number : T 678/89 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 28 November 1990

Appellant : A/G Technology Corporation
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Decision under appeal : **Decision of Examining Division 031 of the European Patent Office dated 24 April 1989 refusing European patent application No. 86 303 319.7 pursuant to Article 97(1) EPC**

Composition of the Board :

Chairman : E. Turrini
Members : M. Chomentowski
M.V. Lewenton

Summary of Facts and Submissions

I. European patent application No. 86 303 319.7 (publication No. 0 204 424) was refused by decision of the Examining Division.

II. The reason for the refusal was that the subject-matter of Claims 1 to 5 of the valid set of claims as filed with a letter dated 31 October 1988 was not novel in the sense of Article 54 EPC having regard to the disclosure of document GB-A-2 122 103 (D1) and that the subject-matter of the remaining independent Claim 6 failed to involve an inventive step in the sense of Article 56 EPC.

III. The Appellant lodged an appeal against the decision of the Examining Division.

IV. Oral proceedings were held on 28 November 1990, at the end of which the Appellant requested that the decision under appeal be set aside and a patent be granted on the basis of Claims 1 to 6 as filed during the oral proceedings, of which Claims 1 and 4, the only independent claims, read as follows:

"1. A method of gas separation using asymmetric membranes with an integral skin, said asymmetric membranes having a skin side (13) and a non-skin side, comprising the steps of directing a feed gas having a plurality of components along the non-skin side of each asymmetric membrane (12) to cause a component of the feed gas to permeate through the asymmetric membrane (12); and withdrawing the permeated gas component.

4. Apparatus for carrying out the method of Claim 1, the apparatus comprising casing means (21) for supporting a plurality of asymmetric membranes with an integral skin, said asymmetric membranes having a skin side and a non-skin side, and having an inlet (22) for receiving the feed gas, and at least first (26) and second (24) outlets for expelling the permeated component and a rejected component respectively, and means (31, 32) for supporting the asymmetric membranes (11) arranged to present a single passage from the inlet (22) along the non-skin side to the second outlet (24) for the rejected component."

V. In support of his request, the Appellant stressed that document D1 disclosed a method and apparatus which involved the use of membranes consisting of a porous support having a separate high polymer thin film formed thereon, and that it did not, therefore, anticipate the use of asymmetric membranes with an integral skin as set out in the amended claims.

In addition, whilst it was not denied that asymmetric membranes with an integral skin were known per se, the method and apparatus respectively recited in Claims 1 and 4 involved an inventive step because the skilled person trying to substitute such asymmetric membranes for the composite membranes of document D1 would not contemplate feeding the gas to be separated along the non-skin side of the membranes.

In particular, documents GB-A-2 022 457 (D3) and US-A-4 329 157 (D4) only taught, on the one hand, that the integral skin in asymmetric membranes could be located either on the inside or on the outside surface of tubular separation fibres and, on the other hand, that the gas to be separated could be fed either from the inside or from the outside of such fibres. The skilled person could not

derive from these separate teachings any hint at the specific combination set out in Claim 1 and consisting in directing a feed gas along the non-skin side of asymmetric membranes.

Quite on the contrary, the skilled person at the date of the invention would have felt a strong technical prejudice against feeding the gas in that way, which he would have expected to result in the skin being simply torn away from the underlying portion of the membranes, as was evidenced by two affidavits by Dr Menahem Kraus filed with Appellant's Statement of the Grounds of Appeal and by several documents published later than the date of the invention and filed both with his Statements of the Grounds of Appeal and during the oral proceedings.

Accordingly, having regard in particular to the findings in the decision T 274/87 - 3.3.1 of 28 April 1988 (not published in the OJ EPO) that the proper question to ask was not whether the skilled person could have tried a given technical measure but whether he would have done so in the course of his routine investigations, the measure consisting of directing a feed gas along the non-skin side of asymmetric membranes could not be considered to have been derivable in an obvious manner from the state of the art.

Reasons for the Decision

1. The appeal is admissible.

2. The present application documents comply with the formal requirements of the EPC.

In particular, independent Claim 1 has been amended only to specify that the membranes used in the claimed method are "asymmetric membranes with an integral skin" as indicated in the original description (page 2, lines 9 to 12). In independent Claim 4, the membranes have been defined in the same way as in independent Claim 1, and further specified to be "arranged to present a single passage for the rejected component", as is derivable from the original description (page 4, lines 18 to 22). The dependent claims have only been amended by addition of the term "asymmetric" before "membrane" or "membranes" in dependent Claims 2, 3 and 5. The description has been rendered consistent with the wording of the present claims, in particular by deletion of certain passages suggesting that the membranes need not necessarily be of the asymmetric type with an integral skin.

Accordingly, the present patent application does not contain subject-matter extending beyond the content of the application as filed, as required under Article 123(2) EPC.

3. **Novelty**

3.1 Document D4 discloses a method of gas separation using membranes; it is directly derivable from D4 that the disclosed membranes are asymmetrical membranes with an integral skin, said asymmetric membranes having a skin side and a non-skin side in the sense of the present application; in particular, the membranes consist of hollow fibres comprising a wall structure having a radial anisotropic internal void volume and a skin (column 4, lines 57 to 61); the fibres are specified in D4 to be "monolithic" (Claim 1) and produced by a method comprising the step of coagulating polymeric fibres in a coagulating bath, which is a common method of obtaining an integral skin (column 17, lines 9 to 18). In this known method of

gas separation, a feed gas having a plurality of components is directed along one side of each asymmetric membrane to cause a component of the feed gas (for example hydrogen) to permeate through the asymmetric membrane and the permeated gas component is withdrawn (column 25, lines 39 to 61).

Whilst document D4 both discloses that the skin can be at the external or internal surface of the fibre wall (column 7, lines 61 to 63) and that the feed gas can be directed either along the outer fibre wall (column 25, lines 58 to 60) or into the bore of the fibre (column 29, lines 56 to 60), the document neither expressly nor implicitly discloses to direct the feed gas along the non-skin side of the hollow fibre.

Accordingly, the subject-matter of Claim 1 is distinguished from the method disclosed in document D4 in that the feed gas is specified to be directed along the non-skin side of each asymmetric membrane.

3.2 Document D1 discloses a method of gas separation which involves the use of membranes and comprises the steps of directing a feed gas having a plurality of components along either side of the membrane to cause a component of the feed gas to permeate through it and withdrawing the permeated gas component (Claims 3 and 4).

The membranes consist of a porous support membranes having a polymer film formed thereon (Claim 1).

Accordingly, the subject-matter of independent Claim 1 is distinguished from the method disclosed in D1 in that it uses asymmetric membranes with an integral skin on one side of the membrane instead of the known composite membrane.

3.3 The remaining documents on the file do not come closer to the subject-matter of Claim 1.

3.4 For the above reasons, the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

3.5 Similar reasoning is valid, mutatis mutandis, for the subject-matter of independent Claim 4, which defines an apparatus for carrying out the method of Claim 1.

4. **Inventive step**

4.1 Since document D4 not only teaches that feed gas can be directed along either side of a gas separating membrane but, in contrast with document D1, also discloses the use of asymmetric membranes with an integral skin as defined in Claim 1, the method of document D4 is considered to form the nearest prior art.

4.2 Document D4 in separate passages generally teaches that gas separation can be performed using asymmetric membranes having an integral skin on either side and directing a feed gas to be separated on either side of the membrane as well. The document does not however comprise any detailed disclosure of a specific embodiment of a gas separation method combining these separate teachings and showing in particular how to determine the direction of the gas through the membrane in relation to the actual location of the skin.

Accordingly, the technical problem to which the subject-matter of Claim 1 achieves a solution is, in the Board's opinion, to select a proper combination of skin side of the membranes and feeding side of the gas to be separated in order to practically implement the method described in general terms only in document D4.

4.3 To assess the inventive step involved by the specific combination of skin and gas feeding sides set out in Claim 1, the Board agrees to the findings in the decision T 274/87 referred to by the Appellant that the proper question to ask is not whether the skilled person **could** have tried the claimed combination, but whether he **would** have done so with an expectation of solving the technical problem underlying the patent in suit.

In this respect, the Board cannot find in the cited prior art any hint at feeding a gas to be separated through asymmetric membranes having an integral skin along the non-skin side of each membrane. In particular, the membranes disclosed in document D1 are of the composite type, and it is not even excluded that the polymer film formed thereon by plasma polymerisation extends on both sides. Accordingly, the teaching in D1 that the gas to be separated might be either drawn into the tubes forming the membranes or directed onto exterior surfaces (claims 3 and 4, respectively) cannot, without hindsight, be considered to suggest that both gas directions through the membranes would also be equally suitable also when using asymmetric membranes with an integral skin on one side.

D3 mentions anisotropic hollow fibres with a relatively dense region at its exterior side (see page 6, lines 61 to 64); however, since document D3 also encompasses the use of isotropic fibres having essentially the same density throughout their whole thickness (page 6, line 61 to page 7, line 1), the statement in it that the feed mixture to be separated could either be introduced into the bores of the hollow fibres or be provided at the exterior of the latter (page 1, lines 50 to 53; page 6, lines 7 to 21 and Figure 4), which is not linked to any specific type of fibres, cannot reasonably be construed as necessarily implying that both feeding directions are suitable also for asymmetric membranes with an integral skin.

In the face of the evidence on the file, the Board sees no reason either to contest Appellant's submission, supported by two declarations by Dr Menahem Kraus, a specialist of gas separation by membranes, that the skilled person would not have considered to direct the gas to be separated onto the non-skin side of an asymmetric membrane, which he would have expected to result in adverse concentration polarisation effects due to poor mixing at the membrane surface and damaging of the skin when urged away from the less dense portion of the membrane.

For these reasons, having regard to the state of the art, the subject-matter of Claim 1 is considered to involve an inventive step in the sense of Article 56 EPC.

4.4 The same conclusion applies to the subject-matter of independent Claim 4, which defines an apparatus for carrying out the method of Claim 1. This apparatus is, in particular, arranged to present a single passage from the inlet for the feed gas along the non-skin side of the membranes to the second outlet for the rejected component.

As a matter of fact, the skilled person for the reasons indicated above had no obvious ground to direct the feed gas to be separated along the non-skin side of each asymmetric membrane. Accordingly he did not have any such ground either to provide a gas separation apparatus with specific means arranged to allow this non obvious feed gas directing.

5. For these reasons, the subject-matter of independent Claims 1 and 4 is patentable (Articles 52 and 56 EPC). So is the subject-matter of the remaining Claims 2, 3, 5 and 6 by virtue of their dependency on independent Claims 1 and 4.

6. Accordingly, the application and the invention to which it relates meet the requirements of the Convention and the Appellant's request can, therefore, be allowed.

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 grant a patent on the basis of Claims 1 to 6, pages 1 to 3, 3A and 4 to 6 of the description and page 1/1 of the drawings, all filed at the oral proceedings on 28 November 1990.

The Registrar: The Chairman:

P. Martorana E. Turrini