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Case Number: T 0376/96 - 3.4.2

D E C I S I O N of 15 January correcting error in the decision of the Technical Board of Appeal 3.4.2 of 14 October 1997

Appellant: (Opponent)
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Representative:
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Respondent: (Proprietor of the patent)
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 26 February 1996 rejecting the opposition filed against European patent No. 0 348 501 pursuant to Article 102(2) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. Chomentowski
B. J. Schachenmann

In application of Rule 89 EPC the front page under "Decision under appeal" of the decision in the appeal case T 376/96 - 3.4.2 is corrected by the substitution of "... rejecting the opposition filed against European patent No. 0 348 501 persuant to Article 102(2) EPC" for "... revoking European patent No. 0 348 501 persuant to Article 102(1) EPC".

The Registrar:

P. Martorana

The Chairman:

E. Turrini

BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

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D E C I S I O N
of 14 October 1997

Case Number: T 0376/96 - 3.4.2

Application Number: 89903324.5

Publication Number: 0348501

IPC: B01D 53/22

Language of the proceedings: EN

Title of invention:
Process for separating higher hydrocarbons from natural or produced gas streams

Patentee:
MEMBRANE TECHNOLOGY AND RESEARCH, INC., et al

Opponent:
SILICA Verfahrenstechnik GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step: (after amendment) yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0376/96 - 3.4.2

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 26 February 1996 revoking European patent No. 0 348 501 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. Chomentowski
B. J. Schachenmann

Summary of Facts and Submissions

I. The respondent is proprietor of European patent No. 0 348 501, which was granted with 9 claims on the basis of European patent application No. 89 903 324.5, wherein reference was made to inter alia US-A-4 243 701. The patent, wherein E2: US-A-4 370 150 was cited, was granted with only one independent claim reading as follows:

"1. A pressure-driven gas separation process, comprising the steps of:
passing a first gas mixture comprising methane as its major constituent and further comprising at least one gas from the group consisting of ethane and heavier hydrocarbons, across the feed side of a membrane having a feed side and a permeate side, said membrane comprising a microporous support layer and an ultrathin permselective layer of a rubbery material wherein said membrane has a selectivity for propane over methane of 8 or more;
withdrawing from said permeate side a second gas mixture being at substantially lower pressure than said first gas mixture and enriched in at least one gas from the group consisting of ethane and heavier hydrocarbons compared with said first gas mixture wherein the ratio of the volume flows of said second gas mixture and said first gas mixture is less than about 27% and
withdrawing from said feed side a third gas mixture, being at substantially the same pressure as said first gas mixture and enriched in methane compared with said first gas mixture."

II. The appellant filed an opposition against the patent on the grounds that the patent lacked an inventive step having regard to inter alia E2 referred above and E2.1= M.S.Brennan et al., "Natural Gas Separation Using Supported Liquid Membranes", AIchE Journal, Vol. 32, No. 9, September 1986, pages 1558 to 1560.

III. The opposition was rejected.

The Opposition Division took in substance the following view:

Contrary to the process of the opposed claim 1, in the process known from E2,

(a) the support of the membrane was not specified as being a microporous support layer;

(b) said membrane was not specifed as having a selectivity for propane (C_3H_8) over methane (CH_4) of 8 or more;

(c) the ratio of the volume flows of said second gas mixture and said first gas mixture (designated in the patent as "stage cut") was not specified as being less than about 27%.

Starting from the process of E2, the opposed process was for solving a dual, integrated problem, namely:

- achieving a BTU control of the retentate (methane content) remaining on the feed side of the membrane, and

- recovering at maximum purity as useful product the permeate (at least one gas from the group consisting of ethane or heavier hydrocarbons) having passed through the membrane.

E2 dealt essentially with the first part of the objective, concerning BTU control of the retentate stream by use of a membrane; the retentate stream was both purified (H_2S content reduced) and upgraded (ethane and/or higher hydrocarbon content reduced). However, E2 was not concerned with the second part of the objective, i.e. permeate purity, since the permeate gas was recycled back in the feed gas and a possible use of a permeate component could only be envisaged after treatment in a separation plant indicated farther away on the main gas stream. Thus, E2 did not contain any hint towards improving the membrane separator itself in order to recover a usable hydrocarbon in addition to methane. There was no indication in the prior art that a rubbery membrane with a selectivity of heavier hydrocarbons over methane of more than the value of 4.2 indicated in E2 was either available or possible; there is no indication either that the skilled person, starting from E2, could arrive at a selectivity of 8 of the opposed patent only by his general knowledge. Therefore, the process of the opposed patent involved an inventive step.

IV. The appellant (opponent) lodged an appeal against this decision.

V. During the oral proceedings of 14 October 1997, which had been requested auxiliarily by both parties, the respondent filed in particular a new set of 9 claims as main request, with the dependent claims 2 to 9 identical to the corresponding granted claims and wherein claim 1 differed from granted claim 1 in additionally specifying that the claimed pressure-driven gas separation process is "for recovery of propane and higher hydrocarbons from a gas stream,",

with the supplementary feature "; and recovering propane and higher hydrocarbons from said second gas mixture" being added at the end of the claim; moreover, the word "and", after the expression "about 27%", was replaced by ";".

VI. The respondent requested that the appeal be dismissed and that the patent be maintained in amended form in particular on the basis of claims 1 to 9 of the main request, and it argued as follows in support of its request:

A pressure-driven gas separation process was known from E2, which did not comprise the three distinguishing features (a), (b) and (c) indicated in the decision under appeal. Moreover, in the process known from E2, the gas submitted to the separation of its components by the membrane was for providing, as retentate, the fuel for a compressor of the pipeline, and the gas stream at the permeate side of the membrane was rejected in the raw gas and was irrelevant for the process itself; thus, the process was not "for recovery of propane or other higher hydrocarbons" and was therefore not of the same type as the process of the main request. There was no incitation for the skilled person to ameliorate the process of E2 by providing a membrane with a better selectivity of propane over methane.

The documents E2.2: "The 1987 International Congress on Membranes and Membrane Processes - ICOM 1987, Tokyo, Japan, June 8-12, 1987, M.S.Brennan et al., "The use of swollen silicone rubber membranes for natural gas separations", pages 496 to 497 and E2.3: Journal of Polymer Science, Part B: Polymer Physics Edition - Vol. 25, 1 January and 6 June 1987, respectively, S.A.Stern et al., "Structure - Permeability Relationships in silicone polymers", pages 1263 to

1298, submitted by the appellant were not filed in due time and should be disregarded because they were not relevant. In any case, these documents, as well as E2.1, showed membranes of a different type or having different properties, which, in combination with E2, did not lead to the process of the main request. It was admitted that the teaching for making the membranes having the properties for use in the process of the present main request was contained in US-A-4 243 701; however, there was no indication therein that they were convenient for separating methane from higher hydrocarbons, but only from carbon dioxide. Thus, even if the skilled person of E2 could have taken these membranes into consideration, he had no incentive to do so and thus would not have done it. It was the merit of the respondent to recognize that these membranes provided a means for recovering also propane and heavier hydrocarbons and, therefore, the subject-matter of the present main request involved an inventive step.

VII. The appellant requested that the decision under appeal be set aside and that the patent be revoked, and submitted the following arguments in support of its request:

The pressure-driven gas separation process known from E2 indeed did not comprise the distinguishing features indicated in the decision under appeal; a gas stream, taken from a pipeline, was circulated to the feed side of a membrane; on said same feed side of the membrane, a gas stream, the retentate, enriched in methane, was obtained; more important, from the permeate side of the membrane, a gas stream comprising less methane was led to the main stream in the pipeline, which was thus enriched in heavier hydrocarbons, in particular in propane; a separation plant was anyway indicated at the downstream end of the pipeline, and it was directly and unambiguously derivable that separation of constituents

of this gas already enriched in heavier hydrocarbons, for instance propane, could take place there; the separation process of E2, in particular that relating to the membrane, achieved thus the same results as that of the patent in suit. The skilled person carrying out the pressure-driven gas separation process of E2 and wanting to improve it, would find for instance in US-A-4 243 701 membranes which were of the same type as those of the patent in suit and which were indicated as being suitable for such a separation process involving methane and other gas components; he would find in his expertise the parameters such as stage cut or pressure, which were adapted for such a separation process and which were not directly provided by E2 or US-A-4 243 701.

The same remark applied to the membranes of E2.1, E2.2 or E2.3, which provided a better selectivity of propane over methane and with which a separation process of the type known from E2 could be ameliorated. The skilled person, with his expertise, had thus enough information about membranes suitable for separating propane or heavier hydrocarbons from methane, in processes treating raw feed gases containing these constituents, for finding those properties of the membranes and those process conditions of the present main request which were not directly derivable from these documents. Therefore, this process lacked an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Formal requirements concerning the text of the claims

2.1.1 Claim 1 of the main request specifies that the pressure-driven gas separation process is for recovery of propane and higher hydrocarbons from a gas stream, the propane and higher hydrocarbons being recovered from the second gas mixture withdrawn at the permeate side of the membrane. These features, which are disclosed in the granted patent (see in particular page 3, lines 33 to 39; page 7, line 54 to page 8, line 3) and in the original patent application at corresponding text locations, in any case do not lead to a more general process. The appellant has not objected to the introduction of said features. Therefore, the present main request satisfies the requirements of Article 123(3) and (2) EPC that the claims of the European patent may not be amended in such a way as to extend the protection conferred and the European patent may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed, respectively.

2.1.2 The respondent has admitted that the description has to be adapted in view of objections made by the Board in the annex to the summons to oral proceedings in relation to the interpretation of the meaning of granted claim 1 having regard to features of said claim stressed by the respondent in its observations on the statement of grounds of appeal. In this respect, the statement in the patent in suit (see page 6, lines 53

to 54) that the permselective membranes used in the present invention should have a selectivity for propane over methane of at least 5, and preferably 8 or more, is contradictory to the text of claim 1 of the main request, according to which said selectivity should be 8 or more. The same remark applies to the statement in the description (see page 7, lines 42 to 45) that the permeate gas stream may be flared, which is contradictory to the feature of said text of claim 1 that the propane and higher hydrocarbons from said second gas mixture withdrawn from the permeate side of the membrane is recovered.

The objections of the appellant that a plurality of parameters, for instance gas pressures, are involved in a separation process in addition to those indicated in the claim, and that thus the claim was broad and not specific enough, could not convince the Board in that the essential features of the process are mentioned in the claim and, with the features contained in the description which, as pointed out in the preceding paragraph is still to be adapted, the claim unambiguously defines the matter to be protected and is thus clear in the sense of Article 84 EPC.

2.2 Patentability

2.2.1 A process comprising all the features of claim 1 in dispute is not known from the state of the art and is thus new in the sense of Article 54 EPC. The appellant has not contested this either.

2.2.2 It is to be noted that E2.2 and E2.3 are not prima facie irrelevant; therefore, although not submitted in due time, they have been taken into account by the Board (Article 114(2) EPC).

A pressure-driven gas separation process is known from E2 (see the abstract; column 1, line 63 to column 2, line 50; column 3, line 21 to column 7, line 2; claims 1, 4 and 5; Figure 1); this process comprises the steps of:

passing a first gas mixture comprising methane as its major constituent and further comprising at least one gas from the group consisting of ethane and heavier hydrocarbons, through a conduit (9) and then across the feed side of a membrane (12) having a feed side and a permeate side,

said membrane (12) can be a dialkyl silicone membrane such a dimethyl silicone membrane and can be backed, so that it comprises a support layer;

the material of this type provides a permselective layer which is rubbery and which can have a thickness, for the upper value of the preferred range, of about 0.01 mil (0.025 µm), which falls within the preferred range of 0.1 to 1 µm mentioned in the patent in suit and is thus ultrathin in this sense;

there is a step of withdrawing from said feed side of the membrane, through a conduit (13), a third gas mixture, which is depleted in heavier hydrocarbons and thus is enriched in methane compared with said first gas mixture, and which is derivable as being at substantially the same pressure as said first gas mixture.

The known process further comprises withdrawing from said permeate side of the membrane, through a conduit (14, 3), a second gas mixture which is derivable as being at substantially lower pressure than said first

gas mixture, said second gas mixture being enriched in at least one gas from the group consisting of ethane (C_2H_6) and heavier hydrocarbons as compared with said first gas mixture led to the feed side of the membrane.

2.2.3 It has not been contested that, contrary to the process of claim 1 of the main request, this known process does not comprise the three distinguishing features (a), (b) and (c) pointed out in the decision under appeal, i.e.,

(a) the support (backing) of the membrane is not specified as being microporous support layer,

(b) said membrane is not specifed as having a selectivity for propane over methane of 8 or more, but of, for instance, 340/80 = 4.25 (see table II); and

(c) the ratio of the volume flows of said second gas mixture and said first gas mixture is not specified as being less than about 27%.

2.2.4 The appellant has argued in substance as follows with respect to the patentability of the main request:

In E2, the process achieved the same results as in the patent in suit, since a gas stream (9) was circulated to the feed side of the membrane (12) and the gas stream obtained at the permeate side of the membrane (12) and circulated therefrom through the conduit (14) was enriched in heavier hydrocarbons such as propane. It was to be noted that, on the feed side of the membrane, through the conduit (13), a gas stream enriched in methane was obtained. The skilled person carrying out the pressure-driven gas separation process of E2 and wanting to improve it, would find for instance in US-A-4 243 701 (see column 1, lines 27 to 66; column 2, line 57 to column 3, line 48; Table II in

column 7; claim 1) membranes which were suitable for such a separation process involving methane and other gas components and which were of the same type as those of the patent in suit; the skilled person would find in his expertise the parameters such as stage cut, pressure, adapted for such a separation process.

2.2.5 Indeed, in the process of E2, a stream enriched in heavier hydrocarbons such as propane is obtained from the permeate side of the membrane (12). However, as convincingly argued by the respondent, for the following reasons, this known process is not of the same type as that of the main request:

In E2 a stream of raw sour gas comprising methane as its major constituent is led through successive conduits (1, 4, 8) of a pipeline; a compressor (5), necessary for circulating said raw gas, is provided between the conduits (1) and (7, 8); the engine (6) of this compressor (5) is a gas engine employing, as fuel, gas taken from the same raw gas. E2 has two objectives, both related to the fuel for the compressor engine, i.e., avoiding corrosion of the engine by the hydrogen sulfide which is generally comprised in the raw gas and, moreover, improving the relatively low octane rating of such gases, primarily attributable to the significant amounts of higher hydrocarbons. These objectives are met by taking, from the gas circulating in the pipeline, a side gas drawstream at a location between the conduits (7) and (8) which is after the higher pressure side of the compressor, leading this drawstream, which can be only about 4% of the raw gas in the pipeline, through a side conduit (9) to the feed side of a membrane (12) and withdrawing from the feed side of the membrane (12) an upgraded fuel gas depleted in H_2S and in heavier hydrocarbons. The gas stream withdrawn from the permeate side of the membrane (12) is mentioned as being a reject gas stream which is

passed back, through a conduit (14), to the pipeline, more in particular to the compressor via the lower pressure side of said compressor; it is specified that the volume of gas of the main line (1, 2) is so large that no significant difference in main stream quality occurs. Thus, the gas in the pipeline does not differ substantially from the raw gas; there is no indication either about recovering propane or higher hydrocarbons by this process, and in particular from the permeate side of the membrane, as specified in the main request.

The Board concurs with the submissions of the respondent according to which the skilled person of E2, even if inclined to improve this process, would not find in this document membranes with a selectivity of propane over methane of 8 or more, i.e. membranes adapted for carrying out the process of recovering propane or higher hydrocarbons of the present main request, but only membranes with a selectivity of 4.25. The polymer membranes mentioned in E2.1 (see the title; page 1558, the sections "Introduction" and "Experimental"; page 1559, second column, second paragraph and Table 1) have a selectivity ratio of propane over methane of 5.1, i.e. inferior to the value of 8 or more required in the present main request; the values of selectivity mentioned with respect to the supported liquid membranes used for natural gas separation known from said same document E2.1, are irrelevant in that sense that the "liquid" membranes are of a type differing from those of the present main request. The same remark applies to the swollen silicone rubber membranes used for natural gas separation known from E2.2 (see the Introduction and Table 1) which are mentioned as also using liquid to arrive at selectivities up to 16.3 as compared to dry membranes with a value inferior to the selectivity of 8 or more required in the main request. The skilled person can derive from E2.3 (see page 1266, the first

paragraph of the section "Polymer Membranes"; Figure 2 to 22 , on pages 1268 to 1286), which relates to structure-permeability relationships in silicone polymers, that it was known to separate various gases, and in particular propane from methane, using membranes made of microporous substrates carrying thin selective sheets and to arrive at selectivity values higher than 8; however, the polymer membranes are mentioned as having a thickness between 203 and 305 µm, much higher than 0.1 to 20 µm in the patent in suit (see page 6, lines 51 to 52) and, in this sense, they are not ultrathin. Even if the teaching for making the membranes having the properties for use in the process of the present main request were contained in US-A-4 243 701, there is no indication in this document that they were convenient for separating methane from higher hydrocarbons; in this respect, it is to be noted that said document (see column 1, lines 61 to 66) refers to methane only for its separation from carbon dioxide in waste gases for sewage treatment processes whereby enriched oxygen can be produced to enhance sewage digestion, and not of methane from higher hydrocarbons. Therefore, the skilled person could find in E2, E2.1, E2.2 or E2.3 some indications for membranes for recovering methane and/or propane but, even with his expertise, there was no reason for him to use them in the way defined in claim 1 of the respondent's main request. It was the merit of the respondent to have recognized that a membrane made by the process of US-A-4 243 701 was useful in particular for increasing the propane over methane separation selectivity and thus for recovering propane.

2.2.6 Therefore, the process of claim 1 of the main request is not obvious to the skilled person having regard to the state of the art and thus involves an inventive step in the sense of Article 56 EPC, so that the patent can be maintained on this basis (Article 102(3) EPC).

3. Since the main request is allowable, it is not necessary to take the auxiliary request into consideration.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Opposition Division with the order to maintain the patent in amended form on the basis of the following documents:

   Claims 1 to 9 of the main request filed during the oral proceedings of 14 October 1997, the Description to be adapted and the Figure of the granted patent.

The Registrar:

P. Martorana

The Chairman:

E. Turrini

MCA

B. Sch.