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D E C I S I O N
of 21 June 1994

Case Number: T 0289/92 - 3.2.3

Application Number: 86904929.6

Publication Number: 0235295

IPC: F25J 3/04

Language of the proceedings: EN

Title of invention:
Oxygen gas production unit

Patentee:
Daidousanso Co., Ltd.

Opponent:
Linde Aktiengesellschaft, Wiesbaden

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step - non-obvious combination of known features"

Decisions cited:

Catchword:

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0289/92 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 21 June 1994

Appellant: (Opponent)
Linde Aktiengesellschaft, Wiesbaden
Zentrale Patentabteilung
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Representative:
-

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Decision under appeal:
Decision of the Opposition Division of the European Patent Office dated 30 January 1992 rejecting the opposition filed against European patent No. 0 235 295 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: C. T. Wilson
Members: H. Andrae
L. C. Mancini

Summary of Facts and Submissions

I. European patent No. 0 235 295 was granted on 14 June 1989 with a single claim on the basis of European patent application No. 86 904 929.6.

The single claim is worded as follows:

"An oxygen gas production apparatus comprising an air compression means for compressing air from an outside source, a purification means for removing carbon dioxide gas and water vapor from the air compressed by said air compression means, a heat exchange means for chilling the compressed air from said purification means to a cryogenic temperature, a fractionation column for liquefying and fractionating the compressed air chilled to a cryogenic temperature by said heat exchange means and holding nitrogen in gaseous state and oxygen in liquid state, a liquid oxygen storage means for receiving liquid oxygen from an outside source and storing the same, a line for introducing into said fractionation column the liquid oxygen from said liquid oxygen storage means as the refrigerant for liquefaction of compressed air, a liquid level detection-control means for monitoring the liquid level of oxygen held in said fractionation column and controlling the amount of feed of liquid oxygen from said liquid oxygen storage means in response to changes in said liquid level, a second line for guiding gaseous nitrogen in said fractionation column to said heat exchange means as a refrigerant, an expansion means for cooling the gaseous nitrogen in said second line by the principle of adiabatic expansion, and an oxygen gas withdrawal line for guiding the liquid oxygen in said fractionation

column to said heat exchange means as a refrigerant and withdrawing the gaseous oxygen produced by heat exchange as a product oxygen gas."

II. A notice of opposition to this patent was filed on 14 March 1990. The Opponent requested revocation of the patent on the grounds of Article 100(a) EPC. The following documents were cited in support of the opposition:

(D1) LINDE-Bericht aus Technik und Naturwissenschaft, Vol. 54/1984, pages 18 to 20
(D2) EP-A-0 144 430
(D3) DE-B-1 103 947

The following evidence was submitted after the expiry of the time limit provided for giving notice of opposition:

(D4) US-A-3086 371
(D5) DE-A-2 646 690
(D6) Hausen/Linde: "Tieftemperaturtechnik", Springer Verlag 1985, pages 319 to 322

III. The Opposition Division rejected the opposition in a decision dated 12 December 1991 and posted on 30 January 1992. According to the decision, the subject-matter of the claim was novel and involved also an inventive step.

IV. The Appellant (Opponent) filed a notice of appeal on 31 March 1992, paying the appropriate fee on the same date, and submitted a Statement of Grounds of Appeal on 22 May 1992. In the Statement of Grounds of Appeal, he cited the following documents for the first time:

(D7) "Ullmanns Encyklopädie der technischen Chemie", 4th edition, 1973, Vol. 3, pages 240 and 241
(D8) DE-C-1 012 939

In his written submissions and during oral proceedings, he argued essentially as follows:

- The oxygen gas production apparatus according to the claim is not novel vis-à-vis the disclosure of document (D1) since this document describes a line withdrawing liquid oxygen from the low pressure column 6 to the pump 11. Alternatively, when interpreting the oxygen gas withdrawal line according to the claim such that this line constitutes a liquid oxygen line between the fractionation column 13 and the heat exchanger 7, the subject-matter of the claim is arrived at by an obvious combination of the disclosure of document (D1) with that of document (D7).

- When considering the heat flow balance of the apparatus according to the patent in suit, it is found that on increasing the amount of feed of liquid oxygen from the liquid oxygen storage means the extra-refrigeration thus provided cannot be compensated in the system when the expansion means for cooling the gaseous nitrogen is driven with a constant speed. The problem as defined in the communication of the Board dated 6 October 1993 cannot, therefore, be solved, at least not by the apparatus according to the claim.

- It was known from document (D8) at the priority date of the patent in suit to combine in an oxygen gas production unit of the present type the withdrawal of heat by means of expansion with the supply of stocked liquid oxygen such that the expansion machine can be driven with constant speed. The disclosure of document (D8) differs from the present claim of the patent in suit only in that the expansion means expands air instead of gaseous nitrogen and in that

the line withdrawing liquid oxygen from the fractionation column is not connected to the heat exchanger for chilling the compressed feed air. A combination of the teaching of document (D8) with that of document (D7) leads, however, in an obvious way to the subject-matter of the claim.

The Appellant requests that the decision under appeal be set aside and that the patent be revoked.

V. The Respondent (Patentee) argued essentially that the apparatus according to the late-filed document (D7) does not rely on nitrogen expansion in a turbine together with stored liquid oxygen. Furthermore, the "small amount" of liquid oxygen being taken from the lower pressure column in the apparatus of document (D7) cannot be compared with the line for guiding the liquid oxygen in the fractionation column to the heat exchange means as a refrigerant for the feed air. Further, according to the Respondent, in document (D8), there is no disclosure of expanding gaseous nitrogen withdrawn from the column to provide refrigeration and there is no disclosure of a line for withdrawing liquid oxygen from the column to a heat exchange means for chilling the compressed air. It is not, therefore, accepted that these documents are relevant to the patent.

The Respondent requests that the appeal be dismissed and the patent be maintained.

Reasons for the Decision

1. The appeal is admissible.

2. The claim as granted corresponds with the originally filed claim. The amendments introduced into the description of the patent relate to the indication of the background art.

The requirements of Article 123 EPC are therefore complied with.

3. *Novelty*

3.1 It is undisputed between the parties that document (D1) represents the nearest prior art. Document (D1) describes all the features of the claim with the exception of the feature that the apparatus comprises an oxygen gas withdrawal line for guiding the liquid oxygen in the fractionation column to the heat exchange means as a refrigerant and withdrawing the gaseous oxygen produced by heat exchange as a product oxygen. According to document (D1) (cf. Figure 1), an oxygen gas withdrawal line is provided on the upside of reference sign (5) which passes gaseous oxygen from the upper column (6) to the heat exchanger (3).

3.2 Whilst it is conceded that the wording "...oxygen gas withdrawal line for guiding the liquid oxygen..." cannot be considered an optimum choice, it is clear not only from the claim but also from the description and drawings that the "oxygen gas withdrawal line" guides liquid oxygen from the fractionation column to the heat exchanger, cf. the passage in column 5, lines 15 to 18 of the patent in suit "Referring to Figure 1, the reference numeral 34 represents an oxygen transport pipe

(34) for feeding the liquid oxygen ... to the first heat exchanger (7)...". Gaseous oxygen produced by heat exchange is guided from the heat exchanger (7) through product oxygen withdrawal pipe (35).

3.3 A line for withdrawing a gaseous fraction from the fractionation column differs from a line for withdrawing a liquid fraction in several respects, such as for example with respect to the required cross-section of the pipe and the position at which it is connected to the column.

The Board regards, therefore, the term of the claim "an oxygen gas withdrawal line for guiding the liquid oxygen..." as a feature of the apparatus which distinguishes the claimed apparatus from that described by document (D1) in a structural respect.

3.4 It follows from the above consideration that the subject-matter of the claim is novel as compared with the disclosure of document (D1). Having regard to the other documents discussed in the proceedings, novelty of the claimed apparatus was not disputed by the Appellant. Therefore, the subject-matter of the claim satisfies the requirement of novelty.

4. *Inventive step*

4.1 The apparatus according to the relevant prior art described in document (D1) relies on the principle of balanced fluctuations in demand for liquid oxygen and liquid nitrogen. In accordance with the operation of the apparatus (cf. section "Verfahren" in document (D1)), the nitrogen expansion turbine (10) is operated with a variable nitrogen mass flow depending upon the demand for oxygen such that on an increased oxygen demand the turbine mass flow is reduced.

4.2 In accordance with column 2, lines 14 to 31 of the patent in suit, based upon page 3, line 17, to page 4, line 7 of the original description, the operation of the expansion turbine at a speed varying in quick response to changes in load is difficult.

The inherent problem is therefore to be seen in modifying the apparatus known from document (D1) such that a quick response to variations in the demand of product oxygen is obtained, in particular that the speed of the nitrogen expansion means, usually a turbine, can be kept constant irrespective of variations in the oxygen demand whilst keeping constant the purity of product oxygen gas.

Having regard to the solution to this problem, in the case of an increased oxygen demand the liquid level detection control means senses the lowered liquid level in the fractionation column and supplies an increased amount of oxygen from the storage tank into the fractionation column, the oxygen being conducted as a liquid to the heat exchanger. The speed of the nitrogen expansion turbine can remain unchanged since the amount of nitrogen gas fed from the fractionation column is not, at least not substantially, influenced by the increased oxygen supply and since any change of the feed air stream which might change the nitrogen fraction is not required.

In the case of a decreased demand of oxygen, correspondingly, a decreased amount of oxygen is supplied from the storage tank to the fractionation column without affecting the feed air flow and thus the speed of the nitrogen expansion turbine.

In this context, the Appellant argues that the problem as defined above cannot be solved by the embodiment according to the patent in suit. According to his statement, an evaluation of the fluid and gas streams introduced into and withdrawn from the system according to the invention shows that there is no correspondence and compensation for any additional refrigeration due to introducing additional liquid oxygen from the storage tank into the fractionation column so that the apparatus cannot function in the described manner.

In the view of the Board, this argument brought forward only in the oral proceedings before the Board is not convincing. It constitutes a basic physical law that in the balanced state of a closed system the sum of energy amounts introduced into the system is equal to the sum of energy amounts withdrawn from the system. This means in the present case that any amount of refrigeration provided to the fractionation column from the oxygen storage tank must in the balanced state be withdrawn from the system. Such withdrawal of the added refrigeration may occur in various ways such as for example by a temperature decrease of the oxygen and/or nitrogen stream leaving the apparatus and/or by an increased influx of heat from ambience.

The Board is, therefore, satisfied that the inherent problem is solved by the subject-matter of the claim.

4.3 In accordance with the description of the apparatus and process disclosed in document (D1), product oxygen can be withdrawn from the fractionation column only in the gaseous state. Were oxygen withdrawn from the upper fractionation column in the liquid state, there would be no liquid oxygen in the column to be vaporised with the effect of condensing nitrogen during the operation of the apparatus with an increased demand for oxygen. Thus,

nitrogen could not be conducted to the nitrogen storage tank which would prevent proper operation of the apparatus over the whole range of oxygen demand.

It follows from the operation of the apparatus described in document (D1) that withdrawal of oxygen in the gaseous state is indispensible for solving the problem to cope with a varying demand for oxygen.

In the apparatus of document (D1), the skilled person would, therefore, avoid the withdrawal of liquid oxygen from the fractionation column.

4.4 Document (D7) cited in the Statement of Grounds of Appeal as evidence of the skilled person's general knowledge relates to a two-column fractionation apparatus in which pursuant to the paragraph bridging pages 240 and 241 "a small amount of oxygen is withdrawn in the liquid state at position 8", i.e. from the low pressure column (Figure 25).

The Appellant holds that it is absolutely obvious to substitute this feature for the oxygen gas withdrawal line described in document (D1). He points out that due to the small quantity of liquid oxygen withdrawn the skilled person would not expect any negative impact on the process of document (D1) and he would arrive at the subject-matter of the patent in suit by mere customary practice.

In the opinion of the Board, this line of argument cannot bear closer examination. Document (D7) describes an apparatus of a basically different type in which neither an expansion means for guiding gaseous nitrogen nor a liquid oxygen storage for complying with a variable demand for product oxygen are provided so that the inherent problem as defined in above section 4.2 is

not tackled. Moreover, the skilled person would be restrained from withdrawing liquid oxygen from the upper column of the apparatus disclosed in document (D1) since even withdrawal of small quantities of liquid oxygen would decrease the amount of nitrogen to be condensed and stored in the system and thus risk proper operation of the system.

4.5 Document (D8), also cited for the first time in the Statement of Grounds of Appeal, relates with regard to the passages in column 4, line 27 and column 9, lines 36 to 40 (cf. Figure 1) to an apparatus comprising a liquid oxygen tank 80 from which oxygen is conducted to the compartment 30 of the rectification column surrounding the condenser 26 where it is vaporised. In contrast to the claim of the patent in suit, oxygen is withdrawn in the gaseous state from compartment 30 via lines 48, 51 and 52 and regenerators (heat exchangers) 12. Furthermore, the apparatus does not comprise an expansion means for cooling gaseous nitrogen but utilises an air expansion turbine 54 in which a fraction of the compressed feed air is expanded to essentially the pressure prevailing in the low pressure column 29 into which it is fed.

In the embodiment according to Figure 2 of document (D8), neither expansion means for cooling gaseous nitrogen nor liquid oxygen storage means are provided.

It follows from the above that the prior art known both from document (D7) and from document (D8) is more remote from the claimed apparatus than the disclosure of document (D1).

4.6 The Appellant argues further that a combination of the teachings of document (D8) and document (D7) is obvious and leads immediately to the claimed subject-matter.

The examination of this statement leads to the following finding:

First of all, it is questionable whether the skilled person would envisage a combination of these citations since only (D8) is concerned with the problem of complying with variations in demand of oxygen whereas document (D7) does not deal with this problem and does not, therefore, provide an oxygen storage means.

Document (D7) teaches, as illustrated in above section 4.4, to withdraw a small amount of oxygen in the liquid state from the sum of the low pressure column. The purpose of this measure is manifestly to be seen in removing impurities by means of such a rinsing liquid from the oxygen product, as endorsed by the Appellant in the Statement of Grounds of Appeal (cf. page 5, penultimate paragraph and the passage bridging pages 5 and 6). The withdrawal of such a small amount of oxygen cannot be equated with the claimed feature "an oxygen gas withdrawal line for guiding **the** liquid oxygen in said fractionation column to said heat exchange means..." which means that the whole oxygen fraction of the fractionation column is withdrawn in the liquid state (cf. also column 6, lines 9 to 22 of the patent in suit).

Furthermore, the skilled person would by no means introduce the small amount of oxygen withdrawn from the sump of the low pressure column for reason of removing impurities into the oxygen product line if, as at present, purity of the oxygen product is an essential requirement.

A combination of the teaching of document (D7) with that of document (D8) as alleged would not, therefore, be considered by the skilled person and would anyway not lead to the subject-matter of the claim.

4.7 Further, none of the other documents cited in the opposition proceedings appears to give any indication to the skilled person that the subject-matter of the claim would solve the problem as set out in the patent in suit. Since these documents were not discussed any more in the appeal proceedings, no further substantiation is necessary.

5. Summarising, the Board comes to the conclusion that the subject-matter of the present claim cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step (Articles 52(1) and 56 EPC). It is therefore patentable and the patent may be maintained on the basis of this claim.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Maslin C.T. Wilson