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D E C I S I O N
of 19 March 1998

Case Number: T 0418/96 - 3.2.3

Application Number: 88200470.8

Publication Number: 0279500

IPC: F25J 3/04

Language of the proceedings: EN

Title of invention:
Highly pure nitrogen gas producing apparatus

Patentee:
Daido Hoxan Inc.

Opponent:
L'Air Liquide, S.A. pour l'étude et l'exploitation des procédés Georges Claude
Linde Aktiengesellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 56, 111(1)

Keyword:
"Inventive step (yes)"
"Decision re appeals - remittal (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0418/96 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 19 March 1998

Appellant: (Opponent 02)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office dated 8 February 1996, posted on 4 March 1996 concerning maintenance of European patent No. 0 279 500 in amended form.**

Composition of the Board:

Chairman: C. T. Wilson
Members: H. Andrae
M. K. S. Aúz Castro

Summary of Facts and Submissions

I. European patent No. 0 279 500 was granted on 23 December 1992 on the basis of European patent application No. 88 200 470.8.

II. Notices of Opposition were filed by the Appellant (Opponent 2) and the party as of right (Opponent 1). They requested revocation of the patent in its entirety on the grounds of Article 100(a), lack of novelty and inventive step, and of Article 100(c) EPC.

The state of the art cited in support of their requests is reflected inter alia by the following prior art documents:

(D1) FR-A-2 225 705 or corresponding GB-A-1 463 075

(D4) US-A-3 620 032

(D6) JP-A-55-14351 with English translation

(D7) US-A-3 062 016

(D14) US-A-2 685 181

(D15) "Western Electric gets economical, high purity nitrogen from new plant", Cyrogenics & Industrial Gases, September 1969, pages 19, 20, 22

(D16) FR-A-1 295 048

(D17) L.S. Gaumer: "Small Air Separation Plants" I0MA BROADCASTER, May to June 1980, pages 10 to 17

(D19) US-A-4 017 284

III. In the decision given at oral proceedings on 8 February 1996 and issued in writing on 4 March 1996, the Opposition Division held that the patent was to be maintained in amended form on the basis of the first auxiliary request filed during the oral proceedings.

Claim 1 according to this request reads as follows:

"1. Apparatus for producing highly pure nitrogen gas comprising a compressor (9) for compressing air from outside the apparatus, means (12) to remove the carbon dioxide gas and water from the compressed air, a heat exchanger (13, 14) for cooling the compressed air to a cryogenic temperature, a rectifying column (15) for separating the air into a liquefied air portion and nitrogen vapour, a liquid nitrogen store (23), a leading channel (24) to supply liquid nitrogen from the liquid nitrogen store (23) to the upper portion of the rectifying column (15) as a refrigerant, and an outlet channel (27) for withdrawing the nitrogen from the upper portion of the rectifying column (15), and a condenser (16) comprising a heat exchanger (16c) for condensing nitrogen vapour supplied thereto from the top of the rectifying column (15) to provide liquid nitrogen reflux to the column (15) by heat exchange with the evaporating liquefied air portion supplied to the heat exchanger (16c) through a pipeline connecting the condenser (16) with the bottom of the column (15), the condenser (16) being formed to accumulate the liquefied air portion therein and liquid level detecting means (25) being provided to detect the level of the liquefied air portion in the condenser (16) and to control the supply of liquid nitrogen from the store (23) into the column (15) according to this level, the liquid nitrogen store (23) being arranged to receive

and store liquid nitrogen supplied from outside the apparatus and the column (15) and the heat exchanger (13, 14) for cooling the compressed air being contained in a vacuum cooling box and heat insulated by vacuum perlite."

The Opposition Division took the view that the subject-matter of Claims 1 and 2 according to the first auxiliary request met the requirements of Article 123(2) and (3) EPC. In their opinion also, the requirements of novelty and of inventive step were satisfied since the claimed type of vacuum insulation was not derivable from any of the available prior art documents.

IV. An appeal was filed against this decision by the Appellant on 9 May 1996 and the appeal fee paid on the same day.

In the Statement of Grounds of Appeal filed on 12 July 1996 the Appellant cited

(D20) DE-A-3 102 412 and

(FW1) Fastowski et al: "Kryotechnik", Akademie-Verlag, Berlin, 1970, pages 270 to 272

submitting that these documents relate exclusively to the features incorporated into the claims for the first time during the oral proceedings.

V. In his letter dated 7 May 1997 the Appellant cited for the first time

(D21) R.E. Latimer and R.A. Mostello: "Thermodynamic Comparison of Large-Scale Liquefaction of Air, Hydrogen and Helium" A.I.Ch.E. Journal, vol. 10, No. 3, May 1964, pages 407 to 415.

The Appellant set out that the subject-matter of Claim 1 and of the patent in suit, respectively, is not based on an inventive activity in view of the combination of (D1) or (D14) with (D20).

VI. In the communication of 23 September 1997 issued in preparation for oral proceedings, the Board expressed the provisional opinion that the new citation (FW1) and (D20) dealing with the common knowledge about the use of perlite and, respectively, with the feature relating to the arrangement of the distillation column and the heat exchanger in a vacuum cooling box, would probably be admitted into the proceedings whereas (D21) would not seem to be sufficiently relevant for introducing it into the proceedings. Further according to the Board's communication, it would appear that the skilled person would be induced in particular by the teaching of (D6) and his general background knowledge to modify the apparatus described by (D1) in such a way as to arrive in an obvious manner at the subject-matter of Claim 1.

VII. With the letter dated 16 February 1998 the party as of right submitted an extract from the Russian textbook "Radzdielienie Vozdukha", Moscow, 1964, and with the letter dated 19 February 1998 an English translation of this extract, pages 380 to 382, dealing with the application of powder-like materials, in particular perlite, for insulating air separation installations.

VIII. With the letter dated 19 February 1998, the Respondent (Patentee) set out that the claim and the description of the patent in suit require the nominated components to be in a vacuum and that a double-walled jacket is not a vacuum cooling box. With the above-cited letter the Respondent submitted a paper titled "Reports and Tests conducted in connection with EP 0279500", a

report of "Scawin Consultancy Services" filed already during opposition proceedings and a curriculum vitae of Mr J. H. Scawin. Furthermore, the Respondent submitted three sets of claims according to auxiliary requests 1, 2 and 3.

IX. Oral proceedings before the Board were held on 19 March 1998 in the presence of the Appellant and the Respondent. The party as of right had informed the Board by Fax dated 18 March 1998 that they would not attend the oral proceedings.

X. The Appellant requested that the decision under appeal be set aside and that the patent be revoked, or by way of auxiliary request, that the case be remitted to the first instance for further prosecution.

In support of its request, the Appellant relied essentially on the following submissions:

The feature of Claim 1 relating to a vacuum cooling box has to be understood to include also cooling boxes consisting of a double-walled container in which the space between the outer and the inner container wall is evacuated and filled with perlite as described by (D20).

(D1) as the closest prior art document specifies on page 3, lines 13 to 19, that the cold requirements for operation of the rectification column are provided by introduction of liquid nitrogen into the top of the column, the rate of nitrogen introduction being adjusted to keep the system in equilibrium. The skilled person would search in the prior art for means appropriate for controlling the introduction of liquid nitrogen into the column. The features (a) and (b) as defined on page 8 of the decision under appeal, even if not already implicit in (D1) itself, represent the most

common measures for controlling an air separation process and are described for example in (D4), (D6), (D7), (D14) or (D15). In particular, (D14) teaches to make use of a conventional liquefied gas level control system to maintain a predetermined level of liquid in the condenser and the skilled person would fill any gap in the specific information of (D1) with this teaching.

Distinguishing feature (c) as defined in the decision under appeal relates to the problem of avoiding cold losses in the air separation system for reasons of energy and costs saving, this aspect being completely independent from that of the liquid nitrogen feed control. Vacuum insulations are commonly known to be used in application to air separation plants such as described in (D17), (D19), (D20) or (FW1). In particular, (D20) discloses such a vacuum insulation in which perlite is used.

The achievement of a high purity of the nitrogen gas according to the patent in suit is no more than a "bonus effect" arising from the type of insulation claimed. Moreover, the passage on page 15, paragraph 2, of the original application EP-A-0 144 430 relating to the achievement of a highly pure nitrogen gas with 0.3 ppm or less of impurity oxygen was disclosed only with reference to the embodiment of Figure 2 and not to the embodiment of Figure 6 which relates to the provision of a vacuum cooling box. Thus, the aspect of obtaining a highly pure nitrogen gas was not originally disclosed to underly the subject-matter of present Claim 1. The results of the tests carried out by the Respondent cannot be used as an evidence of the achievement of highly pure nitrogen gas since the tests are not derivable from the patent. In particular from the figure of 2 ppm of liquid N_2 oxygen content which is

about 10 times higher than the alleged oxygen content of product N_2 content, it must be concluded that no realistic results were obtained from the tests.

In summary, the skilled person would modify the apparatus according to (D1) by integrating the control means known from (D14) and the insulating means disclosed in (D17) or (D20) to arrive in an obvious way at the subject-matter of Claim 1.

XI. The party as of right has forwarded no request.

XII. The Respondent requested that the appeal be dismissed, by way of auxiliary request with the proviso that the patent be maintained on the basis of Claims 1 and 2 filed as first auxiliary request on 20 February 1998 or on the basis of a single Claim 1 according to a second or a third auxiliary request filed on the same day.

The Respondent's arguments can be summarised as follows:

Distinguishing feature (c) as defined in the decision under appeal can reasonably be interpreted only such that there is a common vacuum in the cooling box to which the column, the heat exchanger and the perlite are exposed. A double-walled vessel with the vacuum provided only between the outer and the inner wall cannot be regarded as complying with the above-cited feature (c).

In the distillation systems known from (D4), (D6), (D7) and (D15) liquid nitrogen fed to the condenser of the column acts as refrigerant which is the sole purpose thereof. It is not introduced into the column as required by Claim 1. (D14) is the only citation which describes the feeding of liquid nitrogen into the column under the control of liquid level detecting

means. This citation originates from the year 1952 and it would not be normal for the skilled person to combine a document dating back so far with a much more recent document such as (D1) published in 1974. Moreover, (D14) relates to a different type of apparatus and there is no reason to apply the control means disclosed therein to produce nitrogen gas of high purity.

Contrary to the opinion of the Appellant there is a link between the aspects of thermal insulation and of a high purity of the nitrogen gas as evidenced by the test results submitted. The lowest oxygen impurity in nitrogen gas achieved in the prior art so far was in the range of 2 ppm. It must be regarded as a surprising advantage that an impurity which is ten times lower than the prior result is arrived at by the invention by taking measures which are not obvious from the prior art.

Reasons for the Decision

1. *Amendments (main request)*

Claim 1 differs in substance from Claim 1 as granted by the additional feature that the column (15) and the heat exchanger (13, 14) for cooling the compressed air are contained in a vacuum cooling box and heat insulated by vacuum perlite. This feature derives from page 7, lines 9 to 11 of the original application and from page 20, paragraph 3 of the parent application from which the application underlying the patent in suit has been divided. It restricts the protection conferred by Claim 1 as granted.

Claim 2 corresponds with Claim 2 as granted which is identical with Claim 2 as originally filed.

Claims 1 and 2 are not, therefore, objectionable under Article 123(2) and (3) EPC.

Having regard to the interpretation of the above-cited additional feature of Claim 1 the Board, after deliberation in the oral proceedings, has come to the conclusion that Claim 1 does not exclude a double-walled form of the vacuum cooling box. According to common understanding the term "vacuum box", similarly to "vacuum flask", comprises containers of the type in which the space available for the goods to be housed is surrounded by a double walled evacuated space so that the useful space of the container is insulated from the environment by means of a vacuum in the form of a jacket. Such an arrangement as for example shown in (D17), (D18), (D19) or (D20) is therefore comprised by the term "vacuum cooling box". As the term "vacuum cooling box" does not provide any information about the construction of the box and positioning of the vacuum, a container housing a distillation column and a heat exchanger in which these components are exposed to a vacuum such as described in (D16) is also encompassed by said term.

2. *Novelty (main request)*

It is undisputed that (D1) reflects the closest prior art in respect of the subject-matter of independent Claim 1.

(D1) describes an apparatus for producing nitrogen gas comprising a compressor (1) for compressing air from outside the apparatus, a heat exchanger (2) for cooling the compressed air to a cryogenic temperature, a

rectifying column (3) for separating the air into a liquefied air portion and nitrogen vapour, a liquid nitrogen store (7) being arranged to receive and store liquid nitrogen supplied from outside the apparatus and connected with a leading channel to supply liquid nitrogen from the liquid nitrogen store to the upper portion of the rectifying column (3) as a refrigerant, an outlet channel (shown in the figure) for withdrawing the nitrogen from the upper portion of the rectifying column (3) and a condenser (5) comprising a heat exchanger for condensing nitrogen vapour supplied thereto from the top of the rectifying column (3) to provide liquid nitrogen reflux to the column by heat exchange with the evaporating liquefied air portion supplied to the heat exchanger through a pipeline (valve 4) connecting the condenser (5) with the bottom of the column (3). The presence of means for removing the carbon dioxide gas and water from the compressed air, although not described, is implicitly disclosed to the skilled person for the reason of obtaining fractions of satisfactory purity.

Claim 1 differs from the apparatus of (D1) by the following features:

(a) the condenser is formed to accumulate the liquefied air portion therein

(b) liquid level detecting means are provided to detect the level of the liquefied air portion in the condenser and to control the supply of liquid nitrogen from the store into the column according to this level; and

(c) the column and the heat exchanger for cooling the compressed air are contained in a vacuum cooling box and heat insulated by vacuum perlite.

From the fact that (D1) describes the closest prior art it follows that the subject-matter of Claim 1 is novel (Article 54 EPC).

Since novelty was not disputed in the appeal proceedings, this issue requires no further argumentation.

3. *Inventive step (main request)*

3.1 The primary object of the invention is to provide a nitrogen gas production apparatus which can produce highly pure nitrogen gas at a low cost yet without any trouble (see the description column 4, lines 3 to 6 of the patent in suit).

Contrary to the view of the Appellant, this object forms already part of the original disclosure as derives from page 4, paragraph 3 of the original application and from page 7, paragraph 2 of the published parent application EP-A-0 144 430.

When combined with the disclosure of (D1), the above-cited distinguishing features (a) and (b) have the effect of controlling the feed rate of the liquid nitrogen into the column. This enables a close follow-up of changes in the quantity of the nitrogen gas product withdrawn and hence a steady and reliable operation of the apparatus with a constantly high nitrogen purity.

The distinguishing feature (c) achieves a reduction of the cold losses of the apparatus and contributes to an increase of the purity of the nitrogen gas. This effect has not only been testified in the Respondent's report of "Scawin Consultancy Services" (see in particular section 2.2.4) filed with the letter dated 19 February

1998, but has also been acknowledged in the declaration by Dr W. H. Aitken submitted by the party as of right on 11 January 1996 (see page 1, paragraphs 5 to 7).

It is therefore credible to the Board that the above-cited object is achieved by the subject-matter of Claim 1. The achievement of highly pure nitrogen gas cannot, therefore, be regarded as a "bonus-effect", but constitutes the objectively underlying problem.

3.2 The principal line of argument of the Appellant is that it would be obvious for the skilled person starting out from the apparatus described by (D1) to integrate therein both the distinguishing features (a) and (b) as known from (D14) and the distinguishing feature (c) as known from (D17) or (D20) and to arrive thus at the subject-matter of Claim 1.

(D14) relates to the separation of the constituents of gaseous mixtures, in particular air, in which process and apparatus liquid nitrogen generated in the apparatus itself rather than supplied from outside (see liquid nitrogen storage container 100 and receiver 90) is used. Liquid nitrogen is introduced into the lower part 28 of the rectification column 30 in response to the level of oxygen enriched liquid in condenser chamber 34 by means of a valve 104 and a liquefied gas level control system 105.

(D14) deals with the problem of obtaining liquid nitrogen and oxygen-enriched liquid or gas (see column 5, lines 12 to 14). There is no suggestion to produce gaseous nitrogen, let alone highly pure nitrogen gas. The skilled person would not, therefore, consider that by making use of the liquefied gas level control system according to (D14) any improvement relating to an increased purity of nitrogen gas was to be expected.

As a further viewpoint, (D14) concerns a disclosure which originates from 1952 and was published in 1954, that is about 20 years before the publication date of (D1). The skilled person would not normally consider a combination of an isolated prior art document such as (D14) with a publication which appeared two decades later, and this particularly in a case as at present in which the older citation does not contain any pointer to the problem to be solved by the patent in suit.

3.3 The further citations (D4), (D6), (D7) and (D15) globally referred to by the Appellant in the context of the distinguishing features (a) and (b) describe the feeding of liquid nitrogen to the condenser of the column for the sole purpose of achieving refrigeration. Since in these systems the liquid nitrogen is not introduced into the column as required by Claim 1, these citations relate to rectification systems being fundamentally different from that according to Claim 1. The skilled person would see no reason to combine any of these citations with the disclosure of (D1) and, even if he considered such a combination, he would not - due to the absence of distinguishing feature (b) - arrive at the claimed subject-matter.

3.4 Among the documents (D16) to (D21), (FW1) and the passage of the Russian textbook submitted by the party as of right (see section VII above) which were cited in view of the arrangement of the column and the heat exchanger in a vacuum cooling box, (D20) is considered by the Board to be the nearest citation. According to (D20) container 1 housing the "cold" constituents of an air separation apparatus comprises a double-walled jacket which is evacuated and filled with an insulating material such as e.g. perlite. Thus, the Appellant is correct in maintaining that the distinguishing feature (c) per se is described by (D20). This feature is likewise described by (D16) which shows an evacuated

container housing the distillation column and the heat exchanger, the container being filled by a granular or powdery insulation material. As a typical example for such a granular insulating material the skilled person would choose perlite.

The teaching of Claim 1 is, however, not exhausted by the measure of improving the insulation of the apparatus by means of a vacuum cooling box to reduce cold losses, but strives for and achieves nitrogen gas product with very low oxygen content.

In the documents "Reports and Tests conducted in connection with EP 0 279 500" and the report of "Scawin Consultancy Services" submitted by the Respondent, (see section VIII above), the results of tests are illustrated designed to show any difference in product nitrogen purity achieved when using an apparatus according to the patent in suit and the same apparatus without vacuum insulation, but perlite only. In the apparatus used the oxygen adsorption cylinder 27a as shown in Figure 2 of the drawings of the patent in suit had been left out (see the figure annexed to the test report) in order to obtain test results which are independent of the oxygen adsorption device.

The test results show that with the test apparatus having an insulation of perlite only, an oxygen impurity of 0.74 p.p.m max was achieved and that the provision of the test apparatus with a vacuum and perlite insulation led to the even lower oxygen impurity of 0.19 p.p.m. max. Such levels of oxygen impurity in the nitrogen gas have also been acknowledged in the declaration by Dr W. H. Aitken submitted by the party as of right on 11 January 1996 (see "Miscellaneous" on the last page) as being low

levels. The Appellant's further argument that the test results are not realistic, in particular in view of the fact that the liquid N_2 oxygen content of 2 p.p.m was about ten times higher than the alleged product N_2 oxygen content, is not convincing.

If the liquid nitrogen supplied from outside the apparatus has a certain oxygen impurity, then the higher the impurity in the liquid nitrogen, the higher will be the contamination in the nitrogen product. In the present case, as the Appellant correctly points out, the liquid N_2 oxygen content was about ten times higher than the product N_2 oxygen content resulting from the test data. The Board considers, however, that, if in spite of a relatively high impurity in the liquid nitrogen the low impurity values as illustrated by the test results could be reached in the product nitrogen, this has to be regarded as an additional surprising result to which the prior art does not give the slightest hint.

3.5 The remaining prior art documents cited in the opposition were not discussed at the oral proceedings. The Board has considered these documents and has found them non-prejudicial to Claim 1, neither alone nor in combination with the documents cited above.

Summarising, the Board comes to the conclusion that the provision of means controlling the feed rate of the liquid nitrogen into the column in dependence on the level of liquefied air in the condenser in combination with the heat insulation of the columns and the heat exchanger in a vacuum cooling box solve the underlying problem of achieving in an economical way highly pure nitrogen gas in a manner which is not obvious to the person skilled in the art (Article 56 EPC).

3.6 As a result of the foregoing the Board is convinced that Claim 1 is valid in the form as maintained by the Opposition Division. Claim 2 which is dependent on Claim 1 and relates to a particular embodiment of Claim 1 is likewise valid.

4. The grounds of opposition do not prejudice maintenance of the patent in amended form in accordance with the Respondent's main request and it is therefore not necessary to consider the Respondent's auxiliary requests.

5. Having regard to the Appellant's auxiliary request for remittal of the case, the following is pointed out: When exercising its discretion pursuant to Article 111(1) EPC the Board has to balance two requirements. Firstly to establish as rapidly as possible in the interests of both the public and of the parties to the proceedings whether or not the patent may be maintained, and secondly to allow the parties to present their cases adequately so that the correct decision can be made (See "Opposition Procedure in the EPO", General Principles, OJ EPO 1989, 417).

In the present case the Respondent's main request in the appeal proceedings corresponds with the claims maintained by the first instance, albeit with a broader interpretation. Furthermore, all the prior art documents and expert opinions relevant to Claim 1 had already been cited during the opposition proceedings so that the Board had at its disposal all the arguments of the first instance relating to the claims on file according to the main request.

For the foregoing reasons, the Board considers it appropriate to decide itself on the merits of the case.

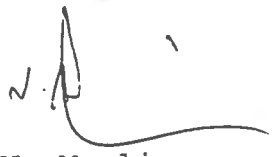
The Appellant's auxiliary request to remit the case to the first instance for further prosecution is therefore rejected.

Order

For these reasons it is decided that:

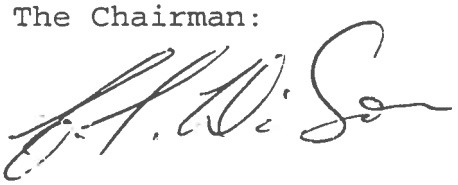
The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C. T. Wilson