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**Datasheet for the decision  
of 19 February 2008**

**Case Number:** T 0018/06 - 3.2.03

**Application Number:** 99104202.9

**Publication Number:** 0947789

**IPC:** F25J 3/04

**Language of the proceedings:** EN

**Title of invention:**

Cryogenic air separation system with integrated machine  
compression

**Patentee:**

PRAXAIR TECHNOLOGY, INC.

**Opponent:**

L'AIR LIQUIDE, S.A. A DIRECTOIRE ET CONSEIL DE SURVEILLANCE  
POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE

**Headword:**

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**Relevant legal provisions:**

EPC Art. 83, 100(b), 56, 100(a)

**Relevant legal provisions (EPC 1973):**

-

**Keyword:**

"Ground of opposition not withdrawn"

**Decisions cited:**

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**Catchword:**

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Case Number: T 0018/06 - 3.2.03

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.03  
of 19 February 2008

**Appellant:**  
(Opponent)

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**Representative:**

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**Respondent:**  
(Patent Proprietor)

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**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
17 November 2005 concerning maintenance of  
European patent No. 0947789 in amended form.

**Composition of the Board:**

**Chairman:** U. Krause  
**Members:** C. Donnelly  
I. Beckedorf

## Summary of Facts and Submissions

- I. The appeal lies from the decision of the opposition division, posted on 17 November 2005, by which the contested patent was maintained in amended form on the basis of the main request comprising claims 1 to 4 and 6 to 8 as granted and an amended independent apparatus claim 5 as filed with letter of 12 October 2004.
- II. The opponent (hereinafter "appellant") filed a notice of appeal on 5 January 2006 requesting that the impugned decision be set aside and the patent revoked.

In the grounds of appeal filed on 22 March 2006 the appellant cited the following state of the art:

D1: EP-A-0684437;

D2: US-A-5329776;

D3: "Meeting the challenge of variable liquid demands" by B. Keenan and K. Reuter, BOC Technology, November 1996, pages 33 to 36;

D4: "Integrated machinery systems for cryogenic processes consisting of turboexpander, compressor, high frequency motor and generator with magnetic bearings" by K. Reuter, Proceedings of the 1997 IEE Colloquium on High Speed bearings for Electrical Machines, 25 April 1997;

D5: EP-A-0672877;

D6: US-A-5386692;

D7: US-A-5765396;

D8: EP-A-0624766 (also cited in the description);

D9: US-A-5924307 (cover page);

D10: Research disclosure 40380 "Integrated Air Booster and Oxygen compressor for Partial pumped LOX Cryogenic Air Separation Process cycle, November 1997;

D11: EP-A-0877217;

D12: US-A-3592078;

D13: "The Technology of Catalytic Oxidations" by Arpentinier et al., Editions TECHNIP, 2001, pp 44-45.

The appellant objected that the subject-matter of claim 1 did not involve an inventive step (Art. 100(a), Art. 56 EPC) and that the invention was not sufficiently disclosed such that the skilled person could carry it out (Art. 100(b), Art. 83 EPC).

III. In letter of 1 August 2006, the respondent requested that the appeal be dismissed or alternatively that the patent be maintained in amended form on the basis of claims 1 to 4 of a first auxiliary request. Further, the respondent was of the opinion that the objection under Article 100(b) EPC had been withdrawn during the oral proceedings before the opposition division and could not now be reintroduced into the appeal procedure.

IV. On 9 November 2007 the Board issued a provisional opinion in a communication pursuant to Article 11(1)RPBA annexed to the summons to oral proceedings. In particular, the parties were informed that the nearest prior art appeared to be D8 whereas D7, D9, D11 and D13 were published after the priority date of the contested patent. Further, it was indicated that D12 seemed very relevant and, although filed for the first time with the grounds of appeal, would probably be admitted into the proceedings. The parties were also informed that it was the Board's provisional view that

the objection under Article 100(b) EPC had not been clearly and unambiguously withdrawn.

- V. By letter of 17 January 2008 the respondent filed auxiliary requests 1 to 3 in replacement of the auxiliary request of 1 August 2006.

By letter of 14 February 2008, the appellant requested that the auxiliary requests of 17 January 2008 not be admitted into the proceedings or should they be so, that the case be remitted to the opposition division.

- VI. Oral proceedings were held on 19 February 2008.

- VII. Claim 1 as granted reads:

"A method for producing gaseous and liquid product from a cryogenic air separation plant comprising:

(A) compressing the total feed air for the cryogenic air separation plant to a base load pressure;

(B) dividing the base load air into a turbine booster fluid and a product boiler booster fluid;

(C) further compressing the turbine booster fluid by passage through at least one turbine booster compressor, and passing the turbine booster fluid into the cryogenic air separation plant;

(D) further compressing the product boiler booster fluid by passage through at least one product boiler booster compressor, passing the product boiler booster fluid through a product boiler, and passing the product

boiler booster fluid into the cryogenic air separation plant;

(E) separating the turbine booster fluid and the product boiler booster fluid in the cryogenic air separation plant by cryogenic rectification into gaseous product and liquid product; and

(F) recovering both gaseous product and liquid product from the cryogenic air separation plant;

characterized by

(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case.

Independent claim 1 according to the auxiliary request of 17 January 2008 is identical to claim 1 as granted except that the characterising portion reads:

(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case,

wherein power is provided to the gear case by a turboexpander and wherein the turbine booster fluid is turboexpanded through the turboexpander prior to being passed into the cryogenic air separation plant."

Independent claim 1 according to auxiliary request 2 of 17 January 2008 is identical to claim 1 as granted except that the characterising portion reads:

"(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case separate from the base load air compressor."

Independent claim 1 according to auxiliary request 3 of 17 January 2008 is identical to claim 1 as granted except that the characterising portion reads:

"(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case separate from the base load air compressor;

wherein power is provided to the gear case by a turboexpander and wherein the turbine booster fluid is turboexpanded through the turboexpander prior to being passed into the cryogenic air separation plant."

VIII. The arguments of the parties with respect to the various contentious issues are summarised below.

IX.

*(a) Admission of late filed documents*

*Appellant*

D12 was filed with the grounds of appeal and forms an essential part of the case in the appeal proceedings. It did not immediately come to light in the search carried out for the opposition since it is classified in a different field from the contested patent. However, this does not distract from its pertinence.

D13 is an excerpt from a textbook and is merely intended to reflect the knowledge of the skilled person in case there should be any doubt as to what this comprises.

*Respondent*

D12 has been filed after expiry of the opposition period and is therefore late filed. Moreover, as stated by the appellant, it is classified in a field which is remote from that of air-separation, hence, by virtue of this fact, it must be deemed prima facie not to be of any particular pertinence.

D13 was published three years after the priority date of the contested patent and is of no more relevance than D9 anyway.

*(b) Main request*

*(i) Insufficiency of disclosure Art. 100(b), Art. 83 EPC*

*Appellant*

This objection was not unambiguously withdrawn drawing during the opposition proceedings. Stating an objection is "not maintained" is not the same thing as stating that it is "withdrawn". Therefore this is not a fresh ground of opposition and must be taken into consideration.



The wording of claim 1 as granted refers in step (C) to "at least one turbine compressor" and in step (D) to "at least one product boiler compressor" whereas in step (G) "all the turbine booster compressors" and "all the product boiler booster compressors" are specified. Since the term "all" necessarily means "more than one" steps (C) and (D) must also be understood in this sense. However, since both embodiments of the contested patent only show one turbine booster compressor the skilled person is not taught by the patent how such an arrangement with multiple compressors should be put into application.

*Respondent*

The objection under Article 100(b) was unequivocally withdrawn during the oral proceedings before the opposition division and cannot now be raised again during the appeal proceedings without the permission of the respondent since it has the status of a fresh ground of opposition.

In characteristic (G) of claim 1 as granted the expression "all" should be understood as "each", since this is compatible with features (C) and (D). Thus, there is no requirement in the claim for there to be more than one compressor. In any case the connection of a plurality of turbine booster compressors would not be a problem since the skilled person would simply connect a further compressor to the single gear case in the same way as the two product booster compressors shown in figure 2.

*(ii) Inventive step*

*Appellant*

The subject-matter of claims 1 and 5 is not inventive in view of D8 in combination with D12 or alternatively D8 in combination with D5 and D12.

The subject-matter of claim 1 as granted is only distinguished from the method disclosed in EP-A-624 766 (D8) by feature (G):

- providing energy to operate all the turbine booster compressors and all the product boiler booster compressors through a single gear case.

In agreement with the contested patent at paragraph [0033] the objective technical problem is one of ensuring that each expander or compressor can be driven at optimum speed for a reduced capital outlay.

If the turbines and the compressors are directly linked they will rotate at the same speed, since the optimum speed for the turbine is not the same as that for the compressor (see D8, column 8, lines 8 to 28) this means that, unless the link is broken, a compromise speed has to be chosen where neither machine is running at its most efficient.

Consequently, the skilled person would see that in order to solve the above problem the direct link between the compressor and the turbine must be replaced and would consult relevant literature provided by the

equipment manufacturers, of which D12 is an example, in the search for ways of how to achieve this.

This document describes a gear-box which allows a motor or turbine (see column 4, lines 22 to 25) to drive two compressors operating in parallel (see column 6, lines 6 to 21 and claim 8), thus permitting each compressor to be run at its optimum speed. The skilled person would understand that this system can be applied to the installation of D8 in order that the compressors can be driven independently, thus allowing a better control of liquid and gas production.

Further, D5 shows how a plurality of compressors can be driven by turboexpanders (as in D8) and/or a motor (to provide supplemental energy if required) through a gear box.

Thus, the subject-matter of claim 1 according to the main request does not involve an inventive step.

*Respondent*

As explained at paragraph [0007] of the contested patent, the objective technical problem to be solved must be seen as one of being able to produce efficiently gaseous product at a defined elevated pressure while the liquid production may be varied in a cost-effective manner.

Difficulties in finding a reasonable solution to this problem arise from the nature of the pumped liquid oxygen cycle that as indicated in paragraph [0003] requires the compressor to supply high pressure feed

air to the product boiler compressor used in vaporising the oxygen to discharge at a constant pressure. Since the discharge pressure is fixed the variability in liquid product is limited.

By using a single gear case the product slate may be varied without compromising efficiency. When it is desired to produce more liquid, the required increase in refrigeration is achieved by increasing power to the gear case which allows the turbine booster compressor to discharge at a higher pressure resulting in a greater pressure ratio across the turbine and hence more refrigeration.

Thus, whilst the use of the gear case allows for the compressors to rotate at optimum speeds (see paragraph [0033]), this is not the problem which the opposed patent seeks to solve. The technical effect achieved by the use of the single gear case is to allow production of gaseous product at a certain pressure, whilst also allowing liquid production to be varied in an efficient manner.

It is a critical feature of D8 that the turbine booster compressor 5 is driven directly without gearing by the turboexpander 7 in order to achieve high efficiency (see column 8, lines 2-28). In essence, the apparatus of D8 achieves an efficient process by decoupling the product boiler booster compressor from the turbine booster compressor. Thus, document D8 teaches away from any integration of the two compressors.

The skilled person would not take D12 into consideration since it is not related to the technical

field of cryogenic air-separation and gives no indication of how a gear-box should be integrated into an installation such as that of D8.

Thus, the skilled person could only think of combining the teachings of D8 and D12 with the benefit of hindsight.

*(c) Admissibility of auxiliary requests*

*Appellant*

The first auxiliary request (AR1) of 17 January 2008 is the same as that of 1 August 2006, hence, there is no objection to this request being admitted.

However, the second and third auxiliary requests (AR2 and AR3) comprise the feature wherein the single gear case is separate from the base load air compressor. Apart from not quite understanding what is intended by this feature, since, normally, the base load compressor must be separate from the gear case because they have different functions, it would seem that the only basis for such an amendment is figure 2. Thus, it has not been possible to carry out the necessary search for relevant documents, accordingly AR2 and AR3 should not be admitted into the procedure.

*Respondent*

AR1 of 17 January 2008 is identical to that of 1 August 2006, hence, there can be no objection to its admittance.

AR2 and AR3 were filed in response to remarks made by the Board with respect to D5 in the preliminary opinion. The requests were filed one month before the oral proceedings so there was enough time for the appellant to do any additional searches for relevant prior art that might have been required.

*(d) First auxiliary request.*

*(i) Inventive step*

*Appellant*

The subject-matter of claim 1 according to the first auxiliary request differs from the method according to D8 by the step of:

(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case,

wherein power is provided to the gear case by a turboexpander and wherein the turbine booster fluid is turboexpanded through the turboexpander prior to being passed into the cryogenic air separation plant.

D8 gives a hint to this additional feature at column 4, line 14 to 19 since it indicates that the turboexpander is used to power the compressor to avoid the need for a generator to capture energy produced by the turbine expansion. When this concept is combined with the standard design requirement for the turbine and compressor to be each run at their respective optimum

speeds it would be evident for the skilled person that a gear case would provide the simplest solution. In the arrangement shown in D12 the turboexpander would be incorporated into the driving machine train 41. In case the turboexpander could not provide enough power a back-up solution would be needed as described for example in D5 (see column 1, lines 13 to 18; 42 to 45 and figure) which details the use of a motor generator 38,40. A back-up function is required anyway in case of turbine malfunction.

Thus, in order to solve the problem of running all the rotating machines in the method and apparatus according to D8 at their optimum speed in the most efficient way, the skilled person would use the gear case of D12 driven by the turboexpander backed up by a motor generator in the standard manner as described for example in D5.

*Respondent*

It is an essential feature of the method and apparatus according to D8 that the turbine booster compressor 5 is driven by the shaft of the turboexpander 7 through which the turbine booster fluid is to be expanded. Thus, D8 teaches away from using the turboexpander 7 to drive a gear case.

Document D12 teaches that the compressor arrangement is driven by a prime mover such as an electric motor or a steam or gas turbine. D12 gives no hint at an arrangement wherein the compressors are driven by a turboexpander which is itself driven by turboexpansion

of fluid which has been compressed by one of the compressors of the compressor array.

The gear case of D5 does not include a product boiler booster compressor and thus would not be taken into consideration by the skilled person except with the benefit of hindsight.

### **Reasons for the Decision**

1. *Admissibility of late filed documents*

D12 was filed with the grounds of appeal and as such, from the beginning of the appeal proceedings, formed an essential element of the appellant's case. Although classified in a different field to that of the contested patent, the Board considers that the document is prima facie relevant since it tackles the problem of running different rotating machinery at optimum speeds with a gear case. Thus, D12 is admitted into the proceedings.

D13 was published three years after the priority date of the contested patent. Accordingly, it cannot be taken as a reliable indicator of the skilled person's general knowledge at that time and cannot be admitted into the proceedings.

2. *Insufficient disclosure Art. 100b, Art. 83 EPC.*

The Board is of the view that the expression "not maintained" used in the minutes of the oral proceedings before the opposition division (see point 1.1) cannot



necessarily be interpreted to mean that the objection under Article 100(b) has been unequivocally withdrawn. In view of the consequences, the highest demands of clarity are required in such cases and normally only a formal request in writing would be sufficient. Hence, the Board is of the opinion that this objection does not constitute a fresh ground of opposition and must be dealt with.

Considering next the substance of the objection, it must first be settled whether the claim requires that there is a plurality of compressors of each type as argued by the appellant.

Features (C) and (D) clearly only call for "at least one turbine booster compressor" and "at least one product boiler booster compressor" to be provided. However, feature (G) specifies "all the turbine booster compressors and all the product boiler booster compressors". Although this may give rise to a slight ambiguity when taking the claim literally, the Board is of the view that the claim cannot be restricted to the case of a plurality of compressors of each type and that the expression "all" should be understood as "each".

The Board is also of the view that the skilled person would know how to connect a plurality of each type of compressor.

Figure 2 of the contested patent depicts an arrangement wherein one turbine compressor (55) and two product boiler compressors (61,63) are connected to the single gear-case. As argued by the respondent, the skilled

person wishing to connect a second turbine booster compressor has merely to adopt the same arrangement used to connect the two product boiler compressors.

Thus, the requirements of Article 83 EPC are met.

3. *Main request*

*(a) Inventive step*

It is common ground between the parties that the subject-matter of claim 1 as granted is only distinguished from the method disclosed in D8 by the feature (G), namely:

- providing energy to operate all the turbine booster compressors and all the product boiler booster compressors through a single gear case.

The respondent accepts that the use of the gear case allows for the compressors to rotate at optimum speeds (see paragraph [0033]). However, the respondent further argues that the objective problem should rather be seen as one of how to achieve the production of gaseous product at a certain pressure, whilst also permitting liquid production to be varied in an efficient manner. The use of a single gear case solves this problem since the required variation in refrigeration determining liquid output can be achieved by regulating the power to the gear case which in turn determines the turbine booster compressor discharge pressure and hence the pressure ratio across the turbine and ultimately the refrigeration produced.

The Board cannot accept this argument since the power source to the gear case is not defined in claim 1 of the main request and the immediate technical effect of a gear case is to allow each piece of rotating machinery to be run at its optimum speed at a minimum cost.

Hence, the Board considers the objective problem to be simply one of providing a way of running each piece of rotating machinery at its optimum speed for the minimum cost.

The respondent is correct to the extent that the specific invention shown in D8 achieves optimum efficiency by appropriate selection of the stream to be compressed (see col. 8, lines 29 to 32). However, D8 also explains the standard design procedures for radial turboexpanders and compressors and in particular states that "the design procedure is to choose the operating speed such that the optimum efficiency is obtained" (see column 8, lines 10 to 12). This part of D8 makes it clear that using gearing to obtain optimum rotational speeds is a standard procedure and that the invention of D8, which does away with the gearing, is a departure from convention.

Accordingly D8 teaches the skilled person that improved efficiency can be obtained either by optimising the speed of each of the rotating machines using gearing or applying the invention according D8.

The decision to use gearing to solve the problem of optimising the speeds of each rotating machine therefore represents a return to conventional practise

and would not require any inventive activity on the part of the skilled person. The precise solution of using a single gear case is given in D12. The Board considers that the skilled person would have consulted this document since it is written by manufacturers of rotating machinery and is addressed to anybody using such machinery faced with the problem of optimising machine speeds, which necessarily includes the skilled person in the field of cryogenic air separation.

In conclusion the skilled person would derive a general teaching from D8 that the use of gearing offers a solution to the problem of driving different rotating machinery at their optimum speeds. In this context the skilled person would not have needed to exercise any inventive skill to adopt the solution offered in D12 of providing a common gear case for driving the turbine booster compressor 5 and the product boiler compressor 3 of D8 and, hence, obtain the subject-matter of claim 1 according to the main request in an obvious manner.

Thus, the subject-matter of claim 1 according to the main request does not involve an inventive step.

4. *Admissibility of Auxiliary requests*

Since the first auxiliary request (AR1) of 17 January 2008 is the same as that of 1 August 2006, the Board can see no objection to this request being admitted. The appellant has also stated that it has no objection either.

However, the second and third auxiliary requests (AR2 and AR3) comprise the feature wherein the single gear case is separate from the base load air compressor. This feature is not specified in any of the claims as granted and would appear to have been derived from the figure 2. In these circumstances, the Board is of the opinion that such an amendment could not have been anticipated and that should the requests be admitted at this stage in the proceedings that the appellant might be unduly disadvantaged.

Thus, the second and third auxiliary requests (AR2 and AR3) are not admitted into the procedure.

5. *First auxiliary request*

*(a) Inventive step*

Both parties agree that the subject-matter of claim 1 according to the first auxiliary request differs from the method according to D8 by the step of:

(G) providing energy to operate all the turbine booster and all the product boiler booster compressors through a single gear case,

wherein power is provided to the gear case by a turboexpander and wherein the turbine booster fluid is turboexpanded through the turboexpander prior to being passed into the cryogenic air separation plant.

In other words, compared with the main request, the auxiliary request additionally specifies how power to the gear case is provided.

When this concept is combined with the standard design requirement for the turbine and compressor to be each run at their respective optimum speeds it would be evident for the skilled person that a gear case would provide the simplest solution.

D12 only indicates that a driving machine is used to power the drive shaft of the gear case arrangement. However, the Board concurs with the appellant that incorporating the drive from a turboexpander would not require any inventive skill since using a turboexpander to drive a compressor is conventional practise in cryogenic installations (as indicated at column 4, line 14 to 19 of D8 for example) and realising the actual linkage of the turboexpander to the drive shaft is a trivial problem for the skilled person.

Further, D5 shows how a motor/generator may be used in association with a turboexpander to ensure that there is always enough power or to provide a back-up solution in case of failure (see column 1, lines 13 to 18; 42 to 45 and figure 4).

Consequently, in order to solve the problem of running all the rotating machines in the method and apparatus according to D8 at their optimum speed in the most efficient way, the skilled person would not require any inventive skill to come up with the solution of using the gear case of D12 driven by the turboexpander.

Thus, the subject-matter of claim 1 according to the first auxiliary request does not involve an inventive step.

**Order**

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

1. The decision under appeal is set aside.
2. The patent is revoked.

Registrar:

Chairman:

A. Counillon

U. Krause.