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Datasheet for the decision of 10 September 2019

Case Number: T 1629/17 - 3.3.05

Application Number: 11757700.7

Publication Number: 2624946

IPC: B01J8/02, B01D53/047

Language of the proceedings: EN

Title of invention:
PROCESS USING A RADIAL BED VESSELS HAVING UNIFORM FLOW DISTRIBUTION

Patent Proprietor:
Praxair Technology, Inc.

Opponents:
L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE
Linde Aktiengesellschaft
AIR PRODUCTS AND CHEMICALS, INC.

Headword:
Radial bed vessel/PRAXAIR

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - all requests (no)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

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D E C I S I O N
of Technical Board of Appeal 3.3.05
of 10 September 2019

Appellant: (Patent Proprietor)	Praxair Technology, Inc. 10 Riverview Drive Danbury, CT 06810 (US)
Representative:	Schwan Schorer & Partner mbB Patentanwälte Bauerstrasse 22 80796 München (DE)
Respondent: (Opponent 1)	L'AIR LIQUIDE, SOCIETE ANONYME POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE 75 Quai d'Orsay 75007 Paris (FR)
Representative:	Laigneau, Amandine L'Air Liquide Direction Propriété Intellectuelle 75, Quai d'Orsay 75321 Paris Cedex 07 (FR)
Respondent: (Opponent 2)	Linde Aktiengesellschaft Klosterhofstrasse 1 80331 München (DE)
Representative:	Imhof, Dietmar Linde AG Technology & Innovation Corporate Intellectual Property Dr.-Carl-von-Linde-Straße 6-14 82049 Pullach (DE)
Respondent: (Opponent 3)	AIR PRODUCTS AND CHEMICALS, INC. 7201 Hamilton Boulevard Allentown, PA 18195-1501 (US)

Representative: Beck Greener LLP
Fulwood House
12 Fulwood Place
London WC1V 6HR (GB)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted on 22 May 2017 revoking European patent No. 2624946 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman E. Bendl
Members: A. Haderlein
S. Fernández de Córdoba

Summary of Facts and Submissions

I. The appeal was filed by the patent proprietor (appellant) against the decision of the opposition division to revoke the patent in suit.

II. The opposition division held, *inter alia*, that the subject-matter of claim 1 of the patent as granted lacked inventive step in view of the combination of

D1A: US 2006/0254420 A1 and
D17: Kareeri, A.A., et al., Simulation of Flow Distribution in Radial Flow Reactors, Ind. Eng. Chem. Res. 2006, 45, 2862-2874.

III. With the statement setting out the grounds of appeal, the appellant filed three auxiliary requests.

IV. Claim 1 as granted (main request) reads as follows:

"1. A fluid purification, separation or reaction process using a radial bed vessel comprising:
a substantially cylindrical vessel shell having a vertical longitudinal axis, an upper cap, and a lower cap;
a substantially cylindrical porous outer basket disposed concentrically inside the shell along the longitudinal axis and attached to at least one of the upper cap and the lower cap;
a substantially cylindrical porous inner basket disposed concentrically inside the porous outer basket along the longitudinal axis and attached to at least one of the upper cap and the lower cap of the vessel;
a substantially annular outer channel disposed between the vessel shell and the outer basket along the longitudinal axis having a cross-sectional flow area

capable of transporting either a feed fluid or a product fluid;
a substantially cylindrical inner channel disposed inside the inner basket along the longitudinal axis having a cross-sectional flow area capable of transporting either a feed fluid or a product fluid;
a substantially annular bed composed of at least one layer of active material disposed in the annular space between the inner and the outer baskets;
wherein:
the ratio of the cross-sectional flow area of the channel transporting the feed fluid to the cross-sectional flow area of the channel transporting the product fluid is in proportion to the ratio of the mass flow rate of the feed fluid to the mass flow rate of the product fluid with the proportionality constant greater than or equal to 0.7 and less than or equal to 1.4; and
the annular bed has a bed height and a bed transfer length sized such that the pressure change over the lengths of the inner and the outer channels are each less than or equal to 10% of the pressure drop across the bed under the operating conditions for the process fluid employed."

V. The wording of claim 1 of each of the auxiliary requests differs from that of claim 1 of the main request as follows:

In claim 1 of the first auxiliary request the expression "A fluid purification... process" is specified to be "An industrial scale fluid purification... process" (emphasis added).

In claim 1 of the second auxiliary request the expression "wherein:" is amended to read "characterized

in that the radial bed vessel is operated in z-flow wherein the flow in the inner channel is in the same direction as the flow in the outer channel,".

Claim 1 of the third auxiliary request contains the amendments of both the first and the second auxiliary requests.

VI. The arguments of the appellant, as far as relevant to the present decision, may be summarised as follows:

Compared with the closest prior art D1A which concerns a z-flow radial bed vessel, it is not contested that the only distinguishing feature is the following: "the annular bed has a bed height and a bed transfer length sized such that the pressure change over the lengths of the inner and the outer channels are each less than or equal to 10% of the pressure drop across the bed under the operating conditions for the process fluid employed" (feature "B"). The problem to be solved is to achieve uniform fluid flow distribution. This problem is solved by adopting the pressure change ratios described above in the process disclosed in D1A, i.e. by having the ratio of the pressure changes over the lengths of the inner and the outer channels be each less than or equal to 10% of the pressure drop across the bed. This is not obvious in view of D17. The latter document disclosed in Figure 10 values for the pressure change ratios or feature "B", of about 20%, whereas this value is 10% or less according to claim 1 of all the requests. The passage on page 2867, right-hand column, last paragraph, of D17 is to be read in combination with page 2872, left-hand column, teaching that π-flow is always more uniform than z-flow. The latter passage thus teaches away from using z-flow as used in D1A. Moreover, the claimed value of 10%

constitutes a fair compromise between the uniformity of flow distribution on the one hand and investment in equipment and operating costs on the other hand. It is not contested that the additional features incorporated in claim 1 of each of the auxiliary requests ("z-flow" and "industrial scale") fail to further distinguish the claimed subject-matter from the process disclosed in D1A.

VII. The arguments of the respondents, as far as relevant to the present decision, may be summarised as follows.

The subject-matter of claim 1 of all the requests differs from D1A, if at all, only by feature "B". The problem to be solved is to achieve uniform flow distribution. Figure 10 of D17 discloses that the pressure change along the annular channel divided by the pressure drop through the bed is close to zero, whereas in the center pipe it is about 20%. D17 teaches lowering the latter value in order to improve flow distribution uniformity by lowering the pressure drop in the center pipe which should be done by increasing its diameter. There is therefore a clear teaching in D17 to lower the pressure drop ratio for the central pipe from a value of 20%. There is no merit in picking the particular value of 10% or less. Thus, the subject-matter of claim 1 of all the requests does not involve any inventive step.

VIII. The appellant requested that the decision under appeal be set aside and the patent be maintained as granted. In the alternative, it requested the maintenance of the patent based on one of the three auxiliary requests filed with the statement of grounds of appeal.

IX. The respondents requested that the appeal be dismissed.

Reasons for the Decision

1. Third auxiliary request

1.1 Since claim 1 of the third auxiliary request comprises all the features of the main request and first and second auxiliary requests and the board finds that the subject-matter of claim 1 of the third auxiliary request does not involve any inventive step (see below), it is, for the purpose of the present decision, appropriate to start with assessing inventive step of that subject-matter.

1.2 The invention concerns an industrial scale fluid purification, separation or reaction process using a radial bed vessel.

1.3 The parties agree that D1A can be considered as representing the closest prior art. Also, the appellant does not contest that the subject-matter of claim 1 differs from D1A only by the feature relating to the pressure change ratios ("feature B").

1.4 The problem to be solved is to achieve uniform fluid flow distribution (paragraphs [0006], [0012] and [0014] of the patent).

1.5 As to the success of the solution, there is agreement amongst the parties that the claimed process leads to uniform fluid flow distribution. Thus, there is no need to reformulate the problem to be solved.

1.6 Considering obviousness of the proposed solution, D17 addresses uniformity of flow distribution, *inter alia*,

in z-flow direction (cf. Figures 1 and 10). D17 teaches that in a radial bed vessel the pressure in the annular channel is almost constant, and thus the pressure change in the outer channel (or "annular channel") is about zero (page 2867, right-hand column, last paragraph and Figure 10). In this context, the board notes that there is agreement by the parties that the pressure change in the inner channel (or "center pipe") as illustrated in Figure 10 of D17 corresponds to a ratio of pressure change along the inner channel to the pressure drop across the bed of about 20%. Put differently, in Figure 10 of D17 this ratio is about 0% for the outer channel (i.e. within the range according to "feature B"), whereas it is about 20% for the inner channel (compared to 10% and below according to "feature B" of claim 1). It is true that D17 does not explicitly teach having the ratio of the pressure change in the inner channel to the pressure drop across the bed length to be 10% or below. D17, however, contains a clear teaching that the pressure change in the inner channel should be lowered in order to improve flow distribution (page 2867, right-hand column, last two sentences). In view of this teaching, the skilled person would at least try to lower the pressure drop in the inner channel to be 10% or below of the pressure drop across the bed, even in the absence of an explicit disclosure of this ratio in D17.

According to the appellant, the skilled person, even when consulting D17, would be confronted with the problem of finding suitable design parameters. The required values of 10% and below were, however, such suitable design parameters striking a reasonable balance between flow distribution uniformity and the dimensions of the radial bed vessel, i.e. investment and operating costs.

This argument is not persuasive because what a reasonable balance between these opposing requirements is will depend on the particularities of a particular case. Moreover, while working at values close to the ideal value of 0% will be considered by the skilled person as unreasonable, they would seriously consider reducing this value from 20% to 10% and below.

Thus, it was obvious to arrive at the claimed subject-matter of claim 1.

1.7 The third auxiliary request therefore does not comply with the requirement set forth in Article 56 EPC.

2. It is not contested that claim 1 of the third auxiliary request comprises all the features of claim 1 of the main request and each of the first and second auxiliary requests. Thus, these requests are not allowable for the same reasons as for the third auxiliary request.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

C. Vodz E. Bendl

Decision electronically authenticated