BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:

(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [X] To Chairmen
(D) [ ] No distribution

Datasheet for the decision of 26 June 2007

Case Number:	T 0777/03 - 3.3.06
Application Number:	96933588.4
Publication Number:	0858366
IPC:	B01J 19/32
Language of the proceedings:	EN

Title of invention:
Structured packing

Applicant:
Sulzer Chemtech AG

Opponents:
Praxair Technology, Inc.
KOCH INDUSTRIES, INC.
LINDE AKTIENGESELLSCHAFT

Headword:
Packing element/SULZER

Relevant legal provisions:
EPC Art. 56

Keyword:
"All requests: inventive step (no)"

Decisions cited:
-

Catchword:
-

Case Number: T 0777/03 - 3.3.06

D E C I S I O N
of the Technical Board of Appeal 3.3.06
of 26 June 2007

Appellant: (Patent Proprietor)	Sulzer Chemtech AG Hegifeldstrasse 10 CH-8404 Winterthur (CH)
Representative:	Sulzer Management AG Patentabteilung / 0067 Zürcherstrasse 14 CH-8401 Winterthur (CH)
Respondent: (Opponent)	Praxair Technology, Inc. 39 Old Ridgebury Road Danbury Cr. 06810-5113 (US)
Representative:	Schwan - Schwan - Schorer Patentanwälte Bauerstrasse 22 D-80796 München (US)
(Opponent)	KOCH INDUSTRIES, INC. PO Box 2256 Wichita KA 67201-2256 (US)
Representative:	Haley, Stephen Gill Jennings & Every LLP Broadgate House 7 Eldon Street London EC2M 7LH (GB)

(Opponent) LINDE AKTIENGESELLSCHAFT
Abraham-Lincoln-Strasse 21
D-65189 Wiesbaden (DE)

Representative: Gellner, Bernd
Linde Aktiengesellschaft
Zentrale Patentabteilung
Dr.-Carl-von-Linde-Strasse 6-14
D-82049 Höllriegelskreuth (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 6 June 2003 revoking European patent No. 0858366 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: P.-P. Bracke
Members: G. Dischinger-Höppler
U. Tronser

Summary of Facts and Submissions

I. This appeal is from the decision of the Opposition Division to revoke the European patent No. 0 858 366 relating to a structured packing in a fluid-fluid contacting apparatus.

II. Three notices of opposition had been filed against the granted patent, wherein the Opponents sought revocation of the patent on the grounds of, *inter alia*, Article 100(a) EPC for lack of inventive step (Article 56 EPC). The oppositions were based, amongst others, on documents

D1' EP-A-0 209 898 and

D4' US-A-5 124 086.

During the opposition proceedings, the Opponents further filed *inter alia* the following document

D9' US-A-5 124 087.

III. The decision under appeal was based on the claims as granted as the main request and on amended claims according to an auxiliary request.

Claim 1 of the main request reads:

"1. Fluid-fluid contacting apparatus (10) in which a structured packing comprises a number of packing elements (20) arranged in succession in a designed direction of fluid flow, each packing element comprising a plurality of crimped sheets (24) of material arranged in face to face relationship with corrugations (26, 28, 28') extending obliquely relative to the direction of fluid flow, successive elements being arranged with the sheets in one element angularly displaced with respect to the sheets of adjacent elements and provision of means (30, 32, 40) for reducing the pressure drop imposed on the continuous phase at an interface (21) between successive elements being arranged in the vicinity of the interface whereby said means is constituted by a localised change on the configuration of the corrugations immediately adjacent the interface, at least some of the sheets of each packing element have at least some corrugations with a crimp angle extended to the interface which varies progressively in the vicinity (30, 32) of at least one of said interfaces, the crimp angle within the body of the packing element in a intermediate portion is substantially a constant and the progressively varying crimp angle is greater than this constant."

Claims 2 to 6 refer to preferred embodiments of the subject-matter of Claim 1.

IV. In its decision, the Opposition Division revoked the patent for lack of inventive step of the subject-matter of Claim 1 as granted and of the then pending auxiliary request in view of the teaching of D9' in combination with that of D1'. Objections under Articles 54, 83 and 123(2) EPC were rejected by the Opposition Division.

V. This decision was appealed by the Patent Proprietor (now Appellant) who maintained the claims as granted as its main request and filed amended sets of claims in three auxiliary requests.

VI. Upon requests made by all parties, oral proceedings before the Board of Appeal were held on 26 June 2007, in the course of which the Appellant filed three further amended sets of claims in replacement of its former auxiliary requests.

For ease of comparison with Claim 1 as granted, the Board has marked in the following the amendments made to Claim 1 of the first and second auxiliary requests so as to show all added features in bold whereas all deletions are crossed out.

Claim 1 of the first auxiliary request reads:

"1. Fluid-fluid contacting apparatus (10) in which a structured packing comprises a number of packing elements (20) arranged in a succession **and in abutting relation with its neighbours** in a designed direction of fluid flow, each packing element comprising a plurality of crimped sheets (24) of material arranged in face to face relationship with corrugations (26, 28, 28') extending obliquely relative to the direction of fluid flow, **said corrugations imparting a change in flow direction as fluid flows through the body of the packing element from one face to the opposite face, said corrugations having terminal portions (30, 32) which intersect said faces,** successive elements being arranged with the sheets in one element angularly displaced with respect to the sheets of adjacent elements and provision of means (30, 32, ~~40~~) for reducing the pressure drop imposed on the continuous phase at an interface (21) between successive elements **and for avoiding an extreme change in direction as the**

fluids pass from one packing element to the next being arranged at or in the vicinity of the interface whereby said means is constituted by a localised change on the configuration of the corrugations **in the terminal portions (30, 32)** immediately adjacent the interface, **said localised change on the configuration of the corrugations serving to reduce and to smooth the rate of change of pressure at and in the immediate vicinity of said interfaces,** at least some of the sheets of each packing element have at least some corrugations with a crimp angle extended to the interface which varies progressively **in the lengthwise direction** in the vicinity (30, 32) of at least one of said interfaces, the crimp angle within the body of the packing element in a intermediate portion is substantially a constant and the progressively varying crimp angle is greater than this constant."

Claim 1 of the second auxiliary request reads:

"1. Fluid-fluid contacting apparatus (10) in which a structured packing comprises a number of packing elements (20) arranged in succession **and in abutting relation with its neighbours** in a designed direction of fluid flow, each packing element comprising a plurality of crimped sheets (24) of material arranged in face to face relationship with corrugations (26, 28, 28') extending obliquely relative to the direction of fluid flow, **adjacent sheets being oriented with the corrugations thereof intersecting in criss-cross fashion,** successive elements being arranged with the sheets in one element angularly displaced with respect to the sheets of adjacent elements**, an interface (21) between successive elements being formed by planar**

edges of the sheets and provision of means ~~*(30, 32, 40)*~~ for reducing the pressure drop imposed on the continuous phase at **the** ~~*an*~~ interface ~~*(21) between successive elements*~~ being arranged at or in the vicinity of the interface, whereby said means is constituted by a localised change on the configuration **in terminal portions (30, 32)** of the corrugations immediately adjacent the interface, **a crimp angle within the body of the packing element is substantially constant between the terminal portions in intermediate portions of the corrugations,** at least some of the sheets of each packing element have ~~*at least some*~~ corrugations with a crimp angle extended to the interface which varies progressively **throughout the terminal portions between the intermediate portions and the interface,** ~~*in the vicinity (30, 32) of at least one of said interfaces, the crimp angle within the body of the packing element in a intermediate portion is substantially a constant*~~ *and* the progressively variing crimp angle is greater than **the** ~~*this*~~ constant **angle of the intermediate portions**."

Claim 1 of the third auxiliary request differs from that of the first auxiliary request only by the addition of the term "and intersects said interfaces substantially perpendicular" at the very end of the claim.

VII. The Appellant, orally and in writing, submitted that the claims of any request complied with the requirements of Articles 123(2) and 54 EPC or, respectively could be brought into compliance with Article 83 EPC. Concerning inventive step of the subject-matter claimed in all requests, the Appellant submitted the following arguments:

- The claimed apparatus solved the problem of combining the high efficiency of packing elements made from corrugated contact sheets of cross-channel structure with the advantage of high capacity by avoiding liquid build-up and reducing flow resistance at the interface between successive packing elements.

- D9' differed in essence from the claimed subject-matter in that the successive packing elements are not angularly displaced, in that the crimp angle of the corrugations at the bottom and top portion of the sheets did not vary progressively, but sharply and in that the bottom portion of the sheets was serrated. This latter feature was provided in D9' in order to enhance the capacity of the packing elements.

- According to the patent in suit, the same problem was solved by completely different means, namely by providing sheets within the packing elements wherein, instead of being serrated, the corrugations have a crimp angle which increases progressively in the vicinity of the interface between successive packing elements.

- However, starting from D9' as the closest prior art, a skilled person had no reason either to modify the arrangement disclosed therein, nor to combine that teaching with the disclosure of D1' or D4' which both related to packing elements wherein the contact sheets were of completely different structure.

- In D1' the contact sheets had neither cross-channel structure nor corrugations with a progressively varying crimp angle at the top and bottom portion of the sheet. Instead, the channels in the sheets were of sinuous shape which prevented - contrary to the patent in suit - formation of vortex trains and thus led to decreased efficiency. Moreover, at the top and bottom portions of the sheets, the channels were not curved but vertical to the bottom face. Unlike the technical problem solved by D9', the arrangement in D1' served to avoid clogging by impurities.

- Also D4' did not relate to the technical problem underlying the patent in suit but to the problem of avoiding the fouling tendency. Nor did D4' disclose contact sheets having a cross-channel structure. The sheets in D4' did not even show a particular shaping of the corrugations at the top and bottom portions and the packing elements of D4' were not well suited for being stacked on each other since the corrugations at the top portion were inclined with respect to the top face of the element.

- It was, therefore, apparent that even if a skilled person should have combined the teaching of D9' with that of D1' or D4', he would not get any incentive to improve the efficiency and capacity of packing elements by the claimed combination of features.

VIII. The Opponents, now Respondents, orally and in writing, raised objections under Articles 123(2), 83 and 54 EPC. With respect to inventive step the Respondents submitted, *inter alia*, the following arguments:

- The essential difference, as alleged by the Appellant, of the claimed subject-matter (all requests) vis-à-vis the apparatus disclosed in D9' consisted in the progressively varying crimp angle of the corrugations at the top and bottom portion of the sheet.

- The technical problem actually solved by that difference in view of D9' consisted in the provision of an alternative solution of the same problem of improving the capacity of the packing element by avoiding liquid build-up at the interface between successive packing elements.

- The proposed solution of providing sheets wherein the crimp angle was progressively varying towards the upper and lower ends of the sheets was hinted at in D1' and D4' which both suggested that an increase of air resistance due to fouling can be prevented if sharp directional changes of the channels formed by the corrugations are avoided.

- Therefore, the subject-matter of Claim 1 of all requests lacked an inventive step over the disclosure of D9' in combination with that of D1' and/or D4'.

IX. The Appellant requested that the decision under appeal be set aside and the patent be maintained as granted or, alternatively, the patent be maintained on the basis of one of the three auxiliary requests submitted during the oral proceedings.

The Respondents requested that the appeal be dismissed.

Reasons for the Decision

1. *General issues*

The question of whether the amendments made to the claims of all requests are admissible under Article 123(2) EPC or whether the claimed subject-matter is sufficiently disclosed (Article 83 EPC) and novel in view of the cited prior art (Article 54 EPC) need not be gone into since, eventually, the appeal fails for lack of inventive step.

2. *Inventive Step*

2.1 Main request

2.1.1 The patent in suit and in particular the claimed subject-matter relate to a fluid-fluid contacting apparatus containing structured packings for use in operations such as distillation, absorption, scrubbing, stripping or heat exchange, where different fluids such as gas and liquid are brought into contact, while flowing counter-currently relative to each other (column 1, paragraph [0001]).

2.1.2 It is explained in the description of the patent in suit that prior art packing elements with sheets arranged so that criss-crossing channels are formed have good efficiency due to the large surface area for mass transfer but suffer from the disadvantage of a pressure drop occurring at the interface between two successive elements since liquid and vapour are forced to move through a change in direction from one element to the other so that liquid tends to build up at the interface, resulting in a loss of capacity (page 2, paragraphs [0002] to [0005]).

2.1.3 Hence, the patent in suit aims at providing a fluid-fluid contacting apparatus wherein good efficiency is secured without unduly sacrificing capacity (page 2, paragraph [0008]).

2.1.4 In conformity with the decision under appeal, all parties based their line of argument for evaluating inventive step, *inter alia*, on D9' as the closest prior art.

2.1.5 The Board agrees that D9' is a suitable starting point for the assessment of inventive step since it is also concerned with the task of providing efficient packing elements for a fluid-fluid contacting apparatus wherein water build-up between successive packing elements is avoided. In other words, D9' also aims at the improvement of the capacity by reducing the pressure drop (column 1, line 39 to column 2, line 2 and column 10, line 31 to column 11, line 7).

In particular, D9' discloses gas-liquid contact bodies for use in counter-current heat exchangers, scrubbers and the like (column 1, lines 6 to 20). The contact bodies can be stacked directly on each other in a tower without special intermediate supporting members (column 2, lines 6 to 13) and comprise a plurality of crimped sheets having corrugations extending obliquely relative to the direction of fluid flow and being arranged in face to face relationship so that adjacent sheets are oriented with the corrugations intersecting in criss-cross fashion. The crimp angle of the corrugations is substantially constant throughout most of the height of the sheet except for a top portion and a bottom portion where the corrugations have axes which are perpendicular to the horizontal, so that the crimp angle at the top and bottom is 90°, thus, greater than this constant (column 7, lines 42 to 68, column 8, line 39 to column 9, line 2 and Figure 1).

According to D9' it is essential that the bottom portions of the sheets are serrated in order to enhance drainage of water from the bottom of the contact body, thereby reducing the pressure drop by preventing water film blockage.

The Board observes that serrations at the bottom portions of the sheets are not excluded from the claimed subject-matter.

2.1.6 It is undisputed between the parties that D9' is silent with respect to an angular displacement of successive packing elements. Further, D9' does not explicitly mention that the crimp angle varies progressively at the top and bottom portion from the oblique angle to the 90° angle. Rather it appears from Figure 1 in D9' that the transition from the oblique part of the corrugations to the vertical part is sharp.

Although, the Respondents have argued towards an implicit disclosure of those features in D9', the Board, accepts in the Appellant's favour these features as distinguishing the claimed subject-matter from this prior art.

2.1.7 The Appellant argued that D9' solved the same technical problem of undesired pressure drop, hence capacity, due to liquid build-up at the interface between successive packing elements by completely different means, namely by serrated bottom portions. The technical problem actually solved by the claimed subject-matter in view of D9' consisted therefore in the provision of another arrangement providing the same capacity.

2.1.8 In this respect, the Board observes that no comparative data are on file showing how the claimed arrangement performs in terms of capacity when compared with the arrangement disclosed in D9'.

The Board, therefore, concludes that the technical problem credibly solved by the claimed subject-matter in view of D9' may be defined to consist in the provision of another fluid-fluid contacting apparatus having good efficiency without unduly sacrificing capacity (see also point 2.1.3 above).

2.1.9 It remains to be decided whether, in view of the available prior art documents, it was obvious for someone skilled in the art to solve the above stated technical problem by the means claimed, namely by arranging successive packing elements so that the sheets of one element are angularly displaced with respect to the sheets of the other element and in that the crimp angle of the corrugations varies progressively at the top and bottom portion from the substantially constant angle to the 90° angle.

2.1.10 As indicated above (point 2.1.6), D9' does not disclose those means.

2.1.11 The Appellant argued that a skilled person would not combine the disclosure of D1' with that of D9' due to the different structure of the packing elements and since - unlike D9' - D1' was concerned with the different technical problem of clogging.

This argument is not convincing since, in the Board's opinion, a skilled person aiming at providing another fluid-fluid contacting apparatus with good efficiency and capacity as that disclosed in D9' would consider those documents which relate to the same purpose, namely the efficiency and capacity in a fluid-fluid contacting apparatus. This is the case for D1' which discloses means for obtaining both, good efficiency and good capacity of the contacting apparatus.

2.1.12 Thus, it is known from D1' that angularly displaced successive packing elements are advantageous with respect to the efficiency of a fluid-fluid contacting apparatus (e.g. D1', column 2, line 62 to column 3, line 2 and column 7, lines 13 to 17). However, this feature is not related to the capacity of the packing element. Hence, it is obvious for a person skilled in the art that good efficiency may be obtained by that arrangement as an alternative for or in addition to the criss-crossing channels provided in D9'.

Further, D1' teaches that sharp directional changes in the channels of the packing elements may impair the operability of the apparatus. In particular, D1' refers to prior art disclosing channels which follow zigzag lines. Channels which are essentially straight as in the packing elements disclosed in D9'are not considered. It is stated that sharp changes such as in the case of zigzag lines may entail a rapid increase of the air resistance, i.e. pressure drop, in a packing element due to clogging by impurities. According to D1' it is, therefore, held to be indispensable that such sharp directional changes in the channels are avoided. For that purpose, D1' suggests using channels of sinuous or arcuate shape instead of zigzag shape (column 1, lines 44 to 58).

D1' specifically addresses the problem of increased pressure drop at unheeded places of turbulence at the entries and exits of the packing element, hence at the interface between successive elements, causing considerable increase of flow resistance (column 1, line 58 to column 2, line 2). In order to avoid that problem, it is suggested to modify the flow conditions at the entries and exits of the packing element so as to render the inflow and outflow laminar rather than turbulent by providing straight discharge channel sections at the top and bottom portion of the sheets (column 2, lines 26 to 34). As is shown in Figures 4 and 7, the channels of sinuous shape progressively change into vertical end sections, thereby avoiding the disadvantages of sharp directional changes as taught in D1'.

The Appellant's argument that the formation of gaseous vortex trains which was beneficial for efficiency would be prevented by the channels of sinuous shape taught in D1' as well as by the sharp directional change at the ends of the channels of D9' is irrelevant since the Appellant has not provided any evidence in support of its allegation. Nor has the Appellant contested the Respondents' argument that the question whether or not such vortex trains are formed and whether their formation is beneficial or not is based merely on a theory if not on speculation.

However, even if such vortex trains were formed in the claimed body of a packing and not destroyed by the claimed progressive directional change at the end of the channels, any benefit obtained in view of the prior art disclosed in D1' and D9' would be the result of the obvious combination of the packing elements disclosed in D9' with the specific teaching in D1' that sharp directional changes have to be avoided in order to increase the capacity of the packing element.

The Board further holds that the aspect of clogging by impurities addressed in D1' in relation with channels following zigzag lines is irrelevant in the present case since both, D1' and D9' aim at the avoidance of water build-up or flow resistance, respectively, between successive packing elements (2.1.5 above), irrespective of whether such resistance may also be influenced by depositions of impurities.

2.1.13 The Board concludes, therefore, that it was obvious for someone skilled in the art seeking to provide another fluid-fluid contacting apparatus with good efficiency and capacity as that disclosed in D9' to modify the known apparatus by angularly displacing successive packing elements and replacing the sharp directional change at the end portions of the channels by a progressive change as is suggested in D1'.

Consequently, the main request must fail since the subject-matter of Claim 1 does not meet the requirements of Articles 56 and 52(1) EPC.

2.2 Auxiliary requests

2.2.1 The subject-matter of Claim 1 of the first auxiliary request differs in substance from that of the main request in that

(a) successive packing elements are arranged in **abutting relation**,

(b) the oblique corrugations impart to the fluid the **function** to **change its flow direction**,

(c) the corrugations have terminal portions which **intersect the faces** of the packing elements,

(d) the means of reducing the pressure drop are arranged in the vicinity of the interface to provide the **function** of **avoiding an extreme change in direction** between the packing elements,

(e) the means for reducing the pressure drop are arranged **in the terminal portion**,

(f) the means for reducing the pressure drop has the function to **reduce the rate of change of pressure** at and near the interfaces, and

(g) the crimp angle varies progressively **in the lengthwise direction.**

2.2.2 The subject-matter of Claim 1 of the second auxiliary request differs in substance from that of the first auxiliary request in that

(h) the sheets are arranged in **cross-channel** fashion,

(i) the top and bottom **edges** of the sheets are **planar**,

(j) the intermediate portions where the crimp angle is substantially constant is **between terminal portions** and

(k) the crimp angle varies progressively **throughout the terminal portions**.

2.2.3 The subject-matter of Claim 1 of the third auxiliary request differs from that of the first auxiliary request only in that

(l) the progressively varying crimp angle **intersects substantially perpendicular** the interfaces between successive packing elements.

2.2.4 The Respondents submitted arguments and reasons why all those features were known in the art.

Accordingly, there are no means necessarily present in the claimed subject-matter by which the abutting relationship of successive element (feature (a)) can be distinguished clearly from elements which are directly stacked on each other as disclosed in D9' (column 2, lines 9 to 13). Further, there is no reason to assume that the functional terms expressed by features (b), (d) and (f) do not apply also in the case of the oblique corrugations of the packing elements of D9' (e.g. Figure 1) or, respectively, the arcuate transition of the channels into vertical sections disclosed in D1' (e.g. Figures 4 and 7). This latter disclosure in D1' necessarily covers also features (c), (e) and (g). Feature (h) is disclosed in D9' (column 8, lines 49 to 53) as well as feature (i) as can be seen from Figure 1 (planar edges are indicated via horizontal lines at the top and bottom portions 32 and 34). Feature (j) is also represented in Figure 1 of D9', whereas feature (l) is represented in Figure 4 of D1'.

Concerning feature (k), the Respondents referred to D4' which also discloses a packing element with a plurality of corrugated sheets arranged in cross-channel fashion for use in e.g. a cooling tower (column 1, lines 9 to 17 and lines 63 to 68). This document is, further, also concerned with the technical problems of efficiency and capacity of the packing element (column 1, lines 49 to 51 and column 2, lines 14 to 17). As can be seen from Figures 1 and 2 and as explained in column 2, lines 28 to 38, the crimp angle of the corrugations preferably changes continuously throughout the terminal portions of the sheets from the area where the corrugations are oblique relative to the direction of fluid flow to the bottom of the sheets where the corrugations have axes which are substantially perpendicular to the horizontal in order to ensure a smooth transition in the flow and to avoid discontinuities which are prone to cause fouling. Hence, feature (k) is also known from the relevant prior art in connection with the technical problem to be solved.

2.2.5 The Appellant did not provide arguments as to why and how these newly added features might include subject-matter on which an inventive step could be based. Instead it was argued that, with respect to the prior art, the essential inventive feature of the subject-matter claimed in the auxiliary requests still consisted in the progressively varying crimp angle of the corrugations at the end portions of the sheets.

The Appellant did not even contest the Respondents' arguments that the additional features of the auxiliary requests were also known in the art or that the functional features present in Claim 1 of the auxiliary requests were also fulfilled by respective features in the prior art.

Therefore, the Board has no reason to conclude that an inventive step could be based on any of those features.

2.2.6 Given these circumstances, the Board has no choice but to conclude that the features newly introduced into Claim 1 of the auxiliary requests merely include particular embodiments already disclosed in D9' or relate to options well-known in the art as represented by D1' and D4' which a skilled person would consider in the expectation of providing a further fluid-fluid contacting apparatus of good efficiency and capacity.

2.2.7 For these reasons, the Board finds that the subject-matter of Claim 1 of the auxiliary requests does not comply with the requirements of Articles 52(1) and 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Rauh P.-P. Bracke