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D E C I S I O N
of 23 May 2001

Case Number: T 0179/99 - 3.2.3

Application Number: 94904278.2

Publication Number: 0680593

IPC: F28F 3/08

Language of the proceedings: EN

Title of invention:
Plate heat exchanger

Patentee:
APV UK Limited

Opponent:
Alfa Laval AB

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 83, 123(2)

Keyword:
"Disclosure - sufficiency - (yes)"
"Amendments - correction of errors"
"Novelty and inventive step - (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0179/99 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 23 May 2001

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 21 December 1998 concerning maintenance of European patent No. 0 680 593 in amended form.**

Composition of the Board:

Chairman: C. T. Wilson
Members: U. Krause
J. P. B. Seitz

Summary of Facts and Submissions

I. The appeal contests the interlocutory decision of the Opposition Division, dated 11 November 1998 and posted on 21 December 1998, to maintain European Patent No. 0 680 593 in amended form, including independent claims 1 and 7 and dependent claims 2 to 6 and 8. The independent claims 1 and 7 read as follows:

"1. A plate heat exchanger comprising a stack of plates (4a,4d) which are compressed together between a head (10) and a follower (14) by means of tie bars (16), at least one plate having an upper and a lower cut-out (25a,26a,26b) formed within the plate area and bounded by the outer periphery of the plate, characterised in that the plates have upper and lower cut-outs (25a,26a,26b) which locate the plates between top and bottom rails (6,8), and in that at least one tie bar extends through one of the said upper and lower cut-outs."

"7. A plate heat exchanger comprising a stack of plates (4a,4d) which are compressed together between a head (10) and a follower (14) by means of tie bars (16), characterised in that the plates have upper and lower cut-outs (25a,26a,26b) which locate the plates between top and bottom rails (6,8), and at least one tie bar (16) extends through an aperture (32) in the body of each plate so as to penetrate the plates in a region surrounded by the flow spaces between the plates, each aperture (32) being sealed from the flow spaces by a seal (34)."

II. The Opposition Division disregarded an objection based on the grounds of Article 100(b) as being not submitted in due time and not prima facie relevant, and held that the grounds of Article 100(a) (novelty and inventive step) and 100(c) did not prejudice the maintenance of the patent. The following prior art was taken into consideration:

D1: US-A-4 249 597

D2: US-A-3 444 926

D3: US-A-2 648 527

D4: ALFA-LAVAL, Instructions and Parts List for Plate Heat Exchangers Types P15-EB.RB.RC, document IM 70098-E1

D5: ALFA-LAVAL, General Instructions for Plate Heat Exchangers, Book No. U-222-2E2

D6: EP-A-0 443 299

D7: GB-A-2 052 038.

D8: GB-A-2 065 289

D9: US-A-1 727 124

D10: WO-A-88/04023

D11: GB-A-624 865

D12: GB-A-428 631

D4 and D5 were undisputedly published in November 1972.

III. The Appellant (Opponent) filed the notice of appeal on 16 February 1999 and paid the appeal fee on the same day. A statement of the grounds of appeal was filed on 27 April 1999.

IV. Oral proceedings were held on 23 May 2001 following a communication pursuant to Article 11(2) RPBA in which the Board informed the parties that the objection under Article 100(b), relating to an embodiment claimed in a dependent claim, would be taken into consideration. During the Oral proceedings the Appellant made reference to the further document

D13: US-A-4 813 478 (mentioned in the patent)

and the Respondent submitted auxiliary requests 1 to 4 relating to amendment or deletion of claims 6 and/or 7 and 8, and an auxiliary request 5 requesting to refer the case back to the Opposition division.

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

The Respondent requested that the appeal be dismissed and that the patent be maintained as upheld by the Opposition division (main request). He subsidiarily requested that the decision under appeal be set aside and that the patent be maintained on the basis of one of the auxiliary requests 1 to 4 filed during the Oral proceedings, or, as a fifth auxiliary request, that the case be remitted to the first instance for further prosecution.

VI. The essential arguments of the parties can be summarized as follows:

The Appellant:

As to the grounds of Article 100(b), the embodiment indicated in figure 6 and claimed in claim 6 could not be put into practice without undue burden because the patent lacked any information as to how the rail between the follower and the support column should be constructed and as to how the tie bar, being situated inside a tubular rail, could be able to clamp the stack of heat transfer plates. The description of Figure 6 in column 3, lines 52 to 55 could not be understood to refer to a short telescopic rail extending from the head to the follower only because in such an arrangement the rails could not exert the alignment and load bearing function which both rails, especially the top rail, must have in plate heat exchangers of the claimed type. Since claim 6 was dependent on claim 1 the problem also applied to claim 1 as covering the unworkable embodiment of claim 6.

Concerning the grounds of Article 100(c), the omission of the feature that the rails are "load-bearing" included in original claims 1, 2 and 8 from the independent claims represented an unallowable extension because this feature was explained as essential in the original application and indispensable in plate heat exchangers of the claimed type as supporting and aligning the plates and providing structural rigidity to the entire arrangement. The wording in the original claims was not in error but deliberately chosen to express the assistance of the rails in compressing the

plates. As to claim 7, the apertures were described in paragraphs 1, 2 and 5 of page 1 of the original application as an alternative to the cut-outs for positioning the tie bars, whereas claim 7 was directed to a combination of apertures and cut-outs.

Novelty of the subject-matter of claim 1 was lacking with respect to D4 because the integration of the rails and tie bars as a unitary part, as shown in D4, was not excluded. This could be made evident by including in claim 1 a limitation stating that the tie bar is constituted by the rail. However, if this was seen as a difference, it could not involve an inventive step because a mere separation of the rails and tie bars into separate parts did not offer any advantages with respect to the problem of arranging the tie bars as close to the flow spaces between the plates as possible. This would require positioning the tie bars inwardly of the rails, as claimed in dependent claims 3 and 5. Since claim 1 was not restricted to such an arrangement the problem underlying the invention claimed in claim 1 would rather be how to separate the functions of the rails and tie bars, and the claimed solution was obvious in view of D4, showing the tie bars extending through the cut-outs, and a number of documents, e.g. D7, D8 or D13, showing the rails and tie bars as separate entities. As to independent claim 7, the prior art as shown in figure 1 of the patent and as described in D7 or D8 was a suitable starting point. A solution to the problem of spreading the clamping pressure evenly across the heat transfer plates was disclosed in D3 which generally relates to heat exchangers and shows tie bars extending through holes in the plates. This principle was not dependent on any particular use of the heat exchanger. A sealing

function of the washers around the tie bars in Figure 4 of D3 was necessary to prevent mixing of the fluids and, therefore, implicit to D3.

The Respondent:

Insufficiency of disclosure was not shown by the Appellant. The problems mentioned by the Appellant could be overcome by a skilled person without undue experimentation. The bottom rail guiding the plates in lateral direction could be constructed on the basis of the description of figure 6 as a telescopic rail terminating at the follower, with the tie bar projecting beyond the follower. The top rail carrying the plates could be tubular with a C-shaped cross-section.

The omission of the "load-bearing rails" resulted from a correction of an obvious error in original claim 1. Support for the corrected text was found in the first paragraph on page 2 of the application as published, mentioning the compression of the plates by means of tie bars, and the second paragraph of the same page where the term "load-bearing" was not used in connection with the rails which were presented as optional. The term "aperture" used in both paragraphs meant the same as the cut-out, whereas the apertures 32 of Figure 7, corresponding to the aperture in claim 7, were provided in addition to the cut-outs.

Claim 1 distinguished between the rails and tie bars and therefore excluded a structure as in D4 wherein the tie bars and rails are formed by a single element. The entire patent was concerned with a construction having separate rails and tie bars in order to gain more

flexibility in positioning the tie bars in relation to the rails for moving the tie bars closer to the optimum compression point whilst allowing the rails to be moved to an edge region of the plate. This also applied to the embodiment of Figure 7 whereby the tie bars could be eccentric within the rails. Whilst D7, D8 and D13 showed separate rails and tie bars, there was no document suggesting to put the tie bars within the cut-outs separately from the rails. The time span of some 21 years between the publication of D4 in November 1972 and the priority date of the patent indicated an inventive step. As to claim 7, D3 showed a heat exchanger for external combustion engines which, by its use and lightweight structure, related to a different technology. It was a very old document which, since its publication in 1953, was not considered by a skilled person when trying to solve the long existing problem of providing an even compression of the plates in plate heat exchangers of the claimed type. Moreover, the washers around the tie bars of D3 had a spacing function only, whereby D3 did not teach the sealing function of the washers.

Reasons for the Decision

1. The appeal is admissible.

2. *Grounds of Article 100(c) EPC*

2.1 Claim 1 states that the stack of plates is compressed together between a head and a follower by means of tie bars, whereas according to the original claims 1, 2 and 8 the compression was effected by means of "load-

bearing rails". This formulation in original claim 1 is in contradiction with the entire disclosure in the description and figures of the application as originally filed which consistently states that the compression is achieved by the tie bars, see for example page 1, last sentence of the first paragraph, page 2, first and fifth paragraph, page 3, last paragraph, page 5, last but one paragraph, and page 6, second paragraph, and that the function of the rails is to support and locate the plates, see page 2, second paragraph, and page 3, last paragraph. Moreover, the solution of the problem to evenly compress the stack of plates by positioning the tie bars as close as possible to the flow spaces between the plates, as stated on page 1, last paragraph, implies a compression by means of the tie bars. There is no indication in the patent that the rails could in any way assist in this compression. It is therefore obvious for the skilled reader of the application that the original claims were in error, and that the correct wording now used in claim 1 was found on page 2, first paragraph. Thus, the replacement of the original words "by means of load bearing rails" by the expression " by means of tie bars" meets the requirements for corrections as set out in Rule 88 EPC.

The objection by the Appellant includes the argument that, notwithstanding the above correction, the feature that the rails are "load-bearing" was an essential feature of the invention as originally claimed and should therefore remain in claim 1. This argument is not convincing because the admissible correction applies to the expression "load-bearing rails" in its entirety, not only to the "rails", because the tie bars are not "load-bearing" and it would, therefore, make no

sense to replace only the word "rails" by "tie bars". The "load-bearing" character is an optional feature of the rails, as is apparent from the specification on page 2, second paragraph, where the rails are mentioned without referring to any "load bearing" function, and on page 3, second paragraph, describing the function of the bottom rail as locating the plates, rather than load bearing.

2.2 The Appellant further objects to claim 7 as claiming a combination of cut-outs and apertures which was not originally disclosed. This objection appears to be based on the misunderstanding that the "apertures" mentioned as an alternative to the cut-outs in the first, second and fifth paragraph of page 2 of the original application correspond to the "apertures" referred to in claim 7. This is, however, not the case as on page 2 the term "aperture" is used as a synonym for the cut-outs at the periphery of the plates, whereas the "aperture" of claim 7 is an aperture in the body of the plates in a region which is surrounded by the flow spaces between the plates. Thus, the apertures mentioned in claim 7 are entirely independent of the cut-outs. In fact, the apertures of claim 7 are for the tie bars which serve the purpose of compressing the stack of plates, whereby the cut-outs are still required for suspending and locating the plates at the rails. Figure 7 showing both an upper cut-out and an aperture provides support for the conclusion derived by a skilled reader that cut-outs must be present even if the tie rods pass through apertures within the plates.

3. *Grounds of Article 100(b) EPC*

3.1 The objection under Article 100(b) relates to an

embodiment of the invention which is shown in Figure 6, described in column 3, lines 52 to 55 and claimed in claim 6. The Opposition Division held that this objection was irrelevant because "at least one possible example of carrying out the invention is disclosed in the patent". It is questionable whether this opinion refers to the particular embodiment in question or to any of the other examples or embodiments described in the patent. In any case, if an embodiment is claimed in a dependent claim and, therefore, clearly belongs to the invention, Article 83 EPC requires that the patent must disclose this embodiment and the invention defined in the dependent claim in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art, i.e. without undue experimentation and the exercise of inventive activity.

3.2 Claim 6 specifies that one of the rails is tubular and a tie bar extends through the one of the rails. Thus, this arrangement could apply to either the top or bottom rail, or to both rails. The description of Figure 6 refers to the bottom rail only. The described arrangement that "the rail is telescoped or compressible to allow tightening of the tie bar against the follower" in column 3, lines 52 to 55 of the patent can reasonably be understood, as indicated by the Respondent, in the sense that the bottom rail extends only up to the follower, rather than all the way to the support column, and the tie bar projects from the rail to allow tightening against the follower. Since such a "short" rail could perform the function of locating the plates, i.e. prevent the plates from swinging sideways, but would hardly be able to support the weight of the plates and of the follower, the skilled person would consider the structure described in connection with

figure 6 as being suitable for the bottom rail only. A simple solution for the top rail, however, would be the use of a tube having a C-shaped cross-section, i.e. a longitudinal slot, over at least a portion of its length, whereby the inside tie bar would engage the follower by means of a radial finger or the like extending through the slot. Since this solution, which could also be used for the bottom rail, is based on general engineering considerations and does not require undue experimentation or the exercise of inventive activity, the Board is convinced that a skilled person is able to carry out the invention also within the region defined by claim 6.

4. *Novelty*

4.1 Novelty of the invention defined in claim 1 was put into question with regard to D4 which discloses a plate heat exchanger comprising a stack of plates (35) which are compressed together between a head (1a) and a follower (2a). The plates are shown to have upper and lower cut-outs, formed within the plate area and bounded by the outer periphery of the plates, for engagement with upper and lower carrying bars (3a,3b). Compression of the stack of plates is effected by means of distance pieces (7) and tightening nuts (8) screwed onto threads formed at the ends of the carrying bars (3a,3b). Thus, the carrying bars combine the function of carrying, locating and compressing the plates.

4.2 According to claim 1 the compression of the plates is effected by means of the tie bars, whereas the plates are located between the top and bottom rails. It is evident from the use of two different terms in claim 1 that the bars and rails are separate elements, not

merely different functions performed by one and the same element. Since claim 1 is clear in this respect it is not necessary to refer to the description and figures for clarification. Nevertheless, the described embodiments all show separate rails and tie bars as a solution of the problem of moving the tie bars as close as possible to the flow spaces between the plates, as stated in column 1, lines 34 to 37. Thus, the subject-matter of claim 1 differs from the heat exchanger disclosed in D4 by the fact that the tie bars and rails are separate entities.

4.3 The Appellant holds the view that claim 1 covers an embodiment combining the tie bars and rails into single elements which could be made clear by including, in claim 1, a limiting feature stating "that the tie bar is constituted by the rail". The Board cannot follow this argument because such a feature would completely alter the meaning of the claim in a direction which is not supported by the application as originally filed.

4.4 The Board therefore concludes that claim 1 meets the requirement of novelty. No corresponding objection was raised with respect to claim 7 and there is no reason to doubt that the subject-matter of claim 7 is new.

5. *Inventive step*

5.1 Claim 1

5.1.1 It is not in dispute that, as stated in the decision under appeal, D4 represents the closest state of the art with respect to the invention claimed in claim 1. As a consequence of the combined rails and tie bars of this prior art the acting point of the force

compressing the plates is tied to the position of the rails. By separating the tie bars from the rails the invention claimed in claim 1 unties this close relation, thereby giving more freedom to move the acting point closer to the flow spaces within the plates where the fluid pressure counteracts the outside clamping pressure, and to design the tie bars and rails for their respective single function of compressing the stack of plates or carrying and locating the plates. As stated in column 2, lines 6 to 10, of the patent, by positioning the tie bar in the cut-out, separately from the rail, this greater freedom is achieved without major modification of the plates. These advantages, which correspond to the objective problem to be solved with respect to D4, also apply, although to a lesser extent, to the embodiment of Figure 6 wherein the tie bar may be moved to an eccentric position within the rail.

It will, therefore, have to be determined whether an indication can be found in the prior art to the solution of the problem of providing greater freedom in suitably positioning and designing the tie bars and rails without requiring major modifications of the plates by extending the tie bars through the cut-outs separately from the rails.

5.1.2 The Appellant has pointed out that plate heat exchangers having rails and separate tie bars are generally known and disclosed in a number of documents, for example D7, D8 and D13. This is not in dispute. However, all of these documents show at least one top rail extending through a cut-out in the plates and tie bars arranged along the lateral sides of the plates, D13 having additional tie bars on the top and bottom

sides adjacent to the cut-outs for the rails. The position of the tie bars relative to the plates cannot be determined accurately but it appears from the figures of D13 that the tie bars extend outside of the outer periphery of the plates. A skilled person would, therefore, derive from this prior art that tie bars, if separate from the rails, should be positioned around the periphery of the plates, distant from the rails which extend through the central cut-outs. Thus, the separation of the functions of tie bars and rails would leave the rail in the center position, as in D4, and shift the tie bars to peripheral positions outside of the cut-out for the rail. This solution would solve the problem posed but would not correspond to the solution of claim 1 which retains both the rails and the tie bars within the cut-outs, i.e. separate but close to each other at the same location.

5.1.3 The Appellant argues that a combination of D4 with either D7, D8 or D13 would lead to the subject-matter of claim 1 because the carrying bars of D4, being rails and tie bars at the same time, extend through the cut-outs, and the feature of positioning the tie bars within the cut-outs is therefore known from D4. In the Boards view, this argument is based on theoretical and hindsight considerations. In D4, the carrying bar combines the functions of the rails and tie bars of claim 1, and this is the obvious reason for compressing the plates together along a line extending through the cut-outs. As pointed out above, all that can be derived from D7, D8 and D13 with regard to the positions of rails and tie bars is that, if the functions are separated, the tie bars should move to a different position outside of the cut-outs. A further document, D1, refers to a different type of plate heat exchanger

without head, follower and rails, wherein tie bars extend through indentations similar to cut-outs provided at the ends of the plates. Since the rails are lacking, however, this document cannot provide an indication as to where to position the tie bars in case that the cut-outs are used for the rails. In summary, there is no evidence available which could suggest making use of the space available in the plates for the cut-outs so as to position the tie bars and the rails separately from each other in the cut-outs.

5.1.4 The other available documents have not been cited against claim 1 and are considered by the Board as being less relevant.

The Board therefore concludes that claim 1 meets the requirement of inventive step.

5.2 Claim 7

5.2.1 In the decision under appeal D3 was considered as closest prior art with regard to claim 7, and the main difference was seen in the last feature of claim 7 stating that each aperture is sealed from the flow spaces by a seal. The Board cannot follow this approach. In fact, D3 discloses a heat exchanger built up of a plurality of plates which are secured between face plates by rivets or bolts, whereby this heat exchanger relates to a frameless type of heat exchanger, in contrast to the claimed type having a frame consisting of a head, a follower and rails for locating the plates. A more reasonable approach is, as pointed out by the Appellant, to start from a heat exchanger of the claimed type, such as the plate heat exchanger described as "typical" prior art heat

exchanger in the patent with regard to Figures 1 to 3, or the corresponding heat exchangers disclosed in D7, D8 or D13. These heat exchangers have in common the features that a stack of plates is compressed together between a head and a follower by means of tie bars, and that the plates have upper and lower cut-outs which locate the plates between top and bottom rails.

5.2.2 In the plate heat exchangers according to the closest prior art the tie bars are positioned around the plates in the periphery of the head and the follower. The force exerted by the fluid pressure in the flow spaces between the plates is transferred through the head and follower to the tie bars. Even the typical massive and strong design of the head and follower cannot always avoid a slight deformation which results in an uneven compression of the stack of plates.

According to claim 7 at least one tie bar extends through an aperture in the body of each plate so as to penetrate the plates in a region surrounded by the flow spaces between the plates. This tie bar takes up the fluid pressure in the region of the flow spaces and thereby reduces the deformation and uneven compression of the stack of plates.

5.2.3 The Respondent made reference to D3 which, according to him, tells the solution to the problem of spreading the clamping pressure more evenly across the heat transfer plates by providing tie bars extending through holes in the plates. D3 discloses a plate heat exchanger wherein the stack of plates is compressed between two opposite face plates (202) by means of a plurality of distributed rivets or bolts (209) penetrating the plates in a region surrounded by the flow spaces

between the plates. Thus, the essential feature of the invention claimed in claim 7, as defined above, is indeed derivable from D3. There is, however, no indication of the reasons for using this rather complex arrangement of distributed bolts. Considering the lightweight structure of the heat exchanger of D3 having the plates clamped between thin flat face plates, a skilled person will be aware that the distribution of the bolts across the plate area is required for holding the stack of plates in compressed condition because the face plates are unable to withstand the bending forces exerted by the fluid pressure when clamped together at their periphery only. This is, however, not the case for heat exchangers of the claimed type wherein a massive and heavy frame structure consisting of head, follower and rails distributes the clamping forces exerted by the peripheral tie bars. The Board, therefore, is not convinced by the argument of the Respondent that a skilled person would take D3 into consideration in a search for a solution to improve the even compression in heat exchangers of the type shown in D7, D8 and D13. Rather, it is the opinion of the Board that D3 relates to a different technology of frameless heat exchangers made for a particular application, which a skilled person would not readily apply to other types of heat exchangers. This opinion is supported by two further facts. Firstly, D3 describes the washers (207,307) as "spacing washers" which underlines that, in the particular application to a gas-gas heat exchange as described in D3, the washers are for spacing the plates rather than for sealing the flow spaces, contrary to what a skilled person would assume for normal heat exchangers and what is also claimed in claim 7. Secondly, the publication of D3 in 1953, i.e. about 40

years before the priority date of the patent, coupled with the fact that heat exchangers of the claimed type having the problem of even spreading of the clamping pressure across the heat transfer plates, were known at least since the publication of D7 and D8 in 1981, i.e. about 12 years before the priority date of the patent, indicates that the skilled person searching for a solution to this problem did not consider D3 but turned to other solutions, for example an offset location of the tie bars on both sides of the plates, as disclosed in D13.

5.2.4 The other documents in the procedure were not cited against claim 7 and do not appear to be of any particular relevance with regard to the invention defined in claim 7. Comparing D1 and D9 with D3, it is observed that the concept of distributing the clamping bolts across the plate area, as shown in Figure 1 of D9, was known in connection with frameless heat exchangers a long time before the publication of D3, and that in this type of heat exchanger the distributed bolts can be replaced by bolts on opposite sides of the plates if, as in D1, flanged face plates are used which better resist bending forces. Both observations support the above conclusion of the Board with respect to D3.

5.2.5 In summary, the subject-matter of claim 7 is not obvious having regard to the available prior art, and claim 7 therefore meets the requirement of inventive step.

6. Since the grounds for opposition do not prejudice maintenance of the patent with claims 1, 6 and 7, i.e. on the basis of the main request, the auxiliary requests do not have to be considered.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Counillon C. Wilson