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File No.: T 0588/91 - 3.2.3
Application No.: 87 907 255.1
Publication No.: 0 327 574
Classification: F28F 3/08, F28F 17/00, B21D 53/04
Title of invention: Plate heat exchanger with a double-wall structure

D E C I S I O N
of 28 July 1993

Applicant: Alfa-Laval Therman AB

Proprietor of the patent: -

Opponent: -

Headword: -

EPC: Art. 56

Keyword: "Inventive step" - "Problem and solution"

Headnote
Catchwords



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Boards of Appeal

Chambres de recours

Case Number: T 0588/91 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 28 July 1993

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Decision under appeal: Decision of the Examining Division of the
European Patent Office dated 4 March 1991 refusing
European patent application No. 87 907 255.1
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: C.T. Wilson
Members: J. du Pouget de Nadaillac
L.C. Mancini

Summary of Facts and Submissions

I. The appeal lies from the decision dated 4 March 1991 of the Examining Division of the EPO rejecting the European patent application No. 87 907 255.1, filed as PCT/SE 87/00478 (PCT publication No. WO 88/03253), on the ground that the subject-matter of Claim 1 filed on 24 August 1990 does not imply an inventive step in view of the following prior art documents:

FR-A-2 454 075 and
DE-A-3 232 602,

hereinafter referenced to as documents FR and DE respectively.

II. Claim 1 received on 24 August 1990 reads as follows:

"A method of manufacturing a plate heat exchanger comprising the steps of arranging a series of heat exchange plates (5,6) in a pack, including alternate plates (6) and other plates (5) intermediate the alternate plates, each plate being generally rectangular with a pressed corrugation pattern of ridges and valleys and having through flow ports (7-10) in corner portions thereof for two heat exchanging fluids, first sealing means (13,15,16) being located between each alternate plate and one of the two adjacent intermediate plates for defining an elongated passage (18) for flow of one of the heat exchanging fluids (A,B) from a said port at one end to a said port at the opposite end of said passage, with alternate ones of said passages accommodating flow of a first said fluid (A) and the other passages accommodating flow of a second fluid (B), and said first sealing means also defining a channel interconnecting opposing ports to accommodate flow of

the other of said exchanging fluids bypassing said passage, assembling each alternate plate (6) and the other of said two adjacent intermediate plates (5) to form a double-wall unit so arranged that an area (20) between the two plates may form a path through which leakage of said fluid through one of the plates can escape between the plates (5,6) to the atmosphere, and providing second sealing means (7a-10a) sealing between the plates of the double-wall unit, said second sealing means comprising welded or soldered joints interconnecting said plates around each pair of opposing ports (7-10) to form channels through which both fluids (A,B) can pass separately without entering said area (20) between the plates, characterised

by forming each double-wall unit by plastic metal deformation of at least one of the plates (5,6) of said unit, while juxtaposed against the other plate, thereby to produce the desired corrugation pattern (14) with the ridges and valleys of each plate of said unit conforming to and in intimate contact with the ridges and valleys of the other plate over the entire area of said passages (18) and the portions surrounding said ports,

said contacting portions of the plates surrounding said ports being interconnected by said welded or soldered joints."

Claims 2 to 7, appendant to Claim 1, relate to further features of the method according to Claim 1.

III. The Examining Division, in its decision, took the view that it was quite obvious for the skilled person, starting from the teaching of Document FR, to select the metal deformation known from Document DE, when looking for a manufacturing technique to bring both plates of the double wall unit into closer contact.

IV. The Appellant (Applicant) lodged the appeal on 29 April 1991, having paid the appeal fee on 24 April 1991. The Statement of Grounds of Appeal was filed on 24 June 1991.

In said statement, the Appellant argued that the present invention departs from the practice usually accepted prior to the invention and according to which both plates of a double wall unit were arranged to define a space or gap between them to provide a leakage path for the escape of a heat exchange media leaking from one of the two plates. Document FR confirms this practice by bringing the plates very close together while still ensuring a clear space. With the present invention, it has been discovered that both plates can in fact be brought into face-to-face contact over their entire area by a method known *per se* for other purposes and that nevertheless a leakage path is still maintained. The decision of the Examining Division has not appraised in a correct way the problem to be solved and document DE does not suggest the existence of any leakage path between both plates pressed together by the method disclosed in this document.

V. Therefore, the Appellant requested the decision under appeal to be set aside and the patent to be granted with the following documents:

- Description: pages 1 to 4 and 4a, filed on 24 August 1990, and
pages 5 to 9, as filed;
- Claims 1 to 7, as filed on 24 August 1990;
- Figures 1 and 2, as filed .

Reasons for the Decision

1. The appeal is admissible.

2. Document FR describes a plate type heat exchanger comprising all the features of the prior art portion of the contested Claim 1. In particular, each plate of the heat exchanger has a pressed corrugation pattern of ridges and valleys and, in its corner portions, flow ports. A single series of heat exchange plates is formed by an alternate plate assembled side-by-side by sealing means with an intermediate plate, and several of these series are stacked to form the heat exchanger, the sealing means being arranged on the flow ports in such a way that alternate ones of the flow passages defined by the plate series accommodate flow of a first heat exchanging fluid while the other passages accommodate flow of a second heat exchanging fluid. This heat exchanger is said to be of the double wall type, since, by stacking the series together, an alternate plate of one series cooperates with the intermediate plate of an adjacent series to provide a **double wall unit**, an open space communicating with the atmosphere being thereby defined between the two plates of this unit. Any possible leakage of a fluid from a series can therefore escape outside of the heat exchanger, thus allowing easy detection thereof.

3. Moreover, this closest prior art teaches to nest both plates of each double wall unit with each other, that is to say to arrange the plates with the ridges and valleys of each plate conforming to and in contact with the ridges and valleys of the other plate (page 3, lines 1 to 10), in order to improve the heat transfer between the plate series and, thus, between the fluids. However, although document FR indicates that the gap between the

plates has an extremely reduced section which can even be considered as nearly non-existent since the plates are in contact with one another, this gap is nevertheless positively provided in order to ensure flow of leakages. This document, further, suggests to insert a metal mesh between these plates to improve the heat transfer and also to provide the corrugations of the plates with planar portions to enlarge the gap between the plates, forming thereby channels which improve the flow of the leakages.

In the exchanger according to document FR, the plates can be interconnected by welded joints around the ports, but there is no contact between the plates in these port areas.

4. The object underlying the present invention is to improve the efficiency of this known heat exchanger, more specifically by improving the heat transfer. This object is different from that formulated by the Opposition Division, since no mention of bringing the plates **into closer contact** appears therein. In document FR, there is no suggestion that the heat transfer could be improved by bringing the plates into closer contact than as disclosed in this document. On the contrary, this document gives doubts about the efficiency of the already restricted space obtained by bringing the plates into contact, since it recommends, as already indicated, to create specific channels to improve the leakage flow. Moreover, this prior art, although dealing with the same problem of improving the heat transfer, teaches, as a solution, to insert a metal mesh between these plates, namely a solution which emphasises the need to separate the plates and, thus, goes in a direction opposite to a closer contact of the plates. This teaching shows further that, although it was well known generally that heat transfer is improved by bringing the plates into

contact, the idea of bringing the plates into closer contact in a heat exchanger of the double-wall type is not self-evident for the person skilled in the art. It is, therefore, clear that the idea itself of bringing the plates known from document FR into even closer contact constitutes a part of the solution and not a part of the problem to be solved. For this main reason, the line of arguments of the decision contested by the present appeal cannot be followed (see the decision T 229/85, OJ EPO 1987, page 237).

5. It is credible that the above-mentioned aim of the patent in suit is achieved by the features of the characterising portion of Claim 1. It is first pointed out that this claim teaches **a method** for manufacturing a heat exchanger and that the above-mentioned problem is solved by first assembling the plates of the **double-wall unit**, and not those of a plate series, as was previously done. By using, then, the method according to the first feature of the characterising portion of Claim 1, a more accurate contact between the plates is obtained for the following reason: In the prior art, identical plates, that is to say plates pressed with the same pattern of corrugations, were assembled together with the result that spaces between these plates were unavoidable, because, due to the plate thickness, the radius of curvature of the ridges is greater than the radius of curvature of the valleys into which the ridges nest. Thus the plates abut at certain points but narrow spaces are still defined between them. With the claimed process, this disadvantage is avoided. During the pressing step, the air between the two plates is also pressed away, so that a very good metallic contact between the plates is reached. Further, the contact is established over the **entire area** of the fluid passages, comprising the portions surrounding the ports. Consequently, the welding or soldering step at the ports

of the plates, which follows the assembling and pressing steps, is greatly facilitated and a very fluid-tight double-wall unit is, therefore, obtained.

It remains to examine if these new manufacturing steps are obvious in view of the state of the art.

6. Document DE, mentioned in the decision contested by the present appeal, is concerned with the manufacturing of pressed motor elements and pertains, therefore, to a technical field remote from the present invention. In this document, it is aimed at reducing the noise produced by cars and the solution disclosed therein makes use of metal sheets of different thicknesses pressed together to form the covers of particular parts of a motor. Normally, the man skilled in the art is expected to consult the prior art in a remote specialised field only if there is a clear linkage between his own problem and such a field. This is, here, clearly not the case, so that a combination of document DE with document FR, in the present case, is not obvious and should, therefore, not be taken into consideration.

7. There is no hint in any of the other cited documents that a heat exchanger could be manufactured by the method according to Claim 1, nor is there an hint to bring the plates into closer contact than the one disclosed in document FR.

- 7.1 US-A-4 249 597, which has nearly the same teaching as document FR, teaches to provide planar portions on the corrugations of the plates to form channels in the double-wall unit and, for the manufacturing of the heat exchanger, discloses first to assemble the two plates of a series of heat exchange plates rather than the plates of a double unit. This last teaching is also found in US-A-3 610 331, which, moreover, suggests to improve the

heat transfer between the two plates of the double-wall unit by providing a layer of heat conductive cement therebetween. Thus, these documents describe completely different solutions for manufacturing a heat exchanger and for improving the heat transfer.

- 7.2 SE-A-8 200 708, also does not suggest the claimed method. Indeed, it shows plates of a double-wall heat exchanger, which are closely nested, so that a metallic contact is said to be established, but **identical** plates are mentioned for the two plates of the double-wall unit, so that the above-mentioned disadvantage still remains. Moreover, no flow ports are shown, so that there is no teaching to bring into contact the areas around the ports. Thus, the two main ideas of the present invention, namely a contact over the entire area of the plates and a more intimate contact between them, cannot be deduced from this document.

GB-A-412 029 is not concerned with heat exchangers having a double-wall structure. It relates to a plate heat exchanger assembled from single **flat** plates and the mention, in one embodiment, of a possible rolling process to join two of these flat plates together cannot lead the skilled person, on the basis of this sole suggestion, to apply such a process for corrugated plates of a double-wall unit, which have a quite different object. The person skilled in the art and faced with the problem underlying the present invention has even no reason to consider this document and, thus, to combine it with the closest prior art.

8. Since none of the other documents cited in the Search Report is concerned with plate heat exchangers with a double-wall structure, they do not deal with the question of how to improve the heat transfer in such a structure and are, thus, irrelevant to the present case.

9. For the above reasons the Board comes to the conclusion that the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC. Dependent Claims 2 to 7 as well as the amended description are not open to objection and are, therefore, allowable.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division with the order to grant a patent on the basis of the documents specified in paragraph V above.

The Registrar:

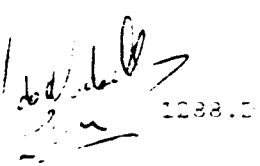


N. Maslin

The Chairman:



C.T. Wilson



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