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**Datasheet for the decision
of 21 November 2022**

Case Number: T 1386/21 - 3.2.01

Application Number: 14790060.9

Publication Number: 3062949

IPC: B23K1/00, F28F3/04, F28F3/08

Language of the proceedings: EN

Title of invention:
A METHOD OF BRAZING A PLATE HEAT EXCHANGER USING SCREN PRINTED
BRAZING MATERIAL

Patent Proprietor:
SWEP International AB

Opponent:
Alfa Laval Corporate AB

Headword:

Relevant legal provisions:
EPC Art. 83, 84, 123(2), 54, 56

Keyword:

Sufficiency of disclosure - (yes)
Claims - clarity - main request (yes)
Amendments - added subject-matter (no)
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

G 0003/14

Catchword:



Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 1386/21 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 21 November 2022

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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
25 May 2021 concerning maintenance of the
European Patent No. 3062949 in amended form.**

Composition of the Board:

Chairman G. Pricolo
Members: S. Mangin
A. Jimenez

Summary of Facts and Submissions

- I. The appeal was filed by the appellant (opponent) against the interlocutory decision of the opposition division finding that, on the basis of the auxiliary request 1B, the patent in suit (hereinafter "the patent") met the requirements of the EPC.
- II. The Opposition Division held that:
- The invention was disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.
 - Claim 1 of auxiliary request 1B met the requirements of Articles 84, 83 and 123(2) EPC.
 - Furthermore, the subject-matter of claim 1 was novel over D2 (US 2004/0181941) and involved an inventive step starting from D2 in combination with D7 (JP2000-337789) or D6 (US 4606495) and starting from D1 (JP9-178384) or D7 in combination with D2.
- III. Oral proceedings were held before the Board on 21 November 2022.
- IV. The appellant (opponent) requested that the decision under appeal be set aside and that the European patent be revoked.

The respondent (patent proprietor) requested that the appeal be dismissed or in the alternative that the patent be maintained on the basis of the first auxiliary request filed with the reply to the statement of grounds of appeal or of the second auxiliary request filed with letter dated 22 September 2022.

V. Claim 1 of the main request (corresponding to auxiliary request 1B) with the feature numbering used by the parties (see page 2 of the statement of grounds of appeal) reads as follows:

(1.0) A method of brazing a plate heat exchanger comprising a stack of heat exchanger plates (110,115) provided with a pressed pattern of ridges (R) and grooves (G) adapted to form contact points between the plates (110, 115) and provide for interplate flow channels for media to exchange heat, said interplate flow channels being in selective fluid communications with port openings (120, 130, 140, 150) provided near corners of the heat exchanger plates (110, 115), the method including the steps of:

(1.1) i. calculating or measuring the exact position of all contact points between the ridges (R) and grooves (G) of the neighboring plates (110, 115); and characterised by the following steps:

(1.2) ii. applying brazing material (B) close to, but not at, the contact points;

(1.3) iii. stacking heat exchanger plates (110, 115) provided with brazing material to a stack;

(1.4) iv. placing the stack of heat exchanger plates (110, 115) in a furnace;

(1.5) v. heating the stack of heat exchanger plates (110, 115) to a temperature sufficient for melting the brazing material (B); and

(1.6) vi. allowing the stack of heat exchanger plates (110, 115) to cool down such that the brazing material (B) solidifies and binds the plates (110, 115) together,

(1.7) wherein step ii. includes

(1.7.1) screen printing the brazing material (B) in form of half-moon shaped, or ()-shaped patterns neighboring the contact point,

(1.7.2) such that the brazing material (B) is placed such that it is in contact with both the ridges (R) of the pressed pattern of one plate (115) and the grooves (G) of the pressed pattern of a neighboring plate (110),

(1.8) wherein in step v.

(1.8.1) a capillary force draws melted brazing material into a crevice formed around the contact point between said ridges (R) and grooves (G) of neighboring plates,

(1.8.2) such that brazing connections formed at contact points between said ridges (R) and grooves (G) formed by the method are at least-partly diffusion bonded.

Reasons for the Decision

1. Main request - Sufficiency of disclosure - Article 100(b) EPC

The invention is disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

- 1.1 The appellant is of the opinion that the invention is not sufficiently disclosed for the following reasons:

(i) - Feature (1.1) requires "*calculating or measuring the exact position of all contact points between the ridges and grooves of the neighboring plates*". However, the patent does not contain any teaching on how to perform such calculations or measurements. CAD/CAM applications do not enable "measuring the exact position of all contact points". According to the appellant, only the tools are computer designed but not the manufactured plates having grooves and ridges and thus CAD/CAM does not enable calculating the exact position of all contact points. Furthermore, the spring

back effect of the plates after being pressed and their deformation after stacking will modify the exact location of the calculated contact points.

Alternatively, measuring the exact position of all contact points after the stacking of the plates is not possible.

(ii) - Feature (1.8) further restricts method step v. *"heating the stack of heat exchanger plates to a temperature sufficient for melting the brazing material"* (feature (1.5)) via a description of how the brazing material behaves during the heating. There is no teaching in the opposed patent on how to perform step v. in such a way that the brazing connections formed at the contact points are "partly diffusion bonded" (the processing temperature and pressure are not disclosed in the parent). Furthermore, there is no disclosure of how to ensure that these features are present in the end product.

(iii) According to claim 11 as maintained, the brazing material is applied only to areas in which a gap having the height h between the groove of an upper heat exchanger plate and the ridge of a lower heat exchanger plate is larger than the grains of the brazing material. The patent does not contain a disclosure regarding this feature that would allow the skilled person to carry it out. No indication on the grain size selection of the brazing material and no indication on the determination of the height h are given in the patent.

1.1.1 (i) The respondent is of the opinion that the skilled person can calculate or measure the exact position of all contact points between the ridges and grooves of the neighboring plates either by using a CAD/CAM on the design drawings of the heat exchanger or by measurements on the actual plates.

(ii) Furthermore step "v. heating the stack of heat exchanger plates (110, 115) to a temperature sufficient for melting the brazing material (B)"; "wherein in step v. a capillary force draws melted brazing material into a crevice formed around the contact point between said ridges (R) and grooves (G) of neighboring plates, such that brazing connections formed at contact points between said ridges (R) and grooves (G) formed by the method are at least-partly diffusion bonded" is described in paragraphs [0005] and [0048]-[0050] of the patent and is sufficiently disclosed for the skilled person to carry out the invention. Moreover, cutting and viewing the brazing point with a microscope may be performed to verify that the brazing connections formed at contact points are partly diffusion bonded.

(iii) Finally, the brazing material is to be applied before stacking the exchanger plate and selecting a commercially available grain size for the brazing material or sieving the grains to obtain a desired grain size are common practice for the skilled person.

1.1.2 The Board does not agree with the appellant and follows the Opposition Division's and the respondent's view (see page 4, points 2.1 of the appealed decision). The Board notes that the skilled person may use common general knowledge to supplement the information contained in the application to carry out the invention.

(i) Although no specific methods for calculating or measuring the exact position of all contact points between the ridges (R) and the grooves (G) of the neighboring plates are disclosed in the patent, the skilled person is well acquainted with CAD/CAM, computer aided design and manufacturing software, and can calculate based on the design models of the heat exchangers the position of all contact points between

the heat exchanger plates. While there may be some minimal variations with the actual position of all contact points due to the manufacturing process, these variations will be within accepted manufacturing tolerances.

Furthermore, direct measurement of the position of the contact points on the heating exchangers is also possible by stacking and unstacking the heat exchanger plates before applying the brazing material. Indeed, the wording of claim 1 with the expression "method including the steps of", does not exclude that additional steps take place before and after measuring the exact position of the contact points.

(ii) The phenomenon occurring with the brazing material close to the contact points and recited in features 1.8.1 and 1.8.2 is described in paragraphs [0049] and [0050] of the patent. Moreover, paragraph [0004] of the patent discloses that heat exchanger plates are often made of stainless steel and lists possible brazing materials such as copper, nickel or iron based brazing materials. Relying on common general knowledge with possibly a few trials and errors, the skilled person is then able to select the brazing conditions (temperature and pressure) according to the materials chosen to achieve a connection, which is at least partly diffusion bonded where the two heat exchangers are in contact. As disclosed in paragraph [0005] of the patent, cutting the plates at a brazing connection and viewing it under a microscope will enable the skilled person to verify the nature of the bond.

(iii) Finally, the skilled person can select the grain size of the brazing material among commercially available brazing material and apply it only to areas in which a gap has a height h larger than the grain

size as defined in claim 11. As discussed above CAD/CAM software may be used.

2. Main request - Added subject-matter

The main request does not extend beyond the content of the application as originally filed.

2.1 The appellant is of the opinion that features 1.8.1 and 1.8.2 do not find support in the application as filed.

Feature 1.8 reads:

"wherein in step v. a capillary force draws melted brazing material into a crevice formed around the contact point between said ridges (R) and grooves (G) of neighboring plates" (feature 1.8.1), "such that brazing connections formed at contact points between said ridges (R) and grooves (G) formed by the method are at least-partly diffusion bonded" (feature 1.8.2).

(i) The appellant argues that the basis for the above feature cannot be the first paragraph of page 9 of the application which is speculative (use of the terms "may", "might") and is not related to the step v.

(ii) Furthermore, page 9, lines 13-16 (*"the brazing material will start to get drawn into the slot or crevice surrounding the diffusion bonding portion of the contact between the ridges and grooves"*) cannot form the basis for the "crevice formed around the contact point".

(iii) Additionally, there is no teaching that brazing connections are formed at contact points, but rather "close to, but not at, the contact points" according to feature 1.2.

(iv) The causal link "such that" between features 1.8.1 and 1.8.2 is not present in the application as filed.

(v) Finally, the appellant argued that the combinations of claim 1 comprising features 1.8.1 and 1.8.2 and claims 5 to 7 defining the specific brazing materials are not directly and unambiguously disclosed in the application as filed.

2.2 The Board agrees with the findings of the Opposition Division and the respondent's view (see point 3 on pages 7-10 of the reply to the statement of grounds). Features 1.8.1 and 1.8.2 find basis on page 9, first and second paragraphs.

(i) While the terms "may" and "might" are used on page 9, lines 1 and 3, the disclosure provided is not to be considered speculative. Indeed, page 2, lines 9-20, describing the same phenomena of diffusion bonding and brazing and the combination of the two types of bonding starts with the expression "it has been found" and is factual.

(ii) Diffusion bonding will take place at the contact points of the two heat exchanger plates such that the two expressions *"the brazing material will start to get drawn into the slot or crevice surrounding the diffusion bonding portion of the contact between the ridges and grooves"* forms the basis for the *"crevice formed around the contact point"*. Furthermore, page 4, lines 17-21 discloses that *"In order to ensure capillary suction forces moving the brazing material into the crevice or gap neighboring the contact points, the brazing material may be placed such that it is in contact with both the ridges of the pressed pattern of one plate and the grooves of the pressed pattern of a neighboring plate"* and can also form the basis for *"crevice formed around the contact point"*.

(iii) The patent teaches that the brazing material applied around the contact points will be sucked by capillary effect to the contact points of the heat

exchanger plates resulting in partly diffusion bonded connections, meaning a combination of both brazing and diffusion bonding. Reference is made to page 2, lines 13-20 ("*The borderline between diffusion bonding and brazing is not sharp*"), page 9, lines 1-15 ("*this is not a pure diffusion bonding*").

(iv) The causal link between features 1.8.1 and 1.8.2 can be found on page 9, line 9 with the expression "in effect".

(v) Finally, the diffusion bonding is a bonding that occurs between the two heat exchanger plates independently of the brazing materials used. The brazing materials defined in claims 5-7 and disclosed in paragraph [0004] have melting temperatures below the ones of the heat exchanger plates such that the phenomenon (suction of the brazing material by capillary effect) explained in the patent will inevitably occur under sufficient temperature and pressure and lead to partly diffusion bonding at the contact points. Therefore, the combination of claim 1 and claims 5-7 does not lead to added subject-matter.

3. Main request - Lack of clarity

The deletion of the expression "at least" in front of the terms "partly diffusion bonded" in feature 1.8.2, limits the claim to the alternative where the brazing connections comprise some diffusion bonding. The alternative where the brazing connections are entirely diffusion bonded is not covered by claim 1 anymore.

According to G3/14, this amendment cannot be examined for compliance with the requirements of Article 84 EPC as it does not introduce a non-compliance (the alternative "partly diffusion bonded" was already present in claim 1 as granted).

The appellant considers that the deletion of the word "at least" renders the meaning of the expression "partly diffusion bonded" unclear and can therefore be examined.

The Board does not agree. The expression "at least partly diffusion bonded" in granted claim 1 defined two alternatives: "fully diffusion bonded" and "partly diffusion bonded". By removing the terms "at least", only the second alternative remains, which was already in claim 1 as granted and can thus not be examined for clarity.

4. Main request - Novelty over D2 (US 2004/0181941 A1)

The subject-matter of claim 1 is novel over D2 as feature 1.7.1 (*"screen printing the brazing material (B) in form of half-moon shaped, or ()-shaped patterns neighboring the contact point"*) is not disclosed in D2.

4.1 Paragraph [0025] of D2 discloses that *"the brazing material may be applied such that it before the brazing has the shape of a ring which surrounds the contact points"*. In contrast claim 1 requires half-moon or () shaped pattern, i.e., patterns that are partly encircling the contact point.

4.2 The appellant argues that claim 1 does not specify that the half-moon and the parenthesis shaped pattern are spaced apart and thus encompasses two half-moon shaped or two parenthesis shaped patterns facing and touching each other thereby forming a ring. Furthermore, the patent specification, discloses a donut as alternative to the half-moon shaped and parenthesis shaped pattern.

- 4.3 The Board does not agree, the skilled person would not consider a ring under half-moon shaped or parenthesis shaped patterns. This interpretation is also in line with the description. Indeed, paragraphs [0060] and [0061] opposes the ring shape to the half-moons and parenthesis shapes which partly encircle the contact point.

Contrary to the respondent, who considers that the term donut used in paragraphs [0035], [0056] and [0061] can have any shape, the Board judges that the term "donut" has typically the shape of a ring, or of a torus, and would be understood this way by the reader. However, the term "donut" appears to be inconsistent with the description which opposes the rings shape to the pattern shapes of the invention partly encircling the contact point (see paragraph [0056], [0060] and [0061]). The Board therefore takes the view that the skilled person would disregard the "donut" shape and would certainly not interpret the half-moon shaped and ()-shaped patterns of claim 1 as encompassing a donut shape.

5. Main request - Inventive step starting from D2

The Board sees no reason to deviate from the decision of the opposition division which considered that the main request involved an inventive step starting from D2 as closest prior art.

- 5.1 The subject-matter of claim 1 differs from D2 in *"screen printing the brazing material (B) in form of half-moon shaped, or ()-shaped patterns neighboring the contact point"* (feature 1.7.1).

Paragraph [0060] of the patent discloses that *"the application in a ring is not suitable if screen printing is used, since printing on the flanges of the ridge R will make it impossible, or at least very difficult to achieve an even thickness of the brazing material due to the screen not being able to contact the flanges"*.

Thus, the problem to be solved may be regarded as to enhance screen printing of the brazing material allowing for a more evenly distributed thickness of the brazing material.

Paragraph [0061] discloses that *"By applying the brazing material in a donut-shape, half-moon shape, or in form of two parentheses signs partly encircling the contact point, this problem is solved, or at least mitigated, since a smaller portion of the brazing material is applied on the flanges of the ridge R if the brazing material is applied in this manner"*.

Neither D2, nor D6 or D7 discloses or suggests *"screen printing the brazing material (B) in form of half-moon shaped, or ()-shaped patterns neighboring the contact point"* to mitigate the problems mentioned in paragraph [0060] of the patent.

In D6 only one heat exchanger plate is corrugated, the other one is flat, and the brazing material is applied along a line at the edge portions of the crenels and D7 discloses screen printing dots. The skilled person would therefore not combine D2 with either D6 or D7. But even if they would, they would not arrive at the subject-matter of claim 1 requiring *"screen printing the brazing material (B) in form of half-moon shaped, or ()-shaped patterns neighboring the contact point"*.

- 5.2 The appellant is of the opinion that no effect can be associated with the identified difference for the following reasons:
- There is no support of the alleged effect in comparison to the prior art in the patent.
 - The alleged technical effect is not plausibly proven. Firstly, it is not apparent how applying brazing material in a donut-shape may lead to any advantage over a ring shape. Secondly, the claim does not specify the dimensions of the half-moon or parentheses and the spacing between them as well as their arrangement/location. Thirdly, the specific pattern is not maintained after the heat exchanger plates are brought in contact with each other.

The appellant therefore formulates the problem as *"to provide a method for brazing a plate heat exchanger with an alternative shape of the brazing material applied via screen printing"*.

- 5.3 Firstly, while the Board agrees with the appellant that screen printing half-moon shaped or ()-shaped patterns over rings without specifying their size may not always result in a reduction of the brazing material, the Board has no reason to doubt the problem of screen printing ring shaped pattern as disclosed in paragraph [0060] and the effect of screen printing half-moon shaped or ()-shaped patterns as disclosed in paragraph [0061].
- Secondly, claim 1 does not define the donut shape, but only the half-moon and the parentheses shaped pattern and the description makes it clear that these shapes should be understood as partly encircling the contact point.

Thirdly as mentioned by the respondent, while feature 1.7.1 does not define that the half-moon shaped or parentheses shaped patterns are screen printed on the ridges rather than on the flange, considering feature 1.7.2 reading "*such that the brazing material (B) is placed such that it is in contact with both the ridges (R) of the pressed pattern of one plate (115) and the grooves (G) of the pressed pattern of a neighboring plate (110)*", claim 1 implies that half-moon and the parentheses shaped pattern of brazing material are at least partly placed on the ridges.

6. The Board thus concludes that none of the objections raised by the appellant prejudice the maintenance of the patent on the basis of the main request.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar:

The Chairman:



A. Voyé

G. Pricolo

Decision electronically authenticated