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File Number: T 100/90 - 3.2.3

Application No.: 84 903 105.9

Publication No.: 0 153 363

Title of invention: A heat exchanger

Classification: F28F 21/08

D E C I S I O N
of 2 April 1991

Proprietor of the patent: Östbo, Karl

Opponent: Gebrüder Sulzer Aktiengesellschaft

Headword: Heat Exchanger/ÖSTBO

EPC Articles 56; 69

Keyword: "Inventive step (yes)"
"Extent of protection conferred"

Headnote

Summary of Facts and Submissions

- I. European patent No. 0 153 363 comprising Claims 1 to 7 was granted on 7 January 1988 on the basis of European patent application No. 84 903 105.9 filed on 22 August 1984.

Its Claim 1 reads as follows:

"A heat exchanger comprising a core including at least one elongate block (12, 20, 27) of a metal having a high heat conducting capacity, and enclosing at least one tube (11, 25) for the passage of a first heat transporting medium, the core being enclosed in a casing (13, 30, 37, 38, 40) governing the flow of a second heat transporting medium along said block, characterized in that the metal is cast around the tube(s), and that the core, at least at its face(s) turned towards the casing, is provided with surface enlarging flanges (15), to present contact surfaces towards the second medium several times larger than what the tube(s) present(s) towards the first medium, the flanges (15) running in parallel to the longitudinal axis of the block (12, 20, 27) and the flanged face(s) of the block (12, 20, 27) being cut transversely by grooves (34), subdividing the face into fields (35a, 35b), wherein the flanges (15a) in one field (35a) are displaced sidewardly so as to be aligned with the grooves (15b) in an adjacent field (35b) in order to provide a tortuous flow path for the second medium along said face of the block."

- II. Opposition to the granted patent was filed on 19 August 1988 on the ground that the granted claims did not define inventive subject-matter. The Opponent requested revocation of the patent in the light of the following documents:

- (D1) EP-B-0 015 915
- (D2) GB-A-987 739
- (D3) FR-A-741 113
- (D4) DE-C-594 483.

III. By its decision dated 12 December 1989 the Opposition Division rejected the opposition pursuant to Article 102(2) EPC.

IV. The Opponent (Appellant) appealed against this decision on 8 February 1990 paying the appeal fee on the same day. The statement of grounds of appeal was filed on 4 April 1990. The appeal contended lack of inventive step of the subject-matter of Claim 1 on the basis of D1 and D4 and requested subsidiarily oral proceedings to be appointed.

V. In an invitation to oral proceedings dated 29 November 1990, accompanied by a communication pursuant to Article 11(2) RPBA the Board gave its provisional opinion as to the question of inventive step of the subject-matter of Claim 1.

VI. In response to the invitation to oral proceedings and the communication of the Board the Appellant cited for the first time the following documents:

- (D5) Friedrich Münzinger: "Dampfkraft" Springer-Verlag, 1949, Figures 78 and 79 on page 55
- (D6) Karl Rudolf Schmidt: "Nutzenergie aus Atomkernen" Vol. I, Verlag Walter de Gruyter & Co., 1959, pages 425 and 427 and Figure XIV, 47.

He maintained essentially his arguments set out in the statement of grounds and contended that D5 and D6 would confirm that in the constructive modification of the displaced arrangement of flange groups alone there could

not be seen any inventive step. He withdrew his subsidiary request for oral proceedings and announced that on the Appellant's side nobody would take part in the oral proceedings appointed.

The Appellant maintains his request that the impugned decision be set aside and the patent be revoked, and the Respondent, in a reply filed by telefax on 28 February 1991 and confirmed by letter received on 5 March 1991, made observations on the relevance of the new citations D5 and D6 and requested that the patent be maintained as granted, suggesting an amendment in column 3 of the description of the patent to adapt the description to the claims.

The Respondent argues essentially that in the arrangement of flanges known from D4 only very small deviations from any field of flanges to an adjacent field are disclosed, no transverse grooves being shown which are necessary to provide a tortuous flow.

VII. The arguments of the Appellant may be summarised as follows:

- (i) The splitting up of the flow of the second heat transporting medium intended with the claimed displacement of the flanges occurs equally with the arrangement of the flanges according to Figure 14 of D1. The difference vis-à-vis the embodiment according to Figure 7 of the patent that the grooves run normal with regard to the longitudinal direction of the flanges and that thereby the flanges of adjacent fields are displaced by half a pitch, results with regard to heat transfer at best in a gradual improvement. At any rate such improvement is not linked with a surprising effect.

(ii) If the feature concerning the displacement of the flanges were essential to the invention, it could have been expected that the grooves in the flanges would have been illustrated in Figure 1, and that in Figure 2 besides the flanges shown in cross-section also flanges being displaced relative to these would be shown. Thus, if the features of Claim 1 as granted were to be regarded as obligatory, Figures 1, 2 and 4 should have been eliminated.

(iii) The presence of a groove subdividing the flanged faces of the metal block into fields is not required in the heat exchanger known from DE-C-594 483 (D4) since this feature is known from EP-B-0 015 915 (D1). The purpose of obtaining a narrow contact of the wall parts indicated in D4 only confirms the fact that there is not provided a transverse groove between the respective groups of ribs. The arrangement would nevertheless provide a tortuous flow path.

VIII. With a notification of cancellation of oral proceedings and by telephone respectively, the parties were informed that the oral proceedings due to take place on 20 March 1991 had been cancelled.

Reasons for the Decision

1. The appeal is admissible.
2. Amendments

Claim 1 is in substance a combination of the originally filed Claims 1, 2 and 4.

The further feature of Claim 1 that the block is elongate, is supported by figure 1 with the corresponding description of the originally filed documents.

Dependent Claims 2 to 7 correspond in substance to originally filed Claims 5 to 10 with the exception of the term "mounted concentrically..." incorporated in Claims 4 and 5 respectively. This additional feature has been disclosed on page 5, paragraph 3, (Figure 6), and on page 6, last paragraph, to page 7, line 1 and Figure 10, respectively, of the originally filed description and drawings. Claims 1 to 7 are not, therefore, objectionable under Article 123(2) EPC.

As the granted claims are maintained unamended, they also meet the requirements of Article 123(3) EPC.

3. Novelty

3.1 The closest state of the art, in the view of the Board in agreement with the Appellant, is that shown in D1.

This document discloses a heat exchanger comprising a core including at least one elongate block of a metal having a high heat conducting capacity, and enclosing at least one tube for the passage of a first heat transporting medium, the core being enclosed in a casing governing the flow of a second heat transporting medium along said block. The metal is cast around the tube(s) and the core is provided with surface enlarging flanges to present contact surfaces towards the second medium several times larger than what the tube(s) present(s) towards the first medium, the flanged faces of the block being cut transversely by grooves subdividing the face into fields (see D1, Figures 1, 2 and 14 with corresponding description).

3.2 The heat exchanger according to present Claim 1 differs from this prior art by the following features:

- (a) the surface enlarging flanges are running in parallel to the longitudinal axis of the block,
- (b) the flanges in one field are displaced sidewardly so as to be aligned with the grooves in an adjacent field in order to provide a tortuous flow path for the second medium along said face of the block.

3.3 No other document is available which discloses all the features of Claim 1. Moreover, novelty of the subject-matter of Claim 1 has not been disputed by the Appellant.

The subject-matter of Claim 1 is therefore novel in the sense of Article 54 EPC.

4. Inventive step

4.1 In comparison with the closest prior art according to D1 the problem to be solved by the invention is to design a heat transfer body having optimum heat transfer characteristics (cf. column 1, lines 40 to 42, of the patent specification and letter of the Respondent dated 17 July 1990, page 4, paragraph 3).

4.2 This aim has been achieved by the features (a) and (b) of Claim 1 as identified above.

Feature (a) has the effect that the surface enlarging flanges are running in that direction in which the tube(s) enclosed by the elongate block principally extend(s). By feature (b), due to the staggered arrangement of groups flanges in adjacent fields, the second heat transporting

medium is prevented from flowing between the surface enlarging flanges straight ahead from the inlet to the outlet of the elongate block and is forced to change its direction of flow in the grooves subdividing the face(s) of the block into fields, thus increasing the length of the flow path available for heat transfer.

- 4.3 In the arrangement of flanged faces being cut by grooves known from D1, the flanges in one field are aligned with corresponding flanges in an adjacent field, one of the two fluid trailing edges of a respective flange being rounded to dispose of a relatively big radius relative to the other trailing edge. This configuration leads to the result that due to the Coanda-effect occurring at the rounded trailing edge of the flange, a thin layer of the medium flowing between the flanges is deviated to the respective adjacent flow path (cf. D1, column 8, lines 47 to 56), whereas the major portion of the medium flows in a more or less straight line ahead through the grooves because of the flanges in one field being aligned with corresponding flanges in an adjacent field.

Since D1 proposes such an aligned configuration of the flanges, it cannot provide an incentive to an arrangement in which the flanges in one field are displaced sidewardly so as to be aligned with the grooves in an adjacent field.

- 4.4 D3 and D4 each discloses a heat exchanger comprising a core including at least one elongate block of metal and enclosing at least one tube for the passage of a first heat transporting medium. A second heat transporting medium flows along said block and the core is provided with surface enlarging flanges to present contact surfaces towards the second medium several times larger than what the tubes present towards the first medium, the flanges

running in parallel to the longitudinal axis of the block.

D4 discloses furthermore, that groups of flanges arranged along the same tube are displaced relative to each other (cf. page 1, lines 47 to 50, page 2, lines 15 to 20, Claim 2 and figures 5 and 7). It is not clear from the cited passages of D4 whether the flanges are displaced sidewardly or circumferentially in respect of the tube on which the flanges are fastened and no homogeneous measure or rule of displacement can be recognised, since according to Figure 7 not all of the opposite flanges are displaced. The purpose of displacing the groups of flanges resides in improving the close contact of all wall parts of the flanges (cf. D4, page 2, lines 15 to 20) and not in governing the flow of the second heat transporting medium in the sense of providing a tortuous flow path. Corresponding to this different problem, D4 cannot be considered to disclose an arrangement in which the flanges in one field are displaced sidewardly so as to be aligned with the grooves in an adjacent field.

Furthermore, neither D3 nor D4 discloses the feature that the flanged faces of the elongate block are cut transversely by grooves.

D4 shows that adjacent groups of flanges arranged along the same tube contact one another. The presence of such grooves subdividing the face(s) into fields is, however, indispensable in an arrangement for providing a tortuous flow path as defined in Claim 1 of the patent because without the grooves any channel formed between two adjacent flanges would be closed in the range between two adjacent fields of flanges, thereby impeding effective heat transfer between the second heat transporting medium and the surface enlarging flanges.

Thus, due to the different problem underlying the flange arrangement of the heat exchanger known from D4 as compared with the problem according to the invention, the skilled person would not be led to consider the teaching of D4 when searching for a solution optimising heat transfer in the heat exchanger known from D1.

If he nevertheless envisaged a substitution of the flange arrangement of D1 by that of D4, he would not, contrary to the Appellant's comment in his letter dated 2 April 1990 (cf. page 5, last paragraph), arrive at the subject-matter of Claim 1. In such a substitution, he would not disregard the principle of the heat exchanger disclosed in D4, that adjacent groups of flanges are in close contact with each other, because such contact is aimed at as shown and expressly stated in the citation. Such an arrangement of the flanges would not, however, solve the problem underlying the invention, as outlined above.

4.5 Having regard to the further arguments of the Appellant, the Board notes the following:

4.5.1 The presence of a surprising effect is not a requirement of the EPC but serves only the purpose of circumstantial evidence in assessing inventive step. The same consideration applies to the question whether an invention leads to an improvement, be it a substantial improvement or a gradual improvement as implied even by the Appellant in the present case (cf. Appellant's letter dated 31 August 1990, page 2, paragraph 1).

4.5.2 In the original description of the underlying patent application (page 5, last paragraph, to page 6, paragraph 1) it has been indicated that a smooth flow along a surface may tend to provide a poor heat transfer

and in order to improve the heat transfer the flanged face of a block is preferably cut up into fields where the flanges in one field are displaced sideways so as to be aligned with the grooves in a following field.

The person skilled in the art will interpret this passage as being relevant not only to the embodiment of Figure 7 but recognises that the improvement described is applicable to the different embodiments of the drawings because the tortuous flow envisaged may be obtained in all the embodiments in which the second heat transporting medium flows along the surface enlarging flanges of the core, i.e. also in the embodiments according to Figures 1, 2 and 4.

Moreover, page 8, second paragraph of the original description emphasises that the block(s) of the basic type shown in Figure 1 can be shaped and combined in many ways within the scope of the claims. Page 4, second paragraph, of the original description which describes the embodiment of Figures 1 and 2 indicates that "the flanges should preferably not run uninterruptedly along the face of the blocks, but should be staggered so as to provide a tortuous flow for the second medium as better explained in conjunction with Figure 7".

It is therefore clear from the original documents that the staggered arrangement of the flanges has been disclosed to be generally applicable without being limited to the embodiment of Figure 7. In agreement with this, it is perfectly clear to the Board from the wording of Claim 1 that the features concerning grooves subdividing the face(s) of the block(s) into fields and the staggered arrangement of the flanges with regard to adjacent fields are obligatory features. It has also been stated by the

Respondent (cf. letter dated 17 July 1990, page 2, paragraphs 5 and 6) that the above-cited features are to be regarded as the important distinction from the prior art in respect of the solution to the inherent problem. The Board notes furthermore that pursuant to Article 69(1) EPC the extent of protection conferred by a patent shall be determined by the terms of the claims. According to the established jurisprudence of the EPO, Articles 69 and 84 EPC have to be construed in the sense that a claim confers protection only as a whole and not with regard to parts of the claim (cf. Decision T 13/84 OJ EPO 1986, 253, point 15, and Decision T 16/86 (unpublished), point 2).

- 4.6 Concerning the late-filed documents D5 and D6 the Board, after having examined these documents, finds them to be not relevant in the sense of leading the Board to a different decision. None of these documents discloses the combination of features that the flanged face(s) of the elongate block of the heat exchanger is(are) cut transversely by grooves subdividing the face(s) into fields wherein the flanges in one field are displaced sidewardly so as to be aligned with the grooves in an adjacent field in order to provide a tortuous flow path for the second medium along said face(s) of the block. These documents cannot, therefore, suggest the solution to the inherent problem as contained in Claim 1.

Thus, the Board, making use of the power conferred to it by Article 114(2) EPC, decided to disregard these documents (cf. T 156/84 OJ EPO 1988, 372, point 3.8).

- 4.7 There is no reason to comment on the other documents cited during the examining and opposition proceedings which have not been discussed in the appeal proceedings since these documents are no closer to the subject-matter of Claim 1

than the prior art cited by the Appellant in the appeal proceedings.

5. For the foregoing reasons, the Board comes to the conclusion that the subject-matter of Claim 1 cannot be derived in an obvious manner from the cited prior art and accordingly involves an inventive step. The patent is therefore to be maintained on the basis of this Claim 1 and dependent Claims 2 to 7 which relate to preferred embodiments of the heat exchanger according to Claim 1.
6. The fact that D1 comes closer to the subject-matter of Claim 1 than the prior art corresponding to the first portion of Claim 1 does not give rise to an amendment of the wording of Claim 1 with regard to Rule 29(1) EPC, since neither this provision nor Article 84 EPC constitutes a ground for opposition (cf. decision T 99/85, OJ EPO 1987, 413).
7. Since the patent is defended in its granted form and the claims are considered to be maintainable, the suggestion to remove the inconsistency in column 3 of the description (cf. Respondent's letter received on 5 March 1991, page 3, paragraphs 5 and 6) with regard to Claim 1, is not considered necessary since such amendment is not required by proper opposition grounds (cf. decision T 127/85, OJ EPO 1989, 271).

The same consideration applies to the term "preferably" in column 3, line 48 and in column 4, line 59, of the description, which is also not consistent with Claim 1.

Order

For these reasons, it is decided that:

The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C.T. Wilson