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Datasheet for the decision of 8 September 2009

Case Number: T 0366/07 - 3.2.03

Application Number: 95117346.7

Publication Number: 0710811

IPC: F28F 1/12, F28D 1/053

Language of the proceedings: EN

Title of invention:
Corrugate fin type heat exchanger

Patentee:
DENSO CORPORATION

Opponent:
Modine Europe GmbH (opposition withdrawn)
VALEO THERMIQUE MOTEUR
Behr GmbH & Co. KG

Headword:
-

Relevant legal provisions:
EPC Art. 123(2), 123(3), 56
RPBA Art. 13(3)

Relevant legal provisions (EPC 1973):
-

Keyword:
"Extension of subject-matter (no)"
"Extension of scope of protection (no)"
"Admittance of late-filed request (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:

-

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Case Number: T 0366/07 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 8 September 2009

Appellant: (Patent Proprietor)
DENSO CORPORATION
1-1, Showa-cho
Kariya-City
Aichi-pref., 448 (JP)

Representative:
Kuhnen & Wacker
Patent- und Rechtsanwaltsbüro
Prinz-Ludwig-Strasse 40A
D-85354 Freising (DE)

Respondents:
(Opponent)
VALEO THERMIQUE MOTEUR
8, rue Louis Lormand
BP 17
F-78321 La Verrière Cedex (FR)

Representative:
Rolland, Jean-Christophe
Valeo Systemes Thermiques
Propriété Industrielle
8, rue Louis-Lormand
La Verrière
F-78321 Le Mesnil St Denis Cedex (FR)

(Opponent)
Behr GmbH & Co. KG
Mauserstr. 3
D-70469 Stuttgart (DE)

Representative:
Wallinger, Michael
Wallinger Ricker Schlotter Foerstl
Patent- und Rechtsanwälte
Zweibrückenstrasse 5-7
D-80331 München (DE)

Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 18 January 2007 revoking European patent No. 0710811 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: U. Krause
Members: C. Donnelly
J.-P. Seitz

Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division, posted on 18 January 2007, revoking European patent no. EP-B-0 710811.

II. The patent proprietor (hereinafter the "appellant") lodged an appeal against this decision on 23 February 2007 paying the fee the same day. The appellant set out its case in the grounds of appeal filed on 25 May 2007 in which it requested that the impugned decision be set aside and the patent maintained as granted or alternatively on the basis of the first or second auxiliary request filed with the grounds.

Opponent II and opponent III (hereinafter "respondent II" and "respondent III") replied to the appellant's case by letters of 14 December 2007 and 6 November 2007 respectively. Both requested that the appeal be dismissed.

All parties made auxiliary requests for oral proceedings to be held.

III. Respondent II made reference in particular to the following documents:

E1: US-A-4 332 293
E3: Lehrbuch der Klimatechnik, Verlag C.F. Müller Karlsruhe, 1997, pages 1,56,57,73,74;
E9: Noboro Ogasawara, Ichiro Iwai, Tsuyoshi Kawabe, Toru Karaki, "A Development of a Light Weight and High Performance Aluminium Radiator", SAE Technical Paper Series, Nr. 920549, February 1992;

E12: Auszug aus Taschenbuch der Physik, Kuchling, Verlag Harri Deutsch, Thun und Frankfurt/Main von 1988.

IV. In a communication dated 1 April 2009, pursuant to Article 15(1) RPBA annexed to the summons to oral proceedings, the Board informed the parties of its provisional opinion.

In response of 7 August 2009 to the communication of the Board, the appellant filed a new main request as well as new first, second and third auxiliary requests.

At the end of the oral proceedings before the Board held on 8 September 2009, the appellant requested that the decision under appeal be set aside and the patent maintained on the basis of the main request filed during the oral proceedings; all other requests were withdrawn. This being the case the main request constitutes the appellant's sole request. Both respondents confirmed their requests for the appeal to be dismissed.

V. Claim 1 according to the main request reads:

"An automobile air conditioning system comprising a corrugate fin type heat exchanger (2) for heat exchanging hot water with air, which is used for a heater core of an automotive air conditioner, said corrugate fin type heat exchanger (2) comprising:

a) a plurality of tubes (2a) disposed in parallel with a flow direction of said air, the flat tubes (2a) are disposed in a single line in said flow direction;

b) at least one corrugate fin (2b) disposed between each pair of said flat tubes (2a) and connected thereto;

c) the height of said corrugate fin (2b) is in a range of 3 -6mm;

d) said flat tubes (2a) and said corrugate fins (2b) are made of aluminium;

e) said plurality of flat tubes (2a) and said corrugate fin (2b) composing a core portion (2c),

f) a hot water inlet tank (2e) disposed at an end of said core portion (2c), said hot water inlet tank (2e) communicating with said plurality of flat tubes (2a) for introducing said hot water into said flat tube (2a); and

g) a hot water outlet tank (2f) disposed at an end of said core portion (2c), said hot water outlet tank (2f) communicating with said plurality of flat tubes (2a) for receiving said hot water flowing from said flat tubes (2a),

characterised in that

h) said core portion (2c) is constructed in such a manner that said hot water flows only in one direction from said hot water inlet tank (2e) at one end to said hot water outlet tank (2f) at the other end of said core portion (2c),

i) a ratio (St/W x D of the total cross-sectional flow passage area (St) of said flat tubes (2a) to the cross-sectional area (W x D) expressed by an overall width dimension (W) and a thickness dimension (D) of said core portion (2c) is set to a range of 0.07 - 0.24 according to said inner thickness of said flat tube (2a) and said height of said corrugate fin (2b);

j) the inner thickness in the short side direction of the flow passage within the flat tube (2a) is in a range of 0.6 - 1.2mm;

k) a wall thickness of said flat tube (2a) is set to a range of 0.2 - 0.4mm; and

(l) a wall thickness of said corrugate fin (2b) is set to a range of 0.04 -0.08mm,

(m) wherein said hot water is circulated by a water pump (3) driven by an automotive engine, and the Reynolds number is set to 1000 or less when the flow quantity of said hot water passing through said core portion (2c) is 16lit/min when the vehicle is running at 60km/h."

VI. The arguments of the parties relevant to the decision can be summarised as follows:

(a) Admissibility of the main request, clarity Article 84 EPC

The respondents maintained that the main request should not be admitted into the proceedings since it had only been filed as the third auxiliary request in extremis

with letter of 7 August 2009 and did not prima facie meet the requirements for clarity under Article 84 EPC. In particular, claim 1 is now directed at an "automobile air conditioning system" and contains new characteristics in that feature m) specifies the Reynolds number, which is a function of the kinematic viscosity and in turn of the fluid temperature which is not specified. A vehicle speed in kmh^{-1} has also been introduced which is unclear because it is the engine speed which determines the flow rate through the pump. Since the claim is unclear and late-filed it has not been possible to prepare adequately for the oral proceedings, consequently the request should not be admitted into the proceedings.

The appellant pointed out that the present main request, except for the addition of the speed requirement of $60kmh^{-1}$ made in response to the provisional opinion of the Board, is identical to auxiliary request 2 filed with the grounds of appeal which in turn is a combination of granted claims 1 and 2. The respondents' contention that the claim is not clear because the kinematic viscosity of the hot water mixture changes substantially with temperature is not technically reasonable since the skilled person would recognise that the patent is not concerned with a start-up situation. The feature of the Reynolds number was anyway in granted claim 2 and cannot be the object of a clarity objection at this stage. The specification of a vehicle speed is also clear, since in practice only the vehicle top gear could be meant, further there can be no doubt that idling is excluded.

Accordingly, the main request is prima facie clear, filed in due time and as such does not represent an undue burden to the respondents.

(b) Article 100(b), Article 83 EPC - Insufficiency of disclosure.

Respondent I argued that since only a very broad definition of the fluid used in the system is given it is impossible for the skilled person to ensure that laminar flow is achieved.

The appellant stated that this ground of opposition had not been admitted into the proceedings by the opposition division and related in any case to a question of clarity which is not a ground for opposition.

(c) Article 123(2) EPC

Both respondents were of the opinion that claim 1 infringes Article 123(2) EPC since in the originally filed claim 1 it was specified that:

"a ratio (St/WxD) of the cross-sectional area (WxD) expressed by an overall width dimension (W) and a thickness dimension (D) of said core portion (2c) to a total cross-sectional flow passage area (St) of said plurality of flat tubes (2a) is set to a range of 0.07 - 0.024".

Whereas feature i) of claim 1 according to the main request specifies:

"a ratio (St/W x D of the total cross-sectional flow passage area (St) of said flat tubes (2a) to the cross-sectional area (W x D) expressed by an overall width dimension (W) and a thickness dimension (D) of said core portion (2c) is set to a range of 0.07 - 0.24"

Thus, the ratio now claimed is the inverse of that originally disclosed.

Further, the passage in column 8, lines 48 to 49 of the published application states that in a preferred embodiment, such as shown in Figure 13 the ratio (St/WxD) is 14.5.

In the appellant's view it is clear which ratio is meant since the same value of 0.07 to 0.24 is referred to in claim 1 of both the original and granted versions and is the only value which falls within the ranges given in the graphs of figures 7, 11 and 12. Given the tube and fin dimensions also specified in the claim the ratio can only be St divided by WxD. The figure at column 8 is a printing error since 14.5 should read 14.5% or 0.145.

(d) Article 123(3) EPC

The respondents also argued that claim 1 of the main request contravened Article 123(3) since the first feature of the characterising portion of claim 1 as granted reads:

"a ratio (St/W x D of the total cross-sectional flow passage **opening** area (St) **opening to said hot water inlet tank** (2e) to the cross-sectional area (W x D)

expressed by an overall width dimension (W) and a thickness dimension (D) of said core portion (2c) is set to a range of 0.07 - 0.24"

However, in claim 1 of the main request the specification that the cross-sectional area is at the opening to said hot water inlet tank (in bold type above) has been removed. Hence, the scope of protection must be broader since there is no restriction on where the cross-sectional area is measured and there is no indication in the claim that the tube section is constant. On the contrary, the contested patent refers to the use of tubes provided with dimples which indicates that the cross-section is not constant. Thus, Article 123(3) EPC is infringed.

The appellant argued that the deletion of the terms "opening" and "opening to said hot water tank" had been made in response to the objection under Article 123(2) EPC that these amendments, made during the examination procedure, represented an extension of the subject-matter since it had only been originally disclosed that the required value for the ratio St/WxD is met throughout the entire length of the tubes making up the core section and not just at the opening to the hot water tank, which is not necessarily the same thing as defining a constant section for the tubes. Thus, if the as granted version is considered to infringe Article 123(2) EPC, for this reason a return to the originally filed version cannot then contravene Article 123(3) EPC.

(e) Inventive Step

The appellant argued that none of the cited prior art documents disclosed or suggested feature m). This feature solves the technical problem of providing a more even heating output in stop-go traffic since up to a speed of 60kmh^{-1} the flow regime is held laminar and a transition to turbulent flow with the corresponding step increase in heat transfer is avoided (see for example figure 14 of the contested patent).

The respondents argued that the conditions defined in feature m), although not explicitly described, would necessarily be provided by automobile air conditioning systems using heat-exchangers which would be obvious to construct, for example by combining the teachings of E1 and E9 or E2 and the skilled person's general knowledge.

Reasons for the decision

1. Admissibility of the main request, clarity Article 84 EPC

1.1 The appellant is correct to remark that the main request, except for the addition of the speed requirement of 60kmh^{-1}, is essentially identical to auxiliary request 2 filed with the grounds of appeal which in turn is a combination of granted claims 1 and 2. Thus, the rump subject-matter of the main request could not have come as surprise to the respondents. The feature of specifying a flow-rate 16lit/min when the vehicle is running at 60kmh^{-1} is considered to be clear,

if broad. In its widest sense the claim means that the system design must at least ensure laminar flow from idling up to a speed of 60kmh-1 with the vehicle in top gear and a flow-rate of 16lit/min flow since this corresponds to the smallest span of engine speed over which the laminar flow regime is to be maintained. Should the skilled person require an indication of idling flow-rate for reference, this is given in the contested patent at column 1, lines 53 to 54. Consequently, although an indication of engine speed might have been preferable, the claim is considered to be specify clear limitations within the constraints imposed by the original disclosure.

1.2 The respondents' are correct in as far that the kinematic viscosity of the hot water mixture changes substantially with temperature. However, the skilled person seeking to understand the contested patent would recognise that a warmed-up engine is under consideration not only because the description implies this (see for example paragraph [0009]) but also because there is no discussion of a start-up phase.

1.3 Consequently, the main request is clear within the meaning of Article 84 EPC and meets the requirements of Article 13(3) RPBA since it does not raise issues which the respondents could not have reasonably been expected to deal with without adjournment of the oral proceedings.

2. *Article 100(b), Article 83 EPC*

2.1 This ground of opposition was introduced by Respondent I after expiry of the opposition period and was not admitted into the procedure by the opposition division.

2.2 The Board considers that the opposition division was correct to do this since Respondent I itself admits that the structural indications provided in the contested patent are sufficient to permit the skilled person to construct the heat exchanger comprised in the claimed air-conditioning system. The further point raised concerning the broad nature of the definition of the fluid is in any case a question of clarity which has been discussed above.

3. *Article 123(2) EPC*

3.1 The ratio (St/WxD) is specified as being 0.07 to 0.24 in both the originally filed and granted versions of claim 1. Further, both the graphs of figures 7, 11 and 12 of the contested patent and application and the passage at column 8, lines 21 to 30 of the published application indicate that this is the correct range. In view of the tube and fin dimensions specified in the claim it is clear that a figure of less than one for the ratio can only be obtained when dividing the total cross-sectional flow passage area (St) of the flat tubes by what must be the larger value of the cross-sectional area (W x D). Therefore, the Board agrees with the view of the appellant that the ratio given at column 8, line 49 of the published application and column, is erroneous and would be disregarded by the

skilled person as inconsistent with the teaching of the rest of the application documents.

3.2 Thus, the skilled person would have no doubt that the same ratio is defined in both claims and accordingly there is no infringement of Article 123(2).

4. Article 123(3) EPC

4.1 The deletion of the terms "opening" and "opening to said hot water tank" from the granted version of claim 1 does not lead to an extension of the scope of protection of claim 1 according to the main request. According to granted claim 1 the conditions for the ratio St/WxD need only be met at the opening to said hot water tank; the wording of the claim leaves no doubt in this respect, consequently there is no immediate cause for the skilled person to seek another interpretation.

4.2 However, in the version according to the main request the situation is not the same since this specific indication has been removed. In view of this, the skilled person must make the most sensible technical interpretation based on the wording of the claim taking into account the description and drawings (Article 69 EPC). The main aim of the patent is to ensure laminar flow conditions in the heat transfer tubes (e.g. see paragraphs [0030],[0036] and [0049]) over a specific operating regime corresponding to low engine speeds. To achieve this the skilled person knows that it is normally not sufficient to specify tube dimensions at a single point since laminar flow is a phenomenon which can only be established and maintained when flow

conditions over a substantial length are respected. Consequently, under these circumstances and without any other clear indication to the contrary, the skilled person would understand that the conditions for the ratio St/WxD must be fulfilled over the entire length of the tubes making up the core section and not just at the opening to the hot water tank. This is not to say that the cross-section of the tubes is necessarily constant which, as the respondents have pointed out, is not defined in the claim.

4.3 Hence, in the Board's view there has been a restriction of the scope of protection and the amendment does not contravene Article 123(3) EPC.

5. *Article 56 EPC, Inventive Step*

5.1 The Board concurs with the appellant that none of the cited prior art documents discloses or suggests feature m). This feature solves the technical problem of providing a more even heating output in stop-go traffic since up to a speed of $60kmh^{-1}$ the flow regime is held the laminar zone and a transition to turbulent flow with the corresponding step increase in heat transfer is avoided as illustrated for example in figure 14 of the contested patent.

5.2 The respondents' argument that the conditions defined in feature m), although not explicitly described, would be provided by existing automobile air conditioning systems using heat-exchangers of the same construction or which would be obvious to construct, for example using a combination of the teaching of E1 and E9 or E2

and the skilled person's general knowledge cannot be accepted.

5.3 The Board agrees with the respondents that a combination of E1 and E9 would lead the skilled person to the construction of a heat-exchanger according to features a) to l) of claim 1 without the need for any inventive skill. However, the additional conditions imposed by feature m) are not obvious.

5.4 The idea of stipulating a Reynolds number of 1000 or less such that laminar flow conditions continue to prevail at engine speeds well above idling is counter-intuitive since conventional heat-exchanger design strives to ensure turbulent flow is initiated at the lowest flow-rate possible such that heat transfer is maximised and heater size minimised (see for example E1, column 8, lines 13 to 28 and paragraph [0016] of the contested patent). Indeed an attempt to promote turbulent flow throughout the operating range by using flat tubes with dimples was the first approach made by the appellant to solve the above defined problem (see column 3, lines 2 to 7 of the contested patent). Thus, any description or indication of the solution provided by claim 1 even its broadest sense is completely lacking in the available prior art documents. No evidence whatsoever has been provided to support the respondents' allegation that condition (m) of claim 1 would necessarily be provided by automobile air-conditioning systems of the kind in question or would result from the other conditions defined in the claim.

5.5 In these circumstances, it can be seen that the first step necessary towards the invention is in fact a

decision not simply to ignore the problem of fluctuating heater performance in stop-go conditions as a necessary nuisance in order to achieve the optimum heat-exchanger performance with turbulent flow. A second step is then required to realise that the air-conditioning system as a whole can be designed to delay rather than promote the laminar-turbulent transition such that flow in the heat-exchanger tubes remains laminar at vehicle speeds normally encountered in stop-go traffic. This technique offers the advantage that it is inherent to the system compared with other potential solutions relying on control valves and bypasses which may be prone to failure and/or need adjustment.

5.6 Thus, the subject-matter of claim 1 according to the main (sole) request meets the requirements of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent with the following documents:

   – Claims 1 to 5 of the sole request filed during the oral proceedings held before the Board.
   – Description page 2 to 6 as filed during the oral proceedings held before the Board
   – Figures 1 to 16 as granted.

Registrar: Chairman:

A. Counillon U. Krause