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**Datasheet for the decision
of 2 February 2016**

Case Number: T 0616/11 - 3.4.03

Application Number: 03076656.2

Publication Number: 1377148

IPC: H05K7/20

Language of the proceedings: EN

Title of invention:

Automotive electronics heat exchanger

Applicant:

Delphi Technologies, Inc.

Headword:

Relevant legal provisions:

EPC 1973 Art. 56

Keyword:

Inventive step - (no)

Decisions cited:

Catchword:



Beschwerdekammern
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European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0616/11 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 2 February 2016

Appellant: Delphi Technologies, Inc.
(Applicant) PO Box 5052
Troy, MI 48007 (US)

Representative: Delphi France SAS
Patent Department
22, avenue des Nations
CS 65059 Villepinte
95972 Roissy CDG Cedex (FR)

Decision under appeal: **Decision of the Examining Division of the European Patent Office posted on 29 October 2010 refusing European patent application No. 03076656.2 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman G. Eliasson
Members: T. M. Häusser
C. Schmidt

Summary of Facts and Submissions

- I. The appeal concerns the decision of the examining division refusing the European patent application No. 03 076 656 for added subject-matter (Article 123(2) EPC) and lack of inventive step (Article 56 EPC 1973) over the following documents:
- D2: EP 1 175 135 A1,
D4: DE 196 45 635 C1.
- II. Oral proceedings before the board of appeal took place in the appellant's absence, of which the board had been notified beforehand.
- III. In writing the appellant had requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 9 of the request submitted with the statement setting out the grounds of appeal dated 22 February 2011.
- IV. In the communication pursuant to Article 15(1) RPBA accompanying the summons to attend oral proceedings, the board confirmed essentially the examining division's objection of lack of inventive step over the combination of documents D2 and D4.
- V. The wording of independent claim 1 is as follows:
- "1. An electronics assembly (10) comprising:
a housing (2);
a lower electronic power device (28) and an upper electronic power device (30) positioned within said housing (12);
a heat sink device (34) positioned within said housing (12) and including a fluid vessel (44)

positioned within said housing (12), and positioned between, and arranged to be in thermal communication with, the lower and upper electronic power devices (28, 30),

the fluid vessel (44) comprising an upper containment plate (54), a lower containment plate (56), a fluid input port (50) for providing coolant (48) from a radiator (46) to the fluid vessel (44), and a fluid output port (52) for returning coolant (48) from the fluid vessel (44) back to the radiator (46);

characterized in that the fluid vessel (44) further comprises at least one fin insert (60) positioned within said fluid vessel (44); and in that the upper and lower containment plates (54, 56), the inlet and outlet ports (50, 52), and the at least one fin insert (60) have been formed using a stamping process and have been brazed together."

VI. The appellant argued essentially as follows:

The invention went further than document D2 in terms of ease of manufacture and reduction of cost. Document D2 did not mention that the components of the heat sink device might be formed by a stamping process. By contrast, it was mentioned that the casing was made by extrusion molding, the fins were made by press molding and that the sockets had female threads. The formation processes in D2 required additional machining operations prior to the brazing operation. The claimed stamping process overcame this problem.

Reasons for the Decision

1. Inventive step

1.1 Closest state of the art

The examining division considered document D4 the closest state of the art. The appellant also argued in relation to inventive step starting from that document as closest prior art. Indeed, document D4 discloses subject-matter that is conceived for the same purpose as the claimed invention, namely for providing an electronics assembly with a housing comprising a heat sink for cooling power devices, and has the most relevant technical features in common with it, as detailed below.

Document D4 is therefore regarded as the closest state of the art.

1.2 Distinguishing features

1.2.1 Document D4 discloses (column 3, line 63 - column 4, line 62; sole Figure) a control device for controlling the electric motor of an automobile. Modules 3 to 6 for implementing various functions of the device are arranged on a cooling module 2, which is located in a housing body 1 comprising a base plate 12 with means 13 for fastening the housing body 1 in the motor vehicle. The cooling module 2 comprises a half shell as the upper part 21 and a cooling body 22 as the lower part, which is configured as an inlay. The cooling medium 27 enters and exits the cooling module 2 through the inlet opening 25 and outlet opening 26, respectively, which are both arranged outside the housing body 1. The surface of the cooling body 22 may be increased by arranging ribs in the direction of flow of the cooling medium 27.

The semiconductor elements 32, 42, and 52 of modules 3 to 5 are arranged on circuit boards 31, 41, 51, respec-

tively, which are in turn mounted on support bodies 33, 43, and 53. The support bodies 43 and 53 of voltage conversion module 4 and charging module 5 are mounted on the surface of the upper part 21 of the cooling module 2, whereas circuit board 31 is mounted directly on the cooling body 22, which constitutes the support body 33 of the power module 3. The semiconductor elements 32, 42, and 52 are therefore in thermal contact with the cooling medium 27 and are thereby cooled.

1.2.2 The board agrees with the examining division that, using the wording of claim 1, document D4 discloses an electronics assembly comprising:

a housing (housing body 1);

a lower electronic power device (semiconductor element 32 of power module 3) and an upper electronic power device (semiconductor elements 42 and 52 of voltage conversion module 4 and charging module 5) positioned within said housing (housing body 1);

a heat sink device (cooling module 2) positioned within said housing (housing body 1) and including a fluid vessel (upper part 21 and cooling body 22) positioned within said housing (housing body 1), and positioned between, and arranged to be in thermal communication with, the lower and upper electronic power devices (semiconductor elements 32, 42, 52),

the fluid vessel comprising an upper containment plate (upper part 21 configured as a half shell), a lower containment plate (cooling body 22), a fluid input port (inlet opening 25) for providing coolant (cooling medium 27) from a radiator to the fluid vessel (upper part 21 and cooling body 22), and a fluid output port (outlet opening 26) for returning coolant (cooling medium 27) from the fluid vessel (upper part 21 and cooling body 22) back to the radiator;

In agreement with the appellant's position the board holds therefore that the subject-matter of claim 1 of the main request differs from the device of document D4 in comprising the characterizing features of claim 1, i. e. in that

- (a) the fluid vessel further comprises at least one fin insert positioned within said fluid vessel, and in that
- (b) the upper and lower containment plates, the inlet and outlet ports, and the at least one fin insert have been formed using a stamping process and have been brazed together.

1.3 Objective technical problem

The examining division considered that the problem to be solved was to improve the heat transfer without adding to the manufacturing costs. The appellant argued in line with this formulation of the technical problem. Indeed, the effect of the fin insert (feature (a)) is to improve the heat transfer by stirring up the coolant flowing through the fluid vessel (see the description, page 6, lines 178-181); furthermore, the effect of the features related to the heat sink device including the fin insert being formed using stamping and brazing (feature (b)) is to provide cost and time benefits regarding the manufacture of the device (see the description, page 6, lines 163-166). Therefore, the objective technical problem is to improve the heat transfer while providing cost and time benefits regarding the manufacturing of the device.

1.4 Obviousness

1.4.1 The subject-matter of claim 1 pending at the time was considered by the examining division to be obvious in view of document D2, which described the use of a fin insert in a heat sink device and its manufacture by means of a brazing process.

Present claim 1 has been amended in relation to refused claim 1 by further specifying that the upper and lower containment plates, the inlet and outlet ports and the fin insert have been formed using a stamping process.

1.4.2 The board notes that it is undisputed that the person skilled in the art would consult document D2. Indeed, this document relates to heat sink devices like the closest state of the art document D4 and would thus be consulted by the skilled person when attempting to solve the posed problem.

Document D2 describes (paragraphs [0001], [0028]-[0036]; Figures 1 to 3) a liquid-cooled heat sink 11 with a flat casing 12 in which a plurality of through holes 12a are formed by a plurality of dividing walls 13 to 15 with notches 16 formed in their ends. Corrugated fins 17 are inserted into each through hole 12a. The ends of the casing 12 are closed by a pair of covers 18 and 19, the former having coolant inlet 18a and outlet 18b formed on it. Coolant entering the casing 12 via coolant inlet 18a flows by snaking through the passage 23 formed by the through holes 12a and notches 16 and is then discharged from coolant outlet 18b. The casing 12 with the dividing walls 13 to 15 is fabricated by extrusion molding of a malleable material made of aluminum or aluminum alloy. Next, notches 16 are formed by milling one or both ends of the dividing walls 13 to 15. The corrugated fins 17 and the covers 18 and 19 are fabricated by press molding,

respectively cutting, a brazing sheet, in which a brazing material is coated onto the surface of a malleable material made of aluminum (alloy), and the coolant inlet 18a and outlet 18b are formed on the ends of the cover 18. The fins 17 and the covers 18 and 19 are inserted into the trough holes 12a and a pair of recesses 12e and 12f of the casing 12, respectively. The assembled heat sink 11 is placed in a heat treatment oven thereby brazing fins 17 and covers 18 and 19 to the casing 12.

A semiconductor device to be cooled is joined to the upper and/or lower surface of the heat sink 11 by means of a ceramic substrate. Since the corrugated fins 17 are inserted into through holes 12a, the contact surface area between heat sink 11 and coolant passing through the passage 23 increases, so that the heat radiation efficiency of the heat sink 11 is improved.

- 1.4.3 Document D2 discloses thus the use of corrugated fins 17 in order to improve the heat radiation efficiency of the heat sink 11. The board considers it therefore obvious for the skilled person, who is seeking to improve the heat transfer, to use such a corrugated fin in the cooling module 2 of the closest prior art document D4. The skilled person would place the corrugated fin in the channel formed between the upper part 21 and the lower part 22 of the cooling module 2. This requires no substantial adaptation of the corrugated fin. In particular, the shape of the fin may remain unchanged and only its dimensions have to be adapted to the size of the cooling module 2. In this way the contact surface area between cooling module 2 and coolant 27 passing through the cooling module 2 is increased, thereby improving the heat transfer from the

semiconductor elements 32, 42, 52 to the cooling medium 27.

- 1.4.4 In document D4 it is not described how the components of the cooling module 2 are manufactured; it is merely mentioned that this module is made of copper or aluminum (column 4, lines 25-28).

The appellant argued that it was not mentioned in document D2 that the components of the heat sink device might be formed by a stamping process; rather, the casing was manufactured by extrusion molding, the fins were made by press molding so that the formation processes required additional machining operations.

However, the board is of the opinion that the skilled person, who is attempting to improve the heat transfer of the closest prior art device while providing cost and time benefits regarding the manufacturing of the device, is not limited to the manufacturing methods mentioned in document D2 but may also consult his common general knowledge.

In the board's judgment stamping is a method of working metals which is well-known to the skilled person. In addition, the aluminum or copper parts of the cooling module 2 of document D4 and the aluminum corrugated fins 17 of document D2 are malleable and lend themselves to being stamped. Furthermore, brazing is a well-known metal-joining process that is also described in document D2 as the process with which the corrugated fins 17 are joined to the casing 12 of document D2 (see point 1.4.2 above). Moreover, the relative advantages and disadvantages of the various manufacturing techniques, in particular in relation to cost and speed

of the fabrication process, are well-known to the skilled person.

1.4.5 Consequently, the board considers it obvious for the skilled person, when attempting to solve the posed problem, to incorporate the corrugated fin 17 of document D2 in the cooling module 2 of document D4 and to use a combination of stamping and brazing when manufacturing that modified module.

Therefore, the subject-matter of claim 1 does not involve an inventive step (Article 52(1) EPC and Article 56 EPC 1973).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



S. Sánchez Chiquero

G. Eliasson

Decision electronically authenticated