Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 22 June 2021

Case Number: T 1060/17 - 3.4.03

Application Number: 07846409.6

Publication Number: 2090146

IPC: H05K7/20, H01L23/467, H02M7/00

Language of the proceedings: EN

Title of invention:
ELECTRONIC DEVICE AND FREQUENCY CONVERTER OF MOTOR

Patent Proprietor:
Danfoss Drives A/S

Opponent:
SEW-EURODRIVE GmbH & Co. KG

Headword:

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

Keyword:
Inventive step - non-obvious solution
Amendments - extension beyond the content of the application as filed (no)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1060/17 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 22 June 2021

Appellant: (Opponent)	SEW-EURODRIVE GmbH & Co. KG Abt. ISI Ernst-Blickle Strasse 42 76646 Bruchsal (DE)
Respondent: (Patent Proprietor)	Danfoss Drives A/S Ulsnaes 1 6300 Graasten (DK)
Representative:	Keil & Schaafhausen Patentanwälte PartGmbB Friedrichstraße 2-6 60323 Frankfurt am Main (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 2 March 2017 rejecting the opposition filed against European patent No. 2090146 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	J. Thomas
	N. Obrovski

Summary of Facts and Submissions

I. The appeal of the opponent is against the opposition division's decision rejecting the opposition against European patent EP 2 090 146.

II. The opposition had been filed against the patent as a whole based on Article 100(a), (b) and (c) EPC.

III. The following documents filed with the notice of opposition will be referred to in this decision:

D1: EP 0 356 991 A2
D3: US 2002/0064028 A1
D4: US 2006/0114652 A1

IV. In the oral proceedings held before the Board the appellant/opponent (hereinafter referred to as the appellant) requested that
- the decision under appeal be set aside and
- the patent be revoked.

The respondent/patent proprietor (hereinafter referred to as the respondent) requested,
as a main request,
- that the appeal be dismissed,
or, as an auxiliary request,
- that the patent be maintained in amended form on the basis of auxiliary request 1 filed with the reply to the statement setting out the grounds of appeal.

V. Claim 1 of the main request (the sole independent claim of this request) reads as follows (labelling "M1" to "M4.3" added by the Board):

M1 "An electronic device, comprising:

M1.1 a circuit board (100) having at least one first heat-generating element (110) and at least one second heat-generating element (111a, 111b, 112) mounted thereon;

M1.2 a heat sink (202) connected to the at least one first heat-generating element (110); and

M1.3 a fan (201) facing the heat sink (202),

M2 wherein the electronic device further comprises an airflow guiding member (211a, 211b, 211c) placed between the fan (201) and the heat sink (202) for guiding the cooling air from the fan (201) to the heat sink (202) and the at least one second heat-generating element (111a, 111b, 112) respectively,

M3 further comprising a separating member (220) for separating a main body of the at least one second heat-generating element (111a, 111b, 112) from the circuit board (100), so as to prevent the cooling air guided to the at least one second heat-generating element (111a, 111b, 112) from flowing to the circuit board (100),

M4 ***characterized in that***

M4.1 the electronic device is further comprising a bracket (226) of the at least one first heat-generating element (110),

M4.2 the bracket comprises sidewalls and

M4.3 insulates thermally the first heat-generating element (110) from other elements on the circuit board (100)."

VI. The findings of the opposition division, insofar as they are relevant to the present decision, are summarised as follows:

Article 123(2) EPC:
Claim 1 did not comprise an intermediate generalisation (see decision, points 6.1.4, 6.1.5 and 6.2) because the subject-matter as defined was originally disclosed in relation to the third embodiment starting from page 19, third paragraph to page 20, third paragraph.

Article 56 EPC 1973:
Claim 1 of the main request involved an inventive step. Document D3 did not disclose features M1.1, M2 and M3 (see paragraph 8.2.1 of the reasons of the decision) and document D1 did not disclose features M1.1 and M3 (see paragraphs 7.3 and 8.2.2 of the reasons of the decision). Even if the skilled person took an ex-post facto approach and combined the teaching of document D3 with that of document D1, the skilled person would not arrive at the claimed subject-matter. The combination of features M1.1, M1.2 and M3 would still be missing. If, however, feature M1.1 would be considered as a standard procedure due to an obvious integration of several electronic elements on the same circuit board, the skilled person would have no motivation to modify the obtained device in order to integrate a separating member.

The opposition division did not indicate whether or not feature M2 was disclosed in document D1.

VII. The arguments of the appellant, insofar as they are relevant to the present decision, are summarised as follows:

Article 123(2) EPC:
Disputed features M4.2 and M4.3 related to the bracket with "sidewalls" or "sidewall plates". A bracket

comprising sidewalls was only disclosed in relation to the following three functions:

- the heat insulation,
- the positioning and
- the prevention from damage in case of explosion of the insulating gate bipolar transistor (IGBT) module.

Not defining the last two functionalities of the bracket with sidewalls in claim 1 presented an unallowable intermediate generalisation.

Article 56 EPC 1973:
The subject-matter defined in claim 1 did not involve an inventive step starting from document D3 and combining its teaching with that of document D1 and the common general knowledge as exemplified in document D4. The only features not disclosed in document D3 were features M1.1 and M3. Feature M2 was disclosed in document D3, since the housing surrounding the fan and the heat sink provided the functionality of the airflow guiding member. The wording of feature M2 would also cover a single airflow passage in which both elements, the heat sink and the second heat-generating member, were reached by the airflow.

The only missing features M1.1 and M3 were obvious to the skilled person. The provision of a plurality of electronic components on the same circuit board as defined by feature M1.1 was part of the common general knowledge, as exemplified by document D4. Feature M3 was disclosed in document D1, figures 10, 11 and 12 and the description, column 10, line 4 to column 11, line 21. These passages showed a capacitor (103) arranged in the refrigerant passage and passing through a hole sealed off with a gasket in order to prevent cooling air to enter from one side of the capacitor to

the other (from the airflow side to the circuit board). Therefore, feature M3 was disclosed in document D1. The skilled person who always tried to simplify assembling of a device in order to save time and costs would mount the choke coils (11) on one of the circuit boards. In order to ensure cooling of the rearranged choke coils, it would also be self-evident that an opening to the air flow passage for cooling the choke coils would have to be provided (see modified figure 1 of document D3 shown in the statement setting out the grounds of appeal, page 8). Hence, the skilled person starting from document D3 would only have to carry out the two modifications above in order to solve the problem of simplifying the assembly.

VIII. The arguments of the respondent, insofar as they are relevant to the present decision, are summarised as follows:

Article 123(2) EPC:
Claim 1 as granted comprised features of original claims 1 to 3. The further features (M4.2 and M4.3) had sufficient basis in the original description, page 19 and page 20 of the application documents as filed. Page 19, line 20 disclosed the bracket thermally insulating the first heat-generating element from the other elements on the circuit board. The bracket, as currently defined in claim 1, was therefore disclosed, both from a purely formal point of view, but also from a technical point of view, and did not constitute an unallowable intermediate generalisation.

Article 56 EPC 1973:
An airflow guiding member as defined by feature M2 was not disclosed in document D3; in particular none of figures 2 or 3 of document D3 showed a corresponding

airflow guiding member. The overall teaching of the application focused on the realisation of two separate flow lines. These separate flow line were created by the airflow guiding member. Like document D3, none of the other available documents referred to such an airflow guiding element.

Concerning feature M1.1, putting a plurality of electronic components on the same circuit board was common general knowledge. No convincing argument had been provided why the skilled person would amend the device shown in document D3 accordingly. D1 disclosed that two elements 104, 106 could be mounted on the same circuit board and connected to a heat sink, so that feature M1.1 was shown. However, none of these elements was separated from the circuit board by a separating member M3. Considering one of the two heat-generating elements 104, 106 shown in document D1 as the first heat-generating element and the heat-generating elements 103a, 103b shown in document D1 as the second heat-generating element, the circuit board 1a could be considered as a separating member for the second heat-generating element. However, in that situation the first and second heat-generating elements were not connected to the same circuit board, as defined in features M1.1 and M1.2.

Even if the skilled person were to combine the teaching of document D3 with that of document D1, the device of document D3 would need to be notably altered in order to be able to combine it with the disclosure of document D1 in order to arrive at the subject matter of the invention.

Reasons for the Decision

1. The appeal is admissible.

2. Main request

2.1 Article 123(2) EPC

2.1.1 Agreement exists that features M1 to M3, M4 and M4.1 have sufficient support in the originally filed documents since they were already defined in original claims 1 to 3.

Features M4.2 and M4.3, which relate to the characteristics of the bracket, are disputed. The question arises if the bracket with "sidewalls" or the "sidewall plates" are only disclosed in relation to the following three functions or if these three functions are disclosed independently each from the other:

- the heat insulation,
- the positioning and
- the prevention from damage in case of explosion of the insulating gate bipolar transistor (IGBT) module.

2.1.2 Original claims 1 to 3 disclose the electronic device comprising a bracket without any further mandatory elements like the "heat insulation member 224". The bracket with sidewalls and thermally insulating the first heat-generating element from other elements on the circuit board has its basis in the third embodiment of the original disclosure exemplified from page 18, third paragraph to page 20, third paragraph and the corresponding figures 7A and 7B.

From page 18, third paragraph to page 19, second paragraph, the bracket is put in relation to the "opening 225" for receiving the first heat-generating element. In the first sentence of the third paragraph of page 19, the bracket is defined to be "formed around the opening 225". The last sentence on page 19 cites that "sidewalls of the bracket 226 may be provided at the sides corresponding to the heat sensitivity elements". These formulations taken in combination with the figures 7A and 7B disclose directly and unambiguously a bracket with sidewalls. Therefore, a bracket with sidewalls for receiving the first heat-generating element is directly and unambiguously disclosed in the originally filed documents whereby only the thermal insulation of the bracket is explicitly mentioned (page 19, line 27 to page 20, line 5).

A bracket always provides a positioning function for the element it holds, regardless of whether this is achieved with or without clearance between the bracket and the element. The positioning function is consequently an implicit feature to any bracket with sidewalls. It is therefore disclosed in the original application documents and also implicit to the subject-matter defined in claim 1.

The third function of damage prevention in case of an explosion of the IGBT module is presented as an optional feature in the application documents as filed. The description presents this prevention from damage by using the words "may be", "further", "can" (page 19, third paragraph to page 20, second paragraph), which renders this feature optional.

2.1.3 Therefore, the Board concludes that the subject-matter defined in present claim 1 does not present an unallowable intermediate generalisation, and consequently does not extend the claimed subject-matter beyond the content of the application as filed.

2.2 Inventive step (Article 52(1) EPC in combination with Article 56 EPC 1973)

2.2.1 Closest prior art

The opposition division and both parties considered document D3 as closest prior art. The Board agrees with this assessment since document D3 refers to a "Cooling apparatus for power semiconductors" and therefore relates to the same kind of device.

Document D3 discloses (in the following paragraph the references in parentheses refer to document D3) an electronic device (abstract, Figures 1), comprising:
a circuit board (6 or 7) having at least one first heat-generating element (4 or 5) mounted thereon and at least one second heat-generating element (choke coils 11) not mounted on the same circuit board (figures 1 and 3);
a heat sink (14) connected to the at least one first heat-generating element (5, figure 3, [0031]); and
a fan (8) facing the heat sink (14), ~~wherein the electronic device further comprises an airflow guiding member placed between the fan and the heat sink for guiding the cooling air from the fan to the heat sink and the at least one second heat-generating element respectively, further comprising a separating member for separating a main body of the at least one second heat-generating element from the circuit board, so as to prevent the cooling air guided to the at least one~~

~~second heat-generating element from flowing to the circuit board~~, wherein the electronic device is further comprising a bracket (figure 3) of the at least one first heat-generating element (5), the bracket comprises sidewalls and insulates thermally the first heat-generating element from other elements on the circuit board (figure 3).

2.2.2 Differentiating features

Features M1.1, M2 and M3 are not disclosed in document D3:

In the device of document D3 the second heat-generating choke coils (11) are not mounted on the same circuit board (6 or 7) together with the first heat-generating element (4 or 5).

No specific guiding member is shown between the fan (8) and the heat sink (24) which guides one part of the airflow from the fan to the heat sink and another part from the fan to the second heat-generating element. In document D3 the heat sink and the second heat-generating element are placed downstream one after the other in the same airflow.

No separating member is shown for separating a main body of the second heat-generating element from the circuit board. It cannot be derived from either figure 1 or figure 3 that a separating unit is present between the circuit boards (6 or 7) and the choke coils (11).

2.2.3 Problem to be solved - technical effect

The problem which is solved by the differentiating features is - as indicated in the patent - to provide an efficient heat-dissipation of the heat-generating elements so as to improve operation quality and lifetime of the electronic device.

2.2.4 Obviousness

The appellant argues that the subject-matter of claim 1 lacks an inventive step in view of the combination of document D3 with document D1.

Document D1, however, does not show or hint at a specific guiding of the airflow originated from the fan into two airflows as defined by feature M2.

The Board interprets the word "respectively" at the end of the definition of feature M2 as meaning that the airflow guiding member directs the airflow into a first airflow from the fan to the heat sink and a second airflow from the fan to the second heat generating element. This is also the only reasonable interpretation of the word "respectively" in the given context, since otherwise it would be redundent and would run counter to the overall teaching of the patent.

In document D1 the switching element 104 (first heat-generating element) and the capacitors 103a and 103b (second heat-generating elements) are cooled in the same airflow originated from the fan 6. In none of the figures, let alone in the description, a specific guiding member is placed between the fan and the heat sink. In particular figures 11 and 12 of document D1 show that no such kind of guiding member is foreseen between the fan and the heat sink. The cooling

fins 3, 3a, 3b, 3c and 3d shown in figure 12 represent the heat sink. If a guiding member in the sense of feature M2 was present it should be located in the region of reference numerals 1ab and 1ac. Nothing like this, however, is shown in document D1.

The appellant's argument ignores the word "respectively" at the end of feature M2 which, as discussed above, contradicts the appellant's interpretation. If the housing surrounding the fan and the heat sink would constitute the airflow guiding member, the cooling air would be guided from the fan to the heat sink and then downstream to the second heat-generating element without separating the air flow into two flow lines, as defined in feature M2.

Since feature M2 is not rendered obvious by the combination of documents D3 and D1, an inventive step is to be acknowledged. Consequently, the question of whether or not the remaining distinguishing features M1.1. and M3 would be considered obvious does not need to be answered.

Nevertheless, it is noted that neither document D3 nor document D1 disclose feature M1.1 in the sense of requiring two heat-generating elements mounted on the same circuit board. The requirement linked thereto that the second heat-generating element has to be separated from the circuit board by a separating member as defined by feature M3 cannot be considered obvious.

Even if it can be considered common knowledge to provide different electronic components on the same circuit board, the skilled person would nevertheless need a motivation for mounting the second heat-generating element on the same circuit board as the

first heat-generating element. In the Board's view, the separation of the different components of the device of document D3 serve the purpose of physically separating the heat-generating compoments from each other.

Furthermore, the skilled person would need an additional incentive to separate the main body of the second heat-generating element from the printed circuit board in order to protect the printed circuit board from contamination by the airflow (see the modified figure 1 of document D3 shown on page 8 of the statement setting out the grounds of appeal).

Hence, the mounting of the first and second heat-generating elements on one and the same circuit board is based on hindsight and would still lack a separating member as defined by feature M3.

As to the appellant's assertion that document D4 exemplifies common general knowledge with regard to feature M1.1, it is noted that a patent document should not be used to indicate common general knowledge. In substance, as stated above (page 12, last paragraph), the board does not question that the assembly of various electronic components on a single printed circuit board can, depending on the circumstances, be seen as part of the common general knowledge. In the present case, however, the required relocation of the choke coils to one of the circuit boards is in the Board's view not obvious, as the separation of the heat-generating entities in document D3 was chosen deliberately.

In view of all of the above, the Board concludes that the subject-matter defined in present claim 1 involves an inventive step as required by Article 56 EPC 1973.

3. Conclusion

3.1 Claim 1 of the main request involves an inventive step within the meaning of Article 52(1) EPC and Article 56 EPC 1973, which also applies to claims 2 to 14 by reason of their direct or indirect dependence on claim 1.

3.2 In the light of this conclusion, the respondent's auxiliary request does not need to be assessed.

4. As none of the grounds for opposition prejudices the maintance of the patent as granted, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated