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**Datasheet for the decision  
of 11 September 2013**

**Case Number:** T 0975/09 - 3.5.02

**Application Number:** 02000162.4

**Publication Number:** 1223661

**IPC:** H02K 9/06, H02K 3/28

**Language of the proceedings:** EN

**Title of invention:**  
Automotive alternator

**Applicant:**  
Mitsubishi Denki Kabushiki Kaisha

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
"Inventive step - after amendment (yes)"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0975/09 - 3.5.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.5.02  
of 11 September 2013

**Appellant:** Mitsubishi Denki Kabushiki Kaisha  
(Applicant) 7-3, Marunouchi 2-chome  
Chiyoda-ku  
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**Representative:** Hoffmann Eitle  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 2 December 2008  
refusing European patent application  
No. 02000162.4 pursuant to Article 97(2) EPC.

**Composition of the Board:**

**Chairman:** G. Flyng  
**Members:** M. Léouffre  
W. Ungler

## Summary of Facts and Submissions

- I. The applicant appealed against the decision of the examining division, posted on 2 December 2008, on the refusal of the European application No. 02000162.4.
- II. The examining division held that the subject-matter of claim 1 of the main request and of the first and second auxiliary requests, then on file, lacked an inventive step in the light of the teachings of documents  
D1 = JP 09 019108 A, and  
D5 = EP 0 454 039 A1.
- III. With the grounds of appeal, dated and received on 8 April 2009, the appellant filed a new main request (which corresponded to the second auxiliary request which was refused by the examining division) and a new auxiliary request.

Considering claim 1 of the new auxiliary request, the appellant argued that although the added feature "wherein a varnish is impregnated inside the slots (14) housing the stator winding (16A, 16B), fixing the stator winding (16A, 16B) to the stator core (15A)" was a well-known feature, it constituted a new practice when read in combination with the feature relating to the provision of a gap (G) formed between the coil end group (16f, 16r) of the stator winding (16A, 16B) and the adjacent axial end surface of the stator core (15A). To support his argument, the appellant cited the following documents: EP 1 093 209 A1, US 3 151 262 B2 and JP Laid-open S62-272836.

IV. In an annex to a summons to oral proceedings the board introduced document D6 = JP 60 204240 A and indicated that it tended to share the view of the examining division that claim 1 of the main request was obvious (Article 56 EPC) in the light of the teachings of documents D1 and D5 together with the common knowledge or with document D6.

Citing further documents D7 = GB 774 821 A, D8 = JP 7 213 029 A and D9 = GB 2 154 157 A the board indicated that it was not aware of a common practice to fill the gaps formed between the coil end groups of a stator winding and the adjacent axial end surface of the stator when using varnish to fix the stator windings.

V. With a response dated and received 9 August 2013 the appellant filed a new main request, based on the former auxiliary request, in which the term "while" was inserted between the two last features of claim 1.

VI. At the oral proceedings, which took place as scheduled on 11 September 2013, the appellant presented claims 1 to 5 and description pages 1 to 26 of a new main request and requested that the decision under appeal be set aside and that a patent be granted based on the following documents:

Description pages 1 to 26 as filed during the oral proceedings of 11 September 2013;

Claims 1 to 5 as filed during the oral proceedings of 11 September 2013;

and

Drawing figures 1 to 10 as originally filed.

VII. Claim 1 reads as follows:

"An automotive alternator comprising

- a shaft (6) rotatably supported by a case (3),
- a rotor (7A) fixed to said shaft,
- a stator (8A, 8B) provided with: a cylindrical stator core (15A) supported by said case (3) so as to envelop said rotor (7A), a plurality of slots (14) extending axially being formed in said stator core (15A) so as to line up circumferentially, and a stator winding (16A, 16B) installed in said stator core,
- a rectifier (12) supported by said case (3) so as to face an axial end surface of said rotor (7A), and
- at least one centrifugal cooling fan (38, 39) fixed to at least one axial end surface of said rotor (7A) between the rotor and the rectifier, wherein said cooling fan (38, 39) is constructed such that a ratio  $(t/h)$  satisfies the expression  $0.2 < t/h < 0.7$ , with  $t$  being the amount by which the cooling fan axially protrudes relative to the apex portion of a winding head (16f, 16r) of said stator winding (16A, 16B), and  $h$  being the axial height of said cooling fan, characterized in that
- said slots (14) are disposed at a ratio of two per phase per pole in said stator core (15A),
- said stator winding (16A, 16B) is composed of six winding phase portions (30a-30f, 40a-40f) each formed by winding a continuous conductor wire on said stator core (15A), and
- a varnish is impregnated inside the slots (14) housing the stator winding (16A, 16B), fixing the

stator winding (16A, 16B) to the stator core (15A), while a gap (G) is formed between said coil end group (16f, 16r) of said stator winding (16A, 16B) and the adjacent axial end surface of said stator core (15A), said gap (G) being positioned closer to an axially-central region than said end surface of said rotor (7A) to which said cooling fan (38, 39) is fixed, and the entire axial region of the gap (G) overlaps one of a first (20A) and a second pole core (21A) of the rotor (7A) in a radial direction, so that there is no radial overlap between the gap (G) and the centrifugal fan (38)."

Claims 2 to 5 are dependent on claim 1.

VIII. The appellant essentially argued as follows:

The features of independent claim 1 might have been known individually from the prior art represented by D1, D5, D6 and D9, but there was nevertheless no incentive for a person skilled in the art to combine the teachings of those documents.

Starting from D1, the objective technical problem was to secure the stator winding while efficiently cooling the coil ends and evacuating the heat generated by the other elements of the generator. The solution was to impregnate the slots with a varnish while keeping gaps between the coil end groups and the adjacent axial end surface of the stator core. The location of the gaps was identified by the feature "said gap (G) being positioned closer to an axially-central region than said end surface of said rotor (7A) to which said cooling fan (38, 39) is fixed".

D9 taught to apply a varnish to the stator coils but D9 was silent about the cooling of the stator coil ends. A vent gap to cool the stator coil ends was shown in D6 but even when combining D1, D6 and D9, a person of ordinary skill would not have arrived at the subject-matter of claim 1, because no teaching about the location of the gap could have been derived from D6 excepting from figure 1 of D6.

D3= EP 0 917 278 A2, which was cited in the search report, taught away from the invention, stating: "In the case where the coil end groups are coated with thick films of resin to provide vibration proof, the gaps between the coil ends are absent. On the other hand, in the case where thick films of resin cover only axial-direction edges of the coil end groups, a plurality of gaps are left between the bases of the coil end groups. In this case, it is important that the ranges where the gaps are left are opposed to the cooling fans while the previously-mentioned relation is maintained" (cf. D3, section [0044]). When considering combining the teachings of the prior art, a person skilled in the art would have considered all of the prior art mentioned in the procedure. He might have considered combining D9 and D6 with D1, but then he would have applied also the teaching of D3 which taught him that the gaps should be facing the fan when the windings are impregnated with varnish. Therefore he would not have thought of reducing the noise while keeping cooling the coil end groups by providing gaps which do not overlap with the fans.

## Reasons for the Decision

### 1. *Article 123(2) EPC*

Claim 1 comprises:

- a preamble corresponding to original claim 1,
- characterising features based respectively on original claim 7, original claim 3 together with the explanation on page 19, the last sentence of the first paragraph of original page 11, original claim 2, and
- two further features reading: "the entire axial region of the gap (G) overlaps one of a first (20A) and a second pole core (21A) of the rotor (7A) in a radial direction, so that there is no radial overlap between the gap (G) and the centrifugal fan (38)". These last two features are considered to be supported by the original description at page 17, lines 3 to 5 and the two subsequent paragraphs of original page 17.

Claim 2 is based on the first full paragraph of original page 19.

Claims 3, 4 and 5 comprise the features of original claims 4 to 6.

Thus, the board is satisfied that the claims meet the requirements of Article 123(2) EPC.

### 2. *Novelty (Article 54 EPC)*

An automotive alternator according to the preamble of claim 1 is known from D1 (cf. abstract and corresponding figure) and it is undisputed that the



subject-matter of claim 1 differs from the automotive alternator disclosed in D1 in that (references added by the board):

- a) said slots (14) are disposed at a ratio of two per phase per pole in said stator core (15A),
- b) said stator winding (16A, 16B) is composed of six winding phase portions (30a-30f, 40a-40f),
- c) each formed by winding a continuous conductor wire on said stator core (15A), and
- d) a varnish is impregnated inside the slots (14) housing the stator winding (16A, 16B), fixing the stator winding (16A, 16B) to the stator core (15A),

while

- e) a gap (G) is formed between said coil end group (16f, 16r) of said stator winding (16A, 16B) and the adjacent axial end surface of said stator core (15A),
- f) said gap (G) being positioned closer to an axially-central region than said end surface of said rotor (7A) to which said cooling fan (38, 39) is fixed, and
- g) the entire axial region of the gap (G) overlaps one of a first (20A) and a second pole core (21A) at the rotor (7A) in a radial direction, so that there is no radial overlap between the gap (G) and the centrifugal fan (38).

The subject-matter of claim 1 is therefore new (Article 54 EPC).

### 3. *Inventive step (Article 56 EPC)*

3.1 Features a), b) and c) are known from D5 (cf. page 3, lines 47 to 49 and figure 10). These features

contribute to reduce the fluctuations in the output voltage and to reduce wind noise (cf. D5, page 7, lines 39 to 44). It would be obvious to apply the features a) to c), as known from D5, to reduce the noise of the alternator of D1. This was not contested by the appellant.

3.2 The stator winding of the automotive alternator according to the invention is fixed to the stator core by impregnating the stator winding with varnish inside the slots (feature d)). This feature is a well known feature (cf. D8 and D9) as acknowledge by the appellant. Hence, feature d) cannot per se be considered as involving an inventive step.

3.3 The automotive alternator according to the invention is further provided with "a gap (G) formed between said coil end group (16f, 16r) of said stator winding (16A, 16B) and the adjacent axial end surface of said stator core (15A)" (feature e)). This feature per se is known from D6, which teaches to provide an automotive alternator with vent gaps 2-c' between the stator coil ends 2-b' and the adjacent axial end surface of the stator core 2-a, to enhance cooling (cf. abstract and figures 1 and 2).

Seeking to cool the stator winding, it would be obvious for the person skilled in the art to provide the automotive alternator of D1 with vent gaps according to D6, i.e. between the coil end group (winding head) and the axial end surface of the stator core.

3.4 Considering features f) and g) the board can find no disclosure in the text of document D6 concerning the axial positioning of the gap relative to the end

surface of the rotor to which the cooling fan is fixed or concerning whether there is any overlap between the gap and the fan. It might be possible to observe that in figure 1 of D6 the vent gap 2-c' appears to be positioned closer to the axially-central region than the end surface of the rotor to which the cooling fans 38, 39 are fixed and that the entire axial region of the vent gap 2-c' appears to overlap one of the pole cores of the rotor in a radial direction, so that there is apparently no radial overlap between the gap 2-c' and the centrifugal fan 7'. However the Board considered that a skilled person would only make such observations with the benefit of hindsight of the present invention.

3.5 None of the other cited prior art documents discloses to arrange a gap in the manner set out in features f) and g). On the contrary, document D3 teaches that, when the coil end groups are coated, the gaps between the end surface of the stator core and the coil end groups should either be closed, or left open and opposed to the cooling fans (cf. D3, section [0044]). This teaches away from feature g).

3.6 In summary, considering the available prior art a person skilled in the art starting from D1 would be led by D5 to chose a number of slots at a ratio of two per phase per pole to reduce the wind noise, by D9 (for example) to impregnate the stator winding with varnish, and by D6 to provide cooling gaps between the coil end groups and the adjacent axial end surface of the stator core. Thereby he would not arrive at an automotive alternator according to claim 1 in which the stator winding is fixed with varnish and gaps provided between

the coil end group and the axial end surface of the stator core do not overlap the cooling fan (features f) and g)).

Gaps located as defined in claim 1 contribute together with the number of slots at a ratio of two per pole per phase, to reduce the wind noise (cf. published application, sections [0055] and [0056]).

The subject-matter of claim 1 is therefore not obvious in view of the cited prior art and hence is considered as involving an inventive step (Article 56 EPC).

4. The background art represented by D1, D3, D5, D6 and D9 has been acknowledged in the description, which has also been adapted to the new claims.

Thus, the Board considers that the appellant's request satisfies the requirements of the EPC and that a patent can be granted.

**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 grant a patent on the basis of the following documents:  
Description pages 1 to 26 as filed during the oral proceedings of 11 September 2013,  
Claims 1 to 5 as filed during the oral proceedings of 11 September 2013,  
Drawing figures 1 to 10 as originally filed.

The registrar:

The Chairman:

U.Bultmann

G.Flyng