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Datasheet for the decision of 15 April 2010

Case Number: T 0048/07 - 3.5.02

Application Number: 98109570.6

Publication Number: 0881750

IPC: H02K 3/24

Language of the proceedings: EN

Title of invention:
Alternator for vehicle

Patentee:
DENSO CORPORATION

Opponent:
VALEO EQUIPEMENTS ELECTRIQUES MOTEUR

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Main request - inventive step (no)"
"Auxiliary request - inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0048/07 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 15 April 2010

Appellant: (Patent Proprietor)
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Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 27 November 2006 concerning maintenance of European patent No. 0881750 in amended form.

Composition of the Board:

Chairman: M. Ruggiu
Members: J.-M. Cannard
P. Mühlens

Summary of Facts and Submissions

I. The opponent and the proprietor contest the decision of the opposition division concerning the maintenance of European patent No. 0 881 750 in amended form in accordance with the proprietor's auxiliary request filed on 13 September 2006 during oral proceedings before the opposition division.

II. Prior art documents:

E4: DE-A-40 31 276,
SU7: SU-A-1 377 964,
E8: FR-A-1 465 068,
E9: DE-U-89 13 392.7, which claims the same priority as FR-A3-2 639 162, and
E10: FR-A-2 603 429,

considered during the proceedings before the opposition division, and

E5: US-A-1 826 295,

cited in the notice of opposition, are mentioned in the present decision.

III. With a letter dated 25 March 2008 the appellant proprietor filed claims according to a first auxiliary request.

IV. In reply to a communication of the Board dated 17 September 2009 and annexed to summons to oral proceedings, the appellant opponent with a letter dated 19 October 2009 mentioned for the first time a document

JP-60-187241 and the appellant proprietor with a letter dated 7 December 2009 filed claims in respect of second to fourth auxiliary requests.

V. Oral proceedings before the Board were held on 15 April 2010.

VI. The appellant proprietor requests that the decision under appeal be set aside and that the patent be maintained unamended (main request) or in amended form in the following version (auxiliary request):

- claims: 1 to 7 filed as fourth auxiliary request with letter of 7 December 2009,

- description: pages 2 to 7 filed in the oral proceedings of 15 April 2010,

- drawings: figures 1 to 12 of the patent specification.

VII. The appellant opponent requests that the decision under appeal be set aside and that the patent be revoked.

VIII. Claim 1 of the main request (claim 1 as granted) reads as follows:

"An alternator for a vehicle, including:

a stator (2) having a stator core (32) with a stator winding which has first and second coil-end groups (31a, 31b) respectively composed of coil ends disposed annularly on opposite ends of said stator core (32) in the axial direction thereof,

a rectifier (5) disposed near said first coil-end group (31a), and

an air drive unit (11, 12) for sending cooling air to both said first and second coil-end groups (31a, 31b),

characterized in that

said first coil-end group (31a) has at least two coil ends which are shifted in the axial direction from each other in such a way that the projected area of said first coil-end group (31a) as viewed from the inner side of said stator core is larger than the corresponding area of said second coil-end group (31b)."

IX. Claim 1 of the auxiliary request (filed as fourth auxiliary request with letter of 7 December 2009) reads as follows:

"An alternator for a vehicle, including:

a stator (2) having a stator core (32) with a stator winding which is inserted in slots of a stator core and which has first and second coil-end groups (31a, 31b) respectively composed of coil ends which are disposed in a regular manner and repeatedly annularly according to the pole pitch on opposite ends of said stator core (32) in the axial direction thereof,

a rectifier (5) disposed near said first coil-end group (31a), and

an air drive unit (11, 12) for sending cooling air to both said first and second coil-end groups (31a, 31b),

characterized in that

said winding is formed by conductor segments which are aligned in the radial direction in the slots of the stator core;

said stator winding is composed of small and large U-shaped conductor segments, an U-turn portion of each large segment of said first coil-end group (31a) being more distant from said stator core than an U-turn portion of each small segment; so that

said first coil-end group (31a) has for every pair of slots which are spaced one pole pitch apart at least two coil ends which are shifted in the axial direction from each other in such a way that the projected area of said coil-end group (31a) as viewed from the inner side of said stator core is larger than the corresponding area of said second coil-end group (31b); wherein

at said second coil-end group (31b) the respective ends of the conductor segments are bent to separate from each other and to form joint portions which overlap with each other in the radial direction."

Claims 2 to 7 of the auxiliary request are dependent on claim 1.

X. The arguments of the appellant proprietor can be summarized as follows:

The two coil-end groups of the alternator winding according to claim 1 of the main request had different

structures. The coil ends of the first coil-end group were shifted in the axial direction from each other and a consequence was that the projected area of said first coil-end group viewed form the inner side of the stator core was larger than the corresponding area of the second coil-end group. None of the cited prior art documents disclosed a difference in the structures of the coil-end groups. In documents E8 and E10, coil ends of both coil-end groups were shifted from each other in the axial direction to improve the cooling. The first coil-end group shown in document E9 was shifted as a whole in the axial direction and had a larger surface than the second coil-end group. The purpose of this extension however was not to enhance the cooling of the first coil-end group. The combination of the teachings of E9 with E8 or with E10 would thus be an artificial one, only conceivable by using the benefit of hindsight. Moreover, the skilled person combining these prior art documents would neither arrive at a winding whose coil-end groups had different structures, nor at a first coil-end group whose larger projection area would be caused by coil ends that were shifted from each other in the axial direction, as recited in claim 1 of the main request.

The coil-end groups of the alternator winding according to claim 1 of the auxiliary request had different structures because in the first coil-end group the coil ends were shifted in the axial direction from each other and at the second coil-end group the coil ends had joint portions which overlapped with each other in the radial direction. None of the cited prior art documents disclosed, or suggested such different structures of the coil-end groups, and more particularly not joint

portions of a second coil-end group which overlapped with each other in the radial direction. The first and second coil-end groups shown in document E4 differed from the claimed corresponding first and second coil-end groups. In E8 or E10, the coil ends of both coil-end groups were shifted from each other in the axial direction in a similar way. Document E5 neither related to a winding for the stator of an alternator, nor disclosed first and second coil-end groups having different structures. The skilled person combining the teaching of the prior art documents would not arrive at a winding whose first coil-end group had coil ends shifted from each other in the axial direction so that it had a larger projection area than a second coil-end group whose joint portions overlapped with each other in the radial direction.

XI. The arguments of the appellant opponent can be summarized as follows:

Document E9 was already considered as the closest prior art by the examining division and was acknowledged in the patent specification according to which the first coil-end group on the rectifier side extended further in the axial direction from the stator core and thus had a larger surface to be cooled than the second coil-end group. Documents E8 and E10 indicated that coil ends of a winding should be shifted in the axial direction from each other to improve the cooling. It was obvious to the skilled person to consider the teaching of E8 or E10 and to shift from each other in the axial direction coil ends of the first coil-end group of E9 to further improve the cooling. Claim 1 did not specify that the first and second coil-end groups had different

structures. Nor was claim 1 restricted to the use of conductor segments. In any case, it was possible to shift the coil ends only on the first coil-end group of E9 to extend further the first coil-end group in the axial direction. The projected area of the first coil-end group would thus be larger that the corresponding area of the second coil-end group. The subject-matter of claim 1 of the main request lacked an inventive step.

It belonged to the general knowledge of the skilled person to use either wires or conductor segments for the winding of an alternator. Applying the teaching of E8 and using conductor segments in the winding disclosed by E9 would result in a winding composed of small and large U-shaped conductor segments and in a first coil-end group whose coil ends were shifted in the way specified in claim 1 of the auxiliary request. At the second coil-end group, the ends of the conductor segments would be bent in a conventional way to form overlapping joint portions, as specified in claim 1. Document E5 disclosed a winding for an electrical rotating machine which was composed of small and large U-shaped conductor segments. At a first coil-end group U-turn portions were shifted in the axial direction from each other and at the second coil-end group the ends of the conductor segments were bent to form overlapping joint portions, as in claim 1 of the auxiliary request.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. It is common ground that document E9, which can be seen as the closest prior art, discloses an alternator for a vehicle which comprises all the features of the pre-characterizing part of claim 1 (see E9, figure 1):

- a stator 1a having a stator core 24 with a stator winding which has first and second coil-end groups 25, 26 respectively composed of coil ends disposed annularly on opposite ends of said stator core in the axial direction thereof,

a rectifier 13 disposed near said first coil-end group 25, and

an air drive unit 30, 31 for sending cooling air to both said first and second coil-end groups 25, 26.

3. Moreover, according to page 4, lines 15 to 31, the fan impeller 30 is situated in the rear housing portion 4, in the region defined by the rear stator coil-end group 25, whilst the front fan impeller 31 is arranged immediately outside the open end 19 of the front housing portion 5. The internal rear fan 30 is of the mixed type with "specialised" blades, that is, with alternating forms for generating axial and radial ventilation flows respectively. The arrangement should enable "a considerably better cooling efficiency" to be achieved than is the case with conventional alternators. The fan 30 draws in air from the outside through the radial apertures 17 in the cover 16 and the apertures 10 in the rear housing portion 4, distributing it axially through the pole fingers 29, 30 and the excitation winding 7 of

the rotor 2 and **radially through the rear stator coil-end group 25**. Thus, according to the description and figure 1 of E9, the axial extension of the first coil-end group 25 and its radially projected area viewed from the inner side of the stator are larger than the axial extension and the radially projected area of the second coil-end group 26.

3.1 However, in E9, the structure of the first coil-end group is neither described, nor is subject to any particular restrictions. Accordingly, E9 does not show an alternator winding in which the first coil-end group has at least two coil ends which are shifted in the axial direction from each other, as recited in the characterizing part of claim 1.

4. E8 discloses a coil-end group for a winding of an electrical rotating machine in which at least two coil ends are shifted and disposed side by side in an axial direction, thus in such a way that the surface of the coil-end group fans out and is thereby extended, to improve the cooling (figure 3; page 1, left column, line 33 to right column, line 17).

4.1 The teaching of E8, as appears more specifically from page 2, right column, lines 14 to 19, and figures 7 and 8, applies to coil ends of a coil-end group of a winding composed of conductor segments having U-turn portions (opponent's letter of 29 March 2007, page 9, line 26, for instance). It is part of the common knowledge of the skilled person that using wires or conductor segments are two alternative ways for producing alternator windings. Therefore, in the judgment of the Board, it would be obvious to the skilled person, starting from E9

and looking for a workable solution to implement on the rectifier side a coil-end group which provides "a considerably better cooling efficiency", to consider using coil ends as shown in document E8 (which is also faced with the problem of cooling) for the rear stator coil-end group 25 of E9. As is apparent from E9, the other coil-end group 26 is more compact and is not extended axially, resulting in a smaller projected area than for the coil-end group 25.

4.2 The skilled person considering the teaching of E9 and E8 in combination would thus, in the first coil-end group on the rectifier side, shift at least two coil ends in the axial direction from each other in such a way that the surface of said first coil-end group and thus its projected area viewed from the inner side of the stator core is larger in an axial direction than the corresponding surface and projected area of the second coil-end group, as recited in claim 1. Accordingly, the subject-matter of claim 1 of the main request does not involve an inventive step (Article 56 EPC).

5. Document JP-60-187241 discloses an alternator in which the axial extension H1 of the second coil-end group of the stator is larger than the axial extension H2 of the first coil-end group disposed nearby a rectifier (page 7 of the translation into English, first paragraph; figure 1) and thus is less relevant than E9.

Auxiliary request

6. Claim 1 of the auxiliary request is in substance based on claim 1 of the main request with added restrictions to a winding which "is formed by conductor segments

which are aligned in the radial direction in the slots of the stator core" and "is composed of small and large U-shaped conductor segments, an U-turn portion of each large segment of said first coil-end group (31a) being more distant from said stator core than an U-turn portion of each small segment"; to a first coil-end group (31a) which has at least two shifted coil ends "for every pair of slots which are spaced one pole pitch apart" and to a second coil-end group (31b) wherein "the respective ends of the conductor segments are bent to separate from each other and to form joint portions which overlap with each other in the radial direction". Said additional features are disclosed in the application as originally filed (see column 4, lines 14 to 17, 33 and 34; column 6, lines 17 to 19; column 8, lines 45 to 48; figures 2 to 4, 10 and 12 of the published application). Dependent claims 2 to 7 are in substance identical to claims 2 to 7 of the patent as granted. The description of the patent in suit has been brought into conformity with the amended set of claims, in particular by deleting the paragraphs [0066] to [0068] and [0075] which do not relate to a winding formed by conductor segments. The Board is satisfied that the amendments made to the claims and the description of the patent in suit satisfy the requirements of Article 84 EPC and do not contravene Article 123(2) or (3) EPC.

7. It is common ground between the parties that E9 does not disclose an alternator for a vehicle which comprises the features recited in the characterising part of claim 1 of the auxiliary request.

8. Starting from E9 and having regard to the effects provided by the claimed invention, the objective technical problem can be seen as providing a stator winding for an alternator in which an undesirable difference in temperature between the two coil-end groups of the winding is avoided. This is in accordance with the technical problem specified in the application as filed (column 2, lines 13 to 15 of the published application) and the corresponding passage of the patent specification.

9. In the Board's judgement, it has not been convincingly shown that the subject-matter of claim 1 of the auxiliary request does not involve an inventive step having regard to the cited prior art documents because these documents, taking alone or in combination, would not arrive at the claimed subject-matter in an obvious way. None of these documents, and particularly not E4, E8, or E10 discloses, or suggests to include in the alternator of E9, a winding composed of small and large U-shaped conductor segments, wherein at the second coil-end group "the respective ends of the conductor segments are bent to separate from each other and to form joint portions which overlap with each other in the radial direction", as specified in the last feature of claim 1 of the auxiliary request. More specifically:

9.1.1 According to figure 7, the alternator disclosed in E4 does not comprise a second coil-end group in which ends of the conductor segments have joint portions that overlap with each other in the radial direction.

9.1.2 E8 is only concerned with coil-end groups whose coil-ends are shifted in the axial direction from each other.

9.1.3 The alternator disclosed in E10 comprises a wired stator winding whose coil-end groups both have the same structure (pages 4 and 5, bridging paragraph), but does not comprise a winding composed of small and large U-shaped conductor segments.

9.1 Document E5 (figures 3 and 8) relates to a rotor of a dynamo electric machine. At the second coil-end group of the rotor winding, the respective ends of small and large U-shape conductor segments are bent and joined. However, the joint portions are not all at the same axial height and thus do not overlap. Thus, it does not appear that the projected area of the first coil-end group would be larger than the corresponding area of the second coil-end group, as specified in claim 1.

9.2 The other cited documents are less relevant and were not discussed in the oral proceedings. More specifically, the alternator of SU7 does not comprise coil ends which are disposed in a regular manner and repeatedly annularly according to one pole pitch (figure 4; page 1 of the translation into English). Figure 1 of SU7 is a diagrammatic representation of the coil ends of the winding and the description does not specify joint portions of ends of conductor segments which overlap with each other in the radial direction at a second coil-end group.

10. As may be seen from the foregoing, the subject-matter of claim 1 of the auxiliary request is not obvious having regard to the prior art on file. The same considerations apply to the subject-matter of claims 2 to 7 which are dependent on claim 1.

11. In the Board's judgement, taking into account the amendments according to the auxiliary request, the patent in suit and the invention to which it relates satisfy the requirements of the Convention (Article 101(3)a) EPC).

Order

For these reasons it is decided that :

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent in amended form in the following version:

   - claims: 1 to 7 filed as fourth auxiliary request with letter of 7 December 2009,

   - description: pages 2 to 7 filed in the oral proceedings of 15 April 2010,

   - drawings: figures 1 to 12 of the patent specification.

The Registrar: The Chairman:

U. Bultmann M. Ruggiu