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**Datasheet for the decision
of 7 March 2007**

Case Number: T 0217/05 - 3.5.02

Application Number: 98109573.0

Publication Number: 0881746

IPC: H02K 3/12

Language of the proceedings: EN

Title of invention:

Stator arrangement of alternator for vehicle

Patentee:

DENSO CORPORATION

Opponent:

VALEO EQUIPEMENTS ELECTRIQUES MOTEUR

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Main request - inventive step (after amendment - yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0217/05 - 3.5.02

DECISION
of the Technical Board of Appeal 3.5.02
of 7 March 2007

Appellant: DENSO CORPORATION
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 08 December 2004
revoking European patent No. 0881746 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: J.-M. Cannard
C. Holtz

Summary of Facts and Submissions

- I. The proprietor appealed against the decision of the opposition division revoking European patent No. 0 881 746. The reason for the revocation was that claim 1 of the main, and first and second auxiliary requests filed with the letter dated 3 September 2004 lacked an inventive step.
- II. Prior art documents:
- E4: DE-40 31 276, and
- SU7: SU-1377964, with a full translation into English,
- considered during the proceedings before the opposition division, remain relevant to the present appeal.
- Document:
- D9: EP-A-0 945 962
- was filed for the first time by the opponent with the reply to the statement of grounds of appeal.
- III. With the statement of grounds of appeal of 18 April 2005, the appellant filed *inter alia* a main request and, with a letter dated 7 February 2007, first to fifth auxiliary requests.
- IV. Claim 1 of the main request reads as follows:
- "Stator (2) of an alternator (1) for a vehicle including a stator core (32) with a plurality of slots (35) and a

multi-phase stator winding, wherein said stator winding comprises a plurality of conductor segments (33, 331, 332) composed of conductor members aligned in said slots (35) and connected with one another to form a first coil-end group (31a) disposed on one axial end of said stator core (32) so that first **continuous U-turn** portions (332c) of said conductor segments (332) are surrounded by second **continuous U-turn** portions (331c) of said conductor segments (331), and a second coil-end group (31b) disposed on the other axial end of said stator core (32) so that ends of said conductor segments (331, 332) are **welded or soldered together** to form lap windings, **wherein the conductor segments having the first and second U-turn portions (332c, 331c) are disposed in the same slots.**"

Claims 2 to 12 are dependent on claim 1.

V. Oral proceedings were held on 7 March 2007.

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

Document E4, which related to a stator of an alternator for a vehicle using the segment technology, formed the starting point of the invention. The winding described in E4 comprised conductor segments which were connected to form continuous U-turn portions on one axial end of the stator and were soldered together at their ends on the other axial end of the core. The conductor segments however did not comprise conductor members aligned in slots of the stator core, and were not connected to have first continuous U-turn portions surrounded by second continuous U-turn portions and to form lap windings.

Starting from E4, the problem addressed by the invention consisted in providing a winding which could be easily formed of basic conductor segments and few specific segments, as appeared from the original application and the patent specification.

The skilled person aware of E4 would not consider the teaching of document SU7 which related to a high voltage machine using the bar technology and whose winding was not easy to manufacture because the bars had to be inserted in a radial direction in the stator slots. In the winding of SU7, the bars might be connected to form first portions surrounded by second portions on an axial end of the stator core. But these bars did not form conductor segments which had first continuous U-turn portions surrounded by second continuous U-turn portions and were disposed in the same slots, as appeared from figure 4 of SU7. A stator resulting from the mere combination of E4 and SU7 would not comprise all the features of the claimed stator. Modifying the winding shown in figure 4 of SU7 to provide a one pole-pitch winding would be a further step only resulting from hindsight.

VII. The arguments of the respondent opponent can be summarized as follows:

The stator disclosed in E4 was not only for use in vehicles. Its winding comprised conductor segments arranged in the slots of the stator core so that continuous U-turn portions of the segments were disposed on one axial end of the core. However, it was difficult to weld the ends of the conductor segments on the other

axial end of the stator core and to manufacture the winding.

The stator disclosed in SU7, which had a winding similar to the claimed winding, provided a solution to this problem. Although the stator of SU7 was designed for a high voltage machine and used conductor bars aligned in the slots of the stator core to form lap windings, it would be considered by the skilled person because bars and conductor segments were known as alternative technologies and the electrical properties of the windings did not depend on their manufacturing process. As appeared more particularly from figure 1 of SU7, the conductor bars disposed in the same slots were connected to form first continuous U-turn portions surrounded by second continuous U-turn portions on one of the axial ends of the stator core. The claimed stator would result from a mere combination of the teachings of E4 and SU7. In figure 4 of SU7, the first and second U-turn portions formed by the connected bars were not disposed in the same slots because the winding was not designed with a one pole-pitch to provide reduced harmonics. But it would have been obvious to the skilled person to select a one pole-pitch winding for obtaining a regular winding in SU7. In such a winding the conductor segments having the first and second U-turn portions would be disposed in the same slots. The claimed stator was obvious having regard to the combination of E4 and SU7.

VIII. The appellant (patentee) requested that the decision under appeal be set aside and that the patent be maintained in amended form in accordance with the main request filed with the grounds of appeal (18 April 2005)

or one of auxiliary requests 1 to 5 filed with letter of 7 February 2007.

- IX. The respondent (opponent) requested that the appeal be dismissed.

Reasons for the Decision

1. The appeal is admissible.

2. Claim 1 of the main request, which corresponds to claim 1 of the first auxiliary request considered in the appealed decision, is based on granted claim 1 with the added restrictions to conductor segments forming on one axial end of the stator "continuous U-turn portions" and being on the other axial end of the stator "welded or soldered together" and with the additional feature "wherein the conductor segments having the first and second U-turn portions (332c, 331c) are disposed in the same slots". Such conductor segments are disclosed in the application as originally filed (see page 9, lines 20 and 21; page 10, lines 18 to 20 and page 15, lines 11 to 15; pages 9 and 10, bridging paragraph). The Board is satisfied that the amendments made to the claims according to the present main request satisfy the requirements of Article 84 EPC and do not contravene Article 123(2) or (3) EPC.

Relevance of document D9 (EP-A-0 945 962)

3. Document D9 which was cited for the first time with the reply to the statement of grounds of appeal is

considered by the opponent as comprised in the state of the art according to article 54(3) EPC. It relates to a method and an apparatus for manufacturing stators of AC generators for vehicles. Neither the description, nor the claims of this document seems to disclose a stator comprising lap windings, as recited in claim 1 of the present main request. The respondent has not explained how it can be determined that the windings, shown only partly in figure 13 of this document, are lap windings. D9, which does not appear *prima facie* to be very highly relevant (for the assessment of novelty), was not considered further in the proceedings.

Claim 1 of the main request - Inventive step

4. Document E4, whose corresponding PCT application 92/06527 is acknowledged in the specification of the patent in suit, forms the undisputed prior art to be treated as the starting point of the invention.

4.1 E4 (figures 1 to 3; column 3, line 9 to column 4, line 39) discloses a stator of an alternator for a vehicle which comprises the following features of claim 1 of the main request:

- a stator core (11) with a plurality of slots (12) and a multi-phase stator winding,

- wherein said stator winding (16) comprises a plurality of conductor segments (14) composed of conductor members (14c) and connected with one another to form

- a first coil-end group (figures 2 and 5) disposed on one axial end of said stator core (11) so that they form

continuous U-turn portions (14b) of said conductor segments (14), and

- a second coil-end group (figures 2 and 7) disposed on the other axial end of said stator core (11) so that ends (18) of said conductor segments (14) are connected together to form windings.

4.2 However, the conductor members of the stator disclosed in E4 are disposed in the slots to form rows and columns (column 3, lines 34 to 38) and their continuous U-turn portions are disposed in parallel in the first coil-end group (figure 5), in such a way that one does not surround the other.

4.3 Thus, the stator according to claim 1 differs from the stator disclosed in E4, because in this stator the conductor segments are not composed of conductor members aligned in the core slots, do not form a first coil-end group disposed on one axial end of the stator core so that first continuous U-turn portions of said conductor segments are surrounded by second continuous U-turn portions of said conductor segments, and are not welded or soldered on the other axial end of the core to form lap windings. Furthermore, in E4 the conductor segments having the first and second U-turn portions are not disposed in the same slots.

5. The Board observes that, in the stator described in E4, the number of different specific conductor segments (19, 20 and 21), i.e. the segments which are necessary to connect the different annular windings of a phase winding together and with the terminals, is high (five),

while the stator specified in claim 1 implies a regular winding requiring only two different specific segments.

6. Starting from E4 and having regard to the effects provided by the claimed invention, the objective technical problem could be seen as providing a stator easily formed of conductor segments with a reduced number of different specific segments. This is in accordance with the technical problem specified in the application as filed (column 3, lines 11 to 16 of the published application) and in paragraphs [0019] and [0020] of the patent specification.

7. In the judgement of the Board, it has not been convincingly shown that the subject-matter of claim 1 of the present main request does not involve an inventive step having regard to the cited prior art documents. None of these documents, and particularly not document E4 or SU7, discloses, or suggests, a winding wherein the conductor segments, which have first continuous U-turn portions surrounded by second continuous U-turn portions, are disposed in the same slots.
 - 7.1 SU7 discloses a stator winding for a high voltage alternating-current electrical machine. The winding comprises a plurality of bars (figure 2) which are aligned in slots (figure 3) and connected with one another so as to provide on one axial end of the stator core continuous U-turn portions, and so as to form on the other axial end of said core lap windings (figures 1 and 4).

7.2 According to the description of SU7 (translation into English, page 2, line 17 to page 3, line 25) and figures 2 and 4, a first annular winding is formed by bars 1 and 4 of half-sections of wave winding and bars 2 and 3 of half-sections of lap winding such that a first U-turn portion is formed by connecting a bar 1 lying in a first slot and a bar 2 lying in a n-th slot and a second U-turn portion is formed by connecting a bar 3 lying in the first slot and a bar 4 lying in the n-th slot. However, it results from the disposition of said bars in the slots (figure 3) that none of the thus formed U-turn portions surrounds another one. A first U-turn portion formed by connecting bars 1 and 4 of the first annular winding may surround a second U-turn portion formed by connecting bars 2 and 3 of a second annular winding on the terminal side. However, the appellant has shown that at least some of the bars forming these first and second U-turn portions are not in the same slots, as may be seen in figure 4. Thus, SU7 does not disclose a winding wherein the conductor segments having first and second U-turn portions, such that the first portions are surrounded by the second portions, are disposed in the same slots, as recited in claim 1.

7.3 The sole embodiment of winding disclosed in SU7 shows different pitches (figure 4). It might be, as alleged by the opponent, that a winding according to SU7 when modified to become a one pole-pitch winding would comprise conductor segments having first and second U-turn portions disposed in the same slots. However, SU7 does not give any hint at replacing the only winding actually disclosed by a one pole-pitch winding.

- 7.4 Nor can such a one pole-pitch winding be derived from the combination of the teaching of E4 and SU7. The skilled person starting from E4 could have considered the teaching of SU7 which solves the objective technical problem addressed by the invention, because it makes it possible to obtain a stator winding having a minimum number of connectors of other types (i.e. specific segments), as explained near the end of the abstract of SU7. However, in doing so, the skilled person would have considered the winding described in SU7 as a whole, because this winding as a whole precisely solves the problem addressed by the invention. Even if the wave winding disclosed in E4 is a one pole-pitch winding, devising an amendment to the wave/lap winding described in SU7, which is considered for replacing the E4 winding because it solves the problem of the invention, would constitute an additional step going beyond the mere combination of E4 and SU7. Such an additional step can only be envisaged with the benefit of hindsight. The other cited documents are less relevant and were not discussed in the oral proceedings.
8. As may be seen from the foregoing, the subject-matter of claim 1 of the main request is not obvious having regard to the prior art on file. The same considerations apply to the subject-matter of claims 2 to 12 which are dependent on claim 1.
9. In the Board's judgement, taking into account the amendments according to the main request, the patent in suit and the invention to which it relates satisfy the requirements of the Convention (Article 103(3) 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 in amended form in the following version:

claims 1 to 12 (main request) as filed with the statements of grounds of 18 April 2005, and description and drawings of the patent specification.

The Registrar:

The Chairman:

U. Bultmann

W. J. L. Wheeler