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Datasheet for the decision of 12 December 2012

Case Number: T 0089/09 - 3.5.02

Application Number: 03014183.2

Publication Number: 1383230

IPC: H02K 15/04

Language of the proceedings: EN

Title of invention:
Method of manufacturing stator winding of an alternator

Applicant:
DENSO CORPORATION

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56, 83, 123(2)

Keyword:
"Inventive step - yes (after amendment)"
"Disclosure - sufficiency - yes (after amendment)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0089/09 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 12 December 2012

Appellant: (Applicant)
DENSO CORPORATION
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Aichi-pref. 448-8661 (JP)

Representative:
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Decision under appeal:
Decision of the Examining Division of the European Patent Office posted 21 August 2008 refusing European application No. 03014183.2 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: M. Ruggiu
Members: G. Flyng
P. Mühlens

Summary of Facts and Submissions

I. The applicant has appealed against the decision of the examining division in which the European patent application No. 03 014 183.2 was refused on the grounds that contrary to Rule 42(e) EPC there was no example in the description which described in detail one way to carry out the invention as claimed and contrary to Article 83 EPC the invention was not disclosed in a manner sufficiently clear and complete for it to be carried out by a skilled person.

In particular, the examining division held that a skilled person needed additional inventive activity to solve the problem of how to maintain the movable top plate 120, which had the exact size of the recess 130, axially once having closed the recess (cf. figures 14, 15 and 18).

Furthermore, the examining division held that a skilled person needed additional inventive activity to solve the problem of how the movable top plate 2202 could be moved axially to reach the same level as the stationary top plate 232 when it only half closed a recess 2301 as shown in figure 19 (i.e. when the movable top plate 2202 was still partially within an accommodating space of the stationary top plate 232).

II. Oral proceedings were held before the Board on 12 December 2012. The appellant requested that the decision under appeal be set aside and that a patent be granted in the following version:

Description:

– Pages 1 to 5 and 12 received during the oral proceedings of 12 December 2012;
– Pages 6 to 11 and 13 to 18 as originally filed;

Claims:

– Nos. 1 to 5 received during the oral proceedings of 12 December 2012;

Drawings:

– Sheets 1/11 to 11/11 as originally filed.

III. Claim 1 received during the oral proceedings of 12 December 2012 reads as follows:

"A method of manufacturing a stator winding mounted in a stator core (32) of a rotary electric machine from a plurality of first U-shaped conductor segments (331, 332) having a turn portion (331c, 332c) and a pair of first straight portions (331a, 331b, 332a, 332b) disposed in a radial direction and a second U-shaped conductor segment (333) having a turn portion (333c) and a pair of second straight portions (333a, 333b) which are longer in the axial direction than the first straight portions (331a, 331b, 332a, 332b), said second conductor segment (333) being lead-specialized conductor segments which are adapted to be cut near the corresponding turn portion (333a) to form leads to said stator winding;
said method comprising:

– *a first step of inserting the straight portions of the first conductor segments (331, 332) and the second, lead-specialized conductor segment (333)*

into holding slots (121, 122, 131, 132) of a twisting apparatus (100, 111, 112);

- *a second step of moving a segment pressing tool (116) down in an axial direction to press the turn portions (331c, 332c) of the first conductor segments (331, 332), the segment pressing tool (116) having a recess (130) for passing the second, lead-specialized conductor segment (333) in the axial direction, so that the segment pressing tool (116) does not interfere with the second, lead-specialized conductor segment (333) when it presses the turn portions of the first conductor segments;*
- *a third step of twisting by circumferentially moving the first straight portions (331a, 331b, 332a, 332b) and the second straight portions (333a, 333b) while restraining the turn portions (331c, 332c) of the first conductor segments (331, 332) in the axial direction with the segment pressing tool (116);*
- *a fourth step of inserting the previously twisted first and second conductor segments into respective slots (35) formed in the stator core (32);*
- *a fifth step of bending the first and second straight portions (331a, 331b, 332a, 332b, 333a, 333b) at ends opposite the turn portions (331c, 332c, 333c) thereof in the circumferential direction;*
- *a sixth step of joining the previously bent first and second conductor segments (331, 332, 333) adjacent to each other; and*
- *a seventh step of cutting at least one portion of the second, lead-specialized conductor segment*

near the turn portion (333c) to provide two lead wires (333f, 333g);

characterized in that:

- *in the first step, the second straight portions (333a, 333b) of the second, lead specialized conductor segment are inserted into said holding slots of the twisting apparatus so as to be disposed at positions shifted from each other in a circumferential direction;*
- *said recess (130) is provided in a stationary top plate (132, 232) of said segment pressing tool (116), which also comprises a movable top plate (120; 2201, 2202) that is kept in an accommodation space (144) of said stationary top plate (132, 232) when the segment pressing tool (116) moves down in the axial direction in the second step;*
- *the movable top plate (120; 2201, 2202) slides in circumferential or radial direction to close the recess (130) after the stationary top plate (132, 232) has passed the turn portion (333c) of the second, lead-specialized conductor segment (333); and*
- *in the third step the turn portions (331c, 332c) of the first conductor segments (331, 332) are pressed by the stationary and movable top plates (132, 120, 232, 220; 2202)."*

Claims 2 to 5 are dependent on claim 1.

IV. The appellant argued in essence that the invention was disclosed in a manner sufficiently clear and complete for it to be carried out by a skilled person (cf. Article 83 EPC) and that the description described at least two ways to carry out the invention as claimed in

sufficient detail for the person skilled in the art (cf. Rule 42(e) EPC).

Furthermore, the appellant argued that the claimed subject-matter was novel and non-obvious in view of the cited prior art.

Reasons for the Decision

1. The appeal is admissible.

2. Article 83 and Rule 42(e) EPC

2.1 The method of independent claim 1 involves a segment pressing tool that comprises a stationary top plate and a movable top plate. A recess is provided in the stationary top plate. When the segment pressing tool moves down in the axial direction in the second step of the method, the movable top plate is kept in an accommodation space of the stationary top plate. After the stationary top plate has passed the turn portion of the second, lead-specialized conductor segment, the movable top plate slides in circumferential or radial direction to close the recess.

2.2 In the contested decision the examining division considered that it was clearly shown in the figures that the movable top plates 120, 2201 were slid completely out of the accommodation space 144 and therefore it became unclear how the movable top plate was maintained in place once slid out of the accommodation space and brought in contact with the large conductor segments 331, because it was shown in

the middle of the recess 130, 2301 without any restraining means. The examining division held that a skilled person needed additional inventive activity to solve the problem of how to maintain the movable top plate 120, which had the exact size of the recess 130, axially once having closed the recess (cf. figures 14, 15 and 18).

Regarding this objection the Board notes that claim 1 does not specify that the movable top plate is slid completely out of the accommodation space. Nor does it specify that the movable top plate has the exact size of the recess. These features are also not mentioned in the description. Rather, it seems that the examining division has taken these features from the drawings, which, given their clearly schematic nature, does not seem appropriate.

Claim 1 states that "the movable top plate ... slides in circumferential or radial direction to close the recess". Also, dependent claim 5 specifies that "after closing said recess, the movable top plate ... is moved down in the axial direction until it reaches the same level as the stationary top plate". In the Board's view, the question to be considered is whether it would require inventive activity for the skilled person to devise a mechanism capable of supporting the movable top plate and carrying out such movements once it has been disclosed that such movements are required.

The appellant has argued that mechanisms capable of carrying out such movements would be well known to the average technically educated person. According to the appellant, one simple solution might include a small

motor, a rack and pinion drive for the circumferential movement and a stepped arrangement of the movable top plate, with a thicker portion able to move axially within the recess while a thinner portion remains in the accommodation space. Having considered these arguments the Board is convinced that the skilled person would have no difficulty in devising a mechanism suitable for supporting the movable top plate and moving it in the manner set out in the invention as claimed. For the same reasons, the Board considers that the embodiments do describe at least one way of carrying out the invention in sufficient detail.

2.3 The examining division also held that a skilled person needed additional inventive activity to solve the problem of how the movable top plate 2202 could be moved axially to reach the same level as the stationary top plate 232 when it only half closed a recess 2301 as shown in figure 19 (i.e. when the movable top plate 2202 was still partially within an accommodating space of the stationary top plate 232).

Regarding this objection, the Board notes that such an axial movement of the movable top plate is specified only in dependent claim 5 and is thus only an optional feature of the invention. This is in line with the originally filed description, which states that such an arrangement is "desirable" (see the application as published, EP 1 383 230 A1, paragraph [0010]). It seems from the submissions of the appellant that an axial movement of the movable top plate is not an essential feature of the invention, because it is possible for the turn portions of the first conductor segments to be adequately restrained in the axial direction by the

movable top plate without necessarily moving it to the same axial position as the stationary top plate.

The description of the second embodiment of figures 17 to 19 states that the "the movable top plate 2201 is moved in the circumferential direction to press the turn portions of the large conductor segment 231 at the bottom surface of the movable top plate 2201, in the same manner as above" (emphasis added). There is no mention of any axial movement of either of the movable top plate 2201 and 2202 relative to the stationary top plate 216 and no suggestion that in this embodiment the movable top plate has to be moved to the same axial position as the stationary top plate. Hence, the Board finds that the problem of how the movable top plate 2202 could be moved axially to reach the same level as the stationary top plate 232 when it only half closed a recess 2301 as shown in figure 19 does not necessarily arise and therefore the examining division's objection is moot. Furthermore, the Board is convinced that the skilled person would have no difficulty in devising a mechanism suitable for moving the movable top plate in the claimed manner.

3. Amendments, Article 123(2) EPC

The Board considers that the amendments made to independent claim 1 are directly and unambiguously derivable from the application as filed. In particular:

- Claim 1 now refers to a second U-shaped conductor segment (rather than a plurality), which is consistent with the statement in claim 1 as filed that the stationary top plate has a recess;

– Claim 1 states: "*said second conductor segment (333) being lead-specialized conductor segments which are adapted to be cut near the corresponding turn portion (333a) to form leads to said stator winding*". To be consistent this feature should perhaps have read: "*said second conductor segment (333) being a lead-specialized conductor segment~~s~~ which is ~~are~~ adapted to be cut near the corresponding turn portion (333a) to form leads to said stator winding*". The feature has a basis in paragraph [0031] of the application as published (see EP 1 383 230 A1), as does the seventh step of cutting at least one portion of the second, lead-specialized conductor segment near the turn portion (333c) to provide two lead wires (333f, 333g).

– The first step of inserting the straight portions of the first conductor segments (331, 332) and the second, lead-specialized conductor segment (333) into holding slots (121, 122, 131, 132) of a twisting apparatus (100, 111, 112) has a basis in paragraphs [0045] and [0046];

– The charactering features of claim 1 have a basis in claim 1 as filed together with paragraphs [0046] and [0048].

4. Novelty and inventive step, Articles 54 and 56 EPC

4.1 The closest prior art may be considered to be that disclosed in US patent US 6 339 871 B1, which will be referred to hereinafter as document D1. Document D1 is related to the Japanese patent document JP 2000-350423 that was discussed in the application as filed (see

EP 1 383 230 A1, paragraphs [0002] to [0008]) and has now been acknowledged in the amended description.

4.2 Document D1 discloses a method of manufacturing a stator winding having all of the features of the preamble of claim 1.

In particular, in the wording of present claim 1, D1 discloses a method of manufacturing a stator winding mounted in a stator core (see figure 16) from a plurality of first U-shaped conductor segments (see figure 1; 310, 320) having a turn portion (312, 322) and a pair of first straight portions (311, 321) disposed in a radial direction and a second U-shaped conductor segment (330) having a turn portion (332) and a pair of second straight portions (331) which are longer in the axial direction than the first straight portions (311, 321). The second conductor segment (330) is a lead-specialized conductor segment which is adapted to be cut near the corresponding turn portion (322) to form leads to the stator winding (see figure 14). The method comprises:

- a first step of inserting the straight portions of the first conductor segments and the second, lead-specialized conductor segment into holding slots (13, 14) of a twisting apparatus (1);
- a second step of moving a segment pressing tool (figure 4, presser cylinder 2) down in an axial direction to press the turn portions of the first conductor segments, the segment pressing tool having (at least) a recess (22, 23) for passing the second, lead-specialized conductor segment in the axial direction, so that the segment pressing tool does not interfere with the second, lead-

specialized conductor segment when it presses the turn portions of the first conductor segments (see figures 7A and 7B);

- a third step of twisting by circumferentially moving the first straight portions and the second straight portions while restraining the turn portions of the first conductor segments in the axial direction with the segment pressing tool (see figure 8);
- a fourth step of inserting the previously twisted first and second conductor segments into respective slots formed in the stator core (200, see figure 11);
- a fifth step of bending the first and second straight portions at ends opposite the turn portions thereof in the circumferential direction (see figure 11);
- a sixth step of joining the previously bent first and second conductor segments adjacent to each other (see figure 12); and
- a seventh step of cutting at least one portion of the second, lead-specialized conductor segment near the turn portion to provide two lead wires (see figures 14 to 16).

4.3 The features of the characterising portion of claim 1 are not disclosed in document D1. In particular:

- in the first step, the second straight portions of the second, lead specialized conductor segment are inserted into holding slots of the twisting apparatus so as to be disposed next to one another, not at positions shifted from each other in a circumferential direction as claimed; and

– there is no suggestion for the segment pressing tool to include a movable top plate arranged as claimed.

Thus claim 1 has to be considered novel over the disclosure of document D1.

4.4 It can be understood from paragraphs [0002] to [0008] of the published application that starting from a stator manufacturing method such as that disclosed in document D1, the invention solves the technical problem of allowing greater flexibility in positioning the lead wires of the stator winding.

4.5 In the invention as claimed, this flexibility is achieved by allowing the straight portions of the lead specialized conductor segment to be inserted into holding slots of the twisting apparatus at positions shifted from each other in the circumferential direction. At the same time, the segment pressing tool is provided with a movable top plate which is kept in an accommodation space of the stationary top plate, leaving the recess of the stationary top plate open, so that the segment pressing tool can be moved down over the turn portion of the lead-specialized conductor segment. Thereafter the movable top plate is moved to close the recess. This allows it to press the turn portions of first (normal) conductor segments which are aligned with the recess of the stationary top plate and which would otherwise be unrestrained during the twisting step.

4.6 None of the prior art documents cited in the search report discloses anything that might lead the skilled person to such an arrangement or method.

It seems to the Board that faced with the problem of arranging the lead wires more flexibly, it might be possible to abandon the use of U-shaped lead-specialised conductor segments and to use separate straight conductor segments for the lead wires instead (as disclosed for example in DE 40 31 276 A1, see "Leiterstäbe" 21 in figures 3 to 5). In any case, nothing in the prior art suggests the claimed solution.

4.7 For these reasons the Board concludes that the subject-matter of claim 1 is not obvious in view of the prior art and hence meets the requirements for inventive step. The same applies to the remaining claims, which are all dependent on claim 1.

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 in the following version:

Description:

- Pages 1 to 5 and 12 received during the oral proceedings of 12 December 2012;
- Pages 6 to 11 and 13 to 18 as originally filed;

Claims:

- Nos. 1 to 5 received during the oral proceedings of 12 December 2012;

Drawings:

- Sheets 1/11 to 11/11 as originally filed.

The Registrar: The Chairman:

U. Bultmann M. Ruggiu