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D E C I S I O N
of 13 July 2004

Case Number: T 1047/01 - 3.5.2

Application Number: 97103403.8

Publication Number: 0795951

IPC: H02K 15/06

Language of the proceedings: EN

Title of invention:
Method and apparatus for slotless stator manufacture

Applicant:
KOLLMORGEN CORPORATION

Opponent:
-

Headword:
-

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

Keyword:
"Admissibility of the amendments (yes)"
"Novelty and inventive step - after amendment (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1047/01 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 13 July 2004

Appellant: KOLLMORGEN CORPORATION
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 9 April 2001 refusing European application No. 97103403.8 pursuant to Article 97(1) EPC.**

Composition of the Board:

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

Summary of Facts and Submissions

I. The appellant contests the decision of the examining division to refuse European patent application No. 97 103 403.8. The reasons given for the refusal was that the subject-matter of independent claims 1 and 8 filed with the letter dated 15 January 2001 did not meet the requirements of Articles 52 and 54 EPC and the requirements of Articles 52 and 56 EPC respectively, having regard to the prior art document: D1: EP-A-0 226 550. The subject-matter of independent claim 7 was considered as known from D2: US-A-4 954 739.

II. The documents:

D1: EP-A-0 226 550, and

D2: US-A-4 954 739,

considered in the first instance remain relevant to the present appeal.

III. The current version of independent claims 1 and 7, which were filed with the letter dated 4 May 2004, reads as follows:

Claim 1:

"A method of making a slotless, teethless stator for an electric machine with the winding coils being located at the air gap between stator and rotor of said electric machine, comprising a cylindrical stator shell (14) and winding coils (12) placed on, and attached to, the inner cylindrical surface of said stator shell (14),

including the steps of providing pre-wound winding coils (12); arranging and temporarily securing and affixing said pre-wound winding coils on a cylindrical transfer tool (10); arranging the transfer tool (10) with the temporarily secured winding coils (12) inside said cylindrical stator shell (14); placing the pre-wound winding coils onto said inner cylindrical surface of said stator shell and removing the cylindrical transfer tool (10) with said winding coils remaining located on said cylindrical inner surface of said stator shell, characterized in that said method further includes the steps of

providing the transfer tool (10) with retractable locating pins (18) at one end;

locating said pre-wound, preformed winding coils (12) on said locating pins (18) of said transfer tool (10);

moving said transfer tool (10) with said winding coils (12) thereon through a bottom plate (26), said stator shell (14) and a top plate (28) holding the cylindrical stator shell (14) in position aligned on the axis of the transfer tool (10), the cylindrical cavity of said stator shell (14) and the bottom plate (26), with coil guides (22) mounted to the bottom side of said plate (26);

using said coil guides (22) of said bottom plate (26) for combing said coils (12) while moving through said shell (14) so that portions of said coils (12) located within said stator shell (14) between end turns (11) of said winding coils are substantially parallel;

retracting said locating pins (18) after said winding coils (12) are located within said stator shell (14);

causing said end turns (11) at the locating pin (18) end of said transfer tool (10) to flair outwardly; and

removing said transfer tool (10)."

Claim 7:

"An apparatus for use in the manufacture of a slotless, theethless stator of an electric motor with the stator winding consisting of pre-wound coils (12) being arranged between the cylindrical inner surface of a stator shell (14) and a rotor provided with permanent magnets, said apparatus comprising a transfer tool (10) and coil guides (22), said transfer tool (10) comprising means for arranging the pre-wound winding coils on its cylindrical surface, transferring said winding coils to the inner, cylindrical surface of the stator shell (14) by inserting the transfer tool (10) into the cylindrical opening of said stator shell, placing said winding coils on said cylindrical surface of said stator shell, and removing the transfer tool after placing said winding coils, characterized in that said transfer tool (10) comprises

retractable locating pins (18) at one end for locating said pre-wound, preformed winding coils (12) on its surface;

and means for retracting said locating pins (18) after placing and arranging said winding coils on said inner

surface of said stator shell so that the transfer tool can be removed,

wherein said coil guides (22) are arranged to be activated for combing said winding coils while inserting said transfer tool into the cylindrical opening of said stator shell so that portions of said winding coils located within said cylindrical opening of said stator shell between end turns (11) are substantially parallel."

Claims 2 to 6 are dependent on claim 1 and claims 8 and 9 are dependent on claim 7.

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

The apparatus disclosed in D1, which comprised a transfer tool for inserting coils into the longitudinal cavities of a stator, was unable to transfer pre-wound coils onto the smooth, uninterrupted, cylindrical inner surface of a slotless, theethless stator. No obvious adaptation of this prior art tool would lead to the claimed apparatus or method for manufacturing a slotless, theethless stator.

V. The appellant requested that the decision under appeal be set aside and that a patent be granted in the following version:

claims: 1 to 9 filed with letter of 4 May 2004,

description: pages 1, 1a, 2 filed with letter of 8 April 2004; pages 3 to 6 as originally filed; and

drawings: Figures 1 to 8 as originally filed.

Reasons for the Decision

1. The appeal is admissible.

Amendments

2. The Board is satisfied that the claims and description according to the present request meet the requirements of Article 84 EPC and do not contravene Article 123(2) EPC.

2.1 This applies in particular to the present claim 1 which relates to "a method of making a slotless, teethless stator for an electric machine with the winding coils being located at the air gap between stator and rotor of said electric machine, comprising a cylindrical stator shell (14) and winding coils (12) placed on, and attached to, the inner cylindrical surface of said stator shell (14)", as this appears from claim 1 and the description (column 1, lines 5 to 8; column 3, lines 51 to 54) as originally filed. Claim 1 comprises all the essential features recited in claim 1 of the application as originally filed and the additional feature according to which the transfer tool is moved "through a bottom plate (26), said stator shell (14) and a top plate (28) holding the cylindrical stator

shell (14) in position aligned on the axis of the transfer tool (10), the cylindrical cavity of said stator shell (14) and the bottom plate (26), with coil guides (22) mounted to the bottom side of said plate (26)". This additional feature is included in the preferred embodiment of realisation disclosed in the application as filed (see, for instance Figures 1 to 8; column 3, lines 54 to 57). The method according to claim 1 does not contravene Article 123(2) EPC.

2.2 Claim 7 relates to "an apparatus for use in the manufacture of a slotless, theethless stator of an electric motor" and specifies in terms of functions all the means used in the method according to claim 1 for transferring the winding coils on the inner surface of the stator shell, in particular retractable locating pins, means for retracting said locating pins and coil guides. These means were disclosed in the application as filed. Accordingly, the apparatus according to claim 7 does not extend beyond the content of the original application.

Novelty

3. The subject-matter of claim 7 is considered to be new (Article 54(1) EPC) because none of the cited prior art documents discloses an apparatus for use in the manufacture of a slotless, theethless stator of an electric motor which comprises in combination all the features recited in claim 7. More specifically:

3.1 D1 discloses (Figures 1 to 4; column 1, lines 4 to 17; column 3, line 14 to column 14, line 51) an apparatus for manufacturing a stator of an electric machine

comprising a cylindrical stator shell (2) and winding coils (A) inserted in longitudinal cavities of the stator shell. This apparatus comprises a support (8) with key guide blades (10) projecting beyond the support and supporting the stator shell (2), a support tool (14) surrounding the key guide blades (10) and having a coil guide member (13), a series of coil guide blades (6) and a thrust member (12). The coil guide blades receive pre-wound winding coils and form with the thrust member (12) a transfer tool which is moved upward to insert the winding coils into the cavities of the stator shell and is removed after the coils have been placed.

3.2 However, there is no indication in D1, and in particular not in column 3, lines 28 to 56, where the operation of the coil guide blades (6) is described, that these guides blades are retracted, i.e. are moved back with respect of the thrust member (12) before this member is removed from its operative position. Neither the coil guide blades (6) nor the coil guide member (13) are arranged for combing the winding coils during the insertion of the transfer tool into the stator shell. D1 thus discloses neither a transfer tool having retractable locating pins at one end, nor means for retracting said locating pins after the coils are located within the stator shell, nor coil guides, as recited in claim 7. An apparatus having the features recited in the characterizing part of claim 7 is not disclosed in D1.

3.3 Document D2 relates to a slotless, theethless motor and a transfer tool (50) for manufacturing the stator of such a motor (Figures 7A to 8D). However, neither a

transfer tool which comprises retractable locating pins at one end for locating pre-wound coils and means for retracting said pins after the coils have been placed on the inner surface of the stator shell, nor coil guides for combing the coils while insertion of the transfer tool into the stator shell are disclosed in D2. The other documents cited in the search report have a teaching similar to that of D2, or are less relevant.

4. The same considerations apply to claim 1 which relates to a method of making a slotless, theethless stator using a transfer tool and coil guides having the features recited in claim 7. In addition, the method of claim 1 is distinguished over the disclosure of D1 by a step of moving the transfer tool through a bottom plate supporting the coil guides, the stator shell and a top plate holding this stator and by a step of causing the end turns at the locating pin end of the transfer tool to flair outwardly before removing the transfer tool. In D1, the transfer tool (12, 6) is first moved through a bottom plate (14) holding the stator and through the stator itself, is removed and the end turns of the coils are then caused to flair outwardly by another tool (22) (column 4, lines 42 to 51). Claim 1 is correctly limited against D1.

Inventive step

5. Starting from D1 and having regard to the technical effects achieved by the invention (see the application as published, column 2, lines 13 to 15), the objective problem addressed by the invention could be seen as providing slotless and theethless stators having reduced coil positioning errors and higher slot-fills

(ratio of copper cross-sectional area to total slot area). This problem is solved by the characterizing features of claim 7.

6. As already mentioned in paragraphs 3 to 3.3 above, no suggestion of such a solution can be found in any of the prior art documents, which disclose transfer tools for making stators of electric motors which differ from the apparatus according to claim 7 by at least two independent features. The method according to claim 1 differs from the methods disclosed in the prior art by at least four steps (see paragraphs 3 to 4 above).

7. For the foregoing reasons, in the Board’s judgement the subject-matter of claim 1 and 7 according to the present request is considered to be new and involve an inventive step within the meaning of Articles 54 and 56 EPC. The application as amended meets the requirements of the 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 grant a patent in the following version:

claims: 1 to 9 filed with letter of 4 May 2004,

description: pages 1, 1a, 2 filed with letter of 8 April 2004; pages 3 to 6 as originally filed; and

drawings: as originally filed.

The Registrar: The Chairman:

D. Sauter W. J. L. Wheeler