Internal distribution code:

(A) [-] Publication in OJ
(B) [-] To Chairmen and Members
(C) [-] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 21 October 2019

Case Number: T 1996/14 - 3.5.02

Application Number: 05752876.2

Publication Number: 1766755

IPC: H02K15/00, B23K35/00

Language of the proceedings: EN

Title of invention:
Rotor for electric motor, compressor unit provided with rotor, method for producing a rotor for an electric motor

Patent Proprietor:
Siemens Aktiengesellschaft

Opponent:
ABB Oy

Relevant legal provisions:
EPC Art. 56, 84
RPBA Art. 12(4), 13(1)

Keyword:
Inventive step - main request (request 1) and auxiliary requests 2 and 2b (no)
Clarity - auxiliary requests 3 to 6 (no)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 1996/14 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 21 October 2019

Appellant: (Opponent)	ABB Oy Strömbergintie 1 00380 Helsinki (FI)
Representative:	Kolster Oy Ab (Salmisaarenaukio 1) P.O. Box 204 00181 Helsinki (FI)
Respondent: (Patent Proprietor)	Siemens Aktiengesellschaft Werner-von-Siemens-Straße 1 80333 München (DE)
Representative:	Siemens AG Postfach 22 16 34 80506 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 14 August 2014 concerning maintenance of the European Patent No. 1766755 in amended form.**

Composition of the Board:

Chairman	R. Lord
Members:	C. Vassoille
	J. Hoppe

Summary of Facts and Submissions

I. The appeal of the opponent (appellant) lies against the interlocutory decision of the opposition division concerning European patent no. 1 766 755.

II. In the decision under appeal, the opposition division came to the conclusion that the main request (patent in amended form based on the claims as filed on 16 July 2013) satisfied the requirements of Articles 83, 123(2) and 56 EPC. With its appeal the appellant requested that the patent be revoked.

III. The following documents are relevant for the present decision:

D4: JP 03-261354 A and its English computer translation

D11: Text book: "Diffusion Bonding of Materials", edited by N.F. Kazakov, Moscow, 1981, Pergamon Press, 1985, the title page, the Contents, the Preface and pages 32 to 35 and 162 to 163.

IV. With the reply to the statement of grounds of appeal, the patent proprietor (respondent) filed a main request (request 1) and five auxiliary requests (requests 2 to 6). The main request (patent in amended form) corresponded to the main request that was considered by the opposition division to fulfil the requirements of the EPC.

V. The parties were summoned to oral proceedings. In a communication under Article 15(1) RPBA annexed to the summons, the board set out their preliminary observations on the appeal, concluding *inter alia* that the subject-matter of claim 1 of the main request as

well as that of request 2 did not seem to involve an inventive step in the sense of Article 56 EPC and that claim 1 of each of requests 3 to 6 seemed not to fulfil the requirements of Article 84 EPC.

VI. With letter of 9 August 2019, the respondent filed amended requests 2b and 3 to 6.

VII. Oral proceedings were held on 21 October 2019. As announced in the letter of 26 August 2019, the appellant did not attend the oral proceedings.

The appellant requested in writing that the decision under appeal be set aside and that the European patent be revoked.

The respondent requested that the appeal be dismissed (main request, "request 1") or as an auxiliary measure that the patent be maintained in amended form based on the claims of the first auxiliary request ("request 2"), filed with letter dated 10 April 2015 or on the basis of the claims of one of the auxiliary requests labelled "request 2b", "request 3", "request 4", "request 5" or "request 6", filed with letter dated 9 August 2019, in that order.

VIII. Claim 1 of the respondent's request 2b reads as follows:

"Rotor (6) for an electric motor (4), said rotor being a squirrel cage that is bonded by hot isostatic pressing, comprising a substantially cylindrical core (30), made from a core material, wherein said core material ist (sic) steel, provided with a plurality of longitudinal grooves (34) which extend substantially parallel to the cylinder axis, conductive rods (31),

made from an electrically conductive material, which are provided in the longitudinal grooves (34), and two short-circuit rings (32) which conductively connect the axial ends of the conductive rods (31) to one another, characterized in that
a diffusion layer (40, 41, 42) extends between the conductive rods (31) and the cylindrical core (30), the diffusion layer (40, 41, 42) comprising a diffusion material, the diffusion material being a different material from the core material, and from the electrically conductive material of the conductive rods,
wherein the diffusion material comprises nickel,
wherein the conductive rods are made from copper and the diffusion layer comprises nickel."

IX. Claim 1 of the respondent's main request (request 1) and of the first auxiliary request (request 2) each differ essentially from claim 1 of request 2b in that it does not define that the diffusion material comprises nickel. Claim 1 of the main request (request 1) additionally does not define the core material to be steel.

X. Claim 1 of the respondent's request 3 reads as follows:

"Rotor (6) for an electric motor (4), said rotor being a squirrel cage that is bonded by hot isostatic pressing, comprising a substantially cylindrical core (30), made from a core material, wherein said core material ist (sic) steel, provided with a plurality of longitudinal grooves (34) which extend substantially parallel to the cylinder axis, conductive rods (31), made from an electrically conductive material, which are provided in the longitudinal grooves (34), and two

short-circuit rings (32) which conductively connect the axial ends of the conductive rods (31) to one another, characterized in that
a diffusion layer (40, 41, 42) extends between the conductive rods (31) and the cylindrical core (30), the diffusion layer (40, 41, 42) comprising a diffusion material, the diffusion material being a different material from the core material, and from the electrically conductive material of the conductive rods,
wherein the diffusion material comprises nickel,
wherein the conductive rods are made from copper and the diffusion layer comprises nickel
wherein the conductive rods (31) are joined to the core (30) by positioning the conductive rods (31) in the longitudinal grooves (34), and supplying heat and applying pressure to at least the conductive rods (31)." (underlining added by the board)

The above underlined feature was also present in claim 1 of each of the further requests 4 to 6.

XI. The arguments of the appellant as far as they are relevant for the present decision are as follows:

Admissibility of document D11

Document D11 was submitted for the first time with the statement of grounds of appeal but should nevertheless be admitted in the appeal proceedings because it supported the appellant's argument that the use of nickel in diffusion bonding of copper and steel belonged to the common general knowledge of the skilled person.

Furthermore, filing of D11 was a reaction to the opposition division's opinion in the decision under appeal that the use of nickel as an intermediate layer in hot isostatic pressing (HIP) was not obvious to the skilled person.

Main request (request 1), auxiliary requests (requests 2 and 2b) - inventive step (Article 56 EPC)

The appellant raised an objection under Article 56 EPC based on D4 as closest prior art. Document D4 disclosed a rotor (1) with a steel core (7) having a number of closed or open axial slot holes (2) on the outer surface of the steel core (7). Conductor bars (3) of copper or copper alloy were provided in the slot holes (2) and short circuit rings (4) connect the axial ends of the conductor bars (3) to one another. The rotor (1), the conductor bars (3) and the short circuit rings (4) were integrated together through diffusion welding caused by hot isostatic pressing (HIP) or cold isostatic pressing (CIP) in a pressure resistant vessel (see D4 on page 3 of the English translation and figures 1 and 2).

The expression "closed or open slot holes" was used on page 3, lines 11 to 12 of the English translation of D4 when referring to the first embodiment of the invention. It was thus clear that the expression "open slot holes" means that they were fully open at the circumference of the rotor i.e. the open slot holes were grooves made in the outer circumference of the rotor in accordance with the subject-matter of claim 1 of each of these requests.

Contrary to what was argued by the respondent, the conductor bars would be attached with a diffusion joint to the rotor core in the HIP process performed in D4.

D4 hence disclosed all the features of claim 1 of the respondent's main request (request 1) except for the use of nickel as a diffusion material between the copper bars and the steel core.

The objective technical problem could be considered to further improve the HIP bond between copper and steel.

The use of nickel in diffusion bonding of copper and steel in order to achieve stronger bonds was common general knowledge long before the priority date of the patent in suit, as could be seen from document D11, which was an excerpt from a basic text book in the field of diffusion welding.

In particular, D11 on page 163, lines 3 to 5 stated that:

"Stronger joints between copper or its alloys and iron are obtained, when a nickel interlayer is used. The nickel forms a continuous range of solid solutions with iron and copper. As follows from the Fe-Ni-Cu phase diagram, the nickel substantially increases the solubility of iron in copper and of copper in iron..."

The teaching in document D11 was thus clear, namely to use nickel as an intermediate layer between steel and copper in diffusion bonding in order to achieve a stronger joint. The reason to use nickel in the joint was that the nickel substantially increases the solubility of iron in copper and of copper in iron. This applied to diffusion welding/bonding and naturally

also to hot isostatic pressing, which was just one variant of diffusion welding.

The reason for using nickel as diffusion material was naturally to achieve a stronger diffusion bond. The currents passing through the copper cylinder would be very high in an acyclic generator.

It would thus have been obvious to apply the teaching of using nickel as a diffusion material in diffusion bonding of copper and steel in order to achieve a stronger diffusion joint between the copper rods and the rotor in the HIP process of D4.

The invention as defined in claim 1 of the main request as well as that of requests 2 and 2b therefore did not involve an inventive step based on the teaching of D4 combined with the common general knowledge of the skilled person. The same applied to the independent method claim 12 of each of these requests.

Auxiliary requests (requests 3 to 6) - clarity (Article 84 EPC)

The additional feature of claim 1 of each of requests 3 to 6 "wherein the conductive rods (31) are joined to the core (30) by positioning the conductive rods (31) in the longitudinal grooves (34), and supplying heat and applying pressure to at least the conductive rods (31)" was based on a portion of independent claim 13 (method claim) of the patent as granted.

This new definition defined a method step in an apparatus claim and it was unclear how this method step could bring any novel distinctive feature to an apparatus claim. Furthermore, hot isostatic pressing

was already included in claim 1, which meant by definition that heat was supplied and pressure applied in order to achieve a diffusion bond. The new method feature included in claim 1 therefore did not limit the scope of protection in any way but rather represented a result to be achieved.

XII. The arguments of the respondent as far as they are relevant for the present decision are as follows:

Admissibility of document D11

Document D11 not only served to fill a gap in the appellant's arguments but represented a new argument. Furthermore, the appellant had not been hindered from carrying out additional searches already at an earlier state of the proceedings. Document D11 also did not go beyond the content of document D5, which disclosed the use of nickel as an intermediate layer in diffusion bonding of copper and steel. Document D11 therefore was not more relevant than the prior art on file and consequently should be excluded from the appeal procedure.

Main request (request 1), auxiliary requests (requests 2 and 2b) - inventive step (Article 56 EPC)

It was questionable why the skilled person, when starting from document D4, would have been motivated to provide a different or better way to connect the conductor rods to the rotor core.

Document D4 referred to a squirrel cage rotor. There was no additional diffusion layer provided, so there was no solid connection between the conductor rods and the rotor core. For this reason, the longitudinal

grooves in document D4 were designed as a positive fit with the conductor rod. This form fit was clearly visible in figure 2 (slot hole). The translation of document D4 disclosed that ".... by inserting the conductor bar into a slot hole of the rotor", which meant that the conductor rods must be inserted axially into the longitudinal grooves of the rotor core and could not be inserted radially, as the profile shape of the conductor rods corresponded to the profile shape of the grooves and therefore, the radial form fit only permitted an insertion in an axial direction.

Document D4 thus provided already for a solid connection between the conductor rods and the rotor core by means of a form fit. Consequently, there was no need to provide an improved material bond between the conductor rods and the rotor core. Document D4 consequently taught away from the present invention.

Document D11 was not in any way related to a squirrel cage rotor according to the present invention. Many different aspects had to be considered when constructing a squirrel cage rotor. D11 was however exclusively concerned with materials science and the skilled person would therefore not consider this document to be relevant on first sight. Furthermore, it was a big step between a laboratory test arrangement to an actual application of theoretical material related knowledge in practice. It was further not obvious that the provision of nickel as an intermediate layer would in practice improve the bond between copper and steel.

The skilled person had therefore no motivation to modify the squirrel cage rotor of D4 in view of the general teaching provided by D11. A combination of D4 and D11 was rather based on hindsight.

Auxiliary requests (requests 3 to 6) - clarity (Article 84 EPC)

The importance of providing a bond between the conductive rods and the rotor core was clarified in claim 1 of requests 3 to 6 by adding the feature "wherein the conductive rods (31) are joined to the core (30) by positioning the conductive rods (31) in the longitudinal grooves (34), and supplying heat and applying pressure to at least the conductive rods (31)". The technical effect was an improved quality of the material bond between the conductive rods and the rotor core resulting from the application of heat and the supply of pressure specifically in the area between these two elements.

The feature was therefore clear in the sense of Article 84 EPC.

Reasons for the Decision

1. The appeal is admissible

2. Admittance of document D11 into the appeal procedure

2.1 Document D11 is an excerpt from a text book, which has been filed with the appellant's statement of grounds of appeal in order to prove that the use of nickel as an intermediate layer in diffusion bonding of steel and copper belongs to the common general knowledge of the skilled person.

2.2 The board does not agree with the respondent that document D11 is not more relevant than document D5. In the context of document D5 the use of nickel is clearly

limited to the specific technical circumstances of an internally cooled rotor for an acyclic generator, while D11 represents the common general knowledge of the skilled person in the context of diffusion welding. This has in principle not been contested by the respondent.

2.3 The board therefore sees no reason to exercise its discretion according to Article 12(4) RPBA to exclude document D11 from the appeal procedure.

3. Admittance of "Request 2b" into the appeal procedure

3.1 Amended request 2b was filed in reaction to the board's communication under Article 15(1) RPBA mentioning a potential problem with respect to Article 123(2) EPC, as regards the expression "the diffusion layer comprises nickel" in the former claims which is now changed to "the diffusion material comprises nickel". The appellant has not presented any request to not admit this amended auxiliary request, filed at a very late state of the appeal procedure.

3.2 Considering these circumstances, the board thus exercises its discretion under Article 13 (1) RPBA to admit request 2b into the appeal procedure.

4. "Request 2b" - inventive step (Article 56 EPC)

4.1 Novelty of the subject-matter of claim 1 of the respondent's request 2b is not in dispute with regard to the documents which are in the procedure. Nor is it in dispute that document D4 represents the most relevant prior art for the assessment of inventive step.

4.2 The distinguishing feature of claim 1 over D4 was identified by the appellant to be that of a diffusion layer extending between the conductive rods and the cylindrical core, the diffusion layer comprising a diffusion material, the diffusion material comprising nickel. The respondent did not contest this finding.

4.3 The parties further agreed that the objective technical problem should be considered to be that of how to improve the hot isostatic pressing (HIP) bond between copper and steel.

4.4 Contrary to the respondent's argument, document D4 does not solve this problem already by providing a form fit between the conductor bars and the longitudinal grooves. Only the figures show an undercut of the longitudinal grooves, which leads to a form fit, which is however not mentioned in the description. To the contrary, document D4 explicitly discloses that the slot holes (longitudinal grooves) provided in the iron rotor core might be open or closed (see page 3, lines 11 to 12 of the English translation).

Furthermore, D4 explicitly discloses that a solid rotor is formed by hot isostatic pressing (see page 4, lines 18 to 23 of the English translation) and there is nothing in D4 that would lead the skilled person to the assumption that a form fit between the conductor bars and the longitudinal grooves (and thus with the rotor core) would render a material bonding between the conductor bars and the rotor core superfluous.

The board is also not convinced that the application of hot isostatic pressing as described on page 4 of D4 does not result in a material bond between the conductor bars and the rotor core, as has been argued

by the respondent. Even if a resulting material bond might not be strong, the assumption that no bonding occurs at all is neither plausible nor supported by D4, as the appellant has credibly argued.

Consequently, it is also a clear aim of D4 to achieve a solid rotor (see page 4, line 23) by providing a solid material bond between the iron rotor core and the copper conductor bars, in particular by application of a HIP process.

4.5 The skilled person working in the field of squirrel cage rotors can be assumed to have knowledge of the relevant fields of material sciences. The common general knowledge of the skilled person working in this field also includes the teaching of D11, which was not contested by the respondent.

The skilled person when starting from D4, and being confronted with the objective technical problem, would use their common general knowledge according to D11 (see page 163, lines 3 to 4) to provide an improved, namely a stronger, connection between steel and copper by using nickel as a diffusion material, which is able to withstand the centripetal forces occurring at high rotational speeds of the rotor.

The fact that document D11 does not refer to a specific application but generally to materials science does not prevent the skilled person in the present case from using their general knowledge corresponding to what is contained in D11 in order to improve the bond between the rotor core and the conductor bar by using nickel as a diffusion material between steel and copper in a hot isostatic pressing process.

Furthermore, the assumption that the theoretical teaching of D11 could not be put into practice or would not work in practice is pure speculation and has not been substantiated by the respondent in any way.

4.6 In conclusion, the subject-matter of claim 1 of request 2b is obvious in view of document D4 in combination with the common general knowledge of the skilled person and therefore does not involve an inventive step in the sense of Article 56 EPC.

5. Main request (request 1) and first auxiliary request (request 2)

5.1 Claim 1 of each of the main request (request 1) and the first auxiliary request (request 2) differs from claim 1 of request 2b only in that it does not comprise the feature that "the diffusion material comprises nickel", and in that the main request additionally does not comprise the feature "wherein said core material is steel".

5.2 The subject-matter of claim 1 of each of request 1 and request 2 is thus broader than that of request 2b and the essential distinguishing features of claim 1 of each these three requests correspond to each other. The board's finding under point 4 above, in particular under points 4.4 to 4.6, that the subject-matter of claim 1 of request 2b does not involve an inventive step in the sense of Article 56 EPC, therefore also applies to the subject-matter of claim 1 of the main request (request 1) and to that of the first auxiliary request (request 2).

6. Requests 3 to 6

6.1 Admittance into the appeal procedure

6.1.1 Amended requests 3 to 6 were filed in reaction to the board's communication under Article 15(1) RPBA mentioning a potential problem with respect to Article 123(2) EPC, which also applied to the former requests 3 to 6. The appellant has not presented any request to not admit these amended auxiliary requests, filed at a very late state of the appeal procedure.

6.1.2 Considering these circumstances, the board thus exercises its discretion under Article 13 (1) RPBA to admit requests 3 to 6 into the appeal procedure.

6.2 Clarity (Article 84 EPC)

6.2.1 Each of the requests 3 to 6 comprises the following additional feature in claim 1:

> "wherein the conductive rods (31) are joined to the core (30) by positioning the conductive rods (31) in the longitudinal grooves (34), and supplying heat and applying pressure to at least the conductive rods (31)"

This feature has been extracted from the independent method claim 13 of the patent as granted. Examining whether the feature in question meets the requirements of Article 84 EPC is therefore consistent with the findings of the Enlarged Board of Appeal in G3/14.

6.2.2 While it is generally accepted that under certain circumstances the inclusion of a method or functional feature in an apparatus claim may satisfy the

requirements of Article 84 EPC, the board in the present case considers that the extraction of the method feature from the independent method claim 13 and its inclusion in the apparatus claim 1 renders the subject-matter of claim 1 unclear.

The feature in question adds nothing to claim 1 that goes beyond what was already contained in the claim. In particular, the board agrees with the appellant that claim 1, by referring to a HIP process and further by defining a diffusion layer, which extends between the conductive rods and the cylindrical core, already implies the supply of heat and the application of pressure to at least the conductive rods. Otherwise, no diffusion layer would be formed, which is an explicit product of the HIP process including the supply of heat and the application of pressure.

The board further observes that the feature in question does not specify either temperature or pressure level, so that it cannot be argued that a certain level of these parameters produces a particular effect that goes beyond what was already achieved by claim 1 without the feature in question.

6.2.3 Since the additional method feature does not provide any substantial contribution to the subject-matter of claim 1, it must be considered redundant. Claim 1 of requests 3 to 6, each of them comprising the feature in question, therefore does not fulfil the requirements of clarity and conciseness (Article 84 EPC).

Conclusion

6.3 Since the subject-matter of the main request (request 1) and requests 2 and 2b does not fulfil the

requirements of Article 56 EPC and since the only further requests 3 to 6 do not fulfil the requirements of Article 84 EPC, the board had to accede to the appellant's request to set the decision under appeal aside and revoke the patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

U. Bultmann R. Lord

Decision electronically authenticated