Internal distribution code:

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

Datasheet for the decision of 22 November 2021

Case Number: T 2058/17 - 3.5.02

Application Number: 08251537.0

Publication Number: 2003765

IPC: H02K9/10, H02K9/04

Language of the proceedings: EN

Title of invention:
Electric motor cooling

Applicant:
Hamilton Sundstrand Corporation

Relevant legal provisions:
EPC Art. 84, 54, 56

Keyword:
Claims - main request support in the description (no) - auxiliary requests 1 and 2 essential features (no)
Inventive step - auxiliary request 2A (yes)

This datasheet is not part of the Decisior
It can be changed at any time and without notic

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 2058/17 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 22 November 2021

Appellant: (Applicant)	Hamilton Sundstrand Corporation One Hamilton Road Windsor Locks, CT 06096-1010 (US)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 5 April 2017 refusing European patent application No. 08251537.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Lord
Members:	G. Flyng
	A. Bacchin

Summary of Facts and Submissions

I. The appeal contests the examining division's decision dated 5 April 2017 with which the European patent application no. 08 251 537.0 was refused.

II. The following document references are used herein:
D1: US 2007/018516 A1.
D2: US 2006/0061222 A1

III. The contested decision was taken according to the state of the file and makes reference to a communication of the examining division dated 13 March 2017 for its grounds. In that communication, the examining division considered the applicant's main request and first to third auxiliary requests filed on 23 February 2017.

Considering the main request the examining division held that claim 1 did not meet the requirements of Article 84 EPC because it did not include all essential features of the invention as it left open whether:
(a) it is the first or the second cooling source, which has the high(er) pressure;
(b) the first cooling flow is provided by the first or the second cooling source; and
(c) the second cooling flow is provided by the second or the first cooling source.

Furthermore, the examining division held that the subject-matter of claim 1 of the main request lacked novelty from document D1, Article 54 EPC. In coming to this conclusion the examining division considered the bearings 42 in document D1 to be journal bearings in the sense of claim 1 (see point XI. below).

The examining division reasoned that even if, rather than the bearings 42, the outer bearings in D1 were considered to be the journal bearings, it would be an obvious measure for the skilled person to provide cooling air to these outer bearings to cool them. Thus, claim 1 also lacked an inventive step, Article 56 EPC.

IV. With the statement setting out the grounds of appeal dated 15 August 2017 the appellant (applicant) filed amended sets of claims of a main request and first to fifth auxiliary requests, and requested that a patent be granted on the basis of one of them.

V. The Board summoned the appellant to oral proceedings, setting out their preliminary observations in a communication pursuant to Article 15(1) RPBA 2020. With regard to the main request the Board considered that the claimed feature according to which the rotor received the second cooling flow did not appear to be supported by the description, contrary to Article 84 EPC. The Board concurred with the appellant that the subject-matter of claim 1 of the main request was novel over document D1 and tended to accept the appellant's argument that the examining division's inventive step objection starting from document D1 was based on hindsight. Nevertheless, it seemed that the subject-matter of claim 1 of the main request might be obvious when starting from document D2. The Board noted that none of the auxiliary requests seemed to overcome the Article 84 EPC objection set out for the main request.

VI. With a letter dated 21 October 2021, submitted electronically on 22 October 2021, the appellant filed claim sets according to a main request, which was identical to that filed with the statement setting out

the grounds of appeal, and new first to fourth auxiliary requests.

VII. With an electronic submission of 17 November 2021 the appellant filed claim sets according to auxiliary requests 3A, 3B, 4A and 4B.

VIII. On 19 November 2021 the rapporteur telephoned the appellant's representative and set out the Board's preliminary observations on the latest requests.

IX. With an electronic submission of 19 November 2021 the appellant filed a claim set according to an auxiliary request 2A.

X. Oral proceedings were held as scheduled on 22 November 2021. The appellant submitted amended pages 1, 2 and 2a of the description. The appellant requested finally that the decision under appeal be set aside and a patent be granted on the basis of the claims of the main request filed with the statement setting out the grounds of appeal, or auxiliarily on the basis of the first or second auxiliary requests filed with letter of 21 October 2021. If that was not possible, the appellant further requested that a patent be granted on the basis of auxiliary request 2A, the claims of which were filed with letter of 19 November 2021, or auxiliarily on the basis of the third or fourth auxiliary requests filed with letter of 21 October 2021. Further auxiliarily, the appellant requested that a patent be granted on the basis of one of auxiliary requests 3A, 3B, 4A, 4B filed with letter of 17 November 2021, or on the basis of one of the fifth to ninth auxiliary requests filed with the statement setting out the grounds of appeal as first to fifth auxiliary requests. In addition to the claims

specified above, auxiliary request 2A also comprised the description pages 1, 2 and 2a filed during the oral proceedings and pages 3 to 5 as originally filed, and drawings pages 1/3 to 3/3 as originally filed.

XI. Claim 1 of the **main request** filed with the statement setting out the grounds of appeal reads as follows:

"1. An electric motor comprising an electric motor cooling system comprising:

first (40) and second (46) cooling sources having different pressures from one another and respectively providing first and second cooling flows, wherein the first cooling source (40) is at a lower pressure than the second cooling source (46) resulting in a differential pressure;

a stator (14) mounted in a housing (16) and receiving the first cooling flow; and

a rotor (120 rotatable relative to the stator and receiving the second cooling flow,

wherein the rotor is supported for rotation relative to the stator by journal bearings (22) mounted in the housing, the second cooling flow flowing through the journal bearing."

Claim 1 of the **first auxiliary reques**t differs from the main request in that the feature concerning the rotor has been amended as follows:

"a rotor (120 rotatable relative to the stator and ~~receiving~~ arranged to be cooled by the second cooling flow".

Claim 1 of the **second auxiliary request** differs from the first auxiliary request in that the following feature has been added at the end:

"and wherein the differential pressure moves the second cooling flow through a circumferential

gap (56) arranged between the stator and the rotor".

Claim 1 of the **auxiliary request 2A** reads as follows (amendments with respect to the main request indicated by the Board):

1. An electric motor comprising an electric motor cooling system comprising:

first (40) and second (46) cooling sources having different pressures from one another and respectively providing first and second cooling flows, wherein the first cooling source (40) is at a lower pressure than the second cooling source (46) resulting in a differential pressure;

a stator (14) mounted in a housing (16) and receiving the first cooling flow; and

a rotor (120) rotatable relative to the stator ~~and receiving the second cooling flow~~,

wherein the rotor is supported for rotation relative to the stator by journal bearings (22) mounted in the housing, the second cooling flow flowing through the journal bearing,

and wherein the differential pressure moves the second cooling flow through a circumferential gap (56) arranged between the stator and the rotor, to cool the rotor.

In view of the Board's conclusion on the auxiliary request 2A, the subsequent requests need not be quoted here.

XII. The appellant's submissions that are relevant for the findings in this decision may be summarised as follows:

Main Request, Article 84 EPC

The introduction of the feature "wherein the first cooling source (40) is at a lower pressure than the second cooling source (46) resulting in a differential pressure" overcame the objection concerning missing essential feature (a) (see section III. above).

Claim 1 did not leave open which of the two cooling source provides which of the two cooling flows (essential features (b) and (c)) as this was clear from the word "respectively" in claim 1.

It was implicit from the feature "a rotor (12)... receiving the second cooling flow" that the rotor was cooled by the second cooling flow. For this to be the case, the rotor had to receive the second cooling flow in some manner. Thus, the flow of the second cooling flow through the circumferential gap arranged between the stator and the rotor could be said to be received by the rotor. The feature was perhaps broad, but it was well established that a broad term within a claim did not necessarily lead to a lack of clarity.

First Auxiliary Request, Article 84 EPC

The feature that the rotor was arranged to be cooled by the second cooling flow was clear. The crucial feature was that the rotor was cooled by the second cooling flow - whether this be by the rotor itself receiving the second cooling flow, or by the second cooling flow flowing through the circumferential gap arranged between the stator and the rotor.

Second Auxiliary Request, Article 84 EPC

The appellant submitted that claim 1 of the second auxiliary request defined that the rotor was cooled by the second cooling flow, and that this was achieved by the second cooling flow flowing through the circumferential gap arranged between the stator and the rotor. The claim was therefore clear.

Auxiliary Request 2A

The appellant submitted that auxiliary request 2A met the requirements of the Convention. In particular, the claims were clear and supported by the description, as required by Article 84 EPC, the amendments did not contravene Article 123(2) EPC, and the claimed subject-matter was novel and inventive within the meaning of Articles 54 and 56 EPC.

Reasons for the Decision

1. *Main Request, Article 84 EPC*

1.1 The Board concurs with the appellant that the introduction of the feature "wherein the first cooling source (40) is at a lower pressure than the second cooling source (46) resulting in a differential pressure" overcomes the examining division's objection concerning missing essential feature (a) (see section III. above).

1.2 Furthermore, the Board concurs with the appellant that it is clear from the word "respectively" in claim 1

that the first cooling source (40) provides the first cooling flow and the second cooling source (46) provides the second cooling flow. The Board can see no other interpretation in the context.

1.3 Nevertheless, there is a deficiency under Article 84 EPC that was not addressed in the contested decision. This concerns the feature of claim 1 that the motor comprises "a rotor (12) ... receiving the second cooling flow".

1.3.1 The second cooling flow is the one provided by the second cooling source (46), which is at a higher pressure than the first cooling source (40). In the disclosed embodiments the second cooling source (46) is cooled bleed air from a turbine engine (see page 3, lines 21 to 31 and figure 2 of the application as filed). As set out there, the second cooling source (cooled bleed air) provides a second cooling flow used to cool the journal bearings 22.

1.3.2 Furthermore, as set out on page 4, lines 1 to 7 of the application as filed:

> "A circumferential gap 56 is provided between the rotor 12 and stator 14. The second flow flows through the journal bearing 22 and leaks past the seal assembly 24, as is typical, entering the cavity 50. Flow from the enclosed cavity 50 enters the gap 56 to cool the rotor."

1.3.3 It is clear from these passages, as well as from figures 2 and 5, that in these broadest embodiments the second cooling flow is received not by the rotor 12, but by the circumferential gap 56 provided between the rotor 12 and stator 14. Indeed that is confirmed by dependent claim 3 of the main request.

1.3.4 Thus, the claimed feature according to which the rotor receives the second cooling flow is not supported by the description, contrary to Article 84 EPC.

1.3.5 The appellant argued that the second cooling flow through the circumferential gap arranged between the stator and the rotor could be said to be "received by the rotor". The Board was not convinced. Following the appellant's argument, it might be said that in the embodiment the second cooling flow through the circumferential gap arranged between the stator and the rotor is in some broad sense received by both the rotor and the stator. However by claiming only that the second cooling flow is "received by the rotor", the impression is given that the rotor receives the second cooling flow, but not the stator. Such an arrangement is not supported by the arrangement set out in the description.

1.4 For these reasons Board came to the conclusion that the subject-matter of claim 1 of the main request did not fulfil the requirements of Article 84 EPC due to lack of support by the description.

2. *First Auxiliary Request, Article 84 EPC*

2.1 According to claim 1 of the first auxiliary request the rotor is arranged to be cooled by the second cooling flow. With this definition solely in terms of the result to be achieved, claim 1 does not meet the requirements of Article 84 EPC because it fails to define the features necessary to achieve this result. In principle it is permissible to define a technical feature in functional terms provided clarity of a claim is not jeopardised. In particular, it is permissible if

the functional features in a claim provide a clear instruction allowing the skilled person to put them into practice without undue burden (cf. also Case Law of the Boards of Appeal of the European Patent Office, 9th edition 2019, II.A.3.4). This requirement is not fulfilled in the present case, since claim 1 does not define how the rotor is arranged such that it is cooled by the second cooling flow that flows through the journal bearing.

2.2 For these reasons the Board came to the conclusion that the subject-matter of claim 1 of the first auxiliary request does not fulfil the requirements of Article 84 EPC due to failure to define all essential features of the invention.

3. *Second Auxiliary Request, Article 84 EPC*

3.1 The amendments carried out in the second auxiliary request do not overcome the objection set out for the first auxiliary request.

3.2 Contrary to the appellant's submission, claim 1 of the second auxiliary request does not define that the cooling of the rotor by the second cooling flow is achieved by the second cooling flow flowing through the circumferential gap arranged between the stator and the rotor. Whilst the claim mentions both features, there is no causal link established between them. In other words, it is not clear that the feature of the second cooling flow moving through the circumferential gap between the stator and rotor is in any way linked to the feature that the rotor is arranged to be cooled by the second cooling flow.

3.3 For these reasons the Board came to the conclusion that the subject-matter of claim 1 of the second auxiliary request does not fulfil the requirements of Article 84 EPC due to failure to define all essential features of the invention.

4. *Auxiliary Request 2A*

4.1 Claim 1 of auxiliary request 2A meets the requirements of Article 84 EPC. It is clear from the amended final feature of claim 1 that the rotor is cooled by the differential pressure moving the second cooling flow through the circumferential gap between stator and rotor. Furthermore, the amended final feature of claim 1 has a basis on page 4, lines 1 to 4 of the application as filed, and thus meets the requirement of Article 123(2) EPC.

4.2 The Board concurs with the appellant that the subject-matter of claim 1 of the main request is novel over document D1. Whilst document D1 discloses a bearing 42 through which cooled pressurised air flows, it does not disclose what type of bearing it is. In particular, it does not disclose that it is a journal bearing as set out in claim 1. As the Board understands it, a journal bearing is a sleeve bearing that relies on a fluid film and has no balls or rollers.

4.3 The Board is convinced by the appellant's argument that the examining division's objection of lack of inventive step starting from document D1 is based on hindsight. Document D1 does not mention any bearings other than the bearings 42 which support the shaft 40. The Board is not convinced that the skilled person would recognise, just from the drawings, that there might be a bearing in some other part of the structure that

supports the rotor (as opposed to the shaft 40) for rotation which is not described in the text. Hence, there would be no motivation for a skilled person to set out to provide a journal bearing in D1 as specified in claim 1 of the second auxiliary request. Furthermore, in document D1 there is no suggestion that the cooling flow that passes through the bearing also passed through the rotor/stator gap to cool the rotor.

4.4 Document D2 discloses the same type of aircraft compressor motor as that described in document D1 and the present application. Furthermore, it discloses that the rotor assembly is supported on air bearings (see abstract). These comprise a thrust bearing 36 and journal bearings 38 arranged on either end of the rotor (see figure 1 and paragraph [0016]). The air bearings and the stator are cooled using two airflow paths (figure 1, references 40, 49). The stator is supplied with air from the compressor inlet 22 on the high pressure side H via motor cooling inlet 42 (see paragraph [0017]). The air bearing is also supplied with air from the high-pressure side H of the ram air duct 23, but via a reverse J-tube 48 (see paragraph [0018]). As is stated there, "Clean cooling fluid flows from the reverse J-tube 48 on the high pressure side H into the bearing cooling inlet 46 and out the vent 44 on the low pressure side L".

4.5 As submitted by the appellant, document D2 does not disclose two cooling sources having different pressures from one another resulting in a differential pressure. Furthermore, D2 does not disclose the second, higher-pressure cooling source providing a second cooling flow which flows through the journal bearing and which is also moved, by the differential pressure, through the rotor/stator gap to cool the rotor.

4.6 Given that neither D1 nor D2 discloses a cooling flow which passes through the journal bearing and is also moved through the rotor/stator gap to cool the rotor, this combination of features in the only independent claim of the auxiliary request 2A is not rendered obvious by the combination of D1 and D2.

4.7 The dependent claims have been amended for clarity and consistency with claim 1. Documents D1 and D2 have been acknowledged in the description, which has also been adapted to the wording of claim 1.

4.8 For these reasons the Board came to the conclusion that auxiliary request 2A 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 examining division with the order to grant a patent in the following version:

claims:
- 1 to 7 filed with letter of 19 November 2021,

description:
- pages 1, 2 and 2a filed during the oral proceedings of 22 November 2021 and
- pages 3 to 5 as originally filed,

drawings:
- pages 1/3 to 3/3 as originally filed.

The Registrar: The Chairman:

U. Bultmann R. Lord

Decision electronically authenticated