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Datasheet for the decision of 20 May 2019

Case Number: T 0236/17 - 3.2.03

Application Number: 08869317.1

Publication Number: 2232164

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Language of the proceedings: EN

Title of invention:
METHOD AND SYSTEM FOR ROTOR COOLING

Applicant:
Johnson Controls Technology Company

Headword:

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

Keyword:
Amendments - allowable (yes)
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
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Beschwerdekammern

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Case Number: T 0236/17 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 20 May 2019

Appellant: (Applicant)	Johnson Controls Technology Company 5757 North Green Bay Avenue Milwaukee, WI 53209 (US)
Representative:	Trinks, Ole Meissner Bolte Patentanwälte Rechtsanwälte Partnerschaft mbB Postfach 10 26 05 86016 Augsburg (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 29 July 2016 refusing European patent application No. 08869317.1 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Ashley
Members:	R. Baltanás y Jorge
	E. Kossonakou

Summary of Facts and Submissions

I. European patent application No. 08 869 317.1 relates to a vapor compression system.

II. The appeal lies from the decision of the examining division to refuse the above-mentioned European patent application.

The examining division held that claim 1 according to the main request did not comply with the requirements of Article 123(2) EPC, that the subject-matter of claim 1 of the first auxiliary request was not novel, and that claim 1 of the second auxiliary request did not comply with Article 123(2) EPC.

III. The applicant (hereinafter: the "appellant") filed an appeal against the above-mentioned decision of the examining division.

In a communication dated 20 February 2019, pursuant to Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), the Board indicated its preliminary opinion of the case.

Oral proceedings were held on 20 May 2019.

IV. Final requests

The appellant requested that the decision under appeal be set aside and a patent be granted on the basis of the main request, which was originally filed with the grounds of appeal as the third auxiliary request.

V. Claim 1 according to the main request reads (amendments compared to claim 1 as filed are shown in bold):

"A vapor compression system **(10)** comprising:
a compressor **(38),** an evaporator **(32)** and a condenser **(30)** connected in a closed loop;
a motor **(36)** connected to the compressor **(38)** to power the compressor **(38);**
a motor coolant system configured to cool the compressor motor **(36);**
the compressor **(38)** comprising:
a first compressor stage **(42)** and a second compressor stage **(44),** the first compressor stage **(42)** providing compressed vapor to an input **(52)** of the second compressor stage **(44);**
the motor coolant system comprising:
a first connection in fluid communication with **the condenser (30) of** the closed loop to deliver refrigerant into a motor cavity **(78),** and a second connection with the refrigerant loop to return **the** refrigerant to an interstage connection **(48)** having an intermediate pressure, the intermediate pressure greater than an evaporator operating pressure and less than a condenser operating pressure; and
a first seal **(70)** located between the motor cavity **(78)** and the first compressor stage **(42),** and a second seal **(70)** located between the motor cavity **(78)** and the second compressor stage **(44),** the first and second seal **(70)** configured to maintain the refrigerant at an intermediate pressure inside the motor cavity **(78);**

characterized in that
the first connection comprises a coolant supply line (37) being configured to directly deliver liquid refrigerant from the condenser (30) expanded to pure vapor into the motor cavity (78) for rotor gap cooling;

and wherein the interstage connection (48) is arranged between the the first stage compressor discharge and the second stage compressor suction inlet (52) and the motor cavity (78) is in fluid communication with the interstage connection (48) through a second flow line (49) so as to vent back the refrigerant provided for rotor gap cooling to the interstage connection (48) having an intermediate pressure."

Dependent claims 2 to 7 concern preferred embodiments of the vapor compression system of claim 1.

VI. State of the art

The following documents were cited in the decision under appeal:

D1: US 6 070 421 A
D2: US 2007/0212 232 A1

VII. The appellant's arguments can be summarised as follows.

The subject-matter of claim 1 is differentiated from D1 in that the coolant supply line is configured to deliver directly liquid refrigerant from the condenser into the motor cavity.

The direct connection of the condenser to the motor cavity is apparent from figure 4 and the corresponding description in paragraph 32 of the original disclosure. All the other amendments to claim 1 find a basis as well in figure 4 and paragraph 32 of the application as originally filed.
The arguments provided by the examining division in point 4.4 of the contested decision are not applicable

with regard to the requirements of Article 123(2) EPC, since claim 1 no longer refers to a "means provided to expand the liquid refrigerant".

Regarding inventive step, the claimed subject-matter differs from D1 in that a first connection supplies liquid coolant directly from the condenser, the coolant being expanded to vapor for delivery into the motor cavity.
The problem to be solved can be regarded as a reduction of system loss or a simplification of the system, the solution of which cannot be derived from either the cited prior art or general knowledge.

Reasons for the Decision

1. Article 123(2) EPC

1.1 The added feature of claim 1 "a first connection in fluid communication with **the condenser (30) of** the closed loop" finds a basis in originally filed application at paragraph 32, second sentence, and in figure 4.

1.2 The feature of claim 1 "a second connection with the refrigerant loop to return refrigerant to an interstage connection" has been amended into "a second connection with the refrigerant loop to return **the** refrigerant to an interstage connection".
The amendment clarifies the origin of the concerned refrigerant as being the one delivered into the motor cavity. This was originally disclosed in the application as a whole (see e.g. paragraph 32 and figure 4).

1.3 The added features "**the first connection comprises a coolant supply line (37) being configured to directly deliver liquid refrigerant from the condenser (30) expanded to pure vapor into the motor cavity (78) for rotor gap cooling**" find a basis in paragraph 32, second sentence.
The wording "**to provide** rotor gap cooling" in the second sentence of paragraph 32 has been amended into "**for** rotor gap **cooling**" in this feature of claim 1, but the Board does not find that this extends the originally disclosed subject-matter, since the wordings are synonymous.

1.3.1 Concerning the feature "to **directly** deliver liquid refrigerant **from the condenser**", the examining division considered that this amendment contravenes Article 123(2) EPC, since it interpreted the feature as meaning that "no other component is allowed to be located on said supply line" (see point 4.4 of the appealed decision). As some means must be present in order to expand the liquid refrigerant coming from the condenser so as to supply pure vapor into the motor cavity, the examining division concluded that the added feature necessarily implies that the expansion means must be "located inside the rotor cavity", something for which no direct and unambiguous disclosure could be found in the originally filed application.

1.3.2 The Board does not agree with the argument of the examining division, although not for the reasons provided by the appellant in its written submissions.

The fact that the feature "means provided to expand the liquid refrigerant" has been omitted in current claim 1 does not mean, as suggested by the appellant, that expansion means are no longer required.

On the contrary, claim 1 requires "a coolant supply being configured to directly deliver liquid refrigerant from the condenser **expanded to pure vapor** into the motor cavity". This requires that some expansion means must be present in order to convert the liquid into pure vapor, even if not explicitly claimed as such.

However, the required presence of such expansion means does not result in an extension of the originally disclosed subject-matter for the following reason.

The fact that the coolant supply line is configured to deliver liquid refrigerant "from the condenser" is originally disclosed in page 10, lines 1 to 3, and in figure 4. However, the word "directly" was never used in the originally filed application in connection with the coolant supply line and the condenser.

The only basis which can be found for the concept of a "direct" delivery of liquid refrigerant from the condenser expanded to pure vapor into the motor cavity is originally filed figure 4 and its corresponding description in paragraph 32. From figure 4 it is clear that the only connection between the condenser 30 and the motor 36 consists of supply line 37, which delivers the liquid refrigerant.
Originally filed page 10, lines 1 to 3, discloses that "the method employs liquid refrigerant from condenser 30 expanded to pure vapor to provide rotor gap cooling, as indicated by coolant supply line 37 (FIG. 4)".

The skilled person, when reading this passage in combination with figure 4, would immediately understand on the one hand that all the liquid refrigerant transported by supply line 37 has its origin in the condenser 30 and, on the other hand, that the liquid

refrigerant transported by supply line 37 is expanded to pure vapor at some point in order to cool the rotor gap.
Thus, when reading claim 1, the adverb "directly" refers to the action of delivering liquid refrigerant, i.e. the supply line is configured such that the liquid refrigerant is directly delivered from the condenser, which means that no other source of liquid refrigerant is foreseen for the supply line.
Consequently, the feature "directly" is considered as being originally disclosed irrespective of where the liquid refrigerant is expanded to pure vapor and which device is used for such purpose.

1.4 The added features "**the interstage connection (48) is arranged between the the first stage compressor discharge and the second stage compressor suction inlet (52) and the motor cavity (78) is in fluid communication with the interstage connection (48) through a second flow line (49) so as to vent back the refrigerant provided for rotor gap cooling to the interstage connection (48) having an intermediate pressure.**" find a basis in the originally filed claim 11 and paragraph 32, second sentence.

1.5 Dependent claims 2 to 7 correspond to originally filed claims 2 to 4 and 8 to 10.

1.6 In view of the above, the Board considers that the set of claims complies with the provisions of Article 123(2) EPC.

2. Novelty

2.1 Document D1 (see figure 1) shows two different and separate motor coolant systems for the motor 6:

- A first one comprises line 7, connected to separator 24 so as to deliver pure vapor into the central motor cavity 9, outlet 8 and a return line connected to the inlet of the second stage 4 of the compressor.

- A second one comprises line 17 coming from condenser 1, input 29, outlet 30 and a return line to separator 24. This cooling system introduces refrigerant fluid at least partially in liquid form in a cooling skirt 26, where it draws off heat from the stator 28 of the motor 6.

Thus the first system concerns pure vapor, whereas the second concerns refrigerant partially in liquid form.

The examining division apparently has referred to features taken individually from both coolant systems (point 3.1 of the decision). It identifies a "first connection (7)" and a "second connection (8)", which both belong to the first coolant system. It then goes on to argue that the first connection "comprises a coolant supply line (17) being configured to deliver a liquid refrigerant from the condenser into a motor cavity (26)", whereas the supply line 17 and cavity 26 belong to the second coolant system.
The examining division argued as well that in D1 "means (18) are provided to expand the liquid refrigerant coming from the condenser to pure vapor in the motor cavity". In point 3.7 it is stated that "reference sign (18) denotes a means to expand the liquid refrigerant coming from the condenser".
However, document D1 clearly discloses in column 4, lines 57 to 64, that "*A small portion of the liquid coolant from the condenser*" is injected into the cavity

27. Even if one may assume that the choke element 18 will decompress the liquid to a certain extent before injection, the passage explicitly describes that, at t he cooling skirt cavity 26, "*part of the liquid coolant is evaporated*", i.e. there is no disclosure of pure vapor being delivered into a motor cavity, but rather of a refrigerant fluid which is evaporated only in part after having passed the skirt cavity 16.

2.2 The first motor coolant system, which is the only one in D1 that delivers pure vapor into a motor cavity, comprises the following features:

- A first connection (7, 14), which is in fluid communication with the condenser (1) of the closed loop to deliver refrigerant into a motor cavity (9).

- A second connection (8) with the refrigerant loop, which returns refrigerant to an interstage connection (i.e. the junction of the outlet 8 and the line leading to the inlet 22 of the second stage 4 of the compressor; see column 3, lines 19 to 22, column 4, lines 44 to 46 and figure 1). This connection has an intermediate pressure that is greater than the evaporator operating pressure, but less than the condenser operating pressure. In particular, this results from the fact that the fluid at the inlet 22 has already being compressed by the first stage 3 of the compressor.

- The first connection (7, 14) comprises a coolant supply line (7) being configured to deliver pure vapor from expanded liquid refrigerant (see column 4, lines 38 and 39) into the motor cavity 9 for rotor gap cooling (see column 4, lines 39 to 43).

- First and second seals are not indicated in figure 1, but can be seen in figure 2, where they are located between the motor cavity (9) and the first and second compressor stages (3, 4), respectively (see figure 2, elements defining the separation between the motor cavity and compressors). Since the compressor stages and the motor cavity are designed to avoid leakages from each of the respective chambers, it is concluded that the first and second seals must maintain the refrigerant at an intermediate pressure inside the motor cavity.

- The interstage connection (i.e. the junction of outlet 8 and the line leading to the inlet 22 of the second stage 4 of the compressor; see column 3, lines 19 to 22, column 4, lines 44 to 46 and figure 1) is arranged between the first stage compressor discharge and the second stage compressor suction inlet (22), and the motor cavity (9) is in fluid communication with the interstage connection through a second flow line (8).

- The second flow line 8 in D1 vents back the refrigerant used for rotor gap cooling (i.e. the vapor delivered by means of the inlet 7) to the interstage connection (i.e. the junction of outlet 8 and the conduction leading to the inlet 22 of the second stage 4 of the compressor; see column 3, lines 19 to 22, column 4, lines 44 to 46 and figure 1) having an intermediate pressure (i.e. the pressure of the fluid leaving the first stage 3 of the compressor in its way towards the second stage).

2.3 The subject-matter of claim 1 differs from the first motor coolant system of D1 in that the coolant supply line is configured to directly deliver liquid refrigerant from the condenser expanded to pure vapor into the motor cavity (see point 1.3.2 above concerning the interpretation of this feature), since the coolant supply line 7 of D1 delivers liquid refrigerant originating from the condenser and from the return line 30 of the second coolant system, which are both merged in the separator 24.

2.4 In view of the above, the Board considers that the subject-matter of claim 1 is novel with regard to D1.

3. Inventive step

3.1 The embodiment of the first motor coolant system of D1 can be considered to be the closest prior art, since it is the only disclosure of liquid refrigerant being delivered from a condenser (even if not "directly") which is then expanded to pure vapor into a motor cavity, followed by venting the refrigerant to an interstage connection arranged between a first stage compressor discharge and a second stage compressor suction inlet.

3.2 Since the above arrangements require use of a separator, the problem to be solved can be regarded as a simplification of the system.

3.3 The Board considers that it would not be obvious for the skilled person to modify D1 such that the claimed arrangement could be achieved for the following reasons:

The skilled person learns from D1 that the two choke elements (18, 23), which are provided for expanding the liquid refrigerant that directly originates from the condenser, do not convert the liquid refrigerant into pure vapor, but rather to a mixture of vapor and liquid refrigerant (choke element 18: see column 4, lines 57 to 62, and point 2.1 above; choke element 23: see column 4, lines 48 to 56).
Thus, even if the skilled person contemplated a direct delivery of liquid refrigerant from the condenser for the first motor coolant system, the most obvious solution would be to deliver the fluid into the motor cavity at least partially in liquid form by making use of the same technology disclosed in D1 concerning the means for expanding refrigerant fluid directly delivered from the condenser.
The idea of delivering pure vapor is yet a further step requiring further modifications, such as a separator or a different kind of expansion means.

3.4 In view of the above, the Board considers that the subject-matter of claim 1 involves an inventive activity with regard to D1 and the common general knowledge of the skilled person.

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 of the main request, corresponding to former auxiliary request 3 filed with the grounds of appeal.
   - Pages 1, 1a and 2 to 11 filed during the oral proceedings of 20 May 2019.
   - Figures 1-6 as published.

The Registrar: The Chairman:

C. Spira G. Ashley

Decision electronically authenticated