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**Datasheet for the decision  
of 28 September 2015**

**Case Number:** T 0309/13 - 3.5.02

**Application Number:** 99122774.5

**Publication Number:** 1005139

**IPC:** H02K9/04, H02K9/18

**Language of the proceedings:** EN

**Title of invention:**

Cooling device for an electric rotating machine

**Patent Proprietor:**

Mitsubishi Hitachi Power Systems, Ltd.

**Opponents:**

Siemens Aktiengesellschaft  
Alstom Technology Ltd

**Headword:**

**Relevant legal provisions:**

EPC Art. 54, 56

**Keyword:**

Novelty - (yes)  
Inventive step - (yes)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern  
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Case Number: T 0309/13 - 3.5.02

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.02**  
**of 28 September 2015**

**Appellant:** Mitsubishi Hitachi Power Systems, Ltd.  
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**Party as of right:** Alstom Technology Ltd  
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**Representative:** Alstom Technology Ltd  
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**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
4 December 2012 concerning maintenance of the  
European Patent No. 1005139 in amended form.**

**Composition of the Board:**

**Chairman** M. Ruggiu  
**Members:** M. Léouffre  
W. Ungler

## **Summary of Facts and Submissions**

- I. The opponent 1 appealed against the interlocutory decision of the opposition division, dispatched on 4 December 2012, on the amended form in which the European patent 1 005 139 can be maintained. The statement setting out the grounds of appeal was received on 8 April 2013.
- II. The proprietor of the patent likewise appealed against the interlocutory decision of the opposition division. The statement setting out the grounds of appeal was received on 15 April 2013.
- III. By a letter dated 25 August 2015, the respondent-opponent 2, who did not appeal, provided comments supporting the point of view of opponent 1.
- IV. The following prior art documents cited in the proceedings before the first instance remain relevant for the present decision:  
E1: US 2 695 368,  
E2: EP 0 279 064 A1, and  
E11: JP 56-101356 A.
- V. Oral proceedings before the Board were held on 28 September 2015.
- VI. The appellant-proprietor requested that the decision under appeal be set aside and that the patent in suit be maintained as granted (i.e. that the oppositions be rejected) or, if that was not possible, that the patent be maintained in amended form on the basis of the claims of one of auxiliary requests 1 to 7 filed with letter of 15 April 2013 and auxiliary requests 8 and 9 filed with letter dated 23 August 2013

VII. The appellant-opponent 1 requested that the decision under appeal be set aside and that the patent in suit be revoked in its entirety.

VIII. The respondent-opponent 2 requested that the appeal of the patent proprietor be dismissed and the appeal of opponent 1 be accepted.

IX. Claim 1 of the patent as granted reads as follows:

"A rotating machine comprising a plurality of coolers (12, 13) for cooling a cooling medium circulating inside the machine, the coolers comprising primary coolers (12a, b) arranged at the axial ends of the rotating machine, characterised in that the coolers further comprise a secondary cooler (13) smaller in size than said primary coolers and arranged between said primary coolers so as to further cool part of the cooling medium cooled by said primary coolers."

Claims 2 to 11 are dependent on claim 1.

X. The appellant-proprietor argued essentially as follows:

In the device shown in figure 3 of E1 the cooling medium flowed entirely through cooler 6c during each cooling cycle, and only part of this cooling medium flowed through the coolers 6d and 6e. The whole cooling medium flowed through a duct leading to the fans 7b and 8b and part of the cooling medium was led to cooler 6d and further to the conductor bars. The coolers 6d and 6e were therefore smaller in size than the cooler 6c. No conclusion about the size of the coolers could be derived from the number of holes representing the cooling pipes of the respective coolers in figure 3 of

E1 as the coolers were only schematically represented on that figure. The primary cooler was the central one referenced 6c and the coolers 6d and 6e were the secondary coolers. The subject-matter of claim 1 differed from the generator of E1 in that the secondary cooler positioned between the primary coolers was smaller in size and further cooled part of the cooling medium cooled by the primary coolers. The term part would have been superfluous if under this term the whole of the cooling medium was envisaged. The term part had to be understood in relation to the context of the other feature "smaller in size". The larger diameter of the fan 8b did not imply a larger mass flow, but was due to a high pressure resistance because the coolers 6d and 6e were used to cool the conductor bars which opposed a greater resistance to the flow of cooling medium. Similarly, in figure 7 of the patent in suit, the ducts 4 in the central portion of the stator were disposed at a smaller pitch to compensate the higher pressure they were facing at their ends on the side of the air gap. Thus, a smaller pitch did not imply a higher mass flow. Figure 1 of the contested patent did not show any size of the coolers. The fact that the relative sizes might have been chosen among three possibilities would be an argument of inventive step.

Section [0010] of the patent defined the terms "smaller in size" as "smaller in capacity".

The invention solved the problem of equalising the temperature increase distribution inside the machine. The flow of cooling medium leaving fan 8b of E1 was spoiled by the cooling of the conductor bars before reaching the stator. Hence the cooling in the middle part of the generator of E1 was not ideal, like in the prior art represented by E2 and mentioned in the

description of the patent in suit. The mass flow passing coolers 6d and 6e was no more than 10%. Smaller in size should be read in its context and making the coolers 6c of E1 smaller than the coolers 6d and 6e was not suggested by E1 and would have only worsened the temperature distribution. The coolers 6c were used in E1 to set the basic running temperature while the fans 6d and 6e were used to remedy possible hot spots.

In E2 the uniform temperature distribution was obtained by a rearrangement of the channel tubes 29 conducting the cooling medium. Hence, starting from E2, there was no need to search for another solution. If, nevertheless a person skilled in the art would have looked for an alternative solution, he would not have applied the solution proposed in E11 because the coolers shown in figure 5 of E11 acted in parallel and the smaller coolers 16 did not improve the cooling of the central part of the generator. Thus, figure 5 of E11 had nothing in common with the invention.

XI. The arguments of the appellant-opponent 1 relevant for the present case can be summarised as follows:

The rotating machine of claim 1 was known from E1, column 3, lines 73 to 76 in connection with figure 3. The cooler 6c was actually made of two coolers which could be called secondary cooler 6c1 and secondary cooler 6c2. Each secondary cooler was positioned between the two coolers 6d and 6e which could be seen as primary coolers. Each of the secondary coolers 6c1, 6c2 was smaller than at least the sum of the two primary coolers 6d and 6e, which helped cooling the middle part of the machine. Furthermore, each secondary cooler could only be made equal, larger or smaller in size than a primary cooler.

The patent in suit taught in section [0010] that the size was due to the choice of positioning the coolers in the middle part of the machine. Smaller in size was thus meant as geometrically smaller.

Concerning inventive step, starting from E2, which did not show any secondary cooler, the problem could have been seen as improving the cooling of the middle part of the machine. A person skilled in the art would have therefore applied the solution known from E11 wherein a larger primary cooler 18 was arranged on an end and a smaller cooler 16 in the middle of the machine.

XII. The respondent-opponent 2 argued essentially as follows:

The flow of a fan was proportional to the surface of its blades and it was clear from figure 3 of E1, that the radius of the fan 8b was larger than the radius of the other fan 7b. Hence the size of each cooler 6d, 6e was larger than the size of the cooler 6c or at least of one of the two half coolers 6c. Another reason why coolers 6d and 6e were of a larger size was because the coolers 6d and 6e were the first coming in the cooling cycle. Furthermore, the size mentioned in claim 1 might have been related to the physical size of the coolers and not the capacity. Figures 6 and 7 of the patent in suit showed a smaller pitch for the ducts 4 provided in the middle part of the stator core than the pitch of the ducts on the sides of the stator core or positioned as shown in figures 2 and 5. Hence the size of the secondary cooler according to the invention had to be larger than the size of the primary coolers close to the extremities of the machine to further cool the necessary extra amount of cooling medium (see also section [0069] of the patent in suit). Figures 8 and 9 of the original application were also suppressed in the



patent as granted. These embodiments showed that the coolers positioned in the middle of the machine could be of a larger size than the other coolers, contrary to claim 1.

As the appellant-opponent 1 mentioned, there were only three possibilities to size the coolers 6c of E1, ranging from the non-existence of the coolers to a size larger than the coolers 6d, 6e. On the one hand, if no cooler 6c would be provided, the temperature of the machine would increase steadily. On the other hand if the coolers 6c were oversized the cooling in the middle part of the machine would be unbalanced. A person skilled in the art would not have exercised any inventive skill in designing the size of the coolers 6c because only one parameter came in question, namely the temperature.

Starting with E2, if the coolers 17 shown in figure 1 were insufficient, a person skilled in the art would have installed secondary coolers on the back of the stator iron core in the middle of its length as shown in figure 5 of E11, or alternatively close to the ends of the conductor bars as shown in E1. He would thereby have arrived at a machine according to claim 1.

### **Reasons for the Decision**

1. The appeals are admissible.
2. The opposition division referred to the embodiment shown in figure 3 of E1 (US 2 695 368) and came to the conclusion that the subject-matter of claim 1 of the main request was known from document E1 (cf. item 13.1 of the appealed decision).

3. *Article 54 EPC*

The rotating machine shown in figure 3 of E1 comprises a plurality of coolers 6c, 6d and 6e for cooling a medium circulating inside the machine. One cooler is arranged at each axial end of the rotating machine. These coolers 6d, 6e can be called primary coolers. A further cooler 6c, which can be called secondary cooler, is arranged between the coolers 6d and 6e.

During each cooling cycle of the machine of E1 the whole cooling medium flows through cooler 6c. The cooler 6c appears to comprise two identical half coolers whereby each half cooler cools part of the cooling medium cooled by said primary coolers 6d and 6e.

The sizes of the coolers 6c, 6d and 6e are not directly and unambiguously derivable from document E1. The description of the patent in suit defines "smaller in size" as "smaller in capacity" (cf. section [0010] of the patent in suit). The capacity of a cooler is usually defined by the amount of cooling medium refrigerated from a first temperature to a second lower temperature in a unit of time. The capacity of the coolers is however also not directly and unambiguously derivable from E1.

Thus the subject-matter of claim 1 differs from the rotating machine disclosed in E1 in that the secondary cooler 13 is smaller in size than the primary coolers. The requirement of novelty (Article 54 EPC) is therefore satisfied.

4. *Article 56 EPC*

4.1 The Board agrees with the analysis of document E1 done by the proprietor (cf. page 2, paragraph 2 to page 4,

paragraph 1 of the statement of grounds of appeal dated 15 April 2013) that E1 aims at solving the problem of cooling the conductor bars. Differently, the invention aims at solving the problem of uneven temperature distribution in the stator core.

4.1.1 In the non-symmetrical machine shown in figure 2 of E1, wherein only one of the two end coolers 6d, 6e is available and referenced cooler 6a, the cooling medium enters the conductor bars from a supply chamber 35 and is discharged from the conductor bars into a coolant collector chamber 33. From this chamber 33 the cooling medium is led over a duct 34 directly to the cooler 6b positioned in the middle of the machine. In this embodiment the spent cooling medium from the bars is not redirected to the stator core and not used for further cooling the stator.

4.1.2 The symmetrical machine shown in figure 3 of E1 is based on the machine of figure 2 (see column 3, lines 80 to 83).

At each end of the machine shown in figure 3 of E1 the flow of cooling medium is split by a couple of fans 7a, 8a and 7b, 8b. Each of the coolers 6d and 6e receives a part of the cooling medium which is directed thereafter to one of the supply chambers 33 and 35. The flow of cooling medium entering one of the chambers 33 and 35 flows through the conductor bars from end to end before being discharged by conduits, 31b, 32c and 32d. In figure 3, the duct 34 is suppressed. The conduits 31b, 32c and 32d end into chambers 22b (the reference for the second chamber is missing) wherein the cooling medium is mixed with the cooling medium flowing from the fans 7a, 7b into the chambers 22b (see column 4, lines 4 to 20 and figure 3). The mixed cooling medium

is then directed towards chambers 23 and 24 via conduits 18 and 19 and further inwardly to the stator core as indicated by arrows 26.

4.1.3 The fact that, in the example of figure 2 and even of figure 1, the cooling medium coming from the conductor bars is not used to further cool the stator indicates to the skilled person that the temperature and amount of fluid cooling the conductor bars, and therefore the cooling capacity of this fluid, are not significant enough for further cooling the stator iron core. The omission of the duct 34 in figure 3 is further understood as an indication that the amount of fluid discharged from the bars is not sufficient to modify substantially the temperature of the cooling fluid coming from the fans 7a and 7b to which it is mixed. Thus, the board shares the view of the appellant-proprietor that the coolers 6d, 6e of the machine of E1 are secondary coolers cooling only a relatively small part of the whole cooling medium, while the cooler 6c is the primary cooler cooling the whole of the cooling medium. The coolers are called accordingly in E1 (see column 3, lines 73 to 76). The board shares also the view of the appellant-proprietor that the primary cooler 6c regulates the average temperature while the secondary coolers 6d and 6e help to avoid possible hot spots by cooling the conductor bars.

4.1.4 Thus, the skilled person would have no reason to make the coolers 6d, 6e, which cool only the conductor bars, larger in size or capacity than half of the cooler 6c. There is also no hint in E1 for a person skilled in the art to raise the capacity of the coolers 6d and 6e because they are used only for cooling the conductor bars. Starting from E1 the subject-matter of claim 1 of

the contested patent is therefore not obvious (Article 56 EPC).

4.2 It is undisputed that the invention disclosed in document E2, like the invention of the contested patent, aims at reducing the uneven temperature distribution in a stator core (see column 2, lines 4 to 8 and column 5, lines 23 to 53 in connection with figures 2 to 4).

The solution proposed in E2 is based on a new arrangement of cooling channels 29L, 30L, 29R, 30R, as shown in figures 5 to 7 (see column 7, line 30 to column 8, line 6).

4.2.1 The subject-matter of claim 1 of the patent in suit differs from the machine shown E2 by the features recited in the characterising part, namely in that "the coolers further comprise a secondary cooler (13) smaller in size than said primary coolers and arranged between said primary coolers so as to further cool part of the cooling medium cooled by said primary coolers".

4.2.2 Considering that the problem of reducing the uneven temperature distribution is solved by the arrangement of the cooling channels of E2, a person skilled in the art would not be prompted to improve the cooling arrangement disclosed in E2. If he nevertheless would look for an alternative solution to the cooling channels of E2 in order to reduce the uneven temperature distribution in the stator, he would not have applied the teaching of document E11 for the following reasons.

E11 shows in figure 5 two parallel cooling circuits, one circuit involving a fan 17, the rotor and a primary cooler 18, while a second circuit comprises a second fan 15 positioned above a middle part of the stator

iron core, the stator itself, the air gap where the cooling medium is divided to flow outwardly through a plurality of ducts formed in the end parts of the stator iron core to reach smaller coolers 16. The arrangement of the cooler 18 and the smaller coolers 16 does not contribute to equalise the temperature distribution over the length of the stator, because all the cooling medium is provided to the fans from a common chamber. Hence, while any of the two coolers 16 of E11 can be seen as positioned between the cooler 18 and the fan 17, the extraction of this particular feature from E11 and its combination with the stator of E2 appear as resulting from hindsight.

4.2.3 Similarly the application of the teaching of E1 for cooling the conductor bars of E2 results from hindsight. Actually, like the conductor bars of the machine according to the present invention, the conductor bars of E2 do not appear to require a separate cooling arrangement. Hence there is no hint in E2 for a separate cooling of the ends of the conductor bars and even less for a particular solution wherein the conductor bars would be enclosed with a separate casing forming chambers in which further coolers of a smaller size would be provided.

5. Thus, claim 1 of the main request is novel and not obviously derivable from the available prior art represented by documents E1, E2 and E11. The same applies to the dependent claims. It is therefore not necessary to comment on the auxiliary requests.

**Order**

**For these reasons it is decided that:**

1. The decision under appeal is set aside.
2. The patent is maintained unamended.

The Registrar:

The Chairman:



U. Bultmann

M. Ruggiu

Decision electronically authenticated