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Datasheet for the decision of 6 February 2012

Case Number: T 1175/09 - 3.2.04

Application Number: 02017651.7

Publication Number: 1286056

IPC: F04D 29/66

Language of the proceedings: EN

Title of invention:
System and method for detecting and diagnosing pump cavitation

Patentee:
Reliance Electric Technologies, LLC

Opponent:
KSB Aktiengsellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 54, 111(1)

Relevant legal provisions (EPC 1973):
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Keyword:
"Novelty - main request (yes)"
"Remittal to the department of first instance (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 1175/09 - 3.2.04

D E C I S I O N
of the Technical Board of Appeal 3.2.04
of 6 February 2012

Appellant: (Patent Proprietor)
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Representative:
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Respondent: (Opponent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 12 March 2009 revoking European patent No. 1286056 pursuant to Article 101(3)(b) EPC.

Composition of the Board:

Chairman: M. Ceyte
Members: A. de Vries
T. Bokor

Summary of Facts and Submissions

I. The Appellant (Proprietor) lodged an appeal, received 22 May 2009, against the decision of the Opposition Division posted 12 March 2009 to revoke European patent No. 1 286 056, and simultaneously paid the appeal fee. The statement setting out the grounds was received 17 July 2009.

II. Opposition was filed against the patent as a whole and based on Article 100(a) EPC in combination with Articles 52, 54 and 56 for lack of novelty and inventive step.

The Opposition Division held that these opposition grounds prejudiced maintenance of the patent. In particular it held that the subject-matter of granted claims 1 and 6 lacked novelty having regard to the following document:

E4: D.Kollmar et al.:"Early Fault Detection for Process Pumps", Proceedings of ASME FEDSM'01, 2001 ASME Fluids Engineering Division Summer Meeting New Orleans, Louisiana, May 29 - June 1, 2001.

III. With the communication of 29 July 2011 pursuant to Rule 100(2) EPC the Board communicated to the parties its preliminary opinion that E4 did not appear prejudicial to novelty. It further opined that a remittal appeared appropriate above all in view of the prima facie relevance of the following further document cited in opposition:

E9: M.Schroll: "Technical fault diagnosis as a contribution to reduce the total life cycle costs of axial flow pumps", Pump Users International Forum, Karlsruhe, 10-12 October 2000.

The parties were asked to comment.

IV. With letter of 28 November 2011 the Appellant agreed to a remittal and withdrew his request for oral proceedings. The Respondent also agreed, with letter of 29 November 2011, to a remittal, in which case he would also withdraw his request for oral proceedings.

V. The Appellant-Proprietor requests that the decision under appeal be set aside and the patent be maintained as granted, or in the alternative, that it be maintained in the amended form of one of auxiliary requests I to III filed with the grounds of appeal.

The Respondent-Opponent requests dismissal of the appeal and that the auxiliary requests not be admitted. Only if the case is not remitted does it request oral proceedings.

VI. The wording of the independent claims as granted is as follows:

1. "A system for detecting cavitation in a motorized pumping system (12), comprising:
a measuring system that measures pump flow and pressure data, and
a detection system (70) that detects pump cavitation according to said pump flow and pressure data, characterized in that

said detection system (70) comprises a classifier system, and
that said classifier system comprises a neural network (200) that is trained thereby providing a varying signal (72) indicative of the existence and extent of cavitation in said pumping system (12)."

6. "A method for detecting cavitation in a pumping system (12) having a motorized pump (14), comprising: measuring pump flow and pressure data, and detecting pump cavitation according to said flow and pressure data,
characterized in that
said method comprises providing said flow and pressure data as inputs to a classifier system that comprises a neural network (200), wherein the neural network (200) provides a signal (72) indicative of the existence and extent of cavitation in the pumping system (12) and can be trained thereby adapting said signal (72) during operation of said pumping system (12)."

VII. The Appellant argues as follows:

The claims should be read as meaning that the measured flow and data pressure are input data for the neural network.

Public availability of E4 before priority is not conclusively proven. In any case, the detailed embodiment of E4 concerns a decision tree, not a neural network, and is based on speed harmonics, not measured flow rate and pressure data. Where it does discuss neural networks it does not give any detail.

VIII. The Respondent argues as follows:

E4 was publicly available before priority. ASME standardly publishes conference papers in CD form which are handed out at the conference on a CD.

The Appellant's arguments merely repeat what was already presented before the first instance. The decision's finding of lack of novelty was correct.

That flow rate and pressure data should serve as input for the neural network is not apparent from the claims' wording.

Reasons for the Decision

1. The appeal is admissible.

2. *Background*

The patent concerns the detection of cavitation in a pump according to measured pump flow and pressure. The main idea is to use a neural network as a classifying system and which is trained to provide an indication of the existence and the extent of cavitation. Granted claims 1 and 6 are to a system and method respectively.

3. *Novelty and E4*

3.1 The Appellant contests that E4 was available before priority, and that in any case it is not prejudicial to novelty. Leaving aside the question of availability the Board finds that E4 does not disclose the *specific*

combination of features claimed in the independent claims 1 and 6.

3.2 E4 is a research paper generally concerned with early fault detection for process pumps based on machine learning, see its abstract, final paragraph. One particular fault it is interested in is *cavitation*, see the list on page 1, and also shown and discussed in connection with figure 10 and table 2 in a section "Building an Early Fault Detection System" where it describes an actual tested system. E4 further also mentions *neural networks*, see the section "Machine Learning" on page 2, first paragraph, where it reviews the relevant literature, citing several examples, notably one, Schroll, which processes pressures and flow among others. The same section also mentions neural networks in its comparison, page 3, of three major machine learning algorithms (case-based learning, neural networks, decision trees).

3.3 However, E4 does not disclose cavitation and neural networks *in combination.* None of the cited examples of neural networks mention their use, specifically or otherwise, for detecting or classifying cavitation. The cited example of Schroll in particular is described as concerned with monitoring sedimentation, pre-swirl and clogging. There is no mention of cavitation.

Similarly, where E4 compares the three machine learning schemes it does so in the most general of terms, without identifying any particular input or output.

3.4 When E4 does mention cavitation it is in a different context. The first mention of cavitation on page 1 is

unspecific to any detection method. It is then again mentioned in the description of the test system in the final section on pages 4 to 6, see in particular Figure 10 and table 2. That test system is however a *decision tree* system as becomes clear on a closer reading.

Thus, in the section "Machine Learning", on page 3, E4 first compares the three machine learning algorithms finding that *case-based reasoning* is "simple to implement but requires very much memory" (page 3, left hand column, 2nd paragraph), that the "flexibility of *neural networks* becomes a burden" (right-hand column, 2nd paragraph), but that for *decision trees* "the requirements for computing power and memory are extremely low" (right-hand, column 3rd paragraph). It then concludes, right-hand column, final two paragraphs) that "decision trees and neural networks do have the same performance on average", but that "the required computing time (1:30 h for the fastest neural network vs. 20 seconds for C5, the most common decision tree program) determined the choice", i.e. for a decision tree system.

The sections that follow on pages 4 to 6, indeed then consider an actual early fault detection system based on this considered choice, i.e. a *decision tree based system*. This is expressly mentioned in the first subsection "Investigation of the pump", last paragraph of page 4, which states "after identifying relevant faults the classes for the *decision tree* have to be defined" (emphasis added). Likewise the subsection "Data acquisition and computing of the classifier", on page 5, last paragraph indicates that "using C5 ... a

decision tree is deduced from the stored data" (emphasis again added). Figure 10 (which defines cavitation classes) and table 2 (validation) present the results for this tested decision system.

3.5 In summary, though E4 discloses the central features of, on the one hand, cavitation detection by classification, and, on the other, neural networks, it does not disclose them in combination. Specifically, it does not disclose a detection system comprising a classifying system with a suitably trained neural network, which detects pump cavitation as claimed in granted claim 1. Nor does it disclose a cavitation detection method in which measured flow and pressure data are provided to a classifier system that comprises a neural network as in granted claim 6.

3.6 The Board adds that these findings are irrespective of how the formulation "according to pump flow and pressure data" in claim 1 is interpreted. If it adopts the generally accepted principles of interpretation as set out in the Case Law of the Boards of Appeal, 6th edition, 2010, II.B.5.1, and gives these terms their normal, usual meaning, as they would be understood by the skilled person who reads them in context, this feature merely means that the detection is based on measured flow and pressure as input. Nothing else is suggested in the patent, and indeed this is what method claim 6 expressly states. The decision tree scheme in E4 on the other hand is based on speed harmonics, page 5, right-hand column, first paragraph, see also figure 5; other input data such as flow and pressure are expressly excluded, page 5, right-hand column, final paragraph. Where E4 considers neural networks,

page 3, left-hand column, it also only mentions speed harmonics as input neuron. Therefore, if any teaching can be derived from E4 regarding classification of cavitation it is that this should be based on speed harmonics and not flow and pressure as input. This is a further *significant* difference between E4 and the claimed subject-matter.

3.7 In view of the above the Board concludes that the subject-matter of independent claims 1 or 6 as granted is novel over E4, irrespective of whether or not E4 belongs to the prior art.

4. *Remittal*

4.1 The decision considered novelty only with regard to E4, though the notice of opposition also cites E9 in that context. E9 indeed strikes the Board as prima facie highly relevant. E9 is a conference paper, the conference was held well before priority and its availability before priority cannot reasonably be doubted. This document deals with fault diagnosis in pumps specifically using neural networks (summary) for classifying of cavitation (figures 6 and 7, neuron 2; page 3, penultimate paragraph, line 10). Among the five sensors for providing input it lists a flow meter and pressure transmitter (page 3, bottom paragraph). The neural network model itself is initiated via back-propagation and supervised training appear, see page 4, bottom paragraph.

4.2 In the Board's view E9's prima facie relevance is such that it may put at risk the maintenance of the patent. Though it was in fact cited as prejudicial to novelty

in the notice of opposition, it was not considered by the first instance. The Board does not consider it appropriate to decide the case within what is thus essentially a new factual framework. It therefore chooses to exercise its discretion under Article 111(1) EPC to remit the case back to the first instance for further prosecution. Both parties have in fact consented to this course of action.

4.3 Further prosecution, which starts from the main request on file, should consider novelty and inventive step in particular in the light of the teaching of E9.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance for further prosecution.

The Registrar The Chairman

G. Magouliotis M. Ceyte