

Internal distribution code:

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

**Datasheet for the decision
of 13 January 2017**

Case Number: T 0191/12 - 3.4.01

Application Number: 04077530.6

Publication Number: 1521089

IPC: G01R21/00, G01R21/06

Language of the proceedings: EN

Title of invention:

System and method of measuring electric energy in an electric motor drive

Patent Proprietor:

Vacon Oyj

Opponent:

ABB OY

Headword:

Relevant legal provisions:

EPC 1973 Art. 56

EPC Art. 123(2)

Keyword:

Inventive step - (no)

Amendments - added subject-matter (yes)

Decisions cited:

Catchword:



Beschwerdekammern
Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0191/12 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 13 January 2017

Appellant: Vacon Oyj
(Patent Proprietor) Runsorintie 7
65381 Vaasa (FI)

Representative: Heinänen Oy Patent Agency
Äyritie 8 D
01510 Vantaa (FI)

Respondent: ABB OY
(Opponent) P.O. Box 184
00381 Helsinki (FI)

Representative: Kolster Oy Ab
Iso Roobertinkatu 23
PO Box 148
00121 Helsinki (FI)

Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 15 November
2011 revoking European patent No. 1521089
pursuant to Article 101(3) (b) EPC.**

Composition of the Board:

Chairman G. Assi
Members: P. Fontenay
J. Geschwind

Summary of Facts and Submissions

- I. The appeal lies from the decision of the opposition division to revoke European patent No. 1 521 089.

The impugned decision was remitted to the post on 15 November 2011.

- II. The opposition had been filed against the patent as a whole. The opponent had relied on the grounds for opposition of Articles 100(a) and 100(b) EPC 1973. More concretely, the opponent held that the claimed invention lacked novelty (Articles 52(1) and 54(1), (2) EPC 1973), did not involve an inventive step (Articles 52(1) and 56 EPC 1973) and contravened Article 83 EPC.

In support of its opposition, the opponent had cited documents D1 to D10.

- III. In the "Reasons" for the decision to revoke the patent, the opposition division held that the subject-matter of claim 6 of the patentee's main request then on file did not imply an inventive step considering the teaching of document D3 (J. Moreno et al. "*Fuzzy logic based Improvements in Efficiency Optimization of Induction Motor Drives*", IEEE 1997, pages 219-224) considered to represent the closest prior art, in view of common general knowledge.

The same conclusion applied when considering D3 and, as an alternative to general knowledge, the content of document D6 (A. Savolainen, Thesis for the degree of Master of Science in Technology, "*Energy Efficiency in Industrial Motor Drive Systems and Calculation Tool*", Espoo, 8 October 2001).

The same findings applied to claim 1 of the first and third auxiliary requests and to independent claim 4 of the second auxiliary request.

The opposition division further held that the subject-matter of claim 4 of fourth auxiliary request was obvious in view of document D9 (User Guide Unidrive model sizes 1 to 5, Control Techniques SKS OY, Part Number 0447-0019, Issue Number 3; November 1997, pages 6-28 to 6-31) in combination with document D6.

IV. The appellant (patentee) filed a notice of appeal on 12 January 2012. The prescribed appeal fee was paid on the same date. The statement of grounds of appeal was received on 6 March 2012.

V. With the statement of grounds, the appellant requested that the decision under appeal be set aside and the patent be maintained in amended form on the basis of one of a main request and first to third auxiliary requests annexed to the statement of grounds.

With regard to the main request, the appellant contested the analysis of document D3 carried out by the opposition division. In its view, the combination of D3 and D6 was not obvious and did not even lead to the claimed subject-matter. Concerning the first to third auxiliary requests, the appellant expounded on why the claimed subject-matter did not result in an obvious manner from document D9, possibly adapted in the light of D6.

VI. With letter of reply dated 5 July 2012, the respondent (opponent) requested that the appeal be dismissed and the decision to revoke the patent be upheld.

The objection concerning the lack of an inventive step of the subject-matter of claims 1 and 6 of the main request was reiterated, taking due account of the amendments carried out in the claims. In the respondent's opinion, said subject-matter was also not inventive when considering the prior art known to the appellant prior to the filing of the priority application and acknowledged in the introductory part of the patent description. Said prior art was identified as D0. Similar findings applied when starting from document D2 (EP-A-1 085 636).

Besides objections regarding the lack of an inventive step of the subject-matter of first to third auxiliary requests, the respondent stressed that the amendments carried out with regard to the independent claims defined added subject-matter contrary to Article 123(2) EPC.

VII. At the request of both parties, a summons to attend oral proceedings was issued on 19 September 2016.

VIII. On 15 December 2016, the Board issued a communication pursuant to Article 15(1) RPBA, expressing its provisional opinion with regard to the parties' submissions and requests then on file.

In this respect, the Board expressed its doubts concerning the selection of D3 as closest prior art. In the Board's provisional opinion, the prior art identified as D0 by the respondent, i.e. the prior art acknowledged by the appellant in the patent application when filing the patent application, or the prior art corresponding to document D2 (EP-A-1 085 636), appeared to define more realistic items of prior art to be

considered when ruling on the inventive merits of the claimed inventions.

- IX. Oral proceedings before the Board took place on 13 January 2017 in presence of the respondent's representatives only. The appellant had previously indicated by letter of 8 December 2016 that it did not intend to attend the oral proceedings.

The respondent maintained its request that the appeal be dismissed.

- X. Claim 1 of the appellant's main request reads:
"1. A method for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches, characterized in that in the frequency converter (10, 11) or equivalent stepless rotational speed regulator, the power taken by the electric drive from the mains is determined, and based on the power taken by the electric drive from the mains, the energy taken from the supply mains, especially the accumulated energy consumption after a given instant is determined."

Claims 2 to 5 of the main request depend on claim 1

Independent claim 6 of the main request reads:
"6. A system for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches and a control unit (CONTROL1), characterized in that the control unit (CONTROL1) is integrated with the

frequency converter or the equivalent stepless rotational speed regulator, the control unit is adapted to measure the power taken by the electric drive from the mains, and based on the power taken by the electric drive from the mains, the control unit is adapted to determine the energy taken from the supply mains, especially the accumulated energy consumption after a given instant."

Claims 7 and 8 of the main request depend on claim 6.

Claim 1 of the appellant's first auxiliary request reads:

"1. A method for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches, characterized in that in the frequency converter (10, 11) or an equivalent stepless rotational speed regulator the power taken by the electric drive from the mains is determined, and based on the power taken by the electric drive from the mains, the energy taken from the supply mains, especially the accumulated energy consumption after a given instant is determined, and that the power taken from the supply mains is determined on the basis of measured load power, which measurement is made with output current and voltage measurement means integrated with the regulator by performing a series of calibration measurements wherein the ratio (k) between the power (Pv) taken from the mains as measured by the regulator when its output frequency has been set to be the same as the supply mains frequency and the load power (Pm) indicated by the regulator is measured with different loads,

which ratio (k) is then specified as a correction factor the power taken from the supply mains being thus $P_v = k \times P_m$ (4)".

Claims 2 and 3 of the first auxiliary request depend on claim 1.

Independent claim 4 of the first auxiliary request reads:

"4. A system for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches and a control unit (CONTROL1), characterized in that the control unit (CONTROL1) is integrated with the frequency converter or the equivalent stepless rotational speed regulator, the control unit is adapted to measure the power taken by the electric drive from the mains, and based on the power taken by the electric drive from the mains, the control unit is adapted to determine the energy taken from the supply mains, especially the accumulated energy consumption after a given instant, and that the regulator is provided with integrated output current and voltage measuring elements (IU, IV, IW) for the measurement of load power taken by the motor drive, and the control unit (CONTROL1) is adapted to determine the power taken from the supply mains by performing a series of calibration measurements wherein the ratio (k) between the power (P_v) taken from the mains as measured by the regulator when its output frequency has been set to be the same as the supply mains frequency and the load power (P_m) indicated by the regulator is measured with different loads, which ratio (k) is

specified as a correction factor, the power taken from the supply mains being

$$P_v = k \times P_m \quad (4)''$$

Claim 1 according to the appellant's second auxiliary request reads:

"1. A method for the measurement of energy in an alternating-current motor drive containing a frequency converter (10,11) or an equivalent stepless rotational speed regulator provided with semiconductor switches, characterized in that in the frequency converter (10,11) or an equivalent stepless rotational speed regulator the power taken by the electric drive from the mains is determined, and based on the power taken by the electric drive from the mains, the energy taken from the supply mains, especially the accumulated energy consumption after a given instant is determined, and that the power taken from the supply mains is determined on the basis of measured load power, which measurement is made with output current and voltage measurement means integrated with the regulator by performing a series of calibration measurements wherein the ratio (k) between the power (P_v) taken from the mains as measured by external measuring devices and the load power (P_m) indicated by the regulator is measured with different loads, which ratio (k) is then specified as a correction factor the power taken from the supply mains being thus

$$P_v = k \times P_m \quad (4)''$$

Claims 2 and 3 of the second auxiliary request are dependent claims.

Independent claim 4 of the second auxiliary request reads:

"4. A system for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches and a control unit (CONTROL1), characterized in that the control unit (CONTROL1) is integrated with the frequency converter or the equivalent stepless rotational speed regulator, the control unit is adapted to measure the power taken by the electric drive from the mains, and based on the power taken by the electric drive from the mains, the control unit is adapted to determine the energy taken from the supply mains, especially the accumulated energy consumption after a given instant, and that the regulator is provided with integrated output current and voltage measuring elements (IU, IV, IW) for the measurement of load power taken by the motor drive, and the control unit (CONTROL1) is adapted to determine the power taken from the supply mains by performing a series of calibration measurements wherein the ratio (k) between the power (Pv) taken from the mains as measured by external measuring devices and the load power (Pm) indicated by the regulator is measured with different loads, which ratio (k) is specified as a correction factor, the power taken from the supply mains being

$$P_v = k \times P_m \quad (4)"$$

Independent claim 1 of the appellant's third auxiliary request reads:

"1. A method for the measurement of energy in an alternating-current motor drive containing a frequency converter (10, 11) or an equivalent stepless rotational speed regulator provided with semiconductor switches in a pumping process, characterized in that

in the frequency converter (10, 11) or an equivalent stepless rotational speed regulator the power taken by the electric drive from the mains is determined, and based on the power taken by the electric drive from the mains, the energy taken from the supply mains, especially the accumulated energy consumption after a given instant is determined, and that the power taken from the supply mains is determined on the basis of measured load power, which measurement is made with output current and voltage measurement means integrated with the regulator by performing a series of calibration measurements wherein the ratio (k) between the power (Pv) taken from the mains as measured by the regulator when its output frequency has been set to be the same as the supply mains frequency and the load power (Pm) indicated by the regulator is measured with different loads, which ratio (k) is then specified as a correction factor the power taken from the supply mains being thus
$$P_v = k \times P_m \quad (4)''.$$

Claims 2 and 3 of the third auxiliary request are dependent claims.

Independent claim 4 of the third auxiliary request reads:

"4. A system for a pumping process for the measurement of energy in an alternating current motor drive containing a frequency converter (10,11) or an equivalent stepless rotational speed regulator provided with semiconductor switches and a control unit (CONTROL1), characterized in that the control unit (CONTROL1) is integrated with the frequency converter or the equivalent stepless rotational speed regulator, the control unit is adapted to measure the power taken by the electric drive from the mains, and based on the

power taken by the electric drive from the mains, the control unit is adapted to determine the energy taken from the supply mains, especially the accumulated energy consumption after a given instant, and that the regulator is provided with integrated output current and voltage measuring elements (IU, IV, IW) for the measurement of load power taken by the motor drive, and the control unit (CONTROL1) is adapted to determine the power taken from the supply mains by performing a series of calibration measurements wherein the ratio (k) between the power (Pv) taken from the mains as measured by the regulator when its output frequency has been set to be the same as the supply mains frequency and the load power (Pm) indicated by the regulator is measured with different loads, which ratio (k) is specified as a correction factor, the power taken from the supply mains being

$$P_v = k \times P_m \quad (4)''.$$

Reasons for the Decision

1. Applicable law

It is noted that the revised version of the Convention (EPC 2000) does not apply to European patent applications pending at the time of its entry into force (13 December 2007), unless otherwise provided. In the present decision, where Articles or Rules of the former version of the EPC apply, their citation is followed by the indication "1973".

2. Admissibility of the appeal

The notice of appeal and the statement of grounds of appeal filed by the appellant comply with the

requirements of Articles 106 to 108 EPC and Rule 99 EPC. The appeal is thus admissible.

3. *Appellant's main request*

3.1 *Added subject-matter (Article 123(2) EPC)*

In the respondent's view, claim 6 defines subject-matter which was not disclosed in the original application documents. In particular, no basis would exist in the original disclosure for the feature according to which "*the control unit (CONTROL 1) is integrated with the frequency converter or the equivalent stepless rotational speed regulator*".

Despite the absence of any explicit support in the original application documents for the objected feature, the Board concurs with the opposition division (see decision under appeal, reasons, 3.1) in its findings that the added feature nevertheless derives directly and unambiguously from the original application documents. More concretely, the indication in paragraph [0006] and [0013] of the published application, according to which the frequency converter is provided with an integrated system of measuring the power and energy taken from the supply means, combined to the fact that said measuring means are part of the control unit (cf. Figure 3) provide a sufficient basis for the disputed feature.

Therefore, the requirements of Article 123(2) EPC are met.

3.2 *Inventive step (Article 56 EPC 1973)*

3.2.1 The subject-matter of claim 6 of the main request was considered not to involve an inventive step when considering the teaching of document D3 as closest prior art and common general knowledge or, as an alternative to said general knowledge, the disclosure of document D6 (cf. decision under appeal, points 3.4.10 and 3.4.15).

An approach based on a power measure in order to improve efficiency in electric drives is disclosed in document D3 (cf. Introduction, section B). In essence, the method disclosed in D3 consists in identifying the minimum loss point by an iterative flux (power) measurement process. Contrary to the view expressed by the opposition division, the Board considers that there is no incentive in D3 to measure the energy. As a matter of fact, the method described in D3 can only be carried out by identifying the instantaneous power (or flux) and not an average power or energy consumed over a certain period. This aspect of the disclosure D3 is indeed essential in the context of D3. According to the iterative process disclosed, as embodied by an algorithm, it is namely the information regarding the "power" that is required in order to guarantee that the process converges to the optimum point, i.e. the minimum loss point. Alternative parameters such as the "energy", i.e. the amount of total energy consumed over a predetermined period, or the "average energy" would not be adapted since they would not permit to identify said ideal conditions. The statement on page 222 of D3, right hand column, last paragraph, relied upon by the opposition division, to justify its interpretation of D3, does not affect these findings. In effect, this statement reflects the mere observation that the energy consumption, under transient conditions, could also be optimized by implementing the disclosed process and

algorithm. It does not, however, suggest to rely on the energy, as such, in order to identify the minimum loss point.

For these reasons, document D3 appears to lead away from the claimed invention and can thus not be considered to illustrate the closest prior art.

Similar findings would apply when considering the disclosure of document D4 (J. M. Moreno-Eguilaz et al., "*Real-Time Power Measuring and Monitoring for an Efficient Vector-Controlled Induction Motor Drive*", IEEE 1998, pages 871-876).

- 3.2.2 In the Board's judgement, the prior art identified as D0 by the respondent, i.e. the prior art acknowledged by the appellant when filing the patent application, or the prior art corresponding to document D2 (EP-A-1 085 636), appear to constitute more realistic starting documents to decide on the question of inventive step.

Concerning the disclosure of D2, the Board shares for the essential the analysis developed by the respondent in its reply to the grounds of appeal. In particular, the system of claim 6 of the appellant's main request appears to differ from the system of D2 only in that the control unit, which carries out the calculation of the energy taken from the supply mains, is integrated to the frequency converter.

Similarly, the method of claim 1 of the appellant's main request differs from the method disclosed in D2 in that the power taken by the electric drive from the mains is determined in the frequency converter.

The integration of the means for measuring the energy taken from the supply mains in the frequency converter allows a direct estimation of the advantages resulting, in terms of energy savings, from the use of such a frequency converter. In particular, errors resulting from external ambiguity factors, are thus eliminated (cf. paragraph [000] of the published application).

In document D3, the power measurement is done at the drive input (cf. Figure 2). Figure 3 describes the experimental equipment used in order to show the advantages of relying on power measurements for control purposes. As such, D3 does not disclose any physical integration of the power measurement means in the frequency converter, but a mere functional combination of a dedicated software with the frequency controller. However, the skilled person would find in section 6 of D3, regarding the conclusion of the experiments carried out, a clear hint for integrating the power measurement unit to the frequency controller. Relying on the encouraging results of the experiments made (cf. section 6, lines 1-16), it is namely reminded that the research was primarily focusing on *"how to design an autonomous efficiency controller, using the energy consumed in a mechanical cycle to adjust the controller gains [...]"*. The reference to an autonomous controller in D3 would have prompted the skilled person to integrate the control unit, not only functionally but also physically, to the frequency converter known from D2, as recited in the independent claims.

The system of claim 6 is therefore obvious in view of document D2 when considering the further teaching of document D3. The same applies to the method of claim 1.

Claims 1 and 6 of the main request, hence, do not involve an inventive step in the sense of Article 56 EPC 1973.

3.3 It follows that the appellant's main request is not allowable.

4. *Appellant's first to third auxiliary requests*

4.1 *Added subject-matter (Article 123(2) EPC)*

Claim 1 according to first auxiliary request contains the additional features according to which the measurement is made "*by performing a series of calibration measurements wherein the ratio (k) [...] is measured with different loads*". In the text of the original application it is stated that the power taken from the supply means is determined "*by performing a series of calibration measurements with different loads, measuring the ratio (k) [...]*" (cf. paragraph [0014] of the published application).

The amendments carried out with regard to the added feature extend beyond a mere rearrangement of the terms of the original disclosure since they appear to convey a teaching different from the one initially intended insofar as ratio (k) is concerned.

The original disclosure appears to imply that the ratio k would be the same for all motor powers (loads) considered. The unicity of ratio k would thus illustrate the linear relationship existing between the power taken from the mains P_v and the motor power P_m actually delivered. In this respect, the multiplicity of measurements with different loads would refer to

current practise in order to obtain a statistically reliable determination of said parameter k .

The wording of the independent claims according to first auxiliary request however allows a broader interpretation of said ratio, since it suggests that k is actually determined for a plurality of loads thus conveying the idea that it may also depend on said load. In other terms, k itself would be a function of P_m . This interpretation would imply that a plurality of relationships of the kind $P_v = k \times P_m$ would concurrently apply, each one valid for a certain range of measured motor powers P_m and characterised by a ratio k specific to said range. P_v would thus be calculated according to equation (4) reproduced in claim 1, after selecting the value of k which was determined for a load power closest to the one actually measured. This interpretation, which basically reflects a non-linear relationship between P_v and P_m , would be equally realistic considering that losses in the motor drive have various origins and are not all load-dependent (cf. document D6, paragraph bridging pages 66, 67).

It follows that independent claims 1 and 4 according to first auxiliary request define a generalisation of the originally disclosed subject-matter for which no basis can be found in the original application documents.

The subject-matter of independent claims 1 and 4 according to first auxiliary request defines therefore added subject-matter contrary to Article 123(2) EPC.

- 4.2 The independent claims according to second and third auxiliary requests contain the same feature as objected to above with regard to first auxiliary request. The

independent claims according to both second and third auxiliary requests are thus infringing the requirements of Article 123(2) EPC for the same reasons mentioned above.

4.3 Appellant's first to third auxiliary requests are therefore not allowable.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



L. Malécot-Grob

G. Assi

Decision electronically authenticated