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DECISION
of 21 January 2004

Case Number: T 0135/01 - 3.5.2

Application Number: 94917721.6

Publication Number: 0700594

IPC: H02P 6/00

Language of the proceedings: EN

Title of invention:
Electric Motor Drive

Patentee:
THE UNIVERSITY OF LEICESTER

Opponent:
Switched Reluctance Drives Limited

Headword:

-

Relevant legal provisions:
EPC Art. 54, 56, 114(2)

Keyword:

"Confirmation of novelty by opposition division implying
introduction of lack of novelty as a ground for opposition -
(no) "

"Fresh factual case based on unfettered sale examinable by
board of appeal - (no) "

"New - (yes) "

"Inventive step (yes) "

"Description sufficient - (yes) "

Decisions cited:
G 0010/91, G 0007/95

Catchword:

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Case Number: T 0135/01 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 21 January 2004

Appellant: Switched Reluctance Drives Limited
(Opponent) East Park House
Otley Road
Harrogate
North Yorkshire HG3 1PR (GB)

Representative: Roberts, Gwilym Vaughan
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Respondent: THE UNIVERSITY OF LEICESTER
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Representative: Harding, Richard Patrick
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Oxford OX4 2RU (GB)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 28 November 2000
rejecting the opposition filed against European
patent No. 0700594 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: R. G. O'Connell
B. J. Schachenmann

Summary of Facts and Submissions

- I. This appeal is against the rejection of the opposition to European patent No. 700 594.
- II. The patent has not been amended. Claims 1 and 25, the independent method and apparatus claims read as follows:

"1. A method of driving an electric motor comprising a switching operation in which current in a winding is switched from a first state to a second different state, the switching operation comprising performing at least first and second switching steps to switch the current from the first state to the second state, characterised in that the interval between the first and second steps is between a quarter and three-quarters of the period of a dominant frequency of vibration of the motor or to an integral multiple of the said period plus a portion between a quarter and three-quarters of the said period."

"25. Apparatus for driving an electric motor including at least one coil winding (C) comprising a power source, a power converter circuit (7) including switch means (SW1, SW2) for supplying voltage across the windings to drive current in the windings, and a controller (1) for controlling operation of the power converter circuit, the controller (1) including means (8) for operating the switch means (SW1, SW2) to switch the current in a winding (C) from a first state to a second state, characterised in that the switch means is adapted to perform at least first and second switching steps, with the interval between the steps being between a quarter and three quarters of the period of a dominant

frequency of vibration of the motor, or to an integral multiple plus a portion between a quarter and three-quarters of the said period."

III. In the notice of opposition the opponent (now appellant) had requested revocation of the patent in its entirety on the grounds of lack of inventive step (all claims), insufficiency and added subject matter. Lack of novelty was not mentioned.

IV. The following prior art documents were cited in the notice of opposition dated 8 September 1998:

D1: 'The Characteristics, Design and Applications of Switched Reluctance Motors and Drives"; Stephenson et al., presented at the PCIM Conference and Exhibition, Nürnberg, Germany, April 27-30, 1992

D2: WO 90/16 111

D3: EP-A- 0 397 514

D4: "The Origin of Acoustic Noise in Variable Reluctance Motors"; Proc IAS Conference, San Diego, October 1989, pp 108-115,

D5: "Design and Control of Low Power Switched Reluctance Motors(<1 KW)" , Weller et al, Proceedings of EPE Conference, Florence, September 1991, Vol.4, pp 1 -7,

D6: Preface to "Active Noise Control"; Tokhi et al, Clarendon Press, Oxford, 1992,

D7: US-A-5 119 902

D8: US-A-5 126 641

D9: DE-C-4 036 565

D10a:DE-A-3 540 011

D10b:GB-A-2 167 253

D11: US-A-5 144 209.

V. With a letter dated 25 June 1999 the proprietor (now respondent) filed the following documents:

D12: US-A-5 446 359 - a postpublished document submitted to shed light on D1;

D13: "Analysis and reduction of vibration and acoustic noise in the switched reluctance drive", Wu et al, IEEE Proceedings, Industrial Application Section, 28th Annual Meeting, October 1993 and

D14: "Time domain analysis of vibration and acoustic noise in the switched reluctance drive", Wu et al, Sixth International Conference on Electrical Machines and Drives, 8 to 10 September 1993.

D13 and D14 - which stem from the inventors of the opposed patent - were published between the claimed priority date of 29 May 1993 and the filing date of the patent and were submitted by the proprietor to acknowledge that claims 1 and 25 might not be entitled to the earliest priority date in their full scope.

VI. With a letter dated 1 August 2000 the opponent filed a further document:

D15: "Handbook of Acoustical Measurement and Noise Control" C.M. Harris. pages 27.1 to 28.5.

This document was to be combined with D4 in support of an argument alleging lack of inventive step.

VII. The appellant opponent argued essentially as follows:

- (a) The ground for opposition of lack of novelty had been introduced into the opposition procedure by the opposition division when it examined the novelty of claims 1 and 25 having regard to documents D13 and D14 submitted by the proprietor which constituted prior art for any claim or claim portion not entitled to the priority date of 29 May 1993 and when it noted its findings on this issue at page 7 of the decision under appeal. It was accordingly not a fresh ground for opposition on appeal. In this respect the case was comparable with decision T 922/94 dated 30 October 1997 (not published in OJ EPO). The fresh factual case of public availability by unfettered sale now made on appeal should be examined by the board in view of the public interest in central examination of this issue at this stage of the procedure. The evidence and arguments had been filed with the statement of grounds of appeal thus affording the respondent proprietor ample opportunity to comment well before the oral proceedings - an opportunity which had been availed of. The fresh case made on appeal

was complete and met the standard of being prima facie highly relevant set in decision T 1002/92 OJ EPO 1995, 605. The evidence of royalties paid to the appellant opponent for use of its acoustic noise control technology, which evidence had been filed with the statement of grounds of appeal, substantiated its case that motors using a technique - documented also in the statement of grounds of appeal - falling within the terms of claims 1 and 25 of the opposed patent had been sold without any obligation of confidentiality before the priority date of the opposed patent. The delay in presenting the evidence was not culpable; the sale had not been effected by the appellant opponent itself, but by an intermediary - a firm which was now defunct and whose employees were not available as witnesses. It was by no means a case where all the evidence had been within the sole knowledge and control of the opponent prior to the beginning of the opposition proceedings. Furthermore an attempt had been made to reach a settlement with the appellant proprietor. It was only when these negotiations foundered that it became clear that the search for evidence of sale had to be vigorously pursued. The evidence of actual unfettered sale had been filed promptly as soon as it came into the hands of the appellant opponent.

- (b) Even if the board decided not to examine the above mentioned fresh case on appeal it should nevertheless examine the issue of lack of novelty having regard to D2. The latter was acknowledged as closest prior art at column 2, line 11ff of the

opposed patent and had served to substantiate the ground for opposition of lack of inventive step of claims 1 and 25 of the opposed patent in the notice of opposition. Following G 7/95 *Fresh grounds for opposition* OJ EPO 1996, 626 it was now submitted that in fact D2 was novelty-destroying for these claims. D2 disclosed a switched reluctance motor employing a classic freewheeling control with 2-step switching and the freewheel duration defined in terms of angle as shown in Figure 5A of D2. It might be assumed, for the sake of argument, that initially this angle corresponded to a time interval outside the range defined in claims 1 and 25 of the opposed patent. As the speed of the motor increased - which in practice it would inevitably do for a variety of reasons eg load decrease, user demand or supply voltage increase - the time interval corresponding to the same angle would reduce and would inevitably, at some speed, fall into the claimed range. In typical operation it would inevitably be within the claimed range about 50% of the time, it could also sit on a particular speed which would leave it permanently within that range. It was therefore for practical purposes a certainty that putting the teaching of D2 into effect would anticipate the claims. The subject-matters of claims 1 and 25 were accordingly not new.

- (c) D4 had identified the source of acoustic noise in switched reluctance motors as ovalisation of the stator leading to radial vibrations and proposed a model for stator acceleration based on a lumped mass-spring-damper system making the problem

amenable to analysis by classical control theory. D6, the preface to a text book, was evidence that cancellation of acoustic noise by destructive interference was common general knowledge in the art. These two items of information provided the person skilled in the art addressing the problem of reducing acoustic noise in a D2 type switched reluctance motor with the elements of the solution claimed in the opposed patent. D15, Chapter 8, pages 28.1 and 28.2 was further evidence of the common general knowledge in the art in the sense of the resources of a design team addressing this problem; it taught that, where possible, noise should be tackled at the source. Given that the voltage could not be varied in the constant voltage source motor drive the obvious control variable was the angle of the switching interval and it was obvious therefore to choose this to generate the required antiphase stator force.

- (d) D13 disclosed the subject-matter of the GB priority document of the opposed patent viz the range "approximately = $\tau/2$ " for the switching interval, τ being the period of a dominant frequency of vibration of the motor. It explained to the skilled person that noise was reduced in a switched reluctance motor by exciting a second vibration in antiphase. It was obvious to the skilled reader of D13 that other values than this optimum value could be used with correspondingly degraded results. It was not credible for the respondent proprietor to argue otherwise when he maintained that the skilled person required no

specific teaching to work the opposed patent in the extended range of claim 1.

- (e) The disclosure in the patent application was not sufficient to enable the invention to be performed over the full range now claimed in the opposed patent. The original teaching in the GB priority document was of a switching interval approximately equal to half the period of a dominant frequency of vibration of the motor. This was extended in the application resulting in the opposed patent to claim the range $\frac{1}{4}$ to $\frac{3}{4}$. Since the former range was disclosed in D13, the respondent proprietor had been obliged to argue that this extension was not obvious. If it was not obvious then the person skilled in the art could not be expected to be able to perform the invention in this extended range without additional detailed disclosure. The respondent proprietor could not have it both ways on this point; it was either obvious or insufficiently disclosed.

VIII. The respondent proprietor argued essentially as follows:

- (a) Lack of novelty was a fresh ground for opposition which according to Opinion G 10/91 *Examination of opposition - appeals* OJ EPO 1993, 420 could only be examined on appeal with the consent of the respondent proprietor; this consent was not given. The fact that the opposition division had confirmed in the decision under appeal that the subject-matters of claims 1 and 25 were new even when the split priority of these claims was taken into account did not amount to the introduction of

lack of novelty as a ground for opposition. The Enlarged Board of Appeal had confirmed in G 7/95 *Fresh grounds for opposition* OJ EPO 1996, 626 that lack of novelty was a fresh ground when the opposition had been based on the ground of lack of inventive step. In addition to being based on a fresh legal ground the statement of grounds of appeal represented incontestably a new legal and factual framework which was tantamount to a new opposition and should therefore be disregarded by the board; cf T 1007/95 OJ EPO 1999, 733 at point 4.5.1. A third test which the present fresh case on appeal failed to pass was that of completeness of the statement of grounds of appeal; cf T 389/95 (dated 15 October 1997, not published in OJ EPO) at point 2.14, where the view was expressed that "facts, evidence and arguments constituting an entirely fresh factual case on appeal should normally be disregarded pursuant to Article 114(2) EPC unless convergence of the debate is guaranteed, eg by a manifestly unanswerable challenge to the validity of the opposed patent necessarily resulting in restriction or revocation of the patent. Furthermore the conclusiveness of this challenge should normally be manifest from the statement of grounds of appeal." The present fresh case was comparable to that dealt with in T 389/95 since it also involved an alleged public prior use of the opponent's own technology. The latter decision had followed T 1002/92 OJ EPO 1995, 605 which noted at point 3.4, last paragraph, that a shift in legal and factual framework should only be permitted very exceptionally where the fresh evidence was

prima facie highly relevant, while in T 951/91 OJ EPO 1995, 202 it was observed that a board of appeal had a discretionary power under Article 114(2) EPC to disregard evidence filed late without adequate excuse regardless of its relevance. The negotiations to explore the possibility of a settlement did not excuse the delay in this case since they took place in January 2002, nine months after the filing of the statement of grounds of appeal. In the present case the values in the EPROM of the motor controller, which had been worked out by the appellant opponent itself as consultant engineers, not by the intermediary firm or their customers, were not adequate as evidence that the method of the patent had been disclosed and in general the present fresh case did not clear the high hurdle set by the jurisprudence of the EPO Boards of Appeal for examination on appeal. It was true that the respondent proprietor had submitted a detailed response to the statement of grounds of appeal, observing *inter alia* that no evidence had been filed of a specific sale, but this was merely a prudent precaution exercised without prejudice to its view that the fresh case evidence should be disregarded by the board.

- (b) As to the new allegation that D2, which had hitherto been used to support an attack on inventive step, was actually novelty-destroying, the respondent proprietor had been taken by surprise by this late submission during oral proceedings before the board. In any case it was without foundation since it completely ignored the

significance of the physical relationship defined in the claims, a relationship which, like any scientific law, only made sense if it held when a relevant variable, here the speed, was varied. There was no suggestion in D2 that this physical relationship existed, was of importance or should be maintained. A teaching which led to a random intermittent compliance with the terms of claim on the basis of a hindsight analysis derived from the opposed patent did not amount to a novelty-destroying disclosure. The claims defined a systematic physical relationship which was simply not derivable in any way from D2.

- (c) The appellant opponent had combined four references D2, D4, D6 and D15 in his attack on inventive step. D4 was effectively acknowledged in the opposed patent at column 1, line 47ff. The analysis in D4 was based on the frequency content of the current squared i^2 ; there was a mixture of quiet speeds and noisy speeds resulting in random destructive interference as in D2. It was a pure frequency analysis, there was no teaching in D4 that vibrations were induced by step changes in voltage which was the critical insight on which the invention of the opposed patent was based. There was no mention of angles in D4 and in D2 there was no suggestion of any link with a dominant frequency over the speed range. As regards D6, this represented a completely different approach based on generating a secondary acoustic field - an anti-noise which reduced the resultant level at the listener's ear. This was a way of living with a noisy motor; the approach in

the opposed patent was to tackle the noise at source to produce a quiet motor. Although D15 suggested in general that noise should be reduced at source and attempted to give an exhaustive list of possible approaches it did not provide any teaching applicable to a switched reluctance motor, in fact the only reference in D15 to electromagnetic machines was at 28.4 which, however, discouraged redesign to prevent noise generation. To get from the vague and general advice in D15 to the idea of cancelling by a further vibration at a controlled switching step represented an enormous leap.

- (d) The appellant opponent's argument that the extended range of the interval between the switching steps in claim 1 was obvious in view of D13 was based on his mistaken assumption that the noise was not reduced for the interval $\tau = \frac{1}{4}$, it being obvious to accept an inferior result. The drawing filed by the respondent proprietor at the oral proceedings before the board demonstrated that the waveform summation shown in the drawing filed by the appellant opponent at the oral proceedings before the opposition division, which underlay that assumption, was not a correct representation of the physical process which occurred. This new drawing was simply an enlarged and clearer representation of the process described in the opposed patent with reference to Figure 3a. The fact that the inventors themselves did not appreciate at the time of publishing D13 that extension of the range was possible with good results was itself evidence that it was not

obvious for the person skilled in the art, since there was hardly anybody more skilled in relation to this particular problem. This was also confirmed by the appellant opponent's misconception in relation to the results obtained in the extended range.

- (e) The appellant opponent's attempted pincer argument of either obvious or insufficient was fallacious. The skilled person would not derive the extended range of $\frac{1}{4}$ to $\frac{3}{4}$ from D13 without exercising inventive skill since the latter appeared to exclude success significantly outside a narrow range around the $\frac{1}{2}$ value. The reader of the patent application was in a different position. He was told explicitly that good reduction of acoustic noise reduction was achievable out to $\frac{1}{4}$ to $\frac{3}{4}$; he did not need any instruction beyond that in the specification once he was told that this is what he should do. The range in the claims was fully supported by the range of examples of switching intervals in the description and drawings. Furthermore the drawings showed in detail the mechanism by which control of the switching interval gave rise to very significant suppression of the initial onset of the noise-generating stator distortion force so that the skilled person could work out for himself how effective this was eg at $\frac{1}{4}$ and $\frac{3}{4}$ by constructing waveform superposition diagrams of the kind filed at the oral proceedings. The drawing submitted by the opponent in the oral proceedings before the opposition division purporting to show that noise was actually increased at the $\tau = \frac{1}{4}$ end of the

range did not show the proper waveform sum, since it did not allow for the phase offset of the compensating force. The true resultant was shown in the drawing filed by the respondent proprietor in the oral proceedings before the board. This information was already contained in figures 3a and 5b of the specification of the opposed patent albeit not so clearly because of the small scale of the drawing.

- IX. The appellant opponent requested that the decision under appeal be set aside and that the patent be revoked.

- X. The respondent proprietor requested that the appeal be dismissed and that the patent be maintained, or, failing this, that the patent be maintained in amended form on the basis of the claims of the first or second auxiliary request filed with letter dated 25 June 1999.

Reasons for the Decision

- 1. The appeal is admissible.

- 2. In the view of the board the mere observation in the course of an opposition procedure, whether by a party or the opposition division, that the subject-matter of a claim is new having regard to the prior art does not mean that lack of novelty is thereby introduced as a ground for opposition. Thus an assessment of inventive step generally begins with a determination of the point of novelty, which implies a finding that the subject-matter of the claim is new. Treating such a routine

affirmation of novelty as introducing the opposition ground of lack of novelty would be tantamount to including the latter ground as an invariant concomitant of the opposition ground of lack of inventive step contrary to decision G 7/95 *Fresh grounds for opposition* OJ EPO 1996, 626. While refraining from attempting a fully-fledged definition of a ground for opposition, the board nevertheless points to an aspect of the examination of novelty in the present opposition proceedings and decision which causes it to fall short of the actual introduction of lack of novelty as ground for opposition. In particular, the board sees as a requirement for affirming that lack of novelty was in substance raised in the opposition procedure as a ground for opposition, the presence of a **contention**, by a party to the proceedings or by a third party presenting observations pursuant to Article 115 EPC or by the opposition division, to the effect **that the subject-matter of a claim is not new** having regard to some specific prior art. In the present case there was no such contention. At point 6), headed "Novelty", in the decision under appeal the opposition division confirms that the intermediate documents D13 and D14 introduced by the proprietor are not novelty-destroying because that part of the subject-matter of claims 1 and 25 that they disclose is entitled to the earlier priority date. The board regards this as the opposition division confirming its earlier implicit procedural decision **not** to exercise its power under Article 114(1) EPC to introduce lack of novelty as a further ground for opposition; cf opinion G 10/91 *Examination of opposition - appeals* OJ EPO 1993, 420 at point 16. The board therefore concludes that its power to examine this appeal in relation to the issue of lack of novelty

is restricted to considering in the context of deciding upon the ground of lack of inventive step, the appellant opponent's contention, first made at oral proceedings before the board, that the subject-matters of claims 1 and 25 are not new having regard to D2, the document acknowledged as closest prior art in the opposed patent; cf G 7/95 *Fresh grounds for opposition* OJ EPO 1996, 626.

3. The latter contention can be dealt with briefly since it is based on a misinterpretation of claims 1 and 25 or the notion of accidental anticipation or both. The appellant opponent's submission is that in the normal operation of the motor disclosed in D2 it will inevitably, during a significant part of the time, be in a state which would cause it to comply with the conditions specified in claims 1 and 25 for the interval between switching steps. The point of the teaching of the opposed patent, however, and this is accordingly a requirement of the claim, is that the defined relationship for the interval between switching steps has to be maintained. It has to be built into the motor control in such a way that it cannot fail to be met; otherwise the reduction of acoustic noise would not be achieved. The fact that the D2 motor would sometimes run quietly as a result of intermittently, even frequently, complying with the claim conditions does not amount even to an accidental anticipation. To do that it would have to inevitably maintain the claimed relationship.

4. The appellant opponent's argument based on combining D2 and D4 with common general knowledge in the art evidenced by D6 and D14 is not persuasive. Even if it were granted that the person skilled in the art addressing the problem of reducing acoustic noise in a switched reluctance motor as known from D2 would make just those selections posited by the appellant opponent - and it has to be said that it strains credibility to do so - he would still fall far short of the crucial idea of generating an additional excitation in the stator winding by means of a switching step exactly timed so as largely to neutralise the ovalising noise-generating stator force. The board finds it particularly difficult to regard D6 as leading the skilled person towards the invention of the opposed patent given that its clear teaching is to generate a secondary acoustic field at the point of reception whereas the invention involves generating an electromagnetic excitation at the source. These two clear specific pointers away from the invention are hardly reversed by the vague general pointer of generating a field that "destructively interferes" with the noise without reference to the time domain. The inventors of the opposed patent have never claimed to have invented a principle of destructive interference or cancellation; they have invented a very specific form of cancellation, applied at a very specific point, at a very specific time by very specific means.
5. It was common ground that, for purposes of assigning priority, claim 1 (applicable mutatis mutandis to claim 25 throughout) was to be regarded as split into a first notional part claim specifying a range for the switching interval of "approximately = $\tau/2$ " which was

entitled to the priority date of the GB application of 29 May 1993, and a second notional part claim to the complementary range of $\frac{1}{4} < \tau < \frac{3}{4}$ punctured by the range of "approximately = $\tau/2$ ", which second part claim was entitled only to the priority of the actual filing date and for which therefore the intermediate publication D13 was prior art. It was also common ground that the range of "approximately = $\tau/2$ " was disclosed in D13. Thus D13, which stemmed from the inventors of the opposed patent, disclosed precisely the range disclosed in the GB priority document ie it disclosed the notional puncture in the range of claim 1. It seems a little strange to argue that D13 suggests to the person skilled in the art that he should try values outside the range "approximately = $\tau/2$ " since it explicitly teaches the opposite. The most the skilled person would conclude from D13 is that it would be "obvious" that values outside could be used but would give inferior noise reduction or even increased noise. It is hardly reasonable to argue that the skilled person would, having regard to D13, do something which he "knew" would give an inferior result. Conversely it is plausible to argue, as the respondent proprietor does, that an inventive step was involved in realising that D13 was wrong in its teaching that good results could only be obtained in the approximately $\tau/2$ range and that the useful range extended from $\frac{1}{4}$ to $\frac{3}{4}$. The fact that the inventors themselves did not realise this immediately is, of course, not conclusive. Nor is the fact that the appellant opponent was apparently convinced that the invention did not work, ie amplified noise, at $\tau/4$. Nonetheless the board considers it not unreasonable to regard these facts as evidence that the

extension of the range was objectively not obvious having regard to D13.

6. The insufficiency argued here is that the invention cannot be performed across the full range of the claims. It appears to stem from the appellant opponent's belief, as expressed in the drawing filed by him in the oral proceedings before the opposition division, that the invention doesn't work for $\tau = \frac{1}{4}$. The respondent proprietor has, however, convinced the board that the opponent's representation of the summing effect is erroneous. The fact that the appellant opponent may have misunderstood the working of the invention cannot, however, in fairness be regarded as an indicium of insufficiency, since it would be difficult for the board to distinguish between genuine misunderstanding and wilful misinterpretation. It is true that the effect of the compensation force at $\tau = \frac{1}{4}$ is more subtle than simple superposition of ideal infinite sine waves would suggest, but a careful study of the description and drawings does make it clear to the skilled reader that the invention is based on a time-domain analysis and that it is to be implemented accordingly with close control of the initial phase of the compensation force. As the respondent proprietor correctly pointed out there is no contradiction in arguing that the person skilled in the art would not derive the extended range from D13 but would be sufficiently instructed by the patent application.

7. The board concludes therefore that the appellant opponent has not shown that, having regard to the state of the art, the subject matters of claims 1 and 25 were known or obvious to a person skilled in the art or that

the application which led to the opposed patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:



D. Sauter

The Chairman:



W. J. L. Wheeler