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D E C I S I O N
of 1 July 2003

Case Number: T 0659/00 - 3.5.2

Application Number: 90305417.9

Publication Number: 0398746

IPC: H02K 3/493

Language of the proceedings: EN

Title of invention:
Dynamoelectric machines with slot closure wedges, and methods of making the same

Patentee:
GENERAL ELECTRIC COMPANY

Opponents:
I. ISOVOLTA AG
II. ABB Schweiz Holding AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"
"Known alternative element"

Decisions cited:
T 0513/90

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0659/00 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 1 July 2003

Appellant I: (Opponent I)
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Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 8 May 2000 concerning maintenance of European patent No. 0398746 in amended form.

Composition of the Board:

Chairman: W. J. L. Wheeler
Members: F. Edlinger
P. Mühlens

Summary of Facts and Submissions

I. The appeal contests the interlocutory decision of the opposition division concerning maintenance of the European patent No. 398 746 in amended form according to the proprietor's first auxiliary request.

II. Claim 1 has the following wording:

"A high permeability material slot wedge for use as a slot wedge in a dynamoelectric machine in the form of an elongated bar of uniform cross-sectional configuration along the length thereof, the material comprising an electrically insulative ferromagnetic material comprising approximately by weight from 60% to 80% relatively small ferromagnetic particles; about 10% reinforcing woven fiberglass fabric; and from 10% to 20% cross-linked thermosetting polyester resin binder uniformly distributed throughout the wedge."

Claims 2 to 4 are dependent on claim 1. Claims 5 to 12 concern methods of making stator bore wedges. Claims 13 and 14 relate to the use of slot wedges of any one of claims 1 to 4.

III. The following documents, which are among the documents considered in the decision under appeal, will be referred to below:

D2: "Technische Mitteilungen Elektroisolierstoffe", MAGNOVAL, issued by Isovolta; and

D9: JP-A-59-92738, Abstract and English translation.

IV. The decision under appeal expressed the opinion that D2 was one of the two documents which could be considered as representing the closest prior art. The subject-matter of claim 1 solved the problem of providing a slot wedge which had certain desirable electrical and magnetic properties combined with the advantage of easy machinability, in the sense that the cured sheets could be easily machined as desired into their final form by any type of commonly known metal working device. D9 only taught that a polyester thermosetting resin, among other possibilities, could be used in the manufacture of slot wedges. No document of the prior art provided any incentive to choose polyester, in particular in order to improve machinability.

V. Oral proceedings were held before the Board on 1 July 2003. Opponent II, being a party to the appeal proceedings as of right (Article 107 EPC), did not appear at the oral proceedings and did not file comments in writing.

VI. The appellant (opponent I) requested that the decision under appeal be set aside and that the patent be revoked in its entirety.

VII. The respondent (proprietor) requested that the appeal be dismissed.

VIII. The appellant (opponent I) essentially argued as follows:

Slot closing wedges for use in a dynamoelectric machine had to fulfil several tasks. They had to mechanically secure the windings in place within the slots of the

machine. This required good mechanical properties including a high dimensional stability in the range of the allowable service temperatures which, dependent on the insulation class of the machine, could be as high as 180°C for the maximum winding temperature. Fibreglass-reinforced composite materials were commonly used for slot closing wedges. Concerning the magnetic properties, it would be desirable to achieve high concentrations of ferromagnetic material in the wedges to increase the permeability in the gap between adjacent stator teeth and thereby enhance the uniformity of the magnetic field. On the other hand, too high a concentration reduced the electrical insulation and led to undesirable eddy current losses. The resin binder served to maintain the position and orientation of the ferromagnetic particles and the fibreglass, to protect them from environments and to provide the required electrical insulation of the particles.

All these effects had been achieved in the prior art by slot wedges comprising small ferromagnetic particles and resin binder uniformly distributed throughout the wedge. Cross-linked thermosetting resins were frequently used because they had inherently higher allowable service temperatures than thermoplastics. Epoxy resins and unsaturated polyester resins were among the most commonly used thermosetting resin binders with reinforcing woven fibreglass fabrics. Although higher service temperatures could be achieved with unsaturated polyester than with thermoplastic resin binders, this was not generally true when comparing unsaturated polyester with epoxy as classes of resins. Each of these had its advantages and

disadvantages which had to be evaluated in order to determine suitability for a particular application. Epoxy resins, for example, were known to adhere well to metal surfaces and to have good chemical resistance but, by comparison to polyester resins, were more expensive and typically slower curing (cf patent specification, page 2, lines 9 and 10).

D2 disclosed a high permeability material (MAGNOVAL) slot wedge for use in a dynamoelectric machine comprising a woven fibreglass fabric, relatively small ferromagnetic particles and a modified epoxy resin (to achieve higher than usual allowable service temperatures). The slot wedge of D2 (page 1, table and page 2, lower figure), except for the polyester resin, had all the features of claim 1 of the opposed patent, had a magnetic permeability in the range as specified in claim 3 and a minimum electrical resistivity as specified in claim 4 of the opposed patent.

The use of a well-known polyester resin binder in place of the epoxy resin binder in the slot wedge of D2 merely constituted a practical choice which a person skilled in the art made as a matter of routine. D9 (page 7, paragraph 1) confirmed this by saying that the resin for fastening the powdery magnetic substance could be chosen in consideration of the heat-resistance required for the magnetic wedges. D9 (page 2, paragraph 2) also explicitly cited polyester as a suitable thermosetting resin for the slot wedge disclosed in D9. Such usage of a material which was generally available on the market and suitable for the purpose should not be considered as inventive (cf T 513/90, OJ 1994, 154).

The purported advantage of the easy machinability of the slot wedges as specified in claim 1 was not supported by detailed information in the patent specification. Machinability was mainly determined by the fibreglass fabric and the ferromagnetic particles. A different resin binder alone could not account for a significantly different machinability allowing the use of simple metal working tools. D2 gave the advice to use special cutting tools (with a diamond dust coating) for machining the sheets into slot wedges because D2 (as usual for a data sheet) indicated the conditions under which best performance would be obtained. There was no evidence that slot wedges in accordance with claim 1 of the opposed patent had better machinability.

IX. The respondent (proprietor) essentially argued as follows:

Electrically insulative ferromagnetic slot wedges had been long known. Nonetheless, there was only a single reference (D9) to polyester resin in the documents on file. Two opponents would not have spent money if this distinction were not important. It was in fact of considerable value in a commercial sense if almost any type of known metal working device was suitable for the forming and machining of the sheets from which the slot wedges were made.

D2 did not disclose a polyester resin binder in combination with the percentages of the material composition as specified in claim 1 of the opposed patent. According to D2, it was absolutely necessary for the machining of the sheets with the composition

disclosed in D2 that special tools with diamond dust coating were used.

The high permeability material slot wedge of the opposed patent provided the combined advantages of certain desirable electrical and magnetic properties and easy machinability. It had particularly good magnetic permeability. The polyester resin gave the composite the necessary strength and resistance to high temperatures as well as excellent mechanical properties. These advantages were not shown in any of the cited prior art documents and could not even be assumed from these documents. The person skilled in the art was given the impression by D9, as admitted by the appellant, that a thermosetting resin had to be used, but no advantage would accrue from using any particular resin. The person skilled in the art would get no indication that modification of the machinability of the wedge material could be achieved by using a particular type of resin, and would be surprised to learn of the effect achieved in accordance with the present invention. There was no suggestion at all that any advantage would be achieved by using polyester resin instead of epoxy resin.

The person skilled in the art would not depart from proven materials without good reasons. One could not automatically use the same percentages with a different resin binder. The properties of a composite material could not be predicted from those of the individual components. There were non-linear dependencies of the individual parameters of the components, and complex models had to be used to determine possible interactions. All these components including the

additives could have an influence on the desired properties of the composite. Likewise, the interactions of the particles and fabric with a different resin binder material could not be determined in advance with the desirable degree of certainty.

There was no indication in the prior art that a polyester resin binder could be advantageously used in a slot wedge material. If it were obvious for a person skilled in the art, in the absence of any indication of some desired effect in the prior art, to try out different materials, patents could never be granted in some technical fields, such as the in the drug business. Since the combined advantages of the new slot wedge were not foreshadowed in the prior art, the subject-matter of claim 1 of the opposed patent was not obvious and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. It is common ground that D2 discloses a high permeability material slot wedge for use as a slot wedge in a dynamoelectric machine in the form of an elongated bar of uniform cross-sectional configuration along the length thereof, and that the material comprises an electrically insulative ferromagnetic material comprising approximately 75% of relatively small ferromagnetic particles by weight (see table in D2), which is within the range from 60% to 80% specified in claim 1. It is likewise not contested by the respondent that the material of D2 comprises about

10% reinforcing woven fibreglass fabric (D2, table: "ca. 7"; "Glasgewebe"; cf patent specification, Example 1: about 10% is embodied by "12.3%") and that the thermosetting resin binder (in D2 a modified epoxy resin) is uniformly distributed throughout the wedge.

3. The Board considers that the slot wedge disclosed in D2 represents the closest prior art because it not only has all the features of the present claim 1 except for the different resin binder, but also has relative magnetic permeability and electrical resistivity in the range set out in the dependent claims 3 and 4 of the opposed patent.

4. The subject-matter of claim 1 thus differs from the prior art disclosed in D2 in that polyester resin binder is used in the slot wedge material instead of the modified epoxy resin binder which is used in D2.

5. The patent specification (page 2, lines 6 to 10 and 26 to 40) starts off from known metal filled composite materials employing thermoplastic resins, in particular a nylon binder, and heterogeneous ferromagnetic wedges comprising a ferrous or magetizable material and an outer insulating coating layer. Among these, a polyester resin surface layer is mentioned which is moulded about a stack of steel punchings. "Glass cloth with iron powder imbedded in an epoxy binder (polyether resin)" is said to be commercially available. But epoxy resins "by comparison to thermoset polyester resins are more expensive and typically slower curing". In view of this prior art, the patent specification (page 2, lines 41 to 46) sets out the objective "to retain the advantages of easy machinability exhibited by

thermoplastics such as nylon while achieving the advantages of lower cost, rapid curing time, and inherently higher allowable service temperatures of cross-linked thermosetting plastics such as those exhibited by many polyester resins". The material from which the slot closing wedges of the opposed patent are made is described in the patent specification (page 3, lines 1 to 7) as having "superior mechanical properties such as being easily machined to the desired configuration and finish, which properties are very similar to those of TEXTOLITE, a well known phenolic impregnated linen material available from the Applicant Company" and "good magnetic characteristics, excellent mechanical properties, ready machinability to close tolerances and to a smooth surface finish and high dimensional stability". Concerning the machining tools, the patent specification (page 5, lines 4 to 6 and 29 to 35) says that the thickened and cured polyester impregnated glass cloth is cut into sheets by, for example, "a conventional metal shear" and that "almost any type of known metal working device may be used in the forming and machining of these sheets". Example I on page 6 of the patent specification has a composition consisting of 12.3% glass fabric, 68.8% iron powder, 16.7% polyester resin and additives. "Example II is the same as Example I except that the VR-3 viscosity reducing agent is omitted, the Luperox catalyst is replaced by a tertiary-butyl perbenzoate" (page 7, lines 14 and 15).

6. However, the patent specification does not support these general statements of advantageous machinability by specific data, much less measurable parameters or comparative examples. There is likewise no technical teaching of a general principle relating to, nor a sufficient number of embodiments throughout, the ranges of 60% to 80% ferromagnetic particles and 10% to 20% polyester resin binder, to credibly establish, by comparison with the closest prior art, an improved machinability of the material with the ranges specified in claim 1. The appellant's argument appears more convincing: a significantly different machinability of the slot wedge material set out in claim 1, in comparison with the slot wedge material disclosed in D2, is unlikely to be obtained by the use of a different resin binder alone.

7. Since the alleged advantage of easier machinability cannot be taken as granted for the subject-matter of claim 1 as a whole, the objective technical problem for assessing inventive step has to be seen as providing a suitable alternative slot wedge which has the required (mechanical, electro-magnetic and thermal) properties for use in a given dynamoelectric machine and which is readily manufactured. Note that there is no difference in electrical resistivity and magnetic permeability (see point 3 above) and that polyester resin binders do not generally have higher allowable service temperatures than epoxy resin binders, as generally agreed by the parties.

8. Addressing this kind of problem forms part of the routine work of a person skilled in the art. Neither the posing of such a problem nor a solution which merely involves routine adaptation or the use of known alternatives goes beyond what may be normally expected from an average person skilled in the art. In the context of these normal design activities, motives for finding alternative routes may include eg a more economic production and the need for alternative materials as such (since the underlying problem is already solved by the known material). There is no need for a further incentive in the prior art to choose one of the well-known alternative materials. It may be accepted that the skilled person would adopt a conservative attitude when choosing the parameters and composition of a material where the effect of any changes is difficult to predict. But, in an attempt to find the most appropriate alternative composite in the given circumstances, the person skilled in the art must be expected to consider the use of well-known alternative materials which have proven to be suitable in a similar use.

9. Polyester resin uncontestedly was, at the priority date of the opposed patent, among the most commonly used thermosetting resin binders in fibreglass composites. D9 (page 2, paragraph 2; page 7, paragraph 1) confirms this for the technical field of magnetic slot wedges in that polyester resin is explicitly mentioned as one of the three thermosetting resins which are considered as suitable for the glass fabric reinforced slot wedge with magnetic admixture and which could be chosen in consideration of the heat-resistance required for the magnetic wedges. Polyester resin surface layers were

likewise used in electrically insulative ferromagnetic wedges (cf point 5 above). The choice of a polyester resin binder in the slot wedge of present claim 1 thus formed part of the normal activities of a person skilled in the art having to select a suitable one among a limited number of well-known alternative groups of resin binders. This choice did not go against an established prejudice and could be made with a reasonable expectation of achieving known advantages (eg a rapid curing time und lower costs) in the new composite material. Following the conservative attitude mentioned above, the person skilled in the art would start routine trials with the same percentages of ferromagnetic particles, fibreglass fabric and resin binder except if a substantially different composition was generally known to be required with the different resin binder. This was not a fact on which the parties relied. Proceeding in this manner, the person skilled in the art would have arrived at a slot wedge as specified in claim 1 by using, in an obvious manner, a material generally available on the market and suitable for the purpose (cf T 513/90, *supra*, point 4.4).

10. Therefore, the subject-matter of claim 1 of the opposed patent does not involve an inventive step within the meaning of Article 56 EPC. The patent thus has to be revoked.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar: The Chairman:

D. Sauter W. J. L. Wheeler