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D E C I S I O N
of 21 February 2001

Case Number: T 0170/99 - 3.5.2

Application Number: 91112226.5

Publication Number: 0469426

IPC: H02K 15/095

Language of the proceedings: EN

Title of invention:
Methods and apparatus for connecting stator coil leads

Patentee:
AXIS S.p.A.

Opponent:
ATOP S.p.A.

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes (after amendment before the opposition division)"

Decisions cited:
CLBA 3rd Edition 1998 I D 1

Catchword:
-

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Case Number: T 0170/99 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 21 February 2001

Appellant: (Opponent)
ATOP S.p.A.
Localita Cipressino, 20
IT-50021 Barberino Val d'Elsa (Firenze) (IT)

Representative:
Celestino, Marco
ABM, Agenzia Brevetti & Marchi
Via A. Della Spina 40
IT-56125 Pisa (IT)

Respondent: (Proprietor of the patent)
AXIS S.p.A.
IT-50028 Tavarnelle Val di Pesa (Firenze) (IT)

Representative:
Moir, Michael Christopher
Mathys & Squire
100 Gray's Inn Road
London WC1X 8AL (GB)

Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 4 December 1998 concerning maintenance of European patent No. 0 469 426 in amended form.**

Composition of the Board:

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

Summary of Facts and Submissions

I. This is an appeal by the opponent as sole appellant from the interlocutory decision of the opposition division proposing to maintain European patent No. 469 426 in amended form.

II. The amended patent as approved by the opposition division includes independent method and apparatus claims 1 and 13 which are worded as follows:

"1. Method of connecting a first lead wire (31, 204, 220) extending from coil portions (30, 202, 221) wound on a pole (21, 203) of a stator core (20, 200, 222) to at least one of a plurality of terminal means (40, 206, 224) by providing a wire manipulating device (60, 211, 231) having a longitudinal axis (x') to engage said lead wire (31, 204, 220) extending from said coil portion (30, 202, 221), said method comprising the steps of:

a) slidably grasping the wire by means of the wire manipulating device (60, 211, 231);

b) actuating said wire manipulating device (60, 211, 231) by rotational movement about said longitudinal axis (x') and translational movement to route said lead wire (31, 204, 220) along a complex path involving at least one rotational directional change about the longitudinal axis so that said lead wire (31, 204, 220) is aligned with said at least one of said plurality of terminal means (40, 206, 224), the wire passing in a controlled manner through the wire manipulating device during said routing; and

c) engaging said lead wire (31, 204, 220) with said at least one of said plurality of terminal means (40, 206, 224)."

"13. Apparatus for connecting a lead wire (31, 204, 220) extending from a coil portion wound on a stator pole of a stator core (20, 200, 222) to at least one of a plurality of terminal means (40, 206, 224) said apparatus comprising:

a) a wire manipulating device (60, 211, 231) having a longitudinal axis (x') and means for slidably grasping said lead wire;

b) means (120) for rotating said wire manipulating device by a rotational movement about said longitudinal axis (x') and for translating said device to route said lead wire along a complex path involving at least one rotational directional change so that said lead wire passes through the grasping means in a controlled manner during said routing and is aligned with said at least one of said plurality of terminal means; and

c) means (80, 213, 233) for engaging said lead wire with said at least one of said plurality of terminal means."

Claims 2 to 12 and 14 to 25 are dependent on claims 1 and 13 respectively.

III. The following prior art documents from the proceedings before the opposition division remain relevant to the present appeal:

D1: US-A-4 000 764

D5: EP-A-0 453 311

D6: A notice of opposition filed by AXIS against D5

D7: US-A-4 692 974

D8: US-A-4 074 418

D10: Video recording of the operation of the USW400 machine referred to in D6.

In addition the following prior art documents were filed by the appellant in the course of the appeal:

D20: Printout of EPO database search result on term "SCARA"

D21: US-A-4 693 666.

IV. In a communication accompanying a summons to oral proceedings the board indicated its reasoned provisional view that the appellant's objections to the opposition division's resiling from the provisional opinion it had expressed in a communication prior to oral proceedings and to the opposition division's admitting amended claims during oral proceedings were not well founded. The board also gave reasons for its provisional view that the allegation of lack of novelty based on D1 or D8 was not well founded but deferred detailed comment on the issue of inventive step. At oral proceedings before the board on 21 February 2001 the appellant indicated that the further prosecution of the appeal would be based solely on the ground of lack

of inventive step.

V. The appellant opponent's arguments can be summarised as follows:

1. Common general knowledge in the art

D20 and D21 were filed in response to the failure of the decision under appeal to give any weight to the opponent's assertion that SCARA (Selective Compliance Assembly Robot Arm) robots were part of the common general knowledge in the art before the priority date of the opposed patent and to the proprietor's response to the corresponding submissions in the statement of grounds of appeal. These documents were evidence of the fact that SCARA was an established term and concept in the automated assembly art. In fact anthropomorphic robots were notorious in many fields of automated manipulation including - to the representative's personal knowledge - knee and brain surgery, long before 1990; specifically SCARA robots were known which could move about six degrees of freedom using only rotational movements.

2. Inventive step

D6 was the notice of opposition filed by the respondent against D5 in 1995, ie after the priority date of 1 August 1990 of the opposed patent the subject of the present opposition appeal. At point 2.5.3 of D6 the respondent stated:

"In the stator manufacturing industry, a robot has

been routinely used since before 1990 for termination of any type of terminal when the lead paths from the coil to the terminal are complex and when the termination machine needs to be programmable to change the lead paths during the life of the machine. This situation occurs when a different stator or a different lead path needs to be obtained without redesigning or adding new parts to the termination machine. Prior to the use of robots, end effectors to manipulate the wire were moved by pneumatic cylinders which generated a series of dedicated movements around and in combination with a support and shield similar to that used on the Machine as described hereafter. Changing the lead path was possible only by reconfiguring the machine, until the Opponent first supplied its Machine incorporating a programmable robot."

3. This assertion on the part of the proprietor was an admission that the subfeature "to route said lead wire along a complex path...the wire passing in a controlled manner through the wire manipulating device during said routing" in feature b) of claim 1 of the opposed patent was known *per se*. Thus the subject-matter of claim 1 was distinguished from the closest prior art - the stator winding and terminating machine designated USW400/4 referred to in D6 and shown in use in the video D10 - solely by the feature "by rotational movement about said longitudinal axis (x')". The disclosure basis for this feature was to be found in the description of the patent at column 7, lines 27 to 32:

"Wire handling assembly 90 carries wire manipulating device 60, wire cutting device 70 and wire insertion rod 80 and is in turn connected to a gear box 120 which permits rotation of wire handling assembly 90 about the X' axis as described heretofore."

4. The person skilled in the art, starting from the D6 wiring and termination machine, and addressing the problem of terminating leads on a new terminal board designed by a client motor designer would come up with the same solution as the inventor of the opposed patent. There was no exercise of inventive skill involved in providing an additional axis of rotation in a robot as required. There was no difficulty for the person skilled in the art in adding a gear box for axial rotation to the D6 machine; in particular no other changes were needed to existing tools. The inspiration, if needed, was to be found in D7 or D1 or D8, each of which taught a wire manipulating device having a longitudinal axis of rotation. In particular D7 taught the laying of a wire along a complex path with a rotational change of direction (D7, Fig 4) by means of a wire manipulating device which had the degrees of freedom specified in claim 1 of the opposed patent (D7, Fig 3 and column 3, lines 49 to 51: "The manipulator arm 106 can also be rotated about its longitudinal axis....and can be moved upwardly and downwardly").

5. The respondent's argument that D7 related to a remote technical field was not plausible. D7 related to the automated termination of electrical

wires in connector sockets which were fully analogous to the slots or holes in the terminals mentioned in the opposed patent. It was not as if the D7 robot was manipulating textile yarn or the like.

6. Alternatively, the person skilled in the art starting from the USW400 machine would have seen from either D1 or D8, both of which related to machines for terminating electric motor stator coil lead wires, that there was no difficulty in adding a rotational movement to the USW400 machine. In D1, manipulating device 40 (Figs 3 and 4) incorporated a mechanism (piston 65 and motor 80) for simultaneously rotating and translating effector 42b. In D8 manipulating device 161 incorporated a mechanism (pistons 164 and 176 in Fig 5) for simultaneously rotating and translating effector 162, the axis 170 being parallel to the stator axis. In this way the person skilled in the art would have been enabled to modify the USW400 by the addition of feature b) of claim 1 and thus arrive at the subject-matter claimed in the opposed patent.

7. Additionally there were a number of indicia pointing in the direction of obviousness, viz:

(i) There was no technical prejudice in the stator coil winding and terminating art against rotation of the axis of the wire manipulating device. Whether this was done or not depended on the design of the stator terminal board, which in turn was determined by the motor designer. The latter might, for

example, require a more compact board with no projections. This was not a case where the problem had to be invented.

(ii) There was no surprising effect involved - changing the wire direction and rotating the wire manipulating device were routine mechanical operations.

8. The extent of the monopoly conferred by this very broad patent claim was not justified by the technical contribution to the art; cf decisions cited in the Case Law of the Boards of Appeal of the EPO 3rd edition 1998 at Section I D 1, last paragraph (page 110 of the English version). In particular the fact that the claim could be infringed by a standard commercial anthropomorphic robot would severely restrict the activities of competitors.

VI. The respondent proprietor argued essentially as follows:

1. The appellant's analysis of the claim was a deconstruction based on hindsight. In relating the claim to the proprietor's statements in D6 it was important to bear in mind that D6 itself was dated 1995 whereas the priority date of the opposed patent was 1 August 1990; it was the stator winding and terminating machine designated USW400 referred to in D6 which was the closest prior art. This was the machine which featured in the video D10.

2. The term "complex" was used in D6 as a relative

term to distinguish the manipulation effected by the USW400 from earlier less flexible machines. In the context of claim 1 of the opposed patent "complex" was used to distinguish the manipulation of the invention to which the opposed patent relates from the relatively simpler action of the USW400. The term "tortuous" would have expressed better the complexity arising from directional changes but it was nevertheless clear from the context of the claim and the description what was meant and that, in particular, it was not the "complexity" referred to in D6.

3. Furthermore in D6, at point 2.5.3 the robots referred to were 3-axis robots, not anthropomorphic robots.

4. With reference to the video D10, which was viewed in the course of the oral proceedings before the board, the respondent pointed out that the prior art approach had been based on guide tooling with the wire manipulating device moving linearly on 3 axes. There was no suggestion of further rotation in the prior art. It was not even a reasonable "could" argument to suggest that it was merely a matter of adding a gearbox to the prior art machine, since a significant change in the whole termination philosophy was involved in dispensing with the guide tooling and having the wire manipulating device execute complex path following operations involving directional changes.

5. As regards the documents D20 and D21, the only thing they shed light on was the meaning of the acronym SCARA, viz Selective Compliance Assembly

Robot Arm. This was significant because selective compliance was a requirement typical of motor vehicle assembly line manufacture, which involved the offering up of parts with an acceptance tolerance. This situation was not typical of electric motor assembly where the stators were presented with millimetric precision, and compliance, ie judder or wobble would be a positive disbenefit. In general the appellant's appeal to the notorious use of anthropomorphic robots was too vague. There was no precise evidence on file in relation to relevant capabilities of these robots nor any suggestions for their use in stator coil termination.

6. As regards D7 it was important to note that it related to making up an aircraft wiring harness. Such harnesses were typically 50 m long, involving an assembly machine bigger than an EPO oral proceedings room. This represented a very different field of endeavour and the person skilled in the stator art would not look to the aircraft industry for solutions to problems arising in the former field. The machine disclosed in D7 was, in effect, a very sophisticated pipe bending machine - hence the provision of two gripping arms in the harness manipulating device. The device moved freely along the harness, stopped, bent and then moved on. The harness was not slidably grasped since it was not held in tension.

7. As regards the argument based on a combination of the USW400 machine and D1, the latter device was simply for wrapping an already aligned wire around

a terminal post. There was no element of manipulation to deliver the wire to the terminal; it was already there waiting to be wrapped around it. The rotation in D1 was a rapid spinning of the wire through many revolutions, whereas it was implicit in the invention that the rotation was a controlled angular movement generally less than a revolution. The appellant missed the point in asserting that the person skilled in the art would have had no difficulty in adding a rotational movement to the USW400 machine. Apart from the fact that there was considerable technical difficulty in doing so, there was no reason why the skilled person should want to. The assertion was mere hindsight. The rotational capability in D1 was not addressing the same problem as the present invention; it was concerned solely with winding the wires onto the terminal posts (D1, column 2, line 67 to column 3, line 3). The problem of delivering the wire to the terminal post was expressly stated to have been solved (column 2, lines 55 to 66) so that the skilled reader of D1 would correctly dismiss it as teaching nothing towards solving the problem addressed by the present invention.

8. In D8 the manipulator 162 was rotatable about pivot 170, ie orthogonally to its longitudinal axis, whereas claim 1 of the opposed patent required the manipulator to be rotatable about its longitudinal axis. Thus even if D8 were somehow combined with the USW400 machine one would not arrive at the claimed invention. But in fact such a combination would not make sense. D8 was a mechanised (hard-automated) inflexible machine

whereas the USW400 was robotised so that the introduction of an inflexible feature from D8 would run counter to the principle of flexible operation on which the former was based.

VII. The appellant opponent requested that the decision under appeal be set aside and that the European patent No. 469 426 be revoked.

VIII. The respondent proprietor requested that the appeal be dismissed and that the patent be maintained in the amended form approved by the opposition division.

Reasons for the Decision

1. The appeal is admissible.

2. The sole remaining issue is alleged lack of inventive step.

2.1 Closest prior art

The opposed patent relates to stators for electric motors and in particular to a method and apparatus for connecting the ends of the lead wires of the stator coils to circuit board terminals, the step following coil winding in the automatic assembly of such motors. At the end of the latter step the lead wire ends are held under tension in temporary wire grippers pending final termination at the next work station. The agreed closest prior art is the machine designated USW400, documented in the video D10 and undisputedly made available to the public before the priority date of the opposed patent. The latter machine is a 3-axis

programmable robot having a wire grasping device which takes the lead wires from the temporary grippers and, while slidably grasping them, connects them to the circuit board terminals. It effects this operation by moving through simple arcs guided by guide-tooling specific to the required terminal layout.

2.2 Objective technical problem

The objective technical problem addressed and plausibly solved by the subject-matter of claims 1 and 13 is to provide a lead wire termination method and apparatus which is capable of effecting a more elaborate and flexible manipulation of the lead wires while dispensing with the guide tooling involved in the termination method used in the USW400, thus providing a method more readily adaptable to different circuit board terminal layouts.

2.3 Solution

The concept underlying the solution defined in detail in claim 1 is to provide the wire manipulating device with an extra degree of freedom - a longitudinal rotational axis - and, with the help of this "wrist action" to route the lead wire along a complex path involving at least a rotational directional change.

2.4 Inventive step

The extent to which the formulation of the problem involves a contribution to inventive step need not be decided since, as shown below, the issue of inventive step can be decided by reference to the solution alone. The board agrees with the respondent's contention that

the solution is not to be seen as a detail improvement simply achieved by adding a gearbox to the prior art machine. It represents a significant conceptual change involving detailed routing of the lead wire along a prescribed complex path in place of simple transfer movements from temporary grippers to terminals.

2.4.1 Combination of USW400 and D7

The appellant argues that, starting from the closest prior art, the USW400 machine as documented in D10, the claimed solution is the obvious application of the teaching of D7 to the problem specified above. The latter document discloses a method of assembling a wiring harness, with particular emphasis on the precise positioning of a connector block having sockets for receiving and holding the ends of the harness wires. A first end of the harness is held fixed in the connector block while a wire routing tool 300, carrying a wire dispensing canister, is moved by a robot along a predetermined path to dispense the wire segment in the harness and install the second end in a second connector block. The tool 300 is mounted on a manipulator arm 106 which is rotatable about its longitudinal (z-) axis and can be moved upwardly and downwardly as well as translated horizontally in x- and y-directions. The tool comprises two downwardly extending independently pivotable legs at the end of each of which is formed a grooved foot. Each foot can independently grasp (clamp) a wire that passes through the groove of that foot or can allow the wire to pass freely within the groove. Although D7 does not describe the manipulation of the harness wiring in complete detail, the board is persuaded that the respondent's characterization of it as similar to pipe-bending is

plausible, ie at a required bend the two grooved feet clamp the harness, bend it by the required amount and then slide freely along the harness to the next point where a bend is required.

The respondent argues that the disclosure of D7 relates to making up wiring harnesses for the aircraft industry, the assignee of the patent being a major aeroplane maker, and that this is a remote and obscure art from the point of view of a person in the field of stator coil winding and termination so that the person skilled in the latter art would not be aware of D7. The board need not decide this point, because in any case the technical problem solved in D7 is significantly different. Making up a wiring harness involves handling a wire which is **not under tension**. Hence the grooved feet of the wire routing tool have two distinct modes of action, clamping (for bending) or sliding freely along. In D7 the wire is **not slidingly grasped** and the two-legged gripper would not be capable of manipulating a wire under tension. The board judges therefore that, if the person skilled in the stator assembly art considered D7, it would not strike him as sufficiently relevant in view of the structure and bimodal action of the wire routing tool. Endowing the wire routing tool of D7 with a (*per se* known) slidingly grasping grip to enable the complex direction-changing wire routing action of D7 to be applied to the termination of a stator coil lead wire under tension represents an inventive transfer of the teaching of D7 in relation to the problem of laying up a wiring harness to the problem underlying the opposed patent.

2.4.2 Combination of USW400 with D1 or D8.

The appellant argues additionally and alternatively that starting from the USW400 machine, the person skilled in the art would derive feature (b) of claim 1 of the opposed patent - rotation about a longitudinal axis - from either D1 or D8. In the judgement of the board, this argument was refuted by the respondent in his response dated 17 February 2000; see VI.7 and VI.8 above.

2.4.3 Anthropomorphic robots

As regards the appellant's argument based on the allegedly notorious use of anthropomorphic robots in the automation of manipulative tasks, the board is not persuaded that this is a realistic argument. The argument has been expressed as an objection to the extent of the monopoly, which, it is alleged, does not correspond to and is not justified by the contribution to the art. A number of decisions of the EPO Boards of Appeal have acknowledged the validity of this general principle of patent law that the monopoly should equiparate to the invention (Case Law of the Boards of Appeal of the EPO 3rd edition 1998, I D 1), but the board agrees with the respondent's submission that this principle does not point to a requirement above and beyond what is expressed exhaustively in the articles and rules of the EPC. In the present case this means that the appellant's argument is to be regarded simply as an allegation that the subject-matter of claim 1 does not involve an inventive step because it would have been obvious for the person skilled in the art before the priority date to program an anthropomorphic robot to carry out a termination method falling within the claim. For this argument to succeed it would be necessary to have evidence of what the precise

capabilities of anthropomorphic robots were at the relevant date. Although the board is prepared to accept that such robots were at least conceptually notorious before the priority date, this falls far short of a plausible argument on inventive step. Even if the constraints, eg of size and speed, implied by the problem of the opposed patent, could have been complied with, it is not self-evident that such an anthropomorphic robot would necessarily have been programmed to execute the termination operation as specified in the opposed claim.

2.4.4 Other arguments

The appellant has also pointed to the alleged lack of technical prejudice in the art regarding the provision of an additional axis of rotation and the lack of surprising effect in the operation of the claimed method. The board observes that these alleged facts may be given weight as indicia in judging whether the claimed solution is obvious or not, but there is no positive requirement in the jurisprudence of the EPO Boards of Appeal that an identifiable specific technical prejudice be overcome or that an identifiable specific surprising effect be achieved in order to reach a conclusion of non-obviousness.

3. The board concludes therefore that, having regard to the prior art on file, including the admittedly publicly prior used machine USW400, the claimed lead wire connecting method is not obvious for the person skilled in the art so that the subject-matter of claim 1 is regarded as involving an inventive step within the meaning of Article 56 EPC. The above arguments and conclusion apply analogously to the

apparatus claim 13.

4. In the view of the board, the patent in the version approved by the opposition division and the invention to which it relates meet the requirements of the EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

M. Hörnell W. J. L. Wheeler