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D E C I S I O N
of 4 August 1997

Case Number: T 0465/95 - 3.5.2

Application Number: 87303443.3

Publication Number: 0244134

IPC: H02K 9/04

Language of the proceedings: EN

Title of invention:
Cooling in electric motors

Patentee:
Johnson Electric S.A.

Opponent:
Siemens AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - yes, after amendment"
"Decision after withdrawal of opposition"

Decisions cited:
-

Catchword:
-



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Boards of Appeal

Chambres de recours

Case Number: T 0465/95 - 3.5.2

D E C I S I O N
of the Technical Board of Appeal 3.5.2
of 4 August 1997

Appellant: Johnson Electric S.A.
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CH-2300 La Chaux-de-Fonds (CH)

Representative: Higgins, Michael Roger
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Respondent: Siemens AG
(Opponent) Postfach 22 16 34
D-80506 München (DE)

Representative: -

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 24 March 1995
revoking European patent No. 0 244 134 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: A. G. Hagenbucher
Members: R. G. O'Connell
C. Holtz

Summary of Facts and Submissions

I. The appellant contests the decision of the opposition division to revoke European patent No. 244 134. The reason given for the revocation was that the subject-matter of claim 1 then on file did not involve an inventive step, having regard to document

(b): DE-C-144 107

and common general knowledge in the art.

II. With the grounds of appeal the appellant filed amended claims and photographs of a motor allegedly manufactured since the early 1980's by Mabuchi Motor Company of Tokyo, Japan and representing in his view the closest prior art design.

III. In a summons to oral proceedings the board additionally referred to document

(a): DE-A-1 047 298 (cited in the examination and opposition procedure).

IV. Furthermore the respondent referred to documents

(c): DE-A-1 488 568 (cited in the opposition procedure)

(e): DE-U-7 028 025 and

(f): "Leitfaden der Elektrotechnik", vol. III, "Konstruktion und Festigkeitsberechnungen elektrischer Maschinen" von Möller-Werr, 1955, "Wicklungsbefestigung" on page 25, especially Figure 25.5.

- V. Oral proceedings were held on 26 February 1997 following which the procedure was continued in writing.
- VI. By letter dated 17 April 1997 the respondent withdrew the opposition.
- VII. With a letter dated 15 July 1997 the appellant filed amended claims 1 and 2 and amended description pages 1, 2, 2A, 2B, 2C, 2D, 3 to 12.
- VIII. Independent claims 1 and 2 read as follows:

"1. A fractional horsepower direct current electric motor, comprising:

a motor casing (5)

a wound armature (3) and a commutator (4) mounted on a motor shaft (2) for rotation in the motor casing (5), the armature (3) comprising an armature core (28, 34) having a central core (34) mounted fast on the shaft (2) and a plurality of pole sections (28) extending radially outwardly from the central core (34), adjacent pole sections (28) being separated by a gap at their outer circumference, and a plurality of armature coils (29) wound around respective pole sections (28) and terminated on tangs (23) of the commutator to electrically connect the coils (29) to the commutator (4),

an end cap (10) closing the motor casing (5) and supporting brush gear of which brushes proper (14) contact the commutator (4);

windows (22) in the motor casing (5) between the armature (28, 34) and the brushes (13); and

a centrifugal fan (24) mounted about the motor shaft (2) between the core (28, 34) of the armature (3) and the brushes (14), the fan (24) comprising a plurality of radially extending fan blades (26, 26') integral with an annular blade support (25, 27; 25', 27') defining the eye of the fan (24),

characterised in that the motor is a permanent magnet direct current motor; the motor casing (5) is a can-like casing and permanent magnet means (18) is mounted in the casing (5);

the armature core pole sections (28) have a mushroom cross-section; and in that the annular blade support (25, 27; 25', 27') comprises a cylindrical wall (27) which rests on an axial end of the armature core (28, 34) at a position adjacent the radially outer peripheral surface of the armature core (28, 34) and axially extending tabs (30) extend from the cylindrical wall and are located in the gap between adjacent pole sections (34), and the blades (26, 26') extend away from the support in the axial direction away from the tabs and over the commutator tangs (23), the blades (26, 26') being radially spaced from the tangs (23), such that air is drawn into the eye of the fan from over the commutator (4) and the armature coils (29) from both axial sides of the fan (24) to cool the commutator (4) and armature (3)."

"2. A fractional horsepower direct current electric motor, comprising:

a motor casing (5)

a wound armature (3) and a commutator (4) mounted on a motor shaft (2) for rotation in the motor casing (5), the armature (3) comprising an armature core (28, 34) having a central core (34) mounted fast on the shaft (2) and a plurality of pole sections (28) extending radially outwardly from the central core (34), adjacent pole sections (28) being separated by a gap at their outer circumference, a plurality of armature coils (29) wound around respective pole sections (28) and terminated on tangs (23) of the commutator to electrically connect the coils (29) to the commutator (4);

an end cap (10) closing the motor casing (5) and supporting brush gear of which brushes proper (14) contact the commutator (4),

windows (22) in the motor casing (5) between the armature (28, 34) and the brushes (13); and

a centrifugal fan (24) mounted about the motor shaft (2) between the core (28, 34) of the armature (3) and the brushes (14), the fan (24) comprising a plurality of radially extending fan blades (26, 26') integral with an annular blade support (25, 27; 25', 27') defining the eye (31) of the fan (24),

characterised in that the motor is a permanent magnet direct current motor, the motor casing (5) is a can-like casing and permanent magnet means (18) is mounted in the casing (5);

the armature core pole sections (28) have a mushroom cross-section; and in that

a fan mounting member (40) is mounted on an end face of the armature core (28, 34), the annular blade support (25, 27) comprises a cylindrical wall (27) adjacent the radially outer peripheral surface of the armature core (28, 34), the cylindrical wall (27) and the fan mounting member (40) having complementary formations (46, 47) by which the fan (24) is snap-fittably engaged with the fan mounting member (40), the blades (26, 26') extending away from the support in the axial direction away from the armature core and over the commutator tangs (23), the blades being radially spaced from the tangs (23), such that air is drawn into the eye of the fan (24) over the commutator (4) and the armature coils (29) from both axial sides of the fan (24) to cool the commutator (4) and armature (3)."

IX. The appellant requests that the decision under appeal be set aside and the patent be maintained on the basis of the following documents:

Claims: 1 and 2 filed with the letter of 15 July 1997.

Description: pages 1, 2 , 2A, 2B, 2C, 2D, 3 to 12 filed with the letter of 15 July 1997.

Drawings: sheets 1/3 to 3/3 as originally filed.

Reasons for the Decision

1. The appeal is admissible.
2. *Article 123(2) and (3) EPC*

Claim 1 is based on the embodiment described with reference to Figures 1 to 6 and claim 2 is based on the embodiment described with reference to Figures 7 and 8. Present claim 1 comprises all the features of granted claims 1 and 2 and additional features taken from the description. Claim 2 comprises all the features of granted claims 1 to 3 and additional features taken from the description. The documents on file meet the requirements of Article 123(2) and (3) EPC.

3. Novelty is not in dispute. It has therefore to be considered whether the subject-matter of claims 1 and 2 involves an inventive step within the meaning of Article 56 EPC.

4. *Closest prior art and problem to be solved*

The appellant referred on appeal to a motor allegedly manufactured since the early 1980's by Mabuchi Motor Company of Tokyo and contended that it should be regarded as the closest prior art design. The appellant filed only photographs of this motor but no detailed description and emphasised that according to Figure 2B of these photographs the motor fan was attached to the commutator in the region of the tangs. Since in his opinion the eye of the fan was obscured, the air-flow was insufficient. Neither the photographs nor the appellant's comments establish that in the Mabuchi motor air is drawn by a fan over both the commutator and the armature coils. Since document (b) shows such a motor, claims 1 and 2 start in their preambles from the motor known from document(b).

However, it can be seen from the figure of document (b) that the eye of the fan (v) is at least partly obscured by the winding support (w). Hence, it is the object of the present invention to provide a solution which improves the cooling of the commutator and the armature coils in an electric motor with the features in the preambles of claims 1 and 2.

5. According to claim 1 this problem is essentially solved by virtue of the fact that the annular blade support comprises a cylindrical wall (27) which rests on the axial end of the armature core at a position adjacent the radially outer peripheral surface of the armature core and that axially extending tabs extend from the cylindrical wall and are located in the gaps between adjacent mushroom shaped pole sections of the central core and that the blades of the fan extend away from the support in the axial direction away from the tabs

and over the commutator tangs, the blades being radially spaced from the tangs, such that air is drawn into the eye of the fan over the commutator and the armature coils from both axial sides of the fan to cool the commutator and armature.

According to claim 2 this problem is essentially solved by virtue of the fact that the annular blade support comprises a cylindrical wall adjacent the radially outer peripheral surface of the armature core, the cylindrical wall (47) and the fan mounting member (40) having complementary formations by which the fan is snap-fittably engaged with the fan mounting member, the blades extending away from the support in the axial direction away from the armature core and over the commutator tangs, the blades being radially spaced from the tangs, such that air is drawn into the eye of the fan over the commutator and the armature coils from both axial sides of the fan to cool the commutator and armature.

Both solutions result in fan mountings providing an increased air-flow because the eye of the fan is not obscured. The cylindrical wall enhances a tunnel effect for drawing air over the armature windings through the clear eye of the fan.

6. Although the 84 year old document (b) describes a motor with a fan by which air is drawn over both the commutator and the armature coils, the construction differs from those of claims 1 and 2. Whereas according to the present invention the fan blades face towards the commutator, the ribs or fan blades of the motor known from document (b) face towards the armature. In document (b) the winding support (w) near the commutator is slotted. This allows the connecting strips from the armature to feed through to the commutator bars. Consequently some air flows from the

central passage (c) directly up to the fan blades without passing through the annular metal disc of the fan contrary to the teaching of the present invention. It follows from document (b) that a substantial proportion of air overshoots the turn at the winding support and flows over the commutator. Thus warm air from the armature is blown over the commutator and will eventually be expelled through slots in the motor casing.

7. Document (e) describes an electric motor in which fan blades are mounted on a ring which joins slot closing strips. The fan blades cause air to flow only over the commutator and not over the armature also as in the present invention. Apart from the fact that the solution of document (e) does not serve to cool both the armature coils and the commutator this solution appears to be incompatible with that of document (b) because the fan blades of the latter face in the opposite direction, namely towards the armature. According to document (e) this is the direction in which the slot closing strips should be oriented, the fan blades however in the opposite direction.
8. Document (f) deals only with the normal use of slot closing strips, namely for preventing outward movement of coil windings and preventing the build up of carbon dust in the winding tunnels but not for the purpose of securing a fan.
9. According to document (a) air is also drawn by a fan over both a commutator and the armature coils and the fan blades are fitted between the armature and the commutator. However, in that case the fan takes up considerable axial space and increases the overall length of the motor because the annular blade support of the fan is not secured to the end of the armature but is located on its extended windings. Moreover, the

fan does not have an eye as such. Air flows over the periphery of the armature and not over the windings in the rotor slots. The winding of the document (a) motor extends far over the armature and would have to be reshaped in order to allow air to be drawn through the annular fan support from the armature side.

10. Document (c) shows fan mounting members having complementary formations but no details of a fan cooling both an armature and a commutator.
11. Summing up, it can be said that the prior art would not lead the person skilled in the art to provide a fan fixed by means of a cylindrical wall to the axial end of the armature and having blades extending away from the armature, the fan having a clear eye through which air is drawn over the commutator and the armature coils to cool both of them.

Hence, the subject-matter of the two independent claims 1 and 2 now on file involves an inventive step within the meaning of Article 56 EPC.

12. In the result, the patent can be maintained in the amended form requested by the appellant.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent in the amended form requested by the appellant (see paragraph IX above).

The Registrar:



S. Fabiani

The Chairman:



A. G. Hagenbucher