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File Number: T 301/86 - 3.2.2  
Application No.: 79 302 650.1  
Publication No.: 0 011 982  
Title of invention: Regenerative rotodynamic machines

Classification: F04D 5/00, F04D 23/00

D E C I S I O N  
of 11 October 1990

Applicant:  
Proprietor of the patent: CompAir Industrial Limited  
Opponent: Siemens Aktiengesellschaft

Headword:

EPC Art. 54, 56

Keyword: "Novelty (yes) - Inventive step (yes)"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 301/86 - 3.2.2

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.2  
of 11 October 1990

**Appellant :** CompAir Industrial Limited  
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**Respondent :** Siemens Aktiengesellschaft  
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**Representative :** G.A. Möller

**Decision under appeal :** Decision of Opposition Division of the  
European Patent Office dated 1 July 1986 revoking  
European patent No. 0 011 982 pursuant to  
Article 102(1) EPC.

**Composition of the Board :**

**Chairman :** P. Delbecque  
**Members :** K. Stamm  
O. Bossung  
P. Dropmann  
W. Moser

## Summary of Facts and Submissions

- I. European patent Nr. 11 982 was granted on 17 March 1982 with one independent and four dependent claims in response to the European application Nr. 79 302 650.1, filed on 21 November 1979 claiming priority of 28 November 1978.
- II. A Notice of Opposition was filed against the European patent on 16 December 1982. The Opponent requested revocation of the patent on the grounds that its subject-matter was not new or inventive having regard in particular to
- (1) alleged prior use of a machine at the University of Karlsruhe, based on "Forschungsbericht zum Forschungsvorhaben EXPERIMENTELLE UNTERSUCHUNGEN AM SEITENKANALVERDICHTER SKV II", Ma-77-02, 31 August 1977, of which the following parts were filed on 16 December 1982:
- (a) Titelblatt;
  - (b) page 4
    - Bild 1: Foto des SKV II
    - Bild 2: Foto des gesamten Versuchsstandes;
  - (c) one page, not numbered
    - Bild 5: Zuordnung von Laufrädern und Kanälen der Kombinationen SKV II-1 bis 7
    - Bild 6: Variation der Schaufel- und Kanalgeometrie, SKV II-1,4,7;
  - (d) one page, not numbered
    - Bild 9: Geometrie zur Schaufelwinkel-Abstufung;
  - (e) one page, not numbered
    - Bild 10: Geometrie zur Schaufelprofilierung;
  - (f) furthermore two colour fotos according to Bild 1 und 2 were filed on 12 December 1983;

- (2) DE-A-1 921 945;
- (3) DE-A-1 403 575;
- (4) GB-A-1 237 363.

III. During oral proceedings before the Opposition Division on 14 January 1986, Professor Zierrep gave evidence as a witness relating to the availability to the public of the machine-tests in the "Institut für Strömungslehre und Strömungsmaschinen der Universität (TH) Karlsruhe" - according to (1). In particular, the witness stated that the machine in question was made accessible to the public during at least one "Tag der offenen Tür". He also stated that the report to which documents (1) refer was for the employer only, secret and not made public, that, however, the essentials of the tests were communicated on the occasion of lectures given by assistants.

IV. Granted Claim 1 reads as follows:

"A regenerative rotodynamic machine comprising a casing (25), a rotor (11) mounted to rotate within the casing and having at least one ring of blades (18A, 18B) thereon concentric with the axis of rotation, said blades rotating in an annular chamber (13) in the casing that is likewise concentric with the axis of rotation, the annular chamber (13) having a dimension in the radial direction greater than the radial extent of the blades (18A, 18B) and providing a channel (13A, 13B) alongside the blades in which fluid passing through the blades can recirculate, and wherein the blades are curved and profiled aerodynamic blades, the machine being characterised in that each blade has a concave inner surface (30) which leads in the direction of rotation of the blades, and a convex outer surface (31) which trails in the direction of rotation, the curvatures being chosen such that in

operation the angle ( $\beta_1 + \beta_2$ ) between the entry and exit flows of each aerodynamic blade, in the plane containing the curvature of the blade, is greater than  $90^\circ$ ."

V. In its decision of 1 July 1986 the Opposition Division revoked the patent because of lack of an inventive step. The subject-matter of Claim 1 was, in the view of the Opposition Division, an obvious conclusion for the skilled observer of the machine according to (1).

VI. The Appellant (Proprietor) filed a Notice of Appeal on 1 September 1986 and paid the Appeal fee likewise. The Statement of Grounds was filed on 3 November 1986. The Appellant gave reasons why the contested decision was not sufficiently based.

As an annex to his letter received on 23 February 1987 the Respondent (Opponent) presented three more sheets of the Report:

(1) (g) "Seite 8", "Bild 8" and "Bild 31",

mentioned in his letter of 7 December 1983, for giving further details of the alleged prior use. The Respondent submits that the machine according to documents (1) and to the corresponding test results are to be regarded as made available to the public.

VII. Oral proceedings before the Board took place on 11 October 1990 at the request of both parties. In his opening remarks the Chairman of the Board asked the parties to give their comments under the assumption that the content of the documents (1) (a) to (1) (g) would have been made available to the public.

The Respondent's (Opponent) observations are summarized as follows:

- 1) The public was able to recognize the shape of the blades during the experiments at the University of Karlsruhe according to documents (1) (a) to (1) (g). The skilled man was, therefore, able to reconstruct a similar machine, to measure its properties during experiments made on his own, and would then necessarily have recognized that the change of the angle of the fluid between entry and exit of the blade according to Claim 1 would have been greater than  $90^\circ$ . (This change of angle is called hereinafter "angle  $\delta$ "). He thus would have found the machine as defined in claim 1.
- 2) The report itself was in fact not made accessible to the public, what never has been alleged by the Respondent. However, the skilled man did not need the information of the report: He would have found the claimed solution by purely measuring the values of the said angles. The report is only used as technical evidence that the result of such an experiment would have produced the same change of the angle. In "Bild 31" several embodiments are shown having such an angle  $\delta$  greater than  $90^\circ$ . In particular the test "SKV II-10" shows this clearly, since the values  $\beta_{w1} = 170^\circ$  and  $\beta_{w2} = 31^\circ$  given there are equivalent to a value of angle  $\delta$  of  $139^\circ$ .
- 3) The machine shown in Karlsruhe comprised the claimed features as latently immanent properties. It was only necessary to state such a fact afterwards.
- 4) Although the Appellant states that the velocity of the machine is important, Claim 1 contains no mentioning of the required velocity.

- 5) It could not have necessitated an inventive step to find out that an angle  $\delta$  of  $90^\circ$  constitutes a lower limit since the Appellant himself stated in the patent specification (col. 2, last paragraph, referring to FR-A-2 338 376) that such an angle of  $90^\circ$  was known in the state of the art as an upper limit.

The Appellant's observations are summarized as follows:

- 6) None of the cited documents (1) (a) to (1) (g), the availability to the public of which is denied, included information sufficient to communicate the importance of the dynamic angle  $\delta$  of the fluid and the importance of lower limit of  $90^\circ$  as defined in contested Claim 1.
- 7) The velocity of the machine is not an isolated parameter, is not critical and has to be determined by engineering considerations. It is possible that such a velocity may be taken as given, and then to design the rest of the dimensional elements of the blades on such a precondition.
- 8) It is totally disagreed with the argumentations in the contested decision under paragraph 15, in particular with the following:
  - a) "... the fact that ... several different types of curved blades were experimented with, must lead a skilled person to the conclusion that the effect of the blades, depending on those selected, would produce one of two results, viz.: an angle between the inlet and outlet flows in a plane containing the curvature of the blade, of a magnitude either greater than or equal to or less than  $90^\circ$ . The mere selection of one of these ranges from only two possible ranges cannot be regarded

as inventive as the skilled person would inevitably compare the results occurring from both ranges before making the selection", and

b) "... the shape of the blades illustrated in the top two diagrams of Fig. 10 of the report are very similar to that illustrated in Fig. 2 of the patent in suit. It is clear, therefore, that the effect of these blades would, at the very least, be similar. Therefore, the machine in Karlsruhe, operating with the blades shown in Fig. 10 of Ma-77-02 would inevitably lead the skilled person to the subject-matter of contested Claim 1."

9) These arguments according to 8) a) and b) are not appropriate when the real situation of the skilled person at the priority date is taken into account. A famous University has been working on the very same machine - a machine still in its infancy, and which even nowadays is rarely used - and did not give any teaching of the importance of the dynamic angle ( $\delta$ ) and of a rule how to determine its favourable value. This fact itself supports the presence of an inventive step.

VIII. The Appellant requests that the contested decision be set aside and the patent be maintained as granted.

The Respondent requests that the appeal be dismissed.

#### Reasons for the Decision

1. The Appeal is admissible.

## 2. Novelty

2.1 In the view of the Respondent a machine having the features of Claim 1, although in an immanent, latent form, has already been realized during the experiments at the University of Karlsruhe according to documents (1) and made accessible to the public.

2.2 The Board cannot follow such a view.

2.2.1 The state of the art realized by the experiments is a construction of a number of blade forms which are part of a test program. The "Forschungsbericht" (1) contains on page 8 (1, g) one indication of a positive result i.e. from the model SKV II-10 under the heading "4.3 Abstufung der Schaufelwinkel", relating to a curved blade but not to a profiled aerodynamic blade. That part of the "Forschungsbericht" therefore cannot be detrimental to the novelty of a construction according to claim 1 which deals with a profiled aerodynamic blade.

On the same page 8 under paragraph 4.4 it is stated that, based on model SK II-10, variations of the thickness of the blades were realised. Three different profiles shown in "Bild 10" were produced. It is to be admitted that the shape of such profiles are in accordance with what is called "profiled aerodynamic" in the contested Claim 1. On "Bild 31" (1, g), under the heading "Gegenüberstellung der Schaufelwinkel mit den Strömungswinkeln", the following entry and exit values are to be found with respect to the mentioned preferred model SKV II-10: Schaufelwinkel:  $\beta_1=140^\circ$ ,  $\beta_2=27^\circ$ ; Strömungswinkel:  $\beta_{w1}=170^\circ$ ,  $\beta_{w2}=31^\circ$ . In view of "Bild 8" and the values  $-140^\circ$ ,  $-27^\circ$  given there for the non-profiled blades, it seems that these angles have been measured for blades without the profiled aerodynamic shapes. No values at all have been produced

with regard to the very different aerodynamically shaped forms according to "Bild 10" so that, as regards the "Strömungswinkel", no conclusion may be drawn. Moreover, no indications of a positive result for these blades are given. The Board is therefore of the opinion that this realisation also does not lead to the totality of the features appertaining to the subject-matter as defined in Claim 1.

2.2.2 The alleged communications made during the seminars held in the "Institut für Strömungstechnik", and the comments concerning the experiments are solely based on the submitted documents. The latter do not, as follows from above, reliably disclose the totality of the features set forth in Claim 1.

2.3 None of the cited documents discloses all the features of Claim 1. Its subject-matter is therefore new.

### 3. Nearest state of the art

Prior use according to document (1) appears to correspond to the first portion of Claim 1 and shows the most features in common with the claim when compared with the other cited documents. Consequently, this document is to be regarded as the closest state of the art.

### 4. Problem and solution

Since this machine was as such accessible only under restrictions related to a running test, the full results of which are deemed to have been kept secret, i.e. without the disclosure of any detailed and precise information as regards the claimed range for the change of the angle between the entry and exit flows, a person skilled in the art could have envisaged as the objective problem to be

solved the improvement of the performance of that machine.

The claimed solution requires a total angle of deviation between the entry and the exit flows greater than 90° and, therefore, involves an appropriate disposal of the blade-geometry and position.

It is admitted that between this definition and the geometric consequences as to the final shape and position of the blades a certain gap appears to exist. However it is the opinion of the Board that a skilled person is informed about the very decisive feature solving the problem and is able, together with the disclosure of the description and drawing, to realize the invention (Article 83 EPC).

The Board accepts the comments in the description according to which not only a considerable improvement in performance but also in noise-reduction is achieved by these features.

5. Inventive step

5.1 The prior use of the machine according to (1) has shown a multitude of various embodiments. The Board accepts therefore that the skilled person might have observed during the test a greater number of variations in the disposition and geometry of the blades.

The Board states that the decisive features concerning the angle of deviation of flow were not perceivable by pure observation under the circumstances of the test.

In the documents put forward as evidence which had allegedly been made public, no object of the tests, no

limiting conditions and no conclusions are set forth therein although this could have been expected as usual minimal information in order to present a test. In particular, these documents contain no indication that the total angle of deviation between entry and exit flows as claimed has been recognized at all as a design parameter.

- 5.2 Even assuming that some results might have been available, as shown for example in (1) (d) and (g), indications could have been found only in relation to each separate angle at the entry and exit locations of the blades themselves which, in addition, did not have an aerodynamic cross-section.

On "page 8" and in "Bild 31" commented on by the Respondent and mentioned under paragraph VII 2) above, the Board, contrary to the Respondent, merely finds information leading the skilled person away from the crucial features set forth in Claim 1. Among all the documents presented by the Respondent only "Bild 31" provides information corresponding to the angle between the entry and exit flows of the fluid. It refers however to blades without aerodynamic cross-sections. Without the knowledge of the invention, the following informations are deducible: Best results are achieved by the test SKV II-10. The angles of the fluid are:  $170^\circ$  and  $31^\circ$ , resulting in an angle of deviation of  $139^\circ$  (not mentioned there). Among the test results having less good properties is SKV II-7: the fluid angles are  $175^\circ$  and  $36^\circ$ , resulting in a deviation of  $139^\circ$  (not mentioned there). The remainder of "Bild 31" implies two tests having an angle  $\delta$  of  $45^\circ$  and  $7^\circ$  and four tests having, together with SKV II-10, an average angle  $\delta$  of  $148^\circ$ . If the skilled man interprets these facts he will certainly become aware that the amount of deviation of the fluid angle, being in the best case identical to that in an unfavourable case, cannot be the

reason for the good qualities of SKV II-10. On the contrary: such an angle would obviously have to be disregarded as being no interesting factor. By no means the skilled person would have been incited to have a closer look at the value of 90° as claimed.

Therefore, the allegations of the Respondent according to which the features of Claim 1 are disclosed in "Bild 31" constitute mere ex post facto deductions based on the subject-matter of Claim 1 pursuant to the patent in suit, and not on the alleged prior use.

In the allegedly published documents no indication may be found referring to the claimed angle. No reason is derivable either from the observed machine or from the submitted papers (1) (a) to (1) (g), even supposing that their content was made public, why any mathematically expressible relationship between the angles of entry and exit of the blades should be an essential design feature. Such a parameter or any similar one was obviously not investigated. Thus no information is derivable to the effect that the sum of the angles should be crucial. Furthermore, no information is derivable from these documents indicating that a resulting angle of deviation not with regard to the blade, but to the flow in operation would be decisive, and finally that it has to exceed 90°.

- 5.3 Therefore, in the view of the Board, neither the test itself nor the documents (1) (a) to (1) (g), even assuming that they have been available to the public, give the skilled man, looking for improvements of that machine, any reason to deduce therefrom the subject-matter of Claim 1 according to the patent in suit in an obvious manner.

- 5.4 The remarks of the Respondent mentioned under VII 4) above having regard to the velocity of the machine as a missing essential feature are not justified. The Board finds that the Appellant's statements under VII 7) are appropriate in this respect and is of the opinion that the definition of Claim 1 is sufficient for the skilled man. The remarks of the Respondent mentioned under VII 5) above with regard to the angle of 90° are not based on the disclosure of the FR-A-2 338 376 itself, but on the findings of the Appellant when commenting on the French disclosure. They are assumptions only possible ex post and thus without relevance.
- 5.5 In the view of the Board the method of argumentation, according to the remarks mentioned above under VII 8) a) and b), appears to suppose unconsciously what is to be deduced, is thus influenced by prejudice and not based on a sufficient reason. Elimination of the ex-post-knowledge of the invention leads to the above results mentioned under points 5.1 to 5.3 above.
- 5.6 Document (2) suggests to provide blades with determined angles between a tangential plane touching the curved blade and a plane vertical to the axis of the machine. This angle is between 30° and 60° at the entry and between 65° and 90° at the exit edges of the blades. The blades have no aerodynamic shapes. Their curvature is perceivable in a cylindrical surface coaxial with the axis of the rotor. This is opposite to the contested Claim 1, where aerodynamic shaped blades are defined having a curvature contained in a plane and thus necessarily extended perpendicularly when compared with the ones shown in (2). In Figure 4 the situation is illustrated with vectors of relative velocity of flow. Although the separate entry and exit angles of fluid are mentioned and schematically shown, no clear statements are made as to

their magnitude and to the relevance of the sum of them, i.e. the resulting angle of deviation.

Document (2) does not, therefore, contain sufficient information which would allow - without the knowledge of the invention - an obvious deduction of the features of Claim 1, neither alone nor in combination with prior use according to documents (1).

- 5.7 The other documents appear even less relevant.
- 6. From the above it follows that the subject-matter defined in Claim 1 was not obvious to the skilled person having regard to the alleged prior art in combination. Thus Claim 1 complies with Articles 52 and 56 EPC.
- 7. No objections are raised against the dependent Claims.
- 8. Finally it has to be made clear that the assumption mentioned under point VII above was only made in order to fix an appropriate approach for the case. No other consequences should be taken from that assumption since it has not been further discussed.

Order

For these reasons, it is decided that:

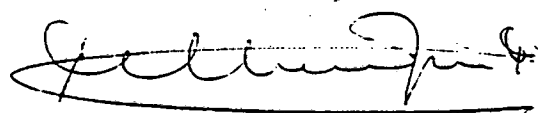
- 1. The decision under appeal is set aside.
- 2. The patent is maintained as granted.

The Registrar:



M. Maslin

The Chairman:



P. Delbecque

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W. Nojir