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Datasheet for the decision of 2 December 2011

Case Number: T 1166/09 - 3.2.04

Application Number: 01108605.5

Publication Number: 1247991

IPC: F04D 29/24, F04D 29/42

Language of the proceedings: EN

Title of invention:
Centrifugal pump

Patentee:
Hitachi, Ltd.

Opponent:
SULZER PUMPEN AG

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
-

Catchword:
-

Case Number: T 1166/09 - 3.2.04

D E C I S I O N
of the Technical Board of Appeal 3.2.04
of 2 December 2011

Appellant: (Opponent)	SULZER PUMPEN AG Zürcherstrasse 12 CH-8401 Winterthur (CH)
Representative:	Steiner, Peter Sulzer Management AG Patentabteilung / 0067 Zürcherstrasse 14 CH-8401 Winterthur (CH)
Respondent: (Patent Proprietor)	Hitachi, Ltd. 5, Kanda Surugadai 4-chome Chiyoda-ku Tokyo 101-8010 (JP)
Representative:	Hano, Christian V. Füner Ebbinghaus Finck Hano Patentanwälte Mariahilfplatz 2-3 D-81541 München (DE)

Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 24 March 2009 concerning maintenance of European patent No. 1247991 in amended form.**

Composition of the Board:

Chairman: M. Ceyte
Members: A. de Vries
C. Heath

Summary of Facts and Submissions

I. The Appellant (Opponent) lodged an appeal, received 25 May 2009, against the decision of the Opposition Division posted 24 March 2009 on the amended form in which the European patent No. 1 247 991 can be maintained, and simultaneously paid the appeal fee. The statement setting out the grounds was received 3 August 2009.

Opposition was filed against the patent as a whole and based inter alia on Article 100(a) together with Articles 52(1) and 56 EPC 1973, for lack of inventive step.

The Opposition Division held that the grounds for opposition under Article 100 EPC 1973 did not prejudice the maintenance of the patent as amended according to a sole request having regard to the following documents among others:

D3: US-A-5 125 799
D4: JP 6-123298 A
D4a: English translation of D4
D8: S. Saha et al.: "Suppression of Performance Curve Instability of a Mixed Flow Pump by Use of a J-Groove", Journal of Fluids Engineering, Transactions of the ASME, Volume 122, September 2000, pp.592-597
D12: Fuchslocher/Schulz: "Die Pumpen", Springer-Verlag, Berlin 1967, pp.13-17

II. The Appellant (Opponent) requests that the decision under appeal be set aside and the patent be revoked in its entirety.

The Respondents (Proprietors) request that the appeal be dismissed.

III. Oral proceedings in appeal were duly held before this Board on 2 December 2011.

IV. The wording of claim 1 in the amended form held allowable by the opposition division is as follows:

"A pump, comprising
an impeller (1) having a plurality of blades (122), and a casing (3) for storing the impeller (1)) therein, a plurality of grooves (124) being formed on an inner surface of the casing (3) in a direction of pressure gradient of fluid, the grooves (124) confronting the impeller (1) around a periphery thereof for connecting between an inlet side of the blades (122) and an area on the inner surface of the casing (121) where the blades (122) exist,
characterized in that the outlet angle (β_2) of the blades (122), being measured from a peripheral direction of the blade (122) of the impeller (1), is set to be within a region from 50 degree to 70 degree."

V. The Appellant argued as follows:

Compared with D3 as closest prior art, the grooves represent the only difference of the claimed pump. According to the patent this feature addresses the problem of instability in the head curve. D8 teaches grooves as solution for this problem. The skilled person would look toward D8 for a solution to the associated problem of performance instability, and would apply its teaching to a pump as in D3 without inventive step.

He would be undeterred by the gap size mentioned in D8, as figure 1 in D3 is not to scale; nor does the patent itself require any particular gap size. Though it mentions an angle of 31.4° in an embodiment, D8's teaching is clearly not limited thereto. It is therefore obvious for the skilled person to apply D8's general teaching to a pump as in D4 to suppress performance instability.

The same conclusion is reached if D4 is taken as closest prior art. Again the only difference resides in the grooves, which are however already known from D8 to suppress instability. D4 itself already provides a solution in the form of a variable diffusion passageway but that is complex, whereas the alternative solution of D8 is much simpler to realize.

VI. The Respondents argued as follows:

In D3, the clearance between impeller and housing is too large for the teaching of D8 to apply.

The fourth embodiment of D4 already proposes a solution to performance instability, namely the use a variable diffuser passage way. It makes no sense to look to another document for a solution.

D8 is strictly limited to small clearances, in the order of 0.7 mm. D8 also only mentions an outlet angle value of 31.4° which is marginally larger than values conventionally used in impeller pumps. He would never consider applying D8's teaching for angles that are even further away from those values, and so go against convention in the field.

Reasons for the Decision

1. The appeal is admissible.

2. Background

The patent is concerned with impeller pumps and how to reduce them in size without increasing rotation speed and while suppressing unstable pressure head response due to stall and/or separation, see specification paragraph [0009]. As explained in paragraphs [0017] to [0020] in conjunction with equations (1) and (2) the diameter of the impeller can in theory be reduced by increasing its blade outlet angle for constant pressure head but this produces stall and/or separation and so unstable performance. This can be suppressed by providing grooves on the casing surface facing the impeller blades extending to the inlet area and in the direction of the pressure differential, allowing the blade outlet angle to be increased to a range of higher than conventional angles.

In claim 1 as granted the specific range of blade outlet angles was 30° to 90°. In claim 1 as held allowable in the decision under appeal this was further narrowed down to the range 50° to 70°.

3. Inventive Step

3.1 The Board considers D3 to represent the closest prior art. This document, see its title, also concerns impeller pumps. With reference to figures 1 and 2, column 1, lines 12 to 65, D3 describes a conventional impeller pump with an impeller 6 in a housing or casing 1. According to column 1, line 49 to 51, the blade outlet angle β_2 has a value of approximately 60°, that is within the claimed range.

3.1.1 The only difference over D3 of the pump of claim 1 as held allowable resides in the feature of the grooves formed on the inner surface of the casing and extending in the direction of the pressure gradient from the inlet to where they face and surround the impeller. These grooves stabilize the head curve, see specification paragraphs [0021] by producing back circulation into the inlet and suppressing pre-swirls there, as explained in detail in [0023]. The objective technical problem addressed by the grooves can be formulated accordingly as how to stabilize head performance or the head curve in a pump such as the prior art pump described in D3.

3.1.2 The skilled person is an engineer specializing in pump design and development and has an extensive knowledge in that field. In particular he will be familiar with research paper D8, which is specifically concerned with the suppression of performance curve instability in mixed flow pumps, see its title. D8 proposes the use of

"J-grooves" to solve this problem, see title and abstract, defined as shallow grooves parallel to the pressure gradient on the pump's casing wall, page 592, right hand column, 2nd paragraph. It presents research carried out on a test pump, see figures 1 and 2, to examine various parameters of the grooves and their effects. The results are summarized in the section "Conclusions" on page 597, where it is stated that the "J-groove of optimum dimensions and proper location can suppress the performance curve instability completely". That section also explains the underlying mechanism, which is based on the reverse flow generated in the J-groove.

3.1.3 Confronted with the above problem the skilled person will as a matter of course draw on D8's teaching addressing that very same problem. By incorporating grooves as taught by D8 in a pump as in D3 he arrives at the subject-matter of claim 1 without an inventive step.

3.1.4 He will not be deterred by the fact that the test pump has an outlet blade angle of 31.4° whereas in the prior art pump of D8 that angle is 60°. He recognizes the typical research value of D8's teaching, where the results obtained for a specific setup are meant to demonstrate or illustrate effects that are presumed to have significance across a much broader field. It therefore requires no inventive insight for the skilled person to realize that D8 which offers "complete" suppression of performance curve instability in mixed pumps, a type of rotary impeller pump which combines the features of a radial and axial impeller pump, may hold out the same promise of success for a radial type rotary impeller pump such as shown in figures 1 and 2 of D3.

3.1.5 The Board is further unconvinced by the argument that the skilled person would never venture so far beyond the range of blade outlet angles identified as conventional in the patent, that is 15° to 25°, column 8, line 3. With an angle value of 31.4° he has namely already taken a decisive step away from those values, and there is no reason why he might not contemplate achieving the same effect for even larger values. This is in particular so as the main reason smaller values have conventionally been chosen in radial impeller pumps is the problem of instability, see textbook D12, page 16, penultimate paragraph ("ein Kanal mit grossem Austrittswinkel .... [hat] Ablösungserscheinungen zur Folge, so dass sich unter Umständen keine stabile Strömung ausbilden kann" - a passage between blades with large blade outlet angle results in flow separation so that flow may not be stable). This textbook knowledge tells him that if he can solve that problem he is freed of a constraint on outlet angle. D8, which concerns a subclass or cross-class of radial pumps, namely mixed pumps which produce both radial and axial flow, provides him with a clear promise of a solution.

3.1.6 Nor is the narrow range in any way associated with an effect other than that already known from D8. There is thus nothing special about this range other than the fact that it represents a new application of D8' teaching.

3.1.7 The Board also doubts that the skilled person sees any incompatibility in the seemingly different dimensions for the blade clearance shown in figure 1 of D3 and given for the test pump in D8 (0.7 mm, page 592, right hand column, bottom paragraph). Figure 1 of D3, though detailed, is a scale-less schematic drawing and does not allow dimensions to be derived therefrom. Moreover, part of D8's teaching, see the conclusions on page 597, is to optimize groove dimensions and location. Rather than that the absence of exact dimensions in D3 might discourage the skilled person from considering D8, this instruction in D8 will therefore motivate him to optimally dimension pump and grooves when applying D8's teaching to the pump as in D3.

3.2 An alternative but similar argument starts from D4 as closest prior art. According to paragraph [0009] of D4a, its English translation, which is undisputed, this document is concerned with the same general problem of size reduction without rpm increase in impeller pumps. In a 4th embodiment, described in paragraph [0042] onwards, it considers the possibility of increasing impeller blade output angle β_{62}, see figure 11, to between 60° and 90°, based on equation (6) relating pump head H to output angle, cf. equation (1) of the present patent. As these angles give rise to an unstable pump head curve, paragraph [0047], it suggests the use of a diffuser with a variable passageway as shown in figure 9.

3.2.1 D4/D4a does not mention or suggest grooves, the sole difference of the claimed pump over this prior art. As the variable passageway diffuser of D4 addresses the same problem, the grooves represent an alternative solution, which can indeed be said to be simpler in realization. The objective technical problem is then formulated accordingly as finding a simpler, alternative way of suppressing performance or head curve instability in a pump as in the 4th embodiment of D4.

3.2.2 As explained above in section 3.1.2 above the skilled person is an engineer in pumps with knowledge of research paper D8's teaching that head curve instability can be completely suppressed with grooves. In search of a simpler alternative he will again as a matter of course draw on that teaching to replace the variable passage way in the pump as in the 4th embodiment of D4 by inlet grooves as taught by D8. He so arrives at the subject-matter of claim 1 without an inventive step.

3.2.3 The considerations set out in sections 3.1.3 to 3.1.6 apply equally if D4 is taken as starting point. Thus neither dissimilarities in dimension or detail of the pumps, nor convention will prevent the skilled person from considering applying D8's teaching to a pump as in the 4th embodiment of D4, which as in D3, is a radial pump.

4. The above reasoning leads the Board to the conclusion that the subject-matter of claim 1 in the form held allowable in the decision under appeal lacks an inventive step. Claim 1 thus does not meet this central requirement of the EPC as set out in Article 52(1) with Article 56.

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. Hampe M. Ceyte