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D E C I S I O N
of 30 November 2001

Case Number: T 0761/99 - 3.2.4

Application Number: 93116264.8

Publication Number: 0591979

IPC: F01C 1/08

Language of the proceedings: EN

Title of invention:
Screw rotor tooth profile

Patentee:
MAYEKAWA MFG CO. LTD

Opponent:
BITZER Kühlmaschinenbau GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

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

Decisions cited:
-

Catchword:
-



Case Number: T 0761/99 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 30 November 2001

Appellant: BITZER Kühlmaschinenbau GmbH
(Opponent) Eschenbrunnlestr. 15
D-71065 Sindelfingen (DE)

Representative: Behrendt, Arne, Dipl.-Ing.
Schneiders & Behrendt
Rechts- und Patentanwälte
Huestrasse 23
(Westfalenbankgebäude)
D-44787 Bochum (DE)

Respondent: MAYEKAWA MFG CO. LTD
(Proprietor of the patent) 13-1 Botan 2-chome
Koto-ku
Tokyo 135 (JP)

Representative: Strehl Schülbel-Hopf & Partner
Maximilianstrasse 54
D-80538 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 25 May 1999
rejecting the opposition filed against European
patent No. 0 591 979 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: C. A. J. Andries
Members: C. D. A. Scheibling
C. Holtz

Summary of Facts and Submissions

- I. The opposition division's decision to reject the opposition was posted on 25 May 1999.

On 23 July 1999 the appellant (opponent) filed an appeal and paid the appeal fee.
The statement of grounds was filed on 23 September 1999.

- II. The following documents were cited during the appeal proceedings:

D1: US-A-4 695 233

D2: US-A-4 527 967

- III. Oral proceedings were held on 30 November 2001.
During the oral proceedings the respondent (patentee) submitted new independent claims 1 and 3, which read as follows:

"1. A screw rotor device for fluid handling, comprising:
a housing having an operating chamber with two adjacent parallel cylindrical bores,
a male rotor (1) disposed in one of the cylindrical bores and comprising a plurality of troughs (13) each having a dedendum (11) within the pitch circle of said male rotor, and
a female rotor (2) disposed in the other cylindrical bore and comprising a plurality of lands (22) each having an addendum outside the pitch circle of said female rotor and engaging said dedendum of said male rotor when both rotors rotate together,

characterised in

that an advancing profile of said addendum of the female rotor has at least three circular arcs smoothly connected to each other to reduce blowholes, wherein a crest of said addendum (21) of said female rotor (1) consists of a single circular arc (S-J), concentric with the shaft of said female rotor."

"3. A screw rotor device for fluid handling, comprising:

a housing having an operating chamber with two adjacent parallel cylindrical bores,

a male rotor (1) disposed in one of the cylindrical bores and comprising a plurality of troughs (13) each having a dedendum (11) within the pitch circle of said male rotor, and

a female rotor (2) disposed in the other cylindrical bore and comprising a plurality of lands (22) each having an addendum outside the pitch circle of said female rotor and engaging said dedendum of said male rotor when both rotors rotate together,

characterised in

that a retreating profile of said addendum of the female rotor has at least three circular arcs smoothly connected to each other to eliminate the formation of semi-occluded pockets between said addendum and the dedendum of the male rotor, wherein a crest of said addendum (21) of said female rotor (1) consists of a single circular arc (S-J), concentric with the shaft of said female rotor."

IV. The appellant requests that the decision under appeal be set aside and that the European patent be revoked.

The respondent requests that the decision under appeal

be set aside and the patent be maintained in the following version:

claims: 1 to 8 as submitted during oral proceedings,

description: column 1 as submitted during oral proceedings, columns 2 to 10 as granted,

Figures: 1 to 6 as granted.

- V. The appellant mainly argued that the two independent claims 1 and 3 lack novelty over D2 or at least do not involve an inventive step when compared with D2 considering the usual skill of a person skilled in the art and that claims 1 and 3 would not involve an inventive step when compared with D1 considering the usual skill of a person skilled in the art.

The respondent countered the appellant's arguments.

Reasons for the Decision

1. The appeal is admissible.
2. *Amendments*
 - 2.1 A minor and unobjectionable difference of the new set of claims over the granted set of claims is that the claimed object is now said to be "a screw rotor device for fluid handling". Since the granted independent claims were already said to comprise a housing, a male rotor and a female rotor, this modification is a clarification which was already implicitly disclosed

and against which the board does not see any objection under Article 123 EPC.

2.2 The added expression "smoothly connected to each other" in the passages "the female rotor has at least three circular arcs smoothly connected to each other to reduce blowholes" (claim 1) and "the female rotor has at least three circular arcs smoothly connected to each other to eliminate the formation of semi-occluded pockets between said addendum and the dedendum of the male rotor" (claim 3) are based on the passages of the description of the application as originally filed, in particular page 5, line 34 to page 6, line 7, respectively page 6, lines 24 to 34. Corresponding passages can be found in the granted patent, column 4, lines 22 to 24, 28 to 30, respectively column 4, lines 45 to 49, 55 to 57.

2.3 The added expression "wherein a crest of said addendum of said female rotor (1) consists of a single circular arc (S-J) concentric with the shaft of the female rotor" was part of claim 8 as originally filed and of claim 7 as granted.

2.4 The dependent claims as well as the description have been adapted to the independent claims.

2.5 Thus, the board does not see any objection under Article 123 EPC.

3. *Interpretation of the independent claims*

The characterising parts of the independent claims refer to the advancing profile and to the retreating profile of the addendum of the female rotor.

According to the description of the patent in suit, the advancing profile is defined by a cross section of the female rotor from the centre of the crest of the addendum to the pitch circle on the advancing side relative to the direction of rotation (column 4, lines 13 to 17), the retreating profile is defined by a cross section of the female rotor from the centre of the crest of the addendum to the pitch circle on the retreating side relative to the direction of rotation (column 4, lines 17 to 20) and the addendum refers to the tips of the lands which extend beyond the pitch circle (column 2, lines 1 to 3).

The crest is defined by the wording of claims 1 and 3 themselves as consisting of a single circular arc, concentric with the shaft of said female rotor.

4. *Closest prior art*

In agreement with the parties, the board considers D2 to be the closest prior art document.

5. *Novelty*

5.1 In agreement with the parties, the board considers that D2 discloses a screw rotor device for fluid handling as specified in the pre-characterizing portion of the independent claims 1 and 3.

5.2 In Figures 2 and 2a of D2 two distinct embodiments are disclosed.

In the passage of the description corresponding to the embodiment according to Figure 2 of D2, it is stated:

"The present invention is further characterized by the unique profile feature of the female lobe geometry N-H. Unlike the prior art female rotor profiles, discussed above, the main lobe is not defined by a true radius swung from female rotor center 48. In the present invention, the main lobe surface portion N-H is a true radius swung from an offset circle 50, which offset circle is centered on the rotor center 48 ..."
(emphasis added), " Specifically, the center of radius R_3 , subscribing the female lobe peripheral surface portion N-H, intersects the outside diameter 20 which is defined by a true radius R_4 from center 48 of the female rotor 4. This creates a sealing strip S, starting at point N, ..." (column 5, lines 50 to 57 and 59 to 64).

Further, in column 6, lines 18 to 20, it is stated that: "the main lobe periphery formed by surface portion N-H, being defined by a circular arc swung from the offset circle 50 ..."

According to these passages, the sealing strip S is part of the circular arc N-H swung from an offset circle which offset circle is centred on the rotor centre. Consequently, the point of intersection between the outside diameter 20 which is defined by a true radius R_4 from centre 48 of the female rotor and the main lobe surface portion N-H which is a true radius swung from an offset circle 50 has to be the point N, which is also the starting point of the sealing strip S.

5.3 The appellant argues that the statement in column 6, lines 25, 26 of D2: "Also, sealing strip S is concentric to female rotor center 48" means that the

outside diameter 20 which is defined by a true radius R_4 from centre 48 of the female rotor and the main lobe surface portion N-H which is a true radius swung from an offset circle 50 intersect not at the beginning of the sealing strip S in point N, but at the end of sealing strip S which is opposed to point N and that the whole sealing strip S is on the outside diameter circle.

- 5.4 As a matter of fact, D2 seems to comprise two contradictory statements. However, the statement according to which the sealing strip is concentric to the rotor centre appears only once in the description, strangely introduced by the adverb "also", which does not appear to be appropriate, whereas the statement according to which the portion N-H (including the strip S) is a circular arc swung from a point offset from the rotor centre appears in column 5, lines 55, 56; column 6, lines 19, 20 and claims 2 and 3. In claim 2 (column 9, line 67 to column 10, line 5) a clear and unequivocal link is made between the true circular arc swung from an offset circle centered on the female rotor axis on the one hand and the thereby formed female rotor lobe sealing strip on the other hand. This is consistent with the indication in the description where it is explicitly stated that the main lobe (arc N-H) is not defined by the true radius swung from the female rotor center 48 (column 5, lines 50 to 54). The conclusion would therefore be that the second statement is the one correctly discussing the sealing strip S.

Furthermore, if the interpretation made by the appellant were to be correct, one could expect the description to name the point of intersection of the

two circles that would delimit the extend of the sealing strip S and to state that the sealing strip extends from N to said intersection point, whereas the description, column 5, lines 63, 64 states "This creates a sealing strip S, starting at point N" which leads to the conclusion that the end of strip S cannot be clearly defined. Such a definition is understandable if the sealing strip is created by an offset swung radius.

- 5.5 Therefore, the board cannot share the opinion of the appellant that D2 discloses a sealing strip S positioned on the outside circle defined by a true radius from the centre of the rotor.

Since N is the only point of the profile of the addendum that can be said to be positioned on the outside circle concentric to the rotor centre, D2 does not disclose a crest in the meaning of the patent in suit (see claims 1 and 3).

- 5.6 Considering the embodiment according to Figure 2a of D2, the appellant argues that the description, column 6, lines 47 to 58, according to which there is shown an alternative lobe flank surface portion 62 formed by subscribing an arc via radius R_6 (the minimum radius being zero resulting in formation of the sharp point N, while the maximum radius is one in which the centre of radius R_6 is located on the pitch circle), clearly discloses to have an intermediate alternative lobe flank surface portion, where radius R_6 is small enough to have the arc of radius R_6 ending within the extend of sealing strip S of Figure 2a.

- 5.7 This "intermediate" embodiment considered by the

appellant is a hypothetical construction that cannot be defined clearly enough to constitute a starting point for a skilled person.

Nevertheless, assuming that such an object could be defined, the point of tangency of the arc of radius R_6 with the remaining part of strip S would be positioned beyond point N in direction to point H. Since, according to the reasoning put forward in section 5.5 above, point N was the sole point to be positioned on the outside circle and since point N does not exist anymore in Figure 2a, none of the other points of the addendum of this "intermediate" embodiment, would be positioned on that outside circle concentric to the rotor centre. However, due to the form of the surface portion generated by the radii R_3 and R_6 , there will of course be a point of the addendum which is radially the farthest away from the female rotor center 48, thereby forming a crest point. But this will not be a crest consisting of a single circular arc concentric with the axis of the female rotor.

5.8 Therefore, the board considers that the subject-matter of independent claims 1 and 3 is new.

6. *Inventive step*

6.1 The screw rotor devices according to claims 1 and 3 differ from that known from D2 by the features of the respective characterizing parts of said claims.

6.2 Thus, the problems to be solved are to provide a profile of the addendum of the female rotor arranged to reduce blowholes (claim 1), and to provide a profile of the addendum of the female rotor arranged to eliminate

the formation of semi-occluded pockets (claim 3).

The board cannot see any reason why these problems would not be solved by appropriately applying the teaching as defined in these claims, especially since no convincing arguments to the contrary have been brought forward.

- 6.3 The appellant argues that in order to improve the profile of the female rotor so as to approach an ideal profile, it would be obvious for a skilled person to multiply the number of arcs in order to approach said ideal profile, because the more the number of arcs increases, the closer the profile approaches the ideal profile.
- 6.4 This point of view cannot be shared. First of all, there is no indication what the so called "ideal profile" should look like and therefore, to state that it can be approached by a succession of arcs is purely speculative. In any event, this would not lead to a solution of the above mentioned problems.
- 6.5 Furthermore, D2 does not give any indication that could give a skilled person a hint to increase the number of arcs.

Although D2 is concerned with the reduction of blow holes, it proposes solutions which are different from that of the patent in suit i. e. which do not relate to the number of arcs of the profile of the addendum. According to D2 this problem is solved on the one hand by providing two radii partially defining the female groove trailing flank to form a smooth uninterrupted surface of the trailing flank, running from point N at

the outside diameter through the pitch circle to point K (see column 5, lines 30 to 49 and column 2, lines 54 to 67), and on the other hand by having the main peripheral surface of each female rotor lobe defined by a true circular arc swung from an offset circle centred on the female rotor axis at the groove trailing side of the female lobe tip (see claim 2; column 9, line 67 to column 10, line 5).

Even in the embodiment according to Figure 2a, the circular arc of radius R_6 is not said to reduce blow holes but to avoid having a sharp point N (column 6, lines 47 to 58).

Thus, D2 cannot give a skilled person any guidance that could lead him to increase the number of arcs comprised in the profile of the addendum of the female rotor in order to solve the posed problems.

- 6.6 In D1 the profile of the female rotor has an addendum on the outer side of the pitch circle comprising for its profile three true circular arcs namely f_2-g_2 , g_2-a_2 and a_2-b_2 , point b_2 being located on the pitch circle and point f_2 being located inside the pitch circle (D1, column 3 line 47 to column 4, line 9 and Figure 1). Now, when applying the definitions given in the patent in suit, the crest of the addendum corresponds to arc g_2-a_2 located on the tip circle C_f of the female rotor, the advancing profile extends from the centre of arc g_2-a_2 until b_2 and thus, comprises part of arc g_2-a_2 and arc a_2-b_2 , whereas the retreating profile extends from the centre of arc a_2-g_2 until the pitch circle in direction of point f_2 and thus, comprises part of arc a_2-g_2 and part of arc g_2-f_2 . Thus, the advancing and the retreating profiles of the addendum of the female rotor

comprise each solely two circular arcs.

It should also be emphasized that these circular arcs are part of the imaginary profile of the female rotor (see column 4, lines 57 and 58) and that its final shape may be different due to reshaping (column 5, lines 56 to 66 and column 6, lines 53 to 56). Although arcs are present after reshaping (see Figure 2 and the corresponding parts of the description), there is no single indication in D1 that these arcs would be circular arcs. This shows that the presence of circular arcs on the profile of the female rotor in D1 is not essential.

Furthermore, D1 neither considers the problem of blowholes, nor the problem of semi-occluded pockets, nor is there any indication that could lead a skilled person to the assumption that the profile of the addendum of the female rotor could be improved by including more than two circular arcs.

6.7 Therefore, D1 does not give a skilled person an incentive to modify the profile of the addendum of the female rotor in the way claimed in the patent in suit. Therefore, also D1 cannot lead to the object of claims 1 or 3 of the patent in suit either in combination with D2 or starting from D1 itself.

6.8 The board comes to the conclusion that the subject-matter of independent claims 1 and 3, also involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent in the following version:

Claims: claims 1 to 8 as submitted during oral proceedings,

Description: column 1 as submitted during oral, proceedings, columns 2 to 10 as granted,

Figures: 1 to 6 as granted.

The Registrar:

The Chairman:

G. Magouliotis

C. Andries