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**Datasheet for the decision
of 1. December 2006**

Case Number: T 0575/03 - 3.2.04

Application Number: 96660030.6

Publication Number: 0750117

IPC: F04C 2/16

Language of the proceedings: EN

Title of invention:

Screw pump and screw of a screw pump

Patentee:

Kone Corporation

Opponent:

Allweiler AG

Headword:

-

Relevant legal provisions:

EPC Art. 56, 100(b), 100(c), 123(3)
RPBA Art. 10a(2), 10b(1)

Keyword:

"Inventive step (yes)"
"Sufficiency of disclosure (yes)"
"Added subject-matter (no)"

Decisions cited:

-

Catchword:

-



Case Number: T 0575/03 - 3.2.04

D E C I S I O N
of the Technical Board of Appeal 3.2.04
of 1. December 2006

Appellant: Allweiler AG
(Opponent) Allweilerstraße 1
D-78315 Radolfzell (DE)

Representative: Hiebsch, Gerhard F.
Hiebsch Behrmann Nüsse
Patentanwälte
Postfach 464
D-78204 Singen (DE)

Respondent: Kone Corporation
(Patent Proprietor) Munkkiniemen Puistotie 25
FI-00330 Helsinki (FI)

Representative: Wahl, Hendrik
Zipse & Habersack
Wotanstraße 64
D-80639 München (DE)

Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
3 April 2003 concerning maintenance of European
patent No. 0750117 in amended form.

Composition of the Board:

Chairman: M. Ceyte
Members: A. De Vries
H. Preglau

Summary of Facts and Submissions

I. On 22 May 2003 the Appellant (Opponent) lodged an appeal against the interlocutory decision of the Opposition Division posted 3 April 2003, concerning the maintenance of European patent No. EP 0750117 in amended form. The statement of grounds of appeal was filed on 28 July 2003.

Opposition was filed against the patent as a whole and based on Article 100(a) in combination with Articles 52(1) and 54 EPC for lack of novelty, Article 100(a) in combination with Articles 52(1) and 56 EPC for lack of inventive step, Article 100(b) in combination with Article 83 EPC for insufficient disclosure, and on Article 100(c) in combination with Article 123(2) EPC for added subject-matter.

The Opposition Division held that the grounds for opposition mentioned in Article 100 EPC did not prejudice the maintenance of the patent as amended in accordance with the auxiliary request and having regard to the following documents:

D1: DE-A-4 107 315

D2: US-A-2 922 377

D3: FR-A-799 903

II. The Appellant requests that the decision under appeal be set aside and the patent be revoked in its entirety. The Respondent (Proprietor) requests that the decision under appeal be set aside and that, as main request, the patent be maintained on the basis of claims 1 to 5 and 7 to 10 as maintained by the interlocutory decision of the opposition division, and claim 6 as filed with

letter of 16 December 2003, or, alternatively, on the basis of claims 1 to 5 as maintained by the interlocutory decision and claims 6 to 8 as filed during the oral proceedings of 1 December 2006 (first auxiliary request), or on the basis of claims 1 to 5 as maintained by the interlocutory decision (second auxiliary request). Both parties requested oral proceedings, which took place before the Board on 1 December 2006.

III. The wording of the independent claims of the requests is as follows:

Main request

Claim 1: Screw pump (1) comprising a driving screw (6) and at least one side screw (7), said screws being placed in a screw channel (5) in the pump casing (2) between a suction space (3) and a pressure space (4), at least one of the clearances between the surfaces of the driving screw, side screws and screw channel being larger in the areas close to the suction and pressure spaces than the corresponding clearance in the middle portion of the pump channel, characterized in that near the ends of the screw channel either a continuous change in the increase of the clearance by a continuous change in the reduction of the external diameter of the screw per a unit of length in the longitudinal direction of the screw channel or a continuous change in the increase of the clearance for a unit of length in the longitudinal direction of the screw channel by enlargement of the screw channel is provided so that the leakage flow (V) through the clearances between the

suction and pressure spaces is substantially the same for all angles of rotation of the screws (6, 7).

Claim 6: Driving screw or side screw (6, 7) including a screw crest (11) for a screw pump (1), placed in a screw channel (5) in the pump casing (2) between a suction space (3) and a pressure space (4), said screw having end portions thinner than the middle portion so as to increase the clearance between the screw channel wall (10) and the screw crest (11) of the driving screw, characterized in that the change in the external diameter of the reduced portion of the screw for a unit of length in the longitudinal direction of the screw has at least two different values within the length (S) of the reduced portion.

First Auxiliary Request

Claim 1 as in the main request

Claim 6 is amended to read:

Driving screw or side screw (6, 7) for a screw pump (1), to be placed in a screw channel (5) in the pump casing (2) between a suction space (3) and a pressure space (4), said screw having end portions thinner than the middle portion, wherein the change in the external diameter of the reduced portion of the screw for a unit of length in the longitudinal direction of the screw has at least two different values within the length (S) of the reduced portion, characterized in that the screw with reduced end portions has a portion of reduced diameter at each end extending through a distance corresponding to 0.4 to 0.65 times the pitch of the driving screw.

Second Auxiliary Request

This request includes only claims 1-5 of the main request.

IV. The Appellant's arguments can be summarized as follows:

Claim 1 of the main request was unallowably amended under Article 123(2) EPC in that features had been added out of their original context, which included abrupt change in screw diameter as essential feature and pertained only to the tapering screw alternative. Moreover, the qualification "total" had been dropped from the term "total leakage flow" in the originally filed claim 1.

As regards insufficiency of disclosure, the linear taper practiced in D1 already brought the pressure pulse reduction to within practical tolerances. Any further reduction was purely theoretical in nature, but could not be realized due to such tolerances.

Addressing inventive step of claim 1 the only meaningful difference resided in the continuously changing taper. The final functional feature was already realized in D1 within practicable limits. D1, moreover, was interpreted too narrowly: its main objective, see column 3, lines 42 to 44, was adapting the chamber closing characteristic, achieved by a pressure side tapering. Lines 52 to 55 of column 3 included a clear suggestion to go beyond the specific embodiment of a linear tapering, as confirmed by varying screw width or pitch alternatives also

considered in D1. A curvilinear taper was a straightforward application of D1's general teaching to the same desired effect.

Alternatively, departing from D1 as nearest prior art the problem could be formulated as adapting the tapering so as to adjust the chamber closing characteristic. D2, also concerned with reducing pressure pulses, in column 8, lines 34 to 44, suggested curvilinear tapers as also shown in figures 89,94 and 97.

For the same reasons claim 6 as amended in response to the appeal failed to define inventive subject-matter, as a curvilinear taper, which has already been argued as obvious with regard to claim 1, must include at least two different change rate values.

V. The Respondent's arguments can be summarized as follows:

Addressing the issue of unallowable amendments, attention was drawn to originally filed claim 7 concerning continuously changing diameter change without an abrupt step. From the relevant passages describing figure 3, it was clear that the abrupt change was an independent measure to be considered in isolation, as was clear from original claim 9, where it was subsidiary to the main idea. Finally, figure 2 showed an embodiment without an abrupt step.

The term "total leakage flow" had significance only in the description, where a mathematical analysis identified component terms.

The Appellant, who carried the burden of proof, had provided no evidence corroborating practical limitations of pulse reduction. In any case, D1, figure 3, showed clear residual pressure pulses, which the invention attempted to further reduce. The term "substantially" in the claim made allowance for any practical limitations.

As regards inventive step of both claims 1 and 6, there was no suggestion in D1 to depart from a simple linear tapering. Column 1, lines 38 to 45, referred exclusively to linear tapering. Lines 52 to 55 of column 3 had to be read in the context of the preceding lines relating the optimal length and pitch of the screws.

D2 offered a different solution to a different problem: column 7, lines 35 to 40 clearly required fixed clearances, and thus taught away from the invention.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is therefore admissible.
2. *Allowability of amendments*
 - 2.1 In claim 1 (main request) the final functional feature is reinstated while further features identifying the two central alternative modes of realization are introduced. With regards to deletion of "total" from "leakage flow" in the final feature, this term merely signifies that the leakage flow consists of component

flows. The two terms, "leakage flow" and "total leakage flow", are in fact interchangeable. No information is lost, and thus no extension of scope results from its deletion. The added features derive from page 6, lines 14 to 24 (first alternative) and figure 2 and page 5, lines 10 to 12 (second alternative). From page 14, lines 6 to 19, as well as claim 7, it is clear to the skilled person that they are central to achieving the required leakage flow and do so independently of the supplementary measures such as that of the abrupt change also featuring in the embodiment on page 6.

2.2 Claim 6 of the main request as amended with letter of 16 December 2003 adds features of the screw crest and the increasing clearance that appear on page 6, lines 8 to 11. These limiting amendments have a clear basis in the original application documents.

2.3 The Board is thus satisfied that the amendments to the claims neither extend beyond the original disclosure, nor extend the scope of protection, and thus meet the requirements of Articles 123(2) and (3) EPC.

3. *Sufficiency of disclosure*

3.1 This ground was raised and substantiated in the notice of opposition. However, detailed arguments regarding this ground were first submitted by the appellant in his reply of 2 November 2006 to the invitation to oral proceedings before the Board, contrary to Article 10a(2) of the Rules of Procedure of the Boards of Appeal (RPBA) which requires that the statement of grounds shall contain the appellant's complete case. Nevertheless, in so far as these arguments repeat or refine arguments

discussed before the first instance and their consideration does not delay the prompt conclusion of the present case, the Board, using its discretion under Article 10b(1) RPBA, admits this late filed ground into the proceedings.

- 3.2 The Board holds that the originally filed application as a whole provides sufficient information for the skilled person, who is a screw pump engineer and using his normal skills, to realize the change in clearance so as to produce the required leakage flow. No evidence has been provided to substantiate the allegation that machine tolerances preclude further improvement of the D1 teaching. Rather, figure 3 of D1, even if schematic in nature shows that pressure pulses persist. The application provides the skilled person with practical instructions for their suppression, namely by a sufficiently specific modification of the screw taper or channel end shape, where the requisite shapes can be determined without undue burden by routine trial and error in reference to a measurable quantity as set out in the final feature of claim 1.

4. *Inventive Step: claim 1*

- 4.1 The Board finds, in agreement with the parties, that D1 discloses the closest prior art. This document discloses a screw pump according to the preamble of claim 1, with a drive screw that is conically tapered at both ends. The taper serves to reduce pressure pulses due to the sudden opening of the chambers formed between drive and side screws.

D3 discloses a similar screw pump in which the problem of pressure pulses is solved by a screw with a conical taper or funnel shaped channel at the pressure space end of the channel only. This document, though further removed, can, however, also be considered as a valid starting point.

4.2 The screw pump of claim 1 differs from the pump of D1 or D3 in its characterizing features of a continuous change in the increase of the clearance near the ends of the screw channel by either of two alternatives, namely by means of a screw with an essentially continuously changing taper at both ends, or by means of a channel which in essence widens at a continuously changing rate at either end. The resultant increase in clearance is such that "leakage flow through the clearances between suction and pressure spaces is substantially the same for all angles of rotation of the screws".

4.2.1 The latter functional qualification is construed by the Board as a limitation of the continuous change required by claim 1, with the term "leakage flow" representing the *instantaneous (total) leakage flow* along the screw as a function of rotation angle as the screw rotates. Claim 1 is thus limited to those increasing clearances that are characterized by leakage flow which is rotation angle invariant.

4.2.2 As noted above in section 3.2, the Appellant has failed to provide evidence that machine tolerances exclude a further suppression of pressure pulses beyond the level achieved in D1. Noting that the Appellant bears the burden of proof of any grounds he raises, the Board

must reject as an unproven allegation the argument that in so far the final feature of claim can be practiced, its result must already be achieved by D1.

- 4.2.3 Nor is the final feature derivable from the passages of D1 and D3 cited by the Appellant. ΔQ_v in figure 3 of D1 denotes total leakage volume flow ("Verlustvolumenstrom") over a pump cycle and is the difference between minimum and baseline values (Q_{vmin} , respectively Q_{vmax}) of the pulsed volume flow. It thus denotes the characteristic value for a pump cycle and provides no information as to the variation of leakage flow as a function of rotation angle.

Similarly, the Board is unable to identify the "regularly increasing pressure" of page 3, line 9, of D3 with a *linear* change of the pressure difference with rotation angle necessary for a rotation angle invariant leakage flow. Rather this passage, when read in context, underlines the effects achieved in D3 by contrasting it with the *irregular* pressure shocks mentioned in the preceding lines and which D3 sets out to reduce. The D3 solution is effectively the same as that of D1, as are its effects.

- 4.3 Starting from either D1 or D3 the Board identifies the problem to be solved by the claimed invention as that given on page 2, lines 20 to 21, namely reducing the *remaining* pressure pulses. Such residual pulses are for example apparent from figure 3, graph B of D1.

- 4.4 The Board holds that the solution to this problem as required by claim 1 is not suggested by the available

prior art, nor is it part of the common general knowledge of the skilled person.

4.4.1 The Appellant's contention that D1 also considers other than linear tapering to reduce pressure pulses is not supported by the cited passages. The Board finds the reference to "inclination angle of the conical surface" in column 1, lines 38 to 45, meaningful only for linear tapers. Similarly, the Board reads lines 52 to 55 of column 3 in conjunction with the preceding lines 7 to 51, which defines the optimal geometry of a linearly tapered screw in terms of various parameters. Finally, the Board concludes from the dependency of claim 7 that varying thread width or screw pitch further refines the main idea of linear taper in D1.

4.4.2 Nor, the Board holds, does the claimed solution arise from a trivial "rounding" of the "kink" or bezel at the channel edge in D1. None of the cited documents teaches the *specific* continuous change required by the final feature of claim 1, which the Board does not hold to be trivial per se. Only D2 shows screw shapes with some form of continuous rate of change, but these are not associated with the problem of pressure pulses or rotation invariant leakage flow. Rather D2, see column 7, lines 35-40, teaches *fixed* clearances. The Board sees no reason why the skilled person would lift the screw shape of D2 from this context against the specific teaching of D2. The Board is also unable to discover any motivation in D1 to look toward D2, given that D1 is exclusively concerned with linear tapers.

4.5 In the light of the above the Board therefore concludes that the subject-matter of claim 1 in the form in which

it was maintained amended involves an inventive step over the cited prior art.

5. *Inventive Step: claim 6*

In independent claim 6 as amended with the submission of 16 December 2003 the screw pump's driving screw is characterized in that, in essence, the rate of change in the end taper has at least two different values. Novelty of the amended claim is not contested. The Appellant's arguments as regards inventive step follow those against claim 1. In particular, the Appellant bases the contention that a curvilinear taper includes two different change rate values on the obviousness of the curvilinear taper in view of D1 (or D3) in combination with D3 as argued with regard to claim 1. As these arguments fail to convince the Board as set out above in section 5, the Board finds that the subject-matter of amended claim 6 also involves an inventive step.

6. In conclusion, the Board holds that none of the grounds for opposition mentioned in Articles 100(a), (b) or (c) prejudice the maintenance of a patent on the basis of the claims of the main request. As the patent can be maintained on the basis of this request, there is no need to consider the respondent's further (first and second) auxiliary requests.

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 on the basis of the following documents:
 - claims 1 to 5 and 7 to 10 as maintained in the interlocutory decision
 - claim 6 as filed with letter of 16 December 2003
 - description and drawings as granted

The Registrar

The Chairman

G. Magouliotis

M. Ceyte