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D E C I S I O N
of 24 May 1996

Case Number: T 0713/94 - 3.2.4

Application Number: 88902964.1

Publication Number: 0349574

IPC: F04C 18/16

Language of the proceedings: EN

Title of invention:
Screw Rotor Machine

Patentee:
Svenska Rotor Maskiner AB

Opponent:
Leybold Aktiengesellschaft

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"
"Closest prior art"

Decisions cited:
-

Catchword:
-



Case Number: T 0713/94 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 24 May 1996

Appellants:
(Opponents)

Leybold Aktiengesellschaft
Wilhelm-Rohn-Strasse 25
Postfach 15 55
D-63405 Hanau (DE)

Representative:

Leineweber, Jürgen, Dipl.-Phys.
Aggerstrasse 24
50859 Köln (DE)

Respondents:
(Proprietors of the patent)

Svenska Rotor Maskiner AB
PO Box 15085
S-104 65 Stockholm (SE)

Representative:

-

Decision under appeal:

Decision of the Opposition Division of the
European Patent Office posted 4 July 1994
rejecting the opposition filed against European
patent No. 0 349 574 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: C. A. J. Andries
Members: M. G. Hatherly
J. P. B. Seitz

Summary of Facts and Submissions

- I. The decision of the opposition division to reject the opposition against European patent No. 0 349 574 was dispatched on 4 July 1994.

On 1 September 1994 the appellants (opponents) filed an appeal against this decision and also paid the appeal fee. The Statement of Grounds of Appeal was received on 11 November 1994.

Oral proceedings took place on 24 May 1996 in the presence of the parties.

- II. Claim 1 of the patent as granted reads as follows:

"Screw rotor machine for a working fluid comprising a pair of intermeshing rotors (3) having helical lands and intervening grooves, and a casing with a working space generally composed of two intersecting bores, each enclosing one of the rotors (3), said casing being composed of a low pressure end section (4), of a high pressure end section (1) carrying bearings (10, 11, 12) for the rotors (3) and of an intermediate barrel section (2), said barrel section (2) being connected to at least one of said end sections (1, 4) by a detachable joint, said high pressure end section (1) being provided with a bearing chamber separated from the working space by an end wall (5) provided with holes (8), each freely surrounding a cylindrical projection (9) of a rotor (3), characterised in one separate annular element (15; 23), surrounding each one of the rotor projections (9) and non-rotatably fixed to the casing, said element (15; 23) being provided with one axial (19; 24) and one radial (20; 21) sealing surface, one surface (19; 21) cooperating with the casing and the other one (20; 24)

cooperating with the rotor projection (9) by a slight or zero contact force, the annular element (15; 23) being movable almost without friction in the direction of said contact force."

III. The appellants referred to a single prior art document during the appeal proceedings, namely

D: DE-A-2 725 299

and argued that it would be obvious to apply the implicit teaching of this document, namely sealing elements in light contact with each other, to a screw rotor machine and so to arrive at the claimed subject-matter.

The respondents countered the appellants' arguments essentially by disputing that the sealing elements of document D could be in contact with each other.

IV. The appellants request that the decision under appeal be set aside and the patent revoked.

The respondents request that the appeal be dismissed (which would mean maintaining the patent as granted).

Reasons for the Decision

1. The appeal is admissible.
2. *The subject-matter of the present patent*
 - 2.1 The present invention concerns minimising the leakage of high pressure gas from the working space of a screw rotor machine to the bearing chamber, see column 1, lines 36 to 38 and column 3, lines 13 to 15 of the patent description.
 - 2.2 While in principle this might be done by merely tightly tolerancing the dimensions of the shaft and the hole in the wall separating the working space from the bearing chamber to provide a minimum running clearance, this would only be satisfactory if the shaft could be guaranteed to be coaxial with the hole and this would necessitate very precise positioning of the components during assembly, such as the rotors, the end walls and the bearings in their chambers. If a larger clearance is provided to allow greater freedom in assembly then the leakage becomes unacceptable and necessitates the use of more complicated seals.
 - 2.3 The two particular embodiments of the present patent minimise the leakage in different, more position tolerant, ways.
 - 2.3.1 In Figures 2 and 4 an annular element 15 surrounds the rotor projection 9 and is located in a recess 14 in the end wall 5. The flow path from the working space along the gap between the hole 8 and the rotor projection 9 is blocked in the radial direction by an O-ring 17 positioned in the annular element 15 and engaging the end wall. Flow in the axial direction is minimised by

providing merely a running clearance between the inner surface 20 of the annular element 15 and the outer surface of the rotor projection 9. The relative positions of the rotor projection 9 and hole 8 in a transverse direction are not critical because the annular element is able to move (with the rotor projection) relative to the hole, resisted only by the rubbing of the O-ring 17 on the end wall. Thus, as set out at the end of claim 1, the sealing surface 20 cooperates with the rotor projection by a slight or zero (radial) contact force, and the annular element is movable almost without friction in the direction of the contact force ie radially.

- 2.3.2 In Figures 3 and 5 the annular element is a split-ring 23 that is biased outwards with a spring force which is, on the one hand, high enough to ensure contact between its radially outer surface 21 and the hole 8 in the end wall 5 to provide sealing against flow in an axial direction but, on the other hand, low enough to give low friction (see column 6, lines 1 to 10) so that one of the end surfaces 24 of the annular element 23 can be moved into contact with one of the side walls of an annular groove 22 in the rotor projection to seal against flow in a radial direction. Thus, as set out at the end of claim 1, the sealing surface 24 of the annular element 23 cooperates with the rotor projection by a slight or zero (axial) contact force, and the annular element is movable almost without friction in the direction of the contact force ie axially. Concerning the non-critical nature of the relative positions of the rotor projection 9 and hole 8 in a transverse direction, it is not apparent from the wording of claim 1 how the transverse adjustability is to be achieved in the case of the second alternative. However it is clear that also the second alternative must solve the problems which the invention sets out to

solve and it is clear from the description at column 6, lines 30 to 34 and from Figures 3 and 5 that the adjustability is achieved because of the clearance between the radially inner surface of the annular element 23 and the bottom of the annular groove 22.

3. *Document D*

3.1 The document D discloses a rotary piston type positive-displacement pump or compressor, eg a Roots blower, comprising a pair of interacting members 3. One of these members 3 is shown in Figure 3, mounted on a shaft 4 supported in bearings 10 in a side wall 5 which separates the pumping chamber from a side chamber 7 (see page 6, line 15 to page 7, line 4). Also provided in the side wall 5 around the shaft 4 are an oil splash ring 11 and a combined diaphragm gland and labyrinth seal 12 for preventing oil penetrating from the side chamber 7 into the pumping chamber 2 (see page 7, lines 4 to 6). The seal 12 comprises an element 15 mounted on the shaft 4 (see page 7, lines 12 and 13).

3.2 The appellants argue that the part of the labyrinth seal that is mounted in the hole in the side wall 5 must be a split-ring squeezed into the hole but axially movable therealong. They continue that while this is not explicitly disclosed by document D it is implicit for the skilled person because otherwise the seal could not be assembled. Thus the split-ring is axially movable, for instance under the influence of the gases flowing through the labyrinth seal, to a position in which one of its side walls contacts one of the walls of the groove with a slight or zero contact force. Since this sealing arrangement in this general type of pump or

compressor is obviously applicable to a specific rotary piston type positive-displacement machine, namely a screw rotor machine, the subject-matter of claim 1 is obvious in the view of the appellants.

- 3.3 While the board agrees that the fixed part of the labyrinth seal in document D might well be a split-ring and thus in principle axially movable, the document does not disclose any contact between said part and the groove in the shaft-mounted element 15. Indeed such labyrinth seals are designed to be contact free (which is confirmed by page 5, line 20) and so the projecting part must have a predetermined position between, and not in contact with, the walls of the groove in which it is located. This clear teaching cannot be overturned by the very schematic drawings. Indeed, even if it were possible to detect contact points in Figure 3 between the rotating and fixed parts of the labyrinth seal, this dubious interpretation would necessarily only be the result of an ex post facto analysis with no basis whatsoever in the disclosure of the document as a whole. On the other hand, the board interprets claim 1 of the present patent to mean that there shall be contact between the surfaces in question, even if the contact force is zero then the surfaces must still be in contact. This is illustrated in the particular embodiments of the invention set out in the patent specification.

- 3.4 Moreover the problem addressed by document D must be considered. It is concerned with the problem of gas that flows from the side chamber 7 to the pumping chamber 2 picking up oil droplets from the shaft bearings 10, see the paragraph bridging pages 3 and 4. In order to overcome this problem and yet to continue to use the conventional seal, a pressure equalising duct 13 is provided between the side chamber 7 and the pumping

chamber 2, see page 5, lines 22 to 29 as well as claim 1. Gas flow is then through this duct and not through the oil-lubricated bearings. The side chamber and the pumping chamber remain at the same pressure.

3.5 Thus the purpose of document D's own invention (to equalise the pressure in the pumping chamber and the side chamber) is exactly the opposite to the purpose of the present invention (to maintain the working space at a different pressure to that of the bearing chamber). Moreover the prior art arrangement uses a contactless sealing arrangement whereas the present invention relies on contact to effect the sealing.

3.6 Accordingly the board cannot accept that document D is an appropriate starting point for the present invention. Even if the skilled person were to consider this document he could not be led by it to do the exact opposite to two important teachings of said document (equalisation of pressure and contactless sealing). The appellants have intimated that the prior art split-ring (if this is what it is) is axially movable under the influence of the gases flowing through the labyrinth seal but the presence of a pressure equalising duct means that there would be an insufficient differential pressure across the seal to move the split-ring. In any case there is no hint that the split-ring force would be low enough to allow axial movement and low rubbing friction but high enough to prevent the ring rotating in the hole along with the shaft.

4. *The closest prior art, problem and solution*

The appellants have built their case in the appeal proceedings upon the single prior art document D which the board does not see as an appropriate starting point for the present invention. The appellants have not shown

the subject-matter of claim 1 to be obvious and so have failed to prove their case. The board considers the closest prior art to be a machine in which the working chamber is kept at a different pressure to that in the bearing chamber. Such a machine is the screw rotor machine disclosed by document US-A-3 462 072 cited in line 31 of column 2 of the present description, see in particular column 1, lines 53 to 57 of the citation. The problem arising therefrom and the solution are set out in the present patent. The board was not given reasons to doubt the patentability of the subject-matter of claim 1.

5. The patent may therefore be maintained unamended based on this granted independent claim and on granted claims 2 to 7 which are dependent on claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C. Andries