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Datasheet for the decision of 17 September 2015

Case Number: T 1085/12 - 3.2.04

Application Number: 98309555.5

Publication Number: 0919726

IPC: F04D19/04

Language of the proceedings: EN

Title of invention:
Vacuum pumps

Patent Proprietor:
Edwards Limited

Opponents:
Leybold Vacuum GmbH
Agilent Technologies, Inc.

Headword:

Relevant legal provisions:
EPC Art. 56
RPBA Art. 13(3)

Keyword:
Inventive step - main request (no)
Late-filed request - amendments after arrangement of oral proceedings - admitted (no)

Decisions cited:
T 0087/05

Catchword:

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Case Number: T 1085/12 - 3.2.04

D E C I S I O N
of Technical Board of Appeal 3.2.04
of 17 September 2015

Appellant: (Opponent 2)	Agilent Technologies, Inc. 5301 Stevens Creek Boulevard Santa Clara, CA 95056 (US)
Representative:	Robba, Pierpaolo Interpatent S.R.L. Via Caboto 35 10129 Torino (IT)
Respondent: (Patent Proprietor)	Edwards Limited Manor Royal Crawley, West Sussex RH10 9LW (GB)
Representative:	Clark, Charles Robert Edwards Limited Intellectual Property Manor Royal Crawley West Sussex RH10 9LW (GB)
Party as of right: (Opponent 1)	Leybold Vacuum GmbH Bonner Strasse 498 50968 Köln (DE)
Representative:	Von Kreisler Selting Werner - Partnerschaft von Patentanwälten und Rechtsanwälten mbB Deichmannhaus am Dom Bahnhofsvorplatz 1 50667 Köln (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 29 February 2012 concerning maintenance of the European Patent No. 0919726 in amended form.**

Composition of the Board:

Chairman	A. de Vries
Members:	J. Wright
	T. Bokor

Summary of Facts and Submissions

I. The appellant (opponent II) lodged an appeal, received 27 April 2012, against the interlocutory decision of the opposition division dated 29 February 2012 on the amended form in which European patent no. 0919726 could be maintained and paid the appeal fee simultaneously. The statement setting out the grounds of appeal was filed on 3 July 2012.

II. Two oppositions were filed based inter alia on Article 100(a) EPC, lack of inventive step.

The opposition division held that the patent as amended according to an auxiliary request met all the requirements of the EPC, inter alia because the decision considered the subject matter of claim 1 to involve an inventive step having regard to the following documents amongst others:

D1: US 4 472 962 A
D2: EP 0 603 694 A
D4: DE 24 42 614 A
D6: US 4 140 441 A
A7: WO 97/15760 A1
A9: H.Ensowa et.al.: "High throughput tandem turbomolecular pump for extreme high vacuum", Journal of Vacuum Science & Technology A, Vacuum, Surfaces, and Films, Second Series, Volume 8, Number 3, Pt. II, pages 2768-2771, May/June 1990.

III. The appellant requests that the decision be set aside and the patent be revoked in its entirety.

The respondent - proprietor, requests that the patent be maintained in the form held allowable by the

opposition division, or in the alternative, that the patent be maintained in amended form according to one of seven auxiliary requests I to VII, all filed with letter of 27 August 2015.

The opponent I, as party as of right, requests that the case be remitted to the opposition division if the case is to be maintained in a form broader than upheld.

IV. Oral proceeding before the Board were duly held on 17 September 2015 in the absence of opponent I, who had indicated with letter of 24 June 2015 that they would not attend the oral proceedings.

V. The wording of claim 1 of the relevant requests is as follows, whereby in the auxiliary requests the Board has emphasised added text in *italics*:

Main request (as held allowable by the division):

"A turbomolecular vacuum pump comprising a plurality of turbomolecular vacuum stages (6, 7) and having a first pump inlet (10) through which, in use, gas can pass through all the pump stages (6, 7) and a second inlet (16) through which, in use, gas can enter the pump at an interstage location and pass only through subsequent stages of the pump (7), characterised in that the tip diameter of the rotor (d1) is smaller in the turbomolecular stages before the interstage location than after the interstage location (D2), such that the pump meets the pressure and pumping capacity requirements of different systems which are attached to the first (10) and second (16) inlet respectively".

Claim 1 of auxiliary request I is the same as in the main request except that it adds the following wording

", *in which a system requiring a lower pressure is attached to the first inlet (10) and a system requiring a higher pressure is attached to the second inlet (16)*" immediately prior to the words "characterised in that..." and in that the words "requirements of different systems" in the last clause of the claim are replaced by the words "requirements of *the* systems".

Claim 1 of auxiliary request II is the same as in auxiliary request I except that after the words "...in which a system requiring a lower pressure" the words "*and smaller pumping capacity*" is added, and in that after the words "and a system requiring a higher pressure" the words "*and higher pumping capacity*" are added.

Claim 1 of auxiliary request III is the same as in the main request except that the wording "A turbomolecular vacuum pump comprising a plurality of turbomolecular vacuum stages (6, 7)" is replaced by the wording "A turbomolecular vacuum pump comprising *two sets* of turbomolecular vacuum stages (6, 7)".

Claim 1 of auxiliary request IV is the same as in auxiliary request III except that the opening lines read:
"A turbomolecular vacuum pump comprising two sets of turbomolecular vacuum stages (6, 7), "*the first set of stages (6) comprising four rotors (8) and four stators (9), the second set of stages (7) comprising six rotors (12) and six stators (13); an interstage 16 between the first and second sets of stages (6,7)*" and in that the wording "gas can enter the pump at an interstage location" is replaced by the wording "gas can enter the pump at *the* interstage location".

Claim 1 of auxiliary request V is the same as in auxiliary request IV except that the wording: "characterised in that the tip diameter of the rotor (d1) is smaller in the turbomolecular stages before the interstage location than after the interstage location (D2) such that..." is replaced by the wording: "characterised in that the tip diameter *(D1)* of the rotor*s* (8) is smaller in the *set of* turbomolecular stages (6) before the interstage location than *set of turbomolecular stages (7)* after the interstage location (D2) such that..."

Claim 1 of auxiliary request VI is the same as in auxiliary request IV except that the wording:

"...only through subsequent stages of the pump (7), characterised in that the tip diameter (D1) of the rotor is smaller in the turbomolecular stages (6) before the interstage location than after the interstage location (D2) such that the turbomolecular pump meets the pressure and pumping capacity requirements of different systems which are attached to the first (10) and second inlets (16) respectively."

is replaced by the wording: "...only through subsequent stages of the pump (7)*, in which a system requiring a lower pressure is attached to the first inlet (10) and a system requiring a higher pressure is attached to the second inlet (16)*; characterised in that the tip diameter (D1) of the rotor*s (8)* is smaller in the turbomolecular stages (6) before the interstage location *than the second set of turbomolecular stages (7)* after the interstage location (D2) such that the turbomolecular pump meets the pressure and pumping capacity requirements of *the* systems which are attached to the first (10) and second inlets (16) respectively."

Claim of auxiliary request VII is the same as in auxiliary request VI except that after the words "...in which a system requiring a lower pressure" the words "*and smaller pumping capacity*" is added, and in that after the words "and a system requiring a higher pressure" the words "*and higher pumping capacity*" are added.

VI. The appellant argued as follows:

Main request

Starting from D2, the subject matter of claim 1 differs in that the rotor tip diameter of the first turbomolecular vacuum stages before the interstage location is smaller than that of the stage after the interstage location, whereas in D2 rotor tip diameters of all stages are the same. This solves the problem of making the pump smaller. The skilled person, who always designs a pump to the system it is required to evacuate by applying standard equations, knows from these equations that a smaller tip diameter gives a smaller pumping capacity. To solve this problem the skilled person will always make the tip diameter as small as possible, as tip diameter directly influences pump size. If a lower pumping capacity is required for the first stages compared to the second stages, they will therefore make the tip diameter of the first stages smaller than that of the second stages as a matter of obviousness and so arrive at the pump claimed without making an inventive step. Even if the split-flow turbomolecular pumps cited have equal tip diameters, the skilled person knows that it is possible to make such pumps with different rotor tip diameters for stages before and after an interstage because this has

already been done in the pumps of D6 and D9. This is because it is a routine design parameter used to dimension pumps.

Auxiliary requests

The requests should not be admitted because they are late filed. It is not possible to prepare against counter arguments with regard to inventive step since none were given prior to the oral proceedings. Furthermore the claims are divergent, adding to the complexity of the task of dealing with them. It would only be possible to consider them with an adjournment of the proceedings.

VII. The respondent proprietor argued as follows:

Main request:

The only arrangement the skilled person knows for a split-flow turbomolecular pumps is one in which rotor tip diameters in the stages before and after the interstage location are equal, as is the case in D1, D2, D4 and A7. Therefore they would never think of having different rotor tip diameters before and after the interstage location.

Furthermore, the skilled person always over-engineers turbomolecular pumps so, if anything, they would over-dimension the stages before the interstage location to draw as much gas as possible into the pump. Therefore it would be counter-intuitive for them to make the rotor tip diameter of these stages smaller than those of the second stages.

Even if the skilled person wanted to increase the pumping capacity of the second stages compared to the first, the skilled person can alter not only rotor tip diameter but many other parameters to achieve this, namely rotor root diameter, blade angle and rotor speed. Thus, even if it is a known design parameter in turbomolecular pumps it is one of many; there is no indication in the prior art to have different tip diameters in split-flow pumps. Only with hindsight would the skilled person select that parameter from all the possible parameters available to them as a way of increasing pumping capacity.

The turbomolecular pumps of D6 and A9 have no inlet at the inter-stage location so they have the same pumping capacity through both sets of stages, therefore these pumps would not prompt the skilled person to change diameters of a split-flow turbomolecular pump in order to meet different pumping requirements in different parts of the pump.

Admissibility of the auxiliary requests:

The filing of the auxiliary requests was timed to take account of the Board's communication. The requests also take into account new arguments of the appellant and hardly diverge since they only contain two different strands which merge in the final requests. The auxiliary requests are minor self explanatory iterations of the the main request, so it is reasonable to expect the Board and the other parties to be able to deal with them without an adjournment of the oral proceedings.

VIII. The respondent - opponent I submitted no arguments.

Reasons for the Decision

1. The appeal is admissible.

2. Background

The patent concerns turbo-molecular vacuum pumps comprising a plurality of stacked stages of alternate rotors and stators, specification paragraphs [0001], [0002]. Systems are known having a plurality of chambers to be evacuated. Typically the vacuum levels required in these chambers and the gas throughput therefrom differ (patent specification, paragraphs [0004] and [0005]). To evacuate more than one chamber in a system, it is known to use a single turbo-molecular pump having a normal (first) inlet for gas required to pass through all stages of the pump and an intermediate (second) inlet between the stages, that is at an interstage location, for gas required to pass only through the latter stages of the pump (specification paragraph [0007]).

Such a pump is known as a split-flow turbo-molecular pump. The patent sets out to rationalise the size and power consumption of such pumps (specification paragraph [0008]). To this end claim 1 in its amended version as upheld by the decision under appeal is directed at a turbomolecular vacuum pump (of the split-flow type) characterised in that the tip diameter of the rotor is smaller in the turbomolecular stages before the interstage location than after the interstage location such that the pump meets the pressure and pumping capacity requirements of different systems which are attached to the first and second inlet respectively.

3. Main request: Inventive step

3.1 The appellant has challenged inventive step starting *inter alia* from D2 combined with the skilled person's general knowledge. It is common ground that D2 is a good starting point for assessing inventive step, since it indisputably relates to a split-flow turbomolecular pump (figure 2, page 5, lines 47 to 51).

The pump has first and second turbomolecular stages, 5a and 5b, mounted on a common shaft. Gas can enter the first stages via an opening 14 and pass through all stages. Gas entering the pump at a second opening 15, which is located between stages at an interstage location, only passes through the last stages 5b. Thus D2 discloses all features of the preamble of claim 1.

3.2 As however can be seen from figure 2, the rotor tip diameters of all stages 5a and 5b are equal. Thus, vis-à-vis D2, the only difference is the above characterising feature (tip diameter smaller of the stages before the interstage to meet pumping capacity requirements).

3.3 Making the tip diameter of the stages before the interstage smaller than after the interstage has the effect of reducing the size of the first turbomolecular stages compared to that of the pump of D2, where all stages have equal tip diameters. Published application paragraph [0013] (deleted in the specification) in particular suggests sizing the upper stages smaller than the lower stages if the low pressure, high vacuum system to which the upper stages are attached requires smaller pumping capacity, while the high pressure system requires a lower pumping capacity. By sizing or

dimensioning the different parts of the pump differently to meet the different requirements of the systems to which the respective parts are attached means the pump is better attuned to its application with concomitant gain in power consumption, cf specification paragraph [0008].

3.4 Thus the objective technical problem can be formulated as how to better size or dimension a split-flow turbomolecular pump, such as that of D2, so as to reduce power consumption.

3.5 The Board notes that the skilled person, a mechanical engineer specialising in turbomolecular pumps, will always design a pump to meet the requirements of whatever system the pump is designed to evacuate. In the case of a system with a plurality of chambers, the skilled person will therefore need to consider the individual requirements of each and every chamber. In this regard, a fundamental requirement is achieving the gas throughput necessary, in other words the pumping capacity. Indeed D2 also recognises this, see D2, page 2, lines 30-31, which recognizes the problem of sizing compression ratios and pumping capacities that are necessary for the individual vacuum chambers ("Das Problem der Dimensionierung von Drückverhältnissen und Saugvermögen, welche für die einzelnen Vakuumkammern erforderlich sind...").

3.6 It is common ground that it is routine for the skilled person to dimension a turbomolecular pump to meet specified system requirements, and that they do so using a variety of design parameters. As also acknowledged by the respondent, these include rotor tip diameter, root diameter, speed and blade angle, all of which are known to have an effect on pumping capacity.

In the case of tip diameter, for example it is known that the larger the tip diameter, the greater the pumping capacity.

3.7 Tasked with sizing or dimensioning the pump of D2 to meet individual pumping requirements of the different chambers attached to it, the skilled person has various design options at his disposal, each of which he will consider as a matter of obviousness. One of these is tip diameter of the rotor-stator stages.

3.7.1 D2 is silent as to the pumping capacity requirements of the system which the pump of figure 2 is to evacuate. If it is a system with a chamber requiring a high vacuum/low pumping capacity and another chamber requiring a lower vacuum/higher pumping capacity, the above obvious choice will inevitably lead the skilled person, tasked to size the pump to reduce power consumption, to make the tip diameter of the first stage, that is the lower pumping capacity stage, smaller than the tip diameter of the second stage, with its higher pumping capacity. Therefore the skilled person will, as a matter of obviousness, modify the split-flow pump shown in D2, figure 2, to arrive at a pump having a first turbomolecular stage with a smaller rotor tip diameter, compared to that of the second stage. The Board notes that in so doing he will also arrive at a lighter pump and thus one with reduced power consumption.

3.7.2 Even if the skilled person were to over-engineer the pump, that is design it to deliver a margin of excess pumping capacity, the Board considers that the result would be the same. This is because they would over-engineer both turbomolecular stages and still arrive at a smaller tip diameter for the first stage relative to

that of the second stage. Evidently, the resulting pump will always meet the pumping capacity requirements of the systems attached to its first and second inlets, because it is to these capacity requirements that it has been designed.

3.7.3 Therefore the skilled person will, as a matter of obviousness, arrive at the subject matter of claim 1.

3.8 The Board is not able to identify any technical bias or general prejudice against providing different rotor tip diameters for the first and second turbomolecular stages as the appellant has argued. D2 suggests a particular channel shape to maximise pumping capacity (D2, page 5, lines 47-51) but, as explained above, it does not mention pumping capacity requirements for the pump of figure 2. Without this information it cannot be said that D2 teaches to provide equal tip diameters of turbomolecular stages irrespective of pumping capacity.

The same applies to the remaining prior art showing split-flow turbomolecular pumps. Although all have two stages with rotors of equal tip diameter, none disclose pumping capacity requirements. The leak detector of D1 and ion microscope of D4 only mention compression ratio requirements (D1, column 3, lines 40-50, D4 page 1, 4th paragraph, page 3 and the figure). Finally A7 merely mentions evacuating chambers or reverse-flow leak detection (cf. figure and page 3, last paragraph).

Though it is true that these documents show the same tip diameter throughout the pump's turbomolecular stages, they thus fail to demonstrate any prejudice or bias against using different tip-diameters for different stages in the pump. The same tip diameter throughout can readily be associated with a simpler

overall design and construction of the pump. However, in the opinion of the Board, the increased complexity resulting from different tip diameters for different parts of the pump is not such as to bar the skilled person from considering and trying such a modification. This limited increase in complexity is the price he is willing to pay if sizing considerations are more important. This weighing of such different factors is routine in designing pumps; how factors are weighed and the choice ultimately made will depend on the specifications that the skilled person must work to rather than that this stems from an inventive insight.

3.8.1 That there is no prejudice or bias against using different tip diameters appears all the more so as the skilled person is already familiar with this feature in other turbomolecular pumps (though not split-flow). For example D6 (figure 1, column 3, lines 13-42) shows a turbomolecular pump having two turbomolecular stages mounted on a common shaft with an interstage area there between. Here the upper, inlet stage has a smaller tip diameter than the lower stage. Similarly, document A9 shows a two-stage turbomolecular pump where the upper stage blades have a smaller tip diameter than those of the lower stage.

3.9 The Board concludes that claim 1 of the patent as deemed allowable by the impugned decision lacks inventive step with respect to document D2, taking into account the skilled person's general knowledge. Therefore the requirements of Article 52(1) with 56 EPC are not fulfilled. Thus the main request of the proprietor must fail.

4. Auxiliary requests I to VII: Admissibility

The auxiliary requests I to VII were filed with letter of 27 August 2015, just three weeks prior to the oral proceedings.

The auxiliary requests were thus filed after filing the response to the grounds of appeal. Consequently, they constitute amendments to the proprietor's case in the sense of Article 13 of the Rules of Procedure of the Boards of Appeal (RPBA). Under paragraph (1) of that article the Board has discretion in admitting such amendments. It shall exercise that discretion "in view of inter alia the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy". Indeed any amendments that the parties cannot reasonably be expected to deal with without an adjournment should not be admitted, Article 13(3) RPBA.

4.1 An approach frequently adopted by the Boards when exercising their discretion in admitting amendments filed shortly before or in the course of oral proceedings can be summarized as follows: unless good reasons exist for filing amendments so far into the procedure - this may be the case when amendments are occasioned by developments during the proceedings -, they are only admitted at such a late stage if they are clearly or obviously allowable, see the Case Law of the Boards of Appeal, 7th edition, 2013, sections IV.C.1.4.1 and 1.4.2 and the case law cited therein. This means that it must be immediately apparent to the Board, with little or no investigative effort on its part, that amendments successfully address the issues raised without giving rise to new ones, see for example T 0087/05, reasons 2.

4.1.1 In the present case the Board does not consider that the amendments are in response to developments during proceedings. The requests are said to be filed with a view to overcome inventive step objections to claim 1 of the main request. However this objection was already raised by the appellant in their grounds of appeal (section 2.2.2). Nor has the proprietor explained what particular new arguments introduced by the appellant after their grounds of appeal might be considered a development in proceedings warranting the filing of new requests.

4.1.2 It is also not immediately apparent to the board that the amendments successfully address the issues raised without giving rise to new ones.

Whereas the letter accompanying the requests does indicate the basis of amendments, the proprietor has provided no explanation as to why the subject matter of the independent claim of the auxiliary requests should involve an inventive step.

Absent any such explanations, the other parties and the Board would be faced with the considerable task of examining inventive step for seven requests from scratch. A task complicated by the fact that the requests are divergent, whether or not some requests combine aspects of the diverging strands.

Given also that most of the auxiliary requests (II to VII) contain amendments said to be based on the description, the Board also considers that it is not immediately apparent that the requests do not introduce new issues, namely added subject matter, which would likewise require significant examination effort by the parties and the Board. Whether or not changes to the

scope of the claims are minor, the task of examining whether amendments extend their subject matter appears considerable.

4.2 Finally, waiting to file requests until after the Board's communication and until the very last moment, namely at the oral proceedings, to present arguments in respect of inventive step means that a proper consideration for the opponent to counter such late presented arguments would not be feasible without adjourning the oral proceedings for this purpose. However, such a course of action is not compatible with the need for procedural economy. Rather the procedure codified by Article 13 (3) RPBA applies, according to which amendments sought to be made after oral proceedings have been arranged shall not be admitted if they raise issues which the Board or the other party or parties cannot reasonably be expected to deal with without adjournment of the oral proceedings.

4.3 For all these reasons the Board decided not to admit auxiliary requests I to VII into the proceedings.

5. As the patent according to the main request fails to meet the requirements of the EPC, and no other requests have been admitted, the Patent must be revoked pursuant to Article 101(3)(b) EPC.

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:

G. Magouliotis A. de Vries

Decision electronically authenticated