

**Internal distribution code:**

- (A) [ - ] Publication in OJ
- (B) [ - ] To Chairmen and Members
- (C) [ - ] To Chairmen
- (D) [ X ] No distribution

**Datasheet for the decision  
of 5 February 2021**

**Case Number:** T 0818/18 - 3.2.04

**Application Number:** 10757819.7

**Publication Number:** 2491249

**IPC:** F04D19/04, F04D17/16

**Language of the proceedings:** EN

**Title of invention:**

VACUUM PUMP

**Patent Proprietor:**

Edwards Limited

**Opponent:**

Agilent Technologies, Inc.

**Headword:**

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

Inventive step - (no)

**Decisions cited:**

T 0478/91

**Catchword:**



**Beschwerdekammern**

**Boards of Appeal**

**Chambres de recours**

Boards of Appeal of the  
European Patent Office  
Richard-Reitzner-Allee 8  
85540 Haar  
GERMANY  
Tel. +49 (0)89 2399-0  
Fax +49 (0)89 2399-4465

Case Number: T 0818/18 - 3.2.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.04**  
**of 5 February 2021**

**Appellant:** Edwards Limited  
(Patent Proprietor) Innovation Drive  
Burgess Hill  
West Sussex RH15 9TW (GB)

**Representative:** Norton, Ian Andrew  
Edwards Limited  
Innovation Drive  
Burgess Hill  
West Sussex RH15 9TW (GB)

**Appellant:** Agilent Technologies, Inc.  
(Opponent) 5301 Stevens Creek Boulevard  
Santa Clara, CA 95051 (US)

**Representative:** Dilg, Haeusler, Schindelmann  
Patentanwalts-gesellschaft mbH  
Leonrodstraße 58  
80636 München (DE)

**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
23 January 2018 concerning maintenance of the  
European Patent No. 2491249 in amended form.**

**Composition of the Board:**

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

## **Summary of Facts and Submissions**

- I. The appeals were filed by the proprietor and opponent against the interlocutory decision of the opposition division finding that, on the basis of the auxiliary request 2, the patent in suit (in the following the patent) met the requirements of the EPC.
- II. The opposition division decided that the subject-matter of the main request (as granted) did not involve an inventive step but that the subject-matter of auxiliary request 2 did involve an inventive step.
- III. Oral proceedings were held on 5 February 2021.
- IV. The appellant-proprietor requests that the decision under appeal be set aside and the patent be maintained as granted, in the alternative that the patent be maintained in amended form according to Auxiliary Request I filed with the grounds of appeal dated 1 June 2018 or auxiliary request II (as maintained in opposition proceedings).
- The appellant-opponent requests that the decision under appeal be set aside and that the patent be revoked.
- V. The independent claim of the main request (as granted) reads as follows:

"A vacuum pump (10) comprising:  
a turbo-molecular pumping mechanism (12) in series with a Siegbahn pumping mechanism (14);  
a first pump inlet (16) through which gas can pass through both the turbo-molecular pumping mechanism and the Siegbahn pumping mechanism; and

an inter-stage inlet (18) through which gas can enter the pump at a location between the turbo-molecular pumping mechanism and the Siegbahn pumping mechanism and pass only through the Siegbahn pumping mechanism; characterized in that flow channels (52, 62) in a first plurality of stages (32, 34) of the Siegbahn pumping mechanism are in fluid communication with the inter-stage inlet and gas entering the pump through the inter-stage inlet is pumped in parallel along said flow channels".

Claim 1 of the first auxiliary request reads as for the main request but adds the following wording at the end of the claim:

"and that the pump further comprises an arcuate baffle (72) extending upwardly from an outer radial portion of the stator (48), and extending around the stator (48) of the first stage of the first plurality of stages, said baffle (72) abutting against an inner surface of the vacuum pump housing to act as a barrier to the flow of gas from the exhaust of the turbo-molecular pumping mechanism to the inter-stage inlet 18, wherein said baffle 72 does not extend fully about the circumference of the stator 48 thereby additionally forming an inlet to allow gas from the exhaust of the turbo-molecular pumping mechanism to enter the Seigbahn pumping mechanism along flow channels 54, 64".

Claim 1 of the second auxiliary request reads as for the main request but adds the following wording at the end of the claim:

"and that the pump further comprises a baffle (72) in the form of an arcuate flange extending upwardly from an outer radial portion of the stator (48) of the first

stage (32) of the first plurality of stages (32, 34), and extending through 240° around the stator (48) of the first stage (32) of the first plurality of stages (32, 34), said baffle (72) abutting against an inner surface of the vacuum pump housing to act as a barrier to the flow of gas from the exhaust of the turbo-molecular pumping mechanism to the inter-stage inlet 18."

VI. In the present decision, reference is made to the following documents:

E1: US 2008/0193303 A1

E3: GB332879

E7: EP1302667 A1

Annex E : "Handbook of Vacuum Technology", edited by Karl Jousten, Wiley 2008, pages I to XXII, pages 415, 420 and 992.

VII. The appellant proprietor's arguments can be summarised as follows:

For the main request, the skilled person would not combine a turbomolecular pump with a series connected Siegbahn drag pump because the prior art, for example Annex E, teaches not to make such a combination. Starting from E1, combining with the Siegbahn pump of E3 cannot be obvious because E3 is very old, yet the combination was never made before the patent was filed. Therefore, the subject-matter of the main request involves an inventive step.

The subject-matter of the auxiliary requests involves an inventive step starting from E1 with E3 and E7. The auxiliary requests add further differing features compared to E1 that relate to a baffle. It is

appropriate to treat the contribution these features make to inventive step separately from those of the main request. When implementing a baffle for a Siegbahn pump, the skilled person would not use the teaching of E7 because it describes a baffle for a Holweck pump.

VIII. The appellant opponent's arguments can be summarised as follows:

Regarding the main request, the combination of a turbomolecular pump backed by a Siegbahn drag pump is known from E1. The skilled person would use the particular Siegbahn pump known from E3 in the arrangement of E1 as a matter of obviousness.

The additional baffle features of the auxiliary requests are obvious in the light of E7.

Therefore, the subject-matter of all requests lacks inventive step.

### **Reasons for the Decision**

1. The appeals are admissible.
2. Background

The invention relates to vacuum pumps (see published patent specification, paragraph [0001]). It is known (see paragraph [0002]) to provide a compound pump having a turbo-molecular pumping stage followed by a molecular drag pumping mechanism. Molecular drag pumping mechanisms operate on the general principle that, at low pressures, gas molecules striking a fast moving surface can be given a velocity component from the moving surface (see paragraph [0003]). Known types

of molecular drag pumping mechanisms include a Holweck pumping mechanism comprising two co-axial cylinders of different diameters defining a helical gas path there between, and a Siegbahn pumping mechanism comprising a rotating disk opposing a disk-like stator defining spiral channels that extend from the outer periphery of the stator towards the centre of the stator (see published patent specification, paragraph [0004]).

It is also known (see published patent specification, paragraphs [0007] to [0009]) to provide a high vacuum evacuated by an inlet at the top of the turbo-molecular stage and a lower vacuum, evacuated by connection to an inter-stage inlet (between the turbo-molecular and drag stages).

The invention (see claim 1 in all its versions) concerns a compound pump with an inter-stage inlet where the drag pump mechanism is a Siegbahn pump.

3. Main request, inventive step starting from E1 with E3
- 3.1 In the Board's view, the subject-matter of claim 1 lacks inventive step.
- 3.2 E1 discloses a vacuum pump 16 (see for example paragraphs [0001] to [0005] and figure 1). The pump has a turbomolecular pumping mechanism (stages 18 and 20) in series with a molecular drag pumping mechanism. Paragraph [003] suggests in particular that the teaching of E1 may be applied to a combination with a variety of different type drag pumps and specifically mentions a Siegbahn drag pump.

Whilst it is true that in figure 1 a Holweck pump 22 is shown, the Board does not consider this to implicitly



teach that a Holweck pump is significantly more preferable than a Siegbahn pump. Rather, E1 (see paragraph [0003]) simply presents the Siegbahn (and Gaede) drag-mechanisms as alternatives to the Holweck example of figure 1, without suggesting a strong preference for any. Therefore E1 directly and unambiguously discloses the combination of turbomolecular stages as shown in figure 1's arrangement in series with a Siegbahn instead of a Holweck drag pump.

- 3.3 In the light of this, the Board agrees with the appellant-opponent that the question of obviousness of a combination with a Siegbahn pump in general is moot.

However, for the sake of completeness, the Board notes that it does not agree with the appellant-proprietor's central argument that annex E (see point 10.2.3 on page 420) teaches the skilled person not to combine a turbomolecular pump with a Siegbahn pump. Rather, by suggesting that difficulties with a turbomolecular/Siegbahn combination compared to a Holweck combination have "impeded [the Siegbahn combination's] *widespread* technical use" (emphasis added by the Board) annex E merely explains that the Siegbahn combination is less common than the Holweck combination.

4. Turning again to E1 (see paragraph [0004] with figure 1), the vacuum pump has a first inlet 24 through which gas can pass through both the turbo-molecular pumping mechanism and the molecular drag pumping mechanism; and an inter-stage inlet 27 through which gas can enter the pump at a location between the turbo-molecular pumping mechanism and the molecular drag pumping mechanism and pass only through the latter.

- 4.1 If a Siegbahn pump is used, as disclosed in E1 paragraph [0003], it will necessarily have at least one flow channel. Moreover, since the inter-stage inlet 27 allows gas to enter and pass through the molecular drag (Siegbahn) stage, this flow channel will be in fluid communication with the inter-stage inlet.
- 4.2 However, E1 gives no detail of any particular Siegbahn pumping mechanism to replace the Holweck mechanism of figure 1. Therefore, the subject-matter of claim 1 differs from E1 in that the Siegbahn mechanism has a [first] plurality of stages, each with a flow channel, and in that gas entering the pump through the inter-stage inlet is pumped *in parallel* [emphasis added by the Board] along these flow channels.
- 4.3 According to the patent (see paragraph [0019]) the effect of this difference is to increase the pumping capacity of the Siegbahn pumping mechanism.

Therefore, the objective technical problem can be formulated as: how to implement the pump arrangement of E1's turbomolecular/Siegbahn combination, in such a way as to achieve a high pumping capacity Siegbahn mechanism.

- 4.4 When looking for a suitable Siegbahn mechanism to implement E1's arrangement, the skilled person would be well aware of E3, which discloses one of the first Siegbahn pumps and aims to provide a high efficiency pump (see page 1, lines 23 to 25). As described on page 1, lines 74 to 82 with the figure, E3's Siegbahn pump has two stages with channels along which gas entering the pump at its input 10 is pumped in parallel (along the spiral grooves in the stator arranged on opposite sides of the disc 1).

4.5 E3 explicitly teaches that this parallel pumping arrangement (see page 2, lines 12 to 20) offers a solution to the above problem (implementation of Siegbahn with a high pumping capacity), albeit couched in different words: the arrangement achieves *double suction velocity (and eliminates pressure difference problems, possibly causing backflow or posing sealing problems)*. Therefore, faced with the above problem, the skilled person would use E3's Siegbahn pump when implementing E1's Siegbahn mechanism, as a matter of obviousness.

4.6 The appellant-proprietor has argued against the obviousness of such a combination by observing that there are other ways than using parallel flow to increase capacity in a Siegbahn stage, such as changing the angles of the channels. This may be true. However, the observation does not render E3's parallel flow solution any less obvious. At most it could only mean additional improvements might be possible.

4.7 Nor does the Board agree with the appellant-proprietor that the age of E3 (1930) demonstrates that it would not be obvious for the skilled person to combine E1 and E3 in the expectation of solving the problem, since no one did so in the many decades between 1930 and the filing for the present patent.

The context of the objective technical problem is a combination of a turbomolecular and Siegbahn pump. This context, and thus the problem itself, only appeared when such a combination became known (cf. E1, published 2008). At most, only the age of E1 might play a role in assessing obviousness of a combination. By contrast, the age of E3, which only concerns a Siegbahn pump, can

play no such role (see CLBA, I.D.10.3 and its citations, for example T478/91, reasons 3.6).

- 4.8 The Board concludes that the subject-matter of claim 1 lacks an inventive step starting from E1 in combination with E3. Therefore the main request must fail.
- 5. Auxiliary request 1, inventive step starting from E1 with E3 and E7
  - 5.1 Claim 1 adds features of a baffle to the subject-matter of the main request (the latter, with its parallel-flow Siegbahn pump, being obvious in the light of E1 with E3).
  - 5.2 The Board considers it helpful to first consider what is meant by the word *baffle* (see Oxford English dictionary on line (OED), meaning 5: *any shielding device or structure, in many technical uses [...]*).
  - 5.3 The baffle of claim 1 acts as a gas barrier between the exhaust of the turbomolecular pump and the inter-stage inlet.
    - 5.3.1 E1 (see paragraph [0004], last two sentences) already discloses such a baffle in general terms, albeit with reference to the Holweck mechanism actually shown in figure 1, rather than its Siegbahn alternative. There it is explained that the function of the baffle is to guide fluid into the (Holweck) drag stage from the inter-stage inlet so that it passes through the Holweck mechanism only. Paragraph [0046] likewise explains that internal baffles guide different flow streams to particular portions of the mechanisms. Thus, it acts as a barrier or shield separating different gas flows, in this case from the turbo-molecular pump to the

(Holweck) drag pump, and from the inter-stage inlet into the drag pump. Thus, it necessarily prevents gas from the turbo-molecular pumping mechanism reaching the flow channels of the drag mechanism near the inter-stage inlet. It is not in dispute that, irrespective of the type of drag pump used (Siegbahn or Holweck), such a barrier will necessarily be present in E1. Bearing in mind the usual definition of a baffle, the Board holds that this barrier, with its shielding function, is a baffle.

Nor does the Board come to a different conclusion in the light of the appellant-proprietor's speculation, that an alternative to using a baffle in E1 would be to simply extend the uppermost stator of the Siegbahn stage above the inter-stage inlet to abut and seal with the inner surface of the vacuum pump housing at that location. Also in this speculative arrangement, the extended part of the stator would shield gas from the turbomolecular pump exhaust reaching the inter-stage inlet. Therefore, it would likewise be a baffle.

5.3.2 Moreover, although E1 (see figure 1) only shows a longitudinal cross-section of the turbomolecular pump and [Holweck] drag pump, the skilled person knows that the turbomolecular pump will be circular in its transverse section. The same applies to the drag-pump, whether of the Siegbahn type, with its rotating disk(s) and disk shaped stator(s) or Holweck type with its coaxial cylinders (cf. patent, paragraph [0004]). Likewise, the inner surface of the pump housing into which these pumps are axially mounted will necessarily have a circular transverse cross-section. Furthermore, all these components will be rotationally symmetric.

5.3.3 Therefore, it is implicit that, E1's baffle (with the Siegbahn option) will be arcuate and extend radially outwards around the outer portion of the first stage of the Siegbahn stator (whether or not in the form of an extension of the stator).

5.3.4 E1's pump will also have to have an opening between the exhaust of the turbomolecular pump and channels of the Siegbahn mechanism away from the inter-stage inlet. Therefore, it is implicit that E1's baffle will not extend into this opening and thus, by its absence in this opening, can be said to form an inlet to allow exhaust gas from the turbomolecular pump to pass into the Siegbahn mechanism as claimed.

5.3.5 Other than these implicit features of the baffle that are necessarily present also when realizing the teaching of E1 with a Siegbahn pump, the document is silent as to how the baffle is arranged. Therefore, the differing features with respect to E1 can be summarised as follows:

- the baffle extends upwardly from an outer radial portion of the stator of the first stage of the Siegbahn mechanism, and [also this extension part] abuts against an inner surface of the vacuum pump housing.

5.4 These differing features can be treated separately for the purpose of assessing inventive step because they have no synergic effect with the first characterising claim feature that defines the particular type of Siegbahn pump that lies downstream of the baffle (multi-stage and parallel flow). The latter differing feature has been dealt with above in the context of the main request.

5.5 The appellant-proprietor has argued that the effect of the baffle extending upwardly and of this part abutting the housing is to improve sealing of the baffle. This in turn, it argues, improves compression characteristics.

In the Board's view, the patent does not explicitly state any effect of this upwardly extending part of the baffle. Although the appellant-proprietor has argued that paragraph [0025] of the published patent specification discloses this effect, the paragraph merely describes the baffle (including its upward extension) without mentioning any sealing or compression effect achieved. At most it explains a blocking effect which, as has already been explained, is also a function of E1's baffle.

5.6 The appellant-proprietor has also argued that this improved sealing effect is immediately evident to the skilled person, a mechanical engineer specialising in vacuum pumps, when they read how the baffle is arranged and see its depiction in the drawings (cf. the published patent specification, paragraph [0025] again with figures 2 and 3). In particular, the skilled person would immediately recognise that because a portion of the baffle extends above the stator 48 and thus extends the surface area on which the baffle seals to the pump housing, improved sealing (resulting in better compression characteristics) is achieved. The Board considers this plausible.

5.7 Thus, the objective technical problem associated with this differing feature (upwardly extending baffle) can be formulated as: how to implement the baffle of E1 to achieve better sealing.

5.8 The skilled person would be aware of document E7 (see abstract, paragraphs [0017] to [0021] and figures 2 to 4) because, as for the pump of claim 1, it discloses a compound pump having a turbomolecular mechanism 6, 7, a multi-channel drag mechanism 20 arranged in series downstream and an inter-stage inlet 36.

Moreover, tasked with the objective technical problem (implementing the baffle), the skilled person would look to E7 for a solution because it discloses (see paragraph [0022] and figures 2 to 5) details of how to implement a baffle that prevents exhaust gas from the turbomolecular stage reaching the inter-stage inlet of the drag mechanism.

5.9 It is true that the drag pump of the detailed embodiment of E7 is a Holweck mechanism, so its baffle will be different from that of E1 when a Siegbahn mechanism is chosen. In particular, in E7's Holweck arrangement, with its vertically arranged coaxial cylinders, the baffle must necessarily extend radially *inwards* to shield the Holweck's channels that pump the inter-stage inlet (see paragraph [0022] with figure 3 and 5). In contrast, in E1's arrangement with the Siegbahn mechanism, gas enters the latter from the side, so the baffle must extend radially *outwards* from the stator of the first Siegbahn stage, as has already been explained.

5.10 Nevertheless, the outer edges of both baffles must form a seal, and it is exactly on this aspect of E7's baffle that the skilled person's eyes will be focused, when tasked with implementing a baffle with better sealing.

5.11 E7 (see paragraph [0022]) describes the baffle 40 as having a radially inwardly directed flange 42 and



explains its blocking function. The usual meaning of the word flange is, amongst other things, a projecting rim or collar (see OED), so the word flange implies that the baffle has an axially extended portion.

Although the paragraph does not explain how the baffle 40, with its flange 42, seals, the skilled person can see it clearly in the figures. For example, on the left of figure 4, the baffle 40 not only extends radially inwardly as it must, but it also has an upwardly extending portion that fits to the side wall of the lowest turbomolecular stage. This portion can also be seen in figure 5, particularly the drawings on the left, and is identifiable as the flange 42.

5.12 In the Board's view, the skilled person who recognises the enhanced sealing effect achieved by the upwardly extending baffle portion of the invention (see above) will likewise recognise in figure 4 of E7 that the baffle's upwardly extending portion that abuts the encircling side wall of the lowest turbomolecular stage achieves the advantage of good sealing by providing an extended surface area for sealing. Moreover, the skilled person will immediately recognise that this idea is independent of the type of drag pump used and the particular counterpart sealing component. So the idea can be applied to achieve the same advantage more broadly than its E7 context.

5.13 Put differently, it is entirely within the skilled person's normal skills of comprehension and abstraction to recognise that this aspect of E7 (baffle with upward extension abutting an encircling wall) improves sealing, even though it is used for a Holweck rather than a Siegbahn drag-mechanism and the extension seals

to the inner surface of a surrounding turbomolecular stage wall rather than that of the pump housing.

5.14 Therefore, tasked with the objective technical problem (implementing the baffle with good sealing), the skilled person will implement the arcuate baffle of E1 in its turbomolecular/Siegbahn pump combination, by making it extend upwards to achieve a good seal with the surrounding inner surface of the pump housing.

5.15 The remaining differing features (parallel flow in plurality of Siegbahn pump stages) have been dealt with in the context of the main request and found to be obvious from the combination of E1 with E3 (see above).

5.16 Since these two differing features (parallel flow Siegbahn and upwardly extending baffle) have no synergic effect and have both been found to be obvious starting from E1 in combination with E3 and E7, the Board concludes that the subject-matter of claim 1 lacks inventive step.

6. Second auxiliary request, inventive step

6.1 The features of claim 1 of this request are common to claim 1 of the first auxiliary request, except for adding that the baffle is in the form of a *flange* and that the baffle *extends through 240°* around the stator.

6.2 As has already been touched in point 5.11 above, the usual meaning of a flange is a projecting rim or collar, so, in its claim context, defining the baffle as a flange is just another way of saying the baffle extends upwardly. Indeed, the word flange is used in E7 (see paragraph [0022]) to signify the upwardly extended portion of its baffle. Therefore, this feature is known

from E7 and obvious for the skilled person from the combination of E1 and E7 for the same reasons given for the first auxiliary request.

6.3 With regard to the 240° extension feature, the appellant-proprietor has asserted that this has surprisingly been found to give an optimal pumping effect. This may well be so, even if the patent itself does not associate any specific advantage with this feature. The feature is taken from the description of the particular embodiment of figure 3 (see published patent specification, paragraphs [0024] and [0025]), where there is no mention of this angle achieving such an optimisation (see column 6, lines 2 to 4).

6.3.1 In the Board's view, however, such optimisation is routine. Given that the purpose of the baffle is to act as a barrier between the turbomolecular stage exhaust and those channels pumping the inter-stage inlet, how far around the stator the baffle extends must be determined mainly by the relative amounts of gas flows from the main (first) pump inlet and inter-stage inlet through the stages, which in turn depend on the levels of vacuum that are meant to be achieved at the pump input and the intermediate stage and desired compression ratio. These are factors that enter into routine practical considerations when designing and dimensioning vacuum pumps, and which will determine e.g. the number of stator-rotor stages of the turbomolecular pumps, as well as the number and arrangement of channels and how many will serve the flow from the turbo-molecular to the drag pump and how many will serve only the flow from the inter-stage inlet through the drag pump. Thus, the particular circumferential extension of the baffle (here 240°) is a matter of routine design and optimisation based only on

parameters, such as the vacuum specifications including the pumping capacity needed to evacuate the different environments, rather than a matter of achieving a surprisingly advantageous pumping effect. Nor has any such surprising effect indeed been shown or proven.

6.3.2 Therefore, defining the circumferential extension of the baffle as  $240^\circ$  does not contribute an inventive step to the subject-matter of claim 1.

6.4 For the above reasons, and the reasons already presented for the first auxiliary request, the subject-matter of claim 1 of the second auxiliary request lacks inventive step in the light of E1 with E3 and E7.

7. Since the subject-matter of all the appellant-proprietor's requests lacks inventive step, and thus all requests fail, the Board must revoke the patent.

**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