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**D E C I S I O N**  
of 5 April 1995

**Case Number:** T 0777/93 - 3.2.4

**Application Number:** 88111226.2

**Publication Number:** 0299458

**IPC:** F04D 19/04

**Language of the proceedings:** EN

**Title of invention:**  
Apparatus for treatment of a process gas

**Patentee:**  
HITACHI, LTD.

**Opponent:**  
LEYBOLD AKTIENGESELLSCHAFT

**Headword:**  
-

**Relevant legal provisions:**  
EPC Art. 56

**Keyword:**  
"Inventive step - yes"

**Decisions cited:**  
-

**Catchword:**  
-



Case Number: T 0777/93 - 3.2.4

**D E C I S I O N**  
of the Technical Board of Appeal 3.2.4  
of 5 April 1995

**Appellant:**  
(Opponent)

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**Representative:**

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**Respondent:**  
(Proprietor of the patent)

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**Representative:**

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**Decision under appeal:**

Decision of the Opposition Division of the  
European Patent Office dispatched on 6 July 1993  
rejecting the opposition filed against European  
patent No. 0 299 458 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 dispatched on 6 July 1993 rejected the opposition against European patent No. 0 299 458 granted on the basis of European patent application No. 88 111 226.2.

II. The granted Claim 1 reads as follows:

"A vacuum pump which comprises a housing (4A) equipped with a suction port (2) and an exhaust path (3) and a rotor (1) supported rotatably inside said housing (4A), and in which a process gas sucked from said suction port (2) is discharged from said exhaust path (3) near to the atmosphere **characterized** by a device for removing reaction products situated on the low vacuum side, said device comprising a heating portion (8, 15, 18) disposed in said exhaust path (3) for preventing adhesion of the reaction products by the process gas on the discharge side, and a heat source (11, 1a) connected to said heating portion."

III. On 6 September 1993 the Appellant (Opponent) both lodged an appeal and paid the appeal fee. The Statement of Grounds was filed on 11 November 1993.

IV. Oral proceedings on 5 April 1995 were attended only by the Respondent (Proprietor). The Appellant was duly summoned for the oral proceedings but informed the Board by letter dated 24 March 1995 that it would not attend. The proceedings were continued in the Appellant's absence in accordance with Rule 71(2) EPC.

V. The following publications played a part in the appeal proceedings:

E1: Theorie und Praxis der Vacuumtechnik, 3. Auflage, 1986, pages 154 and 155

E2: US-A-4 668 160

E3: JP-U-60-43197 (1985)

E4: GB-A-2 119 609

VI. In the Statement of Grounds the Appellant argued essentially as follows:

The document E1 teaches that if there is a danger of condensation in a vacuum pump then this can be avoided by raising the temperature of the pump e.g. by a heater. While the document E1 deals with liquid condensation and the present patent with dust condensation, both arise from a pressure increase, both can lead to blockage and corrosion, and both can be prevented with a heater. It does not matter that one condensation occurs by a change of state of the pumped gas and the other condensation occurs due to a chemical reaction. The present patent does not present the general idea of preventing by a heater condensation resulting from a chemical reaction but in fact is limited to concentrating the heating of the gas to the place where the condensation occurs. To locate a device for removing condensation at the place where the condensation occurs is not inventive, it is already known from document E1. If it is known where condensation occurs and moreover that it can be prevented by heating then it is not inventive to place a heating portion in this area. It is obvious that a heating portion must be connected to a heat source.

VII. During the appeal proceedings, the Respondent argued in writing and in the oral proceedings essentially as follows:

The closest prior art pump known from document E3 solves the problem of clogging of the exhaust path of the vacuum pump which is caused by adhesion or deposition of reaction products by building the pump in such a manner that it can be easily dismantled for cleaning purposes.

The person skilled in the art looking for another solution to the clogging problem has no reason to consider document E1 which aims to avoid condensation of steam which decreases the efficiency of the pump. Thus the pump known from document E1 and the present pump transport different media and are built to solve different problems occurring at different places. Moreover document E1 teaches three ways of avoiding steam condensation and only one of these ways, and this one way is not even the preferred way, entails heating.

The argument that the person skilled in the art simply has to transfer the heating of the displacement pump for avoiding condensation to heating the exhaust path of the vacuum pump known from document E3 for avoiding clogging by reaction products is the result of an ex post facto analysis.

VIII. In the letter dated 24 March 1995 the Appellant requests that the decision be taken on the basis of the file which according to the Statement of Grounds means setting aside the Opposition Division's decision and revoking the patent in its full extent.

IX. The Respondent's requests are:

**main request** - dismissal of the appeal (i.e. maintenance of the patent as granted);

**auxiliary request (a)** - that the Opposition Division's decision be set aside and the patent maintained in amended form based on Claim 1 consisting of Claims 1 to 3 as granted; and

**auxiliary request (b)** - that the Opposition Division's decision be set aside and the patent maintained in amended form based on Claim 1 consisting of Claims 1 to 3 and 5 as granted.

### Reasons for the Decision

1. The appeal is admissible.

2. *Respondent's main request*

2.1 None of the cited prior art documents discloses all the features set out in Claim 1 as granted. This is not disputed by the parties. The subject-matter of Claim 1 as granted is thus to be considered as novel within the meaning of Article 54 EPC.

2.2 Interpretation of Claim 1 as granted

As well as containing clear constructional features of the vacuum pump, the claim contains details of where, how and why the vacuum pump is used e.g. that a process gas containing reaction products enters the vacuum pump's suction port. Thus the vacuum pump must be suitable for a process carried out under vacuum, which uses process gases and which results in reaction products. Such processes are common in semiconductor manufacture, the processes take place under high vacuum

clean conditions and so the claimed vacuum pump must be of a type capable of producing these conditions i.e. must be a high vacuum pump.

Moreover the process gas is discharged from the exhaust path of the vacuum pump at near atmospheric pressure and so the claimed vacuum pump must be of a type capable of generating the required pressure difference and capable of discharging at the required pressure level without e.g. a downstream backing pump.

Accordingly the details of the process in the claim assist in defining the vacuum pump and do in fact restrict the scope of the claim.

The heating portion is specified as being disposed in the exhaust path. This is exemplified by Figures 1, 2 and 5 of the present patent which show a rod-shaped heating member 8 lying centrally in the exhaust path 3, and by Figures 6 to 8 where tubular heating members 15, 18 line the exhaust path. An arrangement where the heating portion lay e.g. in lagging surrounding the pump would not satisfy the definition in the claim.

### 2.3 Closest prior art

Document E3, considered by the Board to be the closest prior art, discloses a system according to the pre-characterising portion of Claim 1 as granted. A mass deposited from the process gas transported by the pump is shown at 10 in Figures 1, 2 and 4 of this document E3, this deposit being removed by dismantling the pump, see column 1, lines 20 to 24 of the present patent.

2.4 Differentiating features, problem and solution

Compared with the disclosure of document E3, Claim 1 as granted additionally specifies a heating portion disposed in the exhaust path for preventing adhesion of the reaction products by the process gas on the discharge side, and a heat source connected to said heating portion.

Starting from the disclosure of document E3, the problem to be solved by the present invention can be seen as being to find another way to avoid clogging of the exhaust path. This includes either preventing deposition in the first place or removing such deposition as has already occurred.

Deposition seems to be caused by the process gas cooling in the exhaust path outside the pumping (compressing) zone and so being unable to maintain as vapour the reaction products which therefore condense on the exhaust path. The heating portion disposed in the exhaust path maintains the temperature of the process gas at such a level as to retain the reaction products in the process gas until discharged from the pump. Alternatively the heat in the exhaust path vaporises already deposited reaction products.

Thus the heating portion in the exhaust path as specified by Claim 1 as granted provides another way of preventing clogging of the vacuum pump's exhaust path. The down time needed for dismantling the pump of document E3 is no longer necessary.

2.5 Document E1

Document E1 states in section 5.3.6 on pages 154 and 155 that with oil-sealed positive displacement pumps which compress from the suction pressure to atmospheric pressure or above, pure steam cannot be transported because the working temperature of the pump is in most cases below 100°C so that the steam condenses during compression in the pump. The saturated vapour pressure of steam at a normal working temperature of about 80°C is about 470 mbar, upon arrival at this pressure the steam in the pump will not be further compressed but will condense. Water collecting in the pump will be taken to the suction side, will vaporize again and so will considerably worsen the pump pressure. The oil film may break down at the lubrication sites and there is a risk of corrosion. It is further stated that the foregoing is valid not only for steam but for every vapour whose saturated vapour pressure at the pump temperature is less than the pump's exhaust pressure of about 1100 mbar.

In order to avoid condensation of steam in the pump, document E1 suggests a heater or heat insulating measures in order to bring the pump to around 110°C, or constant regeneration or exchange of the oil, or preferably a gas ballast solution.

2.6 Inventive step

2.6.1 It is clear that the person skilled in the art would be interested in finding another way of overcoming the clogging problem manifested by the vacuum pump known from document E3 since dismantling is so obviously disadvantageous.

- 2.6.2 He might investigate the mechanical construction of the pump to see whether depositing might be reduced by removing the projection into the exhaust path upon which the mass 10 forms i.e. by smoothing the exhaust path and its walls.
- 2.6.3 The Board however questions whether a person skilled in the art, even if he realised that the mass deposited on the wall resulted from the cooling of the pumped gases by the wall of the exhaust path, would seriously consider document E1 in his search for a solution because of the considerable differences between the pump of this document and the pump with which he is experiencing problems.

Firstly, according to document E1 the condensation occurs within the pumping zone of the pump where compression is taking place whereas in the pump according to document E3 the problem to be solved occurs outside the pumping zone, namely in the exhaust path where compression has already ceased. Furthermore it should be emphasised that, in a positive displacement pump as known from document E1, condensation outside the pumping zone i.e. in the exhaust path downstream of the exhaust valve is no longer of any great importance for the vacuum to be created, so that a person skilled in the art wishing to solve problems in the zone outside the pumping zone would not find **prima facie** a hint in document E1 towards the claimed solution.

Secondly, the media being pumped are very different, in document E1 steam which is totally condensable to water and in document E3 process gas carrying reaction products of which apparently only the latter condense.

Thirdly, the states of the condensates are different, in the pump of document E1 the liquid state and in the pump of document E3 the solid state. If the condensate produced in the latter pump were a liquid then there would be no clogging problem since the condensate would merely drip away.

Fourthly, the problems caused by the condensates are different. In the pump of document E1 the condensate is drawn upstream to re-vaporise, so decreasing the pump efficiency. In the pump of document E3 the condensate restricts discharge of already pressurised gas.

- 2.6.4 Moreover, even if the skilled person saw parallels between the condensates forming in the two pumps, the solutions proposed by document E1 would not lead him to the solution underlying the present invention.

Of the solutions proposed by document E1 to the steam condensation problem, the oil regeneration or exchange and the gas ballast solutions are plainly incompatible with the vacuum pump and associated process with which the document E3 is concerned. The heater solution remains but the skilled person would regard the heating of the **entire** pump as an unattractive proposition for the pump of document E3 because it would prevent cooling the compression region of the pump to improve efficiency.

Thus the Board finds that the skilled person would not use the teaching of document E1 when attempting to solve the clogging problem of the pump known from document E3 and that moreover none of the solutions proposed by document E1 is the solution underlying the present invention.

The Respondent's argument that locating a device for removing condensation at the place where the condensation occurs is already known from document E1 cannot be followed by the Board. The heater of this document heats the entire pump and is not located at the specific place where the condensation occurs. Furthermore, as already explained, document E1 concerns a positive displacement pump so that its condensation problem is linked to the pumping zone, i.e. upstream of the exhaust valve.

- 2.6.5 Neither do any of the other documents in the appeal proceedings disclose a heater at the specific place where condensation occurs in order to remove it.

Document E2 makes no mention of heating or reaction products. Document E3, while recognising the clogging problem, gives a mechanical solution. The heating in the pump known from document E4 accelerates the desorption of the surfaces at the high vacuum side (page 1, lines 9 to 14), this document would not lead the skilled person to solve the clogging problem because the heating is at a different place and for a different purpose.

- 2.6.6 It should be emphasised that the above arguments all presuppose that the skilled person realises that the clogging problem in document E3 is the result of the cooling of the pumped gases by the wall of the exhaust path outside the pumping zone. However the Board was unable to find such a teaching in the documents available to it and so finds it all the more doubtful that a skilled person would be guided towards the claimed solution by the teaching of document E1 which focuses on a condensation problem and even more on a completely different condensation problem.

- 2.6.7 Thus the Board sees no obvious way for the skilled person to arrive at the present invention from the prior art documents present in this appeal proceedings, taken singly or in combination.
3. Therefore, the subject-matter of Claim 1 as granted (i.e. Claim 1 of the main request) is patentable within the meaning of Article 52 EPC so that the patent based on this allowable independent claim may be maintained as granted.
4. Accordingly the Respondent's auxiliary requests need not be considered.

**Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:



N. Maslin

The Chairman:



C. Andries

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