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# D E C I S I O N
## of 17 November 1994

**Case Number:** T 0431/93 - 3.2.1

**Application Number:** 86901374.8

**Publication Number:** 0216810

**IPC:** F16K 25/00, C04B 41/87

**Language of the proceedings:** EN

**Title of invention:**
A process for manufacturing seal disk members having a low friction coefficient

**Patentee:**
Gevipi AG

**Opponent:**
Ideal-Standard GmbH

**Headword:**

**Relevant legal provisions:**
EPC Art. 54, 56

**Keyword:**
"Novelty (yes)"
"Inventive step (no)"

**Decisions cited:**
T 0069/83, T 0192/82

**Catchword:**

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

**Case Number:** T 0431/93 - 3.2.1

# D E C I S I O N
## of the Technical Board of Appeal 3.2.1
## of 17 November 1994

**Appellant:** (Opponent)
Ideal-Standard GmbH
Postfach 18 09
D-53008 Bonn (DE)

**Representative:**
Gesthuysen, Hans Dieter, Dipl.-Ing.
Patentanwälte Gesthuysen, von Rohr & Weidener
Postfach 10 13 33
D-45013 Essen (DE)

**Respondent:** (Proprietor of the patent)
Gevipi AG
Aeulestrasse 5
Postfach 83
Triesen
FL-9490 Vaduz (FL)

**Representative:**
Patrito, Pier Franco, Dr. Ing.
Cabinet Patrito Brevetti
Via Don Minzoni 14
I-10121 Torino (IT)

**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office given on 16 December 1992 and issued in writing on 11 March 1993 rejecting the opposition filed against European patent No. 0 216 810 pursuant to Article 102(2) EPC.**

**Composition of the Board:**

**Chairman:** F. Gumbel
**Members:** S. Crane
J-C. De Preter

## Summary of Facts and Submissions

I. European patent No. 0 216 810 was granted on 22 August 1990 on the basis of European patent application No. 86 901 374.8 filed on 4 February 1986.

Claim 1 of the granted patent reads as follows:

"A process for manufacturing a pair of disk members for a valve, each disk member of the pair having a machined working surface intended to sealingly cooperate with a working surface of the other disk member of the pair in order to regulate a flow of water, the working surface of each one of said disk members being made of a material selected in the group comprising aluminium oxides, aluminium silicates, ceramic material, steatite, metals, synthetic materials and socalled tuflite, at least one of said working surfaces of said two disk members being coated with a material having a hardness higher than the hardness of the core material of the disk member, which forms a covering layer thin with respect to the thickness of the corresponding disk member, and said two cooperating working surfaces being different the one from the other in nature or finish, characterized in that the process comprises the step of applying said material covering at least one of said working surfaces by depositing, through a process of physical or chemical deposition from a gaseous medium, selected in the group comprising the processes called CVD and PVD, the surface modification by ion implantation, the ion implantation under laser treatment, the surface modification by ion irradiation, the plasma-CVD process, and the magnetic field assisted deposition process, the covering material being selected from the group comprising silicon carbide, carbides and

nitrides of metals, especially of the transition metals, metal nitrites, particularly titanium nitrite and chromium nitrite and cubic crystallographic lattice carbon."

Dependent Claims 2 to 4 relate to preferred embodiments of the process according to Claim 1.

II. The patent was opposed by the Appellants on the grounds that its subject-matter lacked inventive step having regard to the state of the art. Of the nineteen prior art documents cited in the opposition proceedings only the following have played any significant role in the appeal proceedings:

(D2) EP-A-0 043 456
(D3) EP-A-0 063 762
(D7) DE-A-2 929 510
(D12) CH-A-452 205
(D18) VDI-Bericht 333, Verschleißschutz durch Oberflächenschichten, Tagung Stuttgart 1979, pages 53 to 57
(D19) "Die chemische Abscheidung aus der Gasphase: das Verfahren, eine Anwendung", Schweizer Archiv, Juni 1967, Seiten 157-166.

III. By its decision taken at oral proceedings on 16 December 1992 and issued in writing on 11 March 1993 the Opposition Division rejected the opposition.

IV. An appeal against this decision was filed on 8 May 1993 and the appeal fee paid 11 May 1993. The Appellants requested that the appealed decision be set aside and the patent revoked in its entirety. The Statement of Grounds of Appeal was filed on 21 July 1993.

V. In a communication pursuant to Article 11(2) RPBA dated 11 March 1994 the Board referred to Italian patent application No. 67 746-A/82 which is mentioned in the description of the patent specification and a translation of which (hereinafter document D20) was filed by the Respondents (Patentees) during the course of the pre-grant examination proceedings.

The view of the Board was expressed that on the basis of what was said in the patent specification the claimed process did not result in a pair of disk members having a lower coefficient of friction than those proposed by document D20 and that accordingly the aim of the claimed process had to be seen in enabling the cheaper production of a pair of disk members having a satisfactory friction coefficient. This appreciation should form the basis for the evaluation of inventive step.

VI. With a letter received on 2 November 1994 the Respondents submitted experimental results concerning the measurement of friction between a pair of sintered silicon carbide disks and a pair of disks comprising a body of ceramic material coated with a thin layer of silicon carbide obtained by vacuum deposition. They argued that these results showed that the claimed process resulted in a pair of disks having a lower coefficient of friction than those proposed in document D20.

VII. Oral proceedings before the Board were held on 17 November 1994.

VIII. The arguments of the Appellants can be summarised as follows:

It had already been proposed in the article by Professor Hintermann on pages 53 to 67 of document D18 to apply thin coatings of a hard material to valve parts by chemical vacuum deposition (CVD). Although admittedly there was no specific reference in this context to pairs of valve disk members the skilled man would understand these as implicitly being meant. Furthermore, the article clearly taught the deposition of films of materials of the group specified in the characterising clause of granted Claim 1 onto materials of the group specified in the preamble of the claim. It was also stated that the advantage of using such a coating extended to the situation where only one of a pair of frictionally interengaging members was coated. Accordingly, all of the features of granted Claim 1 could be found in this document so that the subject-matter of the claim lacked novelty.

However, even if novelty were to be established then the subject-matter of the claim lacked inventive step. Having regard to the teachings of for example document D18 it was obvious for the skilled man to replace a sintered silicon carbide valve disk member as proposed in document D20 by a valve disk member formed by vacuum deposition of a thin silicon carbide film onto a ceramic or other base member. The potential production cost savings were clearly disclosed in document D18. The experimental results submitted by the Respondents were wholly unsuitable to demonstrate that disk members produced by the claimed method were superior in their frictional properties compared to those proposed in document D20 since it was not clear what form the tested disk members had or whether indeed they conformed to what was taught by the patent or document D20 at all.

IX. In support of their request that the appeal be dismissed the Respondents argued substantially as follows:

Professor Hintermann's article in document D18 gave a general overview of the use of vacuum deposition techniques to produce hard wearing and corrosion resistant coatings. Valves were mentioned merely as one possible field of use. It was improper when evaluating novelty arbitrarily to combine parts of the article mosaic fashion.

Furthermore, there was nothing in document D18 or any other of the cited prior art documents which could lead the skilled man to suspect that the use of a hard material coating on a relatively softer base material could lead to a lower frictional coefficient than the use of a solid body of the hard material, as the experimental results submitted by the Respondents demonstrated. In this respect it was not necessary to give precise details of the form of the disk members tested since it was unequivocally stated that those of sintered silicon carbide corresponded to document D20 and that those with a coating of silicon carbide were made according to the process of the invention. The surprising effect found by the Respondents was due to the different behaviour under load of a stratified member of layers of different hardness compared to a member made of one material. Thus the claimed process led to distinct advantages which could not be foreseen from the state of the art and accordingly involved an inventive step.

## Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is therefore admissible.

2. *State of the art*

2.1 Document D2 is concerned in particular with the reduction of friction between valve disk members made of an oxide ceramic. To this end the ceramic includes as a component zirconium oxide or hafnium oxide in which a phase change is induced in the working surface of the disk member by the elevated temperatures caused by grinding and polishing of the disk member. This phase change increases the surface roughness at the microscopic level, which reduces the tendency of the disks to adhere to each other.

2.2 Document D3 proposes making valve disk members for a household water tap out of sintered silicon carbide material. This material is stated to have better wear and friction properties than conventional oxide ceramics.

2.3 In document D20 it is stated that the frictional characteristics of two similar valve disk members of sintered silicon carbide are not wholly satisfactory. It is therefore proposed to use either two disk members of silicon carbide which are of different hardness or alternatively one disk member of silicon carbide and one disk member of for example an aluminium oxide or silicate ceramic, which has a lower hardness than the silicon carbide. Preferably the disk member of harder material is finished to a higher degree of surface smoothness than the other disk member.

2.4 Document D7 proposes providing the working surfaces of various machine parts which are in operative contact with each other with thin coatings of respectively different materials obtained by vacuum disposition. The pairings of materials which are specifically mentioned are titanium carbide/titanium nitride, titanium carbide/silicon carbide and silicon nitride/molybdenum silicide.

2.5 Document D12 relates to particular process parameters for the CVD of for example titanium carbide onto an aluminium oxide ceramic base material. It is stated that the surface coatings produced have a very low roughness so that they only need to be polished subsequently in special cases.

2.6 The article by Professor Hintermann in document D18 gives an overview of the use of vacuum deposition techniques to produce wear and corrosion resistant coatings. In column 1, page 53 it is stated that after initial commercial success in the field of coating hard metal cutting tools, the technique is being extended to providing wear and corrosion resistant coatings on machine elements such as bearings and gears. In column 2, page 56 it is indicated that a reduction in friction can be obtained if only one of the pair of working surfaces is provided with a coating of hard material such as titanium carbide or titanium nitride. From the tables on page 57 it can be seen that it was known to coat aluminium oxide ceramics with silicon carbide or titanium carbide. In column 1, page 65 it is stated that another advantage of coatings of titanium carbide or titanium nitride is that their surface roughness is so low that no subsequent polishing is necessary. In column 1, page 66 the wear on a titanium carbide coated steel measuring tool is compared to that of one of an uncoated steel. It is indicated that the

use of a hard metal to make the tool would lead in comparison to unacceptable fabrication costs. Lastly, in column 1, page 67, under the title "Other uses" it is stated that the useful life of other parts subject to wear such as valves, watch cases, textile machine elements and gear elements has been increased by applying a hard surface coating by CVD.

2.7 Document D19 gives a general overview of in particular the process parameters involved with CVD. In column 1, page 158 it is stated that the deposited coatings grow with a uniform thickness, thus retaining the structure of the base material.

3. *Novelty*

The Appellants have argued that all of the features of granted Claim 1 can be found in document D18 and that consequently the subject-matter of the claim lacks novelty. The Board cannot accept that view for the following reasons:

It has to be noted first of all that document D18 is of significant length and reviews in rather general terms various aspects of the production by vacuum deposition of wear and resistant coatings, and their utility. It is therefore not so much a question as to whether all the features of granted Claim 1 can be found individually in document D18 but whether this document, when considered as a whole, at least implicitly teaches the skilled man the process for manufacturing a pair of disk members for a valve as defined in the claim.

The only reference to valves as a possible field of use of the hard coating discussed in document D18, in column 1, page 67, is in very general terms and makes no indication of what type of valve is being spoken about

or what elements of the valve are involved. Of course, there are many forms of valve which do not employ pairs of disk members within the meaning of Claim 1 and there is no good reason why the skilled man would implicitly understand this bald reference to valves to being to valves of that one particular type. Furthermore, granted Claim 1 requires that the co-operating working surfaces of the pair of disk members are different the one from the other "in nature or finish" which encompasses in the context for example situations where the disk members are coated with different hard materials or where one disk member is so coated and the other not. Although in the first paragraph of column 2, page 56 of document D18 the possibility of using pairings of different hard materials or only coating one surface of a pair with hard material is briefly touched upon there is nothing in the document which could lead the skilled man specifically to choose these possibilities in connection with the formation of hard surface coatings on valve elements of any shape or form.

Accordingly, the subject-matter of granted Claim 1 must be considered as novel with respect to the teachings of document D18. The novelty of this subject-matter with respect to the remaining state of the art is apparent from the analysis thereof in point 2 above. Since this has not been disputed further elaboration is unnecessary.

4. *Problem and solution; inventive step*

4.1 In the introductory description of the patent specification reference is made to difficulties associated with conventional valve disk members for household water taps made of aluminium oxide or silicate ceramics, which due to their accurate surface finish tend to adhere to each other and thereby generate high

sliding friction. Referring then to document D3 it is stated that the valve disk members of sintered silicon carbide proposed there initially exhibit acceptably low levels of friction but that after long use the friction greatly increases to unacceptably high levels. In this context the teaching of document D20 to use disk members of different hardness characteristics, one of them being of silicon carbide, is then stated to provide a surprising and permanent reduction in friction. It is however noted that the manufacture and grinding of silicon carbide disks requires the use of special machinery and techniques. After some further references to less relevant state of the art there comes a statement of object in the following terms:

"Considering these circumstances, the object of this invention is to provide hard material seal members having a limited cost of production and machining and capable of providing a sufficiently reduced friction coefficient, even in the absence of lubrication, so as to allow a proper operation of the apparatuses for a long period of time without requiring any intervention."

The Board can find nothing in this statement which in the given context could indicate that it was an object of the claimed invention to produce valve disk members which exhibit a lower friction coefficient than those proposed in document D20. Instead, the only reasonable interpretation is that the object is to produce such members which have a friction coefficient corresponding to those proposed in document D20, but more cheaply. Furthermore, there is nothing in the body of the patent specification which indicates in any way that a further reduction in friction coefficient is achieved in comparison with this state of the art.

4.2 It is however a crucial part of the case put forward by the Respondents that the process defined in granted Claim 1 not only leads to a reduction in costs but also to an improvement in the frictional characteristics of the valve disk members produced, when compared to the state of the art represented by document D20. With their letter of 2 November 1994 they have submitted experimental results which purport to demonstrate this.

For the following reasons the Board cannot however accept that these experimental results are adequately proof of the technical effect claimed.

In the relevant letter of the Respondents it is stated that the tests show the behaviour "of a pair of plates of sytherized (sic) silicon carbide, corresponding to Italian Patent Application No. 67.746-A/82 (document D20) and a pair of plates of a ceramic material covered with a very thin coating of silicon carbide deposited from a gaseous medium according to the invention." (By "sytherized" sintered is meant.) No further information as to the form of the plates is given. Now, in document D20 it is stated that when both valve disk members are of silicon carbide they must have a different hardness as a result of different crystallographic structure. It is also possible but not mandatory that they are finished to a different degree of surface roughness. In the patent specification, on the other hand, no specific mention is made of the possibility of using hard coatings of silicon carbide on both disk members. If this were the case, however, it would appear from column 4, lines 33 to 41 that then it would be mandatory that the two coatings have different degrees of surface finish. No indication is given in the patent specification as to how it might be possible to deposit coatings of silicon carbide which were of selectively

different hardness, which would appear from the technical considerations involved difficult to achieve in practice.

In the light of the above it is by no means clear that the experimental results submitted by the Respondents actually compare like with like and that the differences in frictional behaviour observed are indeed due to the fact that in the one case solid plates of silicon carbide with different surface hardness are used and in the other the plates merely have a coating of silicon carbide, all other factors being equal.

It must also be noted that granted Claim 1 is of broad ambit and covers for the production of at least one of the valve disk members the formation of a hard coating of one of a large number of materials onto a large number of base materials with the other disk member being similarly coated, coated with a different material or not coated at all, so that the testing of one example, particularly one that does not correspond to any of the preferred embodiments of the invention, could not in any case be seen as being adequate to demonstrate the plausible achievement of a reduced friction coefficient over the whole range claimed.

Lastly, at the oral proceedings the Respondents sought to explain the supposed reduced friction coefficient by reference to the overall behaviour under stress of the coated valve disk members when compared to such members fabricated out of hard material. The Board cannot however find these explanations convincing since friction is essentially a surface phenomenon.

4.3 As a result of the above the technical problem solved by the invention has to be seen as corresponding to that formulated in the patent specification, namely the cheaper production of valve disk members having a sufficiently low friction coefficient, see point 4.1 above.

The broad ambit of granted Claim 1 has already been discussed in point 4.2 above. For the evaluation of inventive step it is however only necessary to consider whether that one example covered by the claim which comes closest to the teaching of document D20 is obvious to the skilled man in the light of the state of the art. That one example is a process for manufacturing a pair of disk members for a valve wherein one disk member of aluminium oxide ceramic or one of the other relatively soft materials stated in the preamble of the claim is provided on its working surface with a thin covering layer of silicon carbide, the thin covering layer being deposited by CVD or one of the other processes defined in the characterising clause of the claim, and the other disk member is formed of uncoated aluminium oxide or aluminium silicate ceramic.

Since document D20 already proposes the pairing of a sintered silicon carbide disk member with a disk member of aluminium oxide or silicate ceramic it is evident that the above elucidated example of the claimed invention differs from this state of the art proposal solely in that the sintered silicon carbide disk member has been replaced by one comprising a thin covering layer of silicon carbide formed by vacuum deposition onto a base member of aluminium oxide ceramic or the like.

The economic benefits of using a thin covering layer of a hard material formed by vacuum deposition on a

relatively softer base material instead of fabricating the whole article involved from hard material are clearly mentioned in document D18, see point 2.6 above. This document, as well as documents D12 and D19, also clearly indicate the advantage associated with vacuum deposition that the deposited coatings essentially retain the surface structure of the base members to which they are applied and do not require subsequent grinding or polishing. In the light of this it is obvious to the skilled man that he can eliminate the costly and difficult surface finishing treatment of the sintered silicon carbide disk member proposed in document D20 by adopting a process in which a relatively softer base disk member is given the high degree of surface finish required and then covered by a thin layer of silicon carbide applied by vacuum deposition.

Accordingly, the Board comes to the conclusion that the subject-matter of granted Claim 1 lacks inventive step (Article 56 EPC). Since, in accordance with the single request of the Respondents Claim 1 can only be considered as one entity, it is not necessary to investigate the inventive step of the many other combinations of base material, covering material, deposition processes and potential pairings of disk members covered by the claim.

4.4 With regard to what is said in points 4.2 and 4.3 above it can be added that even if the Board had been convinced that the claimed process led to a reduction in friction coefficient over and above that achieved by the proposals of document D20 it would have seen this as merely representing a collateral advantage or so-called "bonus effect" of the obvious use of vacuum deposition techniques to form at least one of the disk members involved, see for example the decisions T 69/83 (OJ EPO 1984, 357) and T 0192/82 (OJ EPO 1984, 415).

**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:

S. Fabiani F. Gumbel