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**D E C I S I O N**  
**of 27 March 2003**

**Case Number:** T 0697/00 - 3.2.5

**Application Number:** 95108677.6

**Publication Number:** 0678384

**IPC:** B41J 2/045

**Language of the proceedings:** EN

**Title of invention:**  
Drop-on-demand ink-jet printing head

**Patentee:**  
SEIKO EPSON CORPORATION

**Opponent:**  
Océ-Technologies B.V.

**Headword:**  
-

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

**Keyword:**  
"Novelty, inventive step (yes)"

**Decisions cited:**  
T 0123/85

**Catchword:**  
-



Case Number: T 0697/00 - 3.2.5

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.5**  
**of 27 March 2003**

**Appellant:** Océ-Technologies B.V.  
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**Respondent:** SEIKO EPSON COROPORATION  
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**Representative:** Diehl, Hermann, Dr. Dipl.-Phys.  
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**Decision under appeal:** Decision of the Opposition Division of the  
European Patent Office posted 11 April 2000  
rejecting the opposition filed against European  
patent No. 0678384 pursuant to Article 102(2)  
EPC.

**Composition of the Board:**

**Chairman:** W. Moser  
**Members:** W. R. Zellhuber  
P. E. Michel

## Summary of Facts and Submissions

- I. The appellant (opponent) lodged an appeal against the decision of the Opposition Division rejecting the opposition against the European patent No. 0 678 384.
- II. The Opposition Division held that the grounds for opposition cited in Article 100(a) EPC (lack of novelty, Article 54 EPC, and lack of inventive step, Article 56 EPC) did not prejudice the maintenance of the patent.

The following documents are referred to in the decision under appeal:

D1: EP-A 0 402 171;

D2: US-A 4 072 959;

D3: JP-A 60-90770 with English translation.

- III. Oral proceedings were held before the Board of Appeal on 27 March 2003.
- IV. The appellant requested that the decision under appeal be set aside and that the European patent No. 0 678 384 be revoked in its entirety.

The respondent (patent proprietor) requested as a main request that the appeal be dismissed, or that the decision under appeal be set aside and the patent be maintained on the basis of the following documents filed on 27 February 2003:

- (a) claims 1 to 4 filed as first auxiliary request for FR, and claims 1 to 6 filed as first auxiliary request for DE and GB; or
- (b) claims 1 to 4 filed as second auxiliary request for FR, and claims 1 to 6 filed as second auxiliary request for DE and GB; or
- (c) claims 1 to 6 filed as third auxiliary request for FR, and claims 1 to 6 filed as third auxiliary request for DE and GB.

Furthermore, as alternatives, claim 2 or claim 3 or both were requested to be deleted in all these auxiliary requests, except for the first and second auxiliary requests for FR.

- V. Independent claims 1 and 4 of the patent in suit as granted (main request) read as follows:

"1. A drop-on-demand ink-jet printing head, comprising:  
a base (2; 70; 80; 85);  
a nozzle plate (8; 92) defining a plurality of nozzle apertures (10, 10'; 89);  
an array of piezoelectric elements (12, 12'; 78; 82; 86; 89) each arranged at predetermined intervals, each having an inactive region where no piezoelectric phenomenon is substantially influenced, and each having one end which is fixed onto said base (2; 70; 80; 85) and another end which is free and which is confronted with respective ones of said nozzle apertures (10, 10'; 89) of said nozzle plate (8; 92); and  
an ink reservoir (6a, 6b; 90) formed between said nozzle apertures (10, 10'; 89) of said nozzle plate (8)

and said free ends of said piezoelectric elements (12, 12'; 78; 82; 86; 89);  
characterized in that

- each of said piezoelectric elements (12, 12'; 78; 82; 86; 89) is a lamination having multiple piezoelectric layers (21, 23) and multiple conductive layers (22, 24), obtainable by laminating piezoelectric material and conductive material stacked alternately in layers to form a piezoelectric plate (25) and cutting, at predetermined widths, said piezoelectric plate (25),
- each of said piezoelectric elements (12, 12'; 78; 82; 86, 89) oscillates in an axial direction thereof and
- said inactive region is formed at said one end of said piezoelectric elements."

"4. A method of producing a drop-on-demand ink-jet printing head, comprising:  
providing a base (2; 70; 80; 85);  
forming on said base (2; 70; 80; 85) an array of piezoelectric elements (12, 12'; 78; 82; 86; 89), each comprising an inactive region, and each having one end which is fixed to said base (2; 70; 80; 85) and another end which is free;  
constituting a nozzle plate (18) defining a plurality of nozzle apertures (10, 10'; 89) such that the free end of each piezoelectric element is confronted with a respective one of said nozzle apertures of said nozzle plate(8); and providing an ink reservoir (16a, 66, 90)

between said nozzle apertures of said nozzle plate (8) and said free ends of said piezoelectric elements, characterized in that

- each of said piezoelectric elements (12, 12'; 78; 82; 86; 89) is formed by laminating multiple piezoelectric layers and multiple conductive layers, and oscillates in an axial direction thereof, and
- said inactive region is formed at said one end of said piezoelectric elements."

VI. In the written procedure and during oral proceedings, the appellant argued essentially as follows:

In his response to the notice of opposition, the respondent filed new claims to replace the claims of the patent in suit as granted. These amended claims were thus subject-matter of the procedure. However, during the oral proceedings before the Opposition Division, the respondent, following a suggestion of the Opposition Division, had requested that the opposition be rejected and the patent in suit be maintained as granted. It was believed that a substantial procedural violation had thus occurred in the course of the procedure before the Opposition Division.

Furthermore, the subject-matter of claim 1 of the patent in suit as granted was not novel with regard to document D1, which represented prior art according to Article 54(3) EPC. Document D1 disclosed a printing head comprising a plurality of piezoelectric elements fixed to a base. In the base and the part of these

elements close to the base, no electrodes were provided thus forming inactive regions.

Moreover, the subject-matter of claim 1 of the patent in suit as granted did not involve an inventive step. The printing head disclosed in document D2 differed from the printing head of claim 1 of the patent in suit as granted only in that no piezoelectric elements consisting of a lamination of a plurality of piezoelectric and conductive layers were suggested.

However, document D3 suggested using such a lamination of piezoelectric and conductive layers in a printing head and referred to the advantages of such a lamination (only low voltages needed). It had thus been obvious to improve the printing head of document D2 accordingly. Providing such a piezoelectric structure in the printing head of document D2 resulted in a printing head according to claim 1 of the patent in suit as granted.

The same applied to claim 4 of the patent in suit as granted.

VII. In the written procedure and during oral proceedings, the respondent argued essentially as follows:

Document D1 disclosed neither a nozzle plate nor inactive regions nor a printing head wherein piezoelectric elements were fixed onto a base. In the printing head of document D1, the piezoelectric elements were an integral part of a piezoelectric block.

The subject-matter of claim 1, and, for the same reasons, the subject-matter of claim 4 of the patent in suit as granted was thus novel with regard to document D1.

Document D2 concerned a printing head wherein piezoelectric elements were provided by cutting a comb-like structure into a piezoelectric block. These elements were thus not fixed onto a base. Furthermore, the cuts provided for separating the respective piezoelectric elements (cf. Figure 7) extended only as far as necessary to obtain a reliable electric separation of the individual upper electrodes from one another.

Neither document D2 nor document D3 suggested providing inactive regions formed at the end of the piezoelectric elements. The purpose of such inactive regions was to avoid crosstalk and to increase the stability of the printing head.

Furthermore, there was no motivation to combine the teachings of documents D2 and D3, nor would such a combination result in a printing head according to claim 1 of the patent in suit as granted.

The subject-matter of claim 1 of the patent in suit as granted thus involved an inventive step. The same arguments applied to claim 4 of the patent in suit as granted.



## Reasons for the Decision

### 1. Alleged substantial procedural violation

According to decision T 123/85 (OJ EPO 1989, 336), a patent proprietor requesting maintenance of his patent in a limited form does not, by virtue of such limitation, irrevocably abandon subject-matter covered by the patent as granted, but not by the request as thus limited. According to that decision, the patent proprietor may even reinstate the patent in the form it was granted, provided this does not constitute an abuse of procedural law.

In the present case, the respondent, after having received a notice of opposition, requested maintenance of his patent in a limited form. During the oral proceedings before the Opposition Division he requested maintenance of the patent in the form it was granted.

Due to that request of maintenance of the patent as granted, the appellant had not had to deal with completely new matter, since the notice of opposition was based on the subject-matter of the claims of the patent in suit as granted. Furthermore, in compliance with Article 113(1) EPC, the appellant had a further opportunity to comment on these claims during the oral proceedings before the Opposition Division, cf. point 6 of the minutes. Thus, in the Boards's view, no substantial procedural violation had occurred during the oral proceedings before the Opposition Division.

2. *Novelty*

Claim 1 of the patent in suit as granted (main request) concerns a printing head comprising an array of piezoelectric elements wherein one end of each of the piezoelectric elements is fixed onto a base, and wherein an inactive region is formed at that end of each piezoelectric element. Claim 4 of the patent in suit as granted concerns a method of producing such a printing head.

Document D1, which represents prior art according to Article 54(3) EPC, relates to a printing head including a single, integral laminated piezoelectric element. By cutting a plurality of slits into a part of the piezoelectric element, a plurality of mutually isolated pressure portions facing underlying ink chambers are provided, cf. claims 1 and 9, and description, column 2, lines 48 to 51, and drawings, Figures 3 and 4. Consequently, document D1 discloses neither a printing head comprising an array of piezoelectric elements each fixed at one end onto a base nor a method of producing such a printing head.

The subject-matter of claims 1 and 4 of the patent in suit as granted is also novel with regard to documents D2 and D3, as shown below. Actually, novelty was not in dispute with regard to these documents.

The subject-matter of claim 1 and, accordingly, the subject-matter of claim 4 of the patent in suit as granted is therefore novel within the meaning of Article 54 EPC.

3. *Inventive step*

3.1 In the Board's view, document D3 represents the closest prior art. It concerns a printing head comprising an array of piezoelectric elements each having one end which is fixed onto a base, cf. page 4, second complete paragraph of the English translation, and Figures 1 and 2. The piezoelectric elements may consist of a lamination of a plurality of piezoelectric layers sandwiched between respective conductive layers, cf. page 5, third complete paragraph of the English translation and Figure 3. An electrode 10 is provided between the piezoelectric elements and the base, or the latter may itself serve as an electrode, cf. page 5, second complete paragraph and Figures 2 and 3.

3.2 In order to improve a drop-on-demand ink-jet printing head, the patent in suit suggests a printing head according to claim 1 of the patent in suit as granted, in particular, a printing head comprising an array of piezoelectric elements wherein one end of each of the piezoelectric elements is fixed onto a base, and wherein an inactive region is formed at that end of each piezoelectric element.

According to claim 1 of the patent in suit as granted, such an inactive region is defined as being an area "where no piezoelectric phenomenon is substantially influenced". Consequently, substantially no vibrations are created in that part of the piezoelectric element, which may give rise to an improved stability of the printing head with less mechanical crosstalk between neighbouring piezoelectric elements.

3.3 Document D3 neither discloses nor suggests forming inactive regions at the ends of the piezoelectric elements which are fixed onto the base.

Document D2 concerns a printing head comprising a comb-like array of piezoelectric elements, cf. in particular Figures 2 and 7. The teeth (rods 14) of that comb-like structure form individually controllable piezoelectric elements. The teeth ends facing away from the holes 10 "become the base 16 of the comb", cf. column 3, lines 27 to 29 and Figures 2 and 7. The teeth are thus integral with the base rather than fixed onto a base.

Furthermore, the teeth 14 comprise contact areas which are connected to printed line 17 placed on the comb base 16 via connecting line 18, cf. column 3, lines 29 to 34 and Figure 7. The horizontal line, drawn just below the black dot indicating the end point of the connecting line 18 at the bottom part of the teeth depicted in Figure 7, may be construed as indicating that the contact area on the teeth 14 ends just before the comb base. However, the description of document D3 is silent about that constellation. In the Board's view, a person skilled in the art would consider such a constellation as representing a means for electrically separating the piezoelectric elements from one another.

Consequently, document D2 does not suggest providing an array of piezoelectric elements wherein one end of each of the piezoelectric elements is fixed onto a base, and, in particular, wherein an inactive region is formed at that end of each such piezoelectric element. Moreover, document D2 does not concern a printing head

comprising a lamination of a plurality of piezoelectric and conductive layers.

Therefore, neither document D2 alone nor document D3 in combination with document D2 render the subject-matter of claim 1 of the patent in suit obvious.

3.4 This is also valid when considering document D2 as representing the closest prior art.

Firstly, neither document D2 nor document D3 suggest providing inactive regions.

Furthermore, using a lamination of piezoelectric and conductive elements as piezoelectric element, as suggested in document D3, in the printing head according to document D2, requires a different arrangement of the electrodes, cf. Figure 3 of document D3, and would thus give rise to a different construction of the printing head. Nothing indicates that the combination of the teachings of documents D2 and D3 would result in a printing head as defined in claim 1 of the patent in suit as granted.

3.5 Therefore, the subject-matter of claim 1 of the patent in suit as granted, and, for the same reasons, the subject-matter of claim 4 of the patent in suit as granted involves an inventive step. The subject-matter of claims 2 and 3, which are appendant to claim 1, similarly do involve an inventive step.

4. Consequently, the auxiliary requests of the respondent concerning maintenance of the patent in suit in amended form had not to be considered.

**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:

M. Dainese

W. Moser