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D E C I S I O N
of 9 December 1993

Case Number: T 0343/88 - 3.2.5

Application Number: 81303836.1

Publication Number: 0046676

IPC: B41J 3/04

Language of the proceedings: EN

Title of invention:

Method of operating an on-demand type ink jet head and system therefor

Patentee:

Epson Corporation, et al.

Opponent:

Siemens AG

Headword:

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Relevant legal norms:

EPC Art. 56

Keyword:

"Inventive step (yes, after amendment)"

Decisions cited:

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Catchword:

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Case Number: T 0343/88 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 9 December 1993

Appellant: Epson Corporation
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office dated 9 May 1988 revoking
European patent No. 0 046 676 pursuant to
Article 102(1) EPC.

Composition of the Board:

Chairman: C. Payraudeau
Members: H.P. Ostertag
M. Liscourt

Summary of Facts and Submissions

- I. By decision given on 9 May 1988, the Opposition Division revoked the European patent No. 0 046 676 (application No. 81 303 836.1).
- II. The reasons for the decision were that the subject-matter of the independent Claims 1 and 6 lacked novelty in view of the teaching of the patent publication US-A-4 161 670 (D1).
- III. The Appellant (Patentee) lodged an appeal against this decision and together with his Statement of Grounds filed a "list of amendments" including a set of new Claims 1 to 4.

The independent Claims 1 and 4 read as follows:

"1. A method of operating an on-demand type ink jet head, which comprises a pressure chamber (2) with an inlet (4) which communicates with a supply of ink (6) and an outlet (3) which communicates with the atmosphere, and an electro-mechanical transducer (9) which is arranged in response to an electrical signal to alter the volume of the pressure chamber (2), the said method comprising the steps of applying a signal to the transducer (9) so that the latter is in a stand-by condition in which the pressure chamber (2) is in a contracted stand-by state; altering the said signal to the electro-mechanical transducer (9) so that the volume of the pressure chamber (2) is increased, whereby ink is drawn into the pressure chamber (2); and changing the said signal so that the volume of the pressure chamber (2) is reduced, whereby ink (6) is propelled out of the said outlet (3); the said signal being so changed at a time when the amplitude of oscillation of a mechanical

system formed by the transducer (9), at least part (5) of the pressure chamber and ink (6) within the pressure chamber (2) is substantially at a maximum, characterised in that, in order to draw in the ink, the voltage of the said signal is reduced so that the volume of the pressure chamber (2) is increased to substantially its maximum value by means of oscillation of the said mechanical system (9,5,6); and the voltage of the said signal is directly increased at the said time to its value in the said stand-by condition without changing its polarity.

4. An on demand type ink jet head system comprising: an ink jet head having a pressure chamber (2) with an inlet (4) which communicates with a supply of ink (6) and an outlet (3) which communicates with the atmosphere; an electro-mechanical transducer (9) which is arranged in response to an electrical signal to alter the volume of the pressure chamber (2); and means for supplying the said electrical signal to the electro-mechanical transducer (9); the signal supplying means being arranged, in use, to apply a signal to the transducer (9) so that the latter is in a stand-by condition, in which the pressure chamber (2) is in a contracted stand-by state; to alter the said electrical signal to the electro-mechanical transducer (9) so that the volume of the pressure chamber (2) is increased with respect to its volume in the stand-by state, whereby ink (6) is drawn into the pressure chamber (2); and to change the said signal so that the volume of the pressure chamber (2) is reduced, whereby ink (6) is propelled out of the said outlet (3), the said signal supplying means being arranged, in use, to so change the said signal at a time when the amplitude of oscillation of a mechanical system formed by the transducer (9), at least part (5) of the pressure chamber (2) and ink (6) within the pressure chamber (2) is substantially at a

maximum characterised in that the signal supplying means is arranged, in use, to reduce the voltage of the said signal so that the volume of the pressure chamber (2) is increased substantially to its maximum value by means of oscillation of the said mechanical system (9,5,6) in order to draw in the ink, and the voltage of the said signal is directly increased at the said time to its value in the said stand-by condition without changing its polarity."

- IV. The Appellant requests the revocation of the decision under appeal and the maintenance of the patent in amended form on the basis of the "list of amendments" filed with his Statement of Grounds. He also requests the refund of the appeal fee in the event that the decision is reversed.

In his Statement of Grounds, the Appellant essentially submitted that the subject-matter of method Claim 1 (and of the corresponding apparatus Claim 4) was now restricted to the fact that the signal to the transducer which is changed so as to effect the expulsion of the ink was changed without altering its polarity, the voltage applied to the transducer at this time being directly increased to its value in the stand-by condition of the transducer. These features were neither disclosed nor obvious from the document D1.

- V. The Respondent (Opponent) requests the rejection of the appeal.

In support of his request, the Respondent, who did not contest any more the novelty of the subject-matter of the independent claims, essentially submitted that the amended claims did not show any inventive step in view of document D1 combined with the teachings of the patent publications DE-A-2 850 016 (D2) and US-A-3 683 212 (D3)

already cited during the proceedings before the Opposition Division.

According to the Respondent, it was known from the document D1 to control a piezo-electric element in such a manner that the driving element (pressure chamber) is in a stand-by condition before the control impulse is produced, then has its volume increased and thereafter decreased whereby an ink drop is propelled out of the nozzle. The use of a unipolar signal was already known from the patent publications D2 and D3. The combination of the teaching of the document D1 with the teachings of these documents D2 and D3 was obvious to the person skilled in the art.

Reasons for the Decision

1. *Amendments*

1.1 The present independent Claims 1 and 4 include all the features recited in the corresponding Claims 1 and 8 of the granted patent.

1.2 The features added into these claims relate to keeping the pressure chamber in a contracted state during the stand-by phase and to alter the volume of the pressure chamber by reducing and directly increasing the unipolar voltage of the signal applied to the transducer. These features limit the scope of the protection conferred by these claims with respect to the corresponding claims of the patent as granted. The present Claims 1 and 4 satisfy therefore the requirements of Article 123(3) EPC.

1.3 The features of Claims 1 and 8 of the granted patent were also respectively disclosed in the original Claims 1 and 8 of the patent application as filed. The added features to these claims were disclosed in the description of the patent application as filed in connection with Figures 4A and 4B in the passage beginning page 14, line 8 and ending page 15, line 26 (corresponding to the passage beginning column 6, line 47 and ending column 7, line 51 of the granted patent).

1.4 The new Claim 2 is also supported by the above-cited passage. Claim 3 substantially corresponds to Claim 7 of the application as filed and of the patent as granted.

Hence, the requirements of Article 123(2) EPC are also satisfied.

2. *Novelty*

2.1 Novelty has not been contested in the appeal proceedings.

2.2 The document D1 discloses all the features of the preamble of Claims 1 and 4 but none of the characterising part. The documents D2 and D3 have only been cited against the features of the characterising part of the claims.

2.3 Therefore, the subject-matters of the Claims 1 and 4 are new with respect to the mentioned prior art and these claims meet the requirements of Article 54 EPC.

3. *Inventive step*

3.1 The document D1 which has been acknowledged by both parties as being the nearest state of the art discloses

a method of operating an on-demand type ink jet head which comprises a pressure chamber with an inlet which communicates with a supply of ink and an outlet which communicates with the atmosphere, and an electro-mechanical transducer which is arranged in response to an electrical signal to alter the volume of the pressure chamber, the said method comprising the steps of applying a signal to the transducer so that the latter is in a stand-by condition in which the pressure chamber is in a contracted stand-by state; altering the said signal to the electro-mechanical transducer so that the volume of the pressure chamber is reduced, whereby ink is propelled out of the said outlet; the said signal being so changed at a time when the amplitude of oscillation of a mechanical system formed by the transducer, at least part of the pressure chamber and ink within the pressure chamber is substantially at a maximum.

3.2 According to the principal embodiment disclosed in document D1, no voltage is applied to the transducer during the stand-by phase and a command signal causes the application of a voltage of a polarity opposite to the polarisation voltage of the transducer, resulting in an increase of a given amount of the diameter of the said (tubular) transducer whereby ink is drawn in. The polarity of the voltage is then reversed, resulting in a contraction of the tube of the double amount, whereby an ink droplet is expelled. Thereafter, the stand-by state is restored, whereby the diameter of the tube is increased of the said given amount.

3.3 According to document D1, in a special embodiment (column 2, lines 12 to 15) or in some cases (column 4, lines 16 to 29), in addition to the oscillatory voltage, a constant voltage of the same polarity as the polarising voltage of the transducer is applied to the

latter, this increasing the security of operation of the printer head without changing its principle of operation.

- 3.4 The method according to the present Claim 1, although applying to the transducer, during the stand-by condition, a voltage of the same polarity as the polarising voltage of the transducer which keeps the pressure chamber in a contracting state, operates in a quite different manner. According to this method, the stand-by voltage is reduced without changing its polarity, causing expansion of the chamber and the taking-in of ink, whereupon the voltage is **directly** increased to its stand-by value, causing contraction of the chamber and the ejection of a droplet.
- 3.5 This mode of operation is neither disclosed nor suggested by the document D1.
- 3.6 The Respondent has submitted that the person skilled in the art wanting to simplify the relatively complicated and expensive driving circuit disclosed in document D1, would be incited to use the simpler circuit disclosed in document D2. According to the embodiment illustrated in Figures 1 and 2 of this last mentioned document, the drive circuit operates as follows: in the stand-by phase, no voltage is applied to the transducer of the pressure chamber, so that it adopts its natural shape and volume. A first command signal (SU1...SUn) causes a voltage (the polarity of which is not indicated) to be applied to the transducer so that the volume is increased. A second command signal (SU0) causes a short-circuiting of the transducer so that the voltage is reduced to zero and the volume is decreased to its stand-by condition, whereby a droplet is ejected. Thus, this circuit operates differently from the one specified in Claim 1 since, in particular, it does not apply a

voltage to the transducer during the stand-by condition and short-circuits the transducer instead of increasing directly the voltage to a stand-by value. Therefore, substituting to the circuit of the document D1 the more simple one of the document D2 would not result in the claimed circuit.

3.7 The document D3 teaches to apply to the transducer a command voltage of the same polarity as the polarising voltage of the transducer for causing its contraction and the ejection of an ink droplet. However, the method according to this document consists essentially in "stand-by state - contraction and ejection of a droplet - direct increase to the stand-by state and drawing-in of ink". This method is therefore quite different as well from the method of document D1 as from the method of the invention of the patent in suit and cannot be combined therewith. The person skilled in the art would therefore have no incentive to isolate from the complete teaching of the document D3 the idea of applying a command voltage of the same polarity as the polarising voltage of the transducer and use it in a quite different method, which should have also to be specially adapted to this end in a manner which does not appear to be in itself obvious.

3.8 For the above reasons, the subject-matters of the independent Claims 1 and 4 according to the request of the Appellant cannot be considered as an obvious combination of the teachings of the document D1, D2 and D3 and these claims satisfy therefore the requirements of Article 56 EPC.

3.9 The above considerations apply also to the dependent Claims 2 and 3 which represent particular embodiments of the invention defined in Claim 1.

4. *Reimbursement of the appeal fee*

4.1 In the Statement of Grounds, the Appellant has requested a refund of the appeal fee "in the event that the decision is reversed and the patent allowed".

4.2 Rule 67 EPC provides that "the reimbursement of the appeal fee shall be ordered if such reimbursement is equitable by reason of a substantial procedural violation". In the present case, the Appellant has not submitted that any procedural violation had occurred and the Board, having examined the facts of its on motion, has not uncovered any such procedural violation. The request of the Appellant in this respect cannot therefore be granted.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent on the basis of the European patent as granted together with the amendments indicated in the "list of amendments to the European patent specification filed by the Appellant together with his Statement of Grounds on the 25 August 1988.

3. The request for reimbursement of the appeal fee is rejected.

The Registrar:



A. Townend

The Chairman:



C. Payraudeau

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