BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 48/89 - 3.2.2

Application No.: 83 108 127.8

Publication No.: 0 105 156

Title of invention: Ink jet printing apparatus and methods of operating such apparatus

Classification: B41J 3/04

D E C I S I O N
of 6 March 1991

Applicant: International Business Machines Corporation

Headword:

EPC Article 56

Keyword: "Inventive step (yes, after amendment)"

Headnote

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 48/89 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 6 March 1991

Appellant : International Business Machines Corporation
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Decision under appeal : **Decision of Examining Division** 086 **of the European Patent Office dated** 15 June 1988 **refusing European patent application No.** 83 108 127.8 **pursuant to Article** 97(1) EPC.

Composition of the Board :

Chairman : G. Szabo
Members : W.D. Weiß
W. Moser

Summary of Facts and Submissions

I. European patent application No. 83 108 127.8, filed on 17 August 1983, with priority being claimed from United States application No. 431 407, dated 30 September 1982, was refused by a decision of the Examining Division, dated 15 June 1988.

II. The reason given for the decision was that the then pending independent Claims 1 and 3 lacked novelty and/or an inventive step, because all the features were known from disclosure of US-A-4 266 232 (D1) or were directly derivable therefrom.

III. A Notice of Appeal was filed against this decision on 9 August 1988 and the appeal fee paid simultaneously. The Statement of Grounds was filed on 18 October 1988.

IV. In response to a communication issued by the Board the Appellant filed a set of four amended claims on 14 February 1991. Some further amendments to the independent Claims 1 and 3 were agreed to by the Appellant during a consultation by telephone on 27 February 1991.

V. The Appellant argued that document (D1) failed to mention that a high viscosity ink having different values of viscosity and surface tension depending on whether the ink is in a static or in a dynamic state might be used in connection with this known ink jet printer. Consequently, the added reference to such a particular ink was a substantial amendment of the preceding claims. There was no evidence or suggestion that a skilled man had actually such an ink or that it would have been obvious to use it. The neglect of this amendment by the first instance, therefore,

constituted a violation of the provisions of Article 113(1) EPC. There was, therefore, no basis for the opinion expressed in the decision under appeal that document (D1) disclosed the same solution to the same problem, as was the case with the subject-matter of the amended claims.

VI. The valid independent Claims 1 and 3 filed on 14 February 1991 with subsequent amendments as agreed during the telephone conversation of 27 February 1991 read as follows:

"1. A drop-on-demand ink jet printing apparatus comprising

a reservoir (22) containing a mass of ink,

a print head (10) having an electromechanical transducer (16) operable when actuated to eject a drop of ink (26) from said reservoir,

first pulse generating means (14) for generating a series of drop ejecting voltage drive pulses of at least a predetermined amplitude, said voltage drive pulses being produced at a predetermined drop production rate,

means for coupling said drop ejecting voltage drive pulses to said transducer to actuate said transducer to produce one ink drop in response to each of said drop ejecting drive pulses,

second pulse generating means (14) for generating a series of voltage excitation pulses having a predetermined repetition rate and an amplitude small with respect to said predetermined amplitude, and

means for coupling said voltage excitation pulses to said transducer during intervals between said drop ejecting voltage drive pulses to actuate said transducer to control the characteristics of said mass of ink so as to tend to prevent the occurrence of misplaced or missing drops after an idle period in the operation of said printing apparatus,

characterised in that

said ink is of the high viscosity type having a viscosity and a surface tension both of which have different values depending on whether the ink is in a static or in a dynamic state,

said voltage excitation pulses have a frequency which is faster than the acoustic damping time of said mass of ink in said reservoir and are such as to result in the propagation of a pressure wave in said mass of ink which maintains said ink mass in a dynamic state."

"3. A method of operating a drop-on-demand ink jet printing apparatus of the type comprising a reservoir (22) containing a mass of ink, and a print head (10) having an electromechanical transducer (16) operable when actuated to eject a drop of ink (26) from said reservoir,

said method comprising

generating a series of drop ejecting voltage drive pulses of at least a predetermined amplitude, said voltage drive pulses being produced at a predetermined drop production rate,

coupling said drop ejecting voltage drive pulses to said transducer to actuate said transducer to produce one ink drop in response to each of said drop ejecting drive pulses,

generating a series of voltage excitation pulses having a predetermined repetition rate and an amplitude small with respect to said predetermined amplitude, and

coupling said voltage excitation pulses to said transducer during intervals between said drop ejecting voltage drive pulses to actuate said transducer to control the characteristics of said mass of ink so as to tend to prevent the occurrence of misplaced or missing drops after an idle period in the operation of said printing apparatus,

characterised in that

said ink is of the high viscosity type having a viscosity and a surface tension both of which have different values depending on whether the ink is in a static or in a dynamic state,

said voltage excitation pulses have a frequency which is faster than the acoustic damping time of said mass of ink in said reservoir and are such as to result in the propagation of a pressure wave in said mass of ink which maintains said ink mass in a dynamic state."

The dependent Claims 2 and 4 relate to particular embodiments of the ink jet printing apparatus according to Claim 1 and the method of operating it according to Claim 3, respectively.

VII. The Appellant, by implication, requests grant of the patent on the basis of the following documents:

Claims: Claims 1 to 4 filed on 14 February 1991 with subsequent amendments to Claims 1 and 3 as agreed during the telephone conversation of 27 February 1991;

Description: A description which has to be adapted having regard to the provisions of Rule 27(1)(c) and (d);

Drawings: Figures 1 to 9 as originally filed.

Reasons for the Decision

1. The Appeal is admissible.

2. Amendments

New Claims 1 and 3 consist in essence of a combination of the original Claim 1 with features of the original Claim 7 which have been completed and clarified by features which are disclosed on page 2, first paragraph, and on page 5, last paragraph, to page 6, first paragraph. The word "synchronous" before "drop production rate" did not contribute additional technical information; its omission, therefore, does not change the subject-matter of the claims.

Claims 2 and 4 are based on page 6, last paragraph, to page 7, first paragraph, of the original description.

Therefore, the current version of the claims does not contravene Article 123(2) EPC.

3. State of the Art

The preamble of current Claim 1 starts from document (D1) which apparently discloses:

a drop-on-demand ink jet printing apparatus comprising

a reservoir (14) containing a mass of ink,
a print head (10) having an electromechanical transducer (24) operable when actuated to eject a drop of ink (21) from said reservoir,

first pulse generating means (66) for generating a series of drop ejecting voltage drive pulses (40, 44, 46) of at least a predetermined amplitude (V_T), said voltage drive pulses being produced at a predetermined drop production rate,

means (26) for coupling said drop ejecting voltage drive pulses to said transducer (24) to actuate said transducer to produce one ink drop (21) in response to each of said drop ejecting drive pulses,

second pulse generating means (66) for generating a series of voltage excitation pulses having a predetermined repetition rate and an amplitude (V_M) small with respect to said predetermined amplitude, and

means (26) for coupling said voltage excitation pulses to said transducer during intervals between said drop ejecting voltage drive pulses to actuate said transducer to control the characteristics of said mass of ink so as to

tend to prevent the occurrence of misplaced or missing drops after an idle period in the operation of said printing apparatus.

In the view of the Board this document represents the closest state of the art. Thus, Claim 1 also meets the requirements of Rule 29(1)(a) and (b) EPC, since it is correctly delimited over such prior art.

The same applies to Claim 3, which is directed to an operating method, but contains the same technical features as Claim 1 adapted to this category.

4. Novelty

The particular high viscosity ink chosen according to the characterising portion of the independent Claims 1 and 3 is not mentioned in document (D1).

Although an ink of this type may have been generally known for other purposes before the priority date of the application under appeal, the Board has no proof of the fact that this particular type of ink had been recommended or used in connection with an ink jet printing device before this date.

The other documents mentioned in the Search Report do not refer to such a type of ink either.

The only document which has been cited in connection with the application under appeal and which mentions the use of such a type of ink in connection with ink jet printing is EP-A-0 067 948 (D2), cited in the description, which was published on 29 December 1982 and, hence, only constitutes a state of the art according to Article 54(3) and (4) EPC with respect to the application under appeal. This

document, however, is silent about the formation of low amplitude voltage excitation pulses, and does not, therefore, affect novelty.

Thus, the subject-matter of Claims 1 and 2 is novel in view of all the documents cited.

5. Inventive step

5.1 Document (D1) already aims at solving the problem to avoid irregular drops and to warrant that the drops precisely hit their target place (cf. column 3, lines 24 to 42) and do so at an increased drop rate (cf. column 3, lines 59 to 67). Although the application under appeal has acknowledged this document in its description, there must have been a need for still further improvement, because the former persists in its aim "to provide an improved drop-on-demand printing system which produces high resolution printing under all operating conditions." This was, therefore, the relevant technical problem to be solved.

5.2 There is no indication whatsoever in document (D1) that an "ink of the high viscosity type having a viscosity and a surface tension both of which have different values depending on whether the ink is in a static state or in a dynamic state" was ever considered to be used in the context of this known ink jet printer. The basic problem of this document is caused by a normal fluid behaviour of surface tension which favours the formation of a meniscus in the nozzle passage and results in drops of unequal size, at least when drops have not been produced for some time, and unequal drop spacings, see column 3, lines 25 to 27 and 39 to 40. Moreover, the meniscus formation reduces the maximal drop production rate (cf. column 3, lines 14 to 18).

5.3 Meniscus formation, however, is not the major problem when using a "high viscosity ink" with an ink jet printer. As is well demonstrated by document (D2), which was published after the priority date of the present application, that certain constructional preconditions have to be created before this ink is able to pass the nozzle passage. On the other hand, there is no evidence at all that such conditions were held to be desirable in connection with the device disclosed in document (D1). On the contrary, Figure 1 of this document displays a cylindrical shape of the nozzle passage, whereas the former considers a tapered form to be indispensable when "high viscosity ink" is intended to be used.

5.4 Consequently, the type of ink the use of which is suggested by the application under appeal does certainly not belong to those inks which the person skilled in the art thought of using in connection with the device disclosed in D1.

5.5 But even when the print head were so constructed that the use of a "high viscosity" ink was principally possible, a severe problem, which is demonstrated by the comparison of the Figures 8 and 9 of the application under appeal, would still persist: The first few drops after idle time were either not ejected at all or were ejected with diminished velocity and/or at an uncontrolled direction so that the first few characters after idling would exhibit missing or misplaced drops. As Figure 8 shows the problem is not one of a drop missing here and there, and thus of a lack of perfection, but one where nearly three characters are completely missing. If this difficulty were not solved, this type of ink, which is appreciated for its short drying time and compatibility with the print head materials, would still have to be excluded from use in connection with ink jet printers.

5.6 None of the other documents cited in the Search Report contains any reference to such a high viscosity type of ink. Although this type of ink is admitted by the Appellant to be generally known, there is no evidence that a person skilled in the art was aware of the non-linear dependency on oscillation of its surface tension and viscosity which is the basis for the second characterising feature of valid independent claims on file. Consequently, there is no reason, why the skilled person should have chosen his excitation pulses in a way to keep the ink in the reservoir in its dynamic state. For this and the above reasons it is clear that none of the improvements attained by the invention were foreseeable on the basis of the prior art.

5.7 Document (D2) falls under the definition of Article 54(3) EPC and, in accordance with Article 56 EPC, is, therefore, to be disregarded in deciding whether there has been an inventive step.

5.8 It is, therefore, the view of the Board that the claimed invention is not rendered obvious by the available known art and hence the required inventive step is also involved (Article 56 EPC).

Thus, Claims 1 and 3 define patentable inventions within the meaning of Article 52(1) EPC.

6. Dependent Claims 2 and 4 represent particular embodiments of the invention defined in Claims 1 and 3, respectively. They are, therefore, likewise allowable.

7. Article 113(1) EPC

The technical content of the independent claims on which the decision by the Examining Division was based differed

from that of their predecessors, which was objected to in the communication dated 22 October 1987, mainly by the reference to a certain type of ink being added to these claims.

However, this feature was added to the preambles and was formulated in a manner which gave the impression that it did not belong to the essential features of these claims. This was so interpreted that the amendment merely aimed at a better acknowledgement of the closest prior art document. In this context reference is made to Rule 29(1)(a) EPC and to Guidelines C-III, 2.

Consequently, the Board cannot see that the provisions of Article 113(1) EPC have been violated by the decision of the Examining Division.

8. By virtue of the powers conferred to the Board in Article 111(1) EPC, the case is remitted to the Examining Division for further prosecution. Pursuant to Article 111(2) EPC, the latter shall be bound by the ratio decidendi of the Board regarding in particular the claims now on file, insofar as the facts remain the same.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Examining Division for further prosecution on the basis of Claims 1 and 3 indicated under paragraph VI above and Claims 2 and 4 filed on 14 February 1991.

The Registrar: The Chairman:

N. Maslin G. Szabo