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D E C I S I O N
of 22 October 2003

Case Number: T 0057/01 - 3.5.1
Application Number: 93307989.9
Publication Number: 0592221
IPC: G06K 15/10, B41J 2/05
Language of the proceedings: EN

Title of invention:
Printhead with reduced connections to a printer

Applicant:
Hewlett-Packard Company, A Delaware Corporation

Opponent:
-

Headword:
Printhead/HEWLETT-PACKARD

Relevant legal provisions:
EPC Art. 54, 56, 123(2)

Keyword:
"Amendments - added subject-matter (no)"
"Novelty (yes)"
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-



Case Number: T 0057/01 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 22 October 2003

Appellant: Hewlett-Packard Company
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Representative: Carpmaels & Ransford
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 14 August 2000
refusing European application No. 93307989.9
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: S. V. Steinbrener
Members: R. R. K. Zimmermann
B. J. Schachenmann

Summary of Facts and Submissions

- I. European patent application number 93 307 989.9 was filed on 7 October 1993. The application claims a priority date of 8 October 1992 based on a U.S. patent application for a thermal inkjet printhead and for a method of selectively energizing heater resistors on a printhead interconnected to a printer.
- II. According to the application, the prior art included a printhead circuitry in which the drivers were arranged in a kind of two-dimensional matrix, possibly further split up into groups called primitives, each having its own power supply connections. Using a so-called "integrated drive head or IDH multiplexing" technique, this matrix approach reduced the number of interconnections, and thus the costs of the flexible cable used to interconnect printer and printhead (see column 1, line 36 to column 2, line 22 of the A publication). A multiplexing circuit suitable for this purpose was disclosed in document US-A-5 083 137 (published 21 January 1992).

The European search report drawn up in respect of the application cited, as relevant prior art, the documents EP-A-0 405 574, US-A-5 006 864, and EP-A-0 461 938, all documents published in 1991.

- III. Based on documents US-A-5 006 864 and EP-A-0 405 574, the responsible examining division raised objections against the application for lacking novelty and inventive step, respectively, and refused the application in a decision posted on 14 August 2000.

Moreover, the examining division indicated in passing that even if the claims had been amended "to make it clear that the address signal and print enable signal shared a common conductor", the claimed subject-matter would lack inventive step. "The wish to reduce the number of interconnection lines on the printhead, to thereby reduce costs and increase reliability, (was) not inventive" (see the communication dated 17 April 1997 indirectly referred to in the decision under appeal). While it was accepted that such reduced number of interconnections would require provision of the known printhead with a series-parallel converter, the required circuitry, adding to the bulkiness of the printhead, would not teach away from such an arrangement since a "significant compactization of the known printhead" could be achieved by sharing a common conductor.

IV. The appellant challenged the refusal decision of the examining division through an appeal filed on 16 October 2000, paying the fee for appeal the same day. On 11 December 2000 the appellant filed a written statement setting out the grounds of appeal. Finally, in oral proceedings taking place on 22 October 2003, the appellant submitted amended application documents on which basis the Board announced the present appeal decision.

Claim 1 as filed on 22 October 2003 reads as follows:

"1. A thermal inkjet printhead (14) comprising:
a power interconnection (24, 26);
an array of drivers (32), each driver (31) comprising:

a heater resistor (44) , operably connected to the power interconnection (24, 26), for providing thermal energy for ink droplet generation; and
a switching device (46) for energizing the heater resistor (44) by connecting the heater resistor (44) to the power interconnection (24, 26);
said array of drivers (32) being responsive to an address signal (Ax) and a print enable signal (PEy), so that each address signal (Ax) addresses the switching devices (46) of a respective one of a first plurality of groups of drivers (32) into which the driver array (32) is split up and each print enable signal (PEy) enables the switching devices (46) of a respective one of a second, different, plurality of groups of drivers (32) into which the driver array (32) is split up;
connecting means for receiving, from a printer control and interface circuitry via a flexible cable (18), a print command including, in a combined signal, first print command data for generating the address signal (Ax) and second print command data indicating the group of switching devices which are to be enabled by the print enable signal (PEy), the combined signal being carried on a single wire or an equivalent conductor of the flexible cable (18) to the connecting means; and
means (34, 40, 58) for generating, from the combined signal as received, an address signal (Ax) and a print enable signal (PEy) and providing them to the said driver array (32) for selectively addressing and enabling groups of switching devices (46), thereby selectively energizing groups of switching devices (46) in accordance with the print command."

The only further independent claim filed on 22 October 2003 is directed to a method and has the following wording:

"5. A method for selectively energizing heater resistors (44) in a thermal inkjet printhead (14) for providing thermal energy for ink droplet generation, the printhead (14) being interconnected to a printer (12), the method comprising:
providing a power interconnection (24, 26) to the printhead (44);
connecting a plurality of heater resistors (44) to the power interconnection (24, 26);
providing a plurality of switching devices (46), each switching device (46) of the plurality of switching devices (46) being associated with, and arranged for selectively energizing, a respective heater resistor (44) with power from the power interconnection (24, 26), each switching device (46) together with its associated heater resistor (44) defining a respective driver (31), the plurality of switching devices (36) and their associated heater resistors (44) defining an array of drivers (32);
said array of drivers (32) being responsive to an address signal (Ax) and a print enable signal (PEy), so that each address signal (Ax) addresses the switching devices (46) of a respective one of a first plurality of groups of drivers (32) into which the driver array (32) is split up and each print enable signal (PEy) enables the switching devices (46) of a respective one of a second, different, plurality of groups of drivers (32) into which the driver array (32) is split up;
coupling, from a print control and interface circuitry, a print command to the printhead (14) via a flexible

cable (18), the print command including, in a combined signal, first print command data for generating the address signal (Ax) and second print command data indicating the group of switching devices which are to be enabled by the print enable signal (PEy), the combined signal being carried on a single wire or an equivalent conductor of the flexible cable (18); generating, from the combined signal as received, an address signal (Ax) and a print enable signal (PEy) and providing them to the said driver array (31) for selectively addressing and enabling groups of switching devices (46) in accordance with the print command."

- V. According to the appellant, the prior art multiplexing and matrix approach already succeeded, to some extent, in achieving the goal of reducing the number of interconnections between printer and printhead. The present invention took this approach a step further in this direction by transmitting the print command over a single wire conductor to the printhead, which, however, requires additional decoding and/or demultiplexing within the printhead.

Documents US-A-5 006 864 and EP-A-0 405 574 taught away from such an approach since both documents forced the skilled person to keep, within the printhead, the control and addressing circuits as simple as possible in order to avoid any bulky design of this component. The inventors in the present application, however, had recognized that the balance of advantages laid in simplifying the flexible cable connecting printer and printhead.

VI. Accordingly, the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the application documents presented at the oral proceedings.

Reasons for the Decision

1. The appeal is admissible. The appeal is also allowable since for the reasons set out below the application as amended and the invention to which it relates meet the requirements of the EPC.

Amendments

2. Independent claims 1 and 5, which correspond to independent claims 1 and 7 as originally filed, have been amended to claim embodiments only which transmit a combined print command to the printhead via the flexible cable on a single wire or an equivalent conductor. This limiting feature is explicitly disclosed in the description (see A-publication, column 1, lines 28 to 31, column 5, lines 23 to 26 and column 7, lines 43 to 50) and is clearly supported by Figures 3 and 8 of the drawings. Furthermore, the definition of connecting means for receiving the print command has been added, which means is embodied by the input lines, within the printhead 14, connecting the flexible cable 18 to the driver components 34 and 40 (as well as 58 in Figure 8). After amendment, the independent claims now define a first and second plurality of groups of drivers as well as groups of switching devices selectively energized in accordance with the print command. These groups of drivers may be

considered to be embodied by the "rows" and "columns" of the driver array 32, which are selected by the address and the print enable signals and energized via the power interconnection 24 and 26 (see, for example, column 5, lines 5 to 12). Claims 1 and 5 thus include all features essential for further reducing the number of interconnections still necessary in the prior art IDH multiplexing and matrix approach, an object of the invention which is clearly indicated in the second paragraph of column 2.

Dependent claims 2 to 4 are fully supported by original claims 2, 3 and 6. Finally, the amendments to the description (and drawings) serve to acknowledge the prior art and to adapt these parts of the application to the now limited scope of the claims. These amendments, therefore, do not add any new subject-matter to the content of the application as originally filed.

In summary, the Board is satisfied that the application meets the requirements which the Convention imposes on amendments of a European patent application and in particular the requirements of Article 123(2) EPC and Rule 86 EPC.

Novelty

3. None of the prior art documents cited in the present application or in the European search report discloses, in combination, a matrix-type driver circuitry on a thermal inkjet printhead which is adapted to receive, on a single wire conductor, a print command combining

the "row" and "column" enabling and addressing signals, respectively.

In particular document US-A-5 006 864, cited as novelty-destroying in the decision under appeal, does not disclose these features in combination since selecting heating elements 1H1 to 56H32 requires a great number of interconnections between terminals D1 to D56, P1 to P32 and the printer (see Figure 25). The embodiments of Figures 35 ff., although encoding and multiplexing the print signals, use a plurality of signals lines (L10 and L11) for transmitting the print signals to the printhead.

Document EP-A-0 405 574, showing a matrix-like driver arrangement IC1 to ICn in Figure 7, uses also at least three separate interconnections, namely DATA:SI, EI.CLR and ECLK, for selecting heating resistors 8.

Document US-A-5 083 137, proposing a printhead comprising a multiplexing circuit for the address signals, shows embodiments with at least three address lines (see Figures 1, 4 and 6).

It follows in respect of the prior art cited that the claimed subject-matter meets the requirement of novelty as set out in Articles 52(1) and 54 EPC.

Inventive step

4. The claimed subject-matter of the present application concerns a cartridge or pen type printing system in which the ink source is included in a printhead connected via flexible cable to a power and control

logic within the printer itself (see the introductory part of the description). The application itself identifies the IDH multiplexing and matrix approach as the starting point of the invention. It is indeed arguable whether the prior art documents cited concern the same type of printing system. Even if they do, it is not immediately apparent which of these documents is closer to the invention and thus forms the appropriate starting point for assessing inventive step.

In the present case, however, these questions can be left undecided. The claimed subject-matter is distinguished from each of these documents as well as from the IDH multiplexing and matrix approach by transmitting and receiving a combined print command signal on a single wire conductor as indicated above, thereby solving the technical problem of (further) reducing the number of control interconnections.

It is no question that the prior art lacks any direct hint to the inventive solution, which requires to adapt the printhead circuitry to render it suitable for receiving, and operating on such a combined print command signal.

On a general level, the concept of combining and multiplexing signals for transmission purposes may appear to be within the normal reach of the skilled person. In the view of the Board, however, it is not trivial to apply such a concept to a cartridge type printhead since it contravenes the design prevailing in such systems, which allocates power and control functions to the printer and only the ink drop

generating mechanism and minimum circuitry to the printhead to keep the printhead as simple as possible.

It must be inferred from document US-A-5 006 864, column 1, lines 52 to 58 and column 15, lines 56 to 61, for example, that a simple, compact, small and light design of the printhead is of importance, contrary to the present invention which requires adding circuit components, or to shift such components from the printer, to the printhead. Similarly, document EP-A-0 405 574 indicates in column 5, lines 23 to 27 that the control system for the printhead should not be complicated and its size not be increased. Increasing the complexity of the printhead is the opposite to what the skilled person would infer from these documents.

Increasing the complexity of the printhead circuitry for reducing the number of control interconnections thus means a deviation from the conventional design of this type of printing systems for which a clear hint in the prior art would be necessary to render the invention obvious in the view of the skilled person. The statement made by the examining division in passing[A1] along the line that the skilled person would balance the advantages of having fewer cable conductors against the disadvantages of increased printhead complexity must, in absence of any valid prior art citation, be dismissed as an inadmissible a posteriori argument.

The invention as defined in claims 1 and 5 is thus not obvious to the skilled person so that the requirement of inventive step as set out in Articles 52(1) and 56 EPC is fulfilled.

Further requirements

5. Finally, the Board is satisfied that the application documents as now amended do not give cause for any other objections which may prejudice the grant of the European patent.

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 with the order to grant a patent in the following version:
Claims 1 to 5, description pages 1 to 13 and drawings Figures 1 to 9, all as submitted at the oral proceedings.

The Registrar:

The Chairman:

M. Kiehl

S. V. Steinbrener