(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 February 2016 (04.02.2016)

WIPO | PCT

(10) International Publication Number
WO 2016/015773 A1

(51) International Patent Classification:
B41J 2/045 (2006.01)

(21) International Application Number:
PCT/EP2014/066541

(22) International Filing Date:
31 July 2014 (31.07.2014)

(25) Filing Language: English

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

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(54) Title: PRINTER DRIVE SIGNAL CONTROL

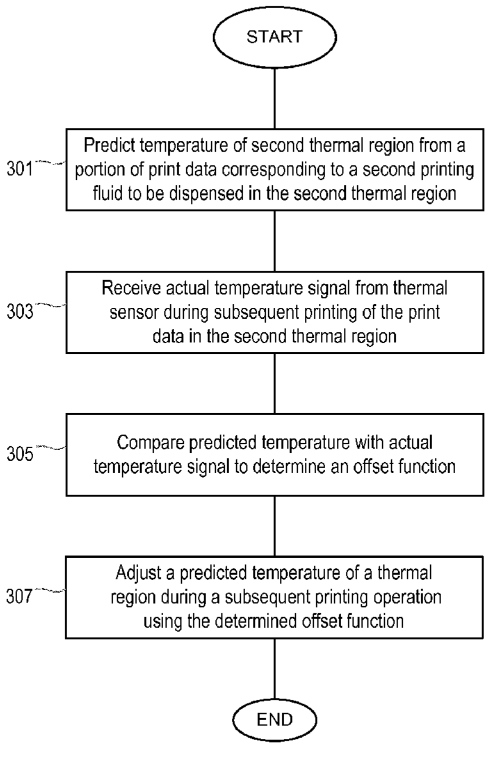

Fig. 3

(57) Abstract: A printer 100 comprises a printhead 101 comprising a plurality of nozzles 103. An input module 105 receives print data containing a specific print pattern corresponding to an image to be printed. A processor module 107 analyses the print data to predict the temperature at a first thermal region of the printhead, the predicted temperature based on a portion of the print data corresponding to a first printing fluid to be dispensed in the first thermal region of the printhead. The processor module 107 controls a first drive signal to fire nozzles in the first thermal region based on the predicted temperature for that first thermal region. A temperature sensor 111 may be provided to sense the temperature of a second thermal regional of the printhead, and wherein the processor module controls a second drive signal to fire nozzles in the second thermal region based on a temperature signal received from the thermal sensor.

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MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Printer Drive Signal Control

In a printer, for example an inkjet printer, a printing process involves droplets of ink being deposited on a print media, such as paper or textile, to form a desired image. The ink droplets, or recording fluid, are ejected from nozzles on a printhead in response to control or drive signals.

In such printers, heating of a printhead can affect the printing process.

Brief description of the drawings

For a better understanding of examples of the present invention, and to show more clearly how the examples may be carried into effect, reference will now be made, by way of example only, to the following drawings in which:

Figure 1 shows an example of a printer;

Figure 2 shows an example of another printer;

Figure 3 shows an example of a calibration method;

Figure 4 shows a method according to another example for controlling a printer drive signal; and

Figure 5 shows an example of another method.

Detailed description

As used herein, the term “ink” includes any form of printing fluid, including colored inks, such as Cyan, Magenta, Yellow and Black, CYMK, or white ink, or any other color ink, and also other liquids which are printed on a print media, such as liquids including biological specimens. Printing fluids may also comprise other forms of fluid, for example a fixer fluid and/or a binder fluid. A fixer fluid is a fluid that may be jetted under and/or over an ink. A fixer fluid for pigment based inks may be designed, for example, to increase chroma and/or optical density.

As mentioned above, inkjet printing is a printing process in which droplets of ink are deposited on a printing media to form a desired image, with the ink droplets being ejected from nozzles on a printhead in response to control or drive signals.

Heating of a printhead die is intrinsic to thermal inkjet (TIJ) technology. When working at high frequencies, if this heat cannot be dissipated in the printing die then the temperature of the material forming the printhead die (for example silicon) can increase, which can result in the print speed having to be reduced in order to reduce the temperature, and/or result in a depletion of the ink being deposited. In some printers, for example, where the number of passes of the printheads across the print media is reduced while also maintaining the image content to print, the firing frequency can increase dramatically. One-pass print modes have been historically used for draft or low quality prints. However in printers such as page wide array printers, which may not have a multi-pass print mode, the requirements for one-pass print modes can be higher than before.

The result of firing a hot printhead die compared to firing a cool printhead die can change the color of a printed image, for example because of drop weight variation, which can degrade image quality.

Some printers operate by ignoring the temperature of a printhead die, and fire the printheads using the same energy, and then modify the drop weight in order to obtain the final color to be printed.

Other printers operate by providing multiple temperature sensors on a printhead for determining the temperature of the printing die during operation of a printer, with the printing process being adapted based on the measured temperature signals.

Figure 1 shows an example of a printer 100. The printer 100 comprises a printhead 101 comprising a plurality of nozzles 103. The printer comprises an input module 105 and a processor module 107. The input module receives print data containing a specific print pattern corresponding to an image to be printed. The processor module 107 analyses the print data to predict the temperature at a first thermal region of the printhead (for example a first thermal region 109_1), the predicted temperature being based on a portion of the print data corresponding to a first printing fluid (for example an ink, such as yellow ink) to be dispensed in the first thermal region 109_1 of the printhead 101. The processor module 107 controls a first drive signal for firing nozzles in the first thermal region 109_1 based on the predicted temperature for the first thermal region 109_1.

It is noted that the processor module 107 may analyse the print data to predict the temperature of at least one additional thermal region (e.g. 109_2 to 109_4 in the example of Figure 1), the predicted temperature of the at least one additional thermal region (109_2 to 109_4) may be based on a respective portion of the print data corresponding to a respective printing fluid to be dispensed in the at least one additional thermal region (109_2 to 109_4) of the printhead.

For example, the additional thermal regions 109_2 to 109_4 shown in the example of Figure 1 may correspond to thermal regions, or channels, where printing fluids corresponding to other inks may be deposited by the printhead. For example, the thermal regions 109_2 to 109_4 may correspond to the channels used for dispensing magenta, cyan and black inks, respectively. It is noted that a printhead 101 may comprise additional thermal regions corresponding to any form of printing fluid.

Thus, in the example of Figure 1, rather than using thermal sensors to monitor the temperature of a printhead, the temperature is predicted in at least one thermal region of the printhead, based on how the nozzles in that thermal region will operate according to the print data (i.e. the portion of the print data that cause the nozzles of that thermal region to fire).

It is also noted that the printer 100 may comprise multiple printheads (e.g. 101_1 to 101_N). In a page wide array printer, for example, the multiple printheads may be arranged across the entire width of the printer. According to one example, each printhead 101_1 to 101_N may be controlled by a common input module 105 and a common processor module 107. According to another example, each printhead 101_1 to 101_N may comprise its own input module and processor module to control the firing of its respective nozzles.

In the example of Figure 1 each thermal region is shown as comprising multiple nozzles 103, for example an array of nozzles 103, for firing a particular printing fluid. It is noted that the nozzles 103 may be arranged in any configuration within a thermal region 109, for example a single row of nozzles, or an array comprising multiple rows of nozzles, or an array where the nozzles are arranged in a staggered manner in multiple rows.

Figure 2 shows another example of a printer 100. The printer 100 comprises a printhead 101. The printhead 101 comprises a plurality of nozzles 103 and a thermal sensor 111. The printer comprises an input module 105 and a processor module 107. As with the example of Figure 1 above, the input module 105 receives print data containing a specific print pattern corresponding to an image to be printed, and the processor module 107 analyses the print data to predict the temperature at a first thermal region of the printhead (for example a first thermal region 109_1), the predicted temperature being based on a portion of the print data corresponding to a first printing fluid (for example an ink, such as yellow ink) to be dispensed in the first thermal region 109_1 of the printhead 101.

The processor module 107 controls a first drive signal for firing nozzles in the first thermal region 109_1 based on the predicted temperature for that first thermal region 109_1.

According to the example of Figure 2, however, a printhead 101 comprises a thermal sensor 111 as mentioned above, for sensing the temperature of a second thermal regional (e.g.109_4) of the printhead. In this example the processor module controls a second drive signal for firing nozzles in the second thermal region 109_4 based on a temperature signal received from the thermal sensor 111.

As noted above in the example of Figure 1, the processor module 107 may analyse the print data to predict the temperature of at least one additional thermal region (e.g. 109_2 and 109_3 in this example of Figure 2), the predicted temperature of the at least one additional thermal region (109_2 and 109_3) based on a respective portion of the print data corresponding to a respective printing fluid to be dispensed in the at least one additional thermal region of the printhead (for example relating to magenta and cyan inks in the example of Figure 2, which are deposited in thermal regions 109_2 and 109_3, respectively).

From the above it can be seen that the example of Figure 2 comprises a combination whereby the temperature of one region (for example a channel where nozzles firing black ink are positioned) is determined from an actual temperature signal from a thermal sensor located at or near that thermal region, while the temperature of at least one other thermal region (for example corresponding to channels where nozzles for firing cyan, magenta and yellow inks are positioned) is predicted based on print data that cause those nozzles to be fired.

The actual and predicted temperature signals can then be used to control drive signals for firing the respective nozzles. For example, dynamic pulse width adjustment can be performed on the respective drive signals, whereby a first drive signal for a first printing fluid (e.g. cyan and/or magenta and/or yellow) is based on a predicted temperature signal for those thermal regions where the nozzles are positioned, and whereby a second drive signal for a second printing fluid (e.g. black) is based on an actual temperature signal for the thermal region where the nozzles for firing the second printing fluid are positioned.

In the example of Figure 2, where a thermal sensor 111 is provided for determining the actual temperature of a particular thermal region, the processor module 107 may calibrate the predicted temperature of the first thermal region (e.g. 109_1) using the temperature signal received from the thermal sensor for the second thermal region (e.g. 109_4).

Figure 3 shows an example of a method for calibrating how a temperature is predicted in one thermal region, based on an actual temperature signal received from a different thermal region. In step 301, the method comprises predicting a temperature of the second thermal region (e.g. thermal region 109_4, which as can be seen from Figure 2, also has an associated thermal sensor) from a portion of the print data corresponding to a second printing fluid (e.g. black) to be dispensed in the second thermal region (e.g. 109_4). In step 303, an actual temperature signal from the thermal sensor 111 is received during subsequent printing of the print data in the second thermal region. In step 305 the predicted temperature is compared with the actual temperature signal to determine an offset function. In step 307, a predicted temperature of a thermal region during a subsequent printing operation is adjusted using the determined offset function.

Therefore, in such an example, the processor module 107 may calibrate the predicted temperature of the first thermal region by: predicting a temperature of the second thermal region from a portion of the print data corresponding to a second printing fluid to be dispensed in the second thermal region; receiving an actual temperature signal from the thermal sensor during subsequent printing of the print data in the second thermal region; comparing the predicted temperature with the actual temperature signal to determine an offset function; and adjusting a predicted temperature of a thermal region during a subsequent printing operation using the determined offset function.

In this way, the presence of a thermal sensor can be used as a type of closed loop feedback signal to adjust how temperatures are predicted.

In one example, the processor module 107 of Figures 1 or 2 may predict the temperature of the first thermal region by receiving print data corresponding to a swath of the printing operation, analyse the print data to determine the firing frequency of nozzles in the first thermal region, and determine the predicted temperature as a function of the firing frequency. The relationship between firing frequency and temperature for a particular printhead may be established, for example, during a training sequence or tests during development of a printhead. According to an example, this may involve counting the expected firing frequency of nozzles in a particular region of the printhead based on the print data, and then estimating how this will affect temperature based on an earlier training sequence. One method of obtaining basic thermal parameters to adjust a function, according to one example, is based on firing a different number of nozzles at different frequencies.

According to one example, a printer may comprise a memory to store a look up table (LUT) comprising the functional relationship between multiple firing frequencies and a corresponding multiple predicted temperatures for a thermal region.

Table 1 shown below provides an example of a look up table that may be used with an example of a printer described herein. In Table 1 the factor “k” represents the slope of heating, as a linear function (degrees per second).

Firing Frequency	Temperature Range	K
0 – 5 KHz	40 – 55 degrees	-3
	55 – 65 degrees	-6
	65 – 70 degrees	-8
	>70 degrees	-10
5 – 10 KHz	40 – 55 degrees	5
	55 – 65 degrees	3
	65 – 70 degrees	1
	>70 degrees	0
15 – 20 KHz	40 – 55 degrees	10
	55 – 65 degrees	7
	65 – 70 degrees	3
	>70 degrees	2
> 20 KHz	40 – 55 degrees	15
	55 – 65 degrees	10
	65 – 70 degrees	7
	>70 degrees	4

Table 1

With such an example, the temperature in a particular region of the printhead can then be predicted, for example using a formula as follows:

Final temp = Max (Initial Temp + k * time, Base Temperature).

For example, if nozzles are being fired for a duration of 0.5 seconds at 25Khz (average firing frequency) and the initial temperature is 55 degrees, the final estimated or predicted temperature after 0.5 seconds will be (using the final section of values in the table above, i.e. the third row from bottom):

Final temp = 55 degrees + (10 deg/sec * 0.5 sec) = 60 degrees.

The appropriate drive signal can then be controlled, for example by selecting an appropriate Pulse Width drive signal, which can then be applied to fire at this temperature. In other words, an appropriate Pulse Width drive signal can be used for a region of a printhead based on the predicted temperature of that region of the printhead being 60 degrees.

If during the next one second time period the printhead is not firing, the final estimated temperature can be determined (using the second row from top in Table 1) as:

Final temp = 60 degrees (i.e. initial or previous temperature) + (-6 deg/sec) * 1 sec = 54 degrees.

The base temperature is referred to as the temperature that is maintained inside the printhead when not firing. It is listed as “base temperature” in the formula above to indicate, for example, that the printhead temperature will not go beyond this point, even if the printhead is not being used.

It is noted that other look up tables with other functional relationships may also be used in the examples described herein. It is also noted that different tables may be used for different thermal regions of a printhead.

The training sequence or tests help determine how the firing frequency of nozzles in a particular area or thermal region cause the temperature of the printhead to change in that thermal region.

Figure 4 shows a method, according to another example, in a printer that receives a printhead comprising a plurality of nozzles. The method comprises receiving print data containing a specific print pattern corresponding to an image to be printed, step 401. In step 403, the print data is analysed to predict the temperature at a first thermal region of the printhead, the predicted temperature based on a portion of the print data corresponding to a first printing fluid to be dispensed in the first thermal region of the printhead. A first drive signal is controlled to fire nozzles in the first thermal region based on the predicted temperature for that first thermal region, step 405.

In one example, controlling the first drive signal may comprise adjusting a pulse width of a drive signal used to fire a nozzle or a plurality of nozzles in the first thermal region.

In an example where a printhead comprises a thermal sensor, the method may comprise receiving a temperature signal from a thermal sensor provided on the printhead for sensing the temperature of a second thermal regional of the printhead, and controlling a second drive signal to fire nozzles in the second thermal region based on the received temperature signal.

In one example, controlling the second drive signal may comprise adjusting a pulse width of a drive signal used to fire a nozzle or a plurality of nozzles in the second thermal region.

The method may also comprise calibrating the predicted temperature of the first thermal region using the temperature signal received from the thermal sensor for the second thermal region.

According to one example, the method may comprise predicting the temperature of the first thermal region by receiving print data corresponding to a swath of the printing process, analysing the print data to determine the firing frequency of nozzles in the first thermal region, and determining the predicted temperature as a function of the firing frequency.

From the examples described herein it can be seen that the number of thermal sensors provided on a printhead may be reduced, for example from one per colorant to just one for all colorants in the example of Figure 2, or removed completely as shown in the example of Figure 1. According to some examples, this may have the advantage of reducing the cost and complexity of a printhead.

The use of a single temperature sensor in the example of Figure 2 allows an accurate temperature for each colorant trench to be acquired, for example by enabling any temperatures which are predicted to be calibrated using the physical temperature sensor.

This calibration process thereby provides a form of closed loop feedback signal for enabling at least one of the predicted temperatures to be checked and verified against an actual temperature signal, such that at least one predicted temperature may be adjusted accordingly.

In such an example there are effectively first and second drive signals that may be controlled, for example by controlling their pulse widths. For example a pulse width of a drive signal for one thermal region, such as for a channel corresponding to a black printing fluid, can be dynamically changed, while a second drive signal for a second thermal region, for example for at least one of a color ink corresponding to a channel for a cyan, magenta or yellow (CYM) color channel, for example, can be dynamically controlled in a different way, for example with a different pulse width adjustment.

Some examples therefore provide a method to be able to estimate those CMY thermal region temperatures, and then applying Dynamic Pulse Width Adjustment (DPWA) in order to minimize wasted heat, thereby providing improved thermal efficiency of the printhead die. Some examples help improve image quality (IQ) by reducing intra die temperature variations, which can allow printhead speed to be increased due to the improved thermal efficiency.

The examples enable accurate thermal data from a printhead to be provided, which may enable dynamic pulse width adjustment to be applied more accurately.

According to some examples, the need to slow down the printing speed in order to avoid the consequences of poor temperature data can be reduced, or can avoid having to reduce the firing frequency in order to work in a more stable way. The examples are therefore suitable for applications having fast printing speeds, for example based on current product and consumer requirements.

According to an example, a pulse width of a drive signal for nozzles in the color slots can be reduced according to a table that consist of predicted temperatures looking ahead at the data to be printed. Then, the temperature of the printhead, instead of being determined from a sensor inside the printhead, is provided by the printing pipeline after analyzing the image content swath by swath before printing.

In the examples a pulse width of a drive signal applied to fire the printhead can be modified based on image processing, or a combination of image processing and an actual temperature signal. In order to calculate a firing pulse a look-up-table can be used for the temperature, for example, based on a training sequence carried out during a development phase.

The examples enable manufacturing costs to be reduced, and improve printhead footprint without affecting Image Quality because of the reduction of sensors inside the die. Where a thermal sensor is provided, the examples utilise temperature signals from such a thermal sensor to monitor real temperature and close the temperature loop.

Decreasing the pulse width of drive signals can, in some examples, also increase the reliability of a printhead, because the printhead is not being overheated unnecessarily, which in turn can reduce warranty costs.

An example comprises dynamically controlling a printhead by analyzing image data and predicting temperature on a swath by swath basis prior to printing.

Although the examples refer to controlling a drive signal by controlling a pulse width of a drive signal, it is noted that a drive signal may be controlled in other ways in order to control how a printing fluid is ejected or fired from a nozzle.

According to another example, there is provided a printhead for a printer. The printhead comprises a plurality of nozzles. The nozzles in at least one thermal region of the printhead are controlled based on a predicted temperature of the at least one thermal region, based on print data relating to an image to be printed.

Figure 5 shows a method according to another example, in a printer comprising at least one printhead, the at least one printhead comprising a thermal sensor and a plurality of nozzles for ejecting multiple printing fluids. The method comprises receiving a temperature signal from the thermal sensor, step 501, the temperature signal corresponding to a first thermal region of the printhead. In step 503 the temperature of at least a second thermal region of the printhead is predicted, the predicted temperature based on print data relating to an image to be printed by nozzles in the second thermal region. In step 505 a first drive signal is controlled to fire a first set of nozzles in the first thermal region based on the received temperature signal. In step 507 a second drive signal is controlled to fire a second set of nozzles in the at least second thermal region based on the predicted temperature signal.

In the examples described herein, a printhead may comprise a die made, for example, from silicon, or any other material.

It should be noted that the above-mentioned examples illustrate rather than limit the disclosure herein, and that those skilled in the art will be able to design many alternative examples without departing from the scope of the appended claims. The word “comprising” does not exclude the presence of elements or steps other than those listed in a claim, “a” or “an” does not exclude a plurality, and a single processor or other unit may fulfil the functions of several units recited in the claims. Any reference signs in the claims shall not be construed so as to limit their scope.

CLAIMS

1. A printer comprising:

a printhead comprising a plurality of nozzles;

an input module to receive print data containing a specific print pattern corresponding to an image to be printed; and

a processor module to analyse the print data to predict the temperature at a first thermal region of the printhead, the predicted temperature based on a portion of the print data corresponding to a first printing fluid to be dispensed in the first thermal region of the printhead; and

wherein the processor module is to control a first drive signal to fire nozzles in the first thermal region based on the predicted temperature for the first thermal region.

2. A printer as claimed in claim 1, comprising a thermal sensor to sense the temperature of a second thermal regional of the printhead, and wherein the processor module is to control a second drive signal to fire nozzles in the second thermal region based on a temperature signal received from the thermal sensor.

3. A printer as claimed in claim 2, wherein the processor module is to calibrate the predicted temperature of the first thermal region using the temperature signal received from the thermal sensor for the second thermal region.

4. A printer as claimed in claim 3, wherein the processor module is to calibrate the predicted temperature of the first thermal region by:

predicting a temperature of the second thermal region from a portion of the print data corresponding to a second printing fluid to be dispensed in the second thermal region;

receiving an actual temperature signal from the thermal sensor during subsequent printing of the print data in the second thermal region;

comparing the predicted temperature with the actual temperature signal to determine an offset function; and

adjusting a predicted temperature of a thermal region during a subsequent printing operation using the determined offset function.

5. A printer apparatus as claimed in claim 1, wherein the processor module is to predict the temperature of the first thermal region by receiving print data corresponding to a swath of the printing operation, analyse the print data to determine the firing frequency of nozzles in the first thermal region, and determine the predicted temperature as a function of the firing frequency.

6. A printer as claimed in claim 5, comprising a memory to store a look up table comprising the functional relationship between multiple firing frequencies and a corresponding multiple predicted temperatures for a thermal region.

7. A printer as claimed in claim 1 or 2, wherein the processor module is to analyse the print data to predict the temperature of at least one additional thermal region, the predicted temperature of the at least one additional thermal region based on a respective portion of the print data corresponding to a respective printing fluid to be dispensed in the at least one additional thermal region of the printhead.

8. A printer as claimed in claim 1, wherein a thermal region comprises an array of nozzles for printing a printing fluid.

9. A printer as claimed in claim 1, wherein the processor module is to control a drive signal by adjusting a pulse width of the drive signal.

10. A method in a printer that receives a printhead comprising a plurality of nozzles, the method comprising:

receiving print data containing a specific print pattern corresponding to an image to be printed;

analysing the print data to predict the temperature at a first thermal region of the printhead, the predicted temperature based on a portion of the print data corresponding to a first printing fluid to be dispensed in the first thermal region of the printhead; and

controlling a first drive signal to fire nozzles in the first thermal region based on the predicted temperature for that first thermal region.

11. A method as claimed in claim 10 comprising:

receiving a temperature signal from a thermal sensor provided on the printhead to sense the temperature of a second thermal regional of the printhead; and

controlling a second drive signal to fire nozzles in the second thermal region based on the received temperature signal.

12. A method as claimed in claim 11, comprising calibrating the predicted temperature of the first thermal region using the temperature signal received from the thermal sensor for the second thermal region.

13. A method as claimed in claim 10 comprising predicting the temperature of the first thermal region by receiving print data corresponding to a swath of the printing process, analysing the print data to determine the firing frequency of nozzles in the first thermal region, and determining the predicted temperature as a function of the firing frequency.

14. A method as claimed in claim 10 comprising controlling the drive signal by adjusting a pulse width of the drive signal.

15. A method in a printer comprising at least one printhead, the at least one printhead comprising a thermal sensor and a plurality of nozzles for ejecting multiple printing fluids, the method comprising:

receiving a temperature signal from the thermal sensor, the temperature signal corresponding to a first thermal region of the printhead;

predicting the temperature of at least a second thermal region of the printhead, the predicted temperature based on print data relating to an image to be printed by nozzles in the second thermal region; and

controlling a first drive signal to fire a first set of nozzles in the first thermal region based on the received temperature signal; and

controlling a second drive signal to fire a second set of nozzles in the at least second thermal region based on the predicted temperature signal.

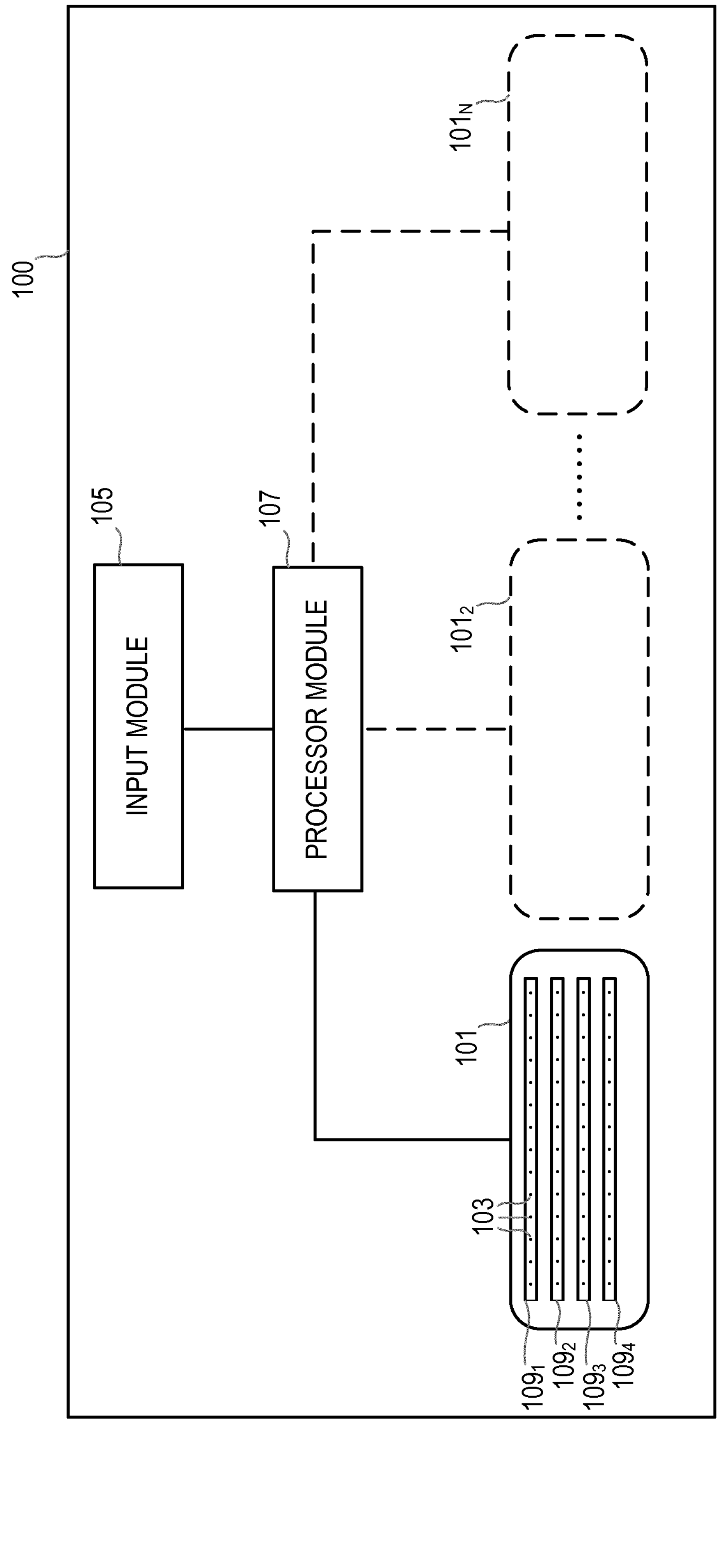
100
105
INPUT MODULE
107
PROCESSOR MODULE
101
103
109₁
109₂
109₃
109₄
101₂
101N

Fig. 1

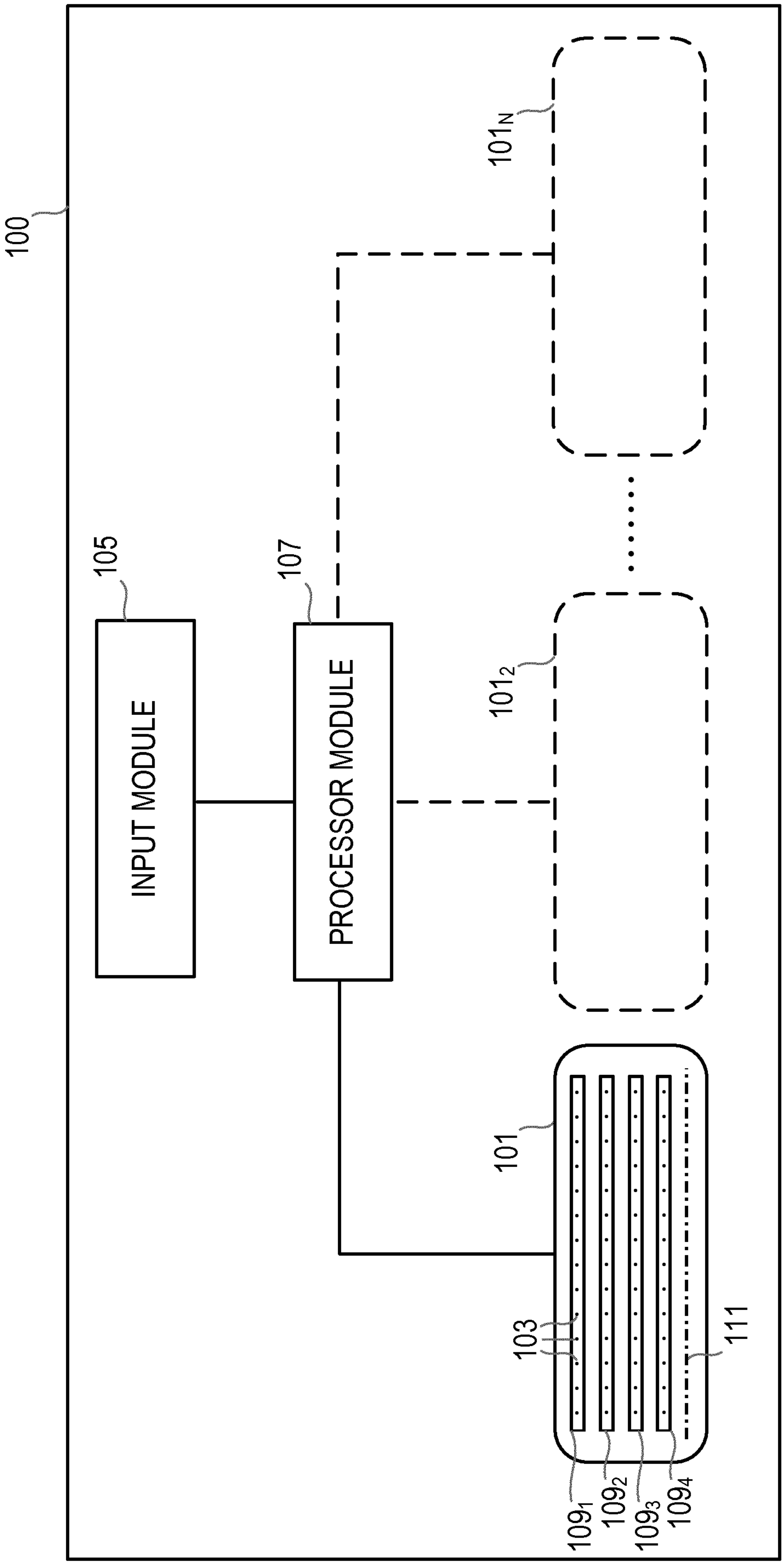
100
105
INPUT MODULE
107
PROCESSOR MODULE
101
101_2
101_N
103
111
109_1
109_2
109_3
109_4

Fig. 2

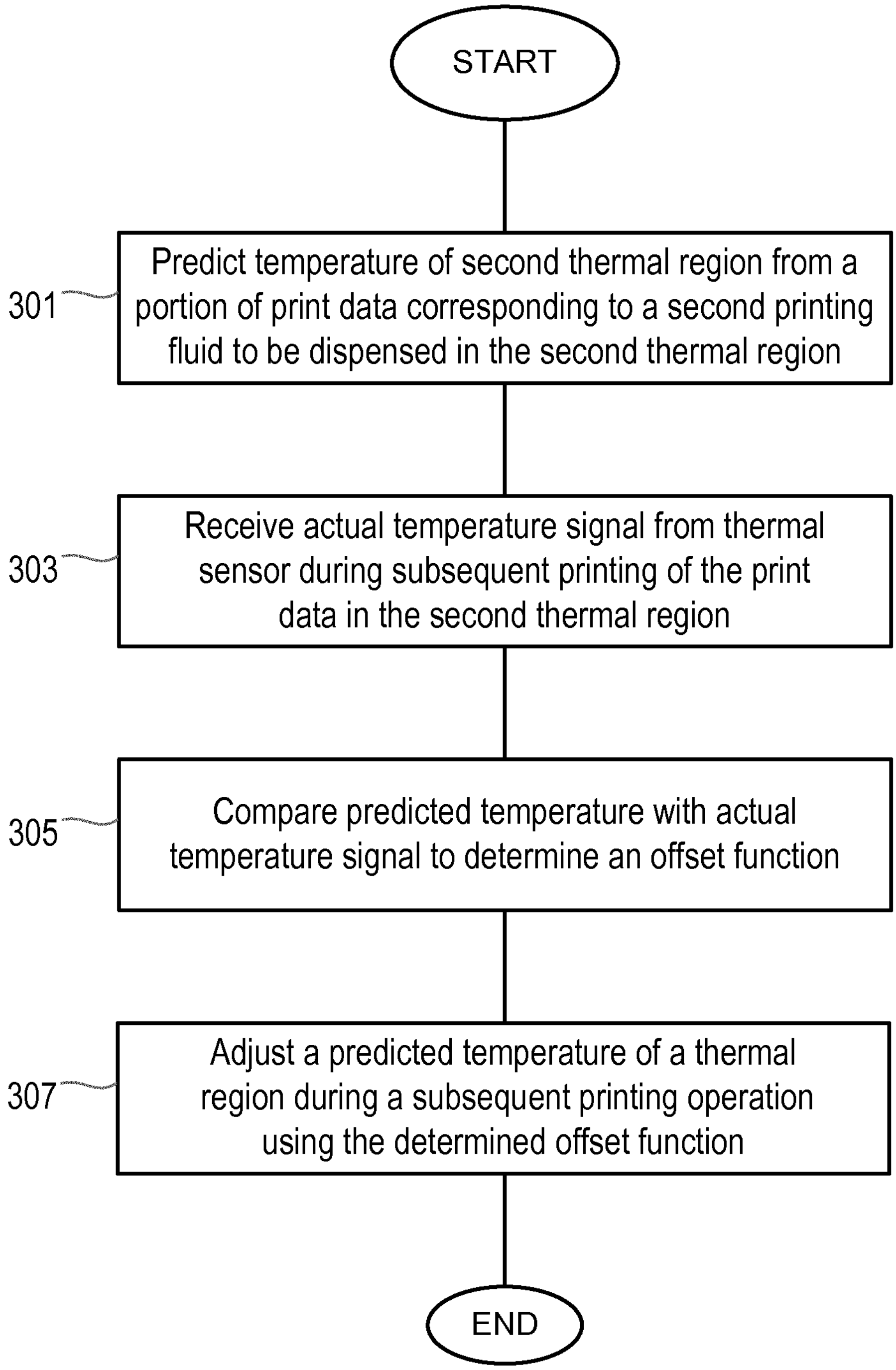
START
301
Predict temperature of second thermal region from a portion of print data corresponding to a second printing fluid to be dispensed in the second thermal region
303
Receive actual temperature signal from thermal sensor during subsequent printing of the print data in the second thermal region
305
Compare predicted temperature with actual temperature signal to determine an offset function
307
Adjust a predicted temperature of a thermal region during a subsequent printing operation using the determined offset function
END

Fig. 3

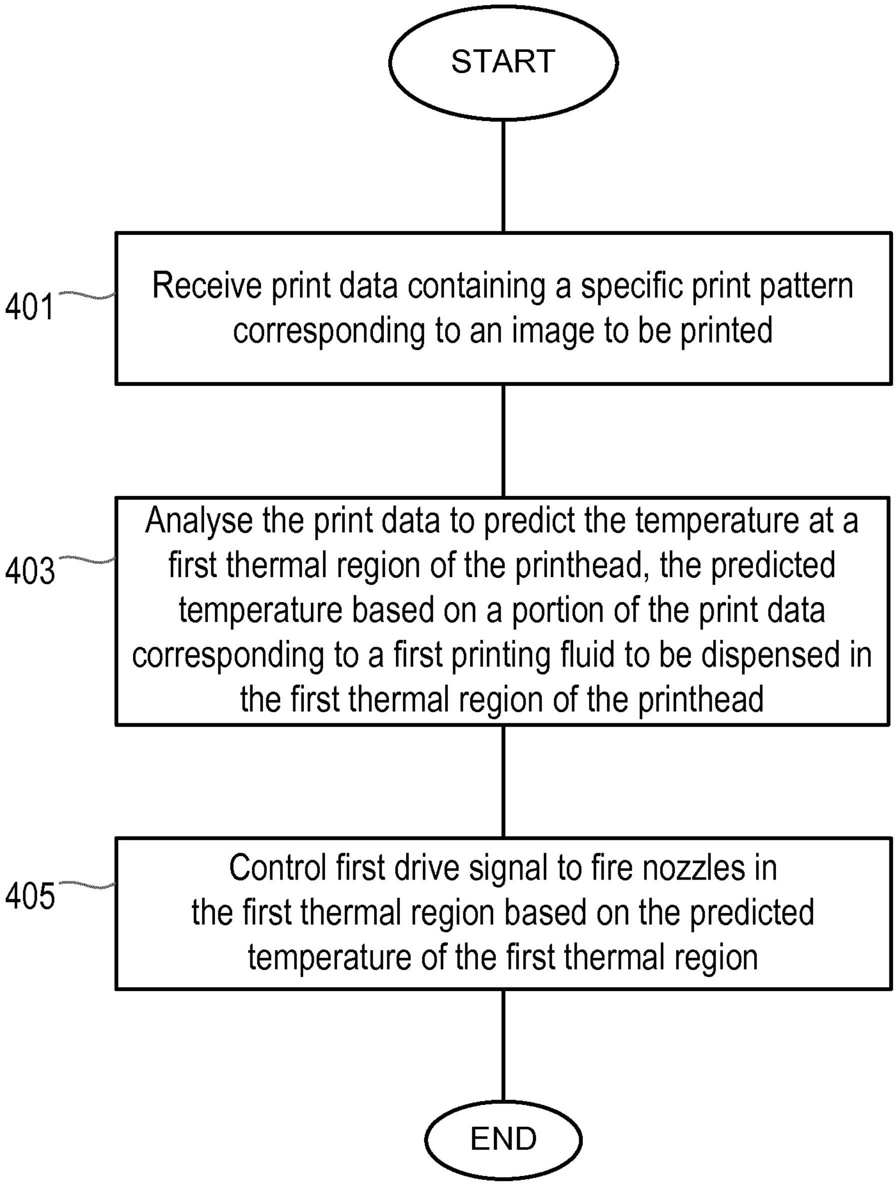
START
401
Receive print data containing a specific print pattern corresponding to an image to be printed
403
Analyse the print data to predict the temperature at a first thermal region of the printhead, the predicted temperature based on a portion of the print data corresponding to a first printing fluid to be dispensed in the first thermal region of the printhead
405
Control first drive signal to fire nozzles in the first thermal region based on the predicted temperature of the first thermal region
END

Fig. 4

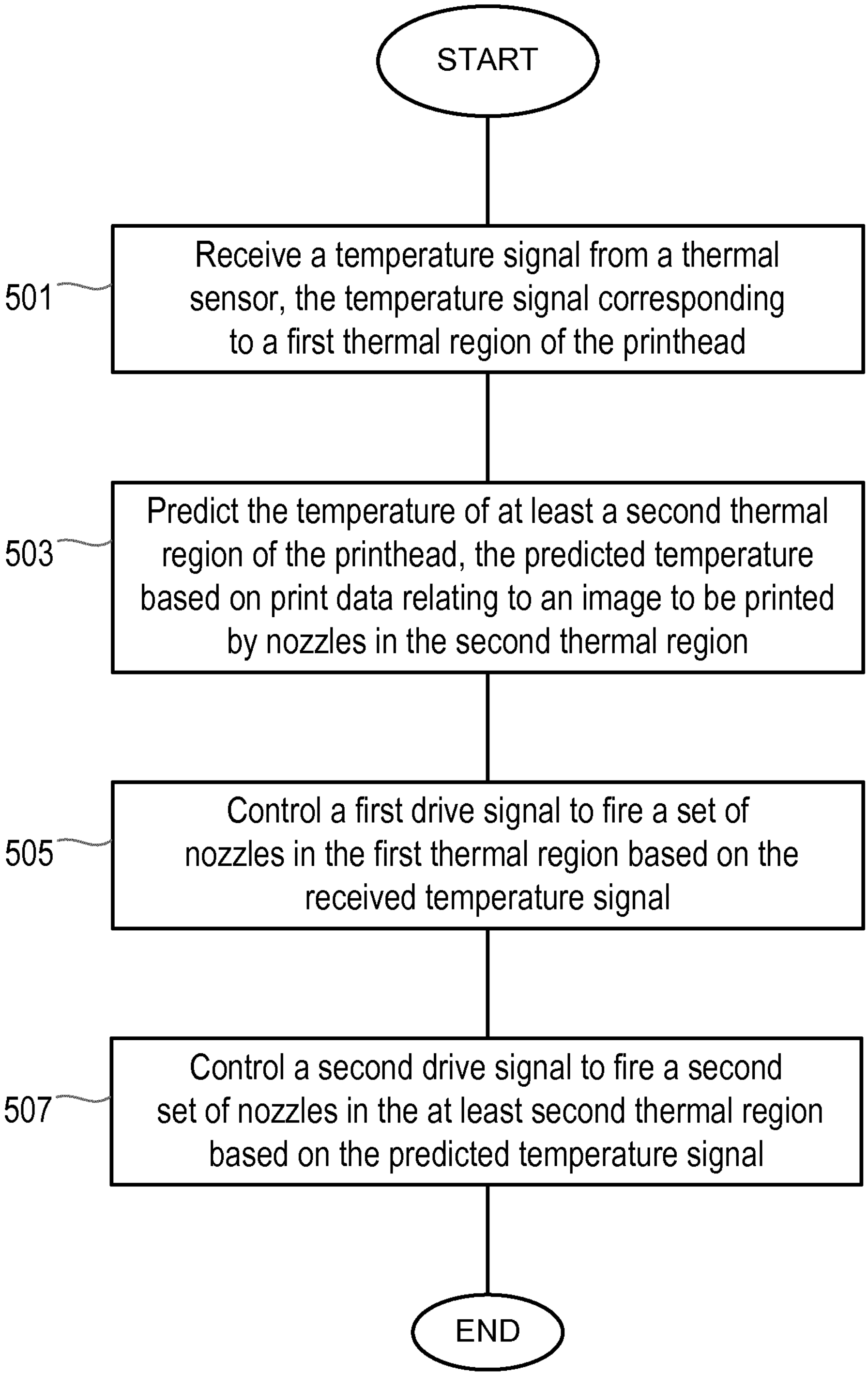
START
501
Receive a temperature signal from a thermal sensor, the temperature signal corresponding to a first thermal region of the printhead
503
Predict the temperature of at least a second thermal region of the printhead, the predicted temperature based on print data relating to an image to be printed by nozzles in the second thermal region
505
Control a first drive signal to fire a set of nozzles in the first thermal region based on the received temperature signal
507
Control a second drive signal to fire a second set of nozzles in the at least second thermal region based on the predicted temperature signal
END

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/066541

A. CLASSIFICATION OF SUBJECT MATTER
INV. B41J2/045
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	column 26, line 31 - column 28, line 60	2,11,12, 15

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Y	paragraphs [0029], [0036], [0038], [0039]	4,12

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2015	02/04/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bardet, Maude

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/066541

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No
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