UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CANON U.S.A., INC., AND CANON INC.,

Petitioners,

v.

SLINGSHOT PRINTING LLC,

Patent Owner.

Case No. IPR2023-00312

Patent No. 7,484,823

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,484,823

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TABLE OF CONTENTS

Page

I. INTRODUCTION 1

II. MANDATORY NOTICES 1

III. IDENTIFICATION OF CLAIMS AND GROUNDS 2

IV. CERTIFICATION AND FEES 4

V. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION 4

VI. LEVEL OF SKILL 6

VII. CLAIM CONSTRUCTION 6

A. "Adjacent" 6

VIII. GROUND 1: BENJAMIN IN VIEW OF GIERE673 RENDERS OBVIOUS CLAIMS 1-3, 5-13, AND 15-17 7

A. Claims 1 and 11 7

1. 1[P] "A chip…" 7

2. 1[A] "a first heater array … first via" 10

3. 1[B] "a second heater array … a second via" 17

4. 1[C] "a region…" 19

5. 1[D] "a temperature sensing element operable to sense a temperature of the region …" 21

6. 1[E] "substantially centrally disposed … and substantially adjacent … and further extends substantially the length" 31

7. 1[F] "operable to receive heating responsive to the temperature of the region …" 33

8. 1[G] "a third heater array… second via" 36

9. 1[H] "a fourth heater array… a third via" 38

10. 1[I] "a second region …" 40

11. 1[J] "a second temperature sensing element …" 42

12. 1[K] "substantially centrally disposed … and substantially adjacent" 42

TABLE OF CONTENTS
(continued)

Page

13. 1[L] "operable to receive heating responsive to the temperature of the second region …. 43

B. Claim 2 44

C. Claims 3 and 13 44

D. Claims 5 and 15 45

E. Claims 6 and 16 46

F. Claim 7 48

G. Claim 8 50

H. Claims 9 and 17 52

I. Claim 10 53

J. Claim 12 54

K. Ample Motivation Existed to Make the Combination 54

IX. GROUND 2: BENJAMIN AND GIERE673 IN FURTHER VIEW OF PARISH RENDERS CLAIMS 4 AND 14 OBVIOUS 59

A. Claims 4 and 14 59

B. Ample Motivation Existed to Modify the Benjamin-Giere673 Combination in View of Parish 59

X. GROUND 3: BENJAMIN IN VIEW OF GIERE178 RENDERS OBVIOUS CLAIMS 1-3, 5-13, AND 15-17 62

A. Claim 1 64

1. 1[P]-1[C], 1[G]-1[I] 64

2. 1[D]-[F] "a temperature sensing element … operable to sense a temperature of the region … [and] substantially centrally disposed … and substantially adjacent … and … substantially the length of … heater array[s]" 64

3. 1[J]-1[L] 70

B. Claim 2 70

C. Claims 3 and 13 70

TABLE OF CONTENTS
(continued)

Page

D. Claims 5 and 15 71
E. Claims 6 and 16 71
F. Claim 7 73
G. Claim 8 75
H. Claims 9 and 17 75
I. Claim 10 75
J. Claim 12 75
K. Ample Motivation Existed to Make the Combination 76
XI. GROUND 4: YABE IN VIEW OF GIERE673 RENDERS OBVIOUS CLAIMS 1-3, 5-10, 11-13, AND 15-17 78
A. Claims 1 and 11 78
1. 1[P] "A chip" 78
2. 1[A] "a first heater array…first via" 79
3. 1[B] "a second heater array…second via" 84
4. 1[C] "a region" 85
5. 1[D]-[F] "a temperature sensing element … operable to sense a temperature of the region … [and] substantially centrally disposed … and substantially adjacent … and … substantially the length of … heater array[s]" 88
6. 1[G] "a third heater array…second via" 100
7. 1[H] "a fourth heater array…third via" 101
8. 1[I] "a second region …" 102
9. 1[J]-[K] "a second temperature sensing element…" 103
10. 1[L] "… operable to receive heating responsive to the temperature of the [second] region…" 105
B. Motivation to Combine Yabe and Giere673 105
C. Claim 2 111
D. Claims 3 and 13 112

TABLE OF CONTENTS
(continued)

Page

E. Claims 5 and 15 112
F. Claims 6 and 16 112
G. Claim 7 114
H. Claim 8 115
I. Claims 9 and 17 116
J. Claim 10 116
K. Claim 12 117
XII. GROUND 5: YABE AND GIERE673 IN FURTHER VIEW OF PARISH RENDERS CLAIMS 4 AND 14 OBVIOUS 117
A. Claims 4 and 14 117
B. Motivation to Combine Yabe and Giere673 and Further in View of Parish 118
XIII. SECONDARY CONSIDERATIONS 119
XIV. CONCLUSION 119
U.S. PATENT NO. 7,484,823 – LISTING OF CHALLENGED CLAIMS 120
CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS 124
CERTIFICATE OF SERVICE 125

TABLE OF AUTHORITIES

Page(s)

Cases

Apple Inc. v. RFCyber Corp.,
IPR2022-00412, Paper 11 (PTAB July 21, 2022) 4

Canon USA, Inc. et al. v. Slingshot Printing LLC,
IPR2023-00313 1

Canon USA, Inc. et al. v. Slingshot Printing LLC,
IPR2023-00313, Paper 2 (PTAB Jan. 21, 2023) 3

Slingshot Printing LLC v. Canon U.S.A., Inc. et al.,
Case No. 2:22-cv-01852, Dkt. 42 (E.D.N.Y. Dec. 1, 2022) 3

Slingshot Printing LLC v. Canon U.S.A., Inc., et al.,
No. 2:22-cv-01852 (E.D.N.Y.) 1

Slingshot Printing LLC v. HP, Inc.,
Case No. 1:20-cv-00186-ADA, Dkt. 82 (W.D.T.X. Jan. 14, 2021) 3

Slingshot Printing LLC v. HP Inc.,
No. 6-19-cv-00549 1

Thryv, Inc. v. Click-To-Call Techs., LP,
140 S. Ct. 1367 (2020) 6

Statutes

35 U.S.C. §§ 102 and 103 2

35 U.S.C. § 102(b) 2, 3

35 U.S.C. § 102(e) 2, 3

35 U.S.C. § 311 1

Other Authorities

37 C.F.R. 42.6(4) 125

37 C.F.R. 42.24(a)(1)(i) 124

37 C.F.R. 42.24(d) 124

37 C.F.R. § 42.100 et seq. 1

EXHIBIT LIST

Exhibit Number	Exhibit Description
Ex. 1001	U.S. Patent No. 7,484,823 to Barkley *et al.*
Ex. 1002	Declaration of Stephen F. Pond, Ph.D.
Ex. 1003	File History of U.S. Patent 7,484,823
Ex. 1004	U.S. Patent No. 7,384,113 to Benjamin *et al.* ("Benjamin")
Ex. 1005	U.S. Patent No. 6,612,673 to Giere *et al*. ("Giere673")
Ex. 1006	U.S. Patent No. 7,163,272 to Parish *et al*. ("Parish")
Ex. 1007	U.S. Patent No. 6,565,178 to Giere *et al*. ("Giere178")
Ex. 1008	U.S. Patent No. 6,527,367 to Yabe ("Yabe")
Ex. 1009	U.S. Patent No. 5,808,640 to Bhaskar *et al.* ("Bhaskar")
Ex. 1010	U.S. Patent No. 6,488,363 to Torgerson *et al.* ("Torgerson")
Ex. 1011	U.S. Patent No. 6,082,854 to Axtell *et al.* ("Axtell")
Ex. 1012	Excerpts of Prior Art Dictionaries – Adjacent
Ex. 1013	Oxford English Dictionary, Second Edition (2005)
Ex. 1014	U.S. Patent No. 7,131,714 to Edelen *et al.* ("Edelen")
Ex. 1015	U.S. Patent No. 6,357,863 to Anderson *et al.* ("Anderson")
Ex. 1016	U.S. Patent No. 6,382,773 to Chang *et al.* ("Chang")

Exhibit Number	Exhibit Description
Ex. 1017	Daniel A. Kearl & Michael S. Ard, Low-Cost Plain Paper Color Inkjet Printing, Hewlett-Packard J. 43, No. 4, 64 (1992)
Ex.1018	William A. Buskirk et al., Development of a High-Resolution Thermal Inkjet Printhead, Hewlett-Packard J. 39, No. 5, 55 (1988)
Ex.1019	U.S. Patent No. 7,278,703 to Benjamin *et al.* ("Benjamin703")
Ex. 1020	*Curriculum Vitae* of Stephen F. Pond, Ph.D.
Ex. 1021	Order Granting Stay of *Slingshot Printing LLC v. Canon U.S.A., Inc. et al*., Case No. 2:22-cv-01852, Dkt. 42 (E.D.N.Y. Dec. 1, 2022)
Ex. 1022	Letter Requesting Extension of Temporary Stay of *Slingshot Printing LLC v. Canon U.S.A., Inc. et al*., Case No. 2:22-cv-01852, Dkt. 43 (E.D.N.Y. Dec. 27, 2022)
Ex. 1023	Order granting Motion to Stay (Dkt. 43) in *Slingshot Printing LLC v. Canon U.S.A., Inc. et al*., Case No. 2:22-cv-01852 (E.D.N.Y. Dec. 27, 2022)
Ex. 1024	Case Management Schedule for *Slingshot Printing LLC v. Canon U.S.A., Inc. et al.*, Case No. 2:22-cv-01852, Dkt. 36-1 (E.D.N.Y. Nov. 2, 2022)
Ex. 1025	Slingshot LLC's Infringement Contentions for *Slingshot Printing LLC v. Canon U.S.A., Inc. et al.*, Case No. 2:22-cv-01852, (E.D.N.Y.)
Ex. 1026	Claim Construction Order for *Slingshot Printing LLC v. HP, Inc.*, Case No. 1:20-cv-00186-ADA, Dkt. 82 (W.D.T.X. Jan. 14, 2021)

Exhibit Number	**Exhibit Description**
Ex. 1027	*Canon USA, Inc. et al. v. Slingshot Printing LLC*, IPR2023-00313, Paper 2 (PTAB Jan. 21, 2023)

I. INTRODUCTION

Pursuant to 35 U.S.C. § 311 and 37 C.F.R. § 42.100 et seq., Petitioners request *Inter Partes* Review ("IPR") of claims 1-17 ("Challenged Claims") of U.S. Patent No. 7,484,823 ("'823 Patent," Ex.1001), purportedly owned by Slingshot Printing LLC ("Patent Owner").

II. MANDATORY NOTICES

Real Party-in-Interest: The real parties-in-interest are **Canon U.S.A., Inc.** and **Canon Inc.**

Related Matters: The '823 Patent was asserted against Petitioner Canon U.S.A., Inc. and Canon Solutions America, Inc. in *Slingshot Printing LLC v. Canon U.S.A., Inc., et al.*, No. 2:22-cv-01852 (E.D.N.Y.), filed on April 1, 2022. The '823 Patent was previously asserted against HP Inc. in *Slingshot Printing LLC v. HP Inc.*, No. 6-19-cv-00549, reassigned as No. 1:20-00189 (W.D. Tex.), which was dismissed with prejudice on March 24, 2021, following the parties' joint stipulation of dismissal. Petitioners are not aware of the '823 Patent being asserted against other parties. Petitioner also challenged U.S. Patent No. 7,594,708, a patent related to the '823 Patent, in *Canon USA, Inc. et al. v. Slingshot Printing LLC*, IPR2023-00313.

Lead Counsel: Dion M. Bregman (Reg. No. 45,645); Back-up Counsel: Amanda S. Williamson (Reg. No. 73,683) and Jason E. Gettleman (Reg. No. 55,202).

Service: Service of any documents may be made to Morgan, Lewis & Bockius LLP, 1400 Page Mill Road, Palo Alto, CA, 94304 (Telephone: 650.843.4000; Fax: 650.843.4001). Petitioners consent to e-mail service at: CanonSlingshotIPRs@morganlewis.com.

III. IDENTIFICATION OF CLAIMS AND GROUNDS

'823 Patent: The '823 Patent, filed on December 30, 2005, has an earliest possible priority date of **December 30, 2005**. It is subject to the pre-AIA provisions of 35 U.S.C. §§ 102 and 103.

Benjamin: U.S. Patent No. 7,384,113 titled "Fluid Ejection Device with Address Generator" to Benjamin *et al*. ("Benjamin"; Ex.1004) was filed on **April 19, 2004** and published on June 10, 2008. It is prior art under 35 U.S.C. § 102(e).

Giere673: U.S. Patent No. 6,612,673 titled "System and Method for Predicting Thermal Conditions of an Inkjet Printing System" to Giere *et al.* ("Giere673"; Ex.1005) was filed on **April 29, 2002** and published **September 2, 2003**. It is prior art under 35 U.S.C. § 102(b).

Parish: U.S. Patent No. 7,163,272 titled "Inkjet Print Head" to Parish *et al.* ("Parish"; Ex.1006) was filed on **June 10, 2004** and published January 16, 2007. It is prior art under 35 U.S.C. § 102(e).

Giere178: U.S. Patent No. 6,565,178 titled "Temperature Measurement Device" to Giere *et al.* ("Giere178"; Ex.1007) was filed on **October 29, 2001** and published **May 20, 2003**. It is prior art under 35 U.S.C. § 102(b).

Yabe: U.S. Patent No. 6,527,367 titled "Ink Jet Recording Head and Ink Jet Recording Apparatus" to Yabe ("Yabe"; Ex.1008) was filed on **September 4, 2001** and published on **March 4, 2003**. It is prior art under 35 U.S.C. § 102(b).

Petitioners request that the Board find each of the Challenged Claims invalid on the following grounds:

Ground	Prior Art	Statutory Basis	Claims
1	Benjamin and Giere673	§ 103	1-3, 5-12, 13, 15-17
2	Benjamin, Giere673, and Parish	§ 103	4, 14
3	Benjamin and Giere178	§ 103	1-3, 5-13, 15-17
4	Yabe and Giere673	§ 103	1-3, 5-13, 15-17
5	Yabe, Giere673, and Parish	§ 103	4, 14

In his Declaration accompanying this Petition, Dr. Pond provides a thorough summary of the '823 Patent (Ex.1002, ¶¶47-59), the prior art (Ex.1002, ¶¶60-107), and the relevant technology at issue (Ex.1002, ¶¶22-46).

IV. CERTIFICATION AND FEES

Petitioners certify that the '823 Patent is available for IPR and that Petitioners are not barred or estopped from requesting this IPR on the grounds identified herein.

Any additional fees may be charged to Deposit Account No. 50,0310 (Order No. 132261-00-0003).

V. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

The PTAB should not discretionarily deny institution per *Fintiv* because the Petition is particularly strong in the underlying merits. *See, e.g.*, *Apple Inc. v. RFCyber Corp*., IPR2022-00412, Paper 11 at 33-34 (PTAB July 21, 2022); Interim Procedure for Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director's Memorandum, 9 (June 21, 2022).

Moreover, the stage of the parallel district court litigation does not support denying institution based on the *Fintiv* factors:

Factor 1 favors institution because the district court has granted a temporary stay and will extend that stay upon the filing of this Petition. Exs. 1021-1023.

Factor 2 favors institution because the district court litigation is in its early stage with **no trial date set**. Trial cannot occur until **after** the last date set in the parties' Case Management Schedule, i.e., **October 25, 2024**. Ex.1024, 2. Moreover, the median time to trial in EDNY is 48.9 months (~4 years) such that the final written decision will be issued well before any trial date.

Factor 3 favors institution because the litigation was stayed in the early stages (e.g., no claim construction or dispositive motions have been filed). Exs. 1021-1024.

Factor 4 favors institution because Petitioners challenge every claim asserted in the litigation and multiple claims that have not been asserted (claims 4, 7, and 14). *See* Ex.1025 (asserting claims 1-3, 5-6, 8-13, and 15-17). Further, the invalidity contentions include some prior art cited in this Petition making it more efficient for the Board to handle the overlapping prior art.

Factor 5 is neutral because Petitioner Canon U.S.A., Inc. is a defendant in the district court litigation, but Petitioner Canon Inc. is not a party to that litigation.[1]

Factor 6 favors institution and is **dispositive** under the Guidance because the **unpatentability challenges here are compelling** and **rely on references that**

[1] Canon Solutions America, Inc. in the litigation is not a real-party-in interest here.

were not before the Office. This IPR is the only challenge to the '823 Patent that has been before the Board, which favors institution, and there is a strong public interest against "leaving bad patents enforceable." *Thryv, Inc. v. Click-To-Call Techs., LP*, 140 S. Ct. 1367, 1374 (2020).

Because all *Fintiv* factors favor institution or are neutral, Petitioners respectfully request that the Board decline discretionarily denying review.

VI. LEVEL OF SKILL

A person having ordinary skill in the art ("PHOSITA") at the time of the alleged invention would have been a person holding a Bachelor's or Master's level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and two years of training or experience in the design of inkjet printheads or semiconductor circuit layout. Ex.1002, ¶¶108-110.

VII. CLAIM CONSTRUCTION

A. "Adjacent"

As used in the '823 Patent, the term adjacent means "next to and can include," such that a region disposed adjacent each heater array can also include that heater array. This is consistent with the '823 Patent claims and specification describing regions that are next to, and can include, heater arrays. Ex.1001, 7:66 ("pulses are applied to heaters within each region"); 7:47-50 ("heaters used in each region"). This construction is also consistent with claims of the related '708 Patent. Ex.1027

(IPR2022-0313, Paper 2), 6-8. Specifically, claims 1 and 9 of the '708 Patent effectively require that any "region between two adjacent ink vias" be both "adjacent" to and "include" the same two heater arrays. Ex.1002, ¶21.

VIII. Ground 1: Benjamin in view of Giere673 Renders Obvious Claims 1-3, 5-13, and 15-17

A. Claims 1 and 11[2]

1. 1[P] "A chip…"

If the preamble is deemed limiting, it is disclosed by Benjamin.

Benjamin discloses a "an inkjet printing system 20"—*e.g.,* an inkjet printer or other printing device—that comprises, among other things, "one printhead or **printhead die 40**"[3] (*magenta*) that "causes characters, symbols, and/or other graphics or images to be printed upon [a] print medium 36" (*orange*) "such as paper," and an "electronic controller" (*green*) that controls the printhead die 40 and

[2] The limitations of claim 11 mirror those of claim 1, and therefore are disclosed by Benjamin-Giere673 for the same reasons as Claim 1. Ex.1002¶¶226-227. A full claim listing can be found in the Appendix.

[3] Emphasis in text and colored annotations in figures added throughout unless otherwise stated.

"defines a pattern of ejected ink drops that form characters, symbols, and/or other graphics or images on print medium 36." Ex.1004,3:32-33; Ex.1002, ¶¶112-118.

Ex.1004, Fig.1

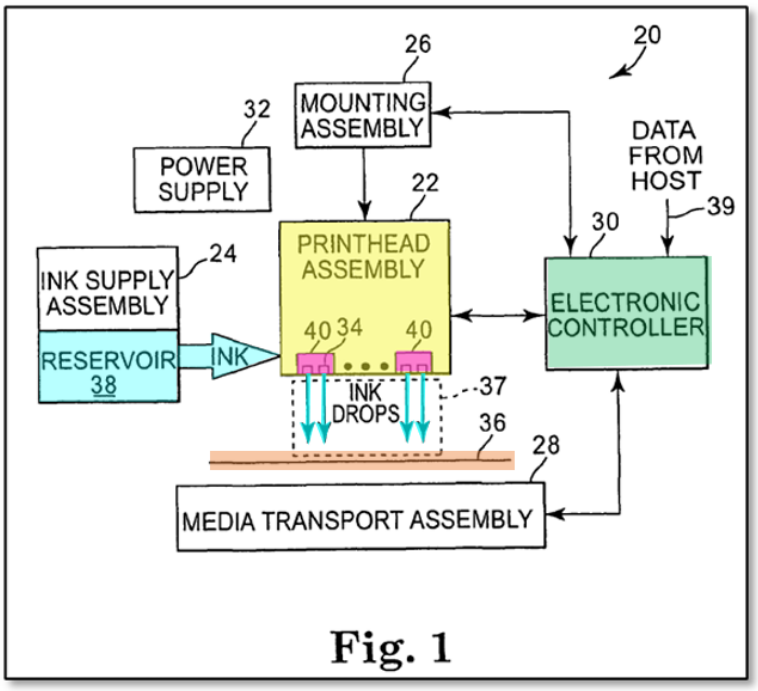
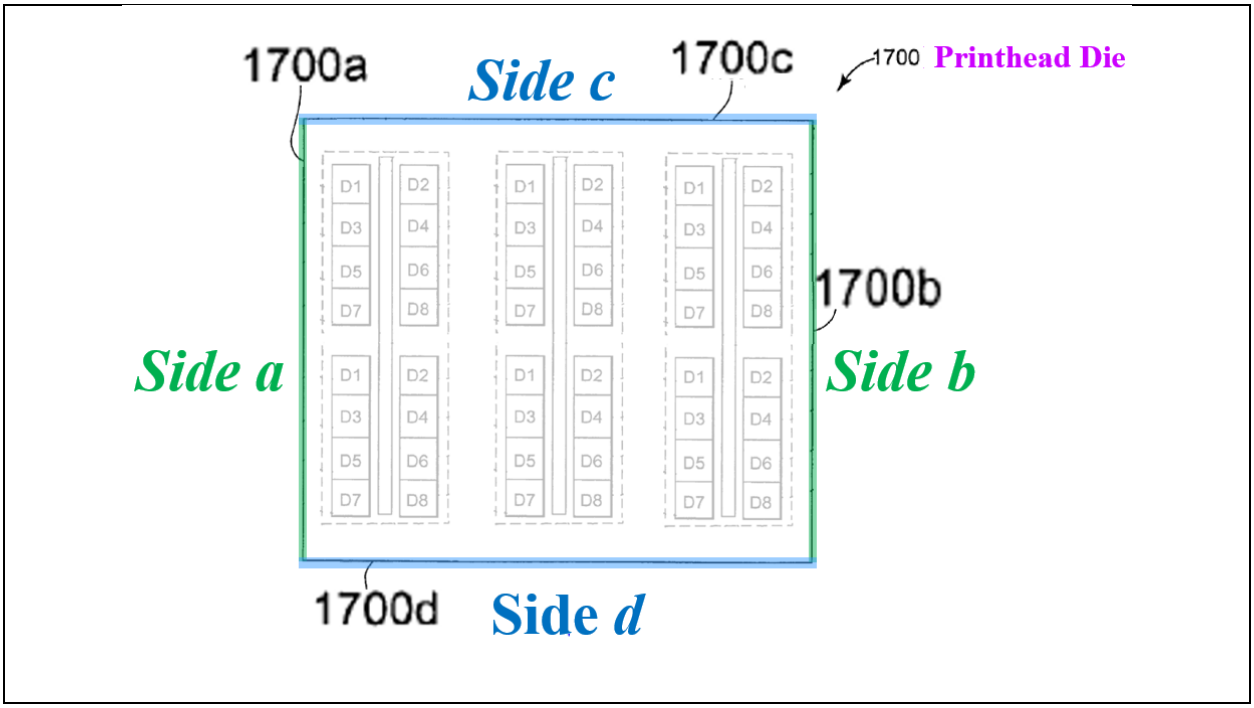


Fig. 1

The printhead die 1700 has a left and right edge (e.g., side 1700a and 1700b, *green below*) and top and bottom edge (side 1700c and 1700d, *blue*), each of which converges with another edge to form a distinct corner of the printhead die 1700. Ex.1004, 69:67-70:3; Ex.1002, ¶115.

Ex.1004, Fig.21(Modified)



Since the term "die" is another name for a chip,[4] a PHOSITA would have understood that Benjamin's printhead die 40 is a "chip for use with a printing device." Ex.1001, 1:21-26 (admitting that prior art printers included a chip on the printhead along with ink vias and heaters located next to the ink vias—"[a] number of printers, copiers, and multi-function products utilize **heater chips in their printheads** for discharging ink drops from one or more ink vias.").

Accordingly, Benjamin discloses "a chip [e.g., printhead die 1700] for use with a printing device [e.g., inkjet printing system such as an inkjet printer]." Ex.1002, ¶¶112-118.

[4] *See* https://en.wikipedia.org/wiki/Die_(integrated_circuit).

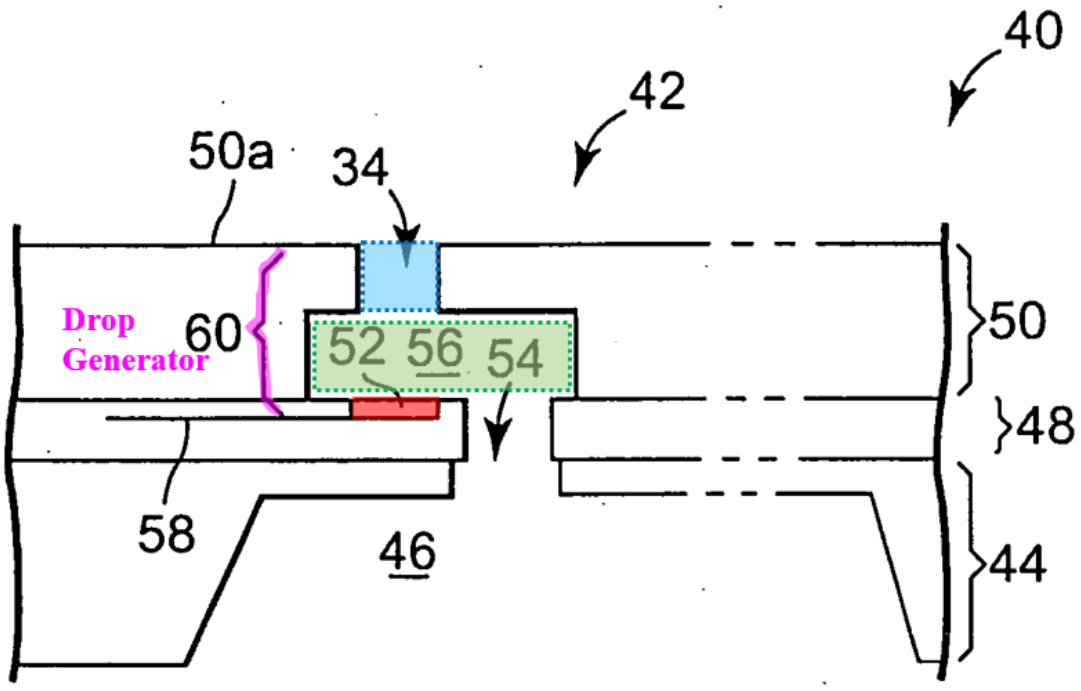
2. 1[A] "a first heater array … first via"

Benjamin discloses 1[A]. Ex.1002, ¶¶119-133.

Like a "typical thermal inkjet printing system," the printhead die "eject[s] ink drops through nozzles [34, *purple*] by ***rapidly heating*** small volumes of ink located in vaporization chambers [56]" which "causes the ink to vaporize and be ejected through the nozzles." Ex.1004, 1:32-38; Ex.1002, ¶116.

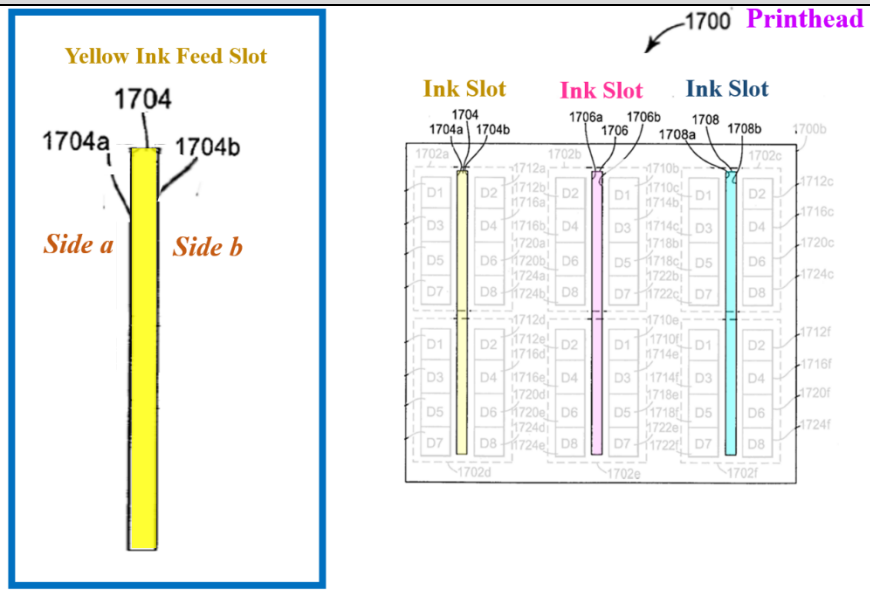
Referring to Figure 2 below, Benjamin teaches that "the ink is heated with **small electric heaters**, such as thin film resistors referred to herein as **firing resistors** [52, *red*]," which together with the vaporization chamber 56 [*outlined in green]* and nozzle opening 34 [*blue*] collectively form a drop generator 60 [*annotated in purple*]. *Id.* "The firing resistors 52 of drop generators 60 are energized in a controlled sequence to eject fluid from vaporization chambers 56 and through nozzles 34 to print an image on print medium 36." *Id.*

Ex.1004, Fig. 2



Benjamin's printhead die 1700 includes three ink feed slots 1704, 17056, and 1708—the "ink feed slot 1704 supplies yellow colored ink, ink feed slot 1706 supplies magenta colored ink and ink feed slot 1708 supplies cyan colored ink." Ex.1004, 65:25-34. Each ink feed slot has **two longitudinal sides**—longitudinal side "a" and longitudinal side "b"—that extend along the y-direction of the printhead die 1700—*e.g.,* the yellow "ink feed slot 1704 includes opposing sides 1704 *a* and 1704 *b* that extend along the y-direction of printhead die 1700," Ex.1004, 65:34-39 (same for magenta and cyan); Ex.1002, ¶123.

Ex.1004, Fig.21(simplified)

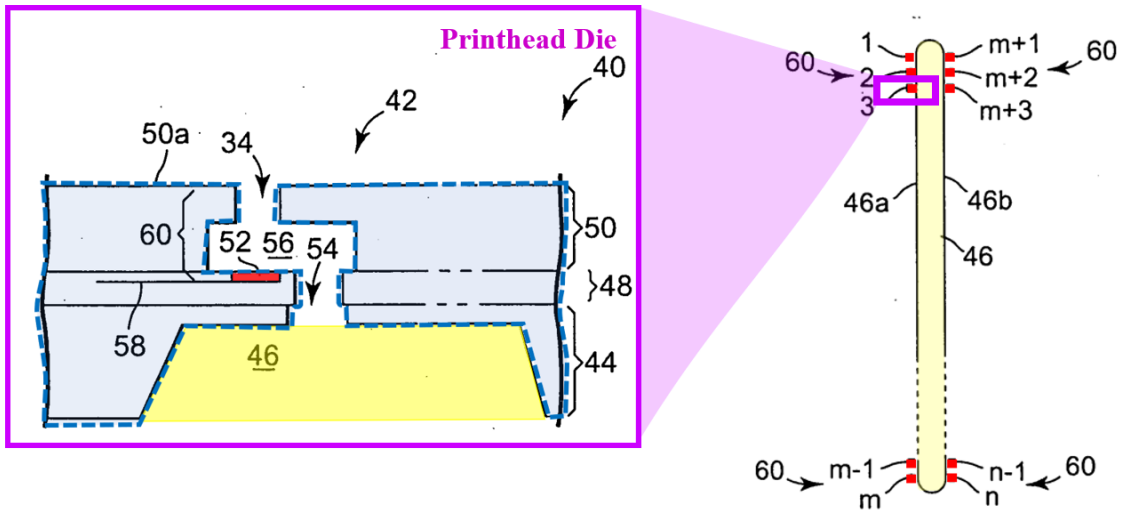


Each ink feed slot is fluidically coupled to a column of [ink] drop generators 60 [*purple below*] disposed adjacent to each longitudinal side of the ink feed slots. Ex.1004, 5:53-54; Ex.1002, ¶121. "A drop generator 60 [*purple*] as referred to herein includes **firing resistor 52** [*red*], nozzle chamber or vaporization chamber 56 [*green*] and nozzle opening 34 [*blue*]." Ex.1004, 5:11-14.

Specifically, Benjamin teaches that "an **array of printing or fluid ejecting elements 52**" [*red*] are "formed on a substrate 44" [*blue below*] with an "ink feed slot 46 [*yellow*] formed therein." Ex.1004, 4:57-61; Fig. 2.. "[I]nk feed slot 46 provides a supply of liquid ink to printing elements 42" through, for example,

"corresponding individual ink feed holes feeding corresponding vaporization chambers and multiple shorter ink feed trenches that each feed corresponding groups of fluid ejecting elements." Ex.1004, 4:61-5:1.

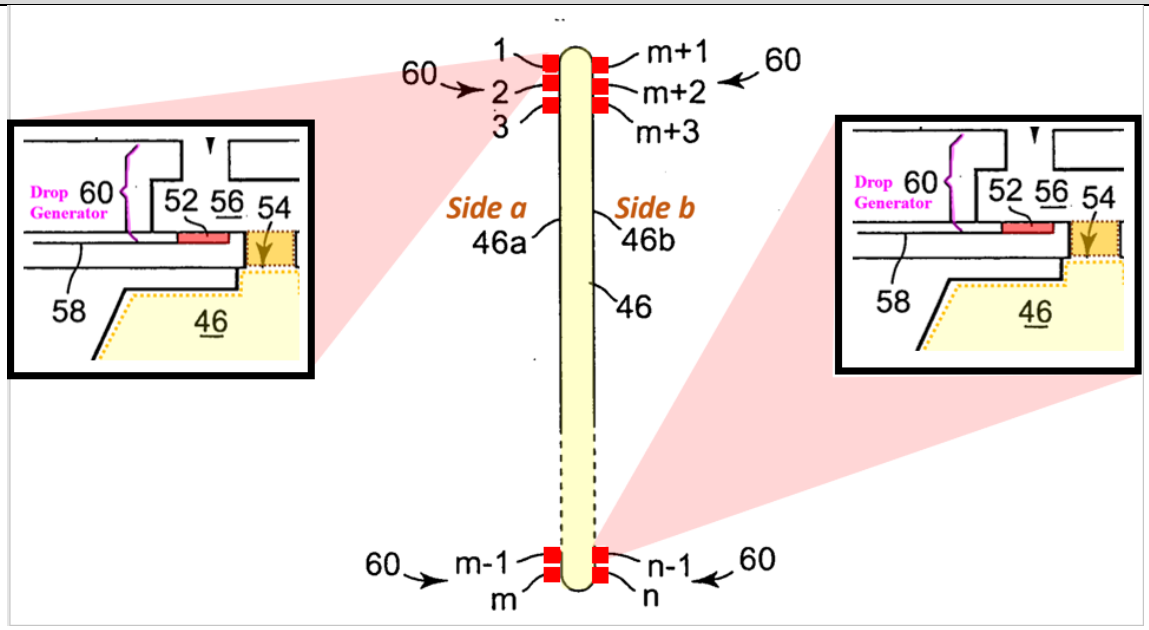
Ex.1004, Figs.2,3



"During printing, ink flows from ink feed slot 46 [*yellow in Figure 2 below*] to vaporization chamber 56 **via ink feed channel 54**," and "nozzle opening 34 [*blue*] is operatively associated with firing resistor 52 such that droplets of ink within vaporization chamber 56 are ejected through nozzle opening 34 (e.g., substantially normal to the plane of firing resistor 52) and toward print medium 36 upon energizing of firing resistors 52." Ex.1004, 5:3-30.

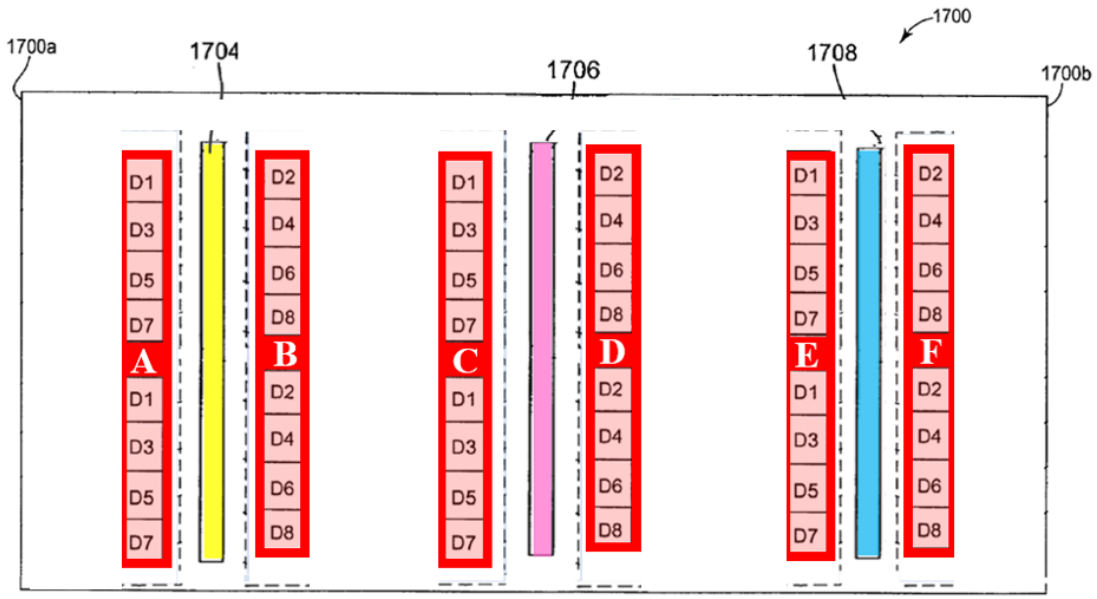
Benjamin discloses that "[a] firing resistor 52 [*red*] is positioned within vaporization chamber 56 and leads 58 electrically couple firing resistor 52 to circuitry controlling the application of electrical current through selected firing resistors." Ex.1004, 5:8-14; Ex.1002, ¶122. "During printing, ink flows from ink feed slot 46 to vaporization chamber 56 via ink feed channel 54," and thereafter "[n]ozzle opening 34 is operatively associated with firing resistor 52 such that droplets of ink within vaporization chamber 56 are ejected through nozzle opening 34 (e.g., substantially normal to the plane of firing resistor 52) and toward print medium 36 **upon energizing of firing resistor 52**." Ex.1004, 5:15-21.

Ex.1004, Figs.2,3



Benjamin teaches that each ink via is associated with two heater arrays, creating "six fire groups 1702a-1702f ***disposed along*** [the] three ink fluid feed sources." Ex.1004, 63:21-24, 64:66-65. "The fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8 and that "[e]ach data line group D1-D8 includes **pre-charged firing cells 120** from each of the fire groups 1702a-1702f." Ex.1004, 63:39-42.

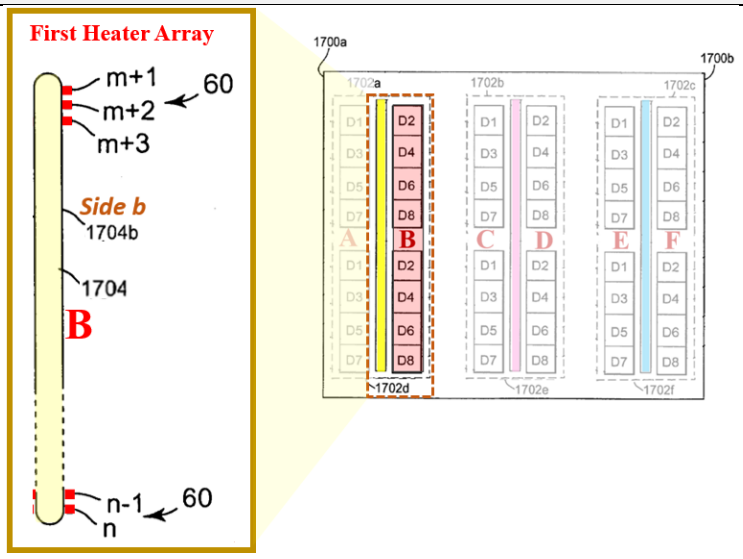
Ex.1004, Fig.21(simplified)



For example, Benjamin's printhead die 1700 includes a first array of firing resistors 52 (*e.g.*, Heater Array B) from the drop generators 60 associated with side 1704b of the yellow ink feed slot 1704—*e.g.*, "[t]he drop generators 60 in FG1 1702*a*

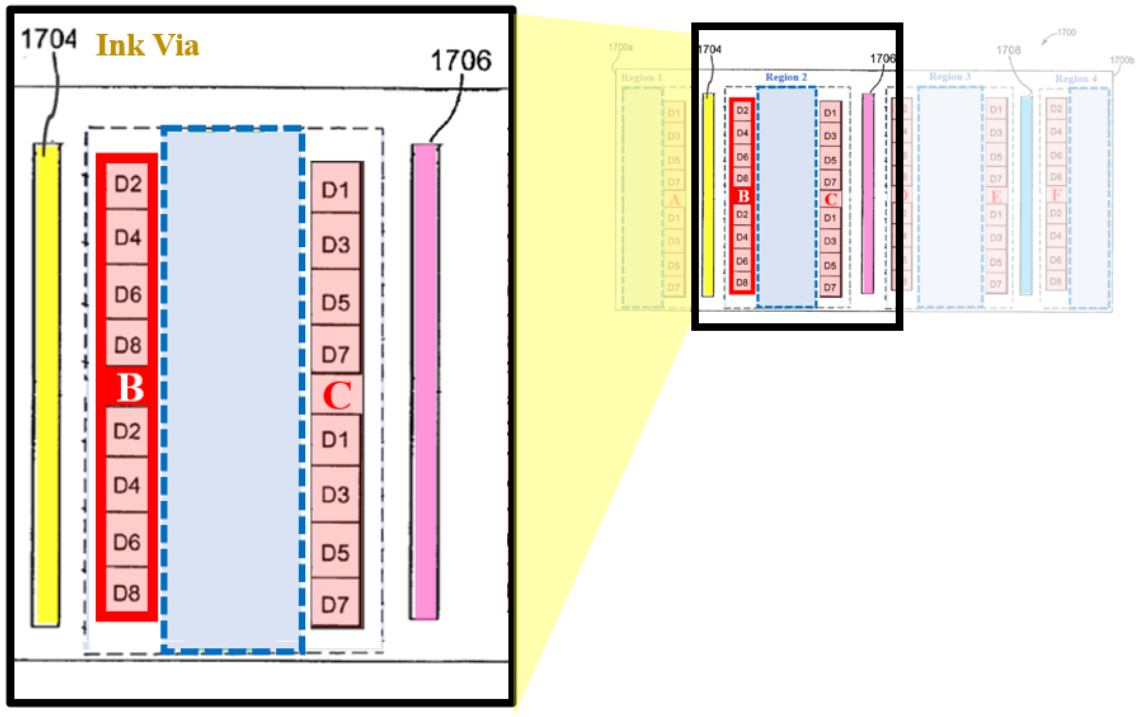
[and in FG4 1702*d*] are disposed along each of the opposing sides 1704 a and 1704 b of ink feed slot 1704." Ex.1004, 66:36-67:8; Ex.1002, ¶124

Ex.1004, Figs.3,21



Heater Array B is disposed next to the yellow ink feed slot 1704, and therefore, substantially adjacent the Yellow Ink Via. Ex.1002, ¶127.

Ex.1004, Fig.21(simplified)



Accordingly, Benjamin discloses "a first heater array [e.g., Heater Array B] positioned substantially adjacent a first via [e.g., positioned next to the Yellow Ink Via]." Ex.1002, ¶128.

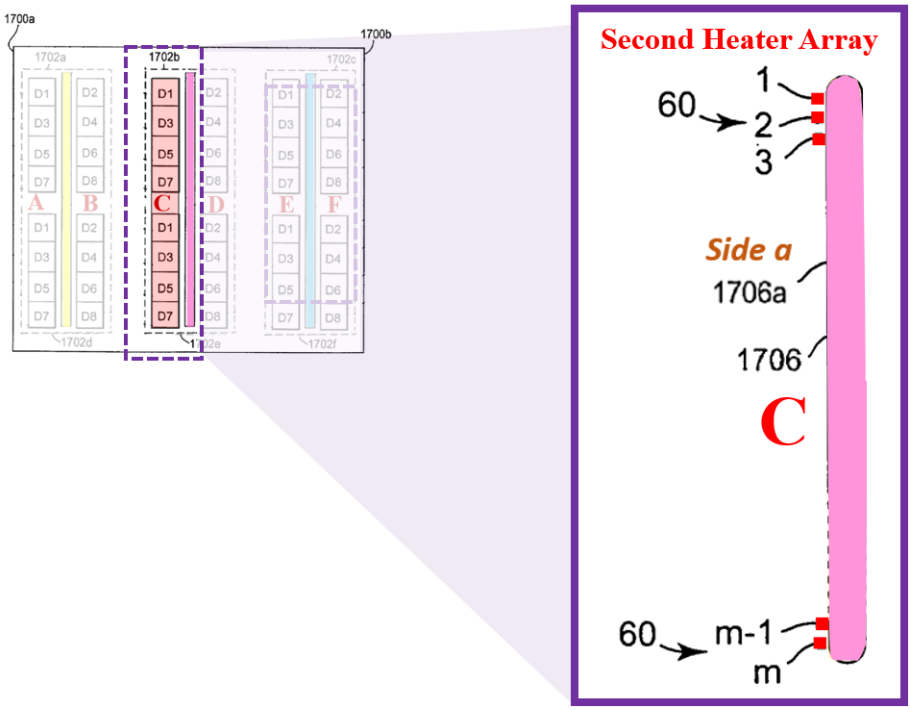
3. 1[B] "a second heater array … a second via"

Benjamin discloses 1[B]. Ex.1002, ¶¶129-133.

The printhead die 1700 includes a second array of firing resistors 52 (*e.g.*, Heater Array C) from the drop generators 60 associated with side 1706a of the magenta ink feed slot 1706—"[t]he drop generators 60 in FG2 1702*b* [and in FG4

1702*e*] are disposed along each of the opposing sides 1706 a and 1706 b of ink feed slot 1706." Ex.1004, 66:36-67:8; Ex.1002, ¶¶130-131.

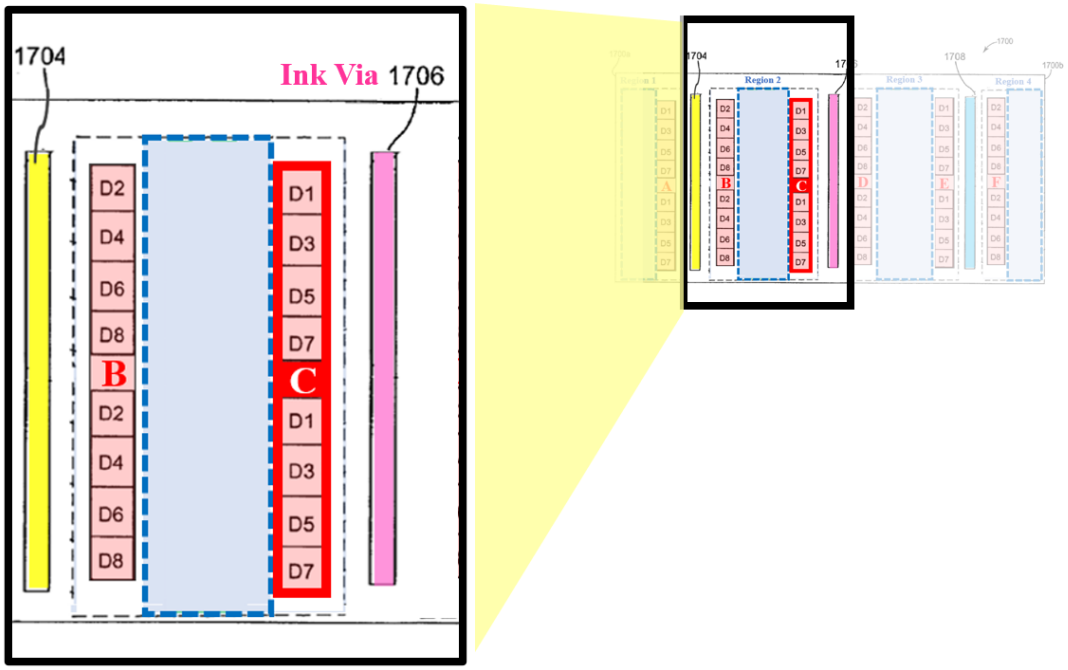
Ex.1004, Fig.21(simplified)



Heater Array C is disposed next to the magenta ink feed slot 1706, and therefore, substantially adjacent the Magenta Ink Via. Ex.1002, ¶132.

.

Ex.1004, Figs.3,21



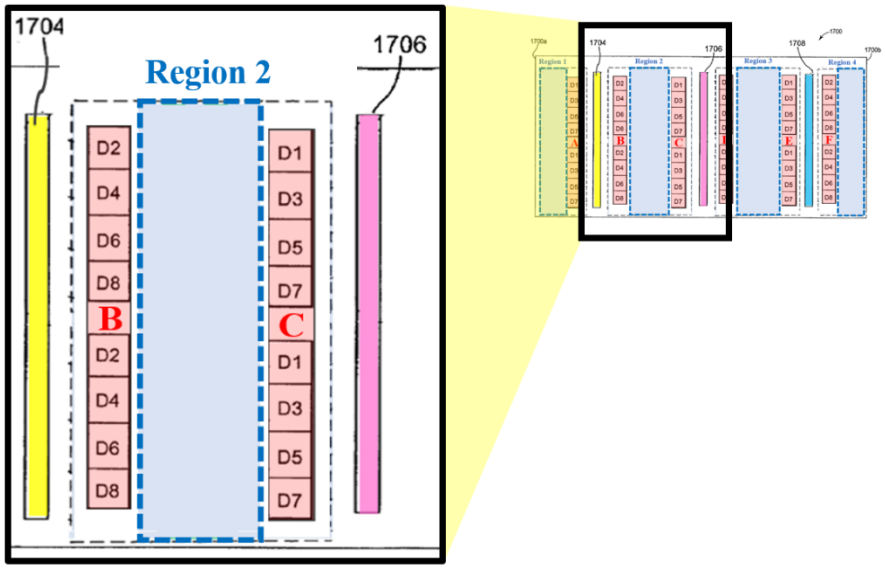
Accordingly, Benjamin discloses "a second heater array [e.g., Heater Array C] positioned substantially adjacent a second via [e.g., positioned next to the Magenta Ink Via]." Ex.1002, ¶133.

4. 1[C] "a region…"

Benjamin discloses 1[C]. Ex.1002, ¶¶134-137.

Benjamin's Printhead Die 1700 includes a first region [*e.g.*, Region 2, *blue below*] positioned between Heater Array C and Heater Array D (*red*).[5] Ex.1002, ¶135.

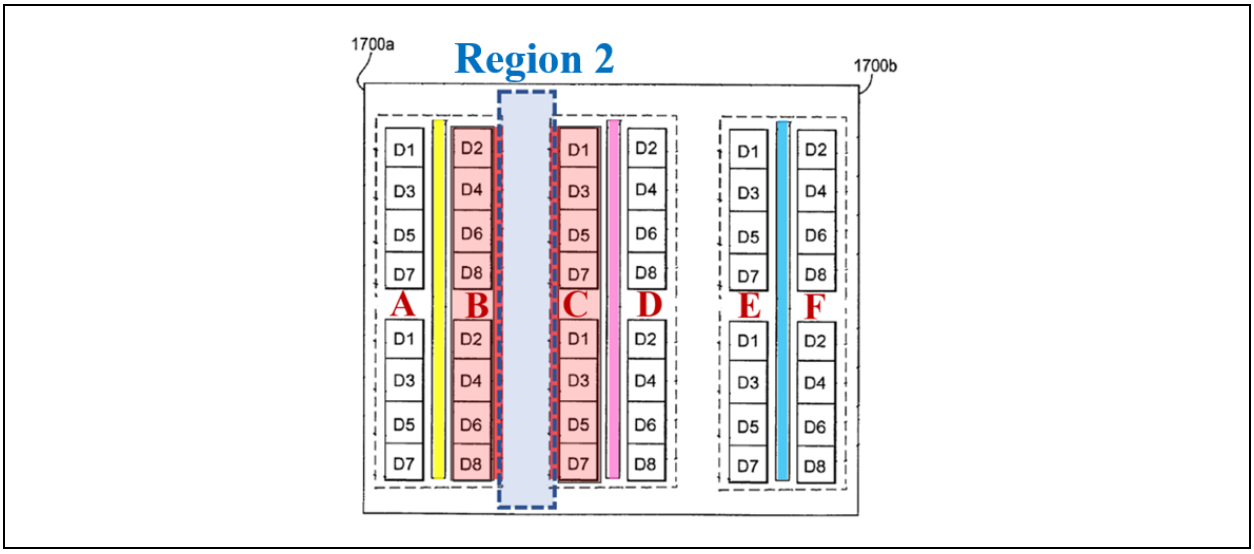
Ex.1004, Fig.21(simplified)



Region 2 of Printhead Die 1700 is also positioned next to (and can include) both Heater Array B and C, and therefore, is substantially adjacent each heater array. Ex.1002, ¶¶136.

Ex.1004, Fig.21

[5] A POSITA relying on *patent figures* to show the region's location with respect to the ink vias and arrays is consistent with how the '823 Patent illustrates these relationships. *See, e.g.*, Ex.1001, 6:65-7:10; Fig.5.



Accordingly, Benjamin discloses "a region [e.g., Region 2] positioned between the first heater array and the second heater array and also positioned substantially adjacent to the first heater array and the second heater array [e.g., positioned next to (and can include) Heater Arrays B and C]." Ex.1002, ¶¶137.

5. 1[D] "a temperature sensing element operable to sense a temperature of the region …"

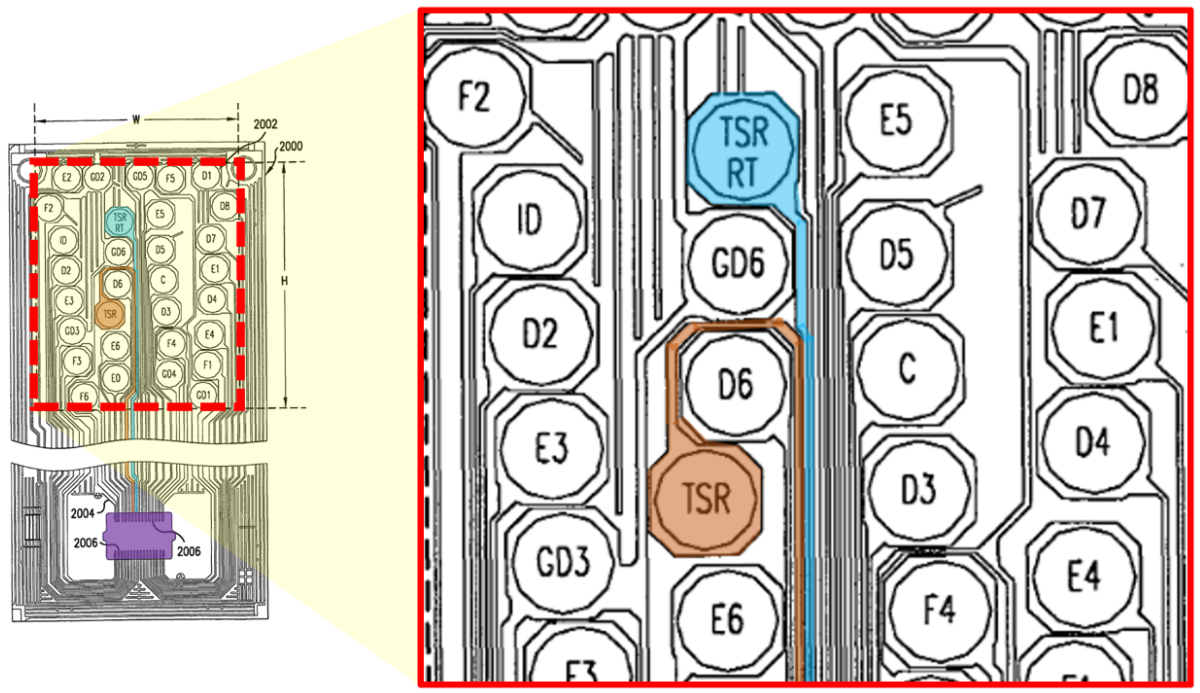
Benjamin in view of Giere673 (Benjamin-Giere673) discloses 1[D]. Ex.1002, ¶¶138-156.

Benjamin's printhead die 1700 includes a "temperature sense resistor" (TSR) allows "a printer coupled to an ink jet cartridge to determine a **temperature of the printhead die**, **based upon a measurement of the resistor**. Ex.1004, 79:60-67.

Upon electrically coupling the printhead die 1700 [*purple below*] to the "temperature sense resistor **contact area** TSR" [orange] and return contact area

TSR-RT" [*blue*] on a flex circuit [*dashed red*], Benjamin teaches that the TSR on the die "provide[s] a TSR value" to the controller 100 on the printer, which then compares the value obtained from the TSR "to the to the thermal sense resistance value stored in the identification cells to determine the temperature of the printhead," and regulates the printhead's temperature "to optimize printing quality." Ex.1004, 79:60-66, FIGS.25A-25B; Ex.1002, ¶¶140-145.

Ex.1004, Fig. 25B



Figures 25A and 25B do not depict the **temperature sense resistor** (TSR) on the printhead die; only the **contact areas** associated with the resistor. However, a PHOSITA would understand from Benjamin's disclosures that the resistor is located

on the printhead die. Ex.1002, ¶¶141-146 (opining that a PHOSITA would know that contact fingers 2006 of the flex circuit are provided to be thermosonically bonded to bondpads on the silicon configured to receive, from the resistor on the printhead die, a TSR value representing the temperature of the printhead die 1700). of the temperature of the printhead die).

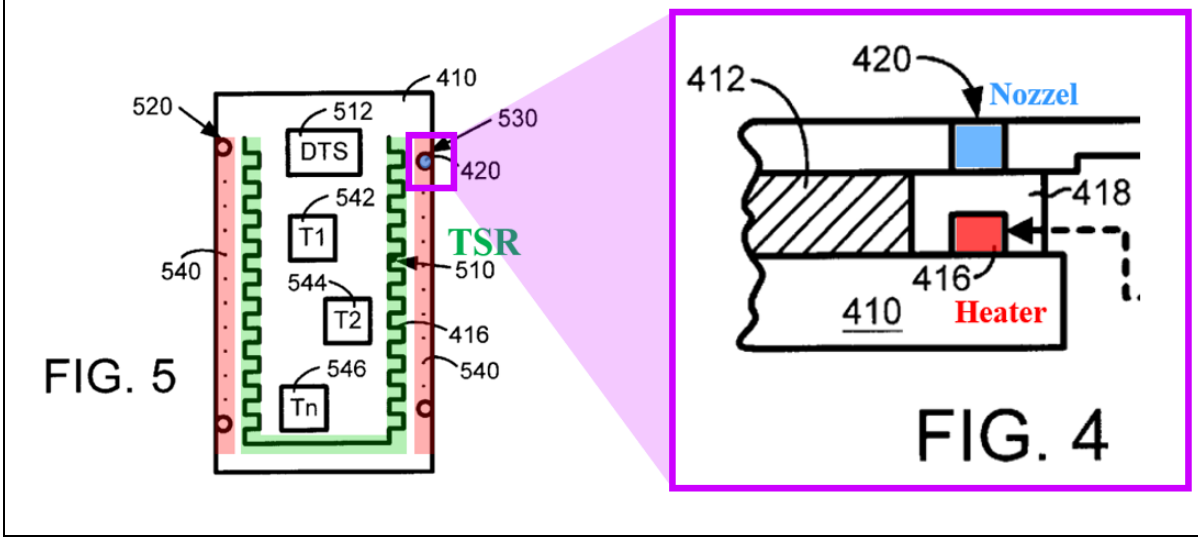
While Benjamin teaches disposing a TSR on the printhead die, it does not say *where* on the printhead die the TSR should be disposed. Giere673, however, provides an optimal location for the TSRs on a printhead die. Ex.1002, ¶¶147-148.

Like Benjamin, Giere673 uses "**[o]ne** or multiple TSRs 510 [to] provide an approximation of the ***mean temperature*** of the substrate [410]" that "aids in controlling the temperature of the substrate and the temperature of each ejection chamber or nozzle chamber," which like Benjamin, "results in improved print quality and printhead life because the printhead will consequently operate closer to its optimum temperature." Ex.1005, 3:5-13, 4:55-56.

Unlike Benjamin, however, Giere673 explicitly discloses *where* on the printhead the TSR should be located for providing these benefits. Not only does Giere673 teach positioning a single temperature sensor—i.e., "temperature sensor resistor (TSR) 510 [*green below*]—between two heater arrays [*red*], but also that the TSR 510 "preferably is not located adjacent to any ***particular*** heating elements" so

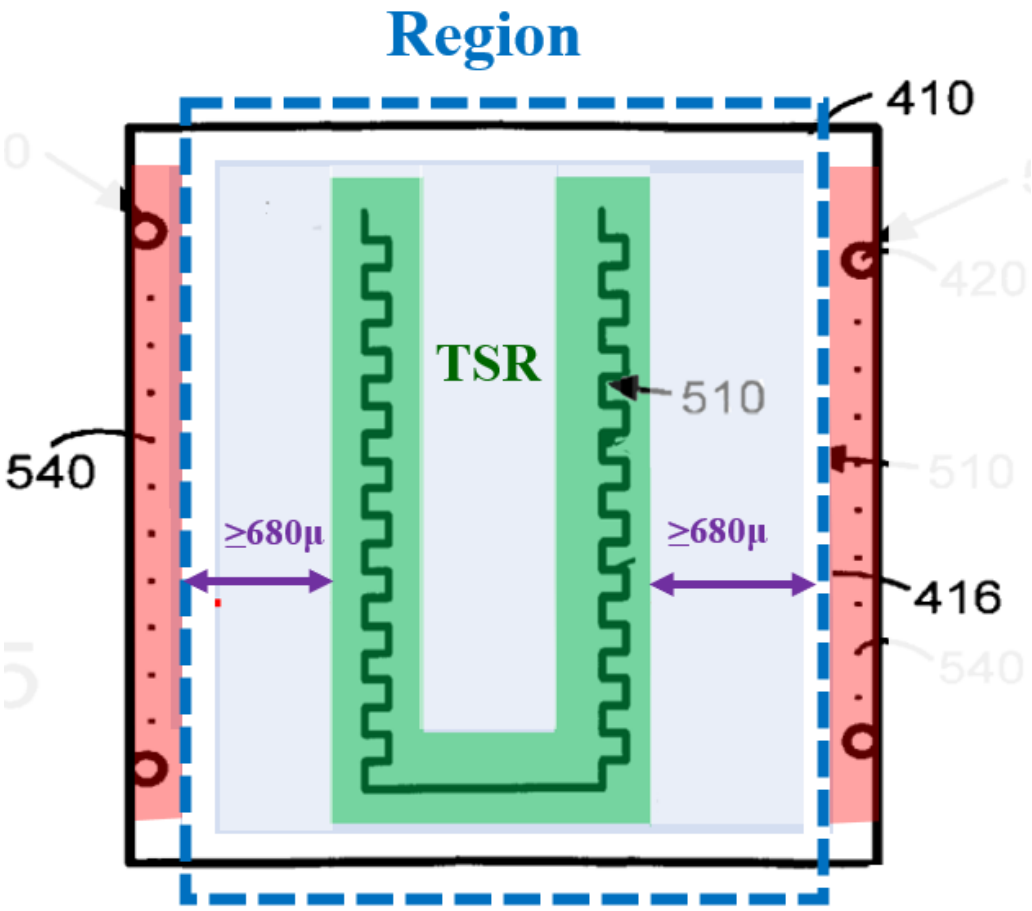
that the obtained TSR value "reflects the temperature of the substrate 410 after heat has moved from the heating elements to the TSR 510." Ex.1005, 2:50, 4:51-56.

Ex.1005, Figs.4,5



Giere673 teaches that "[t]he TSR 510 is located along the length of the substrate 410" and "can have two legs that are approximately 680 µm inboard from the center of the columns of ink ejection elements 416," [*red in Figs. 4 and 5*]," which Giere673 teaches are positioned directly below the nozzle 420 [blue in Figs. 4 and 5]. Ex.1005, 5:5-12.

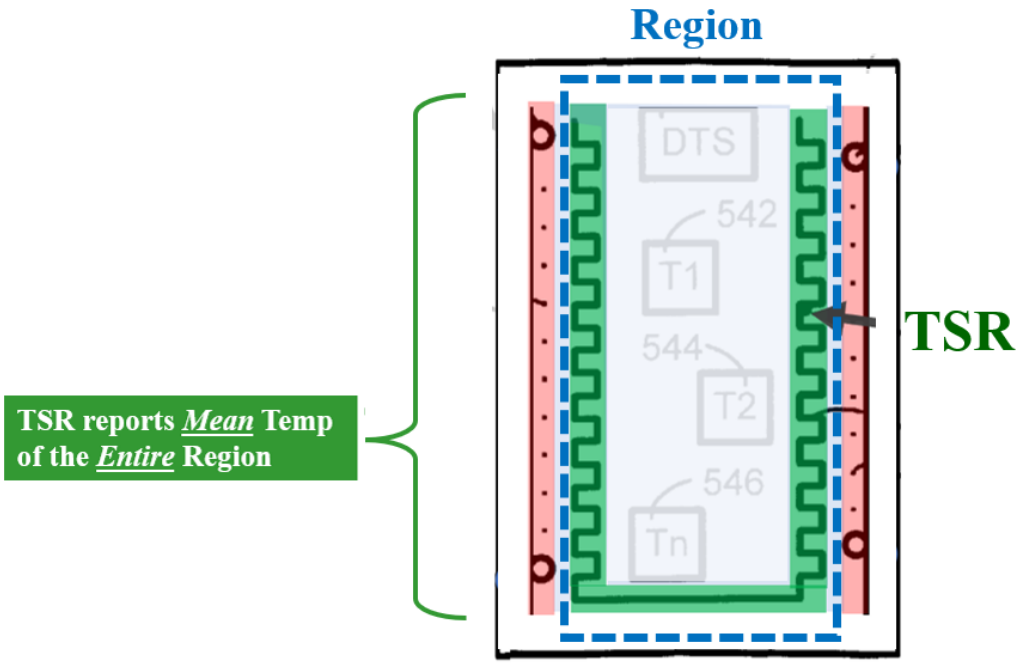
Ex.1005, Fig. 5



Put differently, Giere673 teaches disposing a single temperature sense resistor (TSR) [*i.e.*, serpentine TSR 510, *green below*] in a region on the printhead die [region of the substrate 410, *blue*] adjacent two heater arrays [columns of ink ejection elements 416 and 516, *red*], and positioning that TSR equidistant from the two heater arrays but no less than "**approximately 680 µm inboard** from the center of the [heater arrays]." Ex.1005, 4:57-59.

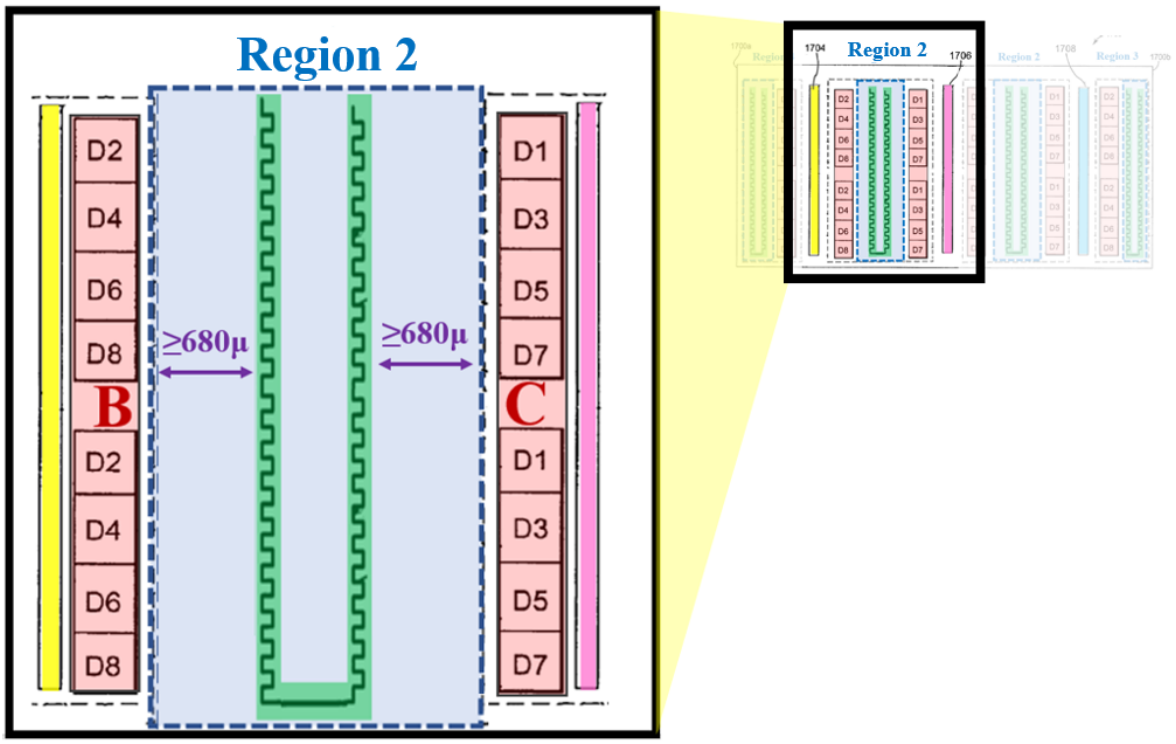
By positioning the TSR 510 in the centre of the region, Giere673 teaches that the TSR value obtained by TSR 510 "reflects heating elements firing that have already occurred," which "more accurately reflects the ***mean temperature*** of the substrate 410," as illustrated below. Ex.1005, 4:57-59. This also "acts as a predictive system for maintaining the substrate at an optimum temperature for producing ink droplets," and as a result, the **quality of the ink droplets will be increased**," **less energy will be used**" to fire heater arrays, and "printhead assembly [] will be **easier to maintain** with less residue being deposited on the [die]."

Ex.1005, Fig. 5



For the reasons set forth below in Section VIII.P., a PHOSITA would have applied Giere673's teachings to Benjamin by (1) disposing a single TSR between each adjacent pair of ink vias on the printhead die [*e.g.*, Regions 2 and 3, *blue below*], and (2) positioning the TSR equidistant from both heater array within the region but no less than approximately 680 µm inboard from the center of the heater arrays, as shown below, to ensure that the temperature value provided by the TSR reflects the mean temperature of the region. Ex.1002, ¶248.

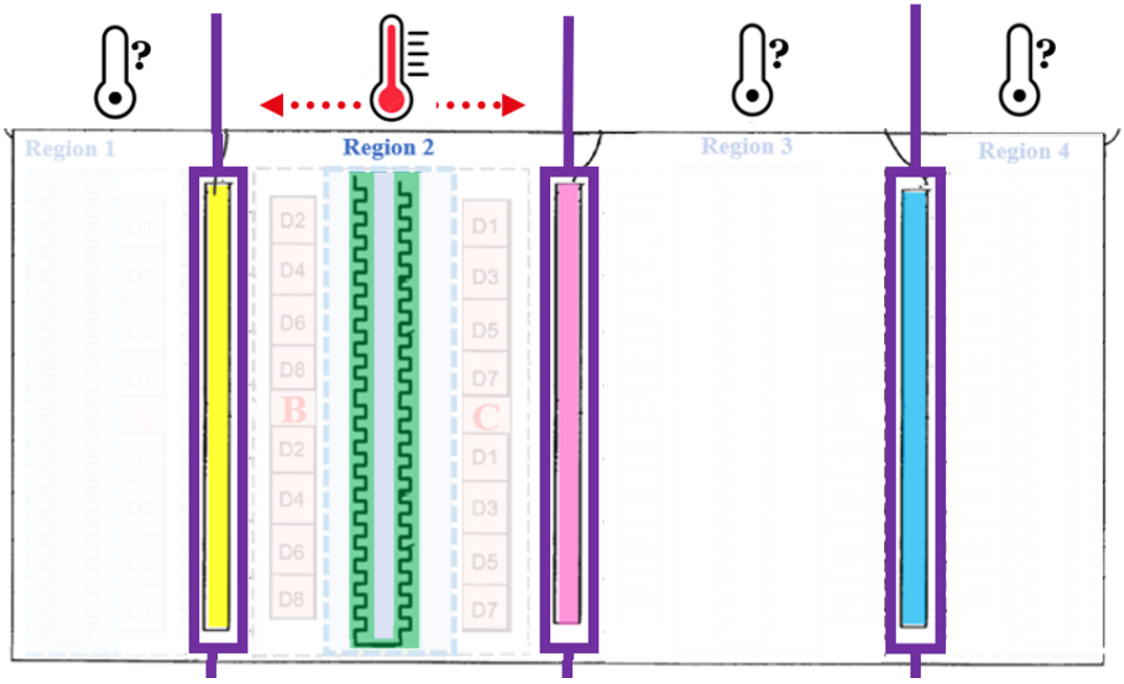
Ex.1004, Fig. 21 (Simplified)



Moreover, a PHOSITA would have known that placing the TSR within Regions 2 and/or 3 *alone* would not accurately report the mean temperature of the ***entire printhead die*** because the ink vias act as thermal insulators between other regions of Benjamin's printhead [Regions 1, 3, and 4], making the temperature value read by the TSR reflective of the temperature of Region 2, but not the mean temperature of the entire printhead. Ex.1001, 5:52-55; Ex.1008 (Yabe), 3:16-21

Benjamin-Giere673

Ink Vias Form a Thermal Barrier Between Each Region



The ’823 Patent readily admits that, during the prior art time period, it was well known to those skilled in the art that “ink vias [] act as thermal barriers between the colors,” and “without accurate temperature readings, the method of providing fire pulses to regulate thermal conditions [for a multi-via printhead] would also be subject to error.” Ex.1001, 2:10-12; 2:47-50. To overcome these challenges, the ’823 Patent admits that prior art heater chips “provid[ed] for temperature sensing on a per-color basis” by placing “three temperature sensors 220, 222, and 224 [green below] in close proximity to each of the heater arrays, each situated on the same side of their respective vias,” thereby “ensuring that there is only a small amount of thermal crosstalk between the temperature sensors.” Ex.1001, 2:3-15

The Applicant-Admitted Prior Art

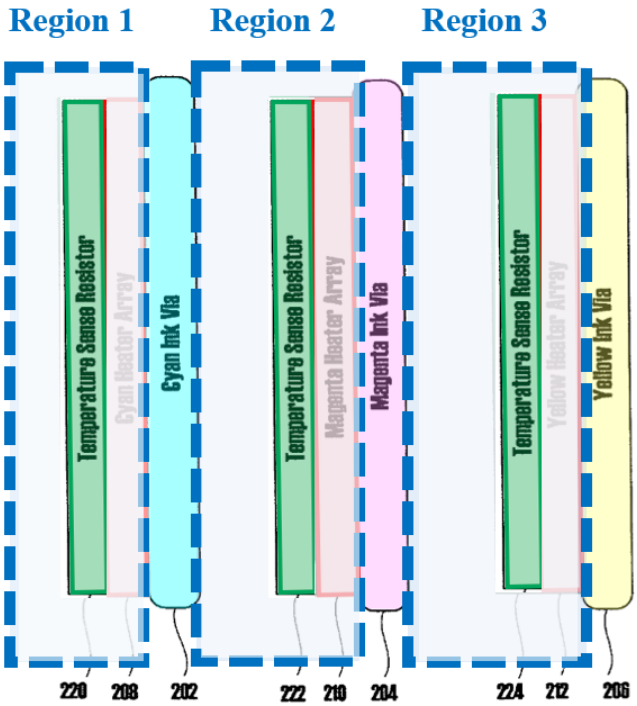
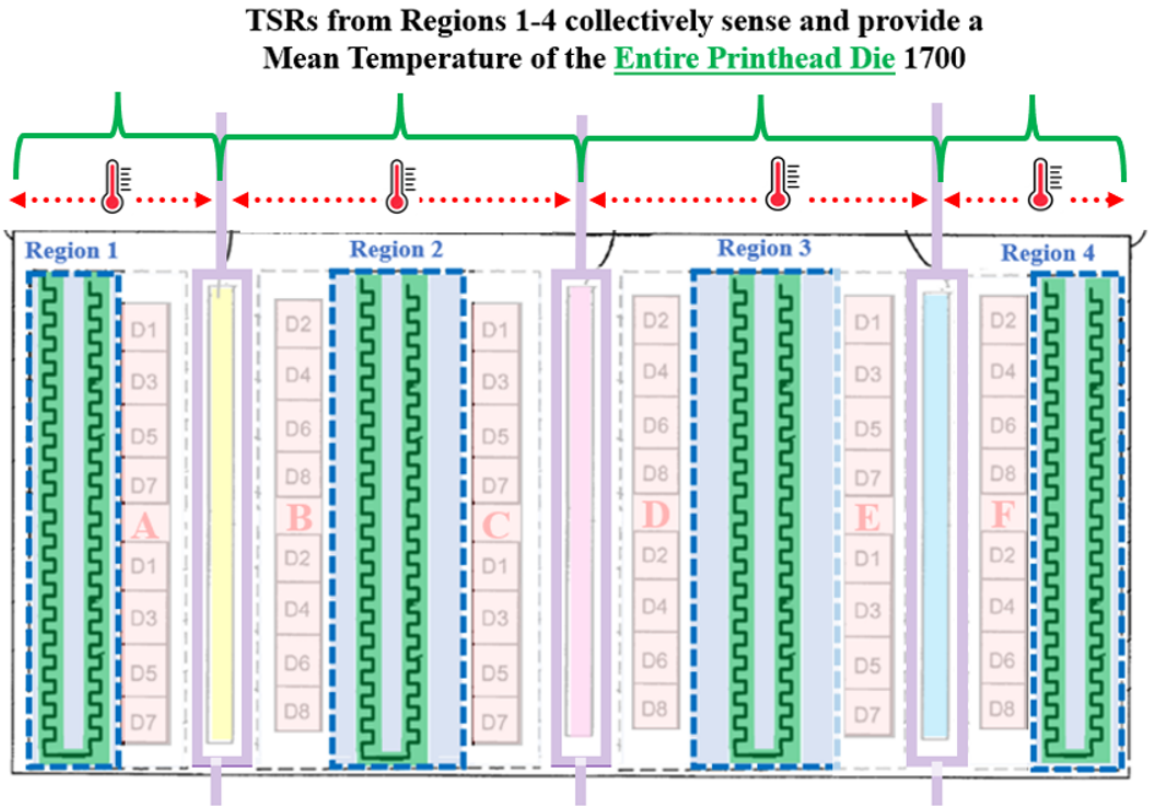


FIG. 2
(Prior Art)

Put differently, the '823 Patent confirms that a PHOSITA would have known to position a TSR within each thermal region because "temperature sensing on a per-color basis" was a well-known means for regulating temperature of a multi-via printhead. Ex.1001, 2:1-2; Ex.1002, ¶¶247-249.

For this reason, a PHOSITA would have known to dispose a single TSR within ***every*** region [e.g., Regions 1-4, *blue below*] so that the TSR value *collectively* provided by the TSRs within Regions 1-4 reflect the mean temperature of Benjamin's printhead die, as illustrated below. Ex.1002, ¶¶250.

Benjamin-Giere673



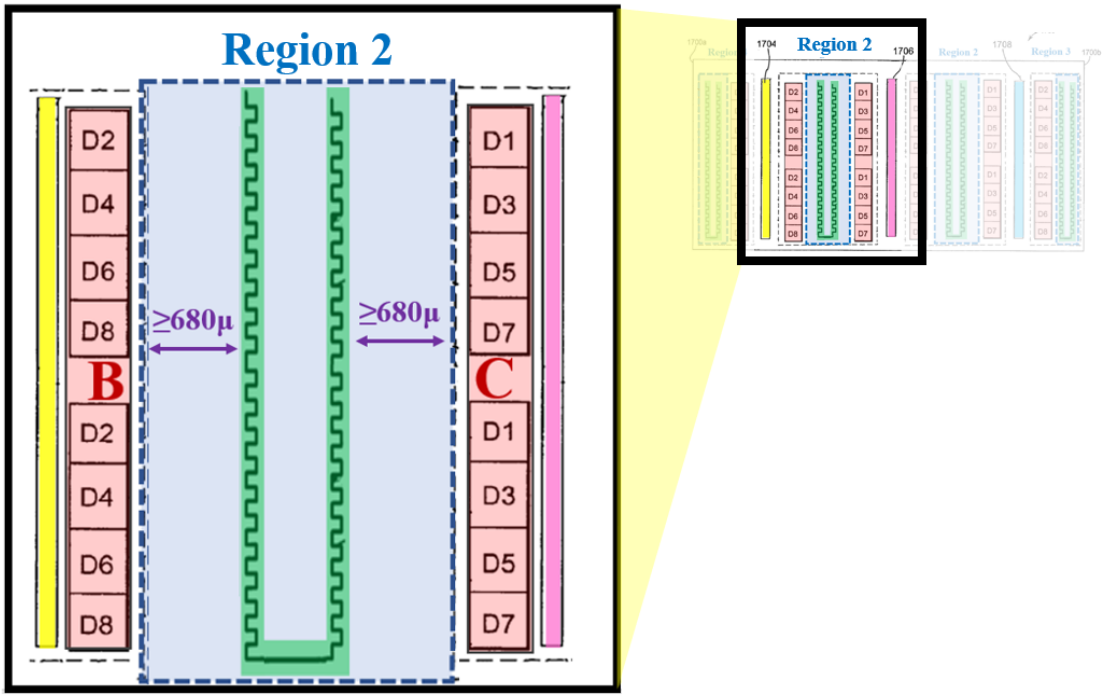
Accordingly, Benjamin-Giere673 discloses "a temperature sensing element [e.g., TSR] operable to sense a temperature of the region [e.g., Region 2], the temperature being representative of the region." Ex.1002, ¶¶138-156.

6. 1[E] "substantially centrally disposed … and substantially adjacent … and further extends substantially the length"

Benjamin-Giere673 discloses 1[E]. Ex.1002, ¶¶157-180.

Per 1[D], Benjamin-Giere673 discloses a TSR [*green below*] within every thermal region on the printhead die [e.g., Region 2 *blue*] and positions each TSR equidistant from the two heater arrays adjacent the region [e.g., heater arrays B and C, *red*] and not less than "approximately 680 µm inboard from the center of the [heater arrays]". Ex.1002, ¶¶159.

Benjamin-Giere673



Accordingly, Benjamin-Giere673 discloses that the "temperature sensing element [e.g., TSR] is substantially centrally disposed with respect to the region [e.g., disposed equidistant from Heater Arrays B and C] and substantially adjacent to both the first heater array and second heater array [e.g., disposed immediately next

to Heater Arrays B and C], and further extends substantially the length of the first heater array and second heater array [e.g., TSR extends substantially the same length as Heater Arrays B and C]." Ex.1002, ¶¶160.

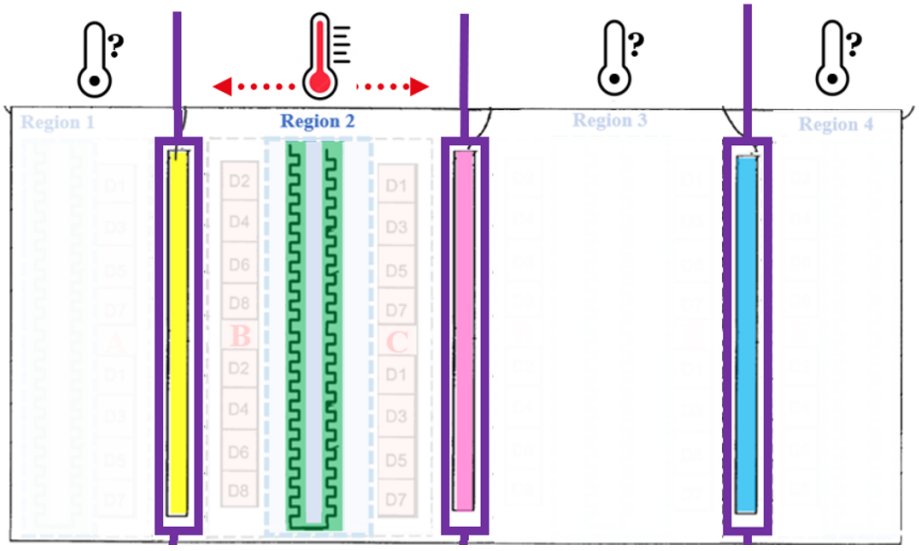
7. 1[F] "operable to receive heating responsive to the temperature of the region …"

Benjamin-Giere673 discloses 1[F]. Ex.1002, ¶¶161-169.

"To control[] the temperature of the substrate and the temperature of each ejection chamber or nozzle chamber," Giere673 discloses that "temperature sensors … determine, at a given time, a mean or ***average temperature of the substrate*** and an ***actual local temperature profile near designated ink ejection elements***." Ex.1005, 2:57-62. Thereafter, "the input data 108" supplied by the TSR is used "to predict thermal conditions of particular ejection chambers for selectively firing the associated heating elements." Ex.1005, 3:1-6

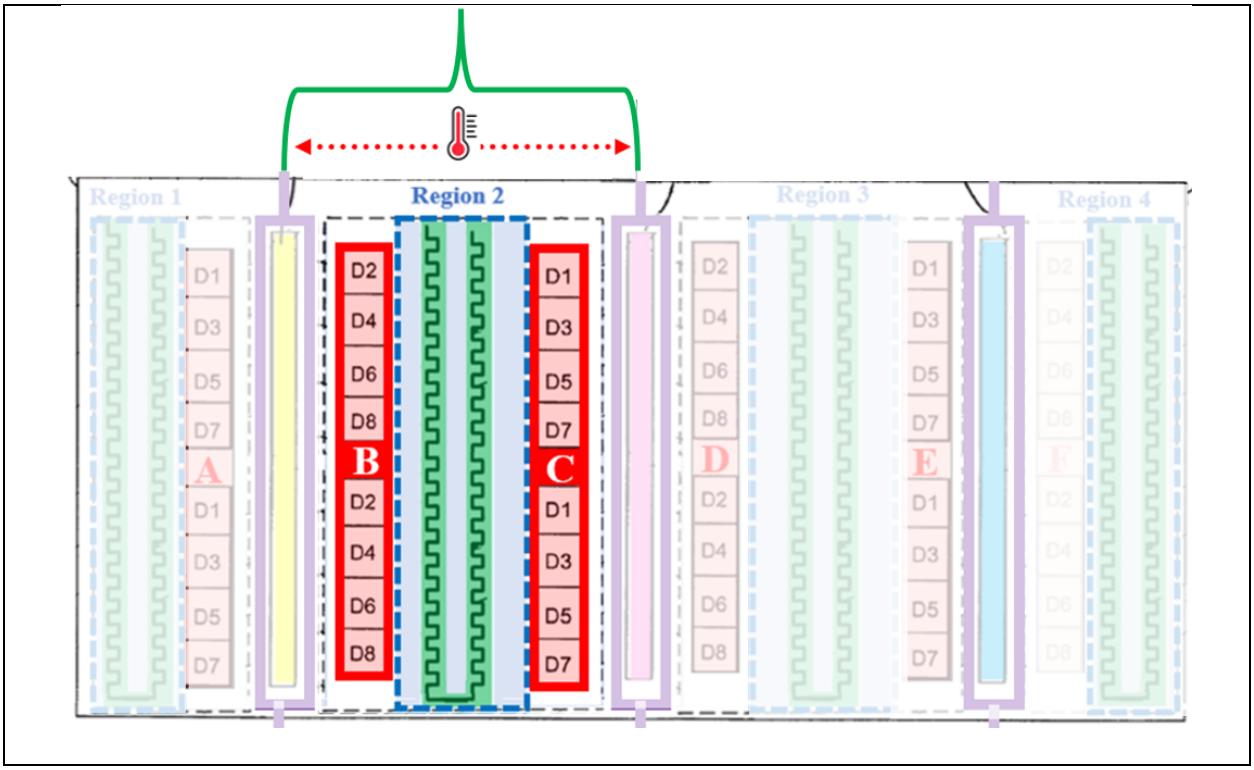
Because the ink vias act as thermal insulators between the four different regions of Printhead Die 1700, the TSR value accurately represents only the temperature between the two adjacent ink vias. Ex.1002, ¶¶165.

Benjamin-Giere673



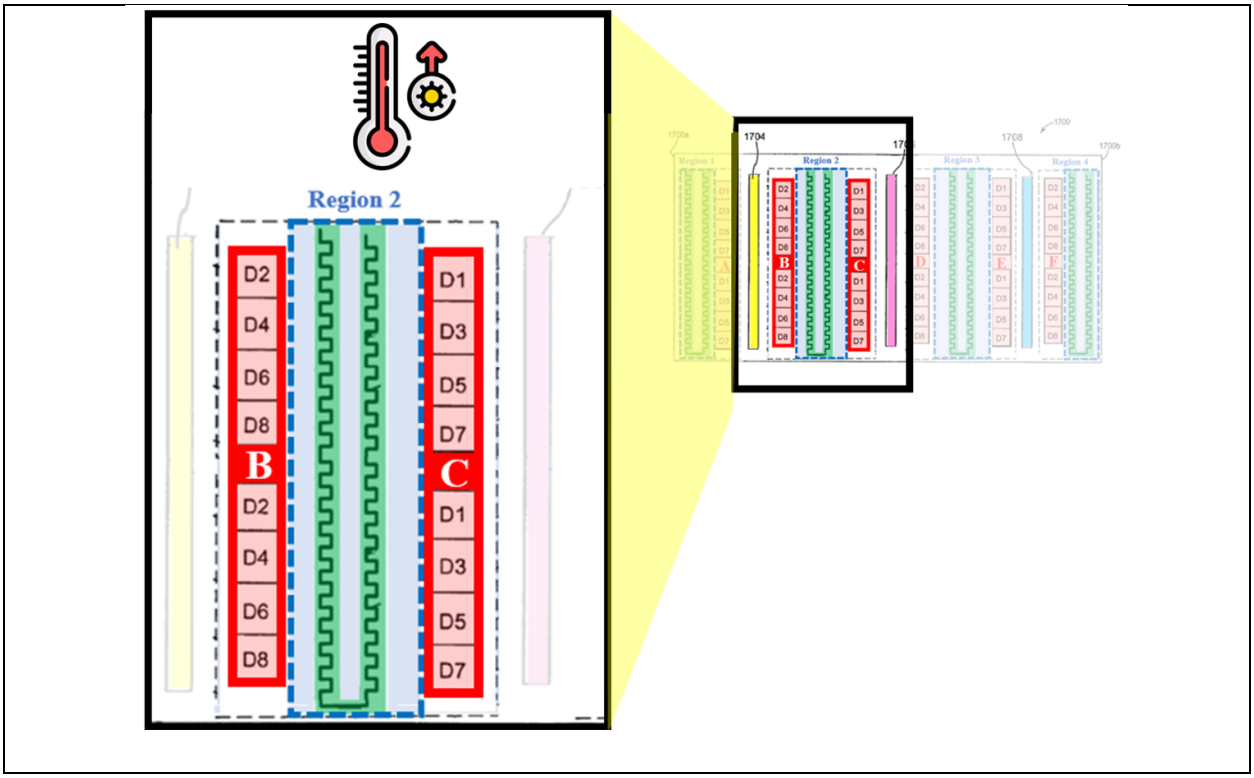
For example, a PHOSITA would know that the TSR within that Region 2 accurately reports the temperature of Heater Arrays B and C because they are positioned between, not outside, the yellow and magenta ink vias. Ex.1002, ¶166.

Benjamin-Giere673



Based upon the temperature sensed by the TSR, Giere673 teaches that the heater arrays receive heating "so that the **temperature of the heater array** [], and therefore the temperature of the ink in the chamber array [], are maintained at an **optimum temperature for the formation of ink droplets**"—e.g., by **generat[ing] firing Voltages 814** and **activates heater elements** that do not eject ink 816." Ex.1005, 7:41-45; 9:8-19; Ex.1005, 2:62-65 (printer uses the TSR value to "control[s] the mean temperature of the substrate of the printhead."

Benjamin-Giere673



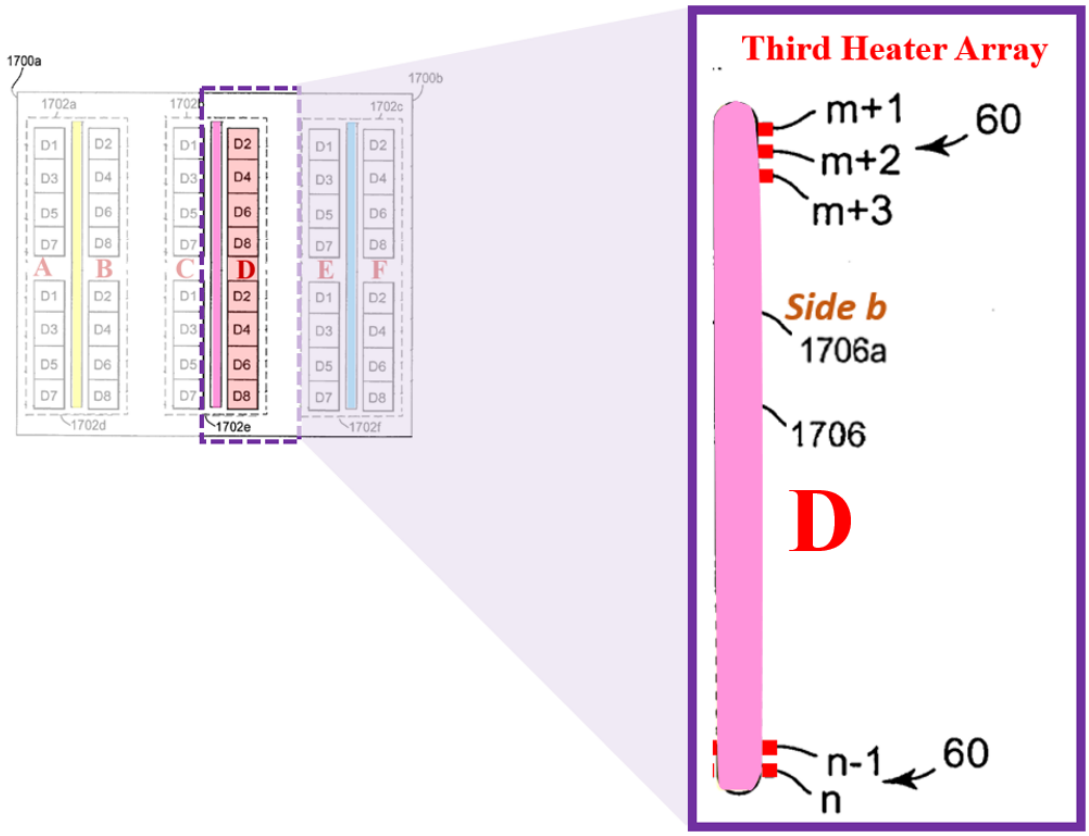
Accordingly, Benjamin-Giere673 discloses "wherein the first heater array [e.g., Heater Array B] and the second heater array [e.g., Heater Array C] are operable to receive heating responsive to the temperature of the region [e.g., Region 2] sensed by the temperature sensing element [e.g., TSR], and wherein the received heating regulates the temperature of the region [e.g., generate firing voltages and activates heater elements]." Ex.1002, ¶¶169.

8. 1[G] "a third heater array… second via"

Benjamin-Giere673 discloses 1[G].

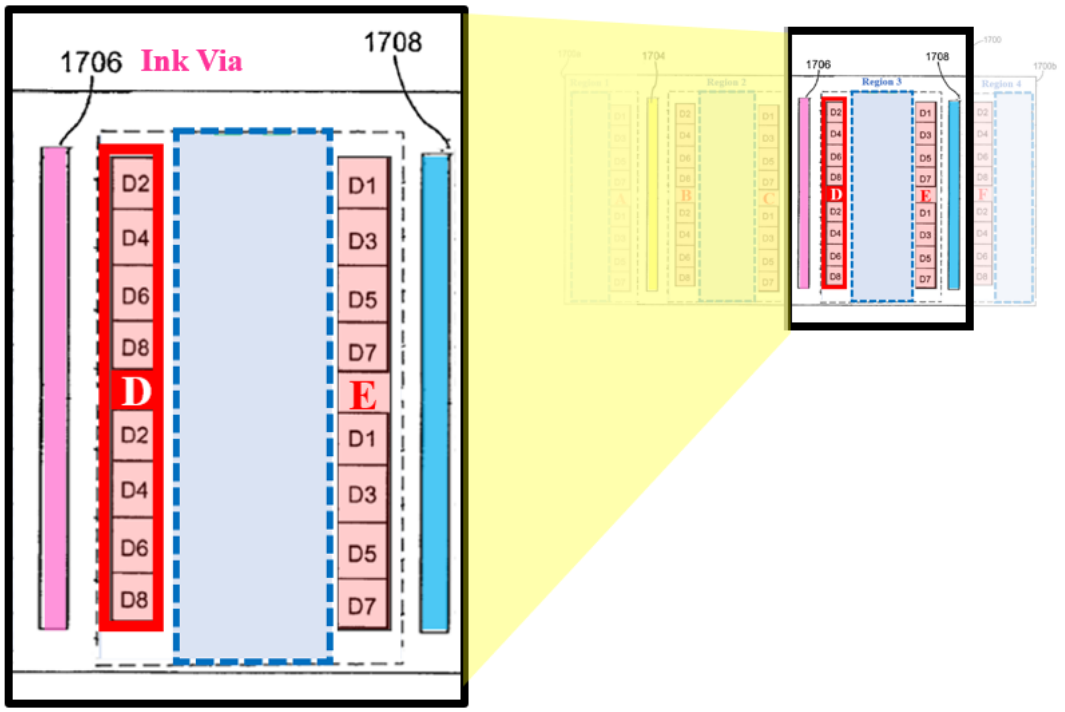
The printhead die 1700 includes a third array of firing resistors 52 (*e.g.*, Heater Array D) from the drop generators 60 associated with side 1706*b* of the magenta ink feed slot 1706. Ex.1004, 66:36-67:8.

Ex.1004, Fig.21(simplified)



Heater Array D is disposed next to the magenta ink feed slot 1706, and therefore, substantially adjacent the Magenta Ink Via. Ex.1002, ¶172.

Ex.1004, Figs. 3,21



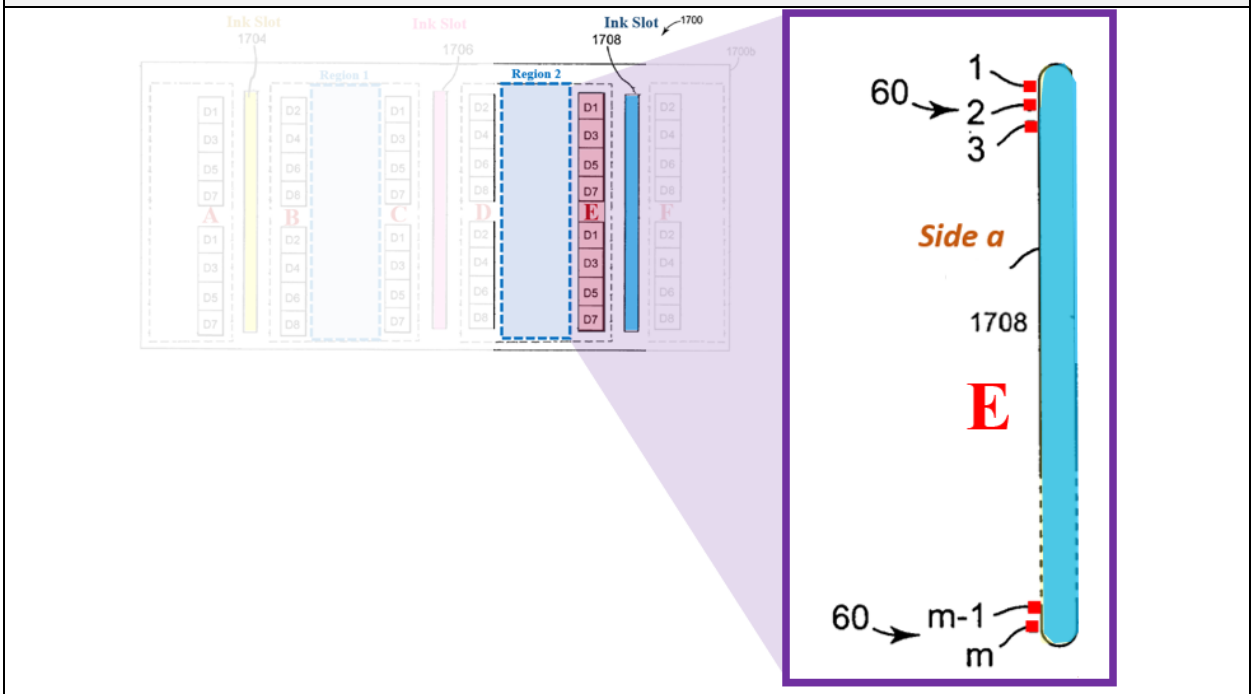
Accordingly, Benjamin-Giere673 discloses "a third heater array[,] [e.g., Heater Array D] positioned substantially adjacent a second via [e.g., Magenta Ink Via]." Ex.1002, ¶173.

9. 1[H] "a fourth heater array… a third via"

Benjamin-Giere673 discloses 1[H]. Ex.1002, ¶¶174-177.

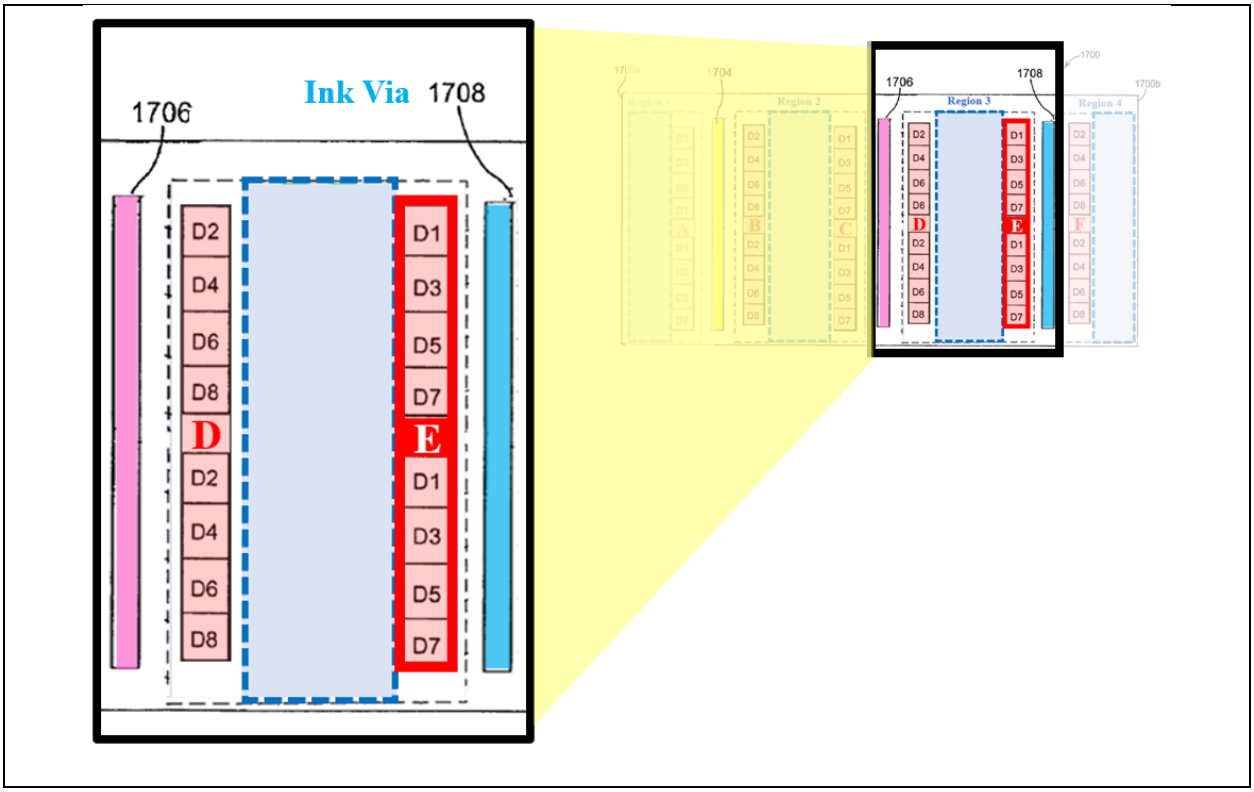
The printhead die 1700 includes a fourth array of firing resistors 52 (*e.g.*, Heater Array E) from the drop generators 60 associated with side 1708*a* of the cyan ink feed slot 1708. Ex.1004, 66:36-67:8; Ex.1002, ¶175.

Ex.1004, Fig.3,21(simplified)



Heater Array E is disposed next to the cyan ink feed slot 1708, and therefore, substantially adjacent the Cyan Ink Via. Ex.1002, ¶176.

Ex.1004, Fig.21(simplified)



Accordingly, Benjamin-Giere673 discloses "a fourth heater array, [e.g., Heater Array E] positioned substantially adjacent a third via [*e.g.*, Cyan Ink Via]." Ex.1002, ¶¶174-177.

10. 1[I] "a second region …"

Benjamin-Giere673 discloses 1[I]. Ex.1002, ¶¶178-180.

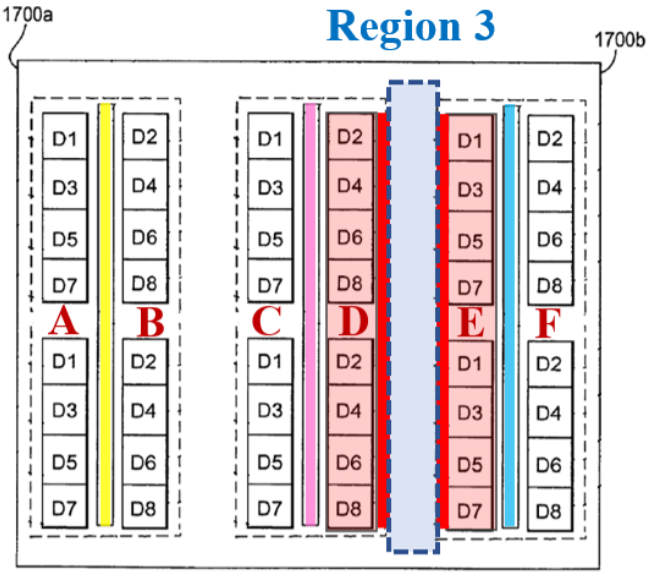
The Printhead die 1700 includes a second region [*e.g.*, Region 3, *blue below*] positioned between Heater Array D and Heater Array E (*red*). Ex.1002, ¶179.

Ex.1004, Fig.21 (simplified)



Region 3 of Printhead Die 1700 is also positioned immediately next to, and shares a border with, both Heater Array D and E, and therefore, is substantially immediately adjacent each heater array. Ex.1002, ¶180.

Ex.1004, Fig.21

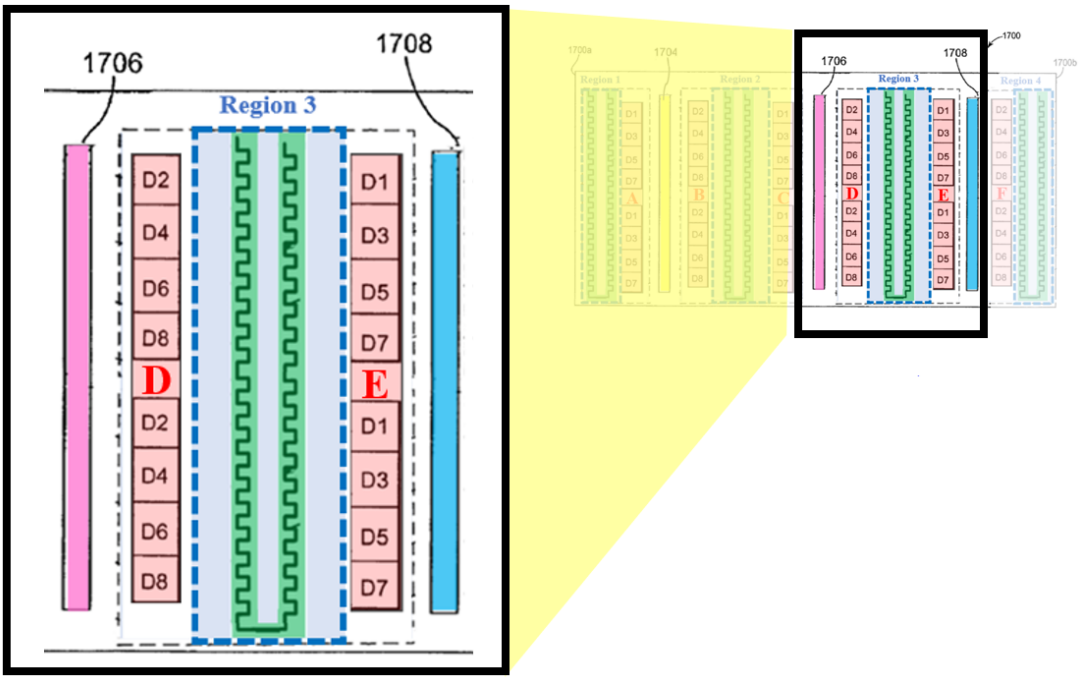


Accordingly, Benjamin-Giere673 discloses "a second region [e.g., Region 3], positioned between the third heater array and the fourth heater array, and also positioned substantially immediately adjacent to the third heater array and the fourth heater array [e.g., positioned between and immediately next to Heater Arrays D and E]." Ex.1002, ¶¶178-180.

11. 1[J] "a second temperature sensing element …"

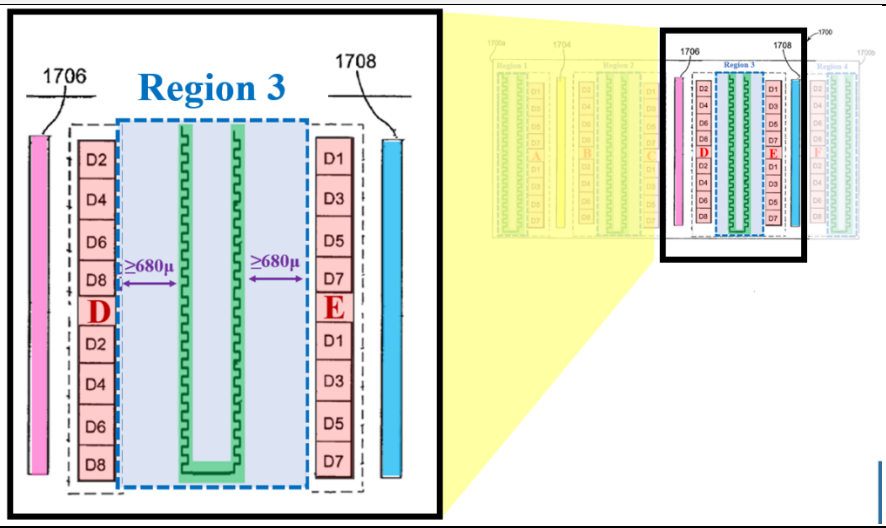
Benjamin-Giere673 discloses this limitation for the same reasons as 1[D]. Ex.1002, ¶¶182-183.

Benjamin-Giere673



12. 1[K] "substantially centrally disposed … and substantially adjacent"

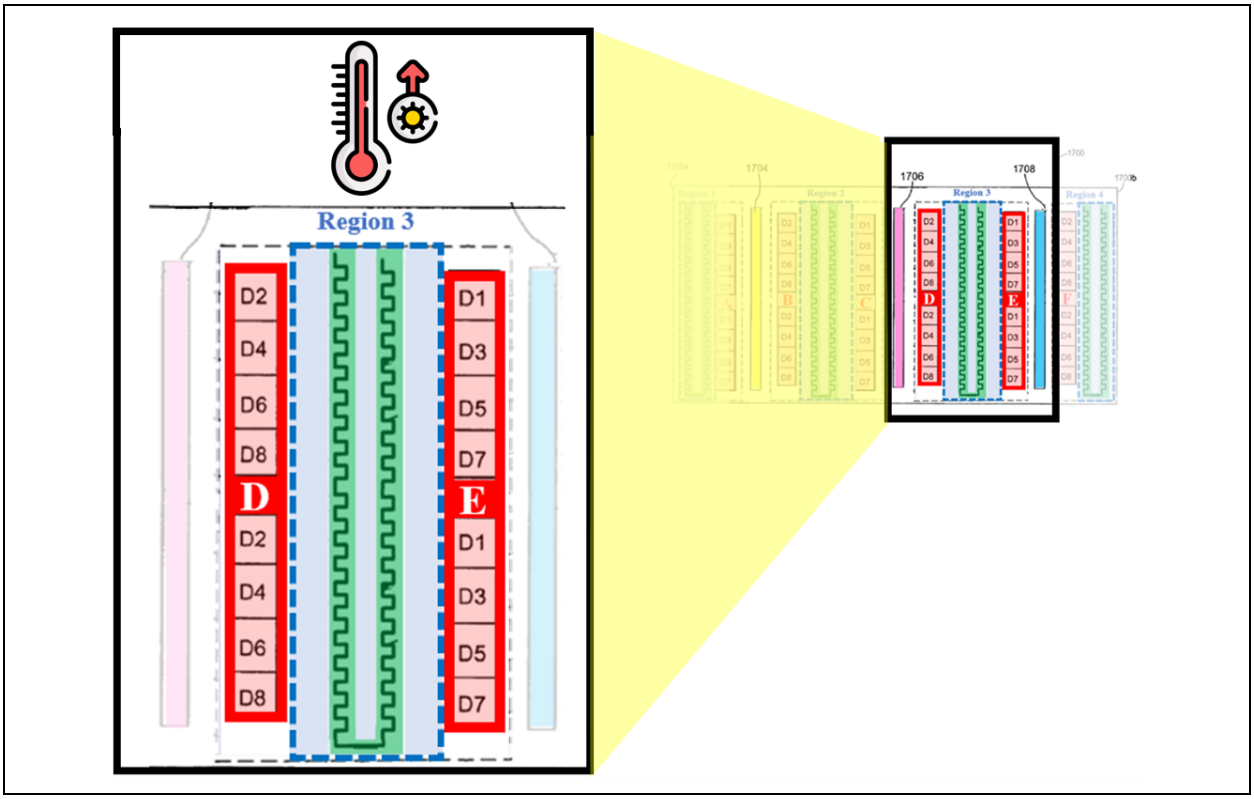
Benjamin-Giere673 discloses this limitation for the same reasons as 1[E]. Ex.1002, ¶¶184-186.

Benjamin-Giere673


13. 1[L] "operable to receive heating responsive to the temperature of the second region …

Benjamin-Giere673 combination discloses this limitation for the same reasons as in 1[F]. Ex.1002, ¶¶187-189.

Benjamin-Giere673



B. Claim 2

Benjamin-Giere673 discloses that "the temperature sensing element comprises a temperature sensing resistor." Ex.1004, 79:60-67 (disclosing "temperature sense resistor" on printhead die 1700); Ex.1005, 4:49-55 (disclosing "a thermal sense resistor (TSR) 510"); Ex.1002, ¶¶190-192.

C. Claims 3 and 13[6]

[6] Claim 13 mirrors claim 3, and therefore, disclosed for the same reasons. Ex.1002, ¶¶231-232.

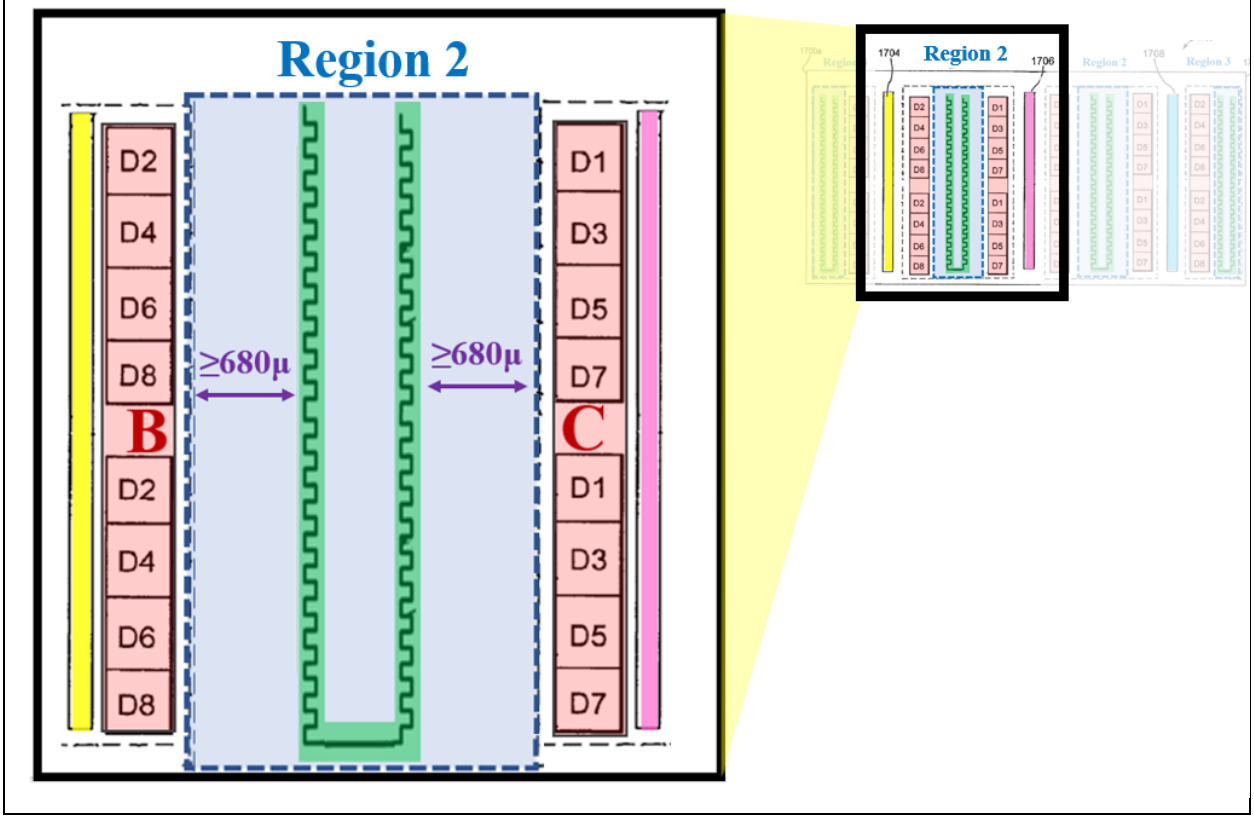
Benjamin-Giere673 discloses that "the temperature sensing element comprises a thermal sense resistor [*i.e.*, TSR 510]." Ex.1004, 79:60-67 (disclosing "temperature sense resistor" on printhead die 1700); Ex.1005, 4:49-55 (disclosing "a thermal sense resistor (TSR) 510"); Ex.1002, ¶¶194-231.

D. Claims 5 and 15[7]

Claim 5 further adds: which For the same reasons as 1[D]-1[F], Benjamin-Giere673 discloses that "the temperature sensing element [e.g., TSR 512] is positioned at least 300 microns from each of the first heater array and the second heater array" [e.g., approximately 680 μm inboard from Heater Arrays B and C."). Ex.1005, 5:10-12 Ex.1002, ¶¶157-198.

[7] Claim 15 mirrors claim 5, and therefore, disclosed for the same reasons. Ex.1002 ¶¶233-234.

Benjamin-Giere673



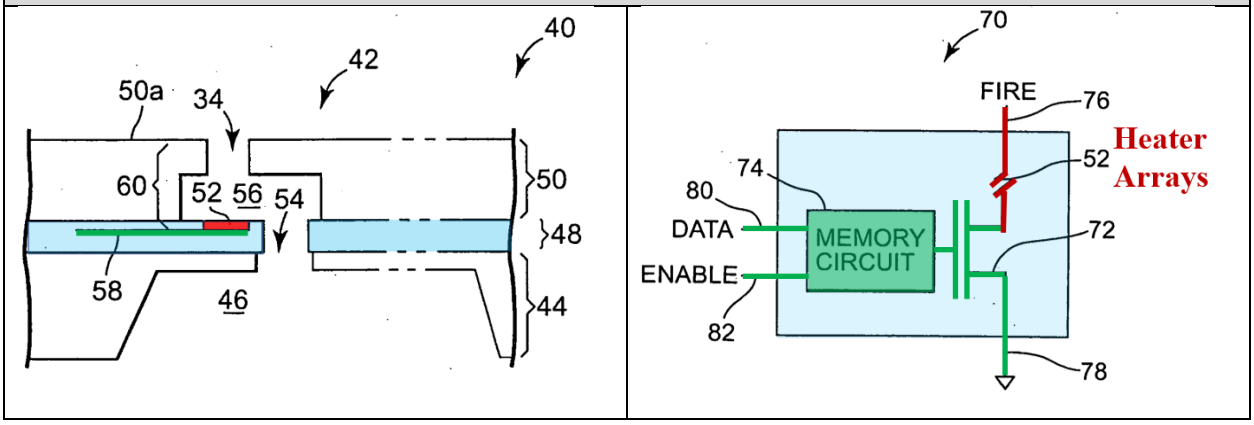
E. Claims 6 and 16[8]

Benjamin-Giere673 discloses that "the temperature sensing element [*i.e.*, TSR 510] is positioned substantially planar to each of the first heater array and the second heater array [*e.g.*, Heater Arrays B and C]." Ex.1002, ¶¶199-205. .

[8] Claim 16 mirrors claim 6, and therefore, is disclosed for the same reasons. Ex.1002, ¶¶ 235-326.

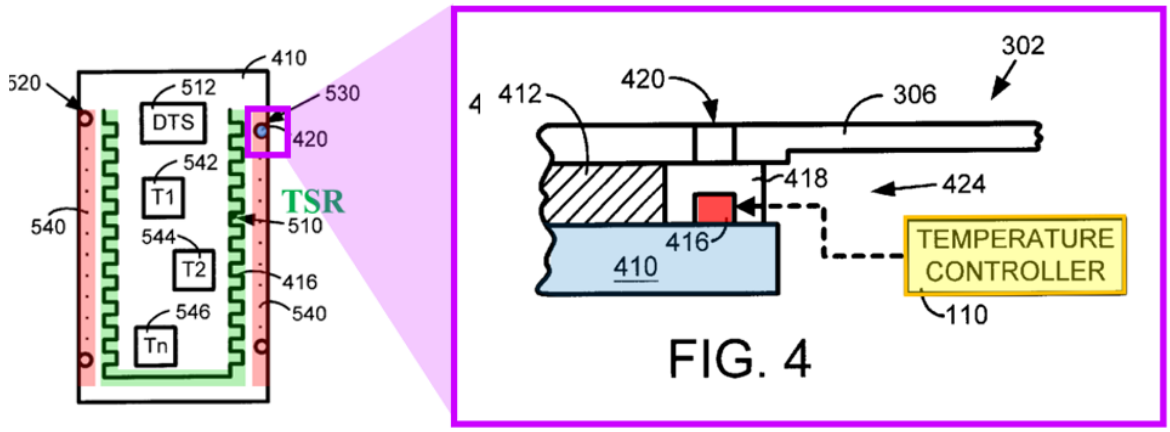
Benjamin teaches disposing circuitry for receiving TSR values in the same "thin-film structure 48 and on substrate 40 (*blue*)" as the circuitry for controlling the firing resistors 52 (*green*), which positions the TSR *substantially* planar to both of heater arrays 52 with that region, particularly given that the '823 Patent treats "substantially planar" to mean "the temperature sensing element is not positioned directly above the first or second heater arrays." Ex.1001, 3:15-16; Ex.1004, 6:8-9.

Ex.1004, Figs. 2 and 4



Moreover, Giere673 teaches that the TSR 510 is positioned "approximately 680 µm ***inboard from*** the center of the columns of ink ejection elements 416" (Ex.1005, 5:10-12), which means that the TSR 510 must be substantially planar to the ink ejection elements 416, at least under the '823 Patent's definition of that term. Ex.1001, 3:15-16.

Ex.1005, Figs. 4 and 5



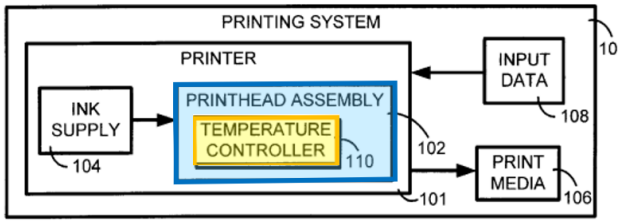
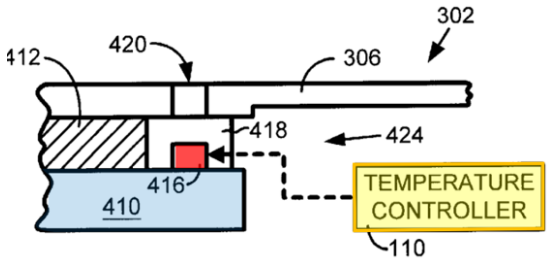
Alternatively, it would have been obvious to a PHOSITA to position the temperature sensing element in substantially the same plane as the first and second heater arrays as doing so would reduce manufacturing costs and time required to manufacture the printhead die. Ex.1002, ¶204.

F. Claim 7

Benjamin-Giere673 discloses "at least one control element [*i.e.*, temperature controller 100] operable to receive a temperature measured by the temperature sensing element [*i.e.*, TSR 510]." Ex.1002, ¶¶206-209.

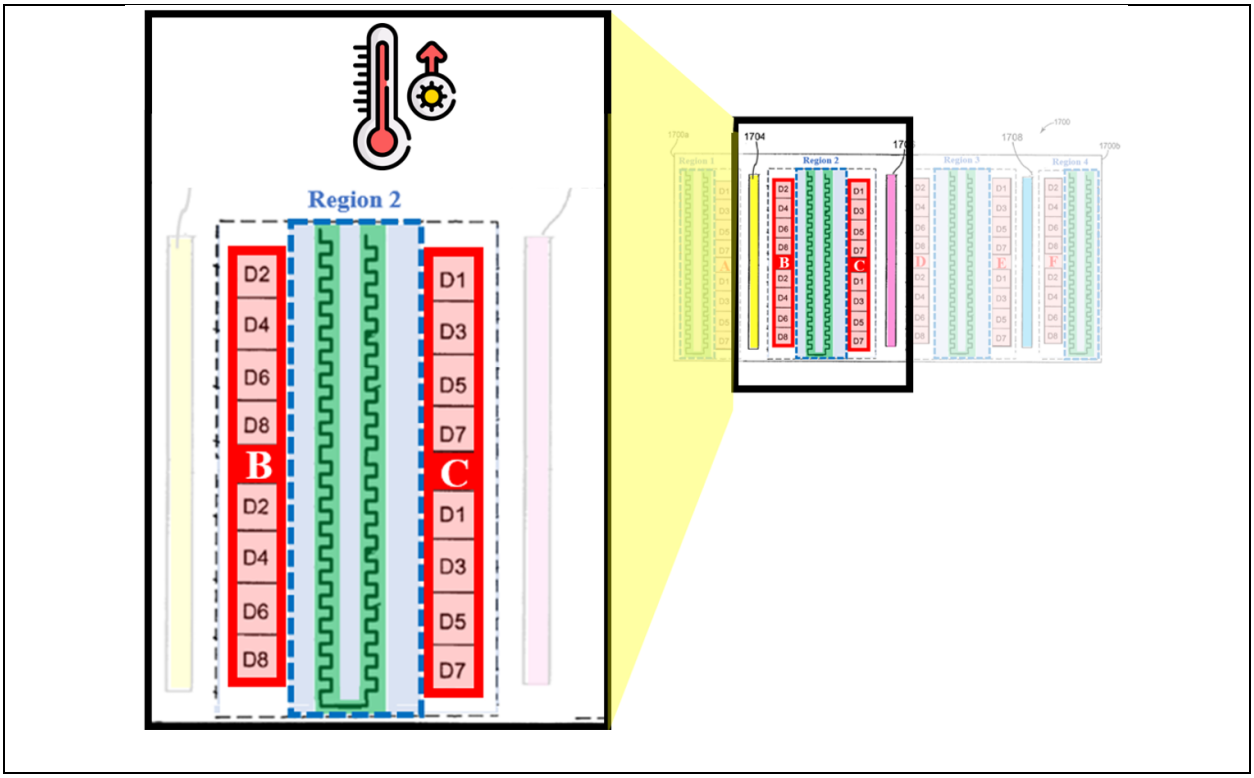
"To control[] the temperature of the substrate and the temperature of each ejection chamber or nozzle chamber," Giere673 teaches that "[t]he temperature controller 110 is coupled to multiple temperature sensors (not shown)," which "determine, at a given time, a mean or ***average temperature of the substrate*** and an

actual local temperature profile near designated ink ejection elements." Ex.1005, 2:57-62; 2:48-52, 2:62-65, 3:1-6.

Ex.1005, Fig. 1	Ex.1005, Fig. 4
 FIG. 1	

Based upon the TSR value provided to the temperature controller 100, Giere673 teaches that the heater arrays receive heating "so that the **temperature of the heater array** [], and therefore the temperature of the ink in the chamber array [], are maintained at an **optimum temperature for the formation of ink droplets**." Ex.1005, 7:41-45; 9:8-19.

Benjamin-Giere673



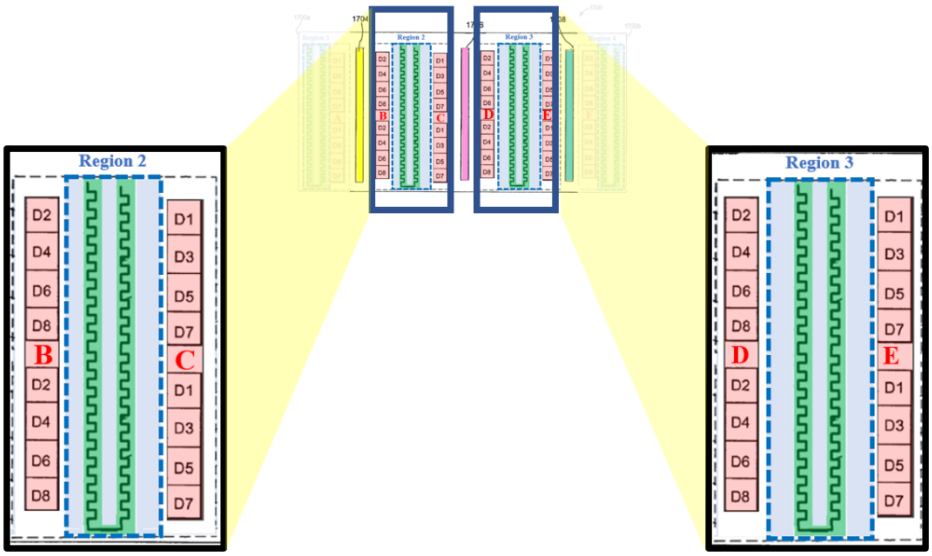
G. Claim 8

Benjamin-Giere673 further discloses that "the temperature sensing element [e.g., TSR] positioned between the first heater array and the second heater array [e.g., Heater Arrays B and C] is different than the second temperature sensing element [e.g., TSR] positioned between the third heater array and the fourth heater array [e.g., Heater Arrays D and E]." Ex.1002, ¶¶215.

Per 1[D] and [J], incorporated here, Benjamin-Giere673 includes a single temperature sense resistor (TSR, *green*) in each region (e.g., Regions 2 and 3,

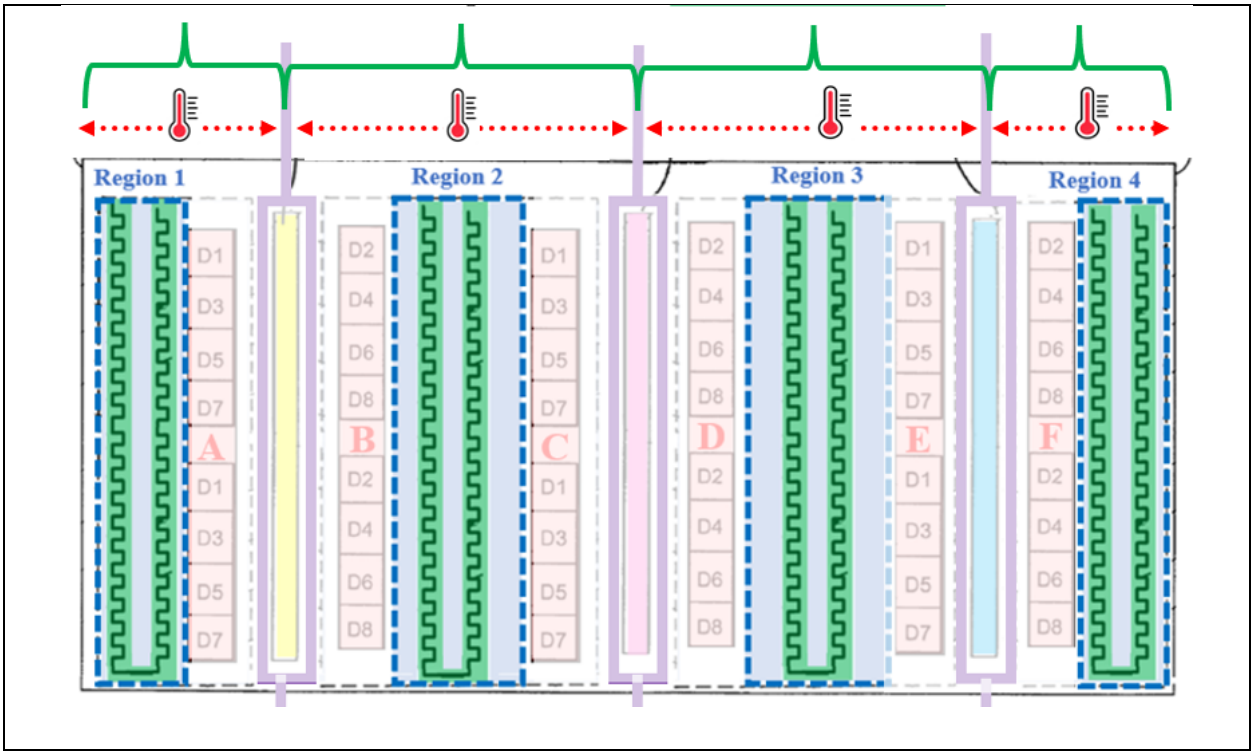
respectively), each of which is positioned between two different pairs of heater arrays (e.g., Heater Arrays D and E], which the TSR senses to provides a mean temperature value for its region. Ex.1002, ¶213.

Benjamin-Giere673



Each of the TSRs is different from one another because they are in different regions of the printhead die, associated with different heater arrays, have different electrical connections, and produce different temperature measurements. Ex.1002, ¶214.

Benjamin-Giere673



H. Claims 9 and 17[9]

Benjamin-Giere678 discloses that "the first heater array [e.g., Heater Array B] and the second heater array [e.g., Heater Array C] are operable to receive non-nucleating heating [e.g., adjustments to firing rate, firing voltage, or pulse width] responsive to the temperature of the region sensed by the TSR. Ex.1002, ¶¶ 216-222.

Non-nucleating heating (NNH) can refer to a technique of applying short pulses to heater resistors, i.e., too short to eject an ink drop (nucleation), but

[9] Claim 17 mirrors claim 9, and therefore, is disclosed for the same reasons.

sufficient to warm the substrate and ensure the heater chip operates at a desired temperature range. *See, e.g.,* Ex.1001, 3:33-39; Ex.1002, ¶¶220.

Giere673 teaches "**controlling the temperature of the substrate**" by manipulating different "printing parameters [which] can include **pulse widths, pulse rates, ink ejection chambers 418 to be fired and when they will be fired, warming using non-ejecting devices, and firing voltages** that act as the inputs for the actual substrate temperature profile 610." Ex.1005, 6:52-57; 9:33-38. "**This rate, width and order of firing** are programmed, and if necessary, **adjusted in the programming**, so that the temperature of the heater array 611 [*pink, below*], and therefore the temperature of the ink in the chamber array 612, are maintained at an optimum temperature for the formation of ink droplets." Ex.1005, 9:13-18. Thus, Giere673 discloses that the heater arrays receive non-nucleating heating (e.g., adjustments to pulse width) responsive to the sensed temperature. Ex.1005, 9:18-20; 3:7-12, 6:21-28, 6:52-57 ("warming using non-ejecting devices"); Ex.1002, ¶ 221.

I. Claim 10

Benjamin-Giere673 discloses that the non-nucleating heating responsive to the temperature of the region sensed by the temperature sensing element is of a short duration such that ink will not be ejected from the first via or the second via during the non-nucleating heating," for the reasons in Section VIII.I(Claim 9) because the

pulse width adjustments made by Benjamin-Giere673 will be of a short duration such that ink will not be ejected from the heater arrays. Ex.1002, ¶¶224;Ex.1005, 9:18-20("The temperature logic system also generates firing voltages 814 and **activates heater elements that do not eject ink 816**."); 6:52-57 ("warming using non-ejecting devices"); 9:33-38 ("limit [shorten] pulse width"); Ex.1002, ¶¶223-224.

J. Claim 12

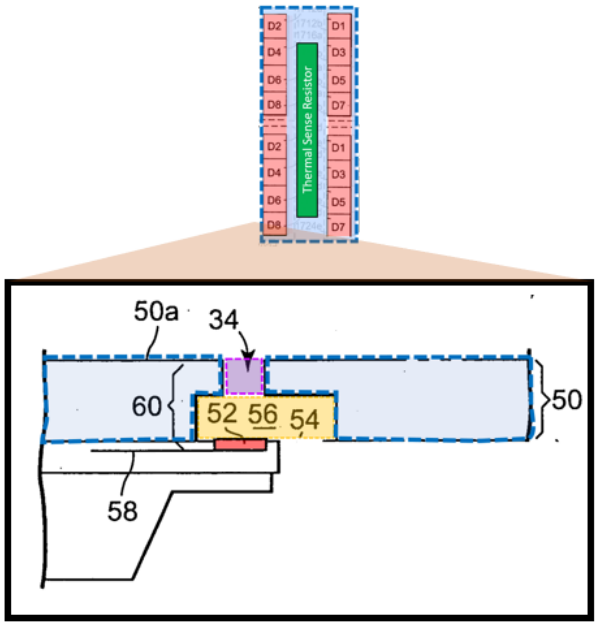
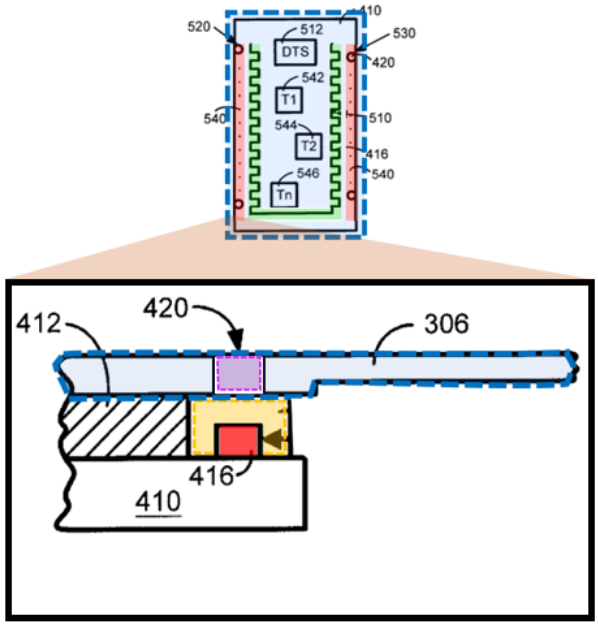
Benjamin-Giere673 discloses that "positioning a temperature sensing element in the region comprises positioning a temperature sensing element in substantially the center of the region," for the same reasons as 1[D] and 1[J] because a temperature sensor that is positioned "substantially the center" of a region [claim 12] is also "substantially centrally" disposed within that region [Claim 1]. Ex.1002, ¶ 228-230.

K. Ample Motivation Existed to Make the Combination

As an initial mater, Benjamin and Giere673 both qualify as analogous art to the claimed invention at least because they are both in the same field of endeavour as the '823 patent—namely, regulating operational temperature of a printhead die. At the very least, Benjamin and Giere673 are both reasonably pertinent to maintaining the optimal temperature of a multi-via heater chip allegedly solved by the inventors of the '823 patent. Ex.1002 ¶ 240.

As another point, ample motivation existed to combine Benjamin with Giere673 for several reasons. Ex.1002, ¶¶239-262.

First, because Benjamin fails to specify where the TSR should be disposed to optimize print quality, a PHOSITA would have looked beyond Benjamin and considered Giere673. Ex.1002, ¶¶242-246. Benjamin and Giere673 both share to the same assignee—*viz.,* Hewlett-Packard Development Company L.P. (Ex.1004, 1; Ex.1005, 1)—and both involve the same field of endeavour— *viz.*—regulating operational temperature of a printhead die for a printing device—and similar printing devices within that field. Ex.1002, ¶240. Referring to the illustration below, the printhead dies of Benjamin and Giere673 both include at least two adjacent ink channels (*not shown*) for feeding ink into a chamber (*yellow below*) and at least two adjacent heater arrays (*red*) for vaporizing the ink within each channel and ejecting drops of the vaporized ink through a nozzle (*purple*) onto a print media, such as paper. Ex.1002, ¶242.

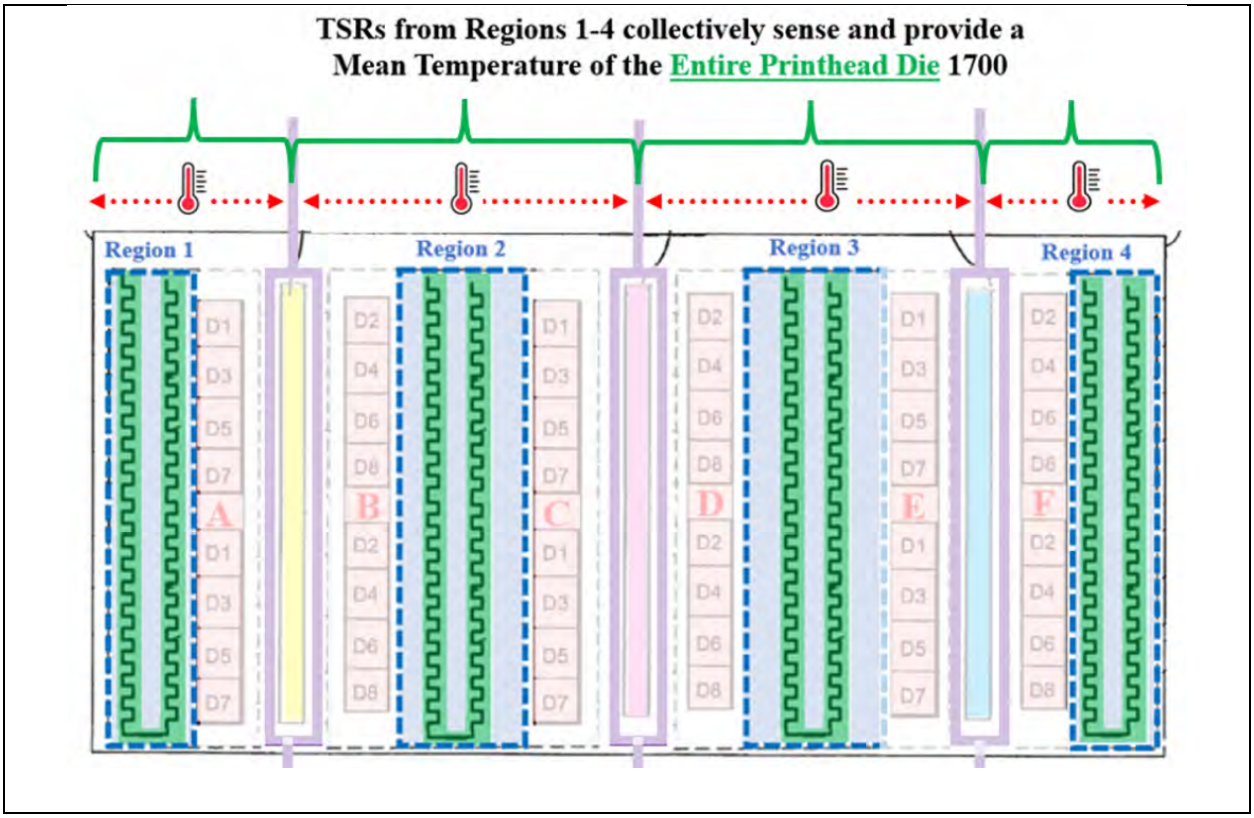
Benjamin's Printhead Die	Giere673 Printhead Die
	

Moreover, Benjamin and Giere673 both address similar problems in their shared field— *viz.,* reduced print quality caused by the printhead die operating outside its optimal temperature —and both provide a similar solution to that problem— *viz.,* disposing a temperature sense resistor (TSR, *green*) on the printhead for determining the mean temperature of the printhead and using a controller to maintain the printhead at its optimal temperature by, for example, lengthening and shortening the firing pulses sent to the heater arrays. Ex.1002, ¶243.

Second, Giere673 itself expressly motivates the combination for the reasons set forth in 1[D]. Ex.1002, ¶¶244-251.

Third, a PHOSITA would not only have motivated by the advantages yielded by Giere673's temperature control system, but would have recognized it as necessity for Benjamin's Printhead Die 1700 "[t]o operate over the widest range of environmental temperatures and the heaviest printing (drop firing) loads." Ex.1002, ¶¶252-256 (combining Giere673's temperature monitoring system with Benjamin's printhead die "adequately allow for countermeasures against the soft and hard failure modes known to occur" in Benjamin's printhead die, including "reduced or unacceptable print quality" and "the 'burn out' of the heater resistor"); 257 ("excessive localized heating of the substrate without compensation for the substrate temperature change can lead to degradation in print quality."); Ex.1007, 5:36-51 ("localized heating of the substrate can occur from firing nozzles at a greater frequency in a particular region of the printhead.").

Benjamin-Giere673



Third, the simple, routine, and low-cost nature of the combination, including adding a temperature controller and thermal sense resistors to a printhead die, would have further motivated a PHOSITA. Ex.1002, ¶¶258-60.

Finally, a PHOSITA would have also had a reasonable expectation of success adding the temperature controller 110 and TSRs 510 from Giere673 to the printhead die 1700 of Benjamin's printhead assembly. Ex.1002, ¶259. Benjamin's printhead die comprises generic components providing known temperature measurement features found in "typical thermal inkjet printing systems," Ex.1004, 80:19-27; and Giere673's temperature controller and thermal sensor resistors "can be incorporated

in any printhead configuration," Ex.1005, 4:7-8. Moreover, while certain figures and descriptions in Benjamin and Giere673 refer to different embodiments, these embodiments are disclosed in adjacent figures, and both Benjamin and Giere673 confirm the interchangeable nature of the various embodiments. Ex.1004, 80:19-26; Ex.1005, 9:42-47. Thus, ample motivation existed to make the combination.

IX. GROUND 2: BENJAMIN AND GIERE673 IN FURTHER VIEW OF PARISH RENDERS CLAIMS 4 and 14 OBVIOUS

A. Claims 4 and 14[10]

Benjamin-Giere673 in view of Parish discloses that "the temperature sensing element comprises an n-type implant donor thermal sensing resistor." Ex.1002, ¶¶262-268.

Parish teaches that the "temperature sense element is or comprises a temperature sense resistor (TSR) 64," which "can include a **N-type source drain (NSD) material**, a N-well layer material, a P-type source drain (PSD) material, a lightly doped drain (LDD) material or another suitable material." Ex.1006, 5:35-39.

B. Ample Motivation Existed to Modify the Benjamin-Giere673 Combination in View of Parish

As an initial mater, Benjamin, Giere673, and Parish all qualify as analogous art to the claimed invention at least because they are both in the same field of

[10] Claim 14 mirrors claim 4, and therefore, is disclosed for the same reasons.

endeavour as the '823 patent—namely, regulating operational temperature of a printhead die. Ex.1002, ¶270. At the very least, Benjamin, Giere673, and Parish are reasonably pertinent to maintaining the optimal temperature of a multi-via heater chip allegedly solved by the inventors of the '823 patent. *Id.*

Moreover, for claims 4 and 13 in particular, ample motivation existed to combine Benjamin-Giere673 with Parish. Ex.1002, ¶271.

First, because Benjamin and Giere673 fail to specify *what* type of TSR should be use to optimize print quality, a PHOSITA would have looked beyond Benjamin and Giere673 and considered Parish. Ex.1002, ¶272.

Second, a PHOSITA would have understood that an n-type thermal sense resistor is a common and well-known material choice for thermal sensor resistors and known amongst the skilled in the art as particularly suited for use in printing applications. Thus, Benjamin and Giere673's failure to identify the material composition of TSR 512 does not preclude a PHOSITA from understanding it to be an n-type implant donor thermal sense resistor. Ex.1002, ¶273.

Third, a PHOSITA would have been motivated to select an n-type implant donor thermal sensing resistor for the TSR disposed on the multi-via printhead die of Benjamin-Giere673, as taught by Parish, because doing so would provide more

accurate readings than those from metal resistive elements, such as aluminium. Ex.1002, ¶¶274-76.

Not only were "temperature sense resistors compris[ing] … NSD materials" well known, they were "preferred" over "over metal TSRs" because the "advantages" of using "implants, such as NSD" on thermal inkjet printheads were also well-known. Ex.1014, 1:26-29, 4:37-41. Even the '823 Patent recognizes that n-type materials were well-known in the art and had long been used in inkjet printing applications. Ex.1001, 6:25-29.

Finally, to the extent that the TSRs of Benjamin-Giere673 do not already comprise an n-type material, a PHOSITA would also have had a reasonable expectation of success of replacing each TSR with thermal sensing elements n-type implant donor thermal sensing resistors (as taught by Parish). Ex.1014, 7:20-25 (n-type TSR "can be used in conjunction with …print heads 10 having other dimensions and features, and the like"); Ex.1004, 80:19-27 (printhead die 1700 and temperature controller 100 are "typical thermal inkjet printing systems"); Ex.1005, 4:7-8 (TSR 510 and temperature controller 100 "can be incorporated in any printhead configuration,"); Ex.1002, ¶277 (integrating Parish's n-type TRS within Benjamin-Giere673's Printhead Die 1700 requires "routine modifications").

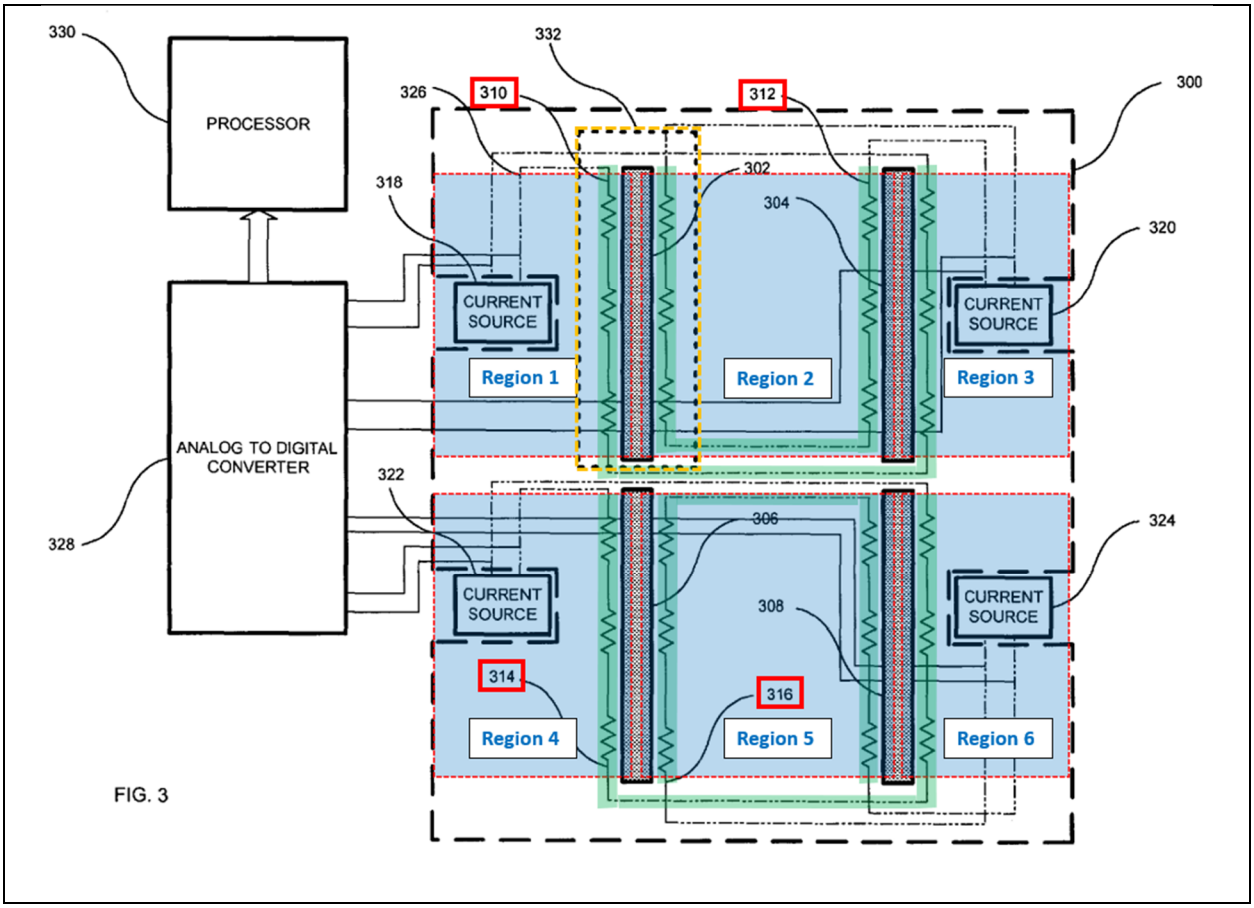
Thus, ample motivation existed for a PHOSITA to make the Benjamin-Giere673-Parish Combination. Ex.1002, ¶¶269-283.

X. GROUND 3: BENJAMIN IN VIEW OF GIERE178 RENDERS OBVIOUS CLAIMS 1-3, 5-13, and 15-17

To the extent that the Board finds that a PHOSITA lacked the knowledge and common sense to position the temperature sense resistor within each thermal region of Benjamin's Printhead Die 1700, then Benjamin in view of Giere178 (Benjamin-Giere178) discloses claims 1-3,5-13, and 15-17.

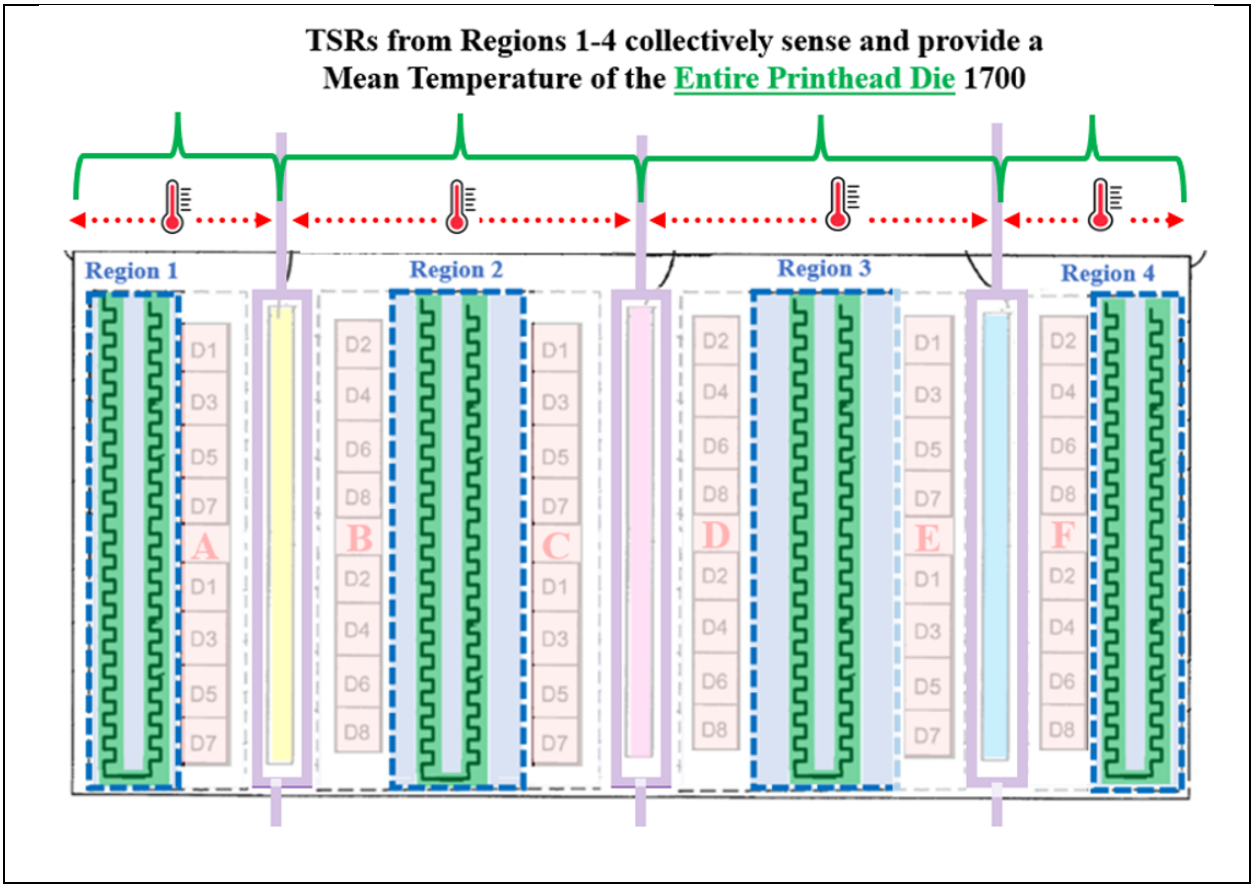
Per Section VIII.A, since Benjamin does not explicitly say *where* the TSR should be disposed on the Printhead Die 1700, a PHOSITA would have also considered Giere178, which expressly teaches positioning a *single* TSR (e.g., resistive elements 310, 312, 314, 316, *green*) within *every* thermal region (Regions 1-6, blue) of a multi-via printhead die (e.g., substrate 300). Ex.1002, ¶¶415-426.

Ex.1007, Fig.3



Thus, to optimize printing quality, a PHOSITA would have combined Benjamin with Giere178 by disposing a *single* TSR within *every* thermal region [e.g., Region 1, 2, 3, 4, blue] so that the temperature value *collectively* provided by the TSRs within Regions 1-4 reflect the mean temperature of Benjamin's ***entire printhead die***, as illustrated below. Ex.1002, ¶¶415-426.

Benjamin-Giere178



A. Claim 1

1. 1[P]-1[C], 1[G]-1[I]

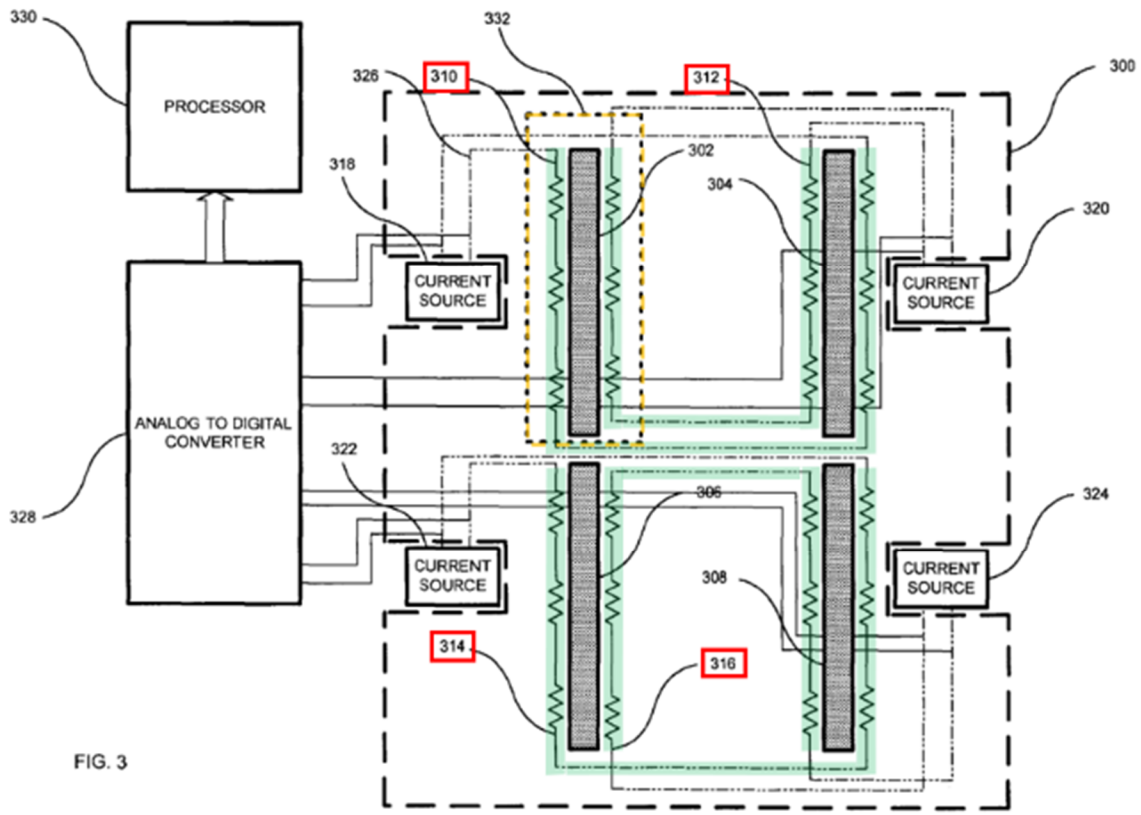
Benjamin discloses 1[P]-1[C] and 1[G]-1[I] for the reasons provided in Section VIII.A., incorporated here. Ex.1002, ¶¶284-365.

2. 1[D]-[F] "a temperature sensing element … operable to sense a temperature of the region … [and] substantially centrally disposed … and substantially adjacent … and … substantially the length of … heater array[s]"

Benjamin-Giere178 discloses 1[D]-1[F]. Ex.1002, ¶¶319-338.

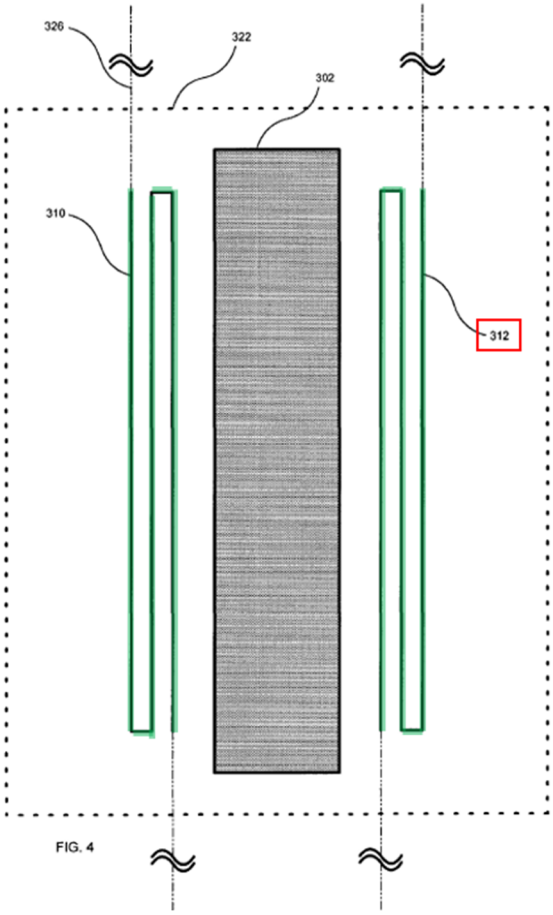
Giere178's temperature measurement system includes ***four*** temperature sensing resistors—"**resistive elements 310, 312, 314, and 316** [*green*]—each located in a thermal region of the substrate 300. Ex.1007, 8:49-51; Ex.1002, ¶319.

Ex.1007, Fig.3



Like the '823 Patent, Giere178's resistive elements have a serpentine path. Ex.1007, 10:24-29 ("**serpentine routed resistive element**."); 11:24-30; Fig. 4 ("resistive elements 310 and 312," *below*); Ex.1002, ¶321.

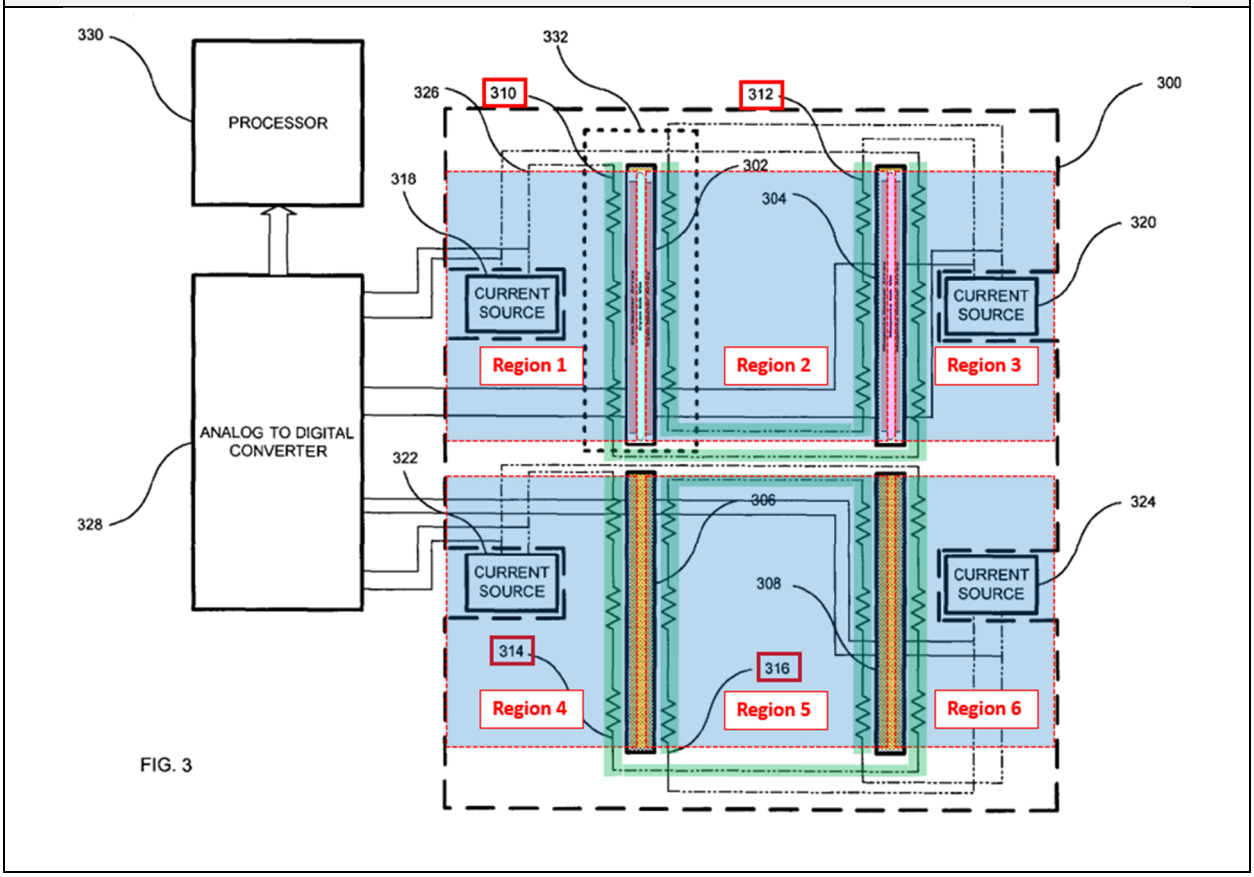
Ex.1007, Fig.3



Giere178's resistive elements are "**located so that they will each assume the temperature of the local region of substrate 300 on which they are** placed." Ex.1007, 8:41-60; 10:7-8 (resistors "estimate **changes in the temperature in the regions of substrate 300**."); Ex.1002,¶322.

Each region of Giere178's substrate 300 includes a single temperature sensing resistive element (*green* below). Ex.1002, ¶323.

Ex.1007, Fig.3



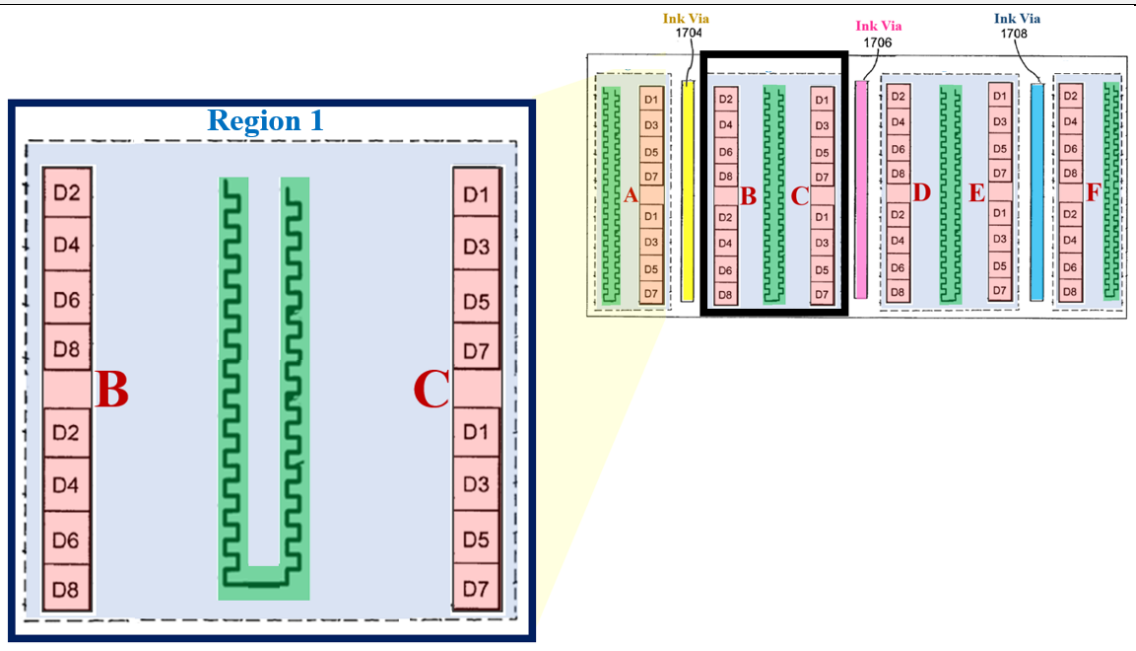
A PHOSITA would also know that Giere178 includes a temperature sensor in each region because its solving a problem of excessive *localized* heating of the substrate in each region. Ex.1007, 5:36-51; 5:52-6:3, 5:44-46, 5:49-51, 5:62-6:3, 8:51-54; Ex.1002, ¶¶324-325.

The temperature sensed by the resistor also senses the temperature of the adjacent heater arrays because the substrate's temperature in that region changes based on the heat generated by the firing resistors. Ex.1007, 5:39-46 ("The **rate at**

which signals are supplied to [firing] resistors associated with the ink ejection chambers affects the temperature of the substrate of the printhead."); Ex.1002, ¶335 (reaching same conclusion due to insulating nature of ink vias).

A PHOSITA would understand "the temperature sense resistor [e.g., resistive element 312, *green below*]" is at least in *substantially* a center portion—if not exactly in the center—of the region (Region 2), especially since Giere178 states that "[r]esistive elements 310, 312, 314, and 316 are located so that they will each assume the temperature of the local region of substrate 300 on which they are placed." Ex.1007, 8:51-54; Ex.1002, ¶329 (opining that a PHOSITA would place the element in *substantially* a center portion to sense the median temperature region).

Benjamin-Giere178



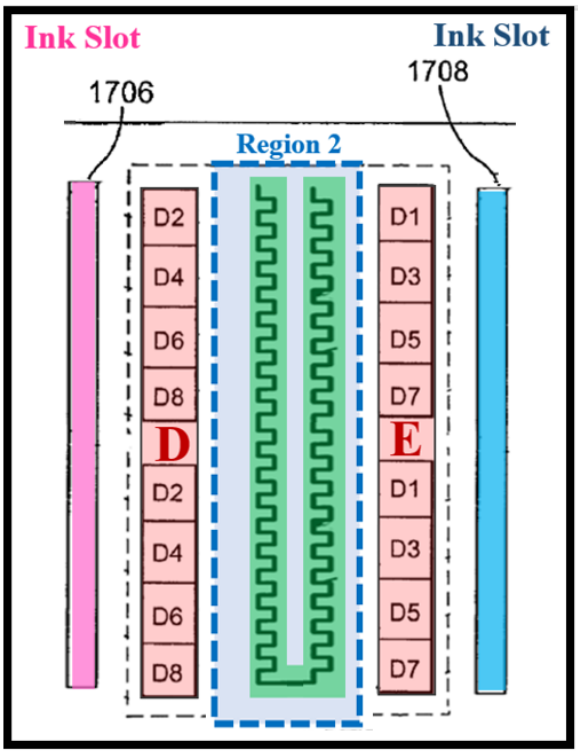
Giere178 discloses that signals from the four temperature sensing resistive elements are converted to digital values that are used to determine the temperature of the regions of the substrate where the resistive elements are located. Ex.1007, 9:44-48 ("By comparing the digital values after pulses have applied to the firing resistors and before pulses have been applied to the firing resistors, a measurement of the temperature change of regions of substrate 300 can be determined."); Ex.1007, 8:60-64; 10:4-8; Ex.1002, ¶333-334. Giere178's digital values are received by "**processor 330** [*yellow*]" that converts them to "digital values that are related to temperatures of substrate 300 in the vicinity of regions 302, 304, 306, and 308." Ex.1007, 9:29-33.

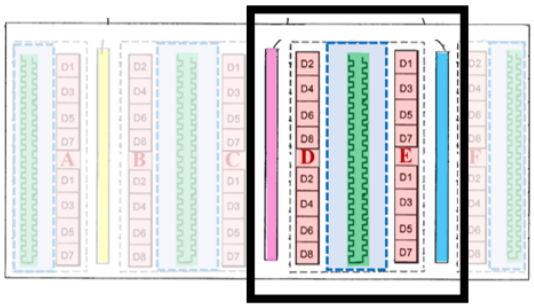
Giere178 further states that its "temperature compensation system," including processor 330 and localized temperature sensors, "may adjust the pulse width of the **drive signals supplied to the firing resistors** s**o that the temperature of [the] substrate [] is controlled substantially at a desired temperature**." Ex.1007, 9:50-60; 9:50-54. In other words, Giere178 discloses that firing resistors (e.g., heater arrays) are operable to receive heating (e.g., drive signals) responsive to the temperature of the region sensed by the temperature sensing element (e.g., resistive elements 310, 312, 314, and 316), and wherein the received heating regulates the temperature of the region.

3. 1[J]-1[L]

Benjamin-Giere178 discloses 1[J]-1[L] for the same reasons as 1[D]-[1F], respectively. Ex.1002, ¶¶352-365.

Benjamin-Giere178





B. Claim 2

Benjamin-Giere178 discloses the limitations added by claim 2 for the reasons stated above in 1[D]-[F]. Ex.1002 ¶¶366-369.

C. Claims 3 and 13

Benjamin-Giere178 discloses the limitations added by claims 3 and 13 for the reasons stated above 1[D]-[F]. Ex.1002, ¶370-373, 407-408.

D. Claims 5 and 15

Benjamin-Giere178 discloses the limitations added by claims 5 and 15. Ex.1002, ¶¶374-378, 409-410.

Giere178 discloses that resistive elements (310, 312, 314, and 316) are located outside the regions (302, 304, 306, and 308) that include the nozzle arrays and associated firing resistors for ejecting ink. Ex.1002 ¶326. It would have been obvious to a PHOSITA that Giere178's resistive elements could be located at least 300 microns from its heater arrays because Giere178 discloses resistive element layouts that include positioning the resistive element at *any point* within its respective region of substrate 300 without restriction on exactly where in that region the element must be placed. Ex.1007, Fig. 3; 8:51-54. In other words, 300 microns would be a design choice. Ex.1002, ¶376.

E. Claims 6 and 16

Benjamin-Giere178 discloses claims 6 and 16. Ex.1002, ¶¶379-382, 411-412.

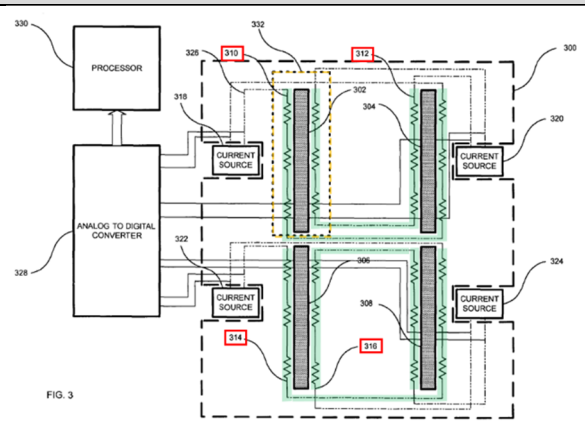
Giere178 defines a typical inkjet printhead as "a silicon substrate having a plurality of thin film layers, **structures built on the substrate**, and connections to the substrate." Ex.1007, 2:59-61; 8:45-46; Ex.1002, ¶380. A PHOSITA would

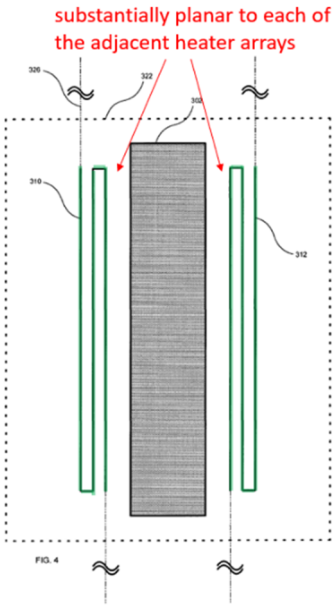
have understood that structures built on a plurality of a substrate's thin film layers would be in substantially the same plane. Ex.1002 ¶330. As such, Giere178's "resistive elements" are positioned substantially planar to each of the adjacent heater arrays (e.g., arrays of ink firing resistors in regions 302, 304, 306, and 308) because they are structures built on substrate 300. *Id*.

Moreover, as illustrated in Figures 3 and 4 (below), resistive elements 310, 312, 314, and 316 are positioned substantially planar along the entire length of the ink via and heater array region, *but not positioned directly above or overlapping the*

ink via and heater array region, as required by the '823 Patent. Ex.1002, ¶331-333; Ex.1007, 10:23-26; Ex.1001, 3:11-13.

Ex.1007, Figs. 3 and 4



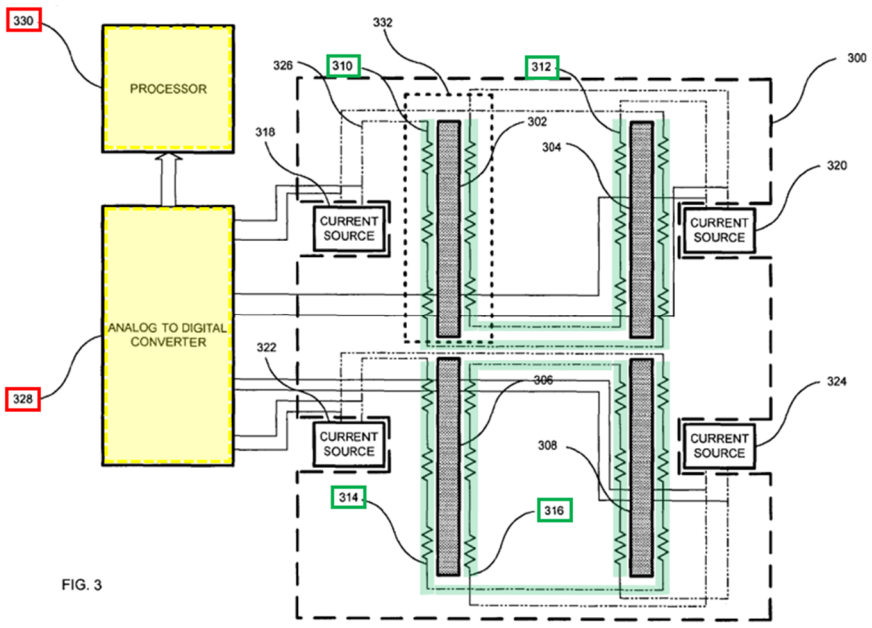


F. Claim 7

Benjamin-Giere178 discloses claim 7. Ex.1002, ¶¶383-391.

Giere178 discloses "**analog to digital converter 328** [*yellow*] includes 4 channels that each **receive a voltage value related to the voltage across resistive elements 310, 312, 314, and 316.**" Ex.1007, 9:10-15; Fig. 3. The digital values are received by "**processor 330** [*yellow*]" that converts them to "**digital values that are related to temperatures of substrate 300 in the vicinity of regions 302, 304, 306, and 308**." Ex.1007, 9:29-33; Fig. 3.

Ex.1007, Fig. 3



Upon the resistive elements sensing the temperature, Giere178's firing resistors (heater arrays) receiving heating via "drive signals," which may "**adjust the pulse width of the drive signals supplied to the firing resistors** so that the **temperature of substrate 300 is controlled** substantially at a desired temperature." Ex.1007, 9:50-53; 9:54-58; 9:58-64.

While Giere178 does not depict the controller on the printhead die, a PHOSITA would have placed the Analog to Digital Converter 328 and Processor 330 on Benjamin's printhead die 1700 to reduce the number of external connections from the substrate to the printer, thereby simplifying its design and manufacture, an

improving the sensor's signal-to-noise reliability. Ex.1002, ¶340-342. Giere178 even incorporates by reference such well-known design. Ex.1007, 8:27-40; Ex.1002 ¶390.

G. Claim 8

Benjamin-Giere178 discloses claim 8 for the same reasons as 1[D]-[F], incorporated here, because a PHOSITA would not only understand that Benjamin-Giere178 provides a single resistive elements (TSR) in all four thermal regions created by the three ink vias on Benjamin's printhead die, but also that these TSRs are different than each other because they are in different regions of the printhead die, associated with different heater arrays, have different electrical connections, and produce different temperature measurements. Ex.1002, ¶¶392-395.

H. Claims 9 and 17

Benjamin-Giere178 discloses claims 9 and 17 because the combined system makes adjustments to firing rate, firing voltage, or pulse width based on the temperature of the region sensed by the TSR. Ex.1002, ¶¶396-398, 413-414.

I. Claim 10

Benjamin-Giere178 discloses claim 10 because the combined system makes pulse width adjustments of a short duration such that ink will not be ejected from the heater arrays. Ex.1002, ¶¶399-401.

J. Claim 12

Benjamin-Giere178 discloses claim 12 for the same reasons as 1[D] and 1[J] because a temperature sensor that is positioned "substantially the center" of a region [Claim 12] is also "substantially centrally" disposed within that region [Claim 1]. Ex.1002, ¶¶404-406.

K. Ample Motivation Existed to Make the Combination

Benjamin and Giere178 both qualify as analogous art to the claimed invention at least because they are both in the same field of endeavour as the '823 patent—namely, regulating operational temperature of a printhead die. At the very least, Benjamin and Giere178 are both reasonably pertinent to maintaining the optimal temperature of a multi-via heater chip allegedly solved by the inventors of the '823 patent. Ex.1002, ¶240.

Additionally, ample motivation existed to combine Benjamin with Giere178. Ex.1002, ¶¶239-262.

First, a PHOSITA would have looked beyond Benjamin and considered Giere178 because both share to the same assignee—*viz.,* Hewlett-Packard Development Company L.P.—both involve the same field of endeavour—regulating operational temperature of a printhead die for a printing device—both provide a similar solution to solve the same problem— *viz.,* monitoring printhead die's

temperature using TSRs and maintaining an optimal temperature by, for example, lengthening and shortening the firing pulses sent to the heater arrays.

Second, Giere178 itself expressly motivates the combination for the reasons set forth in 1[D], Ex.1007, 5:52-6:3; 5:49-51 ("*localized heating* of the substrate can occur from firing nozzles at a greater frequency *in a particular region of the printhead*" and "[i]f at least some compensation is not made for these temperature changes, a perceptible degradation in print quality can result"). Giere178 places a "resistive elements" in each thermal region "so that they will each assume the temperature of the local region of substrate [] on which they are placed." Ex.1007, 8:51-54; *see also* 5:36-51, 9:50-60.

Finally, a PHOSITA would have also had a reasonable expectation of success adding the temperature controller 110 and resistors from Giere178 to the printhead die 1700 of Benjamin for the reasons provided in Section VIII.K. Ex.1002, ¶¶418-420.

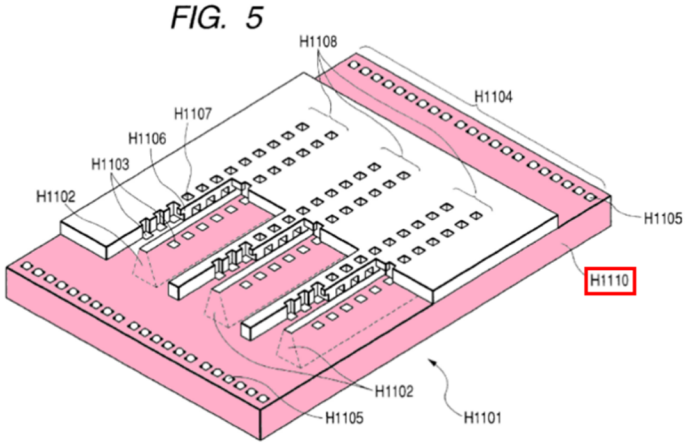
XI. Ground 4: Yabe In View of Giere673 Renders Obvious Claims 1-3, 5-10, 11-13, and 15-17

A. Claims 1 and 11[11]

1. 1[P] "A chip"

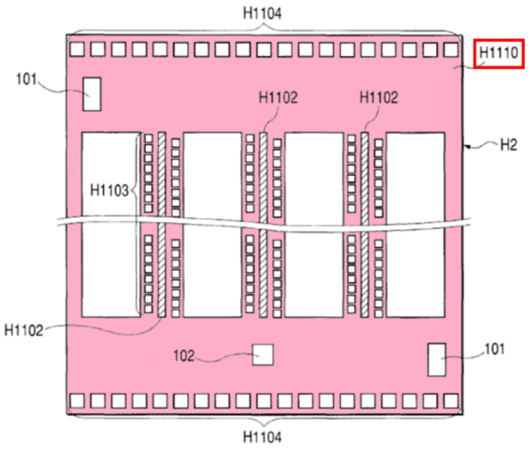
To the extent it is found limiting, Yabe discloses this limitation. Ex.1002 ¶¶427-432. Yabe discloses second recording element base plate H1101 includes silicon base plate H1110 (*pink*) in Figure 5 below. Figure 14 (below) illustrates a layout for the heater board that corresponds to the layout of H1101 shown in Yabe's Fig. 5. Ex.1008, 16:31-34. Silicon base plate H1110 is shown in pink below in both Figures 5 and 14.

Ex.1008, Figs. 5 and 14



[11] *Supra*, FN2. Ex.1002, ¶¶553-555.

FIG. 14



Yabe Fig. 16 depicts a printing device (i.e., **ink jet recording apparatus**) that mounts to a **recording head cartridge H1000** that includes second recording element base plate H1101.

Accordingly, Yabe discloses "**a chip** [e.g., second recording element base plate H1101 having silicon base plate H1110] **for use with a printing device** [e.g., inkjet recording apparatus]." Ex.1002 ¶¶427-432.

2. 1[A] "a first heater array…first via"

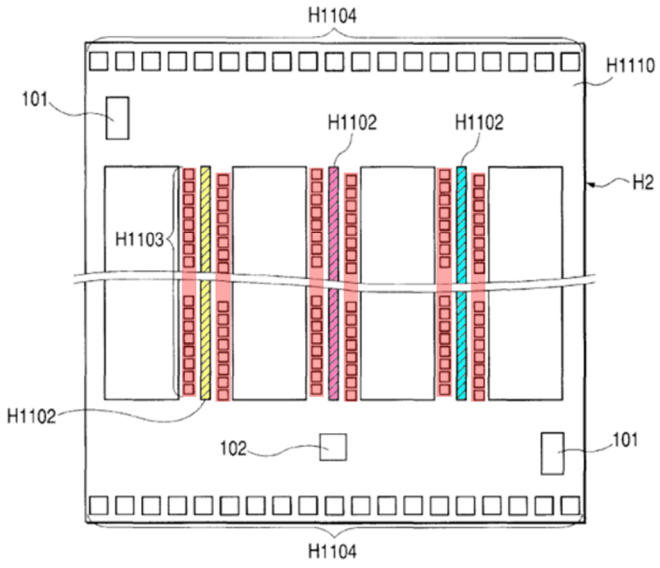
Yabe discloses 1[A]. Ex.1002 ¶¶433-441.

Yabe teaches heaters (i.e., **electrothermal converting devices H1103**) that generate thermal energy for creating film boiling in ink in accordance with electric signals. Ex.1008, 16:31-34 ("Si base plate H1110 provided with the **electrothermal converting devices (heaters) H1103**."); 7:27-31, 8:38-43; 12:6-11; Ex.1002, ¶443.

Yabe's Figure 14 (below) discloses multiple lines (e.g., arrays) of heaters H1103 (e.g., heater arrays) (*pink*). As seen in corresponding Figure 14 below, Yabe discloses electrothermal converting devices H1103 arranged in six arrays.

Ex.1008, Fig. 14

FIG. 14



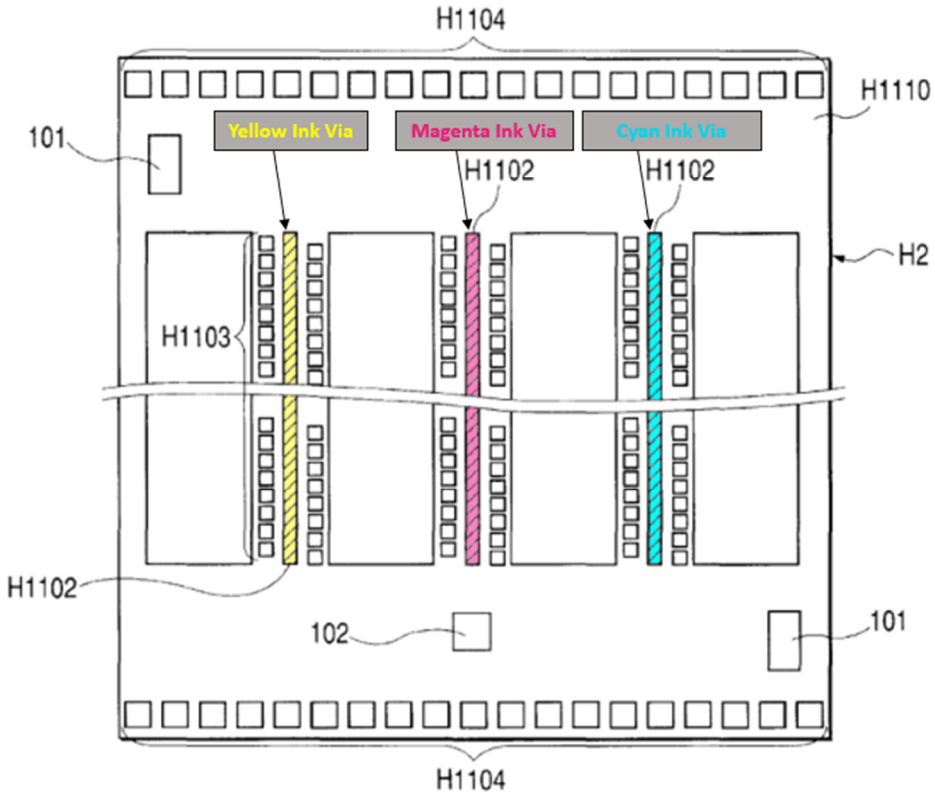
Yabe also teaches a chip having a plurality of ink vias (i.e., **ink supply ports H1102**) arranged parallel to one another. Ex.1002, ¶435. As illustrated in Fig. 14 below, Yabe teaches that "**[t]hree ink supply ports H1102 [*yellow, magenta, cyan*] are formed in parallel**, and **electrothermal converting devices H1103** and ink discharge ports H1107 **are formed on both sides having each of the ink supply**

ports H1102 between them." Ex.1008, 8:46-51; 7:60-62; 16:43, 16:31-34; *see also id.*, Figs. 1, 3.

A PHOSITA would have understood that Yabe's "ink supply ports" are synonymous with the claimed "via" because, like ink vias, they are elongated substrate grooves where "ink supplied from the ink supply port H1102 is discharged from the discharge ports H1107 by means of the bubbles generated by the heating action of the electrothermal converting devices H1103." Ex.1008, 8:39-43, 8:11-21; Ex.1002 ¶¶434-436.

Ex.1008, Fig. 14

FIG. 14

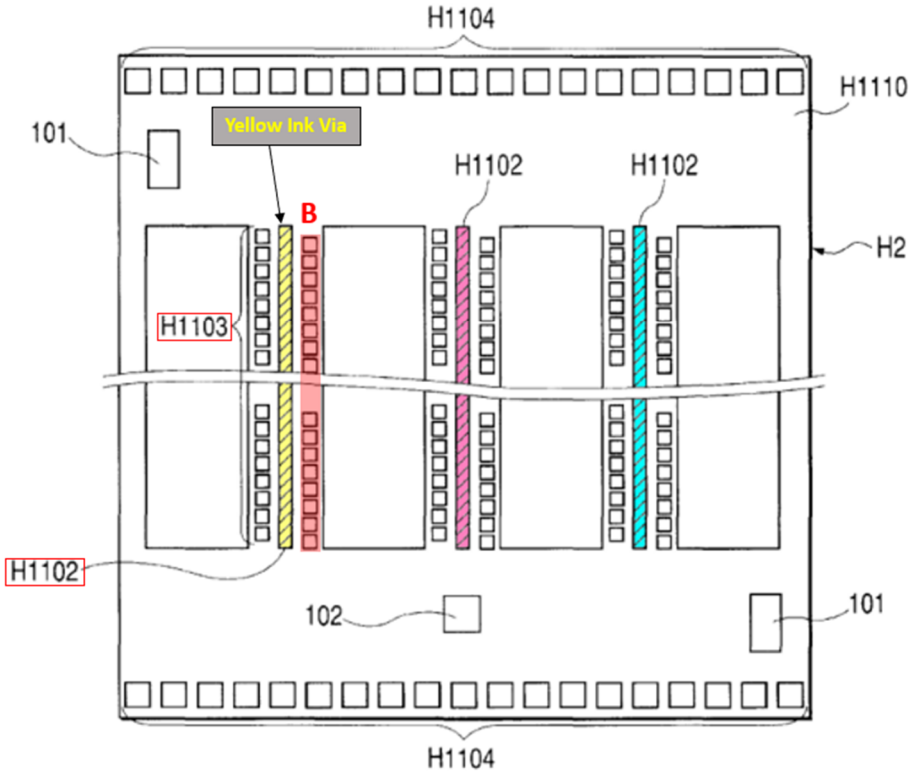


Yabe also teaches that its electrothermal converting devices (heaters) H1103 are arranged in a line (e.g., an array) substantially adjacent a first via. For example, Yabe teaches that "**[e]ach one line of the electrothermal converting devices H1103 is arranged** in the zigzag form, respectively, **on both side across the ink supply port H1102**." Ex.1008, 8:21-23; *see also id.*, 8:47-51. A line of electrothermal converting devices H1103, i.e., Heater Array B (*pink*), is substantially

adjacent, i.e., next to, a first ink via (e.g., yellow ink via H1102). Ex.1002, ¶¶438-439.

Ex.1008, Fig. 14

FIG. 14



A PHOSITA would have understood that Yabe's electrothermal converting devices H1103 (e.g., Heater Array B, *pink*) are positioned substantially adjacent a first ink via (e.g., yellow ink supply port H1102) because the array of heaters are lying next to the ink supply port. *See* Ex.1002 ¶440; Ex.1012; Ex.1013.

Accordingly, Yabe discloses "a **first heater array** [e.g., electrothermal converting devices H1103, Heater Array B] positioned substantially adjacent a **first via** [e.g., yellow ink supply port H1102]." Ex.1002 ¶¶427-441.

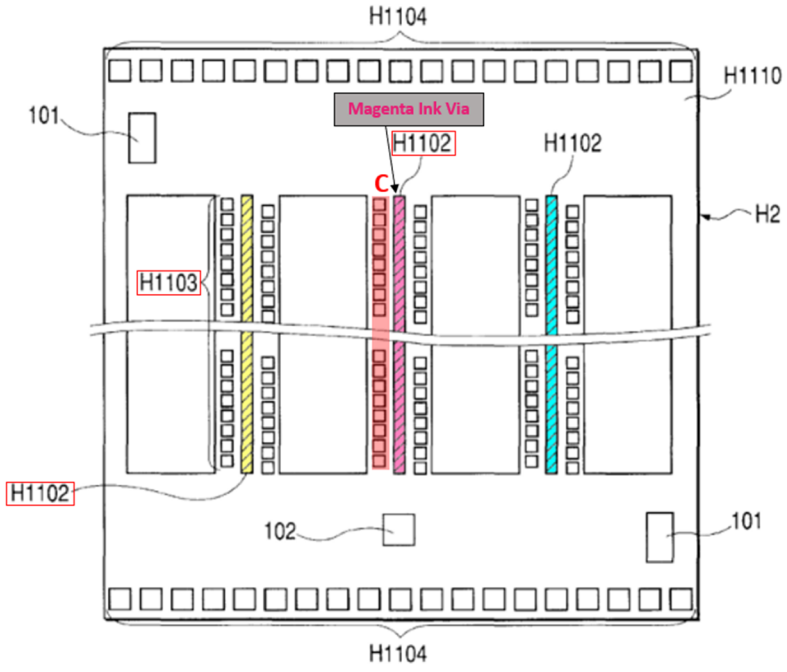
3. 1[B] "a second heater array…second via"

Yabe discloses 1[B]. Ex.1002 ¶¶442-446.

As discussed above in Section XI.A.2, incorporated here, Yabe teaches its electrothermal converting devices (heaters) H1103 are arranged in a line (e.g., an array) substantially adjacent a via (e.g., second via). As seen in Figure 14 below, a line of electrothermal converting devices H1103, i.e., Heater Array C (*pink*), is substantially adjacent, i.e., next to, a second ink via (e.g., magenta ink via H1102). Ex.1002 ¶¶444-445.

Ex.1008, Fig. 14

FIG. 14



Accordingly, Yabe discloses "a **second heater array** [e.g., electrothermal converting devices H1103, Heater Array C] positioned substantially adjacent a **second via** [e.g., magenta ink supply port H1102]." Ex.1002 ¶¶442-446.

4. 1[C] "a region"

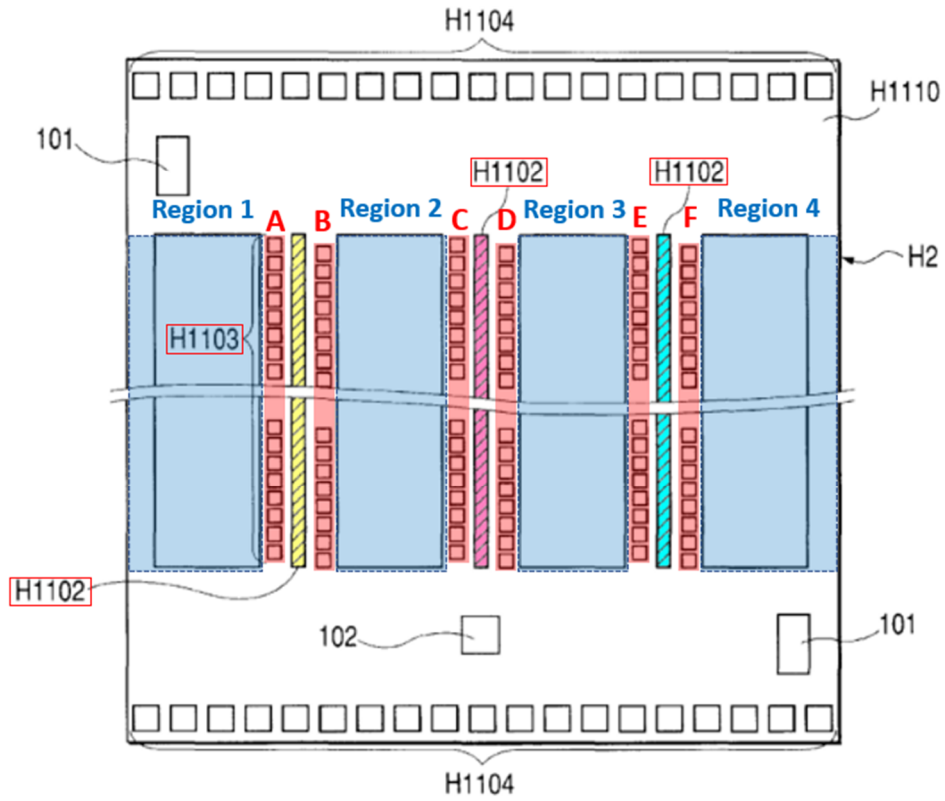
Yabe discloses 1[C]. Ex.1002 ¶¶447-452.

Yabe discloses four regions [Regions 1, 2, 3, and 4, **blue**] adjacent each heater array (e.g., electrothermal converting devices H1103) and situated either between two ink vias (e.g., ink supply ports H1102) or between an ink via and an edge of the

silicon substrate (H1110). Each region [**blue**] is also adjacent each heater array (e.g., electrothermal converting devices H1103 [*pink*]). Ex.1002, ¶448.

Ex.1008, Fig. 14

FIG. 14

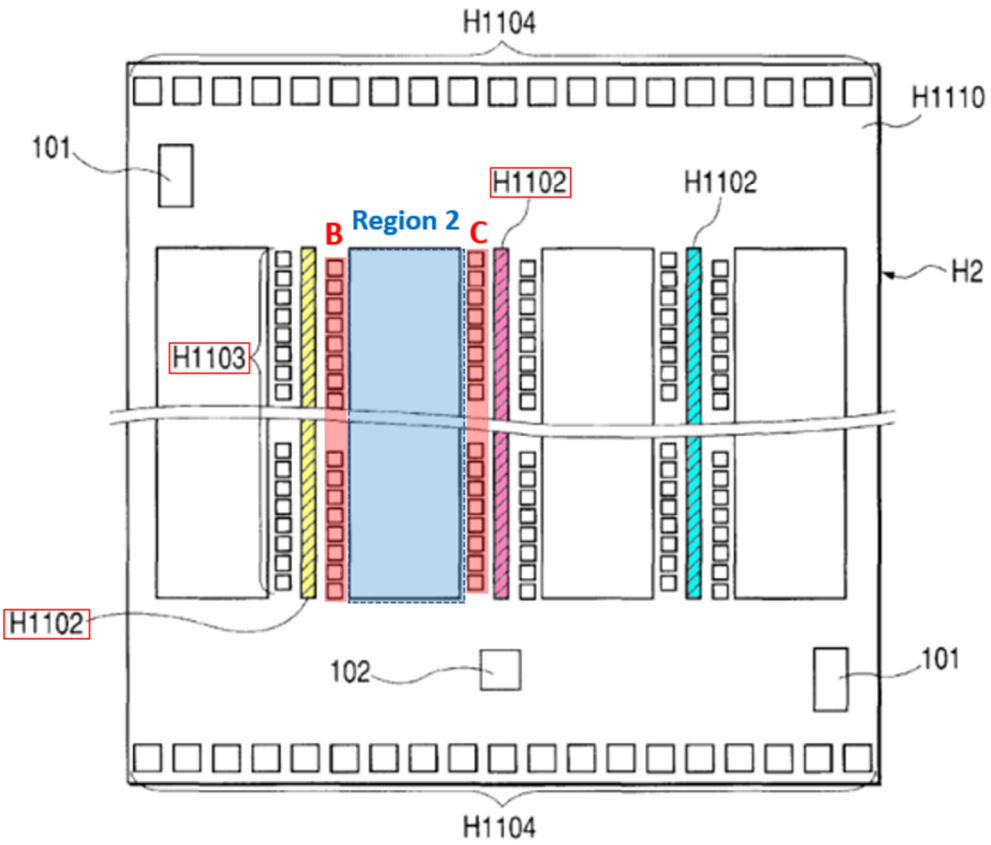


Yabe discloses a region (e.g., **Region 2**, blue) positioned between a first heater array (e.g., Heater Array B, *pink*) and a second heater array (e.g., Heater Array C, *pink*), and also positioned substantially adjacent to the first heater array (e.g., Heater

Array B, *pink*) and the second heater array (e.g., Heater Array C, *pink*). Ex.1002, ¶449.

Ex.1008, Fig. 14

FIG. 14



Since Yabe discloses three ink parallel ink via with heaters disposed on both sides, a PHOSITA would not only have understood that that a first region of the substrate extends between the ink vias and the associated heater arrays, but also that the region (Region 1) is positioned substantially adjacent to the first heater array

(Heater Array B) and the second heater array (Heater Array C) because the region is lying next to each of the first and second heater arrays. Ex.1008, 8:46-51; Ex.1002 ¶¶450-451.

Accordingly, Yabe discloses "a **region** [e.g., Region 2, *blue*] positioned between the **first heater array** [e.g., Heater Array B, *pink*] and the **second heater array** [e.g., Heater Array C, *pink*], and also positioned substantially adjacent to the **first heater array** [e.g., Heater Array B, *pink*] and the **second heater array** [e.g., Heater Array C, *pink*]." Ex.1002 ¶¶447-452.

5. 1[D]-[F] "a temperature sensing element … operable to sense a temperature of the region … [and] substantially centrally disposed … and substantially adjacent … and … substantially the length of … heater array[s]"

Yabe-Giere673 discloses 1[D]-1[F]. Ex.1002 ¶¶453-488.

While Yabe discloses one or more "temperature detecting means 102" (*green*), it does not *explicitly* teach disposing "temperature detecting means 102" substantially centrally with respect to the region substantially adjacent to both the first heater array and second heater array and further extending substantially the length of the first heater array and second heater array. Ex.1008, 2:11-12; 2:49-54; Ex.1002, ¶454.

Ex.1008, Figs. 12, 14

FIG. 12

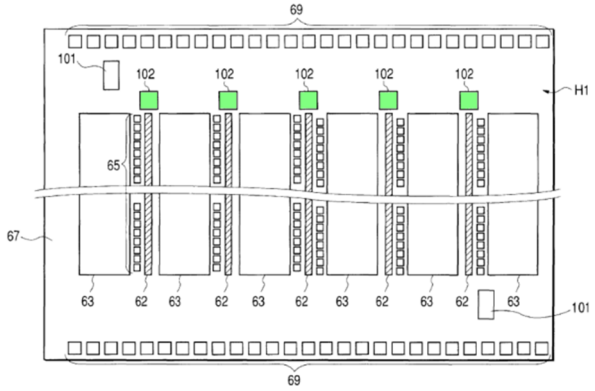
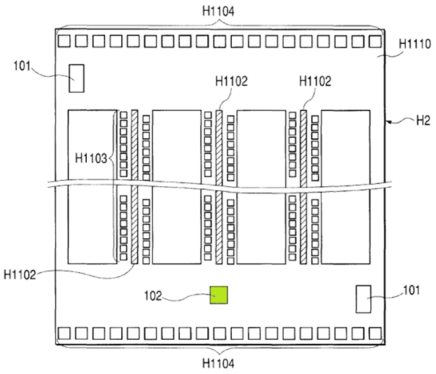


FIG. 14



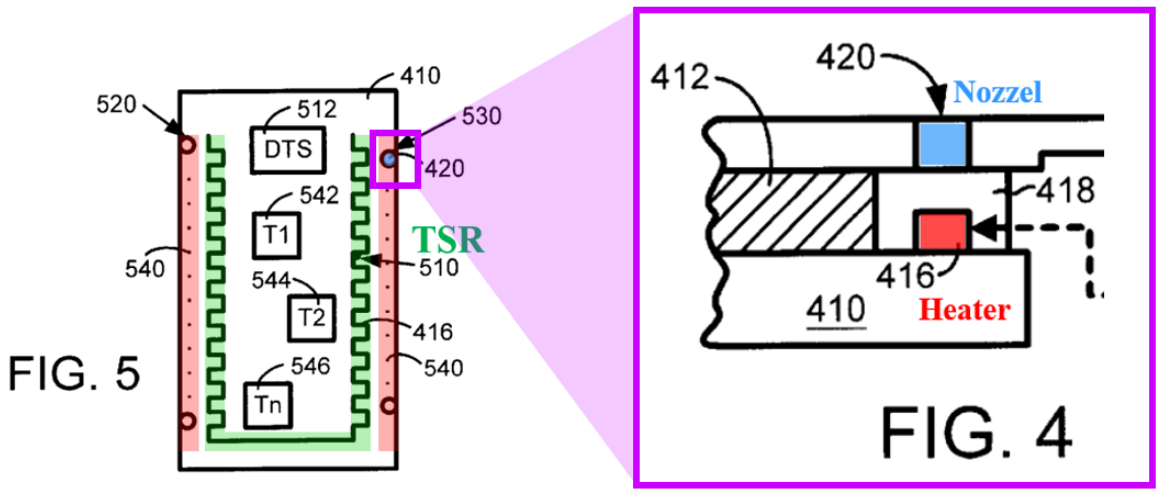
Giere678 uses "[o]ne or multiple TSRs 510 [to] provide an approximation of the ***mean temperature*** of the substrate [410]." Ex.1005, 4:55-56. And just like Yabe, Giere678 optimizes the print quality of the inkjet printer based upon the temperature value provided by the TSR. Ex.1002 ¶¶467 (explaining in greater detail functional benefits motivating the combination).

However, unlike Yabe, Giere678 explicitly discloses putting the TSR between heater arrays (and extending the length of the arrays) to provide a sufficiently accurate temperature value to meaningfully improve print quality. *Id*. Not only does Giere673 teach positioning a single temperature sensor—i.e., "temperature sensor resistor (TSR) 510 [*green below*]—between two heater arrays [*red*], but also that the TSR 510 "preferably is not located adjacent to any ***particular*** heating elements" so that the obtained TSR value "**reflects the temperature of the**

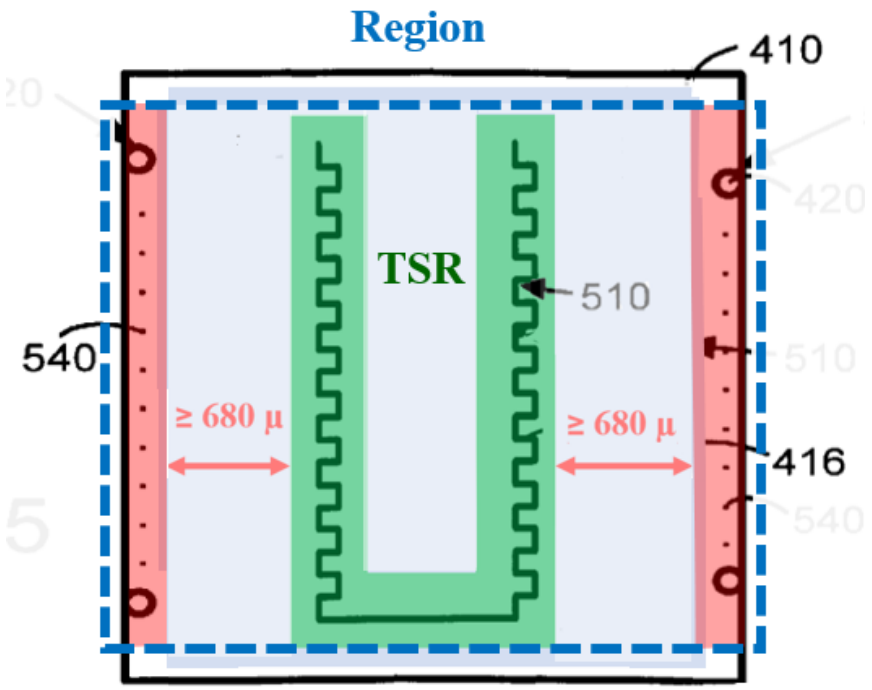
substrate 410 after heat has moved from the heating elements to the TSR 510." Ex.1005, 2:50, 4:51-56; Ex.1002, ¶456.

Giere673 also teaches that "[t]he TSR 510 is **located along the length of the substrate 410**" and "can have two legs that are approximately 680 µm inboard from the center of the columns of ink ejection elements 416," [*red in Figs. 4 and 5*]," which Giere673 teaches are positioned directly below the nozzle 420 [blue in Figs. 4 and 5]. Ex.1005, 5:5-12.

Giere673, Figs. 4 and 5



Ex.1005, Fig. 5

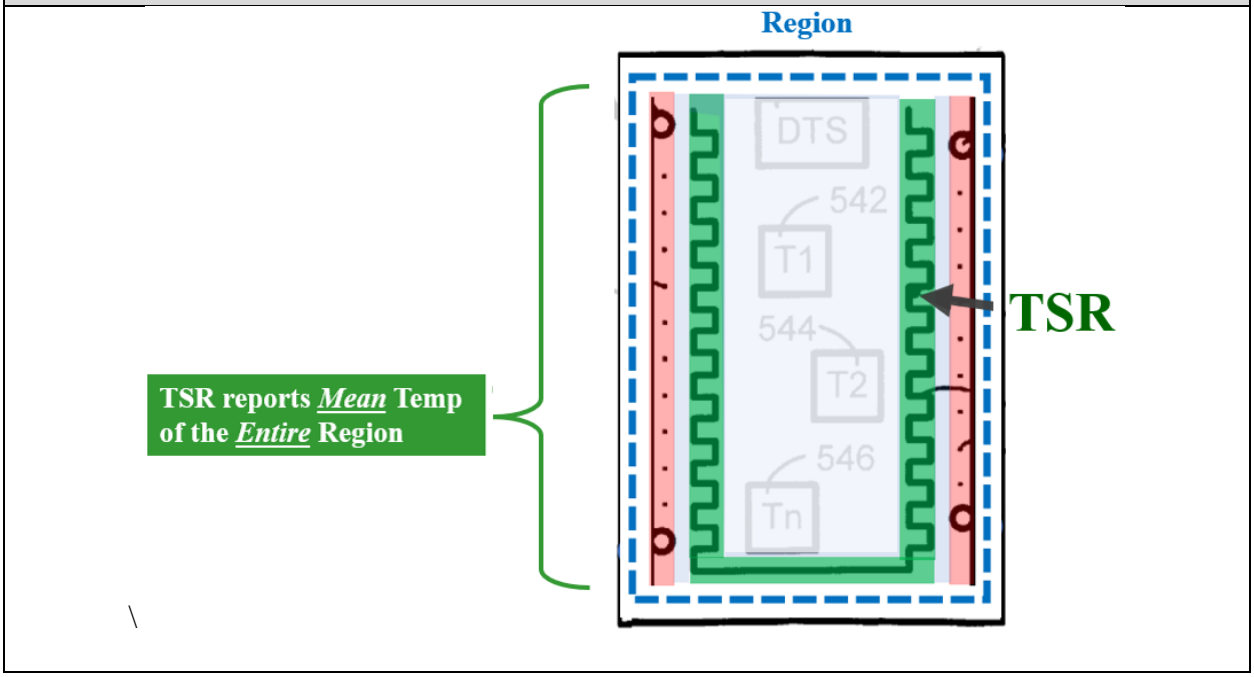


In other words, Giere673 teaches disposing a single temperature sense resistor (TSR) (*i.e.*, TSR 510, *green above*) in a region on the printhead die (region of the substrate 410, *blue*) adjacent two heater arrays (columns of ink ejection elements 416 and 540, *red*), and positioning that TSR equidistant from the two heater arrays but no less than "approximately 680 µm inboard from the center of the [heater arrays]." Ex.1005, 5:10-12; Ex.1002, ¶457.

By positioning the TSR in the centre of the region, Giere673 teaches that the TSR value obtained by the TSR "reflects heating elements firing that have already occurred," which "more accurately reflects the ***mean temperature*** of the substrate

410," as illustrated below. Ex.1005, 4:57-59. Thus, TSR 510 is able to sense the temperature that is representative of the region in which it is located. Ex.1002, ¶458.

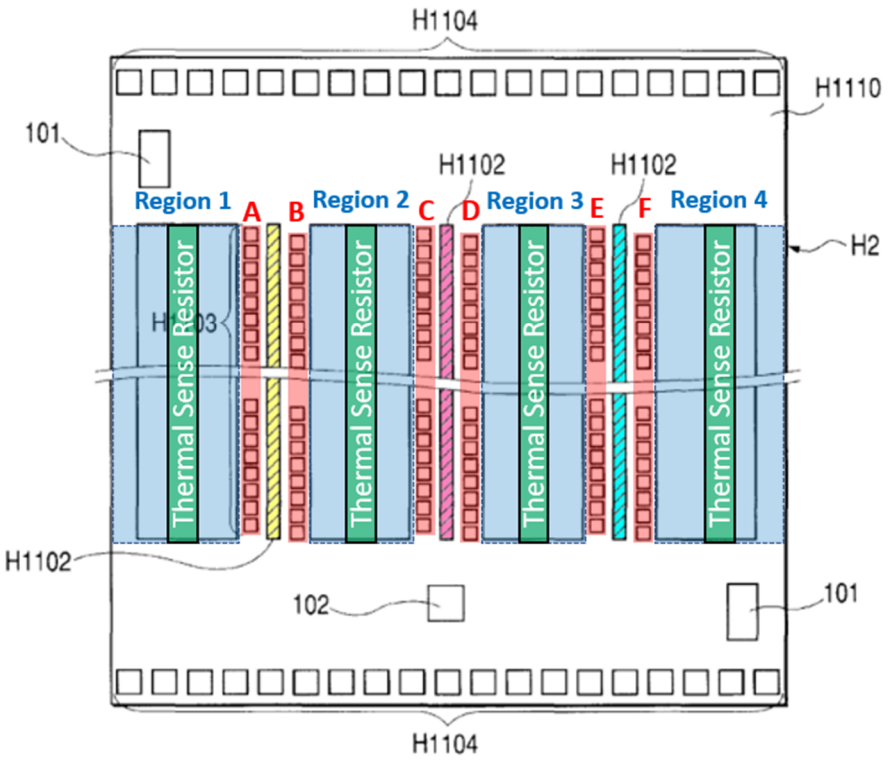
Ex.1005, Fig. 5



To regulate the operational temperature of Yabe's printhead die and optimize the printing quality of the inkjet printing device, a PHOSITA would have further configured Yabe to determine a mean temperature of the ***entire printhead*** by disposing a single TSR within each of the remaining regions [e.g., Region 1, 3, and 4, blue] as shown below so that the temperature value *collectively* provided by the TSRs within Regions 1-4 reflect the mean temperature of Yabe's printhead die. Ex.1002 ¶461; Ex.1001, 6:6-9; Ex.1008, 3:16-21.

Ex.1008, Fig. 14

FIG. 14

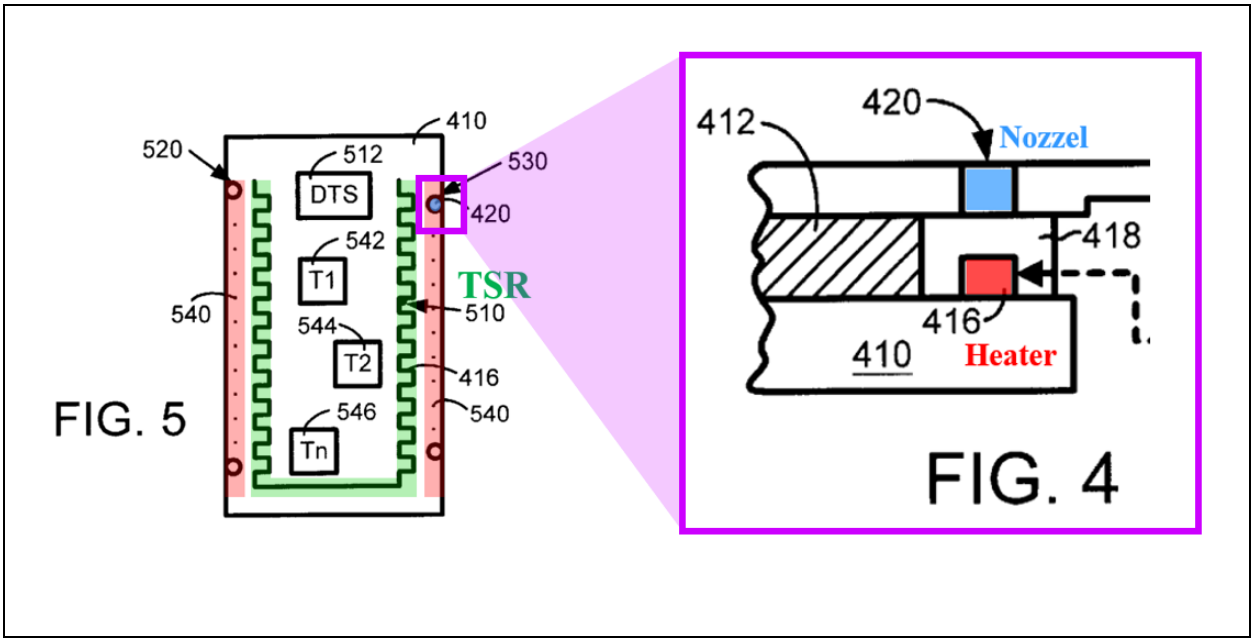


A PHOSITA would have understood that the temperature regulation design illustrated above in Fig. 14 above (i.e., temperature sensors in each region to measure temperature on a per-via basis) would be advantageous for various reasons, including avoidance of printer failure. Ex.1002 ¶462-468. Moreover, a PHOSITA would also have understood that the temperature regulation design illustrated above in Fig. 14 would address the problem of excessive *localized* heating of the substrate

that, without compensation for the substrate temperature change, can lead to significant degradation in print quality. Ex.1002 ¶466; Ex.1007, 5:36-51. Finally, a PHOSITA would understand that the Fig. 21 design above would be highly accurate for measuring substrate temperature and avoid "thermal crosstalk between sensors."

A PHOSITA would have understood that the temperature sense resistor (TSR 510 *green* below) is at least in *substantially* centrally—if not exactly in the centre—of each region because the TSR 510 "preferably is not located adjacent to any ***particular*** heating elements" so that the obtained TSR value "reflects the temperature of the substrate 410 after heat has moved from the heating elements to the TSR 510." Ex.1005, 4:51-56; 4:57-61, 2:50; *see also* Ex.1002 ¶312. Rather, Giere673 teaches that "[t]he TSR 510 is located along the length of the substrate 410" and "can have two legs that are approximately 680 μm inboard from the center of the columns of ink ejection elements 416," [*red in Fig.5*]," which is directly below the nozzle 420 [blue in Fig. 4]. Ex.1005, 5:5-12.

Ex.1005, Figs. 4 and 5



A PHOSITA would have also understood that the temperature sense resistor (i.e., TSR 510 green) is at least substantially adjacent to *both* the first heater array and second heater array and extends substantially the length of the first heater array and second heater array. Ex.1002 ¶473. Giere673 discloses TSR 510 "preferably is not located adjacent to any particular heating element [*e.g., ink ejection elements 416 and 520, red*] and reflects the temperature of the substrate 410 ***after*** heat has ***moved from*** the heating elements to the TSR 510." Ex.1005, 4:57-59. Giere673 teaches that its TSR 510 is not located adjacent either the left *or* right columns of ejection elements(red) but instead is positioned adjacent, i.e., next to, *both* columns of ink ejection elements so as to detect the mean temperature of the substrate as affected by the heat generated by both columns of ink ejection elements.

Giere673 also teaches that the "[t]he TSR 510 is located **along the length** of the substrate 410" and as such, would also extend substantially the length of the left and right columns of ejection elements 416 (*red*).

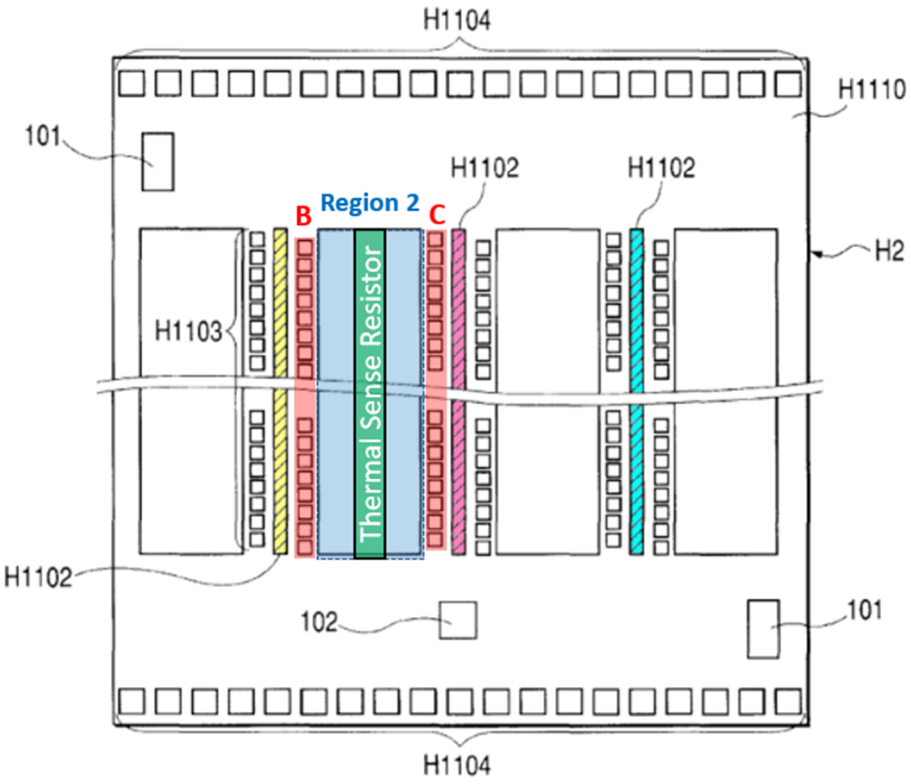
Further, a PHOSITA, through logic and routine experimentation, would have positioned the TSR in substantially the centre of the region and extending substantially the length of the arrays. Ex.1002 ¶474-475 (one sensor in each region adequately measures temperature due to high thermal conductivity and large cross-sectional area of the silicon base material rapidly reaching an equilibrium temperature).

Since Giere673's ink ejection elements 416 form a column that runs along each longitudinal side of the ink channels similar to how Yabe's heaters (H1103) form a heater array along each longitudinal side of the ink supply ports, a PHOSITA would have known to place Giere673's TSR 510 in a similar location within the regions of Yabe's silicon base plate H1110 as shown below. Ex.1002, ¶476.

Thus, Yabe-Giere673 discloses 1[D]-1[E]. Ex.1002 ¶¶453-477.

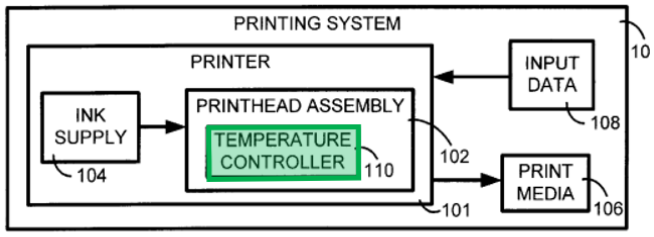
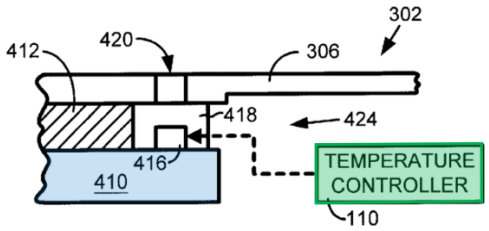
Ex.1008, Fig. 14

FIG. 14



Giere673 further discloses a temperature control system (with temperature controller 110, blue below) that regulates the substrate temperature using its heater arrays and in response to the TSR's sensed temperature. Ex.1002 ¶480; *see also* Ex.1005, 2:48-52, 2:57-62; 4:49-5:5. According to Giere673, the "temperature controller 110 uses the input data 108 [supplied by the temperature sensors]… for selectively firing the associated heating elements." Ex.1005, 3:1-6; 2:62-65 ("The

temperature controller 110… **controls the mean temperature of the substrate of the printhead**."); 4:49-5:5.

Ex.1005, Fig. 1	Ex.1005, Fig. 4
 FIG. 1	 FIG. 4

Giere673's temperature controller 110 **regulates** substrate temperature by using a closed loop method wherein in response to the temperature of the region sensed by the temperature sensing elements generates "printing parameters," including **pulse widths to heaters** and warming using non-ejecting devices. Ex.1005, 3:7-12; 2:66-3:3; Ex.1005, 8:3-13, Figs. 6A-C. Temperature controller 110 includes "**temperature logic system 606** (*teal*)" that generates various printing parameters. Ex.1005, 6:21-28; 6:35-40; 6:46-52. Giere673 further explains that the "printing parameters can include **pulse widths, pulse rates, ink ejection chambers 418 to be fired and when they will be fired, warming using non-ejecting devices, and firing voltages** that act as the inputs for the actual substrate temperature profile 610." Ex.1005, 6:52-57. Giere673 also notes that "[t]his rate, width and order of

firing are programmed, and if necessary, adjusted in the programming, so that the temperature of the heater array 611 [*pink, above*], and therefore the temperature of the ink in the chamber array 612, are maintained at an optimum temperature for the formation of ink droplets." Ex.1005, 9:13-18; 9:9-13. As such, the first heater array and the second heater array (e.g., heating elements) are operable to receive heating responsive to the temperature of the region.

Ex.1005, Fig. 6B

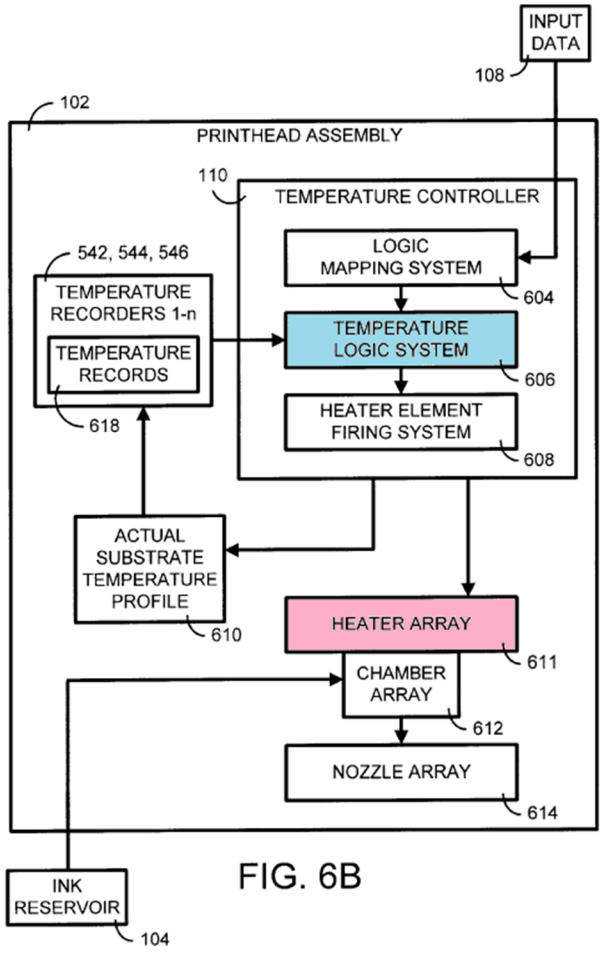


FIG. 6B

Further, like the '823 Patent, Giere673 also discloses using a non-nucleating heating method to control its heaters: "The temperature logic system also generates firing voltages 814 and **activates heater elements that do not eject ink 816**." Ex.1005, 9:18-20; *see also id.,* 6:52-57 ("warming using non-ejecting devices").

Moreover, a PHOSITA would have recognized additional advantages of incorporating Giere673's temperature logic system 606 system into Yabe such as improving printing quality, energy savings, and maintenance, and it was a logical way of regulating the substrate temperature using existing printhead components and thereby reducing costs. Ex.1002 ¶¶486-487; Ex.1005, 9:30-38.

Accordingly, **Giere678 discloses 1[F]**, i.e., the **first heater array** (e.g., Heater Array B) and the **second heater array** (e.g., Heater Array C) are operable to **receive heating** (e.g., firing rate, firing voltage, or pulse width) responsive to the temperature of the region sensed by the **temperature sensing element** (TSR), and wherein the received heating regulates the temperature of the region. Ex.1002 ¶¶478-488.

6. 1[G] "a third heater array…second via"

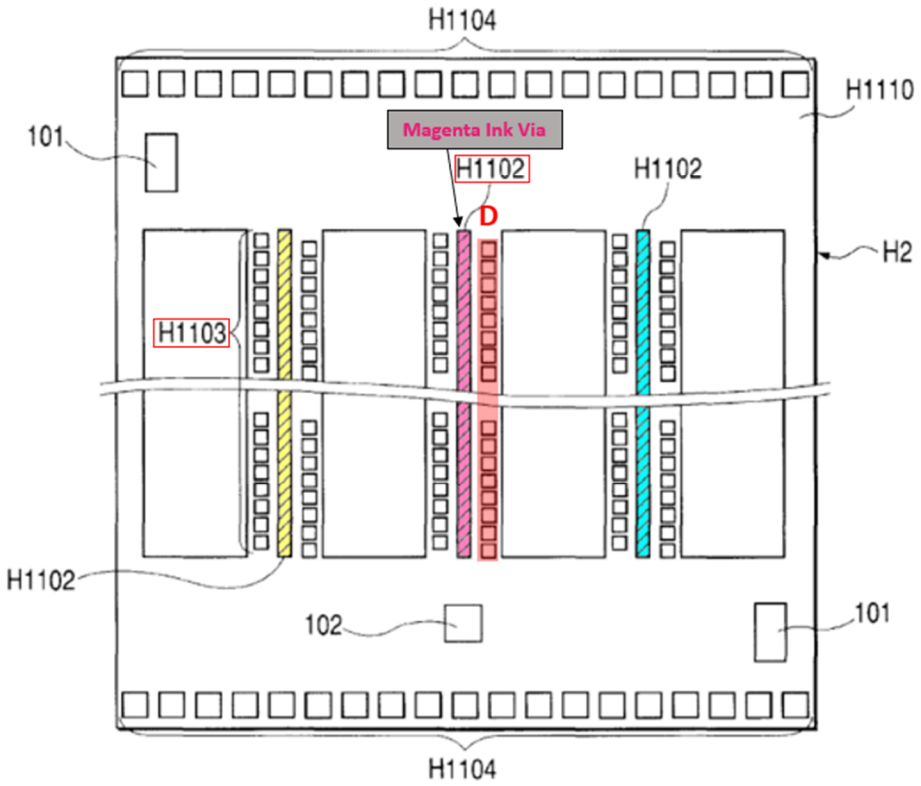
Yabe discloses 1[G]. Ex.1002 ¶¶489-493.

For the reasons discussed above in Section XI.A.2, incorporated here, Yabe discloses "a **third heater array** [e.g., electrothermal converting devices H1103,

Heater Array D] positioned substantially adjacent a **second via** [e.g., magenta ink supply port H1102]." Ex.1002 ¶490, 492.

Ex.1008, Fig. 14

FIG. 14



7. 1[H] "a fourth heater array…third via"

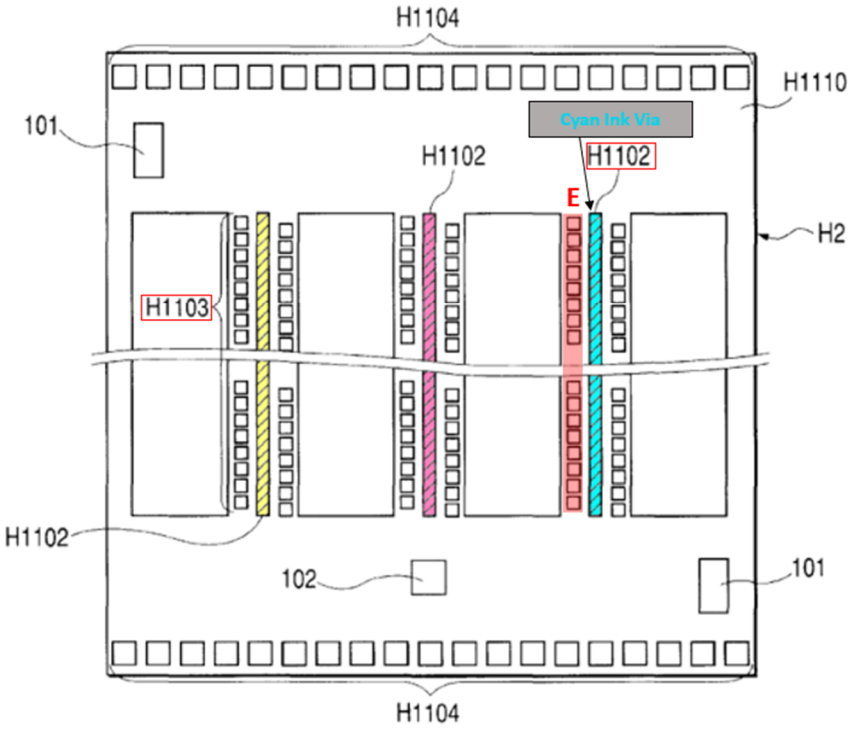
Yabe discloses 1[H]. Ex.1002, ¶¶494-498.

For the reasons discussed above in Section XI.A.3, incorporated here, Yabe discloses "a **fourth heater array** [e.g., electrothermal converting devices H1103,

Heater Array E] positioned substantially adjacent a **third via** [e.g., cyan ink supply port H1102]." Ex.1002, ¶495, 497.

Ex.1008, Fig. 14

FIG. 14



8. 1[I] "a second region …"

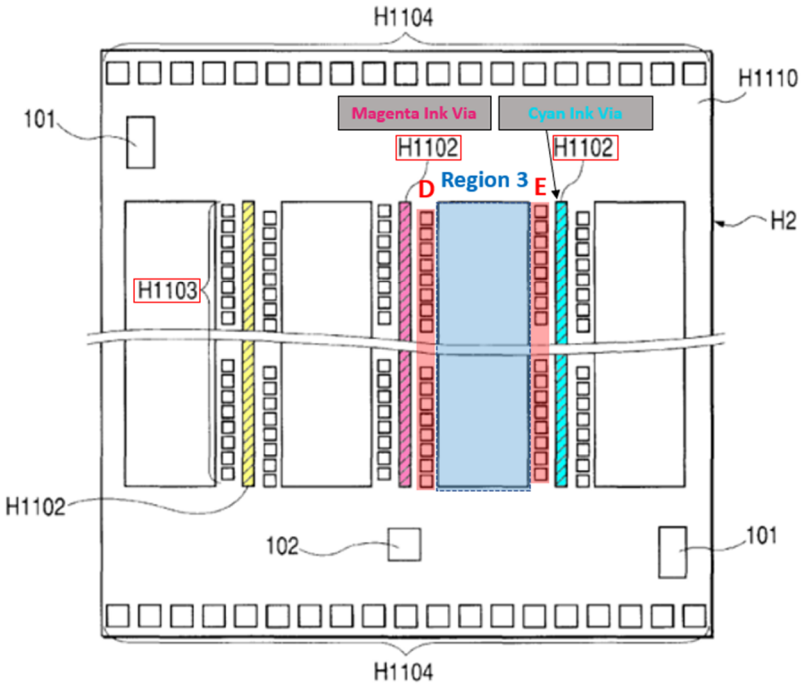
Yabe discloses 1[I]. Ex.1002 ¶¶499-504.

For the reasons discussed above in Section XI.A.4, incorporated here, Yabe discloses a **second region** (e.g., Region 3, blue) positioned between the **third heater array** (e.g., Heater Array D, pink) and the **fourth heater array** (e.g., Heater Array

E, pink), and also positioned substantially adjacent to the **third heater array** (e.g., Heater Array D, pink) and the **fourth heater array** (e.g., Heater Array E, pink). Ex.1002 ¶500, 502.

Ex.1008, Fig. 14

FIG. 14



9. 1[J]-[K] "a second temperature sensing element…"

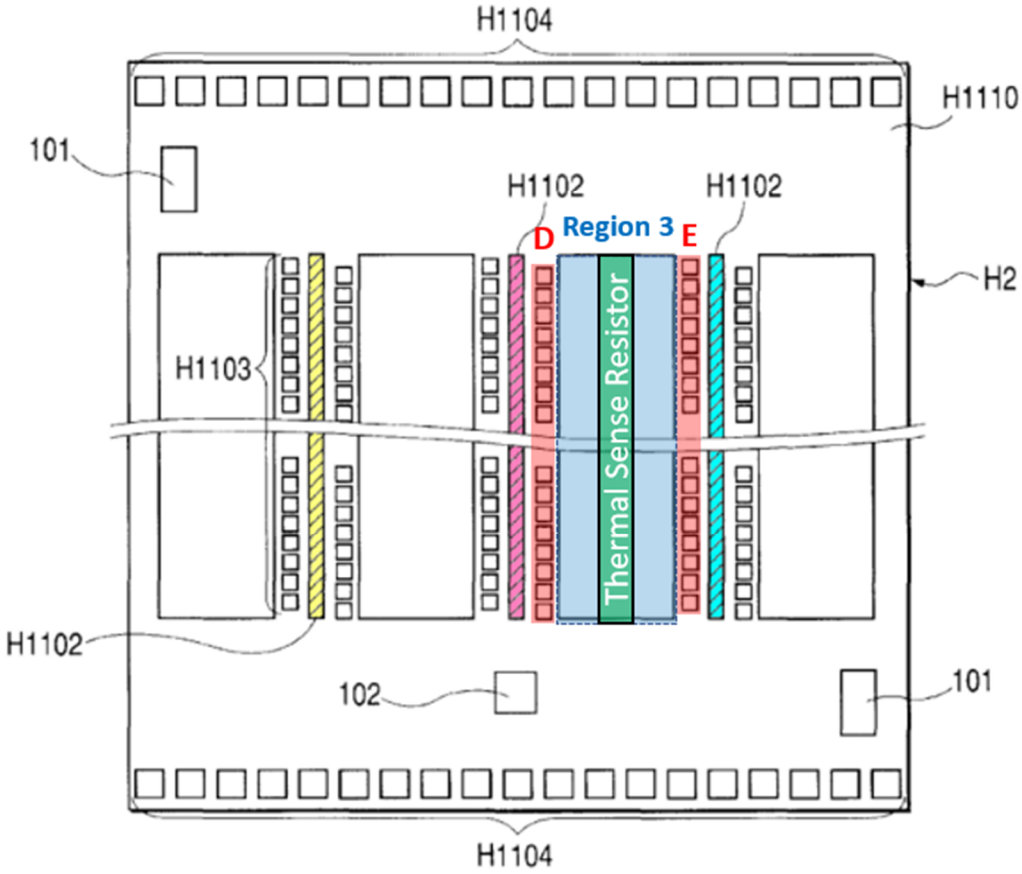
The Yabe-Giere673 Combination Yabe discloses this limitation. Ex.1002 ¶¶505-518.

For the reasons discussed above in Section XI.A.5 and incorporated here, the Yabe-Giere673 Combination discloses "a **second temperature sensing element**

[*e.g.*, TSR 510] operable to sense a temperature of the **second region** [*e.g.*, Region 3, blue below], wherein the temperature sensing element is substantially centrally disposed with respect to the second region and substantially adjacent to both the **third heater array** [*e.g.*, Heater Array D, pink] and **fourth heater array** [*e.g.*, Heater Array E, pink]." Ex.1002 ¶513, 514, 518.

Ex.1008, Fig. 14

FIG. 14



Moreover, for the reasons discussed above in XI.B and incorporated here, a PHOSITA would have been further motivated to modify Yabe's printhead by disposing a single temperature sensor within a region (e.g., Region 3) so that the TSRs collectively regulate temperature on a per-color basis. Ex.1002 ¶¶515-517.

10. 1[L] "… operable to receive heating responsive to the temperature of the [second] region…"

For the reasons discussed above in Section XI.A.6 and incorporated here, the Yabe-Giere673 Combination discloses this limitation. Ex.1002 ¶519-521.

B. Motivation to Combine Yabe and Giere673

Benjamin does not teach *where* on its printhead die a TSR should be disposed. As an alternative to Benjamin, a PHOSITA would have considered Yabe which teaches an inkjet printhead die having multiple "temperature detecting means 102" (diode sensors) used to detect temperature at multiple specific points on the die. Yabe's diode sensors, however, are not TSRs that are substantially centrally disposed with respect to regions between heater arrays and do not extend substantially the length of the heater arrays. As such, for the reasons discussed below and in Section XI.A above, a PHOSITA would have been motivated to arrive at the Yabe-Giere673 Combination. Ex.1002, ¶¶566-600.

First, Yabe and Giere673 are analogous to the claimed subject matter in the '823 Patent because they are all within the same field of endeavour and address

similar problems—namely, sensing and regulating operational temperature of a printhead die for an inkjet printing device. Ex.1002 ¶567, 569-570; Ex.1008, 8:47-51. Moreover, just like the ’823 Patent, the printhead heater chips of Yabe and Giere673 share similar designs with adjacent ink channels and adjacent heater arrays for vaporizing the ink. Ex.1002 ¶568.

Also, as with the ’823 Patent, Yabe recognized the need for increase in inkjet printer recording speed and quality at the time, along with a reduction in noises (e.g., performance issues), and thus designed a “side-shooter” printhead chip with a plurality of ink vias each via having to adjacent heater arrays. Ex.1008, 1:13-16; 2:23-26, 2:34-40, 2:23-26, 2:31-33, 2:41-43, 3:16-18, 2:43-47, 5:19-23, 5:24-27. Ex.1002 ¶571-574.

As with the ’823 Patent, Yabe also recognized that because of the increase in the number of ink drops, heaters, and ink supply ports/vias on a printhead to meet the industry necessity for higher precision of recorded images at higher recording speed, it is extremely important to control the temperature of the inkjet recording head during printing to avoid performance issues. Ex.1008, 3:35-39; 1:43-48; 1:50-2:8. Thus, Yabe discloses a means for regulating the temperature of a heater board having plural ink vias with associated heater arrays on either side so as to maintain high quality printing. Ex.1008, 3:55-62; 3:45-54; 14:27-37; Ex.1002 ¶575-577.

Yabe discloses using diode sensors as "temperature detecting means 102" and explains that there is an "increased degree of freedom" in choosing the locations of the sensors on the heater board. Ex.1008, 15:54-61; *see also id*. at 16:49-57. A PHOSITA would understand that Yabe teaches increased freedom in choosing where to place temperature sensors, such as a TSR, on the heater board as a result of adding sub-heaters to the printhead because it would be unnecessary to place temperature sensors at ***all*** portions of the board (e.g., **both** end portions **and** central portion) when only selected portions would suffice (e.g., in the central portion *only*). Ex.1002, ¶579. As discussed below, a PHOSITA would be motivated to place the TSR in the regions between heater arrays.

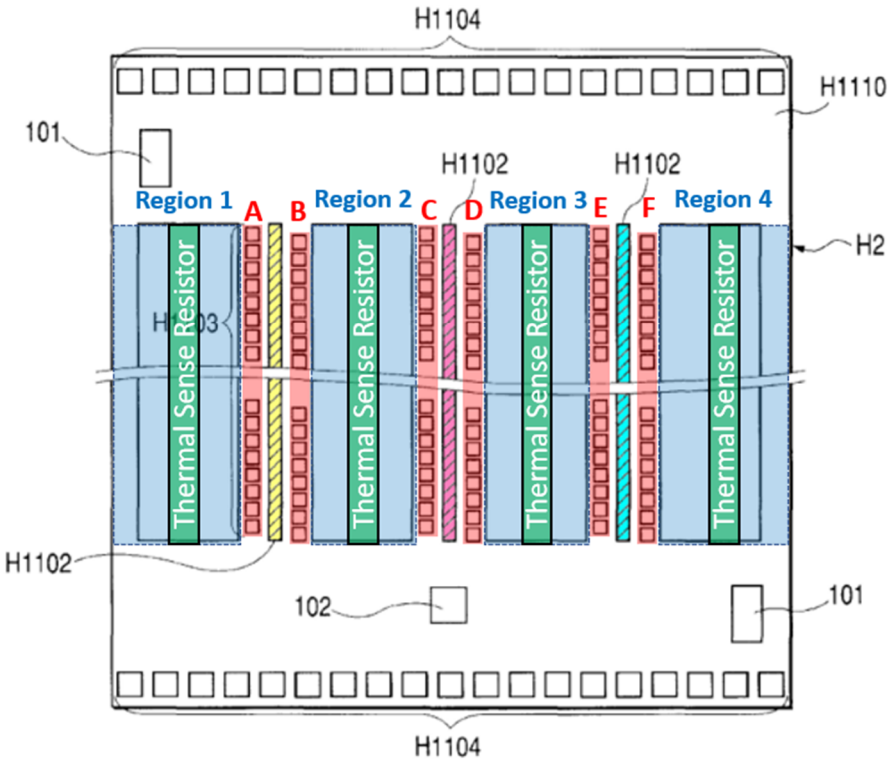
Switching to Giere673, like the '823 Patent and Yabe, Giere673 uses "[o]ne or multiple TSRs 510 [to] provide an approximation of the mean temperature of the substrate [410]." Ex.1005, 4:55-56. As explained above in Section XI.5 (incorporated here), Giere673 optimizes the print quality of the inkjet printer based upon the temperature value provided by the TSR and explicitly discloses placing the TSR substantially centered between heater arrays and along the length of the heater arrays for providing a sufficiently accurate temperature value. Section XI.5; Ex.1005, 4:57-59; Ex.1002 ¶¶580-584.

The U.S. Patent Office also grouped the '823 Patent, Giere673, and Yabe under the same technology classification—class 347 (Incremental printing of symbolic information). Ex.1001 (U.S. Cl.); Ex.1007 (U.S. Cl.); Ex.1008 (U.S. Cl.). Ex.1002 ¶585-586.

Second, upon considering Giere673, a PHOSITA would have applied Giere673's teachings to Yabe by (1) disposing a single TSR [e.g., TSR 510, *green*] within each region of Yabe's printhead die formed between two adjacent heater arrays [*e.g.*, Region 2 and 3, *blue below*], and (2) positioning the TSR equidistant from both heater array within the region but no less than approximately 680 μm inboard from the center of the heater arrays, as shown below, to ensure that the temperature value provided by the TSR reflects the mean temperature of the region. Ex.1002 ¶587.

Ex.1008, Fig. 14 (modified): Yabe-Giere673 Combination

FIG. 14



Giere673 provides express motivation for a PHOSITA to modify Yabe's printhead die to include a single TSR along the length of each region (Regions 1, 2, 3, 4) as illustrated above.

For example, Giere673 explicitly discloses placing the TSR substantially centered between heater arrays and along the length of the heater arrays for providing a sufficiently accurate temperature value to meaningfully improve print quality. Ex.1002 ¶¶588-590; Ex.1005, 2:50, 4:51-56, 5:5-12. By positioning TSR 510 in the

centre of the region between heater arrays, Giere673 teaches that the TSR value obtained by TSR 510 "reflects heating elements firing that have already occurred," which "more accurately reflects the ***mean temperature*** of the substrate 410," as illustrated below. Ex.1005, 4:57-59, 2:57-62, 3:1-6; 2:62-65.

Giere673 further discloses that regulating the substrate temperature on a per color basis can result in improved print quality. Ex.1002, ¶591. As discussed above in Section XI.A.5, and incorporated here, Giere673's temperature controller 110 includes "temperature logic system 606" that generates various printing parameters on a **per color basis** and, based on the sensed temperature, are used to regulate the printhead die temperature. Ex.1005, 6:21-28; 9:8-17, 9:9-18. Because Giere673's "temperature controller 110 aids in controlling the temperature of the substrate and the temperature of **each ejection chamber or nozzle chamber,**" its design "results in improved print quality and printhead life because the printhead 102 will consequently operate closer to its optimum temperature." Ex.1005, 3:7-12.

A PHOSITA would have understood that the Yabe-Giere673 Combination (Fig. 14 above) would address a problem of excessive *localized* heating of the substrate adjacent the heaters that, without compensation for the substrate temperature change, could lead to significant degradation in print quality. Ex.1002 ¶596; Ex.1007, 5:36-51. Thus, a PHOSITA would have also understood that the

Yabe-Giere673 Combination having a TSR 510 (*green*) in each region to measure temperature on a per-via basis would be advantageous for several reasons, including avoidance of printer failure. Ex.1002 ¶¶592-595, 597. A PHOSITA would also understand that the Fig. 14 design above would be highly accurate for measuring substrate temperature and avoid "thermal crosstalk between sensors." *Id*.

Finally, a PHOSITA would have also had a reasonable expectation of success adding the temperature controller 110 and TSRs 510 from Giere673 to the heater board H1110 of Yabe's printhead assembly given the interchangeable nature of these printhead components. Ex.1002 ¶598. Giere673 recognizes that the temperature controller and thermal sensor resistors of "the present invention can be incorporated in any printhead configuration." Ex.1005, 4:7-8; 9:42-47. Moreover, the simple, routine, and low-cost nature of adding a temperature controller and thermal sense resistors to a printhead assembly and printhead die, respectively, would have further motivated a person of ordinary skill in the art. Ex.1002 ¶599.

C. Claim 2

The Yabe-Giere Combination discloses claim 1 and the additional limitations of claim 2. Ex.1002 ¶¶522-524.

For the reasons discussed above in Section VIII.B and XI.A incorporated here, the Yabe-Giere673 combination discloses that "the **temperature sensing element**

[i.e., measurement sensor] comprises a **temperature sensing resistor** [i.e., TSR 510]."

D. Claims 3 and 13

The Yabe-Giere673 Combination discloses claims 2 and 11 and the additional limitations of claims 3 and 13. Ex.1002 ¶¶525-527, 558-559.

For the reasons discussed above in Section VIII.C and XI.A incorporated here, the Yabe-Giere673 combination discloses that "the **temperature sensing element** [*i.e.*, measurement sensor] comprises a **thermal sense resistor** [*i.e.*, TSR 510]." Ex.1002 ¶¶368-370, 401-402.

E. Claims 5 and 15

The Yabe-Giere673 Combination discloses claims 1 and 11 and the additional limitations of claims 5 and 15. Ex.1002 ¶¶528-530, 560-561.

For the reasons discussed above in Section VIII.D and XI.A incorporated here, the Yabe-Giere673 Combination discloses that "the **temperature sensing element** is positioned **at least 300 microns** [*i.e.*, approximately 680 microns] from each of the first heater array and the second heater array." *Id.*

F. Claims 6 and 16

The Yabe-Giere673 Combination discloses claims 1 and 15 and the limitations of claims 6 and 16. Ex.1002¶¶531-536, 562-563.

For example, Yabe teaches recording element components and "temperature sensing means 102" are formed on the same silicon base plate (heater board). Ex.1008, 8:51-55; *see also* Ex.1008, 8:13-16; 14:37-32 ("As described above, for the **base plate (heater board)** of the ink jet recording head, **having thereon the heat generating resistive elements** and…there are provided **temperature detecting means** for detecting the temperature of the heater board…"); Ex.1008, Figs. 5, 12, 14.

Ex.1008, Fig. 12

FIG. 12

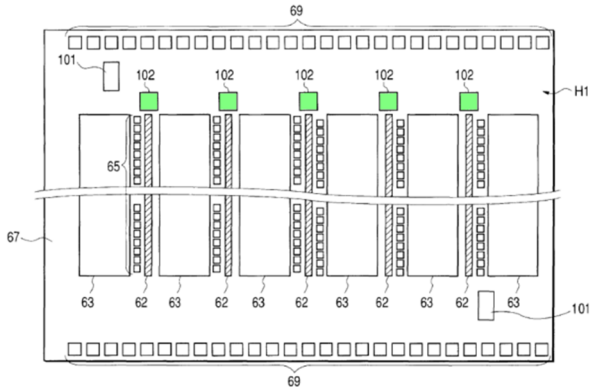
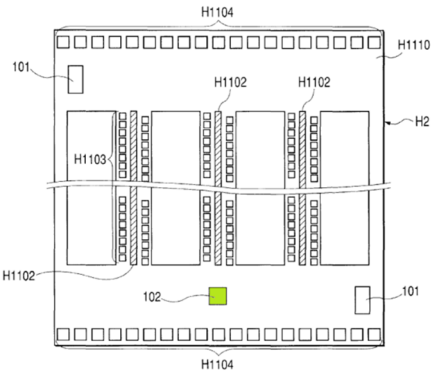


FIG. 14



Additionally, Giere673 positions the TSR 510 (*green*) at a predetermined distance away from each of the two adjacent heating elements 416 within that region—*i.e.*, "approximately 680 μm ***inboard from*** the center of the columns of ink ejection elements 416," which means that the TSR 510 must be substantially planar

to the ink ejection elements 416, at least under 823 Patent's definition of that term. Ex.1005, 5:5-12.

A PHOSITA would also have known to position the TSR in that location because Yabe teaches both electrothermal converting devices H1103 and its own temperature sensing means 102 on the same silicon base plate (H1110), thereby allowing the TSR to be positioned *substantially* planar to the heater arrays (electrothermal converting devices H1103) within each region, particularly given that the '823 Patent treats "substantially planar" to mean "the temperature sensing element is not positioned directly above the first or second heater arrays." Ex.1002 ¶535; Ex.1001, 3:12-16.

For the reasons discussed above in Section VIII.E and XI.A incorporated here, the Yabe-Giere673 Combination further discloses that "the temperature sensing element [*i.e.*, TSR 510] is positioned substantially planar to each of the first heater array [e.g., Heater Array B] and the second heater array [e.g., Heater Array C]." Ex.1002 ¶¶531-536, 562-563.

G. Claim 7

The Yabe-Giere673 Combination discloses claim 1 and the additional limitations of claim 7. Ex.1002 ¶¶537-540.

For the reasons discussed above in Section VIII.F and XI.A incorporated here, the Yabe-Giere673 combination discloses "at least one control element [*i.e.*, temperature controller 110] operable to receive a temperature measured by the temperature sensing element [*i.e.*, TSR 510] and to heat the first heater array [e.g., Heater Array B] and the second heater array [e.g., Heater Array C]." Ex.1005,2:57-62, 2:62-65; 4:49-5:5; Ex.1002 ¶¶537-540.

H. Claim 8

The Yabe-Giere673 Combination discloses claim 1 and the limitations of claim 8. Ex.1002 ¶¶541-543.

As discussed above in Sections XI.A.5 and XI.A.10 and incorporated here, the Yabe-Giere673 combination includes a first temperature sense resistor (TSR) in the first region (Region 2) and a second temperature sense resistor (TSR) in the second region (Region 3). A PHOSITA would understand that these TSRs are different from each other because they are in different regions of the printhead die, associated with different heater arrays and electrical connections, and produce different temperature measurements. Ex.1002 ¶¶542-543. A PHOSITA would also understand that because each ink via (H1102) acts as a temperature insulator a PHOSITA would want independent temperature sensors in each region to measure and regulate independent sets of heater arrays (e.g., per color). *Id*.

I. Claims 9 and 17

The Yabe-Giere673 Combination discloses claims 1 and 11 and the limitations of claims 9 and 17. Ex.1002 ¶¶544-548, 564-565.

For the reasons discussed above in Sections VIII.F, XI.A.6, and XI.A.11 incorporated here, Giere678 discloses wherein the first heater array (e.g., Heater Array B) and the second heater array (e.g., Heater Array C) are operable to receive non-nucleating heating (e.g., adjustments to firing rate, firing voltage, or pulse width) responsive to the temperature of the region sensed by the temperature sensing element (TSR). *See* Ex.1005, 9:18-20; 6:52-57 ("warming using non-ejecting devices"); 6:21-28; 6:46-52; 9:13-18; Ex.1002 ¶¶544-548, 564-565.

J. Claim 10

The Yabe-Giere673 Combination discloses Claim 9 and the limitations of claim 10. Ex.1002 ¶¶549-552.

As discussed in Sections VIII.F, XI.A.6 and XI.A.11, incorporated here, Giere673's temperature controller 110 aids in controlling the temperature of the substrate by, for example, adjusting the pulse width to the heater arrays. A PHOSITA would have understood that the pulse width adjustments will be of a short duration such that ink will not be ejected from the heater arrays. Ex.1002 ¶551. Giere673 specifically states that "[t]he temperature logic system also generates firing

voltages 814 and **activates heater elements that do not eject ink 816**." Ex.1005, 9:18-20; 6:52-57 ("warming using non-ejecting devices"). Giere673 also describes limiting, e.g., shortening, the pulse width. Ex.1005, 9:33-38 ("since the firing system **limits** the rate, voltage or pulse width of firing of heater elements").

K. Claim 12

Claim 12 depends from claim 11, which the Yabe-Giere673 Combination discloses. The additional limitations of claim 12 mirrors limitation 1[D] and thus the Yabe-Giere673 Combination discloses this limitation for the same reasons as in Section VIII.D.1.e, incorporated here. Ex.1002, ¶556-557.

XII. Ground 5: Yabe and Giere673 in Further View of Parish Renders Claims 4 and 14 Obvious

A. Claims 4 and 14

The Yabe-Giere673 Combination discloses Claim 3 and 13 and the limitations of claims 4 and 14. Parish discloses this limitation. Ex.1006, 5:35-39 ("N-type source drain (NSD) material"); Ex.1002 ¶¶601-607.

Accordingly, the Yabe-Giere673 Combination in further view of Parish discloses that "the temperature sensing element [*i.e.*, TSRs 510] comprises an n-type implant donor thermal sensing resistor." Ex.1002 ¶¶601-607.

B. Motivation to Combine Yabe and Giere673 and Further in View of Parish

A PHOSITA would have been motivated to arrive at the Yabe-Giere673-Parish Combination shown below. Ex.1002 ¶¶608-625.

First, Giere673, Yabe, and Parish are analogous to the claimed subject matter in the '823 Patent because they are all within the same field of endeavour and address similar problems—namely, sensing and regulating operational temperature of a printhead die for an inkjet printing device. Ex.1002, ¶609.

For the reasons explained above in Section XI.B and incorporated here, Yabe and Giere673 are analogous to the '823 Patent. Parish is also analogous to the '823 Patent for similar reasons, including Parish's similarities to the '823 Patent in printhead die components and design. *See* Ex.1002, ¶¶610-615; Ex.1006, 4:61-65; 4:40-41; 6:16-18; 6:9-11; 5:30-34; 6:5-8.

Second, for the reasons explained above in Section IX.B and incorporated here, a PHOSITA would have been motivated to add an n-type implant donor thermal sensing resistor as a temperature sense resistor, as taught by Parish, at least because it would improve the temperature sensing system's precision, and she would have had a reasonable expectation of success in making the addition. *See* Ex.1002 ¶616-623; Ex.1006, 5:35-39; Ex.1014, 1:25-28, 4:37-42; 3:17-19; Ex.1005, 4:7-8; 9:42-47.

Finally, it would have been a routine and obvious matter for a PHOSITA to combine, replace, and even modify various features from Yabe and Giere673 to incorporate the features of Parish as these features were common and interchangeable. Ex.1002, ¶624.

XIII. SECONDARY CONSIDERATIONS

To the extent that Patent Owner raises any secondary considerations arguments in its Preliminary Response, Petitioners request authorization to respond thereto before any Institution Decision.

XIV. CONCLUSION

Trial should be instituted, and the Challenged Claims should be cancelled as unpatentable.

Dated: January 25, 2023

Respectfully Submitted,

/ *Dion M. Bregman* /
Dion M. Bregman (Reg. No. 45,645)

U.S. PATENT NO. 7,484,823 – Listing of Challenged Claims

No.	Claim Limitations
Claim 1[p]	A chip for use with a printing device, comprising:
1[a]	a first heater array positioned substantially adjacent a first via;
1[b]	a second heater array positioned substantially adjacent a second via;
1[c]	a region, positioned between the first heater array and the second heater array, and also positioned substantially adjacent to the first heater array and the second heater array; and
1[d]	a temperature sensing element operable to sense a temperature of the region, the temperature being representative of the region, wherein the temperature sensing element is substantially centrally disposed with respect to the region and substantially adjacent to both the first heater array and second heater array, and further extends substantially the length of the first heater array and second heater array,
1[e]	wherein the first heater array and the second heater array are operable to receive heating responsive to the temperature of the region sensed by the temperature sensing element, and wherein the received heating regulates the temperature of the region;
1[f]	a third heater array. positioned substantially adjacent the second via;
1[g]	a fourth heater array, positioned substantially adjacent a third via;
1[h]	a second region, positioned between the third heater array and the fourth heater array, and also positioned substantially immediately adjacent to the third heater array and the fourth heater array; and
1[i]	a second temperature sensing element operable to sense the temperature of the second region, wherein the temperature sensing element is substantially centrally disposed with respect to the second region and substantially adjacent to both the third heater array and fourth heater array,
1[j]	wherein the third heater array and the fourth heater array are operable to receive heating responsive to the temperature of the second region sensed by the temperature sensing element, and wherein the received heating regulates the temperature of the region.
Claim 2	The chip of claim 1, wherein the temperature sensing element comprises a temperature sensing resistor.

No.	Claim Limitations
Claim 3	The chip of claim 2, wherein the temperature sensing element comprises a thermal sense resistor.
Claim 4	The chip of claim 3, wherein the temperature sensing element comprises an n-type implant donor thermal sensing resistor.
Claim 5	The chip of claim 1, wherein the temperature sensing element is positioned at least 300 microns from each of the first heater array and the second heater array.
Claim 6	The chip of claim 5, wherein the temperature sensing element is positioned substantially planar to each of the first heater array and the second heater array.
Claim 7	The chip of claim 1, further comprising at least one control element operable to receive a temperature measured by the temperature sensing element and to heat the first heater array and the second heater array.
Claim 8	The chip of claim 1, wherein the temperature sensing element positioned between the first heater array and the second heater array is different than the second temperature sensing element positioned between the third heater array and the fourth heater array.
Claim 9	The chip of claim 1, wherein the first heater array and the second heater array are operable to receive non-nucleating heating responsive to the temperature of the region sensed by the temperature sensing element.
Claim 10	The chip of claim 9, wherein the non-nucleating heating is of a short duration such that ink will not be ejected from the first via or the second via during the non-nucleating heating.
Claim 11[p]	A method of fabricating chips for use with a printing device, comprising:
11[a]	providing a first heater array, positioned substantially adjacent a first via;
11[b]	providing a second heater array, positioned substantially adjacent a second via;

No.	Claim Limitations
11[c]	positioning a temperature sensing element in a region adjacent to and immediately between the first heater array and the second heater array and substantially adjacent to both the first heater array and second heater array, wherein the temperature sensing element is operable to sense a temperature of the region, the temperature being representative of the region, and wherein the temperature sensing element extends substantially the length of the first heater array and second heater array; and
11[d]	responsive to the temperature of the region sensed by the temperature sensing element, heating the first heater array and the second heater array to regulate the temperature of the region;
11[e]	providing at least one control element operable to receive a temperature measured by the temperature sensing element and to heat the first heater array and the second heater array;
11[f]	providing a third heater array substantially adjacent the second via;
11[g]	providing a fourth heater array substantially adjacent a third via; and
11[h]	positioning a second temperature sensing element in a second region located between the third heater array and the fourth heater array. wherein the temperature sensing element is operable to sense the temperature of the second region, and wherein the temperature sensing element is substantially centrally disposed with respect to the second region and is substantially adjacent to both the third heater array and fourth heater array.
Claim 12	The method of claim 11, wherein positioning a temperature sensing element in the region comprises positioning a temperature sensing element in substantially the center of the region.
Claim 13	The method of claim 11, wherein positioning a temperature sensing element in the region comprises positioning a thermal sense resistor in the region.
Claim 14	The method of claim 13, wherein positioning a temperature sensing element in the region comprises positioning an n-type implant donor thermal sensing resistor in the region.

No.	Claim Limitations
Claim 15	The method of claim 11, wherein positioning a temperature sensing element in the region between the first heater array and the second heater array comprises positioning the temperature sensing element at least 300 microns from each of the first heater array and the second heater array.
Claim 16	The method of claim 15, wherein positioning a temperature sensing element in the region between the first heater array and the second heater array comprises positioning the temperature sensing element substantially planar to each of the first heater array and the second heater array.
Claim 17	The method of claim 11, wherein heating the first heater array and the second heater array to regulate the temperature of the region comprises heating the first heater array and the second heater array using non-nucleating heating.

CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Petition includes 13,870 words, as counted by Microsoft Word, and is therefore in compliance with the 14,000-word limit established by 37 C.F.R. 42.24(a)(1)(i). Accordingly, pursuant to 37 C.F.R. 42.24(d), lead counsel for Petitioner hereby certifies that this Petition complies with the applicable type-volume limits.

Dated: January 25, 2023

Respectfully Submitted,

/ Dion M. Bregman /
Dion M. Bregman, Reg. No. 45,645

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. 42.6(4) and 42.105, lead counsel for Petitioners hereby certifies that on January 25, 2023, copies of this Petition and all supporting exhibits were sent via Priority Mail Express to the correspondence address of record for the '823 Patent:

133676 - Goldberg Segalla LLP
711 3rd Avenue, Suite 1900
New York, NY 10017

A courtesy copy of this Petition and supporting exhibits was also served via email on January 25, 2023 on Patent Owner's counsel of record in the district court litigation against Slingshot Printing LLC involving this patent.

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Dated: January 25, 2023

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