IN THE 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

_____

PATENT OWNER'S NOTICE OF APPEAL

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U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Notice is hereby given, pursuant to 35 U.S.C. §§ 141(c), 142, and 319, and 37 C.F.R. §§ 90.2(a) and 90.3(a), that Patent Owner Slingshot Printing LLC hereby appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered on August 6, 2024 in IPR2023-00312 (Paper 27) (attached hereto as Exhibit A), and from all underlying orders, decisions, rulings, opinions, and issues that are adverse to Patent Owner, including, without limitation, those within the Final Written Decision entered on August 6, 2024 (Paper 27) and Decision on Institution of Inter Partes Review entered on August 7, 2023 (Paper 6).

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Patent Owner further indicates that the issues on appeal include, but are not limited to, the Board's claim constructions; the Board's determination that claims 1–3, 5–13, and 15–17 are unpatentable over U.S. Patent No. 7,384,113 B2 to Benjamin ("Benjamin") and U.S. Patent No. 6,612,673 to Giere ("Giere673"); the Board's determination that claims 4 and 14 are unpatentable over Benjamin, Giere673 and U.S. Patent No. 7,163,272 B2 to Parish ("Parish"); and all other issues decided adversely to Patent Owner in any orders, decisions, rulings, and opinions; the Board's consideration and analysis of the expert testimony, prior art, and other evidence in the record; and the Board's factual findings, conclusions of law, or other determinations supporting or relating to the above issues.

This Notice of Appeal is timely pursuant to 37 C.F.R. § 90.3, having been duly filed within 63 days after the Final Written Decision.

Respectfully submitted,

Dated: October 2, 2024

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that, pursuant to 37 C.F.R. §§ 42.6(e)(4) and 90.2, the foregoing Patent Owner's Notice of Appeal and all accompanying documents, were filed electronically via the P-TACTS system with the Patent Trial and Appeal Board on October 2, 2024, pursuant to 37 C.F.R. 42.6(b)(1), and that the foregoing Notice of Appeal and accompanying documents were served upon the Petitioner pursuant to 37 C.F.R. 42.6(e)(1) via electronic mail on October 2, 2024, by serving the attorneys of record below at CanonSlingshotIPRs@morganlewis.com.

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The undersigned further certifies that a copy of the foregoing Patent Owner's Notice of Appeal and accompanying documents were filed on October 2, 2024, with the United States Court of Appeals for the Federal Circuit through the Court's CM/ECF filing system and that the filing fee is being paid electronically using pay.gov.

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Exhibit A

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Paper 27
Date: August 6, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

SLINGSHOT PRINTING LLC,
Patent Owner.

IPR2023-00312
Patent 7,484,823 B2

Before JO-ANNE M. KOKOSKI, GARTH D. BAER, and JOHN D. HAMANN *Administrative Patent Judges*.

KOKOSKI, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6, and issue this Final Written Decision pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Canon U.S.A., Inc. and Canon Inc. (collectively, "Petitioner") show by a preponderance of the evidence that claims 1–17 (the "challenged claims") of U.S. Patent No. 7,484,823 B2 ("the '823 patent," Ex. 1001) are unpatentable.

A. Procedural Background

Petitioner filed a Petition to institute an *inter partes* review of claims 1–17 of the '823 patent. Paper 2 ("Pet."). Slingshot Printing LLC ("Patent Owner") filed a Preliminary Response. Paper 5. Pursuant to 35 U.S.C. § 314(a), we instituted an *inter partes* review of claims 1–17 on the grounds advanced in the Petition. Paper 6 ("Institution Decision" or "Dec."), 7, 30. After institution of trial, Patent Owner filed a Patent Owner Response ("PO Resp.," Paper 9), Petitioner filed a Reply ("Pet. Reply," Paper 12), and Patent Owner filed a Sur-reply ("PO Sur-reply," Paper 14).

We held an oral hearing on May 9, 2024, and a transcript is included in the record. Paper 26.

B. Real Parties in Interest

Petitioner and Patent Owner each identifies itself as the real parties-in-interest. Pet. 1; Paper 4, 1 (Mandatory Notice).

C. Related Matters

The parties indicate that the '823 patent is at issue in *Slingshot Printing LLC v. Canon U.S.A., Inc.*, No. 2:22-cv-01852 (E.D.N.Y.). Pet. 1; Paper 4, 2. Patent Owner additionally identifies several "concurrent IPR petitions" filed by Petitioner "against patents owned by [Patent Owner],

which patents are asserted along with the challenged patent in pending district court litigation." Paper 4, 1.

D. The '823 Patent

The '823 patent generally relates "to methods and apparatuses for regulating the temperature of multi-via heater chips." Ex. 1001, 1:15–17. Figure 5 is reproduced below.

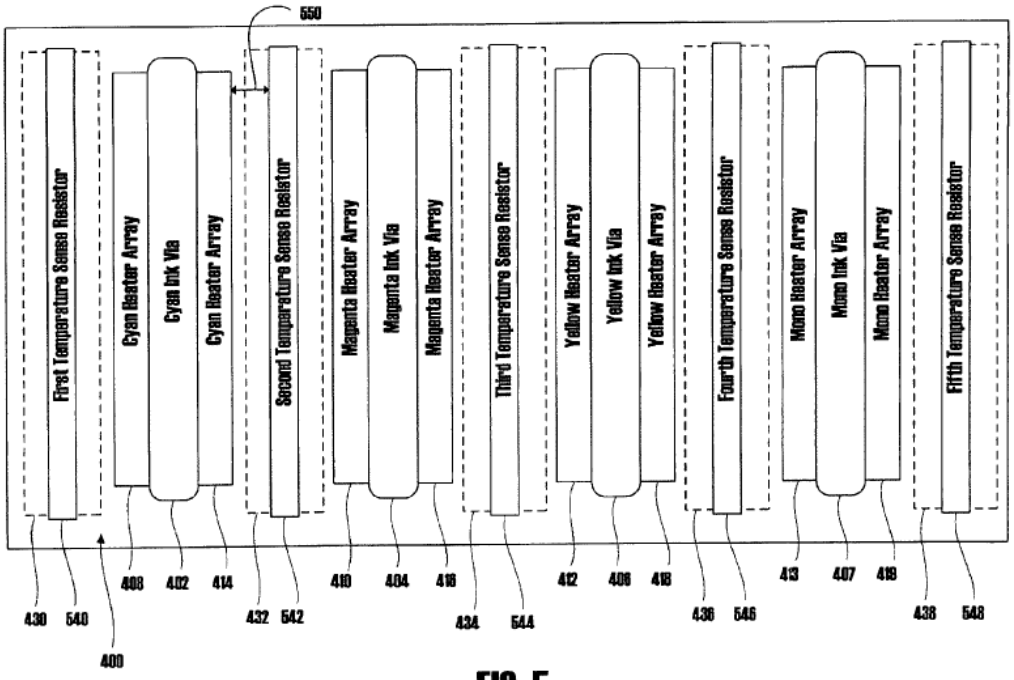


FIG. 5

Figure 5 depicts an exemplary configuration for a heater chip described in the '823 patent. *Id*. at 4:52–54. Heater chip 400 includes cyan ink via 402 with cyan heater arrays 408 and 414, magenta ink via 404 with magenta heater arrays 410 and 416, yellow ink via 406 with yellow heater arrays 412 and 418, and mono ink via 407 with mono heater arrays 413 and 418. *Id*. at 6:24–26. Thermal regions 430, 432, 434, 436, and 438 are defined regions of the silicon substrate of heater chip 400, and are situated around and between ink vias 402, 404, 406, and 407. *Id*. at 6:34–37. "The

minimum width of the thermal regions 430, 432, 434, 436, and 438 is generally limited by the heater chip 400 circuitry." *Id*. at 6:37–39.

The '823 patent teaches that the temperature of heater chip 400 is measured on a per-thermal-region basis by placing a thermal sense resistor ("TSR") in each of the thermal regions, each of which "is operable to measure the temperature of the silicon substrate in a corresponding thermal region." Ex. 1001, 6:40–45. This is shown in Figure 5 above, with TSR 540 in thermal region 430, TSR 542 in second region 432, TSR 544 in thermal region 434, TSR 546 in thermal region 436, and TSR 548 in thermal region 438. *Id*. at 6:55–61. The '823 patent teaches that "TSRs 540, 542, 544, 546, and 548 are placed well away from the heater arrays 408, 410, 412, 413, 414, 416, 418, 419, at a distance 550 of several hundred microns, rather than in close proximity to the heater arrays." *Id*. at 6:61–65.

The '823 patent explains that,

> [d]ue to the relative high thermal conductivity of the silicon substrate, each of the thermal regions 430, 432, 434, 436, 438 have a very uniform temperature across the width of that region. Because of this conductivity, the TSRs 540, 542, 544, 546, 548 can be placed in the center of their respective thermal regions 430, 432, 434, 436, and 438 and still provide an accurate temperature measurement for the region. The ink vias 402, 404, 406, 407, on the other hand, act as thermal insulators between the thermal regions 430, 432, 434, 436, 438.

Ex. 1001, 7:11–20. For example, the '823 patent also explains, "if the right cyan heater array 414 fires, then the adjacent left magenta heater array 410 will quickly be at the same temperature as the right cyan heater array 414." *Id*. at 7:20–22. Thus, the temperature reading from second region 432 represents the temperature of both cyan heater array 414 and magenta heater array 410. *Id*. at 7:23–26.

E. Illustrative Claims

Petitioner challenges claims 1–17 of the '823 patent. Pet. 1. Claims 1 and 11 are independent, illustrative of the claimed subject matter, and reproduced below.

> 1. A chip for use with a printing device, comprising:
>
> a first heater array positioned substantially adjacent a first via;
>
> a second heater array positioned substantially adjacent a second via;
>
> 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
>
> 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 the second heater array, and further extends substantially the length of the first heater array and second heater array,
>
> 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;
>
> a third heater array[] positioned substantially adjacent the second via;
>
> a fourth heater array, positioned substantially adjacent a third via;
>
> 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

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,

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.

Ex. 1001, 8:44–9:16.

11. A method for fabricating chips for use with a printing device, comprising:

providing a first heater array, positioned substantially adjacent a first via;

providing a second heater array, positioned substantially adjacent a second via;

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

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;

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;

providing a third heater array substantially adjacent the second via;

providing a fourth heater array substantially adjacent a third via; and

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.

Id. at 9:47–10:27.

F. Evidence

Petitioner relies on the evidence listed below.

Name	Reference	Date	Exhibit No.
Yabe	US 6,527,367 B2	Mar. 4, 2003	1008
Giere178	US 6,565,178 B1	May 20, 2003	1007
Giere673	US 6,612,673 B1	Sep. 2, 2003	1005
Parish	US 7,163,272 B2	Jan. 16, 2007	1006
Benjamin	US 7,384,113 B2	Jun. 10, 2008	1004

Pet. 2–3. Petitioner also relies on the Declaration of Stephen F. Pond, Ph.D. ("Pond Declaration," Ex. 1002). Patent Owner relies on the Declaration of Steven J. Dietl (Ex. 2003).

G. Asserted Grounds

Petitioner asserts that claims 1–17 would have been unpatentable based on the following grounds:

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 5–13, 15–17	103[1]	Benjamin, Giere673

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, 125 Stat. 284 (2011), revised 35 U.S.C. §§ 102 and 103 effective March 16, 2013. Petitioner argues, and Patent Owner does not contest, that the pre-

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
4, 14	103	Benjamin, Giere673, Parish
1–3, 5–13, 15–17	103	Benjamin, Giere178
1–3, 5–13, 15–17	103	Yabe, Giere673
4, 14	103	Yabe, Giere673, Parish

Pet. 3.

II. ANALYSIS

A. Legal Standards

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc*., 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and

AIA statutory provisions apply to this case. *See* Pet. 2. Accordingly, we apply the pre-AIA versions of §§ 102 and 103.

(4) objective indicia of non-obviousness, if present.[2] *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a claim for obviousness, we also must "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

B. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art ("PHOSITA") "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." Pet. 6 (citing Ex. 1002 ¶¶ 108–110). Although Patent Owner "disagrees that a degree in Materials Science is sufficient," it "does not dispute [Petitioner's] characterization of the level of ordinary skill in the art for the purpose of [the] Response." PO Resp. 34. Patent Owner does not explain its basis for this disagreement, or how the disagreement relates to Petitioner's proposal, which requires, *inter alia*, "two years of training or experience in the design of inkjet printheads or semiconductor circuit layout." Pet. 6; PO Resp. 34.

In the Institution Decision, we adopted the assessment offered by Petitioner. Dec. 8. Because Petitioner's definition of the level of skill in the art is consistent with the '823 patent and the asserted prior art, we maintain it

[2] Patent Owner does not present arguments or evidence of such objective indicia of non-obviousness. *See generally* PO Resp.

for purposes of this Final Written Decision. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Claim Construction

We construe each claim "in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019).

Petitioner proposes that that we construe the term "adjacent" as used in claims 1 and 11 to mean "'next to and can include,' such that a region disposed adjacent each heater array can also include that heater array." Pet. 6. Petitioner contends that this construction "is consistent with the '823 Patent claims and specification describing regions that are next to, and can include, heater arrays." *Id*. (citing Ex. 1001, 7:66, 7:47–50).

Patent Owner disagrees, and contends "that 'adjacent' carries its plain and ordinary meaning throughout the claims." PO Resp. 34. Patent Owner argues that "Petitioners' proposed construction of 'adjacent' to mean 'next to and can include' is not necessary to a proper understanding of the scope and meaning of" the claims, "does not reflect the ordinary meaning of 'adjacent,' and is not supported by a proper reading of the claims or specification of the '823 patent." *Id*. at 36.

We agree with Patent Owner that Petitioner's proposed construction for adjacent (i.e., "next to and can include") does not reflect the plain and ordinary meaning of adjacent. Rather, we conclude that the term "adjacent" should be afforded its plain and ordinary meaning (e.g., next to) in light of the claim language and intrinsic evidence. As we discuss below, Petitioner's showing for claims 1 and 11 is consistent with the plain and ordinary meaning of "adjacent." *See* Section II.D.3, *infra*.

Based on our review of the complete trial record and the claim construction arguments raised by the parties, we determine that it is not necessary to expressly construe any other claim terms to resolve the parties' dispute. *Realtime Data*, 912 F.3d at 1375.

D. Asserted Obviousness over Benjamin and Giere673

Petitioner contends that claims 1–3, 5–13, and 15–17 would have been obvious over the combined teachings of Benjamin and Giere673. Pet. 7–59.

1. Benjamin

Benjamin relates to fluid ejection systems, and in particular to inkjet printing systems that include a fluid ejection device, such as an inkjet printhead assembly, and a fluid supply assembly, such as an ink supply assembly. Ex. 1004, 3:24–27.

Figure 2 is reproduced below.

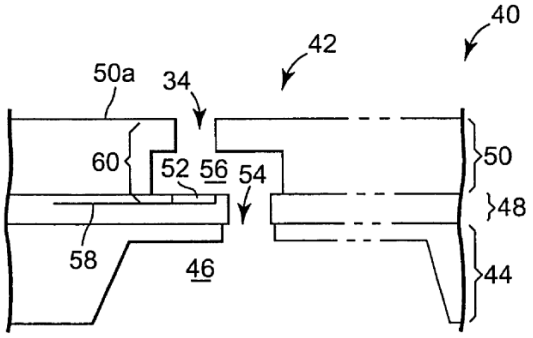


Fig. 2

Figure 2 is a diagram illustrating a portion of one embodiment of a printhead die described in Benjamin. *Id*. at 2:16–17. Printhead die 40 includes array of printing elements 42 formed on substrate 44, which also has ink feed slot 46 formed thereon. *Id*. at 4:58–61. Ink feed slot 46 provides a supply of liquid ink to printing elements 42. *Id*. at 4:61–62. Thin film structure 48 has ink feed channel 54, which communicates with ink feed slot 46, formed therein. *Id*. at 5:1–3. Nozzle opening 34 is formed on face 50a of orifice layer 50. *Id*. at 5:3–5. Also formed on orifice layer 50 is vaporization chamber 56, which communicates with nozzle opening 34 and ink feed channel 54. *Id*. at 5:5–8. Firing resistor 52 is positioned within vaporization chamber 56, and is electrically coupled by leads 58 "to circuitry controlling the application of electric current through selected firing resistors." *Id*. at 5:8–11.

Drop generator 60 includes firing resistor 52, vaporization chamber 56, and nozzle opening 54. Ex. 1004, 5:11–14. Benjamin teaches that ink feed slot 46 includes opposing ink feed slot sides 46a and 46b. *Id*. at 5:53–54. A total of n drop generators 60 are located along ink feed slot 46, with a total of m drop generators 60 located along ink feed slot side 46a,

and n-m drop generators 60 located along ink feed slot side 46b. *Id*. at 5:53–58. Benjamin teaches that, during printing, ink feed slot 46 provides ink to each of the n drop generators 60, and firing resistors 52 in drop generators 60 "are energized in a controlled sequence to eject fluid from vaporization chamber 56 and through nozzles 34 to print an image on print medium 36." *Id*. at 5:64–6:5.

Figure 21 is reproduced below.

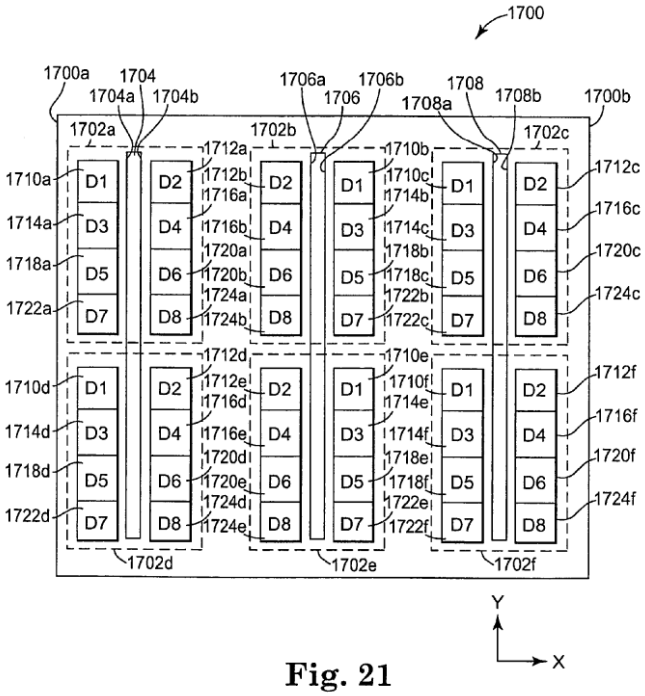


Fig. 21

Figure 21 is a diagram illustrating one embodiment of a printhead die described in Benjamin. Ex. 1004, 64:53–54. Printhead die 1700 includes six fire groups 1702a–1702f disposed along ink fluid feed slots 1704, 1706, and 1708. *Id*. at 64:54–57. Fire groups 1702a–1702f are divided into eight data line groups D1–D8, and each data line group D1–D8 includes pre-charged firing cells 120 (not shown) from each of fire groups 1702a–1702f. *Id*. at 65:5–8.

2. Giere673

Giere673 describes "an inkjet printing system, having a substrate, a plurality of heating elements disposed on the substrate, an ink ejection assembly system adjacent the substrate forming a plurality of ink ejection chambers," wherein "each chamber [is] associated with a different one of the heating elements." Ex. 1005, code (57). A controller is "operatively connected to the heating elements," and "receiv[es] print data and process[es] the print data to predict the thermal conditions of a subset of the ink ejection chambers" to "selectively operat[e] the corresponding heating elements of the subset." *Id*.

Figure 4 is reproduced below.

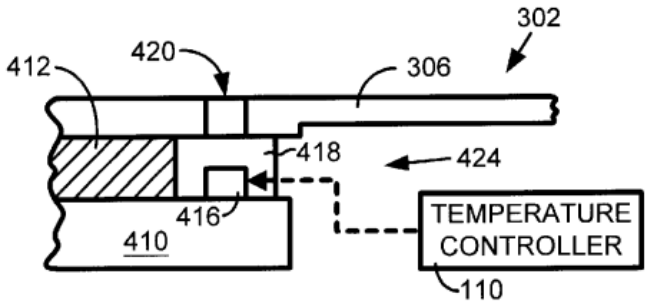


FIG. 4

Figure 4 is a schematic cross-sectional view of a portion of the ink chamber arrangement of a printhead assembly described in Giere673. Ex. 1005, 2:5–8. Thermal head assembly 302 includes barrier layer 412 formed between nozzle member 306 and substrate 410, ink ejection chamber 418, ink ejection element 416, temperature controller 110, nozzle 420, and ink reservoir 424. *Id*. at 4:11–25, 5:41–42. Giere673 explains that, during a printing operation, ink stored in ink reservoir 424 "generally flows around the edges of the substrate 410" and into vaporization chamber 418, energization signals are sent to ink ejection element 416, and, upon

energization of ink ejection element 416, "a thin layer of adjacent ink is superheated." *Id*. at 5:41–50. Energized ink ejection element 416 "causes explosive vaporization and, consequently, causes a droplet of ink to be ejected through" nozzle 420. *Id*. at 5:51–53.

Figure 5 is reproduced below.

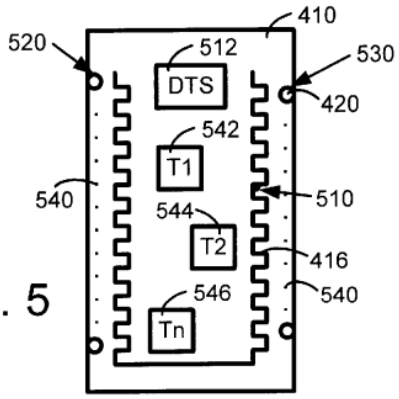


FIG. 5

Figure 5 is a schematic top view of the substrate of the printhead assembly depicted in Figure 4. Ex. 1005, 2:9–11. Substrate 410 includes thermal sense resistor (TSR) 510, digital temperature sensor (DTS) 512, temperature recorders 542, 544, and 546, first column 520 of nozzles 420, and second column 530 of nozzles 420. *Id*. at 4:52–55, 4:62–65, 5:13–14.

Giere673 explains that "[o]ne or multiple TSRs 510 can be used to provide an approximation of the mean temperature of the substrate." *Id*. at 4:55–56. Giere673 further explains that TSR 510 "reflects the temperature of the substrate 410 after heat has moved from the heating elements to the TSR 510" and is preferably "not located adjacent to any particular heating element." *Id*. at 4:57–60. Giere673 teaches that TSR 510, which is located along the length of substrate 410, "can have two legs that are approximately 680 μm inboard from the center of the columns of ink ejection elements 416." *Id*. at 5:9–12.

3. Analysis of Claims 1 and 11

Petitioner contends that the combination of Benjamin and Giere673 teaches or suggests all of the limitations of independent claims 1 and 11.[3] Pet. 7–44; Ex. 1002 ¶¶ 112–261. Petitioner illustrates some of its contentions with an annotated and simplified version of Benjamin's Figure 21, reproduced below. Pet. 15.

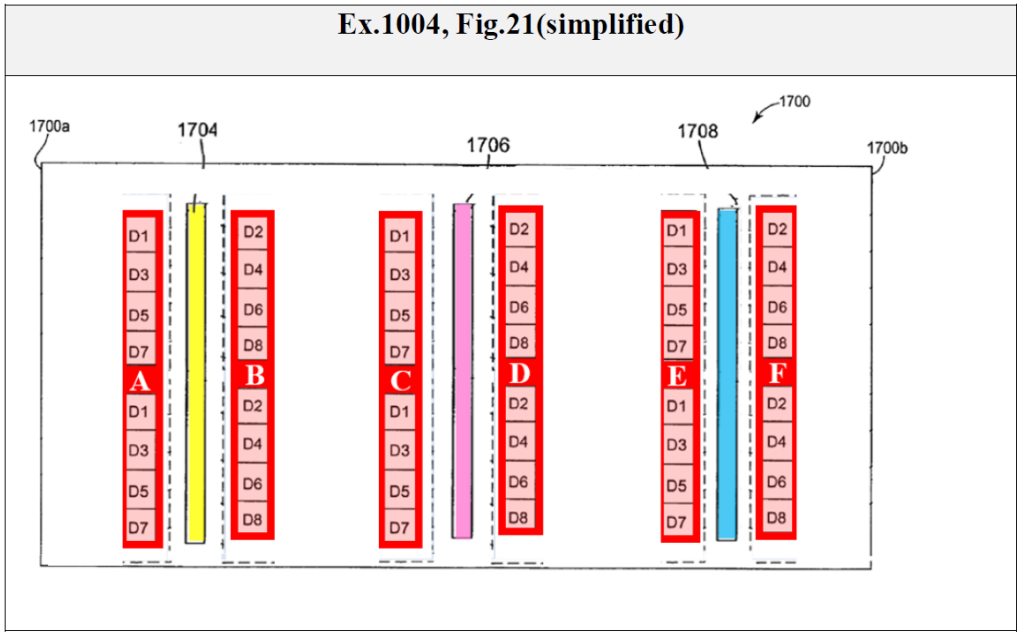


Figure 21 is a diagram of an example layout of one embodiment of a printhead die described in Benjamin. Ex. 1004, 2:62–63. Petitioner modifies Figure 21 by (i) removing the reference numerals, except those for printhead die 1700, sides 1700a and 1700b, and ink feed slots 1704, 1706, and 1708; and (ii) removing two sides of each of the six dotted boxes indicating each of the fire groups. *Compare* Ex. 1004, Fig. 21 *with* Pet. 15.

[3] The parties rely on the same arguments with respect to claims 1 and 11. *See* Pet. 7 n.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.") (citing Ex. 1002 ¶¶ 226–227); PO Resp. 40 ("Independent claim 11 recites similar limitations" to claim 1), 41–54 (addressing Ground 1).

Petitioner annotates Figure 21 by coloring ink feed slot 1704 yellow, ink feed slot 1706 magenta, and ink feed slot 1708 cyan, and the data line groups (D1–D8) for each fire group red. Pet. 15. Petitioner also adds a label to each of the six heater arrays, starting with A for the heater array on the left through F for the last heater array on the right. *Id*.

Referring to annotated Figure 21, Petitioner contends that Benjamin teaches "a first heater array positioned substantially adjacent a first via" (heater array B positioned next to yellow ink via 1704), "a second heater array positioned substantially adjacent a second via" (heater array C positioned next to magenta ink via 1706), "a third heater array positioned substantially adjacent the second via" (heater array D positioned next to magenta ink via 1706), and "a fourth heater array positioned substantially adjacent a third via" (heater array E positioned next to cyan ink via 1708). *Id*. at 10–19, 36–40. Petitioner then identifies the area between heater array B and heater array C (which it calls "Region 2") as the claimed "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 the area between heater array D and heater array E (which it calls "Region 3") as the claimed "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." *Id*. at 19–21, 40–42.

Patent Owner responds that Benjamin and Giere673 do not teach (a) monitoring the temperatures in regions between vias, (b) temperature sensors substantially centrally disposed in regions between ink vias, and (c) supplying heat to adjacent heater arrays in response to a temperature

monitored in regions between ink vias. PO Resp. 41–46. We address each argument in turn below.

a) "a temperature sensing element operable to sense a temperature of the region, the temperature being representative of the region"

Petitioner contends that "Benjamin's printhead die 1700 includes a 'temperature sense resistor' (TSR)" that "allows 'a printer coupled to an ink jet cartridge to determine a temperature of the printhead die, based upon a measurement of the resistor.'" Pet. 21 (citing Ex. 1004, 79:60–67) (emphases omitted). Petitioner asserts that Benjamin teaches that the TSR "'provide[s] a TSR value' to the controller 100 on the printer, which then compares the value obtained from the TSR '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.'" *Id*. at 22 (citing Ex. 1004, 79:60–66, Figs. 25A, 25B; Ex. 1002 ¶¶ 140–145). Petitioner then notes that, although Benjamin teaches disposing a TSR on the printhead die, "it does not say *where* on the printhead die the TSR should be disposed." *Id*. at 23.

Petitioner contends that "Giere673 explicitly discloses *where* on the printhead the TSR should be located" in order to provide benefits such as improved print quality and printhead life. Pet. 23 (citing Ex. 1002 ¶¶ 147–148; Ex. 1005, 3:5–13, 4:55–56). In particular, Petitioner contends that Giere673 teaches disposing a single TSR in a region on the printhead die between two heater arrays, but preferably not "'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." *Id*. at 23–24 (citing Ex. 1005, 2:50,4:51–56). Petitioner also contends that Giere673 teaches positioning the "TSR equidistant from the

two heater arrays but no less than 'approximately 680 μm inboard from the center of the [heater arrays].'" *Id*. at 25 (citing Ex. 1005, 4:57–59) (emphases omitted). According to Petitioner,

> [b]y 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" . . . 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]."

Id. at 26 (citing Ex. 1005, 4:57–59) (emphases omitted).

Patent Owner responds that "Giere '673 does not relate to a printhead chip having any via at all, let alone multiple parallel vias with heater arrays on both sides of the vias." PO Resp. 41 (citing Ex. 2003 ¶ 84). Patent Owner argues that, because Giere673 does not disclose a third or fourth heater array, it "teaches nothing about where to place temperature sensors in the type of printhead disclosed in Benjamin having a plurality of ink vias with heaters arrays on both sides of the vias." *Id*. (citing Ex. 2003 ¶ 84). Patent Owner's arguments in this regard, however, improperly attack the individual teachings of Benjamin and Giere673. Nonobviousness cannot be established by attacking the references individually when the ground of unpatentability is predicated upon a combination of references. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). The relevant inquiry here is whether the claimed subject matter would have been obvious to those of ordinary skill in the art in light of the combined teachings of Benjamin and Giere673. *See In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

Based on our review of the complete trial record, we determine that Petitioner establishes that the combination of Benjamin and Giere673 teaches "a temperature sensing element operable to sense the temperature of the region, the temperature being representative of the region" limitation of claims 1 and 11.

As Petitioner notes, Benjamin teaches using a TSR to determine a temperature of the printhead die, but does not teach where the TSR is located on the die. Pet. 21–23 (citing Ex. 1004, 79:60–67, Figs. 25A, 25B).

Giere673 teaches that "[o]ne or more TSRs 510 can be used to provide an approximation of the mean temperature of the substrate." Ex. 1005, 4:55–56. Giere673 also teaches that, preferably, TSR 510 "is not located adjacent to any particular heating element and reflects the temperature of the substrate 410 after heat has moved through the heating elements to the TSR 510." *Id*. at 4:56–60. Giere673 further teaches that "TSR 510 is located along the length of the substrate 410" and "can have two legs that are approximately 680 um inboard from the center of the columns of ink ejection elements 416." *Id*. at 5:9–12. These disclosures in Giere673 indicate that TSR 510 can be placed in a region between and equidistant from two heater arrays, in order to sense a temperature representative of that region.

We agree with Petitioner that a PHOSITA would have been motivated to combine the teachings of Benjamin and Giere673 to maintain the substrate at an optimum temperature for producing ink droplets in order to increase the quality of the ink drops, use less energy to fire the heater arrays, and more easily maintain the printhead assembly due to less residue being deposited on the die. Pet. 26; *see also DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1358 (Fed. Cir. 2006)

("[A]n implicit motivation to combine exists not only when a suggestion may be gleaned from the prior art as a whole, but when the 'improvement' is technology-independent and the combination of references results in a product or process that is more desirable, for example because it is stronger, cheaper, cleaner, faster, lighter, smaller, more durable, or more efficient" are universal motivators to combine/modify prior art.).

We also agree with Petitioner that Benjamin and Giere673 address the similar problem of "reduced print quality caused by the printhead operating outside its optimal temperature," and provide the similar solution of disposing a temperature sense resistor "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." Pet. 56 (citing Ex. 1002 ¶ 243). In addition, we agree that Benjamin and Giere673 optimize print quality based upon a temperature value provided by a TSR. *Id.* at 55–58; Ex. 1002 ¶¶ 242–257. Accordingly, we find that a PHOSITA would have been motivated to make the proffered combination. *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1379 (Fed. Cir. 2023) ("*[A]ny* need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.") (citations omitted); *KSR*, 550 at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.").

In addition, we find persuasive Petitioner's argument that one of ordinary skill in the art would have been motivated to dispose a single TSR

in each of Benjamin's regions. Pet. 28–31; Ex. 1002 ¶¶ 138–156, 247–250. First, Giere673 teaches that "*multiple* TSRs 510 can be used to provide an approximation of the mean temperature of the substrate." Ex. 1005, 4:55–56 (emphasis added). In addition, Giere673 teaches having a temperature controller coupled to multiple temperature sensors, which determine a mean temperature of the substrate "and an actual local temperature profile near designated ink ejection elements." *Id*. at 2:57–62. Giere673 teaches that the temperature controller selectively fires particular heating elements based on thermal conditions. *Id*. at 3:3–6. These teachings support disposing multiple TSRs across the substrate (e.g., one in each region) to measure the substrate's temperature near each of the heater arrays for selectively firing particular heating elements for print quality optimization. *Id*. at 2:57–62, 3:3–6.

Second, we agree with Petitioner that it was known in the prior art (i) to sense temperature on a per-color basis, and (ii) that ink vias act as thermal barriers between the colors. Pet. 29–30 (citing Ex. 1001, 2:1–15, 2:47–50; Ex. 1002 ¶¶ 247–249). The '823 patent makes these admissions, as shown in its Figure 2 and accompanying text. Figure 2 is reproduced below.

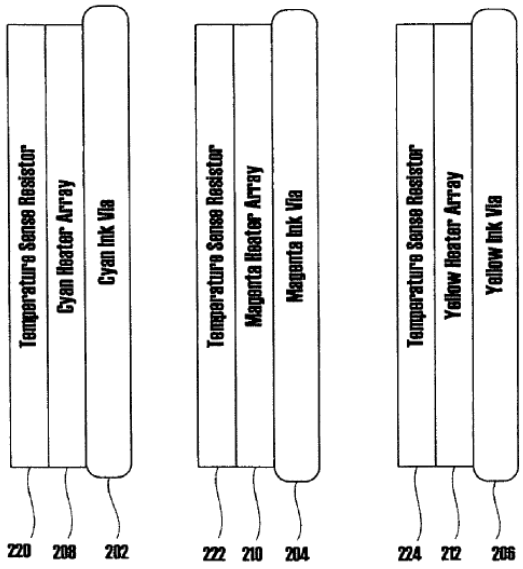


FIG. 2
(Prior Art)

Figure 2 "illustrates a traditional heater chip utilizing temperature sense resistors and heater arrays to monitor and regulate temperature on a by color basis." Ex. 1001, 4:42–44. The Background of the Invention section of the '823 patent explains:

> The heater chip shown in FIG. 2 improves on that of FIG. 1 by *providing for temperature sensing on a per color basis*. Three temperature sense resistors 220, 222, and 224 are placed in close proximity to each of the ink vias, each situated on the same side of their respective ink vias. As shown, a first TSR 220 is situated on the left side of the cyan ink via 202 and cyan heater array 208; a second TSR 222 is situated on the left side of the magenta ink via 204 and magenta heater array 210; and a third TSR 224 is situated on the left side of the yellow ink via 206 and the yellow heater array 212. *The ink vias 202, 204, and 206 act as a thermal barrier between the colors.* All the thermal heater arrays 208, 210, and 212 are situated on only one side of their respective ink vias, ensuring that there is only a small amount of thermal crosstalk between the temperature sense resistors.

Id. at 2:1–15 (emphases added). In other words, it was known to dispose a TSR adjacent to a heater array in each of the three regions separated by the ink vias. *Id.*

In addition, Yabe evidences that a PHOSITA would have known that "ink vias act as thermal insulators between other regions of Benjamin's printhead [Regions 1, 3, 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." Pet. 28 (citing Ex. 1001, 5:52–55; Ex. 1008, 3:16–21). We appropriately consider such evidence of the knowledge that a PHOSITA would have had as part of our obviousness analysis. *See Randall Mfg. v. Rea*, 733 F.3d 1355, 1362–63 (Fed. Cir. 2013).

Accordingly, in light of these admissions and Yabe's teaching, we find that a PHOSITA would have known that placing a TSR within a single region would not accurately report the mean temperature of the entire printhead die. Ex. 1002 ¶ 153; Pet. 28. And, again, it was known to have a TSR adjacent to a heater array for each region separated by ink vias. Ex. 1001, 2:1–15. We also agree with Petitioner and find persuasive Dr. Pond's testimony that a PHOSITA thus would have been motivated to dispose a single TSR within each of Benjamin's regions (e.g., Regions 1–4) to determine temperature across the entire die to regulate the die's operational temperature and optimize the printing quality of the inkjet printing device. Ex. 1002 ¶ 154. In other words, a PHOSITA would have disposed a single TSR in each region "so that, *individually*, each TSR provides a temperature value reflective of the temperature of its region, including the heater arrays within those regions, *and collectively*, the values provided by the TSRs reflect the mean temperature of the entire printhead die." Ex. 1002 ¶ 162; *see also id*. ¶ 250; Pet. 28–30.

In addition, we find that one of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Benjamin and Giere673 as proposed. Pet. 58–59. Benjamin and Giere673 teach similar printing system technologies, and we are persuaded by Dr. Pond's testimony that a PHOSITA would have found it a routine and obvious matter to combine, replace, and modify various features from Benjamin with features taught by Giere673. Ex. 1002 ¶¶ 259–260. We do not find including TSRs in each of Benjamin's regions would have been uniquely challenging or difficult for one of ordinary skill in the art. *See Leapfrog Enterprises, Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007) (citing *KSR*, 550 U.S. at 419–20) (finding that obviousness was supported because there was no evidence that making the combination was uniquely challenging or difficult for one of ordinary skill in the art).

Accordingly, we find that Petitioner provides sufficiently articulated reasoning with rational underpinning to support combining Benjamin and Giere673 in the manner Petitioner proposes. *See In re Kahn*, 441 F.3d at 988; *see also Realtime Data,* 912 F.3d at 1374 ("A motivation to combine may be found 'explicitly or implicitly in market forces; design incentives; . . . and the background knowledge, creativity, and common sense of the person of ordinary skill.'") (quoting *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1371 (Fed. Cir. 2018)).

We considered Patent Owner's arguments and find them unavailing. Patent Owner argues that "the Benjamin device can accommodate only one temperature sense resistor because there is only a single contact area (TSR) . . . on the flex circuit shown in Figs. 25A and 25B . . . , and a single return area (TSR-RT)." PO Resp. 49 (citing Ex. 1004, Figs. 25A–B, 79:29–34, 79:63–65). This argument is akin to arguing that Benjamin and Giere673's

teachings cannot be physically combined, which is an improper focus for determining whether the claim would have been rendered obvious by the prior art as a whole. *See Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (quoting *In re Sneed*, 710 F.2d 1544, 1550 (Fed. Cir. 1983)); *see also id.* (quoting *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc)) ("Etter's assertions that Azure cannot be incorporated in Ambrosio are basically irrelevant, the criterion being not whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole."). Rather, we find that a PHOSITA would have "be[en] able to fit the teachings of [Benjamin and Giere673] . . . together like pieces of a puzzle" because the skilled artisan is "a person of ordinary creativity, not an automaton." *KSR*, 550 U.S. at 420–21.

Patent Owner further argues that "Benjamin already discloses a suitable way of achieving [the temperature of the entire printhead die] using only a single temperature sensor on the printhead die that measures the temperature of the entire printhead." PO Resp. 48–49 (citing Ex. 1004, 79:60–67). As discussed above, however, a PHOSITA would have known that placing a TSR within a single region would not accurately report the mean temperature of the entire printhead die, and thus would have been motivated to dispose a TSR in each region. Ex. 1002 ¶¶ 153–155. Regardless, the proper focus is whether the combination provides a suitable option, which Giere673's teachings do. *See Intel Corp.*, 61 F.4th at 1380–81 (holding the Board erred by concluding there was no reason to combine in part because the base reference "already addresses" a problem, and finding that a petitioner is not required to show that the combination would be an improvement, but only that it was a suitable option).

We also find unavailing Patent Owner's argument that "[d]eploying separate regional TSRs for the purpose of computing a temperature representative of the entire printhead would unnecessarily add cost and take up space on the printhead die and/or the flex circuit." PO Resp. 49 (citing Ex. 2003 ¶ 93). Patent Owner adds that "in designing printheads the space on the printhead chip and attached flex circuit are[] very valuable, and a PHOSITA would have been motivated to keep the size of both the chip and flex circuit to a minimum not only to reduce the size of the printhead and related ink cartridge, but also to reduce manufacturing cost and complexity." *Id*. at 49–50 (citing Ex. 2003 ¶ 93). However, "[t]he fact that [a] motivating benefit comes at the expense of another benefit . . . should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another." *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000); *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) ("[A] given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine."). "Instead, the benefits, both lost and gained, should be weighed against one another." *Winner Int'l*, 202 F.3d at 1349 n.8. Here, Giere673 repeatedly teaches that print quality problems arise from too high temperatures, and that there is an optimal temperature operating range for a printhead. *See, e.g.*, Ex. 1005, 1:7–38. And as we discuss above, a PHOSITA would have known that placing a TSR within a single region would not accurately report the mean temperature of the entire printhead die, and thus would have been motivated to dispose a TSR in each region. Ex. 1002 ¶¶ 153–155. On the whole, we find that the benefit of a more accurate report of the mean temperature to optimize print quality outweighs the purported cost or size concerns. Ex. 1005, 1:7–38; Ex. 1002 ¶¶ 153–155.

Neither Patent Owner nor Mr. Dietl quantifies these cost and size concerns, or weighs them against the benefit of a more accurate temperature measurement. Ex. 2003 ¶ 93. We find that Mr. Dietl's testimony in this regard is conclusory, and lacking in specific detail. *Id.* Moreover, "the fact that [teachings] would not be combined by businessmen for economic reasons is not the same as saying that it could not be done because skilled persons in the art felt that there was some technological incompatibility that prevented their combination. Only the latter fact is telling on the issue of nonobviousness." *Orthopedic Equip. Co., Inc. v. United States*, 702 F.2d 1005, 1013 (Fed. Cir. 1983).

Patent Owner additionally argues that "[t]he only approach for monitoring mean printhead temperature consistent with the teachings of both references would have been to deploy a single TSR on the heater chip rather than multiple TSRs each located in a different region separated by ink vias." PO Resp. 50. In particular, Patent Owner argues that "the solution consistent with the single TSR contact pad of Benjamin's flex circuit would have been to employ one continuous TSR that winds between the vias, providing a single temperature value and requiring only a single temperature input and output." *Id*. at 50–51; PO Sur-reply 8–9. First, Patent Owner incorrectly limits Petitioner's proposed combination to Benjamin's teaching of a "single TSR contact pad of Benjamin's flex circuit." PO Resp. 50. This is akin to arguing that Benjamin and Giere673's teachings cannot be physically combined, and does not account for the ordinary creativity of a skilled artisan. Second, Patent Owner's proposed solution, even if suitable, does not negate that the teachings of Benjamin and Giere673, combined in the manner Petitioner proposes, also provide a suitable option for the reasons discussed above. This suitability supports that a PHOSITA would have been

motivated to combine the teachings. *See Intel Corp.*, 61 F.4th at 1381.

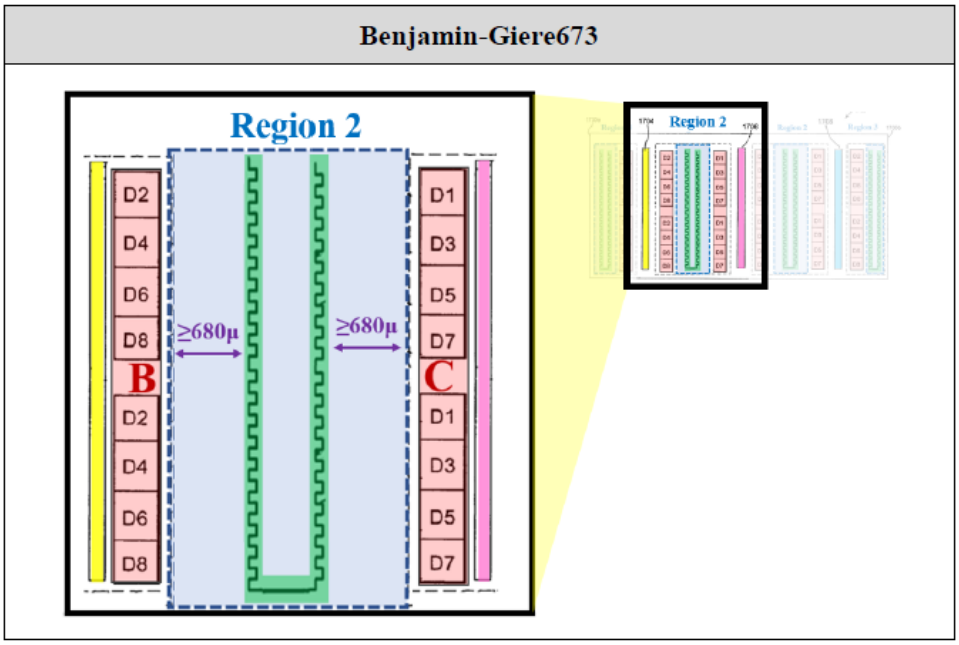
We also find unavailing Patent Owner's argument that "[t]he only source that would have led a PHOSITA to the overall printhead structure and the temperature monitoring approach recited in claims 1 and 11 is the '823 patent specification." PO Resp. 52. To the contrary and as discussed above, we find that Petitioner provides sufficiently articulated reasoning with rational underpinning to support combining Benjamin and Giere673 in the manner Petitioner proposes.

Patent Owner further argues that "Yabe teaches measuring mean temperature of a printhead with sensors in the peripheral region of the die and does not disclose temperature sensors between ink vias." PO Resp. 51; PO Sur-reply 12–14. Petitioner relies on Yabe to show that a PHOSITA would have known that ink vias are insulating. Pet. 28 (citing Ex. 1008, 3:16–21). We consider Yabe for that purpose. *Randall Mfg.*, 733 F.3d at 1362–63.

In sum, we are persuaded that Petitioner shows that the combination of Benjamin and Giere673 teaches the "a temperature sensing element operable to sense a temperature of a region, the temperature being representative of the region" limitation of claims 1 and 11. We also find that Petitioner provides sufficiently articulated reasoning with rational underpinning to support Petitioner's combining of Benjamin and Giere673's teachings. *See In re Kahn*, 441 F.3d at 988.

b) "the temperature sensing element is centrally disposed with respect to the region and substantially adjacent to both the first heater array and the second heater array, and further extends substantially the length of the first heater array and second heater array"

Petitioner provides an illustration of its proposed combination of Benjamin and Giere673, reproduced below, to show its contentions with respect to this limitation of claims 1 and 11. Pet. 32.



Referring to the illustration, Petitioner contends that the combination of Benjamin and Giere673 (as described above with respect to the "temperature sensing element operable to sense a temperature of the region" limitation of claims 1 and 11) disposes a TSR (shaded in green) within each thermal region of the printhead die (Region 2, shaded in blue), positioned equidistant from the two heater arrays adjacent the region (heater arrays B and C, shaded red) and not less than approximately 680 µm inboard from the center of the heater arrays. *Id.* at 21 (citing Ex. 1002 ¶ 159). Petitioner contends that the TSR is disposed immediately next to heater arrays B and C and is therefore "substantially adjacent to both the first heater array and second

heater array," and extends substantially the same length as heater arrays B and C. *Id*. at 32–33 (citing Ex. 1002 ¶ 160).

Patent Owner responds that Giere673's TSR 510 "has two arms that extend along the outer periphery of the region between the two columns of nozzles 520, 530 and their associated heaters 416, rather than being 'substantially centrally disposed with respect to the region [second region]' as recited in claims 1 and 11." PO Resp. 42. Patent Owner argues that, other than "a statement that that the legs of the TSR may be approximately 680 μm inboard from the center of heater arrays," Giere673 "does not disclose any other dimensions, such as the distance between the heaters, the width of the substrate, or alternate spacing between the TSR and the heater arrays, and therefore provides no indication that the identified 680 μm spacing is any different than what is actually illustrated in" Giere673's Figure 5, "where the legs of the TSR . . . are closer to the edge of the substrate than they are to the center." *Id*. at 43.

Again, Patent Owner incorrectly focuses on Giere673's teachings individually, rather in combination with Benjamin. *See In re Merck & Co.*, 800 F.2d at 1097 ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references"). As discussed above, Giere673 teaches that, preferably, TSR 510 "is not located adjacent to any particular heating element and reflects the temperature of the substrate 410 after heat has moved from the heating elements to the TSR 510." Ex. 1005, 4:57–60. Giere673 further teaches that "TSR 510 is located along the length of the substrate 410" and "can have two legs that are approximately 680 um inboard from the center of the columns of ink ejection elements 416." *Id*.

at 5:9–12. In light of the disclosures in Giere673, we credit Dr. Pond's testimony that

> a PHOSITA familiar with Giere673 would have been motivated to dispose a single TSR . . . within each region of Benjamin's printhead . . . and position each TSR equidistant from the two heater arrays adjacent the region . . . and not less than "approximately 680 μm inboard from the center of the [heater arrays]" so that, *individually*, each TSR provides a temperature value reflective of the temperature of its region, including the heater arrays adjacent those regions, *and collectively*, the values provided by the TSRs reflect the mean temperature of the entire printhead die.

Ex. 1002 ¶ 159; *see also id*. ¶¶ 160 (Dr. Pond opining that the combination of Benjamin and Giere673 meets the "centrally disposed" limitation of claim 1), 226–227 (Dr. Pond opining that the combination of Benjamin and Giere673 meets the limitations of claim 11 for the reasons provided for claim 1).

For these reasons, and based on the complete trial record, we find that Petitioner establishes that the combination of Benjamin and Giere673 teaches "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" limitation of claims 1 and 11. Pet. 31–33; Ex. 1002 ¶¶ 157–180, 226–227

c) "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"

Petitioner asserts that Giere673 teaches that, "[t]o control[] the temperature of the substrate and the temperature of each ejection chamber or nozzle chamber," temperature sensors determine "a mean or average

temperature of the substrate and an actual local temperature profile near designated ink ejection elements." Pet. 33 (citing Ex. 1005, 2:57–62) (emphases omitted). Petitioner further asserts that "[t]hereafter, '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.'" *Id*. (citing Ex. 1005, 3:1–6). Petitioner contends:

> 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."

Id. at 35 (citing Ex. 1005, 7:41–45, 9:8–19) (alterations in original, emphases omitted).

Patent Owner responds that Giere673 "does not disclose temperature control by providing heat to heater arrays responsive to the temperature sensed by a temperature sensing element in an adjacent region." PO Resp. 45. Patent Owner argues that Giere673's temperature controller "uses data from TSR 510 as well as inputs from several other temperature sensors and recorders" to establish operating conditions in order to operate the heating elements at an optimal temperature. *Id*. at 45–46 (citing Ex. 1005, 6:5–8, 5:28–31, 6:35–40). Patent Owner also argues that Giere673 neither describes a temperature control system that regulates heat to the heater arrays in response to the temperature sensed by TSR 510 nor provides any guidance on how to implement such an approach. *Id*. at 46 (citing Ex. 2003 ¶ 91).

We disagree. Giere673 teaches that "temperature controller 110 is coupled to multiple temperature sensors" that "preferably 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. Giere673 further teaches that "[w]hen the sensors detect that the mean temperature of the substrate has dropped below a predefined baseline or threshold temperature," temperature controller 110 (which "controls the mean temperature of the substrate of the printhead through a feedback loop") "activates the heating elements in an effort to raise the substrate above the baseline temperature before printing." *Id*. at 2:63–3:3. Giere673 teaches that "temperature controller 110 uses the input data 108 to predict thermal conditions of particular ejection chambers for selectively firing the associated heating elements," and, thus "aids in controlling the temperature of the substrate and the temperature of each ejection chamber or nozzle chamber." *Id*. at 3:4–9. Giere673 also teaches that the rate, width, and order of firing are adjusted as necessary "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." *Id*. at 9:12–17; *see also id*. at 6:10–18 (describing an embodiment where the average temperature is sensed and processed with the firing history in order to set the operating conditions "so that the corresponding heating elements operate at an optimal temperature"), 7:59–64 ("If the system determines the substrate would be too cool, adjustments need to be made to prevent the formation of ink drops that would be too small; conversely, if the substrate would be too hot, modifications need to be made to prevent bubble formation in the chamber array 612 and a consequent build up of residues."), 8:59–67 (explaining that pulse width, voltage to resistors, heating elements other than the resistors, nozzles to be fired and the time at which they are to be fired are based on input data from temperature records).

Taken together, we find that these disclosures in Giere673 teach sensing the temperature of a region and regulating that temperature by generating firing voltages and activating heater elements in order to maintain an optimum temperature for the formation of ink droplets. These disclosures in Giere673, when combined with the disclosures of Benjamin, support Dr. Pond's opinion that

> 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 [TSR], and wherein the received heating regulates the temperature of the region [e.g., generate firing voltages and activates heater elements]."

Ex. 1002 ¶ 169; *see also id*. ¶¶ 162–168.

Accordingly, after reviewing the parties' arguments and evidence, we are persuaded that Petitioner establishes that the combination of Benjamin and Giere673 teaches the "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" limitation of claims 1 and 11. Pet. 33–36; Ex. 1002 ¶¶ 162–169, 226–227.

d) Conclusion: Claims 1 and 11

Other than the arguments discussed above, Patent Owner does not dispute Petitioner's evidence that the combination of Benjamin and Giere673 teaches the limitation of claims 1 and 11. *See* PO Resp. We also reviewed Petitioner's explanations and supporting evidence as to how Benjamin and Giere673 teaches the other limitations of claims 1 and 11, and we agree with, and adopt as our own, Petitioner's analysis. Pet. 7–19, 36–44; Ex. 1002 ¶¶ 112–137, 170–189, 226–227. We also determine that

Petitioner puts forth a persuasive rationale for combining Benjamin with Giere673. Accordingly, we determine that Petitioner establishes by a preponderance of the evidence that independent claims 1 and 11 of the '823 patent would have been obvious over the combined teachings of Benjamin and Giere673.

4. Analysis of Claims 2, 3, 5–10, 12, 13, and 15–17

Petitioner contends that the combination of Benjamin and Giere673 teaches all of the limitations of claims 2, 3, and 5–10 that depend from claim 1, and claims 12, 13, and 15–17 that depend from claim 11. Pet. 44–54; Ex. 1002 ¶¶ 190–225, 228–238. Patent Owner does not dispute that the combination of Benjamin and Giere673 teaches the limitations of these claims. *See* PO Resp. Having reviewed the parties' arguments and evidence, we are persuaded that Petitioner's discussion of the particular structures in Benjamin and Giere673, and the explanations in the Petition and the Pond Declaration, shows that the combination of Benjamin and Giere673 teaches all of the limitations of dependent claims 2, 3, 5–10, 12, 13, and 15–17.

Accordingly, we determine that Petitioner establishes by a preponderance of the evidence that claims 2, 3, 5–10, 12, 13, and 15–17 of the '823 patent would have been obvious over the combined teachings of Benjamin and Giere673.

E. Asserted Obviousness over Benjamin, Giere673, and Parish

Petitioner contends that claim 4, which depends from claim 1, and claim 14, which depends from claim 11, would have been obvious over the combined teachings of Benjamin, Giere673, and Parish. Pet. 59–62; Ex. 1002 ¶¶ 262–283. Patent Owner argues that this challenge "fails for at least the same reasons discussed above relative to" Petitioner's challenge of

claims 1 and 11. PO Resp. 55. Patent Owner does not otherwise dispute that the combination of Benjamin, Giere673, and Parish teaches the limitations of claims 4 and 14. *See id*.

We already determined that Petitioner establishes that claims 1 and 11 would have been obvious over the combined teachings of Benjamin and Giere673. *See* Section II.D, *supra*. We reviewed Petitioner's explanations and supporting evidence as to how the combination of Benjamin, Giere673, and Parish teaches the other limitations of claims 4 and 14, and we agree with, and adopt as our own, Petitioner's analysis. Pet. 59; Ex. 1002 ¶¶ 262–268. We are also persuaded that a PHOSITA would have been motivated to combine the teachings of Benjamin, Giere673, and Parish as proposed with a reasonable expectation of success. Pet. 59–62; Ex. 1002 ¶¶ 269–283.

Accordingly, we determine that Petitioner establishes by a preponderance of the evidence that claims 4 and 14 of the '823 patent would have been obvious over the combined teachings of Benjamin, Giere673, and Parish.

F. Remaining Grounds

Petitioner contends that (1) claims 1–3, 5–13, and 15–17 would have been obvious over the combination of Benjamin and Giere178; (2) claims 1–3, 5–13, and 15–17 would have been obvious over the combination of Yabe and Giere673; and (3) claims 4 and 14 would have been obvious over the combination of Yabe, Giere673, and Parish. Pet. 62–119. Because we find that claims 1–3, 5–13, and 15–17 would have been obvious over the combined teachings of Benjamin and Giere673, and claims 4 and 14 would have been obvious over the combined teachings of Benjamin, Giere673, and Parish, we decline to address these grounds. *See Bos. Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("We agree that the

Board need not address issues that are not necessary to the resolution of the proceeding.").

III. CONCLUSION[4]

After reviewing the record and weighing the evidence offered by both parties, we determine that Petitioner shows by a preponderance of the evidence that claims 1–17 are unpatentable.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–3, 5–13, 15–17	103	Benjamin, Giere673	1–3, 5–13, 15–17	
4, 14	103	Benjamin, Giere673, Parish	4, 14	
1–3, 5–13, 15–17	103	Benjamin, Giere178[5]		
1–3, 5–13, 15–	103	Yabe, Giere673[6]		

[4] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

[5] Because we determine that claims 1–3, 5–13, and 15–17 would have been obvious over the combination of Benjamin and Giere673, we do not reach this ground.

[6] Because we determine that claims 1–3, 5–13, and 15–17 would have been obvious over the combination of Benjamin and Giere673, we do not reach this ground.

17				
4, 14	103	Yabe, Giere673, Parish[7]		
Overall Outcome			1–17	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has established by a preponderance of the evidence that claims 1–17 are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must compy with the notice and service requirements of 37 C.F.R. § 90.2.

[7] Because we determine that claims 4 and 14 would have been obvious over the combination of Benjamin, Giere673, and Parish, we do not reach this ground.

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