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. IPR2022-01541

Patent No. 7,152,951

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,152,951 (CLAIMS 1-7, 9, 10, 20-22, AND 24)

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EXHIBITS FILED BY PETITIONER	
Ex.1001	U.S. Patent No. 7,152,951 to Maher et al.
Ex.1002	Declaration of Mr. Charles M. Curley
Ex.1003	File History of U.S. Patent No. 7,152,951
Ex.1004	U.S. Patent No. 6,719,405 to Powers
Ex.1005	U.S. Patent No. 6,213,587 to Whitman et al.
Ex.1006	U.S. Patent No. 6,491,377 to Cleland et al.
Ex.1007	Japanese Patent Application Publication No. H09-131869 to Hamafuku et al., English Translation, and Affidavit
Ex.1008	U.S. Patent No. 6,299,293 to Imanaka et al.
Ex.1009	U.S. Patent 5,883,650 to Figueredo et al.
Ex.1010	August 1988 Edition of Hewlett-Packard Journal
Ex.1011	August 1992 Edition of Hewlett-Packard Journal
Ex.1012	October 1988 Edition of Hewlett-Packard Journal
Ex.1013	U.S. Patent No. 5,621,524 to Mitani
Ex.1014	U.S. Patent No. 4,719,478 to Tachihara et al.
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Ex.1023	*Curriculum Vitae* of Mr. Charles M. Curley
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Ex.1028	Slingshot LLC's Infringement Contentions, Case No. 2:22-cv-00123
Ex.1029	The New Oxford American Dictionary (2005) (excerpt)
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Ex.1031	U.S. Patent No. 6,045,214 to Murthy et al.
Ex.1032	U.S. Patent No. 6,523,935 to Torgerson et al.
Ex.1033	U.S. Patent No. 6,328,421 to Kojima et al.
Ex.1034	U.S. Patent No. 5,757,400 to Hoisington

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**-7, 9, 10, **20**-22, and 24 (the "Challenged Claims") of U.S. Patent No. 7,152,951 ("'951 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 '951 Patent has been asserted against Petitioner Canon U.S.A., Inc. as well as Canon Solutions America, Inc. in *Slingshot Printing LLC v. Canon U.S.A., Inc., et al.*, No. 2:22-cv-00123 (E.D.N.Y.), which was filed on January 7, 2022. The '951 Patent was also asserted against HP Inc. in *Slingshot Printing LLC v. HP Inc.*, No. 6:19-cv-00363, reassigned as No. 2:20-cv-00185 (W.D. Tex.). That case was dismissed with prejudice on April 1, 2021 following the parties' joint stipulation of dismissal. To the best of Petitioners' knowledge, the '951 Patent has not been asserted against other parties.

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

Service: Service of any documents may be made on 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

’951 Patent: This patent was filed on February 10, 2004 and has an earliest possible priority date of **February 10, 2004**. It is subject to the **pre-AIA** provisions of 35 U.S.C. §§ 102 and 103.

Powers: U.S. Patent No. 6,719,405 titled “Inkjet Printhead Having Convex Wall Bubble Chamber” to James Powers (“Powers,” Ex.1004), was filed **March 25, 2003**, and is prior art under § 102(e).

Whitman: U.S. Patent No. 6,213,587 titled “Ink Jet Printhead Having Improved Reliability” to Charles Whitman (“Whitman,” Ex.1005), was published on **April 10, 2001**, and is prior art under § 102(b).

Cleland: U.S. Patent No. 6,491,377 titled “High Print Quality Printhead” to Todd Cleland et al. (“Cleland,” Ex.1006), was published on **December 10, 2002**, and is prior art under § 102(b).

Hamafuku: Japanese Patent Application Publication No. H09-131869 titled “Inkjet Head” to Yukinori Hamafuku et al. (“Hamafuku,” Ex.1007), was published on **May 20, 1997**, and is prior art under § 102(b).

Imanaka: U.S. Patent No. 6,299,293 titled "Substrate for Liquid Discharge Head and Liquid Discharge Apparatus" to Imanaka et al. ("Imanaka," Ex.1008), was published on October 9, 2001, and is prior art under § 102(b).

None of these references were cited or considered by the Patent Office during prosecution of the '951 Patent.

In his declaration in support of this Petition, Mr. Charles M. Curley, provides summaries of each prior art reference. Ex.1002, ¶¶61-113.

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

Ground	Prior Art	Statutory Basis	Claims
1	Powers and Whitman	§ 103	**1**-3, 6, 9, and 10
2	Powers, Whitman, and Cleland	§ 103	4, 5, 7, **20**-22, and 24
3	Hamafuku, Imanaka, and Whitman	§ 103	**1**-4, 6, 7, 9, 10, **20**-22, and 24
4	Hamafuku, Imanaka, Whitman, and Cleland	§ 103	5

IV. CERTIFICATION AND FEES

Petitioners certify that the '951 Patent is available for IPR and that Petitioners are neither barred nor estopped from requesting this IPR on the grounds identified herein.

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

V. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

The PTAB should not discretionarily deny institution per *Fintiv*, as 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 is neutral because, although Petitioners requested a stay in the district court, it would be speculative for the Board to predict whether the court will grant that request. *See Sand Revolution II, LLC v. Continental Intermodal Grp. – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020).

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 set date in the parties' Case Management Schedule, i.e.,**October 25, 2024**. Ex.1024, 6. Moreover, the median time to trial in EDNY is 48.9 months (~4 years). Thus, the final written decision will be issued well before any trial date.

Factor 3 favors institution because the litigation is in its early stages with invalidity contentions due October 17, 2022, the exchange of claim construction terms on April 7, 2023. Ex.1024, 4. Thus, by the institution deadline, the Court would not have issued any claim construction rulings and likely would not have ruled on any dispositive motions or considered invalidity.

Factor 4 favors institution because Petitioners challenge every claim asserted in the litigation and multiple claims that have not been asserted (claims 4, 9, 20-22, and 24). *See* Ex.1028 (asserting claims 1-3, 5-7, and 10). The invalidity contentions will include 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 were not before the Office**. Additionally, this IPR is the only challenge to the '951 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).

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

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

VI. THE ’951 PATENT

The application leading to the ’951 Patent (Ex.1001) was filed on February 10, 2004 and issued on December 26, 2006. The listed assignee is Lexmark International, Inc., and the inventors are Maher and Powers.

The ’951 Patent “relates to inkjet printheads and in particular to ink jet printheads having increased resolution….” Ex.1001 at 1:5-7; Ex.1002, ¶¶25-36.

In his declaration in support of this Petition, Mr. Charles M. Curley provides an overview of the ’951 Patent. Ex.1002, ¶¶25-36.

VII. PERSON OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) at the time of the alleged invention would have been a person holding at least a Bachelor’s level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and at least two years of training or experience in the design of inkjet cartridges and printheads. Ex.1002, ¶40. Before February 10, 2004, Mr. Curley had a level of skill in the art that was at least that of a POSITA, and is therefore, qualified to provide opinions concerning what a POSITA would have known and understood at that time. *Id.*, ¶41.

VIII. CLAIM CONSTRUCTION

The claim terms in the Challenged Claims should be afforded their plain and ordinary meaning.

IX. BACKGROUND OF THE ART

The basic anatomy of inkjet printheads has not changed substantially since Canon and HP introduced the first inkjet printers in the mid-1980's. Ex.1002, ¶43. The printhead anatomy consisting of three fundamental layers—substrate, barrier layer, and nozzle plate—is claimed in each of the independent claims of the '951 Patent. Ex.1002, ¶¶43-60. As Mr. Curley opines in his declaration, the challenged claims of **the '951 Patent present a collection of inkjet printhead fabrication features and parameters which were already well known in the art**. *Id.*

X. ARGUMENT

A. Ground #1: Powers in View of Whitman Renders Claims 1-3, 6, 9, and 10 Obvious

1. Claim 1[2]

a. 1[p]

Powers discloses "**a printhead for an ink jet printer**." Powers states that "[t]he present invention relates to **inkjet printheads**." Ex.1004, 1:6-10. Powers further states that "**[i]nkjet printers for housing the printheads** are also disclosed."

[2] A full claim listing can be found in the Appendix.

Id., 2:29-30; *see also* Ex.1004, 6:46-47, 7:31-33, Fig. 4. Accordingly, Powers discloses "[a] printhead for an ink jet printer." Ex.1002, ¶¶116-119.

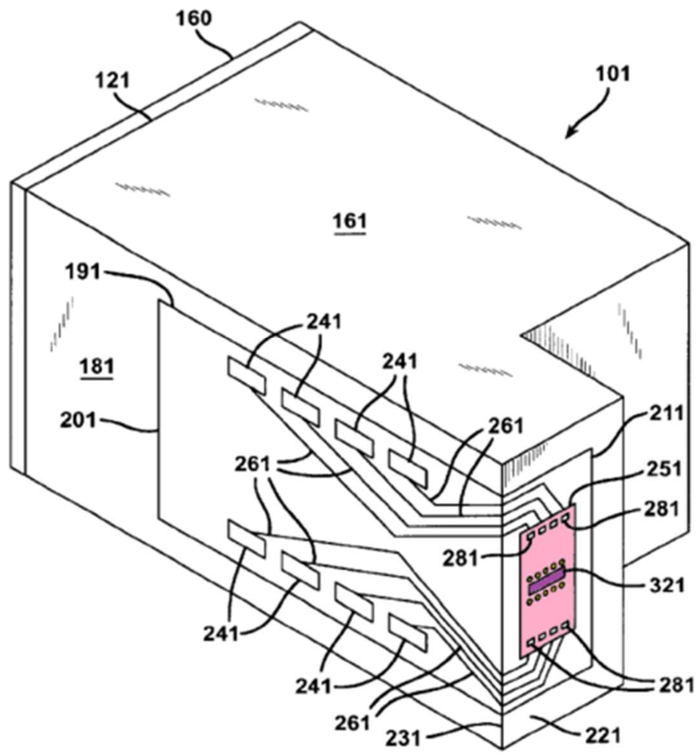
b. 1[a]

Powers discloses "**the printhead comprising: a semiconductor substrate containing at least one ink feed edge and a plurality of ink ejection actuators spaced a distance from the ink feed edge**."[3]

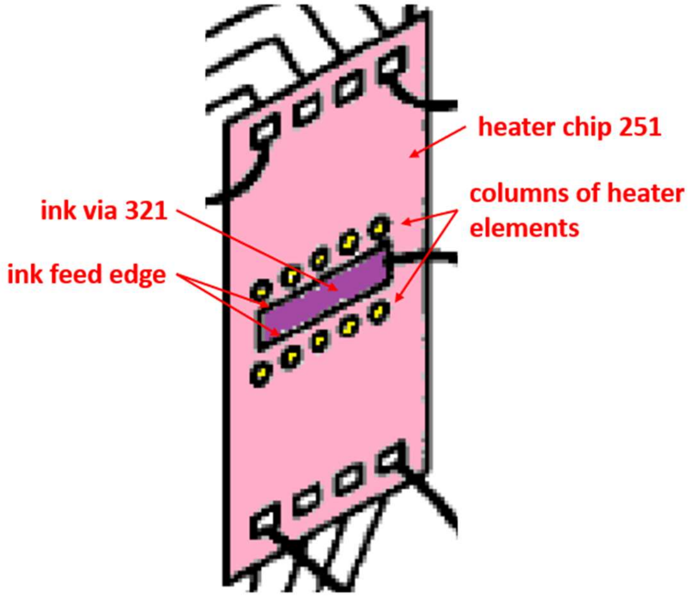
Powers discloses a semiconductor substrate (e.g., heater chip) containing at least one ink feed (or ink via) having an edge. Powers's Figure 4 (below) illustrates heater chip 251 (pink) where "**heater chip 251** [pink] **contains at least one ink via 321 (alternatively: element 40)** [purple] that **fluidly connects the heater chip to a supply of ink internal to the housing**." Ex.1004, 7:15-17.

[3] The '951 Patent teaches that this limitation is prior art, e.g., Figure 5. *See* Ex.1001, Fig. 5. Ex.1002, n.1.

FIG. 4



As illustrated in an excerpt of Figure 4 (below), the heater chip 251 (pink) includes ink via 321 (i.e., ink feed) (purple) and "**two columns of heater elements** (represented as yellow circles) on **either side of via 321**." Ex.1004, 7:17-26. Ink via 321 is a slot in the heater chip that includes "edges" or borders.



With reference to bubble chamber diagrams in Figures 1a, 1b, and 2[4] below, Powers describes the ink flow from the "ink via 321 (alternatively: element 40)" (purple) through ink flow channels (50) to bubble chambers (12). Ex.1004, 4:43-56; 2:18-28; Figs. 1a, 1b, 2, 4:51-56, 4:43-56. In order to reach ink channel 50, ink (teal)

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[4] Powers uses the same reference numerals to refer to common elements in Figures 1a, 1b, and 2. As such, a POSITA would understand that Figures 1 and 2 are substantially similar except for the shapes of the bubble chambers. *See* Ex.1004, 4:58-64; 3:23-46; Ex.1002, n.4; *see also Ex parte Grabelsky*, Appeal No. 2012-004212, 2015 WL 252852, at *2-3 (PTAB Jan. 16, 2015) ("U.S. patent application disclosures apply identical reference characters to only an invention's 'same' features.") (quoting 37 C.F.R. 1.84(p)(4)).

must pass over the edge of ink via 321/40 as it flows from the ink housing below the chip. Ex.1002, ¶123.

FIG. 1a

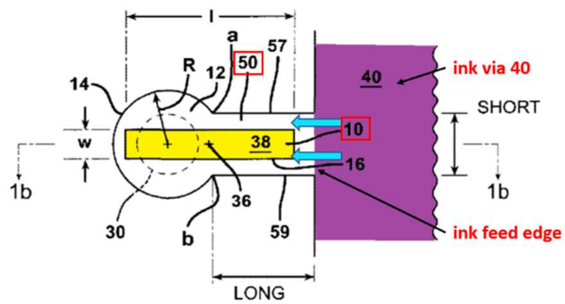


FIG. 1b

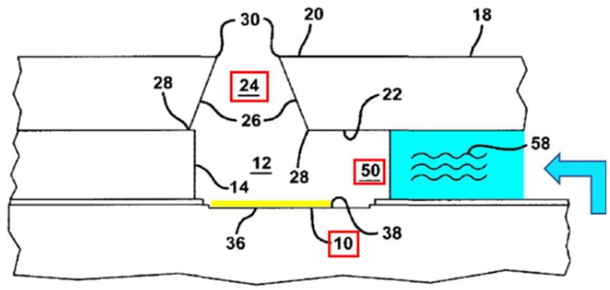
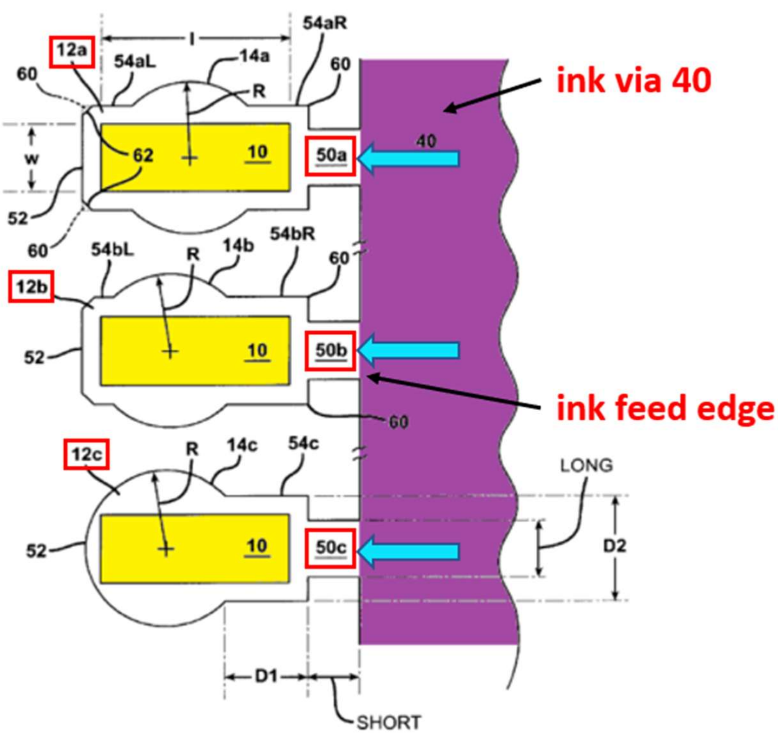


FIG. 2



Powers also discloses a semiconductor substrate (e.g., heater chip) having a plurality of ink ejection actuators[5] (e.g., heater elements). Powers illustrates "heater element 10 [yellow]" in Figures 1a, 1b, and 2 below at the base of bubble chamber 12 within the heater chip (e.g., semiconductor substrate (green)). Ex.1004, 1:31-34 ("The **heater chip, in turn, typically includes a plurality of thin film resistors or heater elements…**"). Ex.1002, ¶125.

FIG. 1a

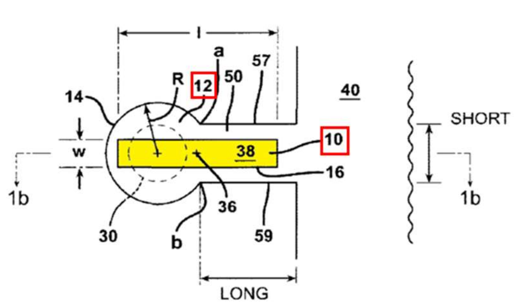
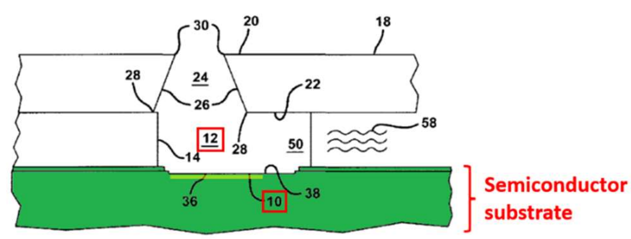
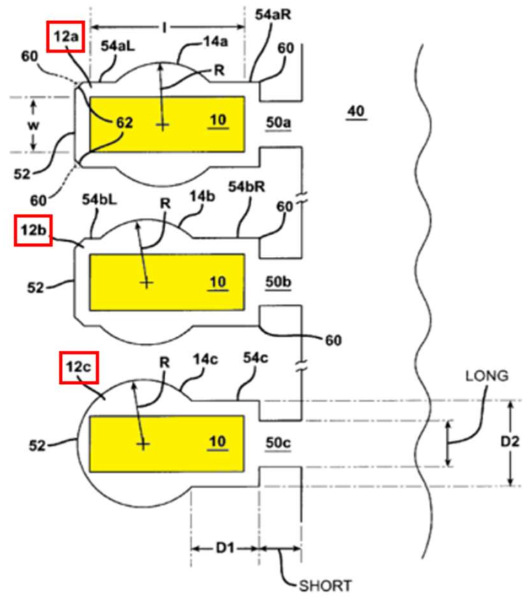


FIG. 1b



[5] According to the '951 Patent, "**ink ejection actuators comprise heater resistors**." Ex.1001, cl. 2; 3:15-23. Ex.1002, n.5.

FIG. 2



Powers's ink ejection actuators (i.e., heater elements) are also spaced a distance from the ink feed edge. A POSITA would understand that the Powers heater elements are "spaced a distance from the ink feed edge" at least because they are arranged in columns on either side of the ink via 321. Ex.1004, 7:20-26; Ex.1002, ¶128.

Powers's Figures 1a and Figure 2 further discloses a plurality of ink ejection actuators (i.e., heater elements, yellow) spaced a distance from the ink feed edge (i.e., the edge of Power's ink via 40, purple).[6] *See* Ex.1004, Fig. 2; 4:59-5:8.

FIG. 1a

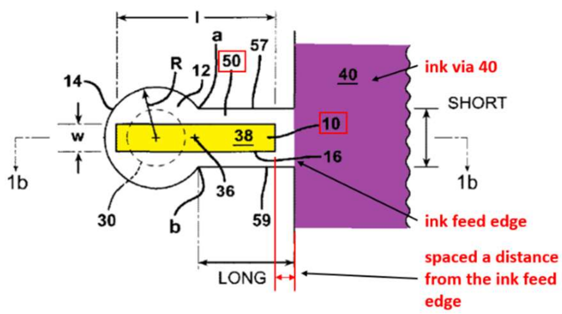
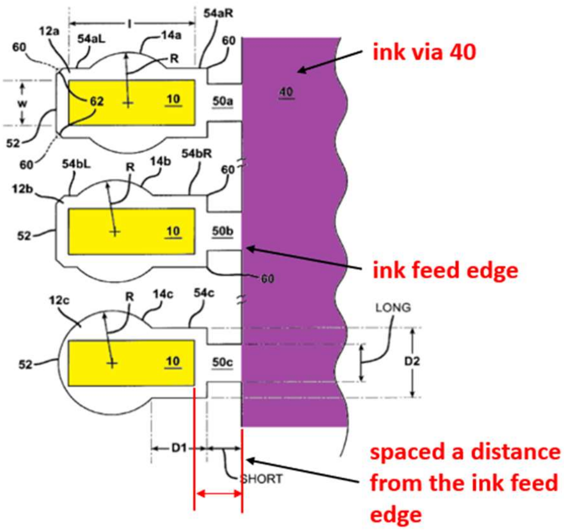


FIG. 2



Accordingly, Powers discloses "the printhead comprising: a semiconductor substrate [e.g., heater chip 251 having a substrate] containing at least one ink feed edge [e.g., edge of ink via 321/40] and a plurality of ink ejection actuators [e.g.,

[6] A POSITA relying on *patent figures* to show the heater element *distance from the ink feed edge* is consistent with how the '951 Patent illustrates this distance relationship. Ex.1002, n.7; Ex.1001, 4:21-25; Fig. 6.

heater elements 10] spaced a distance from the ink feed edge [e.g., distance from the edge of the yellow heaters to the edge of the ink via 40].” Ex.1002, ¶¶120-130.

c. 1[b]

Powers discloses “**each of the ink ejection actuators having an aspect ratio**[7] **ranging from about 1.5:1 to about 6:1**.”[8]

Powers discloses dimensions and corresponding aspect ratios of its “substantially rectangular heater element.” Ex.1004, 3:23-26. Powers states that “[b]y **dividing a length by a width dimension**, **the heater element has an aspect ratio**[9] **of more than about 2.0. More preferably, it has an aspect ratio of about 4.0 or 5.0 or greater than about 2.5.**” Ex.1004 at 1:58-63; *see also id.*, claim 7 (“**aspect ratio…greater than about 2.0**”), claim 8, claim 10; *see also* Ex.1004,

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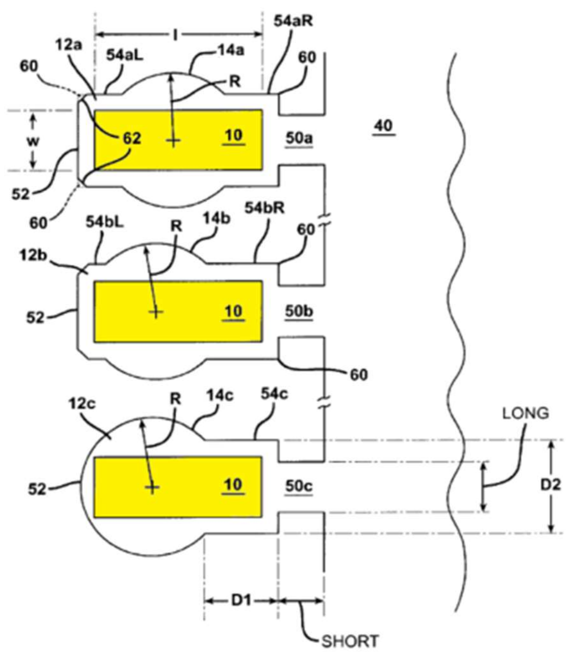
[7] *See* Ex.1001, 2:29-31; Ex.1002, n.8.

[8] Limitations 1[b], 1[g], 10[b], 20[c], 20[h], and claims 3-5 and 10, recite ranges. “It is … an elementary principle of patent law that when, as by a recitation of ranges or otherwise, a claim covers several compositions, the claim is anticipated if one of them is in the prior art.” *Medichem, S.A. v. Rolabo, S.L.*, 353 F.3d 928, 934 (Fed. Cir. 2003) (internal quotations omitted).

[9] *See supra* Section VIII.

3:23-35. Rectangular heater elements 10 are illustrated in Figure 1a and below in Figure 2 (yellow).

FIG. 2



Accordingly, Powers discloses each ink ejection actuator "having an aspect ratio ranging from about 1.5:1 to about 6:1 [e.g., about 2.0, about 4.0 or 5.0, or greater than about 2.5]." Ex.1002, ¶¶131-134.

d. 1[c]

Powers as modified by Whitman discloses "**a thick film layer attached to the semiconductor substrate**."[10]

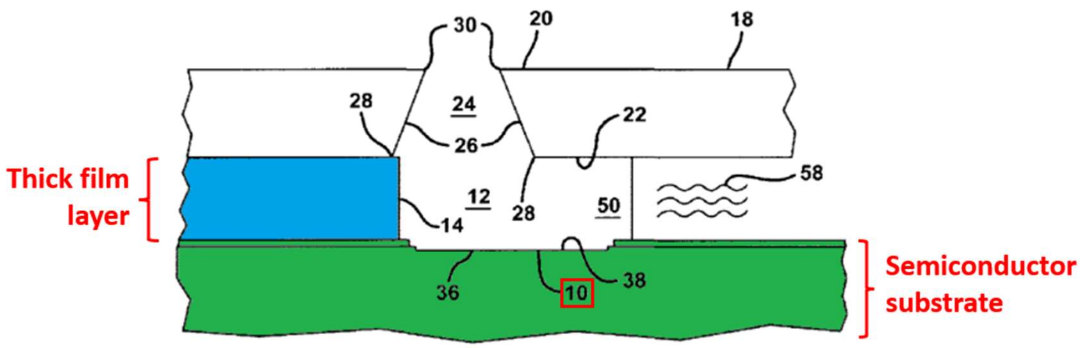
[10] Petitioners reserve the right to argue that this limitation is indefinite in other forums.

Powers discloses a thick film layer (e.g., barrier layer) attached to the semiconductor substrate (e.g., heater chip). Ex.1002, ¶136. Specifically, Powers discloses that "the nozzle plate becomes adhered to a **barrier layer that overlies the heater chip**." Ex.1004, 7:26-30; *see also* 1:26-31 ("barrier layer"). Powers also discloses that the bubble chamber and ink flow channels can be formed in a "**barrier layer** between the nozzle plate and the heater chip."[11] *Id.*, 2:9-12; 2:25-28; Fig. 1b, 2.

Powers not only discloses that its barrier layer is *between* the nozzle plate and heater chip but it further discloses that its barrier layer *overlies*, or is attached to, the semiconductor substrate (heater chip). Ex.1004, 7:26-30 ("Alternatively the nozzle plate becomes adhered to a **barrier layer that overlies the heater chip**."). As such, as illustrated in Fig. 1b below, Powers discloses "a thick film layer [i.e., barrier layer, blue] attached to the semiconductor substrate [green]." Ex.1002, ¶137.

[11] Like the Powers barrier layer, the '951 Patent discloses that "**the ink chambers and ink channels may be formed exclusively in** either the nozzle plate or **thick film layer**." Ex.1001, 6:31-36.

FIG. 1b



The term "thick" is not defined in the '951 Patent or the claims and, as such, is unclear. To the extent that a POSITA can understand this term, "thick" is a relative term and a POSITA would understand that Powers's barrier layer (blue) is "thick enough" to provide ink chambers and ink channels therein, and is "thicker" than, for example, the thickness of heater element 10. *See* Ex.1004, 2:9-12, 2:25-28, 6:31-38; Fig. 1b; Ex.1002, ¶138. Moreover, Powers's disclosure, including the dimensions of the printhead features illustrated in Fig. 1b above, further confirms that Powers's barrier layer (blue) is a "thick" film layer. Ex.1002, ¶139. As such, Powers's barrier layer (blue) is a thick film layer.

To the extent that Powers is deemed not to explicitly or inherently disclose a "thick film layer" it would also have been obvious to a POSITA to modify Powers printhead chamber design to include the "thick film layer" disclosed in Whitman. Ex.1002, ¶141.

Whitman states that "chamber 18 can be formed in a **thick spacer or insulating film 26, referred to hereinafter as the thick film layer.**" Ex.1005, 6:21-23; 6:31-33; Ex.1002, ¶142. As illustrated in Whitman's Figures 5 and 7 below, printhead chip 11 includes a **thick film layer 26** (blue) attached to semiconductor substrate base 14 (green).

FIG. 5

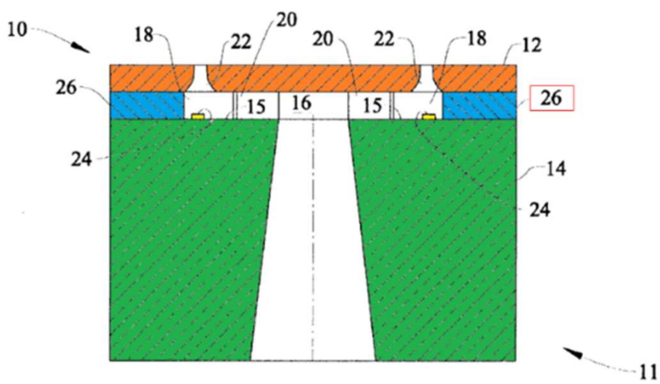
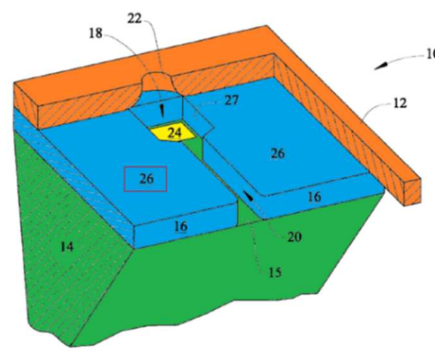


FIG. 7



Whitman also discloses that its "thick film layer 26" is within the same "thickness" dimension range as the '951 Patent's thick film layer. The '951 Patent states that its "**thick film layer 70 has a thickness ranging from about 6 to about 30 microns**." Ex.1001, 5:40-43. Whitman discloses exemplary thicknesses/heights of **26 microns, 27 microns, and 30 microns**. *See* Ex.1005, Tables 1, 3, 4, and 5; Ex.1005, 11:26-29 ("reducing the **barrier height (H) to about 26 microns** (prior to attachment) increases the predicted MTTF of the printhead"); Figs. 5, 7, 6, and 6A-

E. As such, Whitman discloses the same thick film layer as the '951 Patent. Ex.1002, ¶145.

To the extent Powers does not disclose a "thick film layer" as discussed above, a POSITA would either modify Powers's barrier layer to be as thick as Whitman's thick film layer 26 or replace Powers's barrier layer with Whitman's thick film layer 26 for the reasons discussed below. *See* Section X.A.7; Ex.1002, ¶146.

Accordingly, Powers as modified by Whitman discloses "a thick film layer [e.g., Powers's barrier layer; Whitman's thick film layer 26] attached to the semiconductor substrate [e.g., Powers heater chip]."[12] Ex.1002, ¶¶135-147.

e. 1[d]

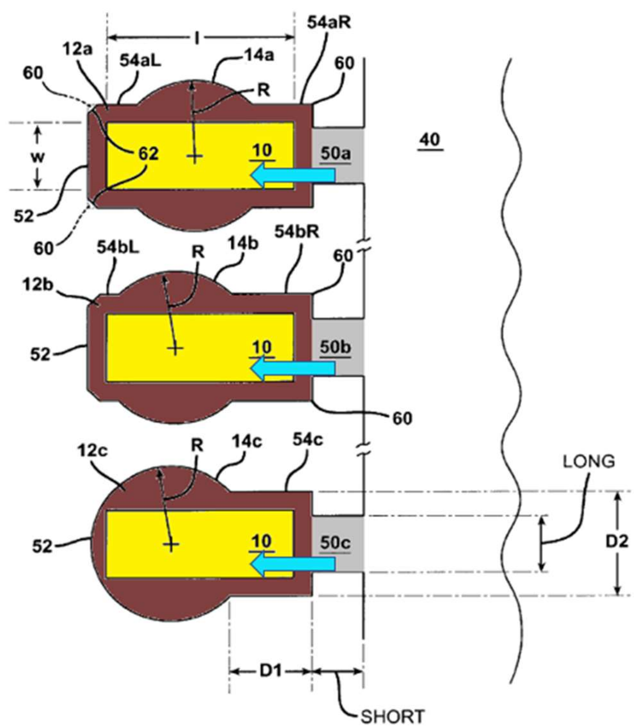
Powers as modified by Whitman discloses "**the thick film layer having formed therein a plurality of ink feed chambers and ink feed channels corresponding to the plurality of ink ejection actuators**."

Powers discloses that the bubble chambers and ink flow channels can be formed in a "**barrier layer between the nozzle plate and the heater chip**." Ex.1004, 2:9-12; 2:25-28; *see also* Fig. 1b, 2. Ex.1002, ¶149.

[12] To the extent the Board agrees that Powers alone discloses this limitation as discussed above, Whitman is not necessary in combination with Powers for this limitation.

As illustrated in Figure 2 below, the plurality of ink flow channels (50a, 50b, 50c) (gray) feed ink (teal) into a plurality of corresponding bubble chambers (12a, 12b, 12c) (brown) each corresponding to one of a plurality of heater elements 10 (yellow). Ex.1002, ¶150.

FIG. 2



Whitman also discloses in Figures 5 and 7 a "thick film layer having formed therein a plurality of ink feed chambers [chamber 18, brown] and ink feed channels [channel 20, gray] corresponding to the plurality of ink ejection actuators [heaters 24, yellow]." Ex.1002, ¶153. Whitman also discloses that each chamber 18 includes a corresponding "ink channel 20". Ex.1005, 6:51-54. Whitman further discloses that "**each of the heaters is preferably arranged in a respective one of a plurality of chambers**." *Id.*, 7:1-5.

FIG. 5

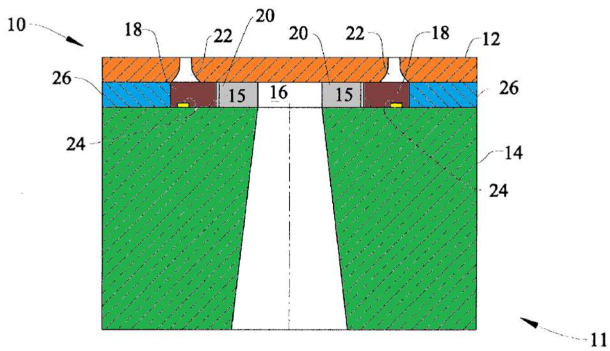
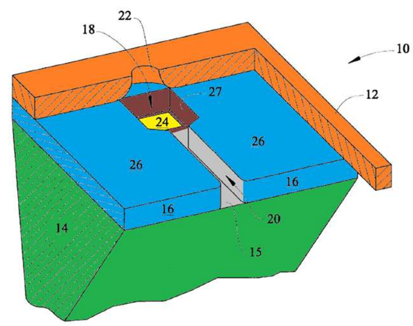


FIG. 7



Accordingly, Powers as modified by Whitman discloses "the thick film layer [e.g., Powers barrier layer; Whitman's thick film layer 26] having formed therein a plurality of ink feed chambers [e.g., Powers bubble chamber 12; Whitman's chambers 18] and ink feed channels [e.g., Powers ink flow channels 50; Whitman's channels 20] corresponding to the plurality of ink ejection actuators [e.g., Powers heater elements 10]."[13] Ex.1002, ¶¶148-155.

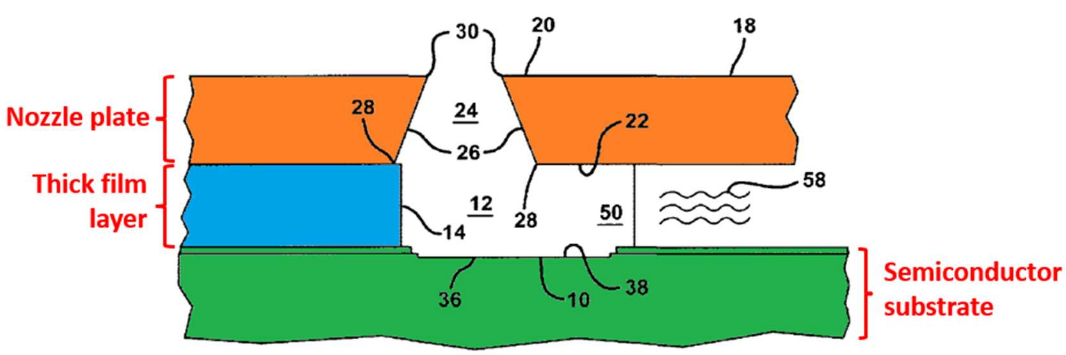
[13] To the extent the Board agrees that Powers alone discloses this limitation as discussed above, Whitman is not necessary in combination with Powers for this limitation. Ex.1002, n.15.

f. 1[e]

Powers discloses "**a nozzle plate attached to the thick film layer**."

Powers discloses that "the **nozzle plate becomes adhered to a barrier layer** that overlies the heater chip." Ex.1004, 7:30-31; *see also id.*, cl. 7 ("a nozzle plate having a thickness with an orifice therein"); 1:26-31. As illustrated in Powers Fig. 1b, below, a nozzle plate 18 (orange) is attached to the barrier layer (blue). Powers states that "**[a]bove the bubble chamber is a nozzle plate 18**…fastened by epoxy or the like." Ex.1004, 4:19-21. Powers further discloses that "the **nozzle plate attaches to a barrier layer** that overlies the layers of the heater element." *Id.*, 4:40-42.

FIG. 1b



Accordingly, Powers in combination with Whitman discloses "a nozzle plate [e.g., Powers nozzle plate 18] attached to the thick film layer [e.g., Powers barrier layer; Whitman's thick film layer 26]."[14][15] Ex.1002, ¶¶156-159.

g. 1[f]

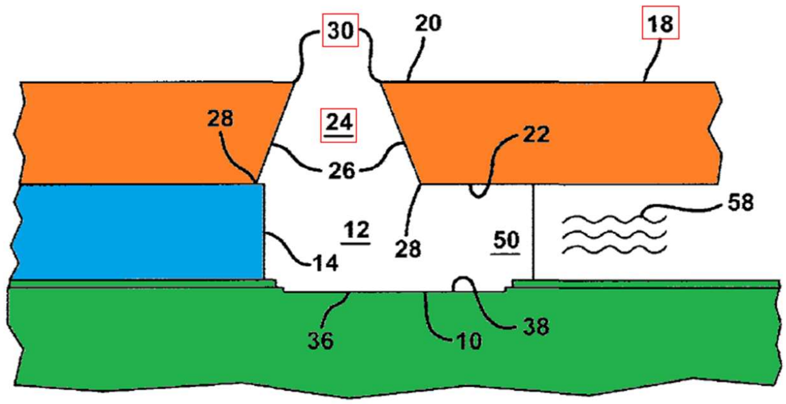
Powers discloses "**the nozzle plate containing a plurality of nozzle holes in the nozzle plate corresponding to the plurality of ink feed chambers**."

With respect to Fig. 1b below, Powers discloses that nozzle plate 18 includes an orifice 24. Ex.1004, 4:23-26. Powers also states that "[a] **nozzle plate (element 18, FIGS. 1a, 1b) with pluralities of orifices** adheres over the heater chip such that the nozzle holes align with the heaters." *Id.*, 7:26-29; *see also* cl. 17 ("a **nozzle plate having a plurality of orifices…**"); 4:33-35; 4:40-42; 4:30-33; cl. 7; 7:26-29. Because the orifices align with the heater element and reside directly above the heater element, the orifice also corresponds to the ink feed chamber where the heater element resides. Ex.1002, ¶163.

[14] To the extent the Board agrees that Powers alone discloses this limitation as discussed above, Whitman is not necessary in combination with Powers for this limitation. Ex.1002, n.16.

[15] Whitman also discloses this limitation. Ex.1002, n.17.

FIG. 1b



Accordingly, Powers discloses "the nozzle plate [e.g., nozzle plate 18] containing a plurality of nozzle holes [e.g., orifices 24] in the nozzle plate corresponding to the plurality of ink feed chambers [e.g., bubble chambers 12]."[16] Ex.1002, ¶¶160-164.

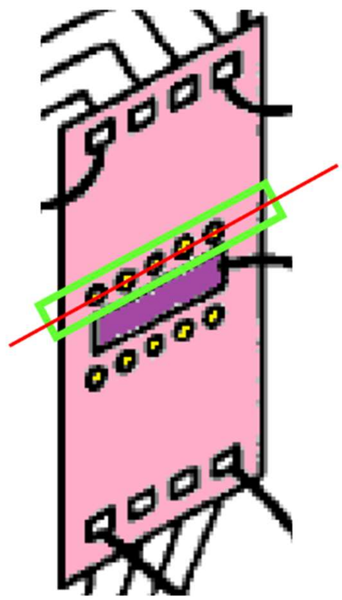
h. 1[g]

Powers discloses "**wherein adjacent ones of the nozzle holes are spaced apart with a pitch[17] ranging from about 600 to about 2400 dpi**."

[16] Whitman also discloses this limitation. Ex.1002, n.18.

[17] *See* Ex.1001, 2:25-29 ("center to center spacing between adjacent nozzles or ejection actuators in a direction substantially parallel with an axis aligned with a columnar nozzle array"). Ex.1002, ¶166.

As discussed above (*supra* Section X.A.1.b) and incorporated here, a POSITA would understand that each of the heaters illustrated in Figure 4 (below) have a nozzle residing directly above each one and, as such, the nozzles are also arranged in a column, i.e., a direction substantially parallel with an axis (red line) aligned with a columnar nozzle array (green rectangle). Ex.1002, ¶167.



Powers also discloses adjacent nozzle holes are spaced apart with a pitch ranging from about 600 to about 2400 dpi. With respect to orifice 24 having opening 30 (e.g., nozzle hole) in Figure 1a, Powers explains that "present day printheads have **small diameter openings** on the order of about 11 or 14 microns" and "[i]n the future, it is expected that this dimension [i.e., diameter opening] will gradually shrink as printing resolutions increase **from 600 DPI (dots-per-inch) to 900 or 1200**

DPI or more." Ex.1004, 4:35-42.[18] Thus, a POSITA would understand that Powers discloses a 600 DPI, or 900 DPI, or 1200 DPI pitch.

Accordingly, Powers discloses "wherein adjacent ones of the nozzle holes [e.g., orifices] are spaced apart with a pitch ranging from about 600 to about 2400 dpi [e.g., 600 dpi, or 900, or 1200 dpi]." Ex.1002, ¶¶165-170.

i. 1[h]

Powers discloses "**wherein the distance from the ink feed edge is substantially the same for each of the ink ejection actuators**."

[18] Powers is enabled with respect to DPI values "from 600 DPI (dots-per-inch) to 900 or 1200 DPI or more." First, improvement disclosures such as this are enabling. *See, e.g., CFMT, Inc. v. Yieldup Int'l Corp*., 349 F.3d 1333, 1340 (Fed. Cir. 2003). Second, a POSITA at the time of Powers (i.e., March 25, 2003) could have made a printhead having pitches of 600 DPI to 900 or 1200 DPI or more as printheads having these pitches were well-known in the patent literature as well as the inkjet printhead industry. Ex.1002, ¶¶51-55; *see* Ex.1004, References Cited (Kojima, Hoisington). Third, at a minimum, Powers is at least enabled as to 600 DPI (which is at the lower end of the '951 Patent's claimed range) because Powers states that "printing resolutions increase *from* 600 DPI (dots-per-inch)" meaning that printing resolutions must already be at least 600 DPI at the time of Powers.

As explained above (*supra* Sections X.A.1.b and X.A.1.h) and incorporated here, a POSITA would understand that the distance from the ink feed edge is substantially the same for each of Powers's ink ejection actuators (heaters) at least because they are arranged in columns (i.e., items arranged in a line) on either side of the ink via. Ex.1004, 7:17-26; Ex.1002, ¶¶173-174.

Figure 2 (below) also illustrates heater elements 10 (yellow) are arranged in a column and the distance from the ink feed [ink via 40, purple] edge is substantially the same for each heater (as indicated by the red dashed line annotations).[19] [20]

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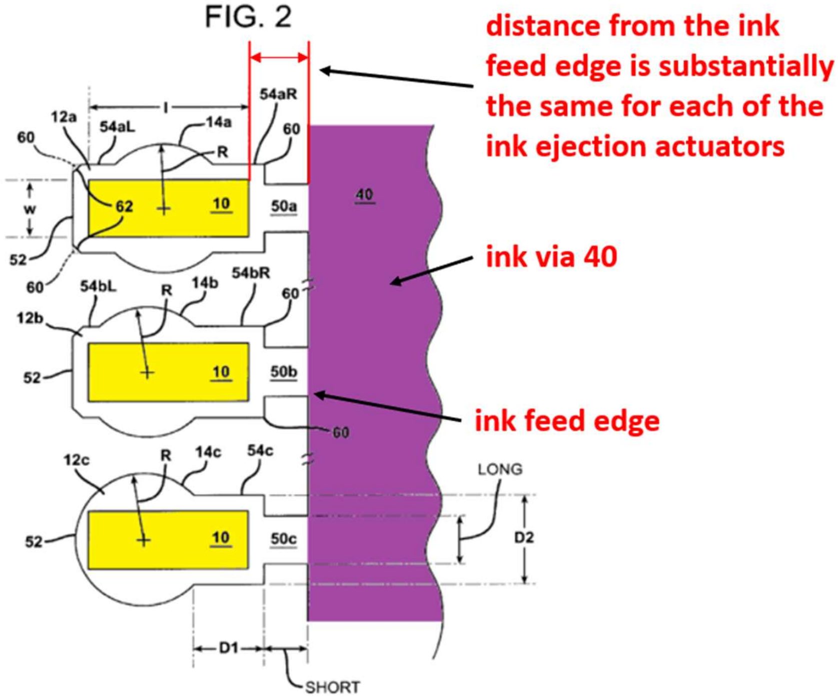
[19] Although each of the bubble chambers (12a, 12b, 12c) have different curved and rectangular wall portions the distance from the ink feed edge is substantially the same for each of the heater elements 10 (yellow). *See, e.g.*, Ex.1004, 4:58-5:18, 4:43-57.

[20] *See* Ex.1002, ¶174.

FIG. 2



Accordingly, Powers discloses "wherein the distance from the ink feed edge [e.g., edge of ink via] is substantially the same for each of the ink ejection actuators [e.g., heater elements 10]." Ex.1002, ¶¶171-175.

For the reasons discussed above in Section X.A.1 and the motivations discussed below in Section X.A.7, claim 1 is obvious over Powers in view of Whitman. Ex.1002, ¶176.

2. Claim 2

Powers discloses "The printhead of claim 1, wherein the **ink ejection actuators** [e.g., heater elements] **comprise heater resistors** (e.g., "a plurality of thin film resistors or heater elements…")." Ex.1004, 1:31-34; Figure 2 (heater element 10, yellow). Ex.1002, ¶178.

Accordingly, Powers discloses "wherein the ink ejection actuators [e.g., heater elements] comprise heater resistors."[21] Ex.1002, ¶¶178-181. Claim 2 is therefore obvious.

3. Claim 3

Powers discloses "The printhead of claim 2, wherein the **heater resistors** have a **width of less than or equal to 15 microns**."

Powers discloses that "**heater element 10**…has a substantially rectangular shape defined by a periphery 16 with a length l and **width w dimension**." Ex.1004, 1:24-27. In one embodiment "**the width dimension is about 13.2 microns**" and in another embodiment "**the width dimension is about 10 microns**." *Id.*, 3:29-35; *see also id.*, claims 9, 11.

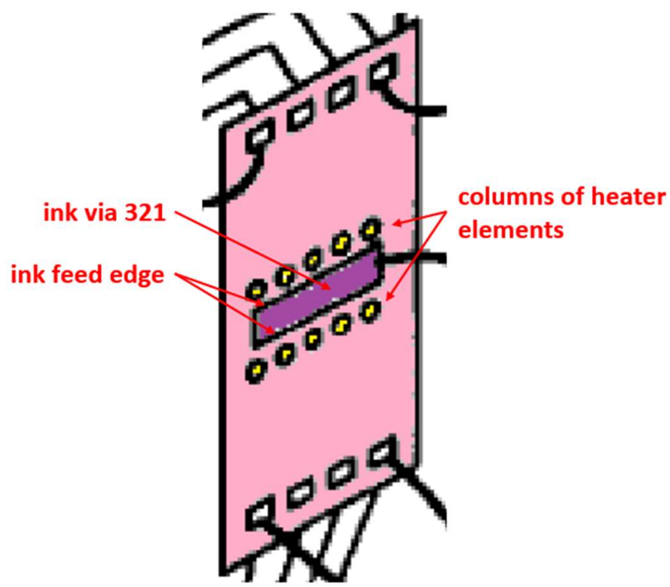
Accordingly, Powers discloses "wherein the heater resistors [heater elements 10] have a width of less than or equal to 15 microns [e.g., 10 or 13.2 microns]." Ex.1002, ¶¶182-184. Claim 3 is therefore obvious.

[21] Whitman also discloses this limitation. Ex.1002, n.21.

4. Claim 6

Claim 6 states: "The printhead of claim 1, wherein the **ink feed edge** comprises an **ink feed slot**[22], and wherein the plurality of **ink ejection actuators** are disposed on **both sides of the ink feed slot**."

As illustrated below in Figure 4, Powers's heater chip 251 includes at least one ink via 321 (i.e., ink feed slot) that includes an "edge." *See supra* Section X.A.1.b (limitation 1a); Ex.1004, 7:15-17; Ex.1002, ¶186. Powers discloses "**two columns of heater elements on either side of via 321**." Ex.1004, 7:20-26.



[22] Petitioners reserve the right to argue that this limitation is indefinite in other forums. For example, while a substrate or a slot may comprise an "edge," it is unclear how an "edge" can comprise a "slot" as claimed in the '951 Patent.

Accordingly, Powers discloses "wherein the ink feed edge comprises an ink feed slot [e.g., ink via 321], and wherein the plurality of ink ejection actuators [e.g., heater elements] are disposed on both sides of the ink feed slot." Claim 6 is therefore obvious.[23] Ex.1002, ¶¶185-189.

5. Claim 9

Powers as modified by Whitman discloses "The printhead of claim 1, wherein a **distance from** the **ink ejection actuators** to an **exit of the nozzle holes** is **greater than the pitch**."

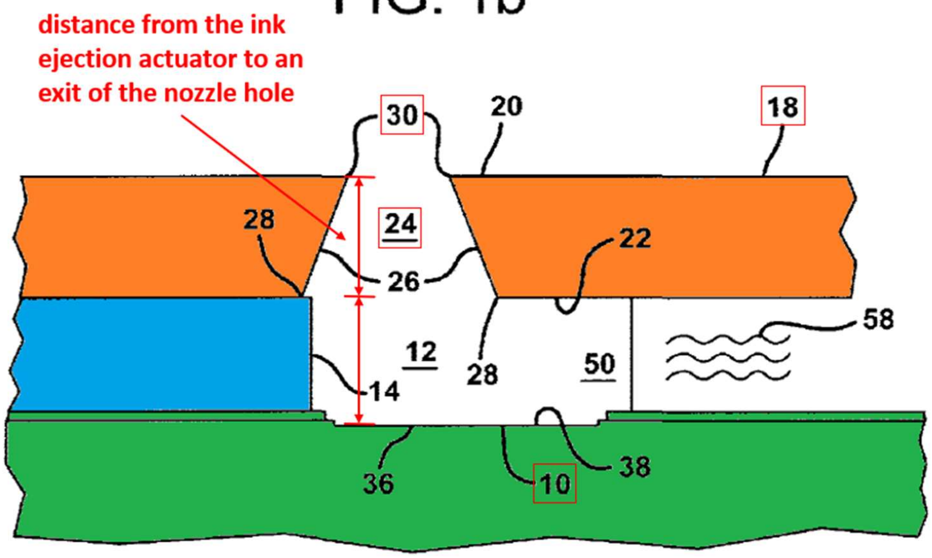
As explained above in Section X.A.1.h and incorporated here, a POSITA would have understood that Power's "pitch" is equal to **600 DPI, or 900 DPI, or 1200 DPI**. Ex.1004, 4:37-40; Ex.1002, ¶191. A POSITA would have also understood that those pitches correspond to the following distance between nozzles: approximately **42.33 microns for a 600 DPI printhead design,** approximately **28.22 microns for a 900 DPI printhead design**, and approximately **21.17 microns for a 1200 DPI printhead design**. Ex.1002, ¶191. Therefore, the **pitch distance disclosed by Powers is 21.17 microns – 42.33 microns**.

A POSITA would understand that the "distance from the ink ejection actuators to an exit of the nozzle holes" in Powers is equal to the nozzle plate 18 thickness

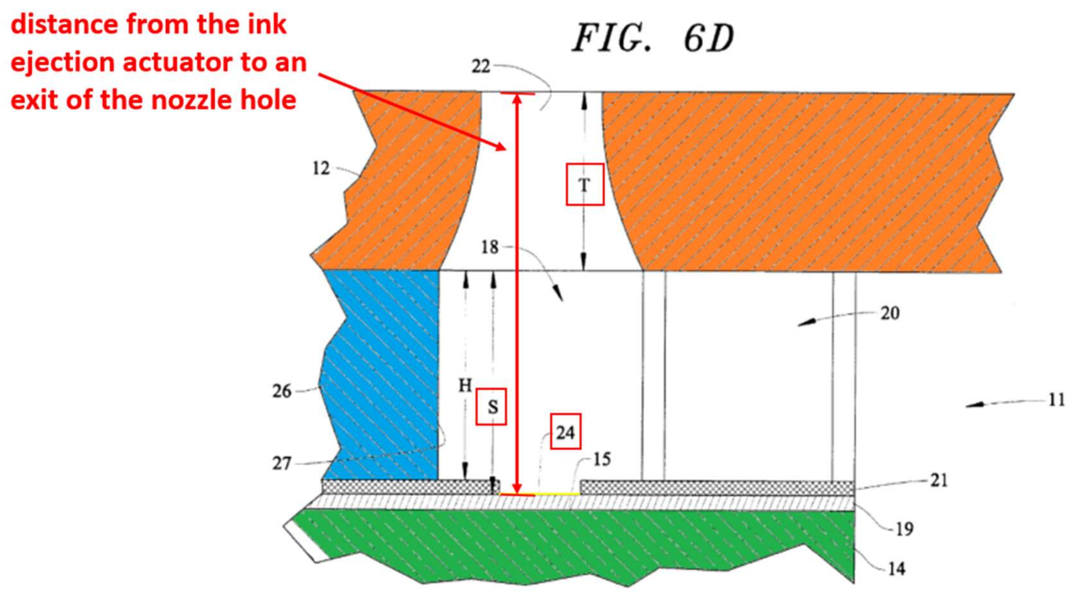
[23] Whitman also disclose this limitation. Ex.1002, n.23.

plus the separation distance between the nozzle plate 18 and the heater element 10, as illustrated in Fig. 1b below. Ex.1002, ¶192; *see also* Ex.1004, 4:33-35, 4:19-23.

FIG. 1b



Although Powers does not expressly disclose all the relevant dimensions, Whitman provides dimensions of the nozzle plate thickness (T) and the separation distance (S) between the nozzle plate and the heater (as illustrated in Fig. 6D, for example). Ex.1002, ¶193.



With reference to Figure 6D (above), Whitman discloses nozzle plate (orange) having a thickness (T) of about 35 microns to about 55 microns. *See* Ex.1005, 7:52-64 ("**thickness (T) of from about 35 microns to about 55 microns being more preferred**"); 6:34-37. Whitman further discloses a "separation distance (S) between the nozzle plate 12 and the transducer[24]" of about 8 microns to about 27 microns. *See* Ex.1005, 8:9-15 ("**separation distance (S) of from about 8 microns to about 27 microns would be preferred**.") Therefore, Whitman discloses a distance from the ink ejection actuators to an exit of the nozzle holes (i.e., sum of thickness (T) and

[24] Whitman's "transducers" are also referred to as "thin film resistors (or heaters)." Ex.1005, 1:15-18.

separation distance (S)) can range from **43 microns to 82 microns**. Ex.1002, ¶¶194-196.

A POSITA would understand that values within the range from 43 microns to 82 microns (i.e., Whitman's distance from the ink ejection actuators to an exit of the nozzle holes) are all greater than the pitches disclosed in Powers. Ex.1002, ¶¶197-199. Specifically, **43 microns, i.e., the lowest value in the range, is greater than 42.33 microns (600 DPI), 28.22 microns (900 DPI), and 21.17 microns (1200 DPI)**.

Accordingly, Powers as modified by Whitman discloses "wherein a distance from the ink ejection actuators to an exit of the nozzle holes [e.g., Whitman's 43 – 82 microns] is greater than the pitch [Powers 42.33 microns, 28.22 microns, and 21.17 microns]." Ex.1002, ¶¶190-200. Claim 9 is therefore obvious.

6. Claim 10

Powers as modified by Whitman discloses "The printhead of claim 1, wherein a **ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes ranges from about 0.5 to about 1.5**."

As explained above in Section X.A.5, incorporated here, a POSITA would have understood that Whitman discloses a **distance from the ink ejection actuators to an exit of the nozzle holes can range from 43 microns to 82 microns**. Ex.1002, ¶203.

Thus, for Powers's 600 DPI design (42.33 micron pitch), a POSITA would have understood that "a ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes" is equal to 42.33 microns divided by 43 microns (i.e., lower dimension of Whitman's distance range), or **0.98**. Ex.1002, ¶204. This value is within the claimed range "from about 0.5 to about 1.5."

For Powers's 900 DPI design (28.22 micron pitch), a POSITA would have also understood that the claimed ratio is equal to 28.22 microns divided by Whitman's 43 microns, or **0.66**. Ex.1002, ¶206. This value is also within the claimed range "from about 0.5 to about 1.5."

For Powers's 1200 DPI design (21.17 micron pitch), a POSITA would have also understood that the claimed ratio is equal to 21.17 microns divided by Whitman's 43 microns, or **0.49** (i.e., "**about** 0.5"). Ex.1002, ¶207. This value is also within the claimed range "from **about** 0.5 to about 1.5." *Id.*

Accordingly, Powers as modified by Whitman discloses "wherein a ratio of the pitch [Powers 42.33 microns (600DPI), 28.22 microns (900DPI), or 21.17 microns (1200DPI)] to a distance from the ink ejection actuators to an exit of the nozzle holes [e.g., Whitman's 43 microns – 82 microns] ranges from about 0.5 to about 1.5 [e.g., 0.98 (600DPI), 0.66 (900DPI), 0.49 (1200DPI)]." Ex.1002, ¶¶201-208. Claim 10 is therefore obvious.

7. Motivation to Combine Powers and Whitman

For the following reasons, a POSITA would have been motivated to combine Whitman with Powers. Ex.1002, ¶¶209-220.

First, Powers and Whitman are analogous to the claimed subject matter in the '951 Patent because they are all within the same field of endeavor—"inkjet printheads." Ex.1002, ¶210; Ex.1001, 1:5-7 ("**The invention relates to inkjet printheads**…"); Ex.1004, 1:6-9 ("**The present invention relates to inkjet printheads**."); Ex.1005, 1:5-9 ("**The present invention relates to an inkjet printhead**….")

Likewise, the '951 Patent, Powers, and Whitman all have the same assignee listed on the face of the patents—Lexmark International, Inc. Ex.1002, ¶211.

The U.S. Patent Office also grouped the '951 Patent, Powers, and Whitman under the same technology classification—class 347 (Incremental printing of symbolic information)—and they also share sub-classes. Ex.1002, ¶212; Ex.1001 (U.S. Cl.); Ex.1004 (U.S. Cl.); Ex.1005 (U.S. Cl.).

Second, Powers and Whitman are analogous to the '951 Patent because they are reasonably pertinent to the technical problem allegedly addressed by the claimed invention—i.e., addressing performance and reliability issues of inkjet printheads. Ex.1002, ¶213. In other words, each of the '951 Patent, Powers, and Whitman describe problems with existing inkjet printhead structure design than can be improved in order to improve the overall performance and reliability of the printhead. Ex.1002, ¶¶213-217.

Third, a POSITA would have been motivated to modify Powers based on Whitman's express teachings. Powers and Whitman disclose a similar printhead design utilizing an exemplary 3-layer anatomy. However, a POSITA wanting to build the printhead in Powers would not have the dimensions of certain printhead structures. Ex.1002, ¶218. Whitman provides these dimensions, including the barrier height (i.e., thick film layer 26), nozzle plate thickness, and nozzle plate separation from the transducer, and explains which dimensions would be "especially beneficial." Ex.1005, 8:9-14; 11:41-45; 7:55-58. Whitman further discloses that "**[u]nder nominal power density, an improvement in MTTF**[25] **can be obtained by lowering the nozzle plate thickness (T) and barrier height (H)**[26]." *Id.*, 15:59-

[25] Whitman discloses that "[t]he median time to failure (MTTF) is a common measure of the average life of a heater" and that "[g]enerally, the higher the MTTF, the more reliable the printhead." Ex.1005, 9:27-30.

[26] Whitman discloses that "FIGS. 6A and 6C-6E illustrate alternate embodiments where the **barrier height (H) [i.e., thick film layer] is substantially equal to the nozzle plate separation distance (S)**…." Ex.1005, 6:11-20.

61. Indeed, Whitman teaches that "reducing the nozzle plate thickness (T) and barrier height (H) [to the disclosed dimensions] can produce an improvement in printhead life" (Ex.1005, 11:60-62) and "**increasing the expected lifespan of the transducers would improve the reliability of the printheads in which they are used**" (Ex.1005, 1:39-45). Thus, a POSITA wanting a more reliable printhead would have been motivated to modify Powers in view of Whitman's teachings by either modifying Powers's barrier layer to be as thick as Whitman's thick film layer 26 or by replacing Powers's barrier layer with Whitman's thick film layer 26. Ex.1002, ¶218.

Fourth, modifying Powers printhead to include Whitman's structures and dimensions would also have been an obvious combination of known prior art elements to yield a predictable result. A POSITA could have combined Whitman's structures and dimensions with Powers's printhead using known methods to design the well-known 3-layer anatomy, and Whitman's structures would merely perform the same functions—forming a heater chamber to allow for reliable ink ejection—as taught by Whitman. Ex.1002, ¶219. This would have resulted in improved printhead and would have been predictable to a POSITA. *Id.* Thus, it would have been obvious to a POSITA wanting a more reliable printhead to modify Powers in view of Whitman. *Id.*

Finally, a POSITA would have had **a reasonable expectation of success** in modifying Powers's printhead to include Whitman's structures and dimensions. Ex.1002, ¶220. The printhead components described in Powers and Whitman were well-known at the time. *See* Ex.1004, 1:13-25; 1:26-42. Ex.1002, ¶¶43-60, 220. It would also have been straightforward for a POSITA to modify Powers's printhead to include Whitman's structures and dimensions and that such a system would operate in the same successful manner as other printheads that had historically utilized the 3-layer anatomy. Ex.1002, ¶220.

B. Ground #2: Powers in View of Whitman, and in View of Cleland, Renders Claims 4, 5, 7, 20-22, and 24 Obvious

1. Claim 4

Powers as modified by Whitman and Cleland discloses "The printhead of claim 2, wherein the **heater resistors** have a **resistance** ranging from **about 80 to about 200 ohms**."

Cleland discloses a "**heater resistor [that] has a resistance of about 140 Ω…**." Ex.1006, 8:24-26; 8:21-23; 8:26-32.

Accordingly, Powers[27] as modified by Cleland discloses "wherein the heater resistors [Powers heater elements] have a resistance ranging from about 80 to about

[27] Powers alone also discloses "heater resistors [Powers heater elements] have a resistance ranging from about 80 to about 200 ohms [e.g., Powers's 73.3, 117.2, or

200 ohms [e.g., Cleland's 140 ohm heaters]." Ex.1002, ¶¶222-232. Claim 4 is therefore obvious.

2. Claim 5

Powers as modified by Whitman and Cleland discloses "The printhead of claim 1, wherein the **nozzle holes** comprise **oblong nozzle holes** having a **long axis to diameter ratio greater** than **about 1.15**."

Powers discloses a plurality of nozzle holes (orifices 24). *See supra* Section X.A.1.g; Ex.1004, 4:23-26; *see also id.*, 7:26-29, cl. 17. Ex.1002, ¶234.

Cleland also discloses a plurality of nozzle holes. Ex.1006, 8:15-17, 8:17-20; *see also* Fig. 12; 19:5-8 ("The **drop generator nozzles are shown…**"). Ex.1002, ¶235.

Cleland further discloses, with reference to Figures 6A and 6B (below), that "**orifice openings may be created in the form of an ellipse**" and that "the **major axis 601 to minor axis ratio falls in the range of 2:1 to 5:1**." Ex.1006, 10:55-62.

146.5 Ohm heater elements]." Ex.1002, ¶¶223-229. As such, the Board may find that Cleland is not necessary in combination with Powers for this limitation.

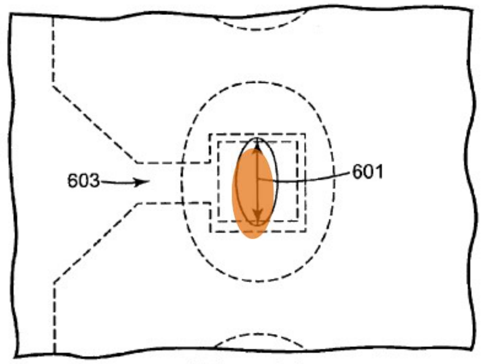


Fig. 6A

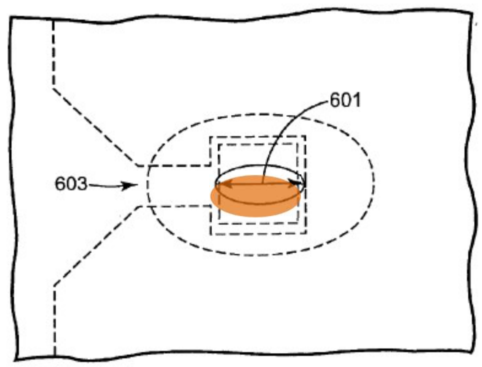


Fig. 6B

Accordingly, Powers as modified by Cleland discloses "wherein the nozzle holes [e.g., Cleland's orifices (orange)] comprise oblong nozzle holes having a long axis [e.g., Cleland's major axis 601] to diameter ratio greater than about 1.15 [i.e., a ratio of 2:1 to 5:1]." Ex.1002, ¶¶233-237. Claim 5 is therefore obvious.

3. Claim 7

Powers alone, or as modified by Cleland, discloses "The printhead of claim 1, wherein the ink feed edge comprises an ink feed slot, and wherein the semiconductor substrate contains **two or more ink feed slots**."

With reference to Figure 4, Powers states that "heater chip 251 contains ***at least one*** **ink via 321** (alternatively: element 40) that fluidly connects the heater chip to a supply of ink internal to the housing [121]." Ex.1004, 7:15-17. A POSITA would understand that Powers disclosure of "at least" one ink via (i.e., ink feed slot) means that the heater chip 251 may have more than one ink feed slot, i.e., two or more ink feed slots. Ex.1002, ¶239.

To the extent that Powers is deemed not to explicitly disclose this limitation, it would have been obvious to a POSITA to modify Powers as taught by Cleland.

Cleland discloses that "[i]n a three color (e.g., cyan, yellow, and magenta) print cartridge, **three elongated openings are utilized to supply each of the three colors**." Ex.1006, 18:57-59. As illustrated in Fig. 13A below, Cleland further discloses three independent sets of "eight primitives [that] are arrayed on **either side of an elongated opening, or slot**." *Id.*, 17:22-24; *see also id.*, 18:59-64; 20:15-18; 20:20-25, 21:60-22:8; Fig. 13A/B. Ex.1002, ¶242.

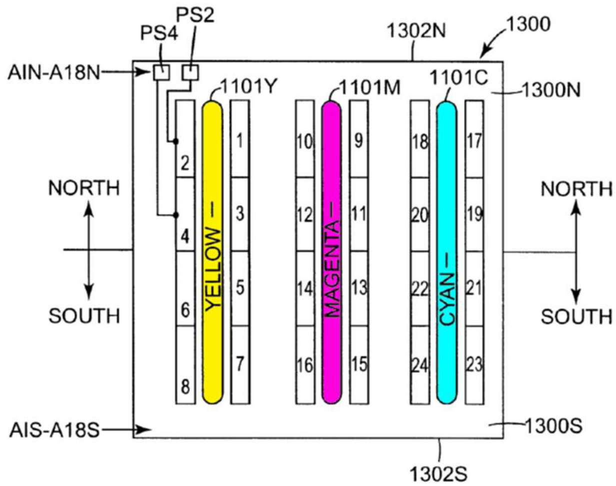


Fig. 13A

Accordingly, Powers alone, or as modified by Cleland, discloses "wherein the ink feed edge comprises an ink feed slot [e.g., ink via 321/40], and wherein the semiconductor substrate [e.g., heater chip] contains two or more ink feed slots [e.g., ink feed slots]." Ex.1002, ¶¶238-244. Claim 7 is therefore obvious.

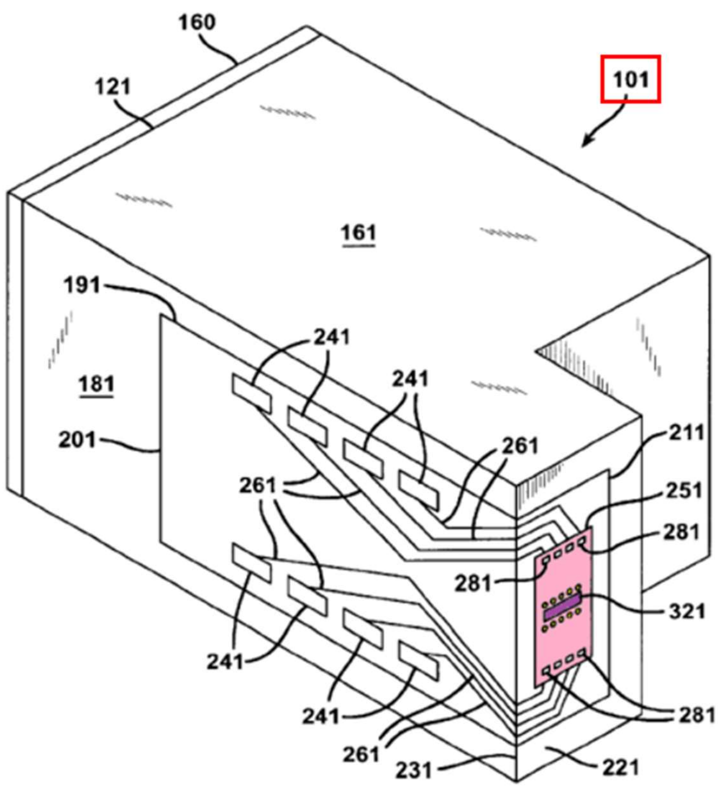
4. Claims 20 - 22

Each of claim 20 through 22's limitations are analogous to other claims discussed above. Ex.1002, ¶¶245-248 (*see* detailed table). As such, each of claim 20 through 22's limitations are disclosed by the Powers-Whitman-Cleland combination for the reasons provided above and below, and incorporated here. *Supra* Sections X.A.1, X.A.2, X.A.4, X.B.1, X.B.3. Claims 20 through 22 are rendered obvious by the Powers-Whitman-Cleland combination.

5. Claim 24

Powers discloses "An **inkjet printer cartridge containing the printhead of claim 20**." Powers discloses "[a]n inkjet printer cartridge [e.g., printhead 101] containing the printhead of claim 20" in Figure 4 (shown below). Ex.1004, 6:46-62; *see also* Ex.1004, 1:26-31, 7:1-5. Ex.1002, ¶¶250-253. Claim 24 is therefore obvious.

FIG. 4



6. Motivation to Combine Powers, Whitman, and Cleland

A POSITA would have been motivated to modify Powers in view of Whitman for the reasons explained above in Section X.A.7 and incorporated here. A POSITA would have further been motivated to modify the Powers-Whitman combination in view of Cleland for the following reasons. Ex.1002, ¶¶254-268.

First, like Powers and Whitman, Cleland is also analogous to the claimed subject matter in the ’951 Patent because it is directed to inkjet printheads. Ex.1006, 4:34-36 (“A high quality **inkjet printhead** includes…”), 1:10-13; *see also id.*, 7:24-37. Ex.1002, ¶255. *See supra* Section X.A.7.

As stated above in Section X.A.7, the ’951 Patent, Powers, Whitman, share the same technology classification (class 347) and certain sub-classes. Ex.1002, ¶256. Cleland also shares the same technology classification and sub-class: 347/62 (Resistor specifics). Ex.1006 (U.S. Cl.).

Second, Powers, Whitman, and Cleland are analogous to the ’951 Patent because they all describe problems with existing inkjet printhead structure design than can be improved in order to improve the overall performance and reliability of the printhead. Ex.1002, ¶¶257-261.

Like Powers and Whitman, Cleland describes a problem wherein printhead components are “susceptible to fluid mechanical stresses (cavitation) as the vapor bubble collapses, thereby allowing **ink to crash into the ink firing chamber**

components." Ex.1006, 2:24-47; Ex.1002, ¶261. Cleland aims to solve this problem by "reduc[ing] [] the amount of energy input to the printhead for higher frequencies and greater drop generator densities to be realized." *Id.*, 2:59-61.

Third, a POSITA would have been motivated to modify the Powers-Whitman combination to include **Cleland's oblong orifices** doing so would have "**provide[d] increased control over the direction of ink drop ejection, reliable placement of ink dots on the medium, and a reduction of satellite droplets and spray**." Ex.1006, 10:55-62. Such an improvement would have been achieved by modifying the orifice shape to an "ellipse" shape, as taught by Cleland. *See id.*, 11:24-31; Ex.1002, ¶262.

A POSITA would also have been motivated to modify the Powers-Whitman combination to include **Cleland's heater resistance values** ranging from about 80 to about 200 ohms (i.e., 140 Ohms) because doing so would help lower the temperature of the printhead and thereby improve the reliability of the printhead device. Ex.1002, ¶263. Cleland also explains that by using higher value resistance can help reduce costs. Ex.1006, 3:44-52. Thus, a POSITA wanting improve the reliability and performance of a printhead or reduce the cost of the printhead would have been motivated to modify the Powers-Whitman combination to include Cleland's resistors having resistance values. Ex.1002, ¶263. Moreover, a POSITA could have replaced Cleland's resistors for Powers's resistors using known methods, and Cleland's resistors would merely perform the same functions—generating heat for reliable ink ejection from the heater chamber—as taught by Cleland. *Id.*, ¶264. This would have resulted in improved printhead and would have been predictable to a POSITA. *Id.*

A POSITA would also have been motivated to modify the Powers-Whitman combination to include **Cleland's multiple ink feed slots** to facilitate color printing with a single printhead. Ex.1006, 7:24-28; *see also* Ex.1002, ¶265. Thus, a POSITA wanting a more versatile printhead, i.e., able to print color instead of just black, would have been motivated to modify the Powers-Whitman combination to include Cleland's multiple ink feed slots. Ex.1002, ¶265.

Fourth, modifying Powers printhead to include Cleland's elliptical orifices would also have been an obvious combination of known prior art elements that yields a predictable result. Ex.1002, ¶266. A POSITA could have combined Cleland's elliptical orifices with Powers's printhead using known methods, and Cleland's elliptical orifices would merely perform the same functions—being an outlet for reliable ink ejection from the heater chamber—as taught by Cleland. *Id.*, ¶267. This would have resulted in improved printhead and would have been predictable to a POSITA. *Id.*

In addition, modifying Powers printhead to include Cleland's multiple ink feed slots would have been an obvious combination of known prior art elements that yields a predictable result. A POSITA could have combined Cleland's multiple ink feed slots with Powers's printhead using known methods, and Cleland's multiple ink feed slots would merely perform the same functions—providing multiple paths of ink to the printhead firing chambers instead of just a single path for a single color ink —as taught by Cleland. Ex.1002, ¶267. This would have resulted in improved printhead and would have been predictable to a POSITA. *Id.*

Finally, a POSITA would have had a **reasonable expectation of success** in modifying Powers-Whitman to include Cleland's elliptical orifices, heaters, or multiple ink feed slots. The printhead components described in Powers, Whitman, and Cleland were well-known at the time. *See* Ex.1004, 1:13-25; 1:26-42; Ex.1002, ¶¶43-60, 268. It would also have been straightforward for a POSITA to modify Powers's printhead to include Cleland's elliptical orifices, heaters, and multiple ink feed slots and that such a system would operate in the same successful manner as other printheads that had historically utilized the 3-layer anatomy. *Id.*

C. Ground #3: Hamafuku in View of Imanaka, and in View of Whitman, Renders Claims 1-4, 6, 7, 9, 10, 20-22, and 24 Obvious

1. Claim 1

a. 1[p]

Hamafuku discloses "a **printhead for an ink jet printer**."[28] Hamafuku states that "the present invention is an **inkjet head that ejects ink onto a recording paper**…." Ex.1007, [0013]. Hamafuku's "inkjet head 31" is illustrated in Figures 1 through 3. *Id.*, [0017], [0018]. Hamafuku also states that "the **inkjet head 31**…**is attached to the ink cartridge 32**" and "FIG. 5 is a partial cross-sectional view of an **inkjet printer using the inkjet head 31**." *Id.*, [0034], [0039].

Accordingly, Hamafuku discloses "[a] printhead [e.g., inkjet head 31] for an ink jet printer." Ex.1002, ¶¶272-273.

b. 1[a]

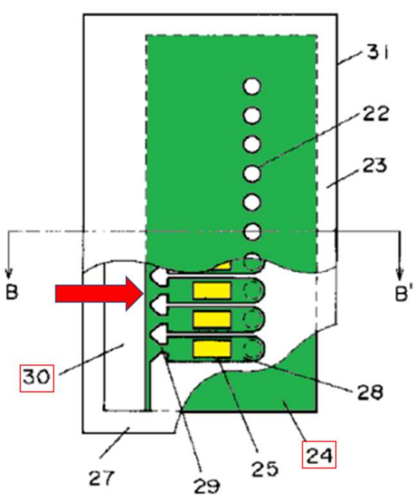
Hamafuku discloses a **semiconductor substrate** (e.g., substrate 24). Ex.1007, [0018] ("31 represents an inkjet head including…**substrate 24** [green in Figures 1-3 below]…."); Ex.1007, [0020] ("material of the **substrate 24**, can be…a **semiconductor**….").

As illustrated below in Figures 1 to 3 (below), Hamafuku's substrate 24 (green) includes **at least one ink feed edge** (red arrow in Figures below), e.g., outer

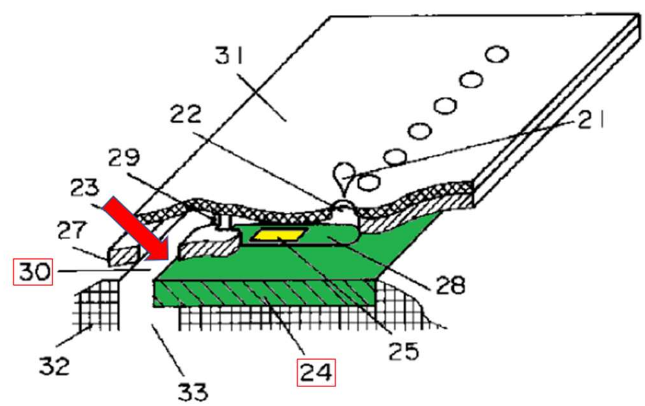
[28] *See supra* n.3.

edge of substrate[29] over which ink (teal) passes from **common ink chamber 30**. Ex.1007, [0034]; [0018] ("**30 represents a common ink chamber that supplies ink 21 to the pressure chamber 28 through the ink flow path 29**."); [0019]. Ex.1002, ¶¶275-276.

【図１】

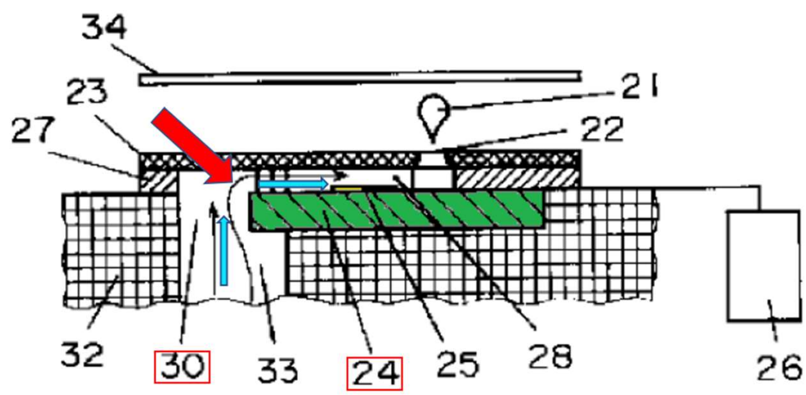


【図３】



[29] The '951 Patent confirms that an *outer edge* of a substrate may be the claimed "ink feed edge". Ex.1001, 3:35-41 ("a **fluid feed edge** 40…**may be** an edge of the feed slot 34, or in the case of an **edge feed configuration**, **an outer edge of the substrate** 18."

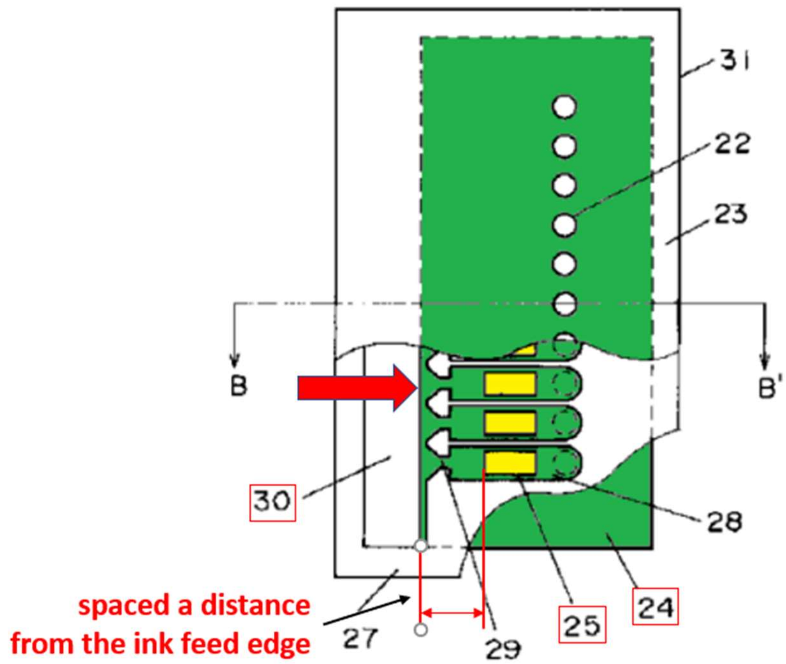
【図2】



As illustrated in Figure 1 below, Hamafuku's substrate 24 also includes a plurality of ink ejection actuators (e.g., heater parts 25) (yellow) spaced a distance from the ink feed edge (identified by red arrow).[30] Ex.1007, [0017] ("**heater part 25 is provided on the substrate 24**."); Ex.1002, ¶278.

[30] *See infra* n.31.

【図1】



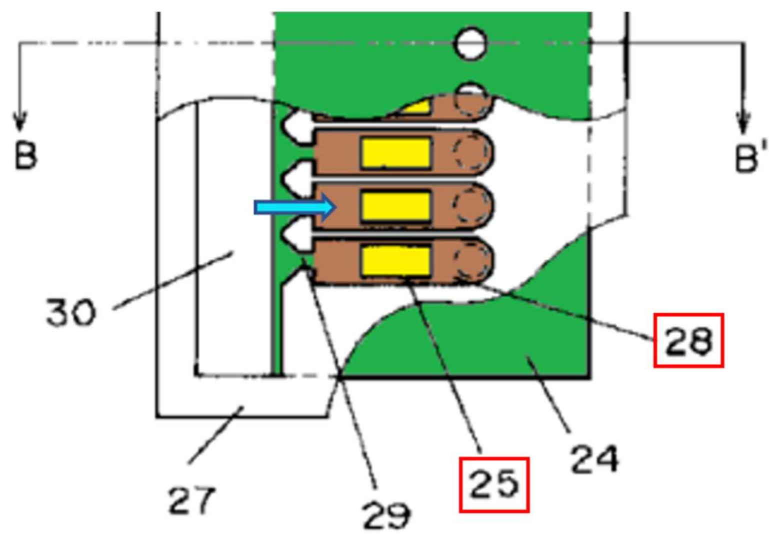
Hamafuku, Figure 1

Accordingly, Hamafuku discloses "the printhead comprising: a semiconductor substrate [e.g., substrate 24] containing at least one ink feed edge [e.g., edge of substrate 24 as indicated by the red arrow] and a plurality of ink ejection actuators [e.g., heater 25] spaced a distance from the ink feed edge [e.g., distance from the edge of the heaters to the edge of the substrate 24]." Ex.1002, ¶¶274-279.

c. 1[b]

Hamafuku as modified by Imanaka discloses "**each of the ink ejection actuators having an aspect ratio ranging from about 1.5:1 to about 6:1**."

As illustrated in Figure 1 below, Hamafuku discloses that its ink ejection actuators (i.e., heater portions 25) "**can be made rectangular** and the shape of the **pressure chamber 28** [brown] **can be elongated** with respect to the flow of the ink 21 [teal] compared to the shape of a conventional pressure chamber**.**" Ex.1007, [0017]. Ex.1002, ¶282. It would be understood and obvious to a POSITA that Hamafuku's rectangular heater elements have a length longer than its width and an aspect ratio within the claimed ratio ranges of 1.5:1 to 6:1. Ex.1002, ¶281.



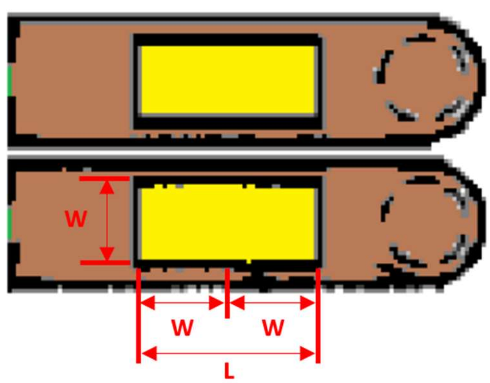
Hamafuku, Fig. 1 (excerpt)

A POSITA would understand that Hamafuku's rectangular heater parts 25 have an aspect ratio ranging from "about 1.5:1 to about 6:1" for several reasons. Ex.1002, ¶284.

First, as Mr. Curley explains in his declaration (Section IX), rectangular heaters having an aspect ratio (length/width) ranging from "about 1.5:1 to about 6:1" (as claimed by the '951 Patent) were well-known in the art and had regularly been used to derive optimal printhead fabrication parameters. Ex.1002, ¶285.

Second, it would be obvious to POSITA (and implicit in Hamafuku's disclosure) that the selected size of Hamafuku's rectangular heaters would satisfy Hamafuku's explicit goal of providing a high density arrangement of heaters in a single row. *See* Ex.1007, [0044] ("the present invention can provide a **high density arrangement of the ink ejection parts by collectively arranging the ink ejection parts in a row**."); *see also id*., [0017]; Ex.1002, ¶286. For example, an aspect ratio that **doubles** the number of heaters in the same row (i.e., doubling the number of dots per inch) would be obvious to try for a POSITA. Ex.1002, ¶286. As Mr. Curley explains in his declaration (Section IX), by using rectangular heaters having an **aspect ratio of 2:1**, twice the number of nozzles can fit into the same vertical row of 1 inch chip space. *Id.* As such, it would be obvious to a POSITA (and implicit in Hamafuku's disclosure) that Hamafuku's rectangular heater parts have an aspect ratio of at least 2.0:1 which is within the claimed aspect ratio range of "about 1.5:1 to about 6:1."

Finally, a comparison of the relative dimensions of Hamafuku's heater part (yellow) indicates that it has a **length (L) that is twice its width (W)**.[31] As such, Hamafuku's Figure 1 reasonably discloses and suggests to a POSITA (and corroborates the analysis above) that Hamafuku's rectangular heater has an aspect ratio (L/W) of at least 2.0:1 (i.e., within the claimed aspect ratio range of "about 1.5:1 to about 6:1"). Ex.1002, ¶287.



[31] The relative dimensions in patent figures of inkjet printheads, such as those disclosed in Hamafuku, are relatively accurate. Ex.1002, n.35. However, the Board can rely on prior art figures to teach relative dimensions as long as its conclusions with regard to the relative dimensions are not inconsistent with the teaching of the reference. *See Ex Parte Dadd*, Appeal No. 2022-001584, 2022 WL 1684059, at *15 (PTAB May 24, 2022).

To the extent that Hamafuku is deemed not to disclose the claimed aspect ratio, it would have been obvious to a POSITA to modify Hamafuku's heater dimensions to be same as the heater dimensions disclosed in Imanaka.

Imanaka discloses that the "pitch of the **heat generating members 2** is about 21 μm, and the **width thereof is selected as 14 μm** including a margin"[32] and the "**length of the heat generating member 2 is selected as 60 μm**." Ex.1008, 7:53-58. As such, a POSITA would understand that Imanka discloses an ink ejection actuator (e.g., heat generating member 2) having an aspect ratio of 60 μm (length) divided by 14 μm (width) (**4.29**), i.e., an aspect ratio (L/W) of 4.29:1. Ex.1002, ¶289.

Accordingly, Hamafuku alone, or as modified by Imanaka, discloses "each of the ink ejection actuators [e.g., Hamafuku's heater parts 10; Imanaka's heat

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[32] A POSITA would understand based on Imanaka's specification that the phrase "width thereof is selected as 14 μm *including a margin*" means that 14 microns is the preferred heater width but that a range of width dimensions (e.g., a margin) are possible. Ex.1002, n.31.

generating members 2] having an aspect ratio ranging from about 1.5:1 to about 6:1. [Hamafuku's 2.0:1; Imanaka's 4.29:1]"[33] Ex.1002, ¶¶280-290.

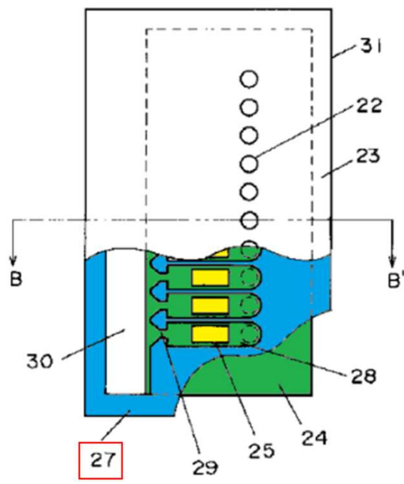
d. 1[c]

Hamafuku alone, or as modified by Whitman, discloses "**a thick film layer attached to the semiconductor substrate**."

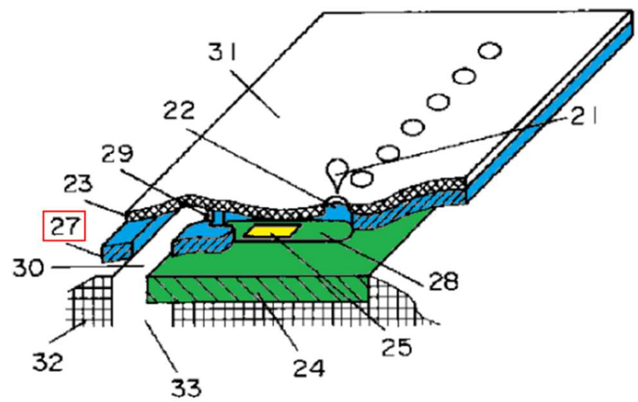
As illustrated in the Figures below, Hamafuku discloses a thick film layer (e.g., flow path member 27) (blue) attached to the semiconductor substrate (e.g., substrate 24). Ex.1007, [0017] ("**27 represents a flow path member provided between the nozzle plate 23 and the substrate 24…**."); Figs. 1-3; [0019] ("common ink chamber 30 is formed by **attaching the** nozzle plate 23 and the **flow path member 27 to the substrate 24**").

[33] To the extent the Board agrees that Hamafuku alone discloses this limitation as discussed above, Imanaka is not necessary in combination with Hamafuku for this limitation.

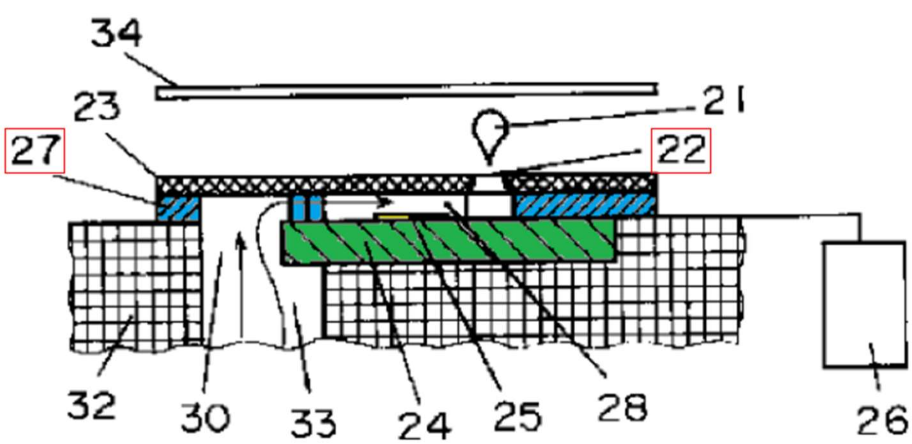
【図１】



【図３】



【図２】



The term "thick" is not defined in the '951 Patent or the claims and, as such, is unclear. To the extent that a POSITA can understand this term, "thick" is a relative term and a POSITA would understand that, like the '951 Patent's "thick film layer

70," Hamafuku's flow path member (blue) is formed separate from the nozzle plate and is "thick enough" to provide ink chambers and ink channels therein, and is "thicker" than, for example, the thickness of heater part 25. *See* Ex.1007, [0017] ("28 represents a pressure chamber including…flow path member 27), Fig. 2; Ex.1002, ¶294. Moreover, Hamafuku's disclosure, including the dimensions of the printhead features illustrated in Figs. 2 and 3 above, further confirms that Hamafuku's flow path member 27 (blue) is a "thick" film layer. *Id.*, ¶295. As such, Hamafuku's flow path member (blue) is a thick film layer. *Id.*, ¶¶294-295.

To the extent that Hamafuku is deemed not to explicitly or inherently disclose a "thick film layer" it would also have been obvious to a POSITA to modify Hamafuku's inkjet printhead design to include the "thick film layer" disclosed in Whitman. Ex.1002, ¶¶297-301.

As discussed above in Section X.A.1.d, and incorporated here, Whitman discloses a "**thick spacer or insulating film 26, referred to hereinafter as the thick film layer.**" Ex.1005, 6:21-23; *id.*, 6:31-33. As illustrated in Whitman's Figures 5 and 7 below, printhead chip 11 includes a **thick film layer 26** (blue) attached to semiconductor substrate base 14 (green).

FIG. 5

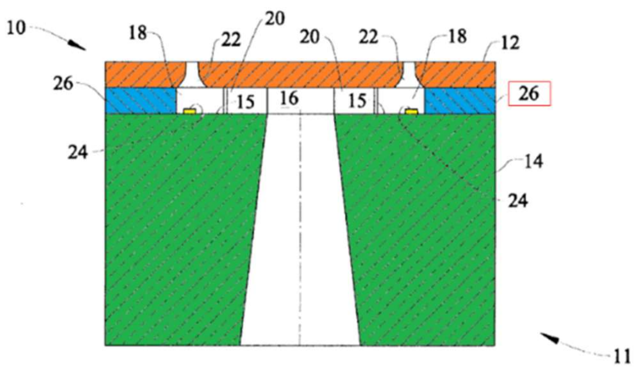
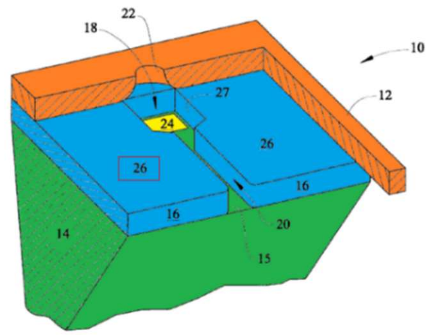


FIG. 7



To the extent Hamafuku does not disclose a "thick film layer" as discussed above, a POSITA would either modify Hamafuku's flow path member to be as thick as Whitman's thick film layer 26 or replace Hamafuku's flow path member with Whitman's thick film layer 26 for the reasons discussed below. *See* Section X.C.11; Ex.1002, ¶302.

Accordingly, Hamafuku as modified by Whitman, discloses "a thick film layer [e.g., Hamafuku's flow path member 27; Whitman's thick film layer 26] attached to the semiconductor substrate [e.g., Hamafuku's substrate 24]."[34] Ex.1002, ¶¶291-303.

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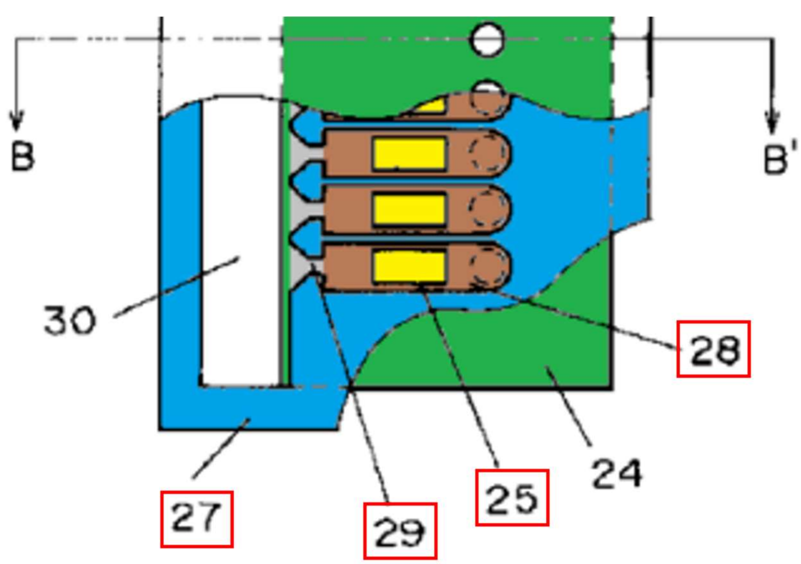
[34] To the extent the Board agrees that Hamafuku alone discloses this limitation as discussed above, Whitman is not necessary in combination with Hamafuku for this limitation.

e. 1[d]

Hamafuku as modified by Whitman discloses "the **thick film layer having formed therein a plurality of ink feed chambers and ink feed channels corresponding to the plurality of ink ejection actuators**."

As illustrated in an excerpt from Figure 1, below, Hamafuku discloses a thick film layer (e.g., ink flow path member 27, blue) having formed therein a plurality of ink feed chambers (e.g., pressure chamber 28, brown) and ink feed channels (e.g., ink flow path 29, gray) corresponding to the plurality of ink ejection actuators (e.g., heater part 25, yellow). Ex.1007, [0017] ("**28 represents a pressure chamber including…the flow path member 27; and 29 represents an ink flow path for supplying ink 21 to the pressure chamber 28**."); [0018].



To the extent that Hamafuku is deemed not to explicitly disclose this limitation it would have been obvious to a POSITA to modify Hamafuku's inkjet printhead to include the "thick film layer" disclosed in Whitman. Ex.1002, ¶306.

As discussed above in Section X.A.1.d and X.C.1.d, and incorporated here, and as illustrated below in Figures 5 and 7, Whitman discloses a "thick film layer [26, blue] having formed therein a plurality of ink feed chambers [chamber 18, brown] and ink feed channels [channel 20, gray] corresponding to the plurality of ink ejection actuators [heaters 24]." Ex.1005, 6:21-23, 6:51-54; Ex.1002, ¶308. Whitman further discloses that "each of the heaters [24, yellow] is preferably arranged in a respective one of a plurality of chambers." Ex.1005, 7:1-5.

FIG. 5

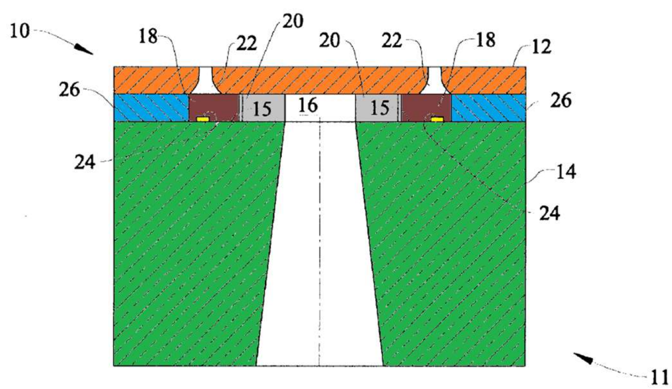
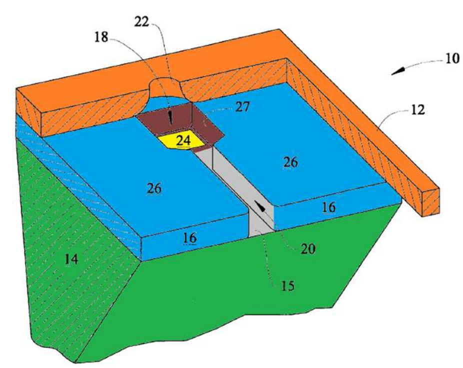


FIG. 7

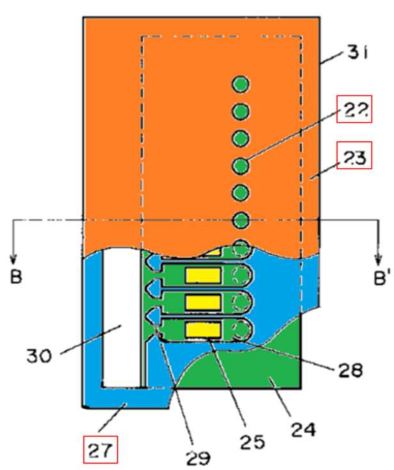


Accordingly, Hamafuku as modified by Whitman discloses "the thick film layer [e.g., Hamafuku's ink flow path member 27; Whitman's thick film layer 26] having formed therein a plurality of ink feed chambers [e.g., Hamafuku's pressure chambers 28; Whitman's bubble chambers 18] and ink feed channels [e.g., Hamafuku's ink flow paths 29; Whitman's ink flow channels 20] corresponding to the plurality of ink ejection actuators."[35] Ex.1002, ¶¶304-309.

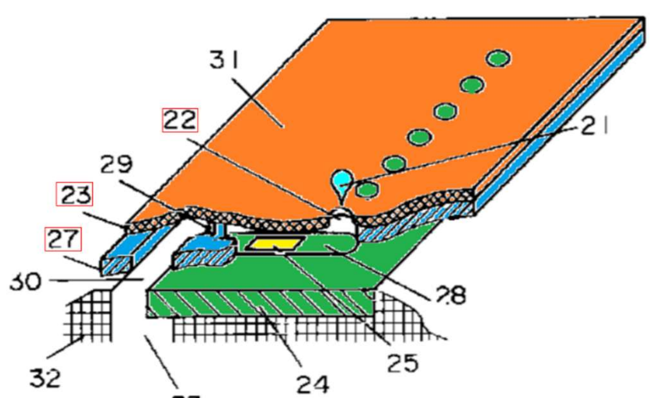
f. 1[e]

As illustrated in Figures 1-3 below, Hamafuku discloses a **nozzle plate** (e.g., nozzle plate 23) (orange) **attached to the thick film layer** (e.g., flow path member 27 (blue)). Ex.1007, [0017] ("23 represents a nozzle plate [orange] having the nozzle 22."); *see also* Ex.1007, [0019] ("attaching the nozzle plate 23 and the flow path member 27 to the substrate 24"); Ex.1002, ¶311.

【図1】

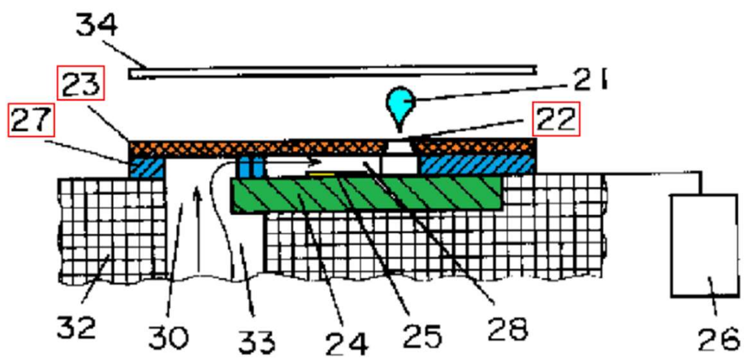


【図3】



[35] To the extent the Board agrees that Hamafuku alone discloses this limitation as discussed above, Whitman is not necessary in combination with Hamafuku for this limitation.

【図２】



Accordingly, Hamafuku in combination with Whitman discloses "a nozzle plate [e.g., Hamafuku's nozzle plate 23] attached to the thick film layer [e.g., Hamafuku's ink flow path member 27; Whitman's thick film layer 26]."[36][37] Ex.1002, ¶¶310-313.

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[36] To the extent the Board agrees that Hamafuku alone discloses this limitation, Whitman is not necessary in combination with Hamafuku for this limitation.

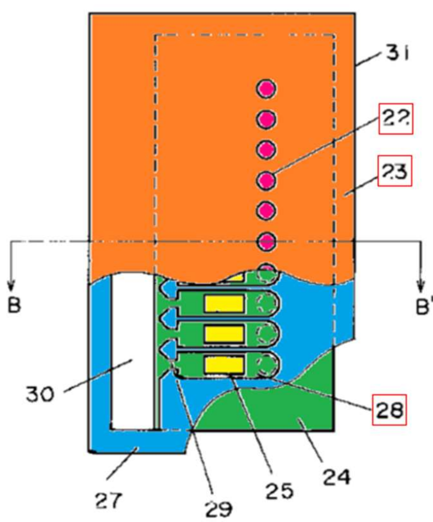
[37] Whitman also discloses this limitation. Ex.1002, n.39. To the extent that Hamafuku is deemed not to explicitly disclose a "thick film layer" it would have been obvious to a POSITA to modify Hamafuku's inkjet printhead design to include the "thick film layer" disclosed in Whitman for the reasons discussed in Section X.C.11; Ex.1002, n.39.

g. 1[f]

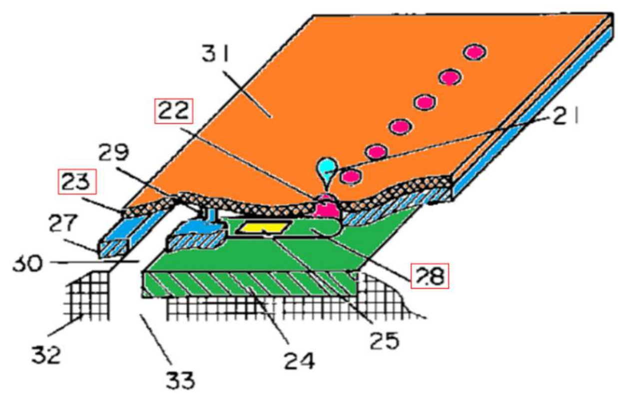
Hamafuku discloses "the **nozzle plate containing a plurality of nozzle holes in the nozzle plate corresponding to the plurality of ink feed chambers**."

As illustrated in Figures 1 and 3 below, Hamafuku discloses that nozzle plate 23 (orange) includes a plurality of nozzles 22 (magenta). Ex.1007, [0017]. Ex.1002, ¶315.

【図1】



【図3】



A POSITA would understand that each pressure chamber 28 has a corresponding nozzle 22 because Hamafuku describes an "**ink ejection part**" that includes a "**plurality of nozzles 22**, the heater part 25, **a pressure chamber 28**, and an ink flow path 29." Ex.1007, [0018]; *see also id.*, [0017] ("22 represents a nozzle which is an ejection port for the ink 21 [teal]"), [0043]. Ex.1002, ¶316.

Accordingly, Hamafuku discloses "the nozzle plate containing a plurality of nozzle holes [e.g., nozzles 22] in the nozzle plate [e.g., nozzle plate 23] corresponding to the plurality of ink feed chambers [e.g., pressure chambers 28]."[38] Ex.1002, ¶¶314-317.

h. 1[g]

Hamafuku alone, or as modified by Imanaka, discloses "**wherein adjacent ones of the nozzle holes are spaced apart with a pitch ranging from about 600 to about 2400 dpi**."

Hamafuku discloses in Figure 1 (below) adjacent nozzles arranged in a direction substantially parallel with an axis (black dashed line) aligned with a columnar nozzle array (black rectangle), i.e., the heaters are arranged in a column.

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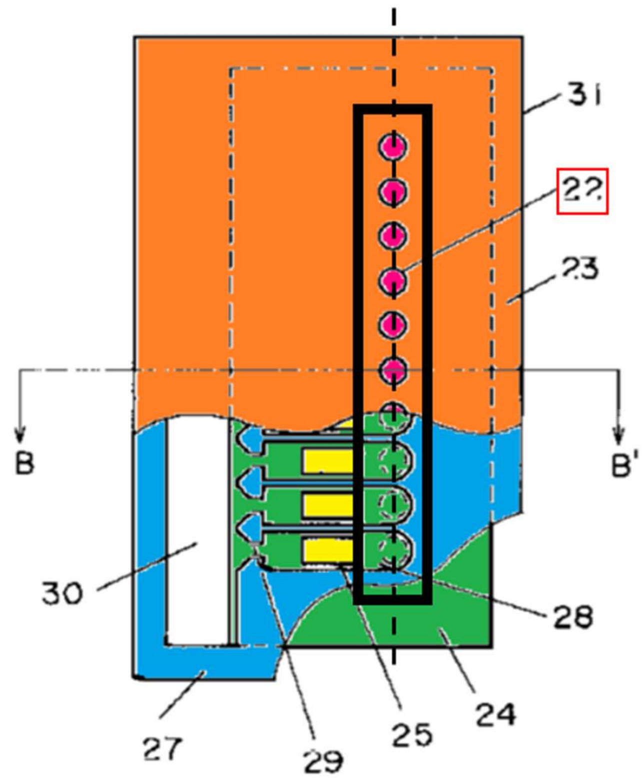
[38] Whitman also discloses this limitation. Ex.1002, n.40.

【図1】



Hamafuku further explains that as a result of the rectangular heater parts and elongated pressure chamber 28, "it is possible to achieve a **high-density arrangement of ink ejection parts in a row**, which would not have been possible with a conventional configuration unless the ink ejection parts are in a staggered arrangement." Ex.1007, [0017]; [0043]. As discussed in Mr. Curley's declaration, at the time of the '951 Patent, common "high-density" heater/nozzle arrangements were considered to be at least 600 DPI up to 1200 DPI or more. *See, e.g.,* Ex.1008, 7:7-10; Ex.1025, 4:63-65; 6:32-34. Ex.1002, ¶321.

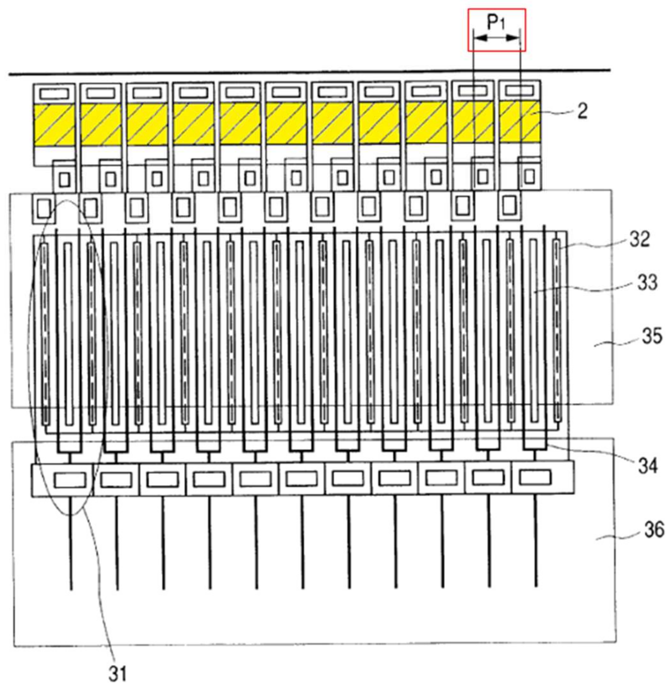
Thus, a POSITA would have understood that Hamafuku's disclosure of ink ejection parts "arranged in a row **at high density**" includes nozzles that are spaced apart with a pitch ranging from **at least 600 dpi** (e.g., 600 DPI up to 1200 DPI or greater) because those were the pitches for high-density arrangements of inkjet nozzles on an inkjet printhead chip at the time. Ex.1002, ¶¶322-323. As such, Hamafuku discloses "wherein adjacent ones of the nozzle holes [e.g., nozzles 22] are spaced apart with a pitch ranging from about 600 to about 2400 dpi [e.g., 600 DPI or 1200 DPI]." Ex.1002, ¶323.

To the extent that Hamafuku is deemed not to explicitly or inherently disclose this limitation, it would have been obvious to a POSITA to modify Hamafuku's inkjet printhead design to include the nozzle pitch disclosed in Imanaka.

In the Background of the Invention, Imanaka discloses advantages of bubble jet technology, or ink jet technology, including ink discharge openings (i.e., nozzles) having a **high-density arrangement** to keep the printhead compact in size. Ex. 1008, 1:38-47; Ex.1002, ¶¶325-326.

With respect to Figure 3 (below), Imanaka discloses that the heat generating members 2 (yellow) are arranged in a high-density pitch of "600 dpi or higher." For example, Imanaka discloses that the substrate "employs **heaters** arranged with a **high density,** providing a resolution of **600 dpi** (dot per inch) **or higher** in the recorded image. … The <u>**pitch P1**</u> of the **heater drivers 31** is **same** as the **pitch** of the **heat generating members 2** [yellow], and is selected in a range of **15 to 42 µm**."[39] Ex.1008, 7:7-19; *see also* 8:3-8, 8:9-11; 1:38-47; Ex.1002, ¶327.

FIG. 3



Imanaka further states that with respect to Figure 3, "the **heat generating members 2** are so arranged as to attain a resolution of **1200 dpi** on the recorded

[39] As discussed above in Section X.A.5 (claim 9) and incorporated here, a POSITA would understand (based on well-known formulas) that a pitch of approximately **42.33 microns equates to a 600 DPI printhead** design, **21 microns equates to a 1200 DPI printhead** design, and **15 microns equates to a 1693 DPI printhead** design. Ex.1002, ¶327.

image." Ex.1008, 7:45-47. Imanaka discloses that "[t]he **pitch of the heat generating members 2 is about 21 µm**…**for attaining the recording density of 1200 dpi**." *Id.*, 7:54-57. Ex.1002, ¶¶328-329.

A POSITA would understand that Imanaka's heat generating members 2 each have a corresponding nozzle (i.e., discharge opening 5). Ex.1002, ¶326. A POSITA would also understand that Imanaka's heat generating members 2 and corresponding nozzles are arranged in a way that satisfies the '951 Patent's definition of pitch. Ex.1002, ¶¶330-332. Accordingly, Hamafuku alone, or as modified by Imanaka, discloses "wherein adjacent ones of the nozzle holes [e.g., Hamafuku's nozzles 22; Imanaka's discharge openings 5] are spaced apart with a pitch ranging from about 600 to about 2400 dpi [e.g., Hamafuku's 600 DPI, 900 DPI, or 1200 DPI; Imanaka's 600 DPI or 1200 DPI]."[40] Ex.1002, ¶¶318-333.

i. 1[h]

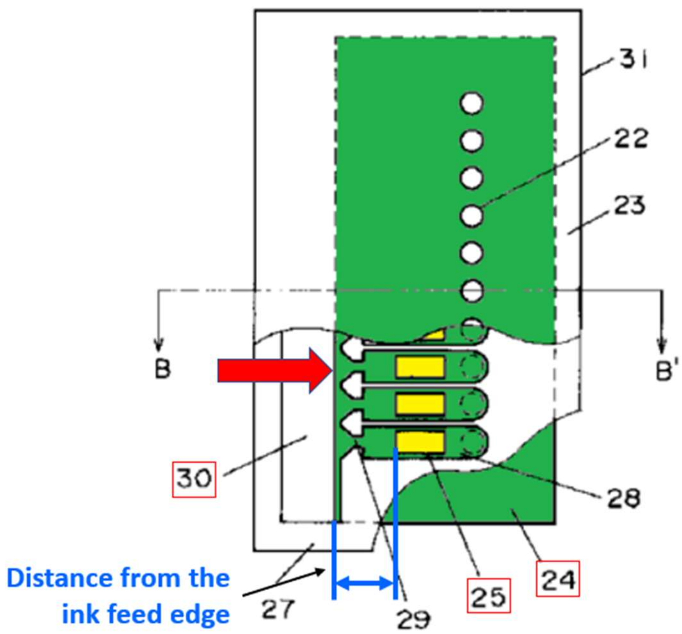
Hamafuku discloses "**wherein the distance from the ink feed edge is substantially the same for each of the ink ejection actuators**."

As explained above (*supra* Section X.C.1.b) and incorporated here, Hamafuku's Figure 1 below illustrates that the distance between each heater portion

[40] To the extent the Board agrees that Hamafuku alone discloses this limitation Imanaka is not necessary in combination with Hamafuku for this limitation.

25 (ink ejection actuator) (yellow) and an edge of the substrate over which ink flows from common ink chamber 30 (ink feed edge) (denoted by red arrow) is substantially the same (as illustrated by the blue annotation).[41] Ex.1002, ¶337.

【図1】



A POSITA would also understand that Hamafuku's heater portions are substantially the same distance from the ink feed edge because they are arranged in a row (i.e., line) within the ink feed path. Ex.1007, [0043]; [0019], [0017]. Ex.1002, ¶336.

[41] *See* supra n.31.

Accordingly, Hamafuku discloses "wherein the distance from the ink feed edge [e.g., edge of the substrate over which ink flows from common ink chamber 30] is substantially the same for each of the ink ejection actuators [e.g., heater portion 25]." Ex.1002, ¶338.

For the reasons discussed above in Section X.C.1 and the motivations discussed below in Section X.C.11, claim 1 is obvious over Hamafuku in view of Imanaka and Whitman. Ex.1002, ¶339.

2. Claim 2

Hamafuku discloses "The printhead of claim 1, wherein the ink ejection actuators comprise **heater resistors**."

Hamafuku discloses that "[element] **25 represents a heater part for generating bubbles**" and **"**26 represents a signal generator that **applies a voltage to the heater part 25**." Ex.1007, [0017]. A POSITA would understand that Hamafuku's disclosure of a heater part that receives a voltage in order to generate bubbles is referring to a heater resistor for an inkjet printhead. Ex.1002, ¶341.

Accordingly, Hamafuku discloses the additional limitations of claim 2 of the '951 Patent.[42] Ex.1002, ¶¶340-342. Claim 2 is therefore obvious over Hamafuku in view of Imanaka and Whitman.

3. Claim 3

Hamafuku as modified by Imanaka discloses "The printhead of claim 2, wherein the **heater resistors** have a **width** of less than or equal to **15 microns**."

Although Hamafuku does not expressly disclose the width of its heater parts, it would have been obvious to a POSITA to modify Hamafuku's heater dimensions to be same as the heater dimensions disclosed in Imanaka because at the time of the '951 Patent rectangular heater resistors of various lengths and widths had regularly been used to derive optimal printhead fabrication parameters. *See supra*, Sections X.C.1.c; *see also* Section IX; Ex.1002, ¶344.

Imanaka discloses heater resistors where the "**width thereof is selected as 14 μm** including a margin." Ex.1008, 7:53-56. As such, a POSITA would understand

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[42] Imanaka also discloses this limitation. Ex.1008, 5:16-23, 7:63-65; *see also id.*, 7:58-62; Ex.1002, n.44. To the extent that Hamafuku is deemed not to explicitly disclose a "ink ejection actuators comprise heater resistors" it would have been obvious to a POSITA to modify Hamafuku's inkjet printhead design to include heater resistors as disclosed in Imanaka. Ex.1002, n.44.

that Imanka discloses heater resistors (e.g., heat generating members 2) having a width of less than or equal to 15 microns, i.e., 14 microns. Ex.1002, ¶345.

Accordingly, Hamafuku as modified by Imanaka discloses the additional limitations of claim 3 of the ’951 Patent. Ex.1002, ¶¶343-346. Claim 3 is therefore obvious.

4. Claim 4

Hamafuku as modified by Imanaka discloses claim 4, i.e., “**heater resistors** have a **resistance** ranging from about **80 to about 200 ohms**.” Ex.1002, ¶347. Specifically, Imanaka discloses that “the resistance of the heat generating member 2 for 1200 dpi is selected as **200 Ω** or higher.” Ex.1008, 7:57-64; 7:56-60. Claim 4 is therefore obvious. Ex.1002, ¶¶347-350.

5. Claim 6

Claim 6 states: “The printhead of claim 1, wherein the ink feed edge comprises an ink feed slot, and wherein the plurality of **ink ejection actuators are disposed on both sides of the ink feed slot**.” Hamafuku as modified by Imanaka and Whitman discloses all the limitations of claim 1 for reasons discussed above. The additional limitations of claim 6 would also be obvious in light of Hamafuku.

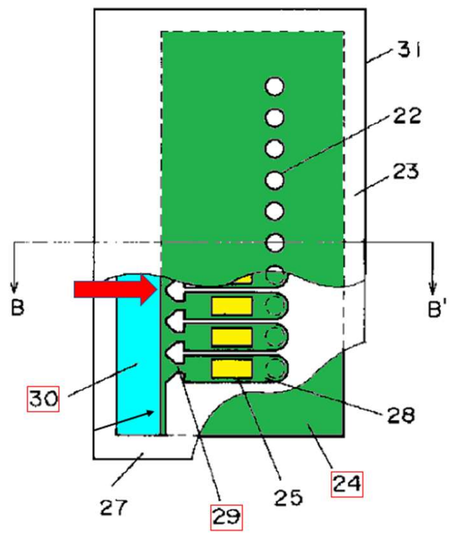
A POSITA would understand that Hamafuku's common ink chamber 30 is an ink feed slot[43] because it is a long, thin opening or hole that allows ink to be provided to pressure chambers 28 through ink flow paths 29 connecting common ink chamber 30 to pressure chambers 28. Ex.1007, [0018] ("**30 represents a common ink chamber that supplies ink 21 to the pressure chamber 28 through the ink flow path 29**."); [0019] ("a hole formed…."); [0043] ("**common ink chamber 30** is formed by the nozzle plate 23 and the **hole formed**…"); Ex.1002, ¶352.

As discussed in Section X.C.1 and incorporated here, Figure 1 (below) illustrates Hamafuku's substrate 24 (green) that includes an edge (identified by red arrow) over which ink flows from common ink chamber 30 [e.g., ink feed slot] (teal) through ink flow path 29. Ex.1007, [0034], [0018]. Figure 1 shows that ink ejection

[43] The '951 Patent states that a "slot" is an "opening" that, for example, allows fluid to be provided to a fluid chamber through a fluid channel connecting the slot to the fluid chamber. *See* Ex.1001, 3:24-28 ("opening or slot 34"). This is consistent with the plain and ordinary meaning of the term "slot" as a "long, thin opening." *See* Ex.1030; *see also* Ex.1006 9:20-25 ("ink Supply opening 508 is an elongated oblong slot"); 17:22-24 ("elongated opening, or slot"); Fig. 5, 11A. Ex.1002, n.45.

actuators [e.g., heater part 25 (yellow)] are disposed on ***one side*** of the common ink chamber 30. Ex.1002, ¶353.

【図1】

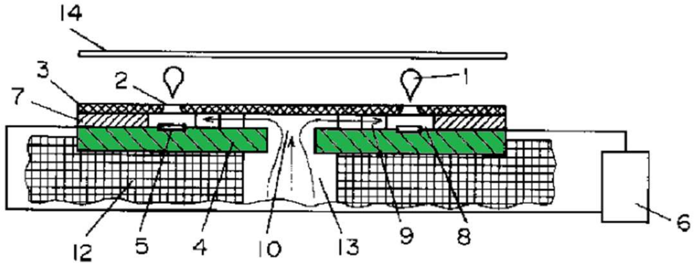


It would have been obvious to a POSITA to modify Hamafuku's inkjet head to have ink ejection actuators disposed on ***both sides*** of the ink feed slot (e.g., common ink chamber 30) for several reasons. Ex.1002, ¶354.

Hamafuku's invention does not need to expressly describe the second column of heaters/chambers, as a POSITA would either know this is present, or would know that it is obvious to increase the number of dots on the page (thereby increasing image resolution) by adding a second column of heaters/chambers/nozzles and there existed an acknowledged and overarching desire in the printer industry to do so. *See supra* Section IX (Background of the Art); Ex.1002, ¶¶51-55, 356.

It would also be obvious for a POSITA to incorporate a second column of heaters/chambers/nozzles in Hamafuku's printhead by adding a second substrate on the *opposite side* of common ink chamber 30 that includes a column of elongated pressure chambers having rectangular heaters that also receive ink from common ink chamber 30. A POSITA would be motivated to make this modification because doing so would take advantage of the high density arrangement obtained using rectangular heaters and elongated chambers with the added benefit of doubling the number of ink drops (i.e., two columns) obtained using a common ink chamber. Ex.1002, ¶356. A POSITA would also have a **reasonable expectation of success** in modifying Hamafuku's printhead this way because it would have been straightforward for a POSITA to add another substrate (green) having a column of heaters on the opposite side of common ink chamber 30 and that such a system would work, similar to the design depicted in Hamafuku's Figure 7 (below). Ex.1002, ¶357.

【図7】



Accordingly, claim 6 would be obvious in light of Hamafuku. Ex.1002, ¶¶351-358.

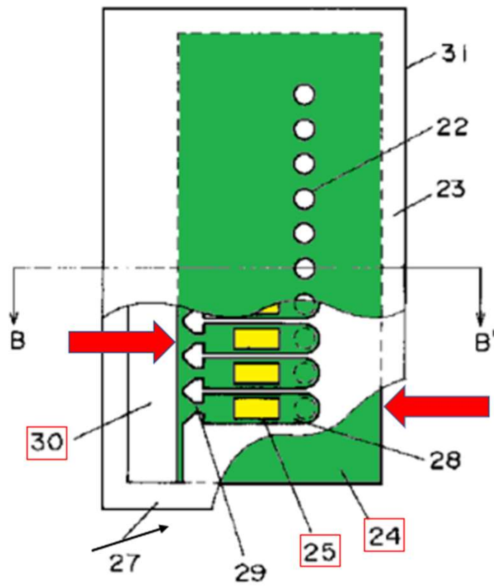
6. Claim 7

Hamafuku as modified by Whitman discloses "The printhead of claim 1, wherein the ink feed edge comprises an ink feed slot, and wherein the semiconductor substrate contains **two or more ink feed slots**."

As explained above, Hamafuku discloses at least one ink feed edge, i.e., edge of substrate over which ink flows, of an ink feed slot, i.e., common ink chamber 30. *See supra*, Sections X.C.1.b; X.C.5.

Although Hamafuku does not expressly disclose "two or more ink feed slots," it would have been an obvious design choice to a POSITA to modify Hamafuku to include an ink feed edge on each of the outer edges of substrate 24 (as illustrated by the red arrows below) at least because printheads having two ink feed edges were well-known. Ex.1002, ¶¶361-362.

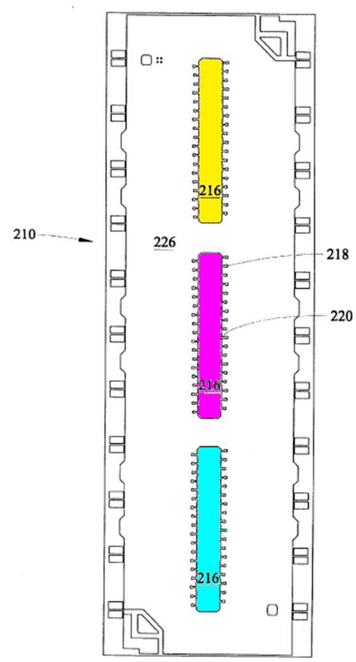
【図1】



Whitman discloses in Figure 10 a "**multi-color printhead chip**." Ex.1005, 3:40-41; *id*., 8:54-56. With reference to Figure 10 (below) and Figures 11-13, Whitman states that "multi-color (color) printheads 210 separately and selectively eject inks of at least two different colors, typically through associated dedicated apertures 22." *Id.*, 7:42-45. Whitman's color printhead 210 in Figure 10 (below) shows three ink vias or channels 216.[44] *See id.*, 5:48-52.

[44] A POSITA would understand based on Whitman's specification that what is labelled "216" are channels because Whitman uses similar annotations for similar features in its other figures (e.g., Figures 5, 7, 8, and 9). Ex.1002, n.46.

FIG. 10



Whitman also discloses that **channel 16 can exist at the edge of the chip, such as in an edge feed configuration**. Ex.1005, 5:52-55 ("channel 16 can be cut into the base 14…or can exist between an **edge** of the chip 11 and the ink reservoir 48."); *id.*, 16:54-65 ("Further examples…may include…using an **edge-feed arrangement**….").

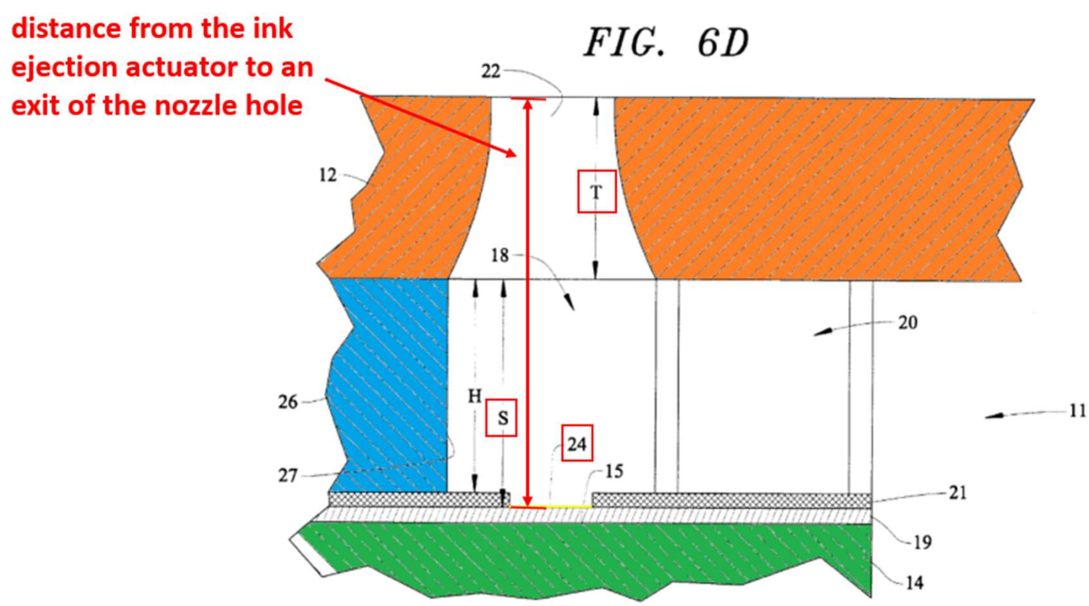
Accordingly, Hamafuku alone, or as modified by Whitman, discloses the limitations of claim 7 of the '951 Patent. Ex.1002, ¶¶359-366. Claim 7 is therefore obvious.

7. Claim 9

Hamafuku as modified by Whitman discloses "The printhead of claim 1, wherein a **distance from** the **ink ejection actuators** to an **exit of the nozzle holes** is **greater than the pitch**."

As explained above in Section X.A.6 and incorporated here, a POSITA would have understood that a pitch of approximately **42.33 microns** is used for a 600 DPI printhead design and a pitch of approximately **21 microns** is used for a 1200 DPI printhead design. Ex.1002, ¶368.

Although Hamafuku does not expressly disclose all the relevant dimensions, Whitman provides dimensions of the nozzle plate thickness (T) and the separation distance (S) between the nozzle plate and the heater (as illustrated in Fig. 6D below, for example). *See* Ex.1005, 6:34-37. Ex.1002, ¶369.



As discussed above in Section X.A.6 and incorporated here, Whitman discloses a distance from the ink ejection actuators to an exit of the nozzle holes can range from **43 microns to 82 microns** (i.e., (35+8) microns to (55+27) microns). Ex.1002, ¶¶371-372.

A POSITA would understand that Whitman's distances (i.e., from 43 microns to 82 microns) are "greater than the pitch" taught by Hamafuku's high density nozzle arrangement. Ex.1002, ¶373. Specifically, **43 microns, i.e., the lowest value in Whitman's range, is greater than 42.33 microns (600 DPI) and 21.17 microns (1200 DPI)**.

Hamafuku's heater part 25 is not directly under the nozzle exit 22. However, because the distance between Hamafuku's heater part and the nozzle exit is **greater** than it would have been if it were directly under the nozzle (as taught by Whitman), a POSITA would understand that the distance from Hamafuku's heater to the nozzle exit is actually **greater than 43 microns** when using Whitman's dimensions. Ex.1002, ¶375. A POSITA would be motivated to try Whitman's dimensions in Hamafuku's design at least because it could lead to an improvement in the average life of the heaters and a more reliable printhead. *See* Ex.1005, 15:59-61; Ex.1002, ¶379; *see also* Section X.C.11, incorporated here.

Accordingly, Hamafuku as modified by Whitman discloses "wherein a distance from the ink ejection actuators to an exit of the nozzle holes [e.g., Whitman's 43 – 82 microns] is greater than the pitch [Hamafuku's 42.33 microns, and about 21 microns]." Ex.1002, ¶¶367-381. Claim 9 is therefore obvious.

8. Claim 10

Hamafuku as modified by Whitman discloses "The printhead of claim 1, wherein a **ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes** ranges from about 0.5 to about 1.5."

As explained above in Sections XI.C.1.h and X.C.7 and incorporated here, a POSITA would have understood that the "pitch" disclosed in Hamafuku is equal to **600 DPI** (or approximately **42.33 microns**) or **1200 DPI** (or approximately **21 microns**). Ex.1002, ¶383.

Also as explained above in Section X.C.7 and incorporated here, a POSITA would have understood that Hamafuku as modified by Whitman discloses a distance from the ink ejection actuators (e.g., heater part 25) to an exit of the nozzle holes (nozzle 22) that is **greater than 43 microns**. Ex.1002, ¶384.

Assuming for example a distance from the ink ejection actuators (e.g., heater part 25) to an exit of the nozzle holes of 44 microns (i.e., greater than 43 microns), for a pitch of **42.33 microns** (i.e., 600 DPI), the "a ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes" is equal to **42.33 microns divided by 44 microns**, i.e., **0.96**. This value is within the range "from about 0.5 to about 1.5."

Alternatively, for a pitch of **21 microns** (i.e., 1200 DPI), a POSITA would have understood that "a ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes" is equal to **21 microns divided by 44 microns**, i.e., **0.48**. Ex.1002, ¶386. As such, as confirmed by Mr. Curley, 0.48 (i.e., "about 0.5") is within the range "from about 0.5 to about 1.5," as claimed. *Id.*

Accordingly, Hamafuku as modified by Whitman discloses "wherein a ratio of the pitch [Hamafuku's 42.33 microns (600DPI) or about 21 microns (1200DPI)] to a distance from the ink ejection actuators to an exit of the nozzle holes [e.g., Whitman's 43 microns – 82 microns] ranges from about 0.5 to about 1.5 [0.96 (600DPI), 0.48 (1200DPI)]." Ex.1002, ¶¶382-388. Claim 10 is therefore obvious.

9. Claims 20 - 22

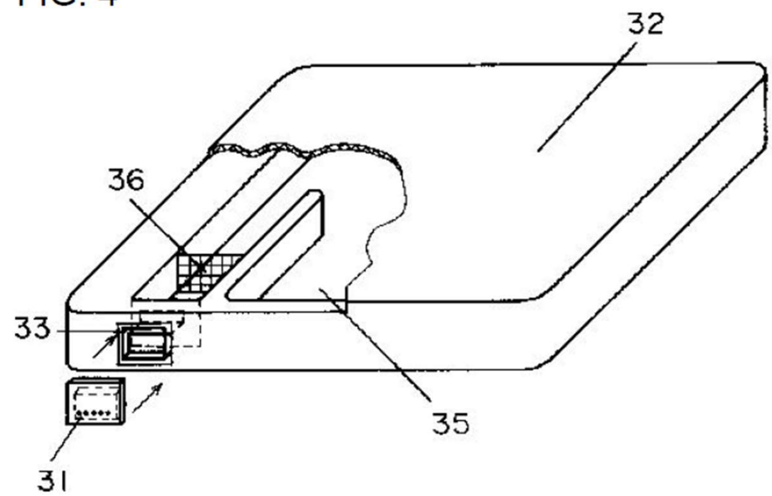
Each of claim 20 through 22's limitations are analogous to other claims discussed above. Ex.1002, ¶¶389-392 (*see* detailed table). As such, each of claim 20 through 22's limitations are disclosed by the Hamafuku-Imanaka-Whitman combination for the reasons provided above, and incorporated here. *Supra* Sections X.C.1, X.C.2, X.C.4-6. Claims 20 through 22 are rendered obvious by the Hamafuku-Imanaka-Whitman combination.

10. Claim 24

As illustrated in Figure 4 below, Hamafuku discloses an "**inkjet head 31** [e.g., printhead] having the **ink ejection part described in FIG. 1, FIG. 2, and FIG. 3 is**

attached to the ink cartridge 32 [e.g., inkjet printer cartridge].” Ex.1007, [0034]; *see also id.*, [0033]. Hamafuku also discloses an inkjet printer housing ink cartridge 32. *Id.*, [0039], [0040], [0041].

FIG. 4



Accordingly, Hamafuku discloses “an inkjet printer cartridge containing the printhead of claim 20.” Ex.1002, ¶¶394-395. Claim 24 is therefore obvious.

11. Motivation to Combine Hamafuku, Imanaka, and Whitman

A POSITA would have been motivated to combine Imanaka and Whitman with Hamafuku for the following reasons. Ex.1002, ¶¶396-409.

First, Hamafuku, Imanaka, and Whitman are analogous to the claimed subject matter in the ’951 Patent because they are all within the same field of endeavor—“inkjet printheads.” Ex.1002, ¶397; Ex.1001, 1:5-7 (“**The invention relates to inkjet printheads**…); Ex.1007, [0001] (“The present invention relates to an **inkjet head of an inkjet printer**…”); Ex.1008, 1:7-12 (“The present invention relates to a **liquid discharge head and a liquid discharge apparatus for discharging desired liquid** ….”), claim 10 (“adapted to discharge ink…”); Ex.1005, 1:5-9 (“**The present invention relates to an inkjet printhead**….” Ex.1005, 1:5-9.

Second, Hamafuku, Imanaka, and Whitman are analogous to the ’951 Patent because each of the ’951 Patent, Hamafuku, Imanaka, and Whitman describe problems with existing inkjet printhead structure design than can be modified in order to improve the overall performance and reliability of the printhead. Ex.1002, ¶¶398-402.

Third, a POSITA would have been motivated to modify Hamafuku based on Imanaka’s and Whitman’s express teachings. At the time of the ’951 Patent, there existed a desire for printheads that were more complex, including “printheads having higher resolution that can operate at higher ejection frequencies.” *See* Ex.1001, 1:42-46, 1:11-18, 1:19-41; *see also* Section IX. A POSITA wanting to achieve those goals in designing a printhead would have been motivated to modify Hamafuku in view of Imanaka’s and Whitman’s express teachings. Ex.1002, ¶403. A POSITA wanting to build the printhead in Hamafuku would not have the dimensions of certain printhead structures and Imanka and Whitman provide these dimensions. *Id.*

Imanaka discloses dimensions for the nozzle pitch, heater aspect ratio and heater resistance. Imanaka discloses that its heater pitch (and corresponding nozzle pitch) and heater aspect ratio are selected “**in order to secure the area thereof**

required for attaining the recording density of 1200 dpi." Ex.1008, 7:53-58; 7:45-47. Thus, a POSITA wanting a higher resolution printhead would have been motivated to modify Hamafuku in view of Imanaka's teachings to incorporate Imanaka's heaters having the size and spacing to produce a high density nozzle arrangement. Ex.1002, ¶404.

Imanaka also discloses that by selecting the heat generating members arranged with a high density as stated above, the "substrate 1 can be formed compact in the chip size." *Id.*, 8:3-11. Thus, a POSITA wanting a more compact printhead (and potentially less costly printhead) would have been further motivated to modify Hamafuku to view in Imanaka's teachings. Ex.1002, ¶405.

Imanaka also explains that "[i]n order to drive the heat generating member 2 with an **interval of several microseconds**, the **resistance of the heat generating member 2 has to be made high**" and "[t]herefore, the **resistance of the heat generating member 2 for 1200 dpi is selected as 200 Ω or higher**." Ex.1008, 7:58-65. Thus, a POSITA wanting a printhead that ejects ink faster would have been motivated to modify Hamafuku in view of Imanaka's teachings. Ex.1002, ¶406.

Whitman also provides dimensions for the barrier height (i.e., thick film layer), nozzle plate thickness, and nozzle plate separation from the transducer, and explains which dimensions would be "especially beneficial." Ex.1005, 8:9-14; 11:41-45; 7:55-58. Whitman further discloses that "**[u]nder nominal power**

density, an improvement in MTTF[45] **can be obtained by lowering the nozzle plate thickness (T) and barrier height (H)**[46]." *Id.*, 15:59-61. Indeed, Whitman teaches that "reducing the nozzle plate thickness (T) and barrier height (H) [to the disclosed dimensions] can produce an improvement in printhead life" (Ex.1005, 11:60-62) and "**increasing the expected lifespan of the transducers would improve the reliability of the printheads in which they are used**" (Ex.1005, 1:39-45). Thus, a POSITA wanting a more reliable printhead would have been motivated to modify Hamafuku in view of Whitman's teachings. Ex.1002, ¶407.

Fourth, modifying Hamafuku's printhead to include Imanaka and Whitman's structures and dimensions would also have been an obvious combination of known prior art elements that yields a predictable result. A POSITA could have combined Imanaka and Whitman's structures and dimensions with Hamafuku's printhead using known methods, and Imanaka and Whitman's structures would merely perform the same functions—forming a high density arrangement of chambers having heaters that allow for reliable ink ejection—as taught by Imanaka and Whitman. Ex.1002, ¶408. This would have resulted in improved printhead and would have been predictable to a POSITA. *Id.* Thus, it would have been obvious

[45] *See* supra n.25.

[46] *See* supra n.26.

to a POSITA wanting a more reliable printhead to modify Hamafuku in view of Imanaka and Whitman. *Id.*

Finally, a POSITA would have had a **reasonable expectation of success** in modifying Hamafuku's printhead to include Imanaka and Whitman's structures and dimensions. The printhead components described in Hamafuku, Imanaka, and Whitman were well-known at the time. Ex.1008 1:24-47; Ex.1007, [0007], [0008]; *supra* at Section IX; Ex.1005, 1:13-25; 1:26-42; Ex.1002, ¶¶43-60, 409. As such, it would also have been straightforward for a POSITA to modify Hamafuku's printhead to include Imanaka and Whitman's structures and dimensions and that such a system would work. *Id.*

D. <u>Ground #4: Hamafuku in View of Imanaka and Whitman, and Further in View of Cleland, Renders Claim 5 Obvious</u>

1. Claim 5

Hamafuku as modified by Imanaka, Whitman, and Cleland discloses "The printhead of claim 1, wherein the **nozzle holes** comprise **oblong nozzle holes** having a **long axis to diameter ratio greater than about 1.15**."

As discussed above in Ground 2, Section X.B, and incorporated here, Cleland discloses "**orifice openings may be created in the form of an ellipse**," where "the **major axis 601 to minor axis ratio falls in the range of 2:1 to 5:1**," as shown in Figs. 6A/6B. Ex.1006, 11:24-31.

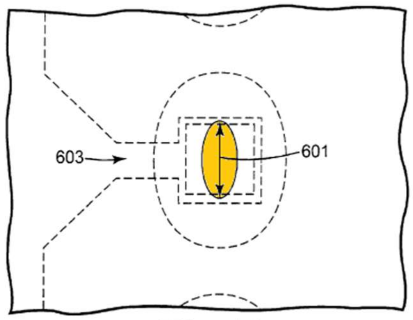


Fig. 6A

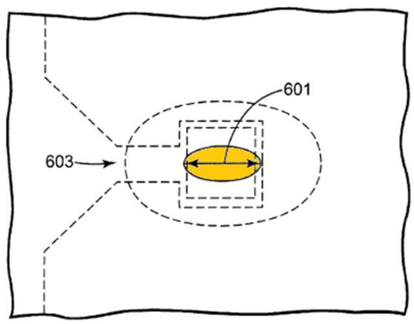


Fig. 6B

Accordingly, Hamafuku as modified by Imanaka and Cleland discloses "wherein the nozzle holes [Cleland's orifice openings] comprise oblong nozzle holes having a long axis [Cleland's major axis 601] to diameter ratio greater than about 1.15 [i.e., a ratio of 2:1 to 5:1]." Ex.1002, ¶¶412-413. Claim 5 is therefore obvious.

2. Motivation to Combine Hamafuku, Imanaka, Whitman, and Cleland

A POSITA would have been motivated to modify Hamafuku in view of Imanaka and Whitman for the reasons explained above in Section X.C.11 and incorporated here. For the following reasons, a POSITA would have been motivated to modify the Hamafuku-Imanaka-Whitman combination in view of Cleland. Ex.1002, ¶¶414-424.

First, Hamafuku, Imanaka, and Whitman are analogous to the claimed subject matter in the '951 Patent because they are all within the same field of endeavor—"inkjet printheads." Ex.1002, ¶415. *See supra* Section X.C.11. Cleland is also directed to inkjet printheads. Ex.1006, 4:34-36 ("A high quality **inkjet printhead** includes…"), 1:10-13; *see also id.*, 7:24-37

Second, Hamafuku, Imanaka, Whitman, and Cleland are analogous to the '951 Patent because they are reasonably pertinent to the technical problem allegedly addressed by the claimed invention—i.e., addressing performance and reliability issues of inkjet printheads. *Supra* Sections X.A.7, X.B.6, X.C.11. Ex.1002, ¶¶416-421.

Third, a POSITA would have been motivated to modify the shape of Hamafuku's orifices because, as Cleland discloses, doing so would have "**provide[d] increased control over the direction of ink drop ejection, reliable placement of ink dots on the medium, and a reduction of satellite droplets and spray**." Ex.1006, 10:55-62. Ex.1002, ¶422. Such an improvement would have been achieved by modifying the orifice shape to an "ellipse" shape, as taught by Cleland. *See* Ex.1006, 11:24-31. Ex.1002, ¶422.

Fourth, modifying Hamafuku's printhead to include Cleland's elliptical orifices would also have been an obvious combination of known prior art elements that yields a predictable result. Ex.1002, ¶423.

Finally, a POSITA would have had a reasonable expectation of success in modifying the Hamafuku-Imanaka-Whitman combination to include Cleland's elliptical orifices. Ex.1002, ¶¶43-60, 424.

XI. CONCLUSION

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

Dated: October 6, 2022

Respectfully Submitted,

/ Dion M. Bregman /

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

U.S. PATENT NO. 7,152,951 – Claim Listing

No.	Claim Elements
Claim 1[p]	A printhead for an ink jet printer
1[a]	the printhead comprising: a semiconductor substrate containing at least one ink feed edge and a plurality of ink ejection actuators spaced a distance from the ink feed edge
1[b]	each of the ink ejection actuators having an aspect ratio ranging from about 1.5:1 to about 6:1
1[c]	a thick film layer attached to the semiconductor substrate
1[d]	the thick film layer having formed therein a plurality of ink feed chambers and ink feed channels corresponding to the plurality of ink ejection actuators
1[e]	a nozzle plate attached to the thick film layer
1[f]	the nozzle plate containing a plurality of nozzle holes in the nozzle plate corresponding to the plurality of ink feed chambers
1[g]	wherein adjacent ones of the nozzle holes are spaced apart with a pitch ranging from about 600 to about 2400 dpi
1[h]	wherein the distance from the ink feed edge is substantially the same for each of the ink ejection actuators
Claim 2	The printhead of claim 1, wherein the ink ejection actuators comprise heater resistors.
Claim 3	The printhead of claim 2, wherein the heater resistors have a width of less than or equal to 15 microns.
Claim 4	The printhead of claim 2, wherein the heater resistors have a resistance ranging from about 80 to about 200 ohms.
Claim 5	The printhead of claim 1, wherein the nozzle holes comprise oblong nozzle holes having a long axis to diameter ratio greater than about 1.15.
Claim 6	The printhead of claim 1, wherein the ink feed edge comprises an ink feed slot, and wherein the plurality of ink ejection actuators are disposed on both sides of the ink feed slot.
Claim 7	The printhead of claim 1, wherein the ink feed edge comprises an ink feed slot, and wherein the semiconductor substrate contains two or more ink feed slots.
Claim 9	The printhead of claim 1, wherein a distance from the ink ejection actuators to an exit of the nozzle holes is greater than the pitch.

No.	Claim Elements
Claim 10	The printhead of claim 1, wherein a ratio of the pitch to a distance from the ink ejection actuators to an exit of the nozzle holes ranges from about 0.5 to about 1.5.
Claim 20[p]	A printhead for a thermal ink jet printer
20[a]	the printhead comprising: a semiconductor substrate containing at least one ink feed edge and a plurality of heater resistors spaced a distance from the ink feed edge
20[b]	each of the heater resistors having a resistance ranging from about 80 to about 200 ohms
20[c]	and each of the heater resistors having an aspect ratio ranging from about 1.5:1 to about 6:1
20[d]	a thick film layer attached to the semiconductor substrate
20[e]	the thick film layer having formed therein a plurality of ink feed chambers and ink feed channels corresponding to the plurality of ink ejection actuators
20[f]	a nozzle plate attached to the thick film layer
20[g]	the nozzle plate containing a plurality of nozzle holes in the nozzle plate corresponding to the plurality of ink feed chambers
20[h]	wherein adjacent nozzle holes are spaced apart with a pitch ranging from about 600 to about 2400 dpi
20[i]	wherein the distance from the ink feed edge is substantially the same for each of the heater resistors
Claim 21	The printhead of claim 20, wherein the ink feed edge comprises an ink feed slot, and wherein the plurality of heater resistors are disposed on both sides of the ink feed slot.
Claim 22	The printhead of claim 20, wherein the ink feed edge comprises an ink feed slot, and wherein the semiconductor substrate contains two or more ink feed slots.
Claim 24	An inkjet printer cartridge containing the printhead of claim 20.

CERTIFICATION OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Petition includes 13,944 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 the Petitioner hereby certifies that this Petition complies with the type-volume limits established for a petition requesting IPR.

Dated: October 6, 2022

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 October 6, 2022, copies of this Petition and all supporting exhibits were sent via Priority Mail Express to the correspondence address of record for the ’951 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 October 6, 2022 on Patent Owner’s counsel of record in the district court litigation against Slingshot Printing LLC involving this patent:

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Dated: October 6, 2022

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