

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Canon U.S.A., Inc. and Canon Inc.,

Petitioners

v.

Slingshot Printing LLC,

Patent Owner

Case No. IPR2023-00309

Patent No. 7,290,864

DECLARATION OF STEPHEN F. POND, Ph.D.

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I, Stephen F. Pond, Ph.D. declare as follows:

I. INTRODUCTION

1. I formerly worked for the Xerox Corporation for over 25 years. I now work as a consultant in the area of electronic printing and have done so for the past 24 years. Accordingly, I have extensive experience in electronic printing, including ink jet technology. I have been retained by Canon U.S.A., Inc. and Canon Inc. (collectively, “Canon” or “Petitioners”) in connection with the above-captioned Petition for *Inter Partes* Review.

2. I understand that the Petition involves U.S. Patent No. 7,290,864 (“the ’864 Patent”) (Ex.1001). I have been asked by Canon to offer opinions regarding the ’864 Patent, including the patentability of the claims in view of certain prior art. This declaration sets forth my opinions that I have reached to date regarding these matters.

3. In preparing this declaration, I have reviewed the ’864 Patent and considered each of the documents cited herein. In reaching my opinions, I have relied upon my experience in the field and also considered the viewpoint of a person having ordinary skill in the art (“PHOSITA”) at the time of the earliest claimed priority date of the ’864 Patent, *i.e.*, the year 2005. As explained below, I am familiar with the level of a PHOSITA regarding the technology at issue as of that time.

4. I am being compensated at my normal rate of \$500 per hour in connection with this review. My compensation is not contingent on the outcome of this review or on the substance of my opinions. I further have no financial interest in Canon. I have been informed that the '864 Patent may currently be assigned to Slingshot Printing LLC ("Slingshot"). I have no financial interest in Slingshot.

II. BACKGROUND AND QUALIFICATIONS

5. A true and correct copy of my *curriculum vitae* is attached as Ex.1003. As set forth in my CV, I have over 49 years of research, product engineering, and consulting experience in the field of electronic printing, including thermal inkjet ink printing technologies. I received a Bachelor's Degree (Magna Cum Laude) in Physics in 1967 from Dartmouth College, a Master's Degree in Physics from University of Illinois in 1968, and a Ph.D. in Physics from University of Illinois in 1971. I am a member of the Phi Beta Kappa honor society.

6. I served for 26 years at Xerox Corporation in numerous areas related to electronic printing. From 1972-1979, I served as a scientist at Xerox responsible for experimental studies in toner adhesion, was project leader and principal technical contributor for feasibility studies for a magnetographic electronic duplicator and became a charter technical contributor to Xerox's continuous inkjet research program. In that last role, I was responsible for early continuous inkjet demonstration, technical strategy, and competitive technology information analysis.

As part of that role, I examined Lexmark printers as they entered the market until my retirement in 1998.

7. During the 1980s, I was a manager at Xerox in the Advanced Marking Development Section, in the Electronic Marking Device Area, and in the Electronic Marking Laboratory, where I was responsible for thermal inkjet research and technology feasibility demonstration.

8. From 1989-1994, I was Chief Engineer in Xerox's Components Development and Manufacturing Unit, where I was responsible for thermal inkjet advanced technology and product development. In that role, I had line management responsibility for approximately 60 engineers and scientists, and I managed inkjet development collaborations with foreign OEM suppliers and a Xerox Japanese subsidiary. My efforts on behalf of the company were recognized in 1991, when I received the Xerox President's Award—the highest individual honor attainable within the organization.

9. From 1994-1998, I was a Principal in Xerox's Ink Jet Business Group, where I was responsible for workgroup and special product concept development. In that role, I managed the initial productization project for Xerox 600 dpi thermal inkjet printhead and ink technology, and I managed the development of a state of the art thermal inkjet printer mechanism.

10. For the past 24 years, I have been an electronic printing and microelectromechanical systems (MEMS) consultant, working with outside investors and corporate managers to evaluate intellectual property for MEMS devices, and inkjet printing.

11. I am a registered patent agent, and I am named an inventor on 51 issued United States Patents. I am also the author of numerous publications in the field of inkjet printing, including the textbook “Inkjet Technology and Product Development Strategies,” Torrey Pines Research (2000).

III. MATERIALS REVIEWED

12. In formulating my opinion, I have taken into consideration not only my general knowledge and experience, but also the following:

<i>Exhibit #</i>	<i>Description</i>
Ex. 1001	U.S. Patent No. 7,290,864 to King <i>et al.</i>
Ex. 1003	<i>Curriculum Vitae</i> of Stephen F. Pond
Ex. 1004	File History of U.S. Patent 7,290,864
Ex. 1005	U.S. Patent No. 7,722,144 to Benjamin <i>et al.</i> (“Benjamin ’144”)
Ex. 1006	U.S. Patent No. 7,278,703 to Benjamin <i>et al.</i> (“Benjamin ’703”)
Ex. 1007	U.S. Patent No. 6,582,062 to Childers <i>et al.</i> (“Childers”)
Ex. 1008	Certified English Translation of Japanese Patent Application No. 11-245409 to Uenishi <i>et al.</i> (“Uenishi”)

Ex. 1009	U.S. Patent Publication No. 2001/0045967 to Hayasaki (“Hayasaki”)
Ex.1013	THE PENGUIN DICTIONARY OF ELECTRONICS (Valerie Illingworth ed.) (3d ed. 1998)
Ex.1014	Claim Construction Order for <i>Slingshot Printing LLC v. HP, Inc.</i> , Case No. 1:20-cv-00186-ADA, Dkt. 82 (W.D.T.X. Jan. 14, 2021)

IV. RELEVANT PATENT LAW AND LEGAL STANDARDS

A. Priority Date

13. I have been asked to use September 30, 2005, as the priority date for my analysis and this declaration. I understand that because the application leading to the '864 Patent was filed before March 16, 2013, pre-AIA 35 U.S.C. §§ 102 and 103 apply.

B. Obviousness

14. I understand that a determination that a claim is “obvious” is based on underlying factual issues including the content of the prior art and the level of ordinary skill in the art. I understand that for a single reference or a combination of references to render the claimed invention obvious, a PHOSITA must have been able to arrive at the claims by modifying or combining the references.

15. I have further been informed and understand that a claim is unpatentable as **obvious** if the difference between the subject matter sought to be

patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a PHOSITA.

16. I also have been informed and understand that the combination of familiar elements according to known methods is obvious when it does no more than yield predictable results. However, I further understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art. I understand that to prove a claim would have been obvious, one must demonstrate that a PHOSITA would have been motivated to combine or modify the prior art to achieve the claimed invention, while having a reasonable expectation of success in doing so.

17. I further understand that a claim may be obvious if common sense directs one to combine multiple prior art references or add missing features to reproduce the alleged invention recited in the claims. I also understand that if a PHOSITA could implement a predictable variation, then the claim is likely unpatentable. For the same reason, if a technique has been used to improve one device and a PHOSITA would recognize that it would improve similar devices in the same way, then using the technique is obvious. I further understand that a claim can be obvious if it combines old elements with no change to their respective functions or alters prior art by merely substituting one element for another known in the field to yield a predictable result.

C. Standard of Proof

18. I understand that the standard to prove unpatentability is by a preponderance of the evidence, which means more likely than not.

V. SUMMARY OF OPINIONS

19. Having reviewed the '864 Patent and the prior art cited above, I have formed the following opinions:

- The combination of Benjamin '144 and Benjamin '703 discloses all of the limitations of claims 1-3, 5-6, 8-10, and 13-15;
- The combination of Benjamin '144, Benjamin '703, and Childers discloses all of the limitations of claims 4, 11-12, and 16-20;
- Uenishi discloses all of the limitations of claims 1, 3, 5-6, 8-10, 13, and 15;
- The combination of Uenishi and Hayasaki discloses all of the limitations of claims 4, 11, and 12.

The reasons for my opinions are discussed in further detail below.

VI. CLAIM CONSTRUCTION

20. I have been advised that “ink via” found in independent claims 1, 8, and 16 has not been previously construed in the context of the '864 patent. I understand, however, that “ink via” as used in the claims of another Slingshot patent (U.S. Patent No. 7,559,629) was construed by Judge Albright in the Western District of Texas during a previously pending litigation asserted by Slingshot against HP Inc. to mean

“[a] path to fluidly connect [a] supply of ink to one or more heaters.” Ex.1014, 4. The ’864 Patent and U.S. Patent No. 7,559,629 both have the same sole inventor, David. G. King, both were filed in 2005, and both are in the same class—B41J2/14072. I agree with this construction and have applied it to my analysis of the prior art below.

VII. THE PRIOR ART

A. Summary of the Prior Art

21. I have been advised that U.S. Patent No. 7,722,144 to Benjamin *et al.* (“Benjamin ’144”; Ex.1005) is pre-AIA 35 U.S.C. § 102(e) prior art to the ’864 Patent. Benjamin ’144 was filed on April 4, 2004, which is nearly 18 months prior to the filing date of the ’864 Patent, *i.e.*, September 30, 2005. *Compare* Ex.1005 with Ex.1001.

22. I have been advised that U.S. Patent No. 7,278,703 to Benjamin *et al.* (“Benjamin ’703”; Ex.1006) is pre-AIA 35 U.S.C. § 102(e) prior art to the ’864 Patent. Benjamin ’703 was filed on April 4, 2004, which is nearly 18 months prior to the filing date of the ’864 Patent, *i.e.*, September 30, 2005. *Compare* Ex.1006 with Ex.1001.

23. I have been advised that U.S. Patent No. 6,582,062 to Childers *et al.* (“Childers”; Ex.1007) is pre-AIA 35 U.S.C. § 102(b) prior art to the ’864 Patent.

Childers published on June 24, 2003, which is more than one year before the filing date of the '864 Patent, *i.e.*, September 30, 2005. *Compare* Ex.1007 with Ex.1001.

24. I have been advised that Japanese Patent Publication No. JP H11-245409A to Uenishi *et al.* (“Uenishi”; Ex.1008) is pre-AIA 35 U.S.C. § 102(b) prior art to the '864 Patent. Uenishi published on September 14, 1999, which is more than one year before the filing date of the '864 Patent, *i.e.*, September 30, 2005. *Compare* Ex.1008 with Ex.1001.

25. I have been advised that U U.S. Patent Application Publication No. 2001/0045967 to Hayasaki. (“Hayasaki”; Ex.1009) is pre-AIA 35 U.S.C. § 102(b) prior art to the '864 Patent. Hayasaki published on November 29, 2001, which is more than one year before the filing date of the '864 Patent, *i.e.*, September 30, 2005. *Compare* Ex.1009 with Ex.1001.

B. Brief Description of the Prior Art

1. U.S. Patent No. 7,722,144 to Benjamin *et al.* (“Benjamin '144”; Ex.1005)

26. Benjamin '144 is a Hewlett-Packard Development Company, L.P. patent publication directed to a thermal ink jet printhead that discloses all of the elements of the claimed invention of the '864 Patent. *See, e.g.*, Ex.1005. Benjamin '144 was neither cited nor considered by the Patent Office during prosecution of the '864 Patent.

27. Figure 21 of Benjamin '144 provides “a diagram illustrating an example layout of one embodiment of a printhead die 1700.” Ex.1005, 63:20-21.

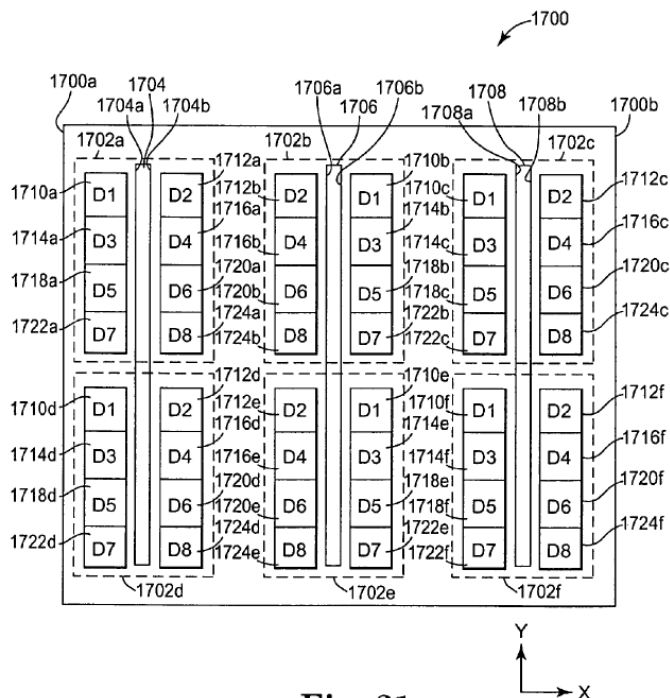


Fig. 21

Ex.1005, Fig. 21.

28. As seen in Figure 21, the “printhead die 1700 includes six fire groups 1702a-1702f disposed along three ink fluid feed sources, here depicted as feed slots 1704, 1706 and 1708.” Ex.1005, 63:21-24. Benjamin '144 further explains that “[t]he fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8 and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the fire groups 1702a-1702f.” Ex.1005, 63:39-42.

29. Figure 22 of Benjamin '144 provides “another aspect of the example layout of one embodiment of printhead die 1700.” Ex.1005, 67:36-38.

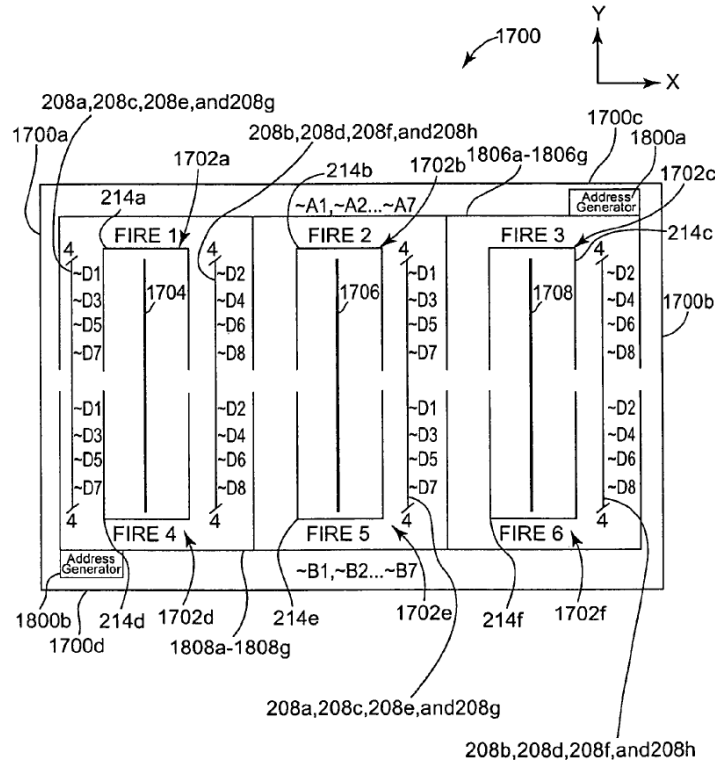
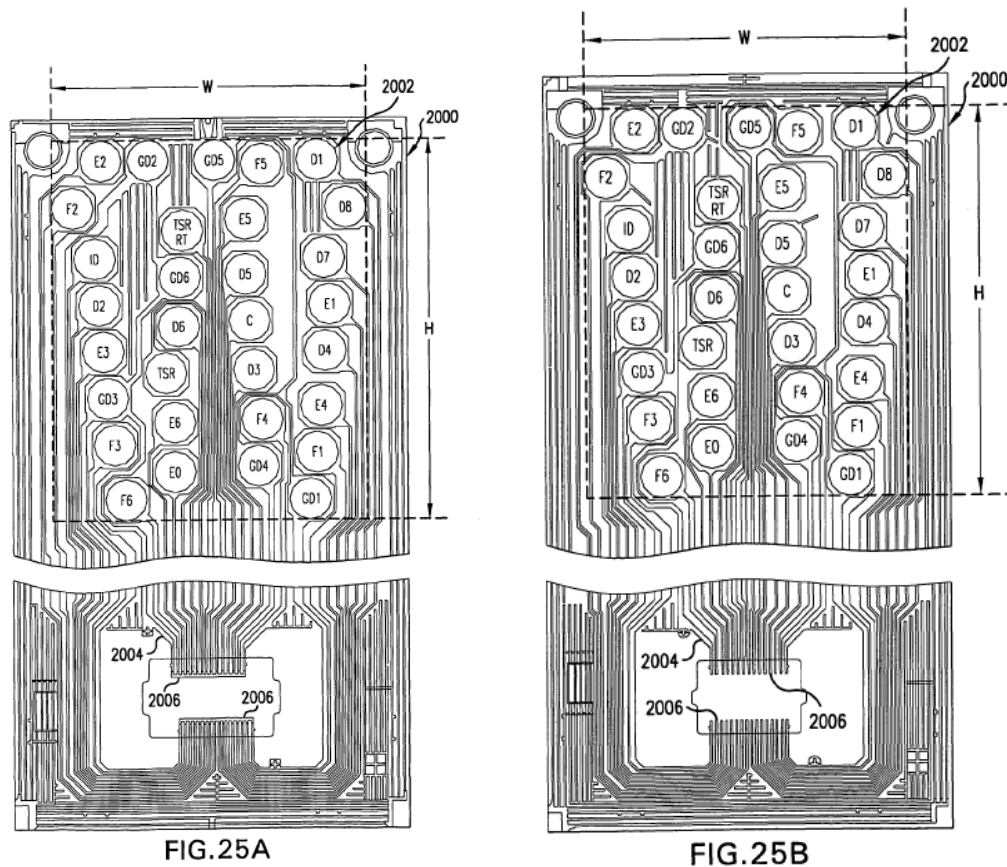


Fig. 22

Ex.1005, Fig. 22.

30. Benjamin '144 explains that as seen in Figure 22, the “conductive fire lines 214a-214f are located along ink feed slots 1704, 1706 and 1708 to supply energy signals FIRE1, FIRE2 . . . FIRE6 to the fire groups 1702a-1702f, respectively. Ex.1005, 69:42-45. Benjamin '144 further notes that the “fire lines 214a-214 supply energy to firing resistors 52 in conducting pre-charged firing cells 120 to heat and eject ink from drop generators 60,” and “the corresponding fire line 214a-214f is configured to uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f.” Ex.1005, 69:45-51.

31. Benjamin '144 further explains that “the address signals may be provided from an external source” as opposed to being placed on the printhead die itself. Ex.1005, 77:32-35. Figures 25A-25B depict “contact areas 2000 of a flex circuit 2002 that may be utilized to couple external circuitry to a printhead die 40.” Ex.1005, 77:41-44.



Ex.1005, Figs. 25A-25B.

32. Benjamin '144 explains that Figure 25 shows “[f]ire line contact areas F1-F6 configured to receive energy pulses and to provide the energy signals along fire lines Fire1-Fire6 to the appropriate fire groups, e.g. fire groups 202a-202f and

1702a-1702f.” Ex.1005, 77:61-63. Benjamin ’144 further teaches “[t]he contact areas 2000 [i.e., F1-F6] are electrically coupled via conductive paths 2004 to contacts 2006 which provide coupling to the printhead die.” Ex.1005, 77:41-46.

2. U.S. Patent No. 7,278,703 to Benjamin *et al.* (“Benjamin ’703”; Ex.1006)

33. Benjamin ’703 is a Hewlett-Packard Development Company, L.P. patent publication directed to a thermal ink jet printhead that discloses many of the elements of the claimed invention of the ’864 Patent. *See, e.g.*, Ex.1006. Benjamin ’703 was neither cited nor considered by the Patent Office during prosecution of the ’864 Patent.

34. Benjamin ’703 includes overlapping inventors, was filed on the same day as Benjamin ’144, and includes identical portions of Benjamin ’144’s specifications. *Compare* Ex.1005 *with* Ex.1006.

35. As shown in Benjamin ’703 figure 10, below, Benjamin ’703 teaches “printhead die 40 includes an identification signal input pad 702, a data line input pad 704 and a **fire line input pad 706** [yellow].” Ex.1006, 19:34-36.

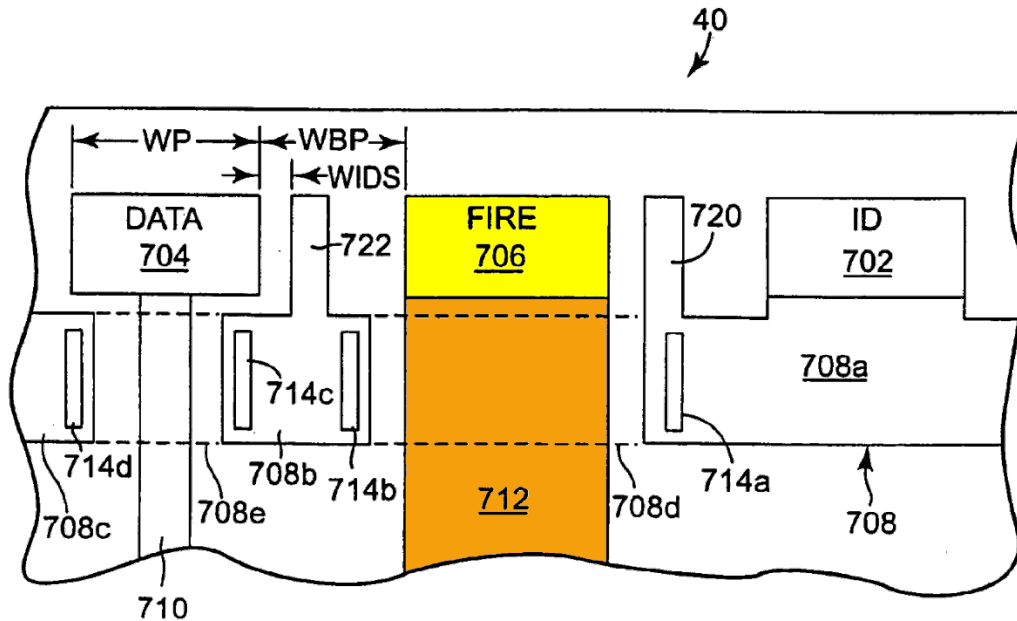


Fig. 10

Ex.1006, Figure 10

36. Benjamin '703 further teaches "[t]he identification signal input pad 702, data line input pad 704 and **fire line input pad 706 are formed as part of the second metal layer of printhead die 40.**" Ex.1006, 19:36-39. Benjamin further teaches "[t]he **fire line input pad 706 [yellow] is electrically coupled to fire line 712 [orange] that is electrically coupled to firing cells 120 in printhead die 40.**" Ex.1006, 19:45-47. Benjamin '703 is explicit that "[f]ire line 712 receives fire signal FIRE and provides fire signal FIRE to firing cells 120 in printhead die 40." Ex.1006, 20:4-5.

3. U.S. Patent No. 6,582,062 to Childers *et al.* (“Childers”; Ex.1007)

37. Childers is a Hewlett-Packard Development Company, L.P. patent application publication directed to a thermal ink jet printhead that discloses certain elements of the claimed invention of the '864 Patent. *See, e.g.*, Ex.1007. Childers was neither cited nor considered by the Patent Office during prosecution of the '864 Patent.

38. Childers teaches “[t]he present invention relates in general to **thermal ink jet (TIJ) printheads...**” Ex.1007, 1:6-7. Childers explains that “[t]he printhead of the present invention is suitable for **high-speed printing systems** such as large format printing systems and drum printers.” Ex.1007, 3:62-65.

39. Childers teaches “[t]he present invention relates...more specifically to **a large array printhead** having a large array of TIJ thin-film ink drop generators formed on a single monolithic substrate.” Ex.1007, 1:6-9. In particular, Childers teaches “the present invention is embodied in **a large array printhead having a large array of ink drop generators** formed on a single monolithic substrate.” Ex.1007, 2:13-15. Childers explains that “[t]he printhead of the present invention is suitable for **high-speed printing systems** such as large format printing systems and drum printers.” Ex.1007, 3:62-65.

40. Childers further teaches “[a] ink feed channel 400...provides ink to a plurality of firing chambers (not shown) and resistors 410.” Ex.1007, 6:14-17.

41. As shown in Figure 3A, below, Childers teaches “[i]n a preferred embodiment, the orifice array 305 is...created by **two rows of nozzles** (each row having a resolution of 300 dpi).” Ex.1007, 5:30-33. Childers further teaches that “[p]referably, there are approximately **1500 nozzles** formed on the printhead 300.” Ex.1007, 5:34-35. In other words, Childers teaches an ink jet print head with 750 nozzles or drop generators in each array, and thus 750 heaters in each array. Ex.1007, 1:44-46 (“the drop generators eject ink drops through a nozzle or an orifice by rapidly heating a small volume of ink...vaporization of the ink drops typically is accomplished using an **electric heater**, such as a small thin-film (or firing) resistor.”)

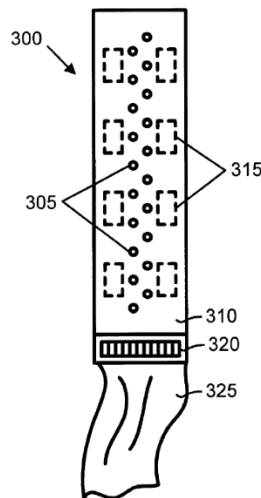
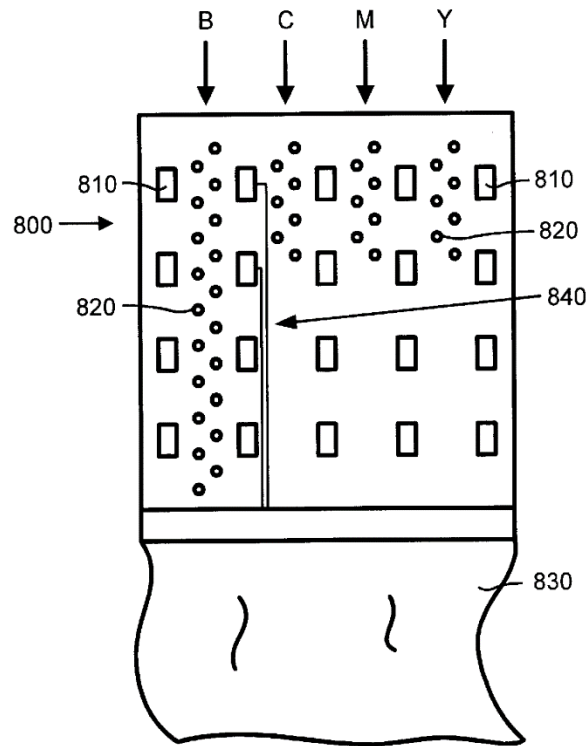


FIG. 3A

Ex.1007, Figure 3A

42. Childers teaches “[a] ink feed channel 400...provides ink to a plurality of firing chambers (not shown) and resistors 410.” Ex.1007, 6:14-17. Childers also

teaches “FIG. 8 is another embodiment of the present invention showing a **multi-chamber** large array **printhead** of the present invention.” Ex.1007, 3:34-36.



Ex.1007, Figure 8

43. Childers teaches that “in FIG. 8 there are **four different colors of ink** on the large array printhead 800 including **black (B), cyan (C), magenta (M) and yellow (Y).**” Ex.1007, 7:39-41. Childers also teaches “two rows of nozzles” for each orifice array, as shown in Figure 8, above.

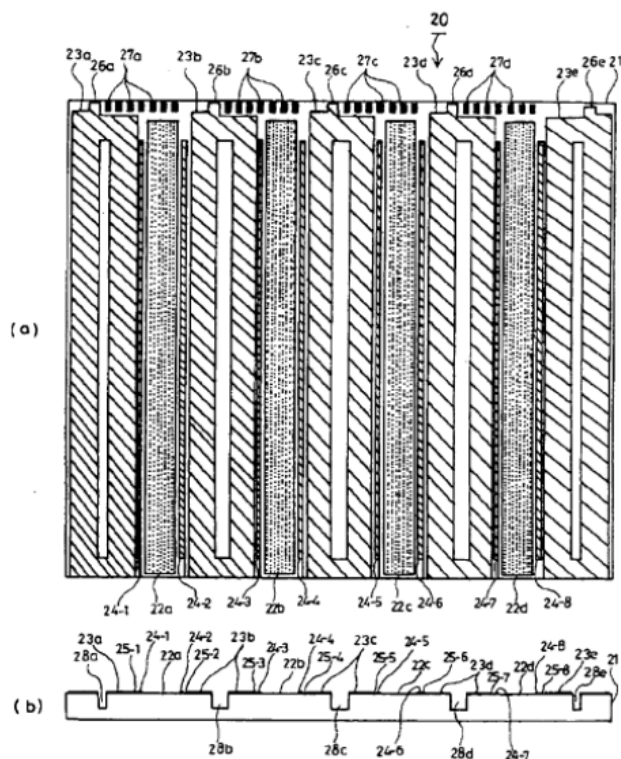
4. Japanese Patent Publication No. JP H11-245409A to Uenishi *et al.* (“Uenishi”; Ex.1008)

44. Uenishi is a Casio Computer Company, Ltd. Japanese patent publication directed to a thermal ink jet printhead that discloses all of the elements

of the claimed invention of the '864 Patent. *See, e.g.,* Ex.1008. Uenishi was neither cited nor considered by the Patent Office during prosecution of the '864 Patent.

45. Uenishi describes a thermal ink jet head 20 that includes “a thermal inkjet head...that is constituted having **a single ink supply channel installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024].

46. Figure 1 of Uenishi shows “a plan view that shows the constitution of the thermal inkjet head in one embodiment” and is reproduced below illustrating a heater chip for use in a printing device.

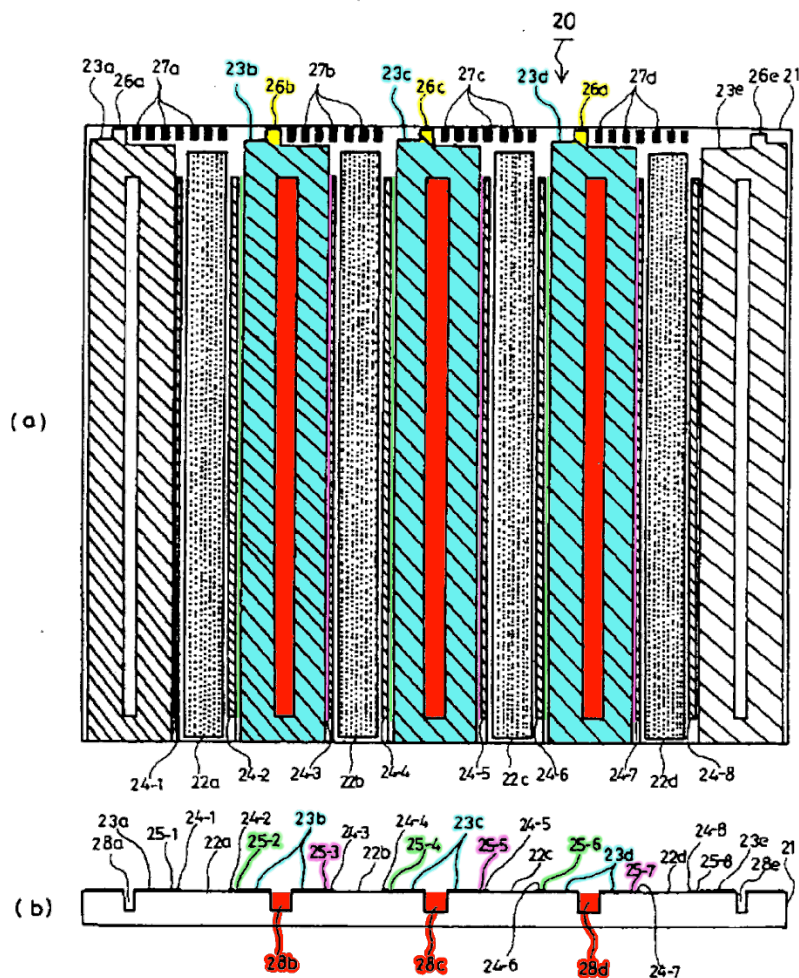


Ex.1008, Fig. 1.

47. Uenishi further teaches “a thermal inkjet head equipped with a **plurality of heating heads that disposes a plurality of heating elements in an array form...**” Ex.1008, [0024]. Uenishi further teaches there is “a single ink supply channel [ink via] **installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024]. As Uenishi further explains, “electrodes comprised of Ni or the like and **miniature resistors of Ta-Si-SiO or the like are formed using thin-film technology.**” Ex.1008, [0006].

48. Uenishi also teaches “A common electrode 23a has a first orifice array resistor 25-1 connected thereto via an individual wiring electrode 24-1 between it and the common electrode 23a and a second orifice column resistor 25-2 connected thereto via an individual wiring electrode 24-2 between it and a common electrode 23b.” Ex.1008, Abstract. Uenishi then teaches “[t]o these five common electrodes 23a–23e, electricity-feed terminals 26a–26e are formed linked respectively to them...” Ex.1008, [0033].

49. As seen in Figure 1 of Uenishi, the electricity-feed terminals 26 (yellow) supply power to heating resistors 25 (green and magenta) via the common electrodes 23 (teal) and wiring electrodes 24.



Ex.1008, Fig. 1 (annotated).

5. U.S. Patent Application Publication No. 2001/0045967 to Hayasaki (“Hayasaki”; Ex.1009)

50. Hayasaki is a Canon Inc. patent application publication directed to a thermal ink jet printhead that discloses certain elements of the claimed invention of the '864 Patent. *See, e.g.*, Ex.1009. Hayasaki was neither cited nor considered by the Patent Office during prosecution of the '864 Patent.

51. Hayasaki teaches “[t]he present invention relates to a printhead, printhead driving method, and data output apparatus and, more particularly, to a

printhead which **selects a block consisting of a plurality of printing elements that can be simultaneously driven...** Ex.1009, [0001]. Hayasaki explains its invention “can **speed up** transfer of image data and driving of printing elements **without increasing the number of signal lines and connection terminals** and a printing apparatus using the printhead.” Ex.1009, [0026]. This is consistent with Uenishi’s goal of reducing the number of components. Ex.1009, [0023], [0040]-[0041].

52. Hayasaki teaches “The printhead of this embodiment has 352 printing elements×2 rows, i.e., a total of 704 printing elements, and can drive the printing elements in the respective rows under different conditions.” Ex.1009, [0081]. Hayasaki further teaches “the printing elements in one row are grouped into eight blocks...[and] [o]dd- and even-numbered printing elements are respectively driven at different timings in accordance with image data corresponding to the 44 printing elements belonging to a block corresponding to each code.” Ex.1009, [0082]. Hayasaki teaches that in such an arrangement, “[e]ach output can simultaneously activate eight printing elements.” Ex.1009, [0089].

53. In one embodiment, Hayasaki teaches a “printhead...[that] has **352 printing elements×2 rows**, i.e., a total of 704 printing elements...” Ex.1009, [0081]. Hayasaki teaches that its “printing elements” are “**heaters**.” Ex.1009, [0012] (“reference numeral 1 denotes an electrothermal transducer such as **a heater provided for each printing element**.”).

54. Hayasaki explains that by utilizing additional heaters or printing elements using its proposed method, **printing speed is increased without changing the size and cost of the printhead**. Ex.1009, [0032].

VIII. PERSON HAVING ORDINARY SKILL IN THE ART

55. I was also asked to provide an opinion regarding the skill level of a PHOSITA of the '864 Patent during the period leading up to September 30, 2005. I considered several factors, including the types of problems encountered in the art, the solutions to those problems, the pace of innovation in the field, the sophistication of the technology, and the education level of active workers in the field.

56. In my opinion, a PHOSITA at the time of the alleged invention of the '864 Patent would have been a person holding a Bachelor's or Master's level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and two years of training or experience in the design of inkjet printheads or semiconductor circuit layout.

57. At all relevant times, I have had a level of skill as great as a PHOSITA. I am able to provide insight into the understanding of one of ordinary skill in this art at all relevant times by virtue of my education, training, and experience. All of my opinions expressed herein are as viewed through the eyes of a PHOSITA before the alleged priority date

IX. GROUND 1: BENJAMIN COMBINATION RENDERS OBVIOUS CLAIMS 1-3, 5-6, 8-10, AND 13-15 OF THE '864 PATENT

58. In my opinion, Benjamin '144 in view of Benjamin '703 discloses all of the limitations of claims 1-3, 5-6, 8-10, and 13-15 of the '864 Patent.

A. Benjamin Combination discloses Claim 1

59. As I explain below, the Benjamin Combination discloses each and every limitation of independent claim 1.

1. Benjamin Combination discloses 1[P] “A heater chip for use in a printing device”

60. I have been informed by counsel that a preamble is generally not limiting unless it is necessary to give life, meaning, and vitality to the claim. I understand that the preamble here is not limiting because it merely states the intended use of the purported invention and is not a limitation of the independent claim.

61. To the extent the preamble is determined to be limiting, in my opinion Benjamin Combination discloses **“a heater chip for use in a printing device.”**

62. Benjamin '144 explains that Figure 1 illustrates “an inkjet printing system 20” that “includes a fluid ejection device, such as **inkjet printhead assembly 22**, and a fluid supply assembly, such as ink supply assembly 24.” Ex.1005, 3:23-27. The “inkjet printhead assembly 22 includes one **printhead 40**.” Ex.1005, 4:46-47. A PHOSITA would appreciate that Benjamin '144's “inkjet printing system 20” is an inkjet printer.

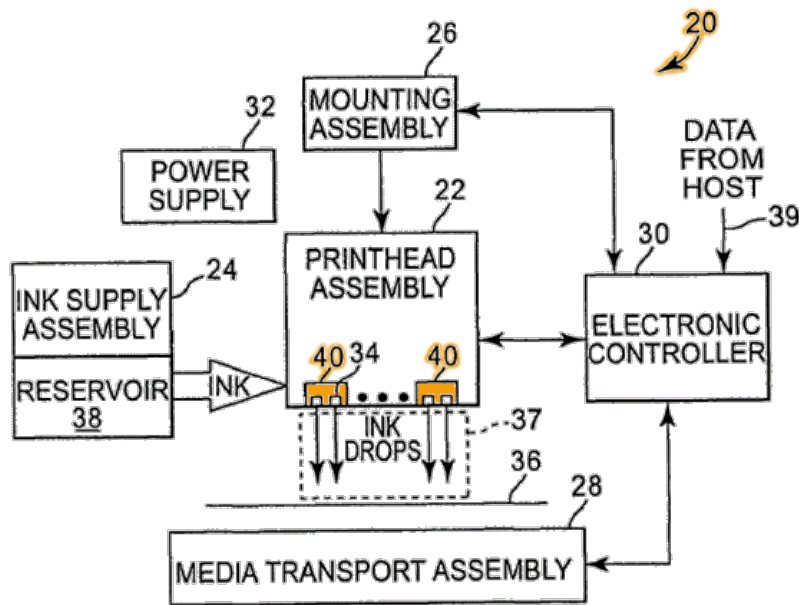


Fig. 1

Ex.1005, Fig. 1.

63. Figure 3 of Benjamin '144 “is a diagram illustrating drop generators 60 located along ink feed slot 46 in one embodiment of **printhead die 40.**” Ex.1005, 5:46-47. A “die” defined as a “chip.” See Ex.1013, 125. As Benjamin '144 explains, “[e]ach of the n drop generators 60 includes a firing resistor 52, a vaporization chamber 56 and a nozzle 34.” Ex.1005, 5:60-62. “The **firing resistors 52** of drop generators 60 are energized in a controlled sequence to eject fluid from vaporization chambers 56 and through nozzles 34 to print an image on print medium 36.” Ex.1005, 5:64-67. In other words, the drop generators 60 include firing resistors 52 that are heaters.

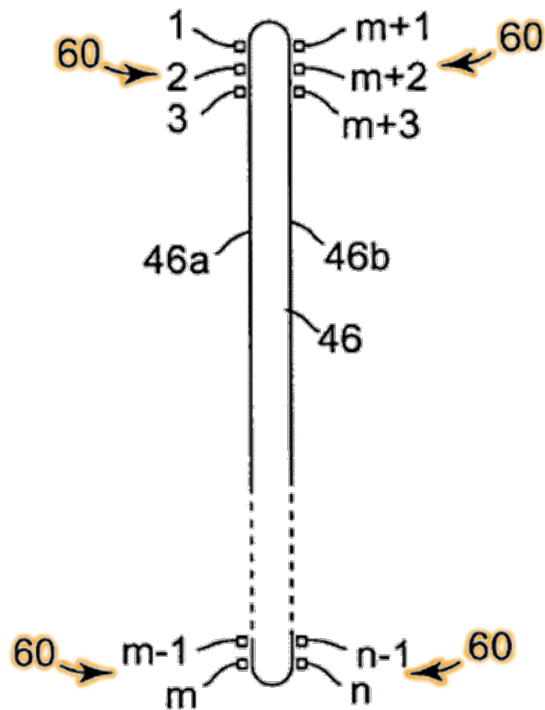


Fig. 3

Ex.1005, Fig. 3.

64. Figure 21 of Benjamin '144 provides “a diagram illustrating an example layout of one embodiment of a **printhead die 1700**.” Ex.1005, 63:20-21.

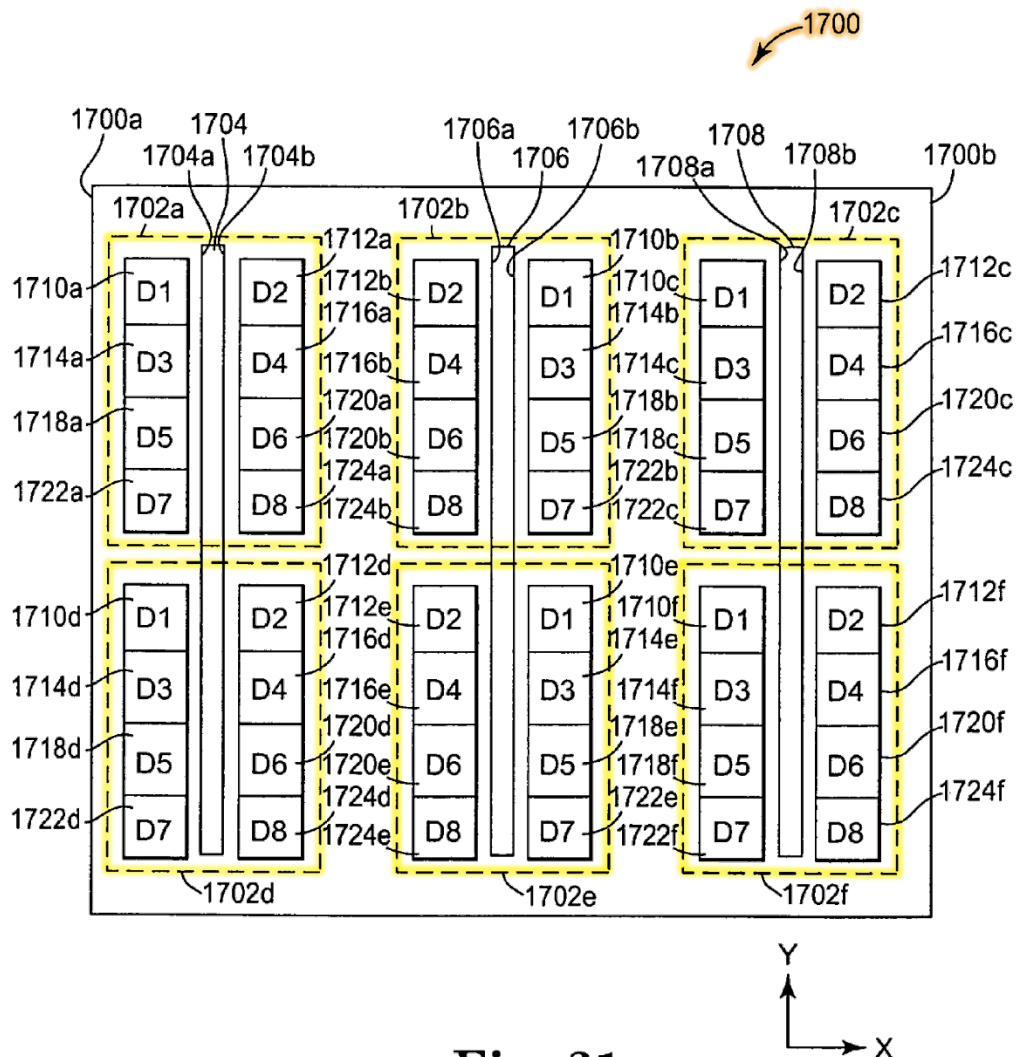


Fig. 21

Ex.1005, Fig. 21.

65. As Benjamin '144 explains, the “**printhead die 1700** includes six fire groups 1702a-1702f disposed along three ink fluid feed sources, here depicted as feed slots 1704, 1706 and 1708.” Ex.1005, 63:21-24.

66. In light of the above, it is my opinion, that the **printhead die 1700** in Benjamin '144 corresponds to the claimed “heater chip for use in a printing device,”

because a PHOSITA would have understood that the claim term “heater chip” is synonymous with Benjamin ’144’s **printhead die**.

67. In fact, the ’864 Patent admits that “[a] number of printers, copiers, and multi-function products utilize **heater chips in their printheads** for discharging ink drops from one or more ink vias. **Inkjet heater chips** typically contain one or more ink vias as well as arrays of heaters located next to an ink via.” Ex.1001, 1:15-19. In other words, the ’864 Patent explains that conventional prior art printers included a heater chip located on the printhead and contained ink vias and heaters located next to the ink vias.

68. Accordingly, it is my opinion that Benjamin ’144 discloses **a heater chip** [e.g., printhead die 1700] **for use in a printing device** [e.g., inkjet printer].

2. Benjamin Combination discloses 1[A] “an ink via”

69. Claim 1 of the ’864 Patent recites “**an ink via**.” In my opinion, the Benjamin Combination discloses this element.

70. Figure 21 of Benjamin ’144 provides “a diagram illustrating an example layout of one embodiment of a printhead die 1700.” Ex.1005, 63:20-21.

71. As Benjamin ’144 explains, the “printhead die 1700 includes six fire groups 1702a-1702f disposed along **three ink fluid feed sources**, here depicted as **feed slots 1704 [red]**, 1706 and 1708.” Ex.1005, 63:21-24.

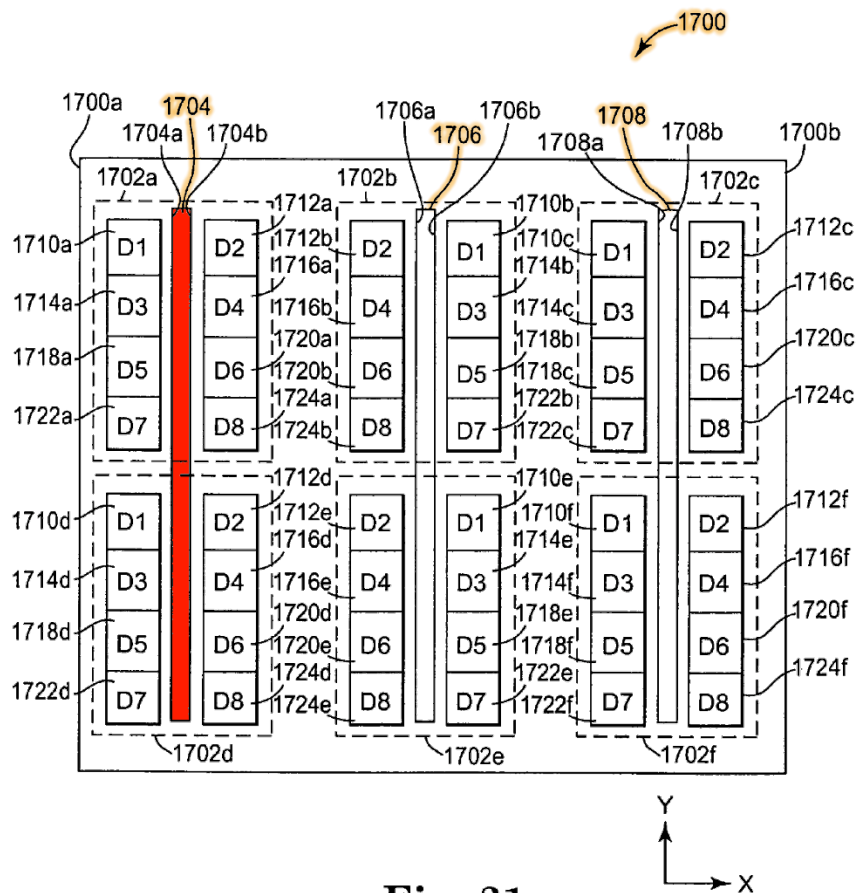


Fig. 21

Ex.1005, Fig. 21 (annotated).

72. Accordingly, it is my opinion that Benjamin Combination discloses “an **ink via** [e.g., ink fluid feed sources, including feed slot 1704].”

3. **Benjamin Combination discloses 1[B] “a first heater array adjacent at least a portion of one side of the ink via; a second heater array adjacent at least a portion of another side of the ink via”**

73. Claim 1 of the '864 Patent recites “a first heater array adjacent at least a portion of one side of the ink via; a second heater array adjacent at least a portion

of another side of the ink via.” In my opinion, Benjamin Combination discloses this element.

74. Benjamin '144 explains that Figure 21 provides “a diagram illustrating an example layout of one embodiment of a printhead die 1700.” Ex.1005, 63:20-21. The “printhead die 1700 includes six fire groups 1702a-1702f disposed along three ink fluid feed sources, here depicted as feed slots 1704 [red], 1706 and 1708.” Ex.1005, 63:21-24. Benjamin '144 further explains that “[t]he fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8” and that “[e]ach data line group D1-D8 includes **pre-charged firing cells 120** from each of the fire groups 1702a-1702f.” Ex.1005, 63:39-42. Benjamin '144 teaches “[p]re-charged firing cell 120 is one embodiment of firing cell 70” and that “[f]iring cell 70 includes a **firing resistor 52**...[that] is part of a drop generator 60.” Ex.1005, 8:7-8, 6:3-5.

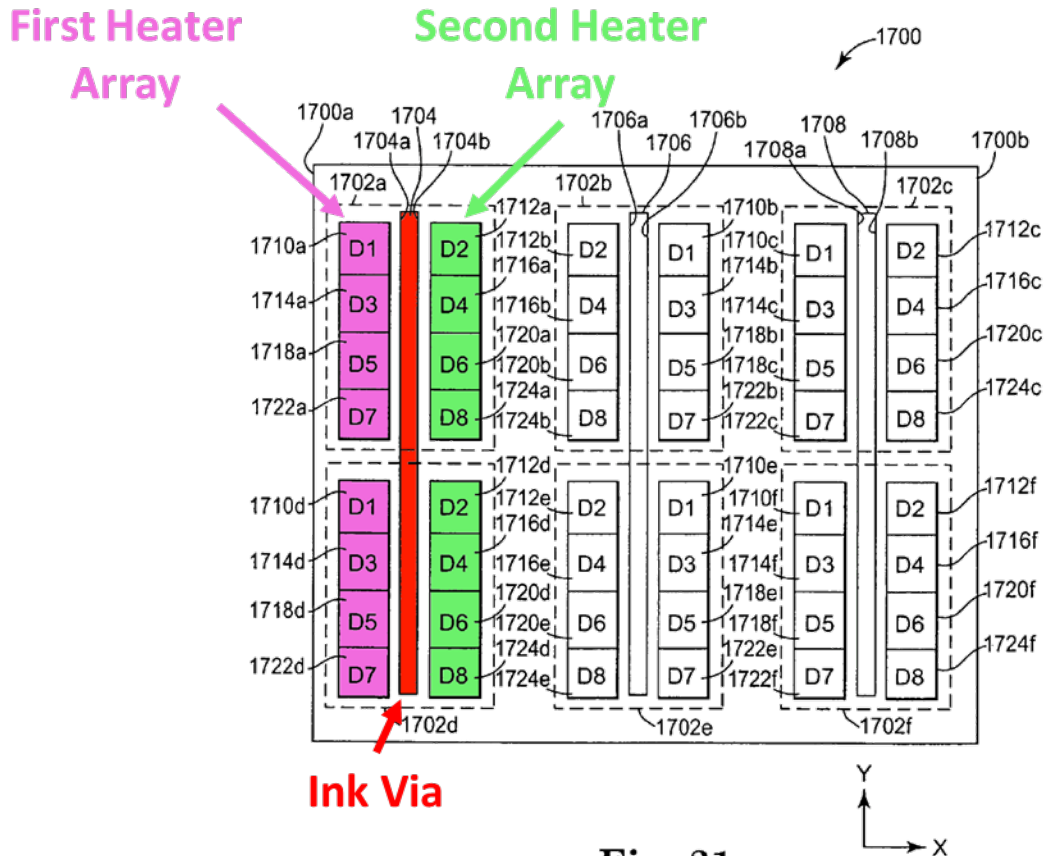


Fig. 21

Ex.1005, Fig. 21 (annotated).

75. As Benjamin '144 explains, “[d]rop generators 60 in data line groups D1, D3, D5 and D7, indicated at 1710a, 1714a, 1718a and 1722a [all magenta, top half], are disposed along one side 1704a of ink feed slot 1704 and drop generators 60 in data line groups D2, D4, D6 and D8, indicated at 1712a, 1716a, 1720a and 1724a [all green, top half], are disposed along the opposing side 1704b of ink feed slot 1704.” Ex.1005, 64:9-14. Benjamin '144 continues noting that “[f]ire group four (FG4) 1702d is disposed along the other half of the length of ink feed slot 1704,” and the “drop generators 60 in FG4 1702d are disposed along opposing sides

1704a and 1704b of ink feed slot 1704 and fluidically coupled to ink feed slot 1704 to receive ink from ink feed slot 1704.” Ex.1005, 64:35-39.

76. Benjamin '144 also notes that “[i]n one embodiment, **drop generators 60** in data line groups D1, D3, D5 and D7, indicated at **1710d, 1714d, 1718d and 1722d [all magenta, bottom half]**, are **disposed along one side 1704a of ink feed slot 1704** and **drop generators 60** for data line groups D2, D4, D6 and D8 at **1712d, 1716d, 1720d and 1724d [all green, bottom half]** are **disposed along the opposing side 1704b of ink feed slot 1704**. Ex.1005, 64:51-57.

77. Benjamin '144 further notes that “[t]he pre-charged firing cells 120 in printhead die 1700 include **firing resistors 52 that are part of drop generators 60**.” Ex.1005, 64:2-4.

78. As a “[f]iring resistor 52 is part of a drop generator 60,” and “[t]he **firing resistors 52 of drop generators 60 are energized in a controlled sequence to eject fluid from vaporization chambers 56** and through nozzles 34 to print an image on print medium 36,” the firing resistors 52 within the drop generators 60 in data line groups 1710a, 1714a, 1718a, 1722a, 1710d, 1714d, 1718d and 1722d [all magenta] correspond to the claimed first heater array, and the firing resistors 52 within the drop generators 60 in data line groups 1712a, 1716a, 1720a, 1724a, 1712d, 1716d, 1720d and 1724d [all green] correspond to the claimed second heater array. Ex.1005, 5:64-67, 6:4-5.

79. As seen in Figure 21 above, the first heater array (firing resistors 52 within drop generators 60 in data line groups 1710a, 1714a, 1718a, 1722a, 1710d, 1714d, 1718d and 1722d, all magenta) is adjacent at least a portion of one side of the ink feed slot 1704 [red]. And, the second heater array (firing resistors 52 within drop generators 60 in data line groups 1712a, 1716a, 1720a, 1724a, 1712d, 1716d, 1720d and 1724d, all green) is adjacent at least a portion of another side of the ink feed slot 1704 [red].

80. Figure 22 similarly shows the first heater array (firing resistors 52 within drop generators 60 in data line groups D1, D3, D5, D7 [all magenta]) is adjacent at least a portion of one side of the ink feed slot 1704 [red]. And, the second heater array (firing resistors 52 within drop generators 60 in data line groups D2, D4, D6, D8 [all green]) is adjacent at least a portion of another side of the ink feed slot 1704. As Benjamin '144 explains, Figure 22 provides “another aspect of the example layout of one embodiment of printhead die 1700.” Ex.1005, 67:36-38.

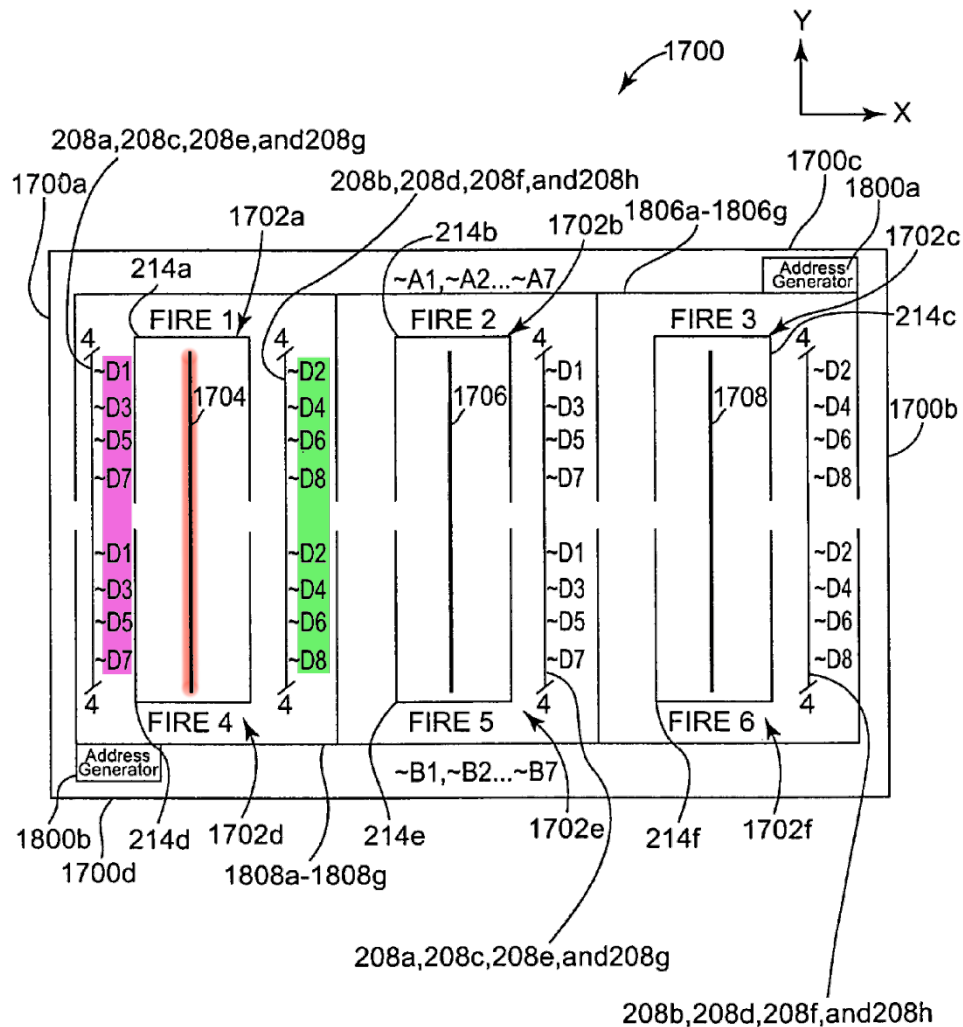


Fig. 22

Ex.1005, Fig. 22.

81. Accordingly, it is my opinion that Benjamin '144 discloses “a **first heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in 1710a, 1714a, 1718a, 1722a, 1710d, 1714d, 1718d and 1722d (magenta)] **adjacent** at least a **portion of one side of the ink via** [e.g., side 1704a of ink feed slot 1704]; a **second heater array** [e.g., vertical array of firing resistors 52 within drop

generators 60 in 1712a, 1716a, 1720a, 1724a, 1712d, 1716d, 1720d and 1724d (green)] **adjacent** at least a **portion** of **another side** of the **ink via** [e.g., side 1704b of ink feed slot 1704].”

4. Benjamin Combination discloses 1[C] “a bondpad wherein the bondpad supplies power to at least a portion of the first heater array and to at least a portion of the second heater array”

82. Claim 1 of the '864 Patent recites “a bondpad wherein the bondpad supplies power to at least a portion of the first heater array and to at least a portion of the second heater array.” In my opinion, Benjamin Combination discloses this element.

83. As seen in Figures 21-22 below, the “printhead die 1700 includes data lines 208a-208h, fire lines 214a-214f [214a, 214d in orange], ink feed sources, e.g. ink feed slots 1704 [red], 1706 and 1708 and the six fire groups 1702a-1702f.” Ex.1005, 67:38-41.

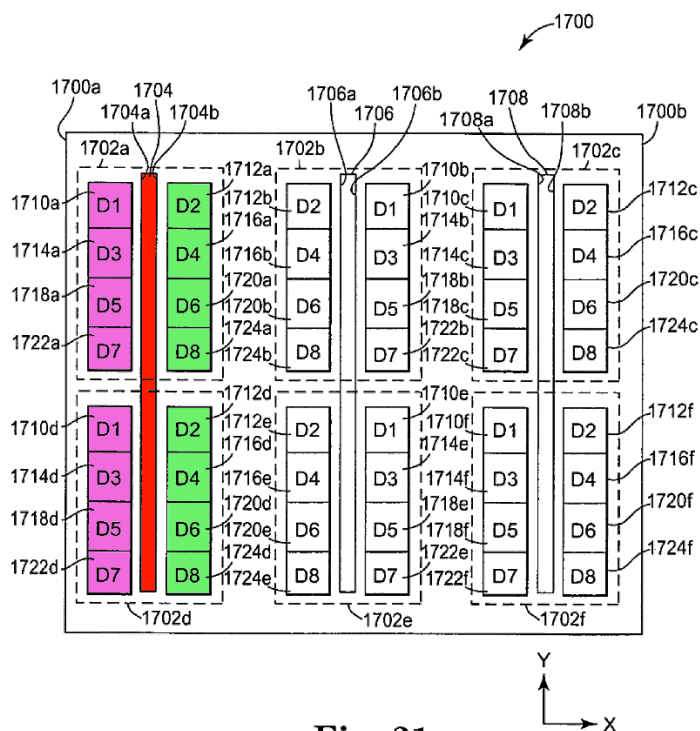
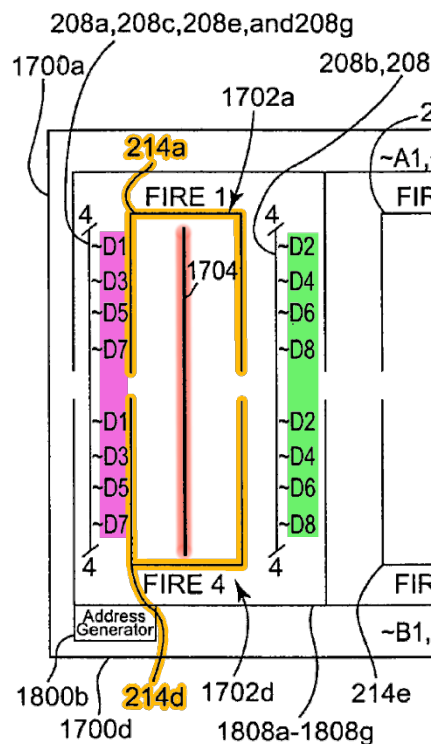


Fig. 21



Ex.1005, Figs. 21-22 (annotated and excerpted).

84. Benjamin '144 explains that the “fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8,” and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the first groups 1702a-1702f.”

Ex.1005, 63:39-42. “Each of the pre-charged firing cells 120 in a data line group D1-D8 is electrically coupled to one data line 208a-208h.” Ex.1005, 63:42-44.

85. Benjamin '144 further explains that:

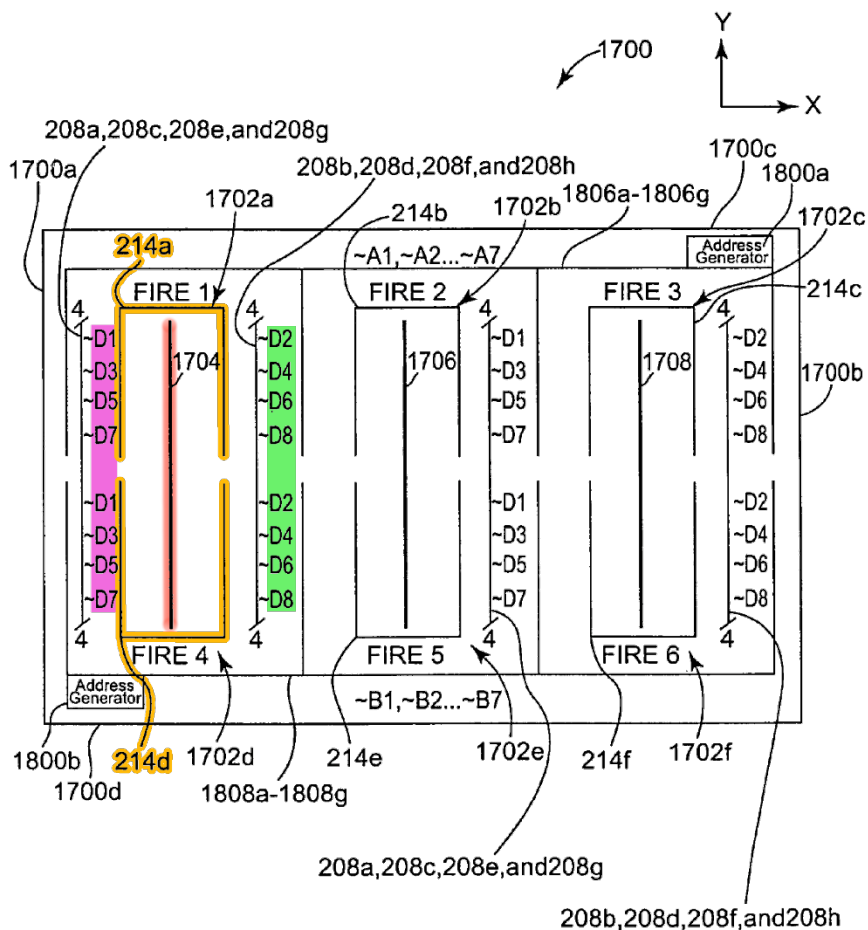
The conductive fire lines **214a-214f** are located along ink feed slots **1704, 1706 and 1708** to supply energy signals **FIRE1, FIRE2 . . . FIRE6** to the fire groups **1702a-1702f**, respectively. The fire lines **214a-214f** supply energy to firing resistors **52** in conducting pre-charged firing cells 120 to heat and eject ink from drop generators 60.

To uniformly eject ink from each drop generator 60 in a fire group 1702a-1702f, the corresponding fire line 214a-214f is configured to uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f.

Ex.1005, 69:42-60.

86. Benjamin '144 also notes that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.” Ex.1005, 70:51-54. For example, “[f]ire line 214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a” while “[f]ire line 214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.” Ex.1005, 70:54-55, 71:8-9.

87. Fire lines 214a and 214d are depicted in orange in annotated and excerpted Figure 22 below.



Ex.1005, Fig. 22 (annotated and excerpted).

88. Thus, Benjamin '144 teaches that the U-shaped fire line 214a located along both sides of the top half of ink feed slot 1704 supplies energy signal FIRE1 to fire group 1702a and to the firing resistors 52 in fire group 1702a. In other words, fire line 214a provides energy to the upper firing resistors located in both the first and second heater array. Similarly, the U-shaped fire line 214d located along both sides of the bottom half of ink feed slot 1704 supplies energy signal FIRE4 to fire group 1702d and to the firing resistors 52 in fire group 1702d. In other words, fire

line 214d provides energy to the lower firing resistors located in both the first and second heater array.

89. Benjamin '144 also explains that:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12. In other words, the firing resistors 52 via fire lines 214 are electrically coupled to external supply circuitry via **interface pads**.

90. Benjamin '144 also refers to its **interface pads** as **bond pads**. In particular, Benjamin '144 notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6,**” Ex.1005, 75:60-67 (ellipses in original). Benjamin '144 uses the terms interface pads and bond pads interchangeably.

91. Benjamin '144's bond pads are also explicitly shown in Benjamin '144's figures. Benjamin '144 explains that the layouts in Figures 21 and 22 can be used where address signals are provided from an external source. Ex.1005, 77:33-

36. Benjamin '144 notes that “[t]he fire lines 214a-214f are **electrically coupled to external supply circuitry by appropriate interface pads.** (See, FIGS. 25A and 25B).” Ex.1005, 11:9-12. Figures 25A and 25B show “contact areas 2000 of a flex circuit 2002 that may be **utilized to couple external circuitry to a printhead die**” where the “contact areas 2000 are **electrically coupled via conductive paths 2004 to contacts 2006 which provide coupling to the printhead die.**” Ex.1005, 77:41-46.

92. Figure 25B, below, show the “flex circuit 2002” that the “printhead die” is “electrically coupled” to via “contacts 2006”:

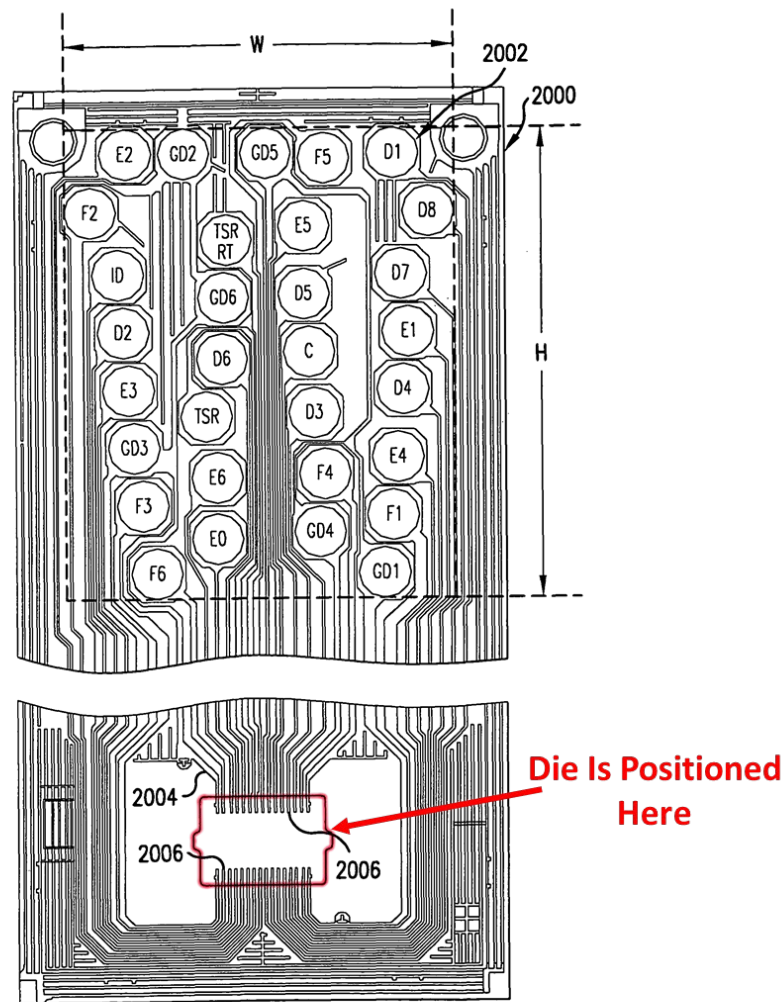
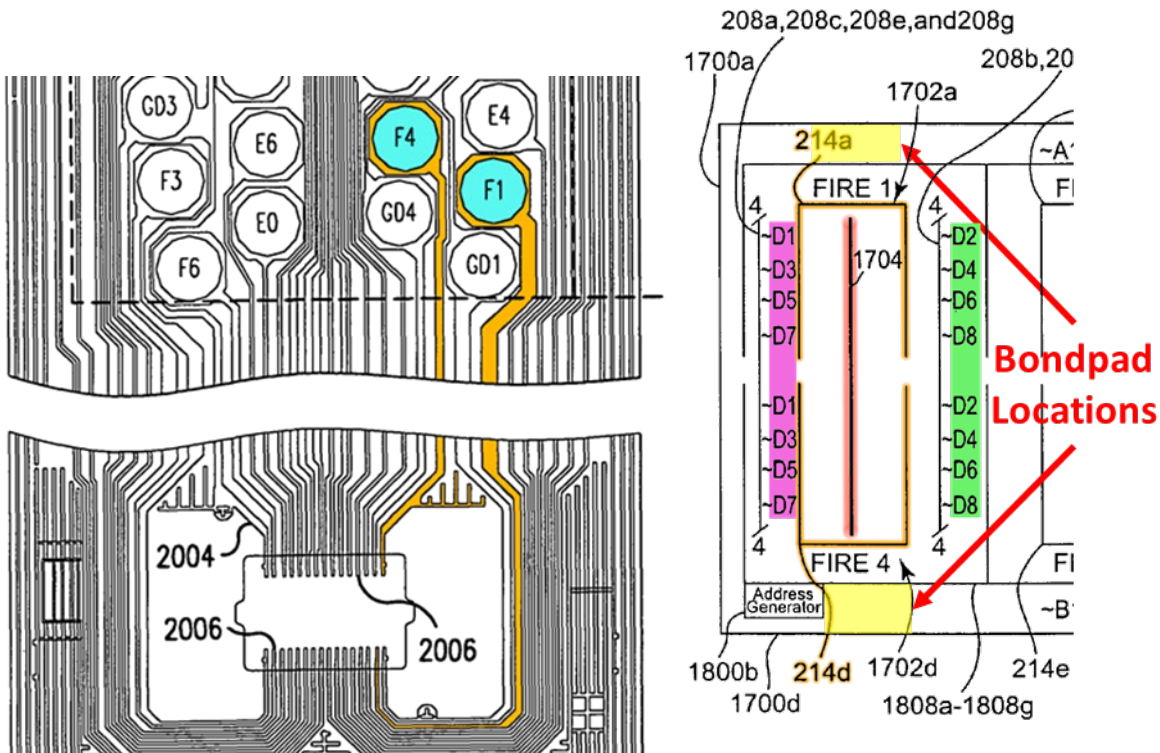


FIG. 25B

Ex.1005, Figure 25B

93. Benjamin '144 explains that Figure 25 shows “[f]ire line contact areas **F1-F6** configured to receive energy pulses and to **provide the energy signals along fire lines Fire1-Fire6 to the appropriate fire groups, e.g. fire groups 202a-202f and 1702a-1702f.**” Ex.1005, 77:61-63. Benjamin '144 further teaches “[t]he contact areas 2000 [i.e., F1-F6] are electrically coupled via conductive paths 2004 to contacts 2006 which provide coupling to the printhead die.” Ex.1005, 77:41-46.

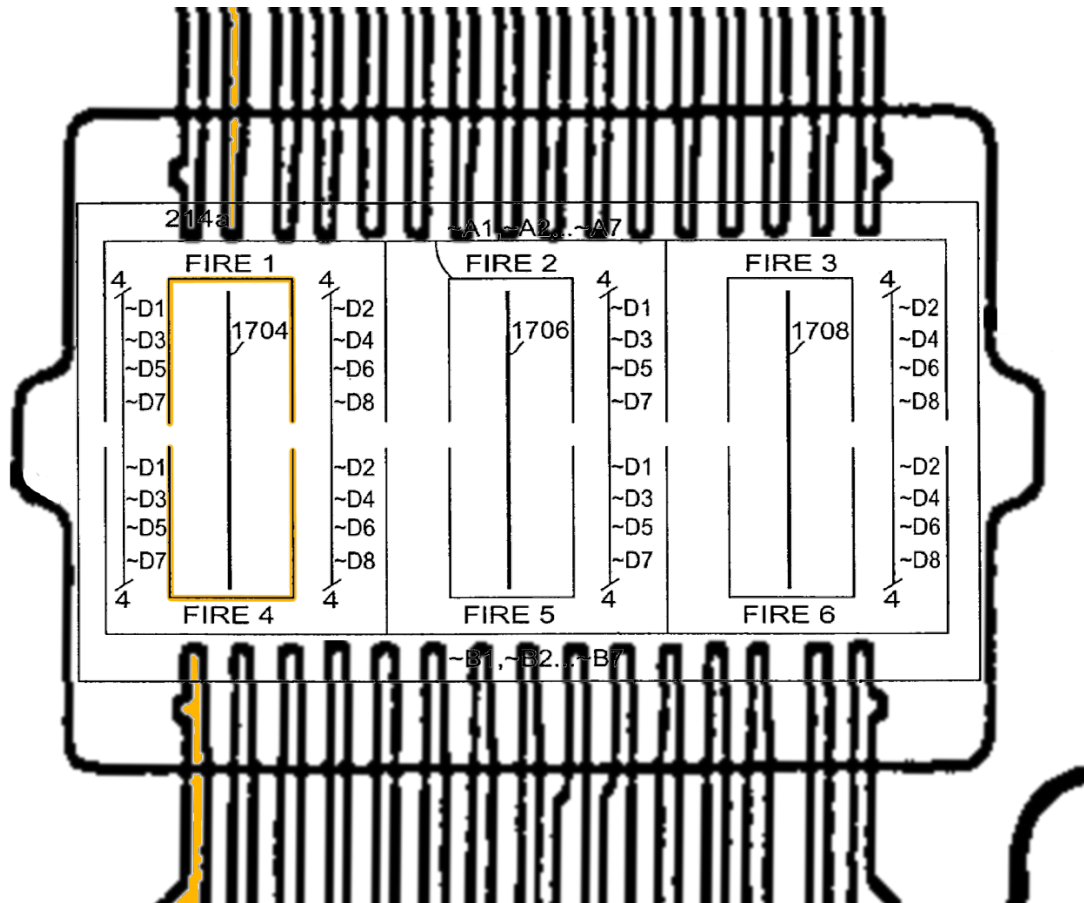
94. As shown in figures 22 and 25B, “energy pulses” from external circuitry are sent from fire line contact areas F1 and F4 [teal] “via conductive paths 2004 [orange] to contacts 2006 which provide coupling to the printhead die” on “flex circuit 2002.”



Ex.1005, Fig. 22 (annotated and excerpted), 25B (annotated and excerpted).

95. I have annotated figure 22, right, to identify the approximate locations of the bondpads (yellow) for fire lines 214a and 214d based on the locations of contacts 2006. I have also prepared an overlay of figures 22 and 25B showing how the printhead die would be placed on the flex circuit 2002 to confirm the locations of the bondpads. To create the overlay, I rotated figure 25b 180 degrees so the

energy signals FIRE 1 and FIRE 4 would be received at their respective fire lines 214a and 214d:



96. Thus, in my opinion, Benjamin '144 explicitly teaches that an interface or bond pad supplies power to at least a portion of the first heater array and to at least a portion of the second heater array because, as seen in Figures 21-22 above, FIRE1 fire line spans heater arrays on both sides of the ink slot within fire group 1702a.

97. To the extent PO contends Benjamin '144 does not expressly disclose a "bondpad wherein the bondpad supplies power to at least a portion of the first

heater array and to at least a portion of the second heater array,” in my opinion, this would have been obvious in view of **Benjamin ’703’s** disclosures.

98. Benjamin ’703, which includes overlapping inventors, was filed on the same day as Benjamin ’144, includes identical portions found in Benjamin ’144’s specification, and explicitly teaches a bondpad. As shown in Benjamin ’703 figure 10, below, Benjamin ’703 also discloses that the “printhead die 40 includes an identification signal input pad 702, a data line input pad 704 and a **fire line input pad 706** [yellow].” Ex.1006, 19:34-36.

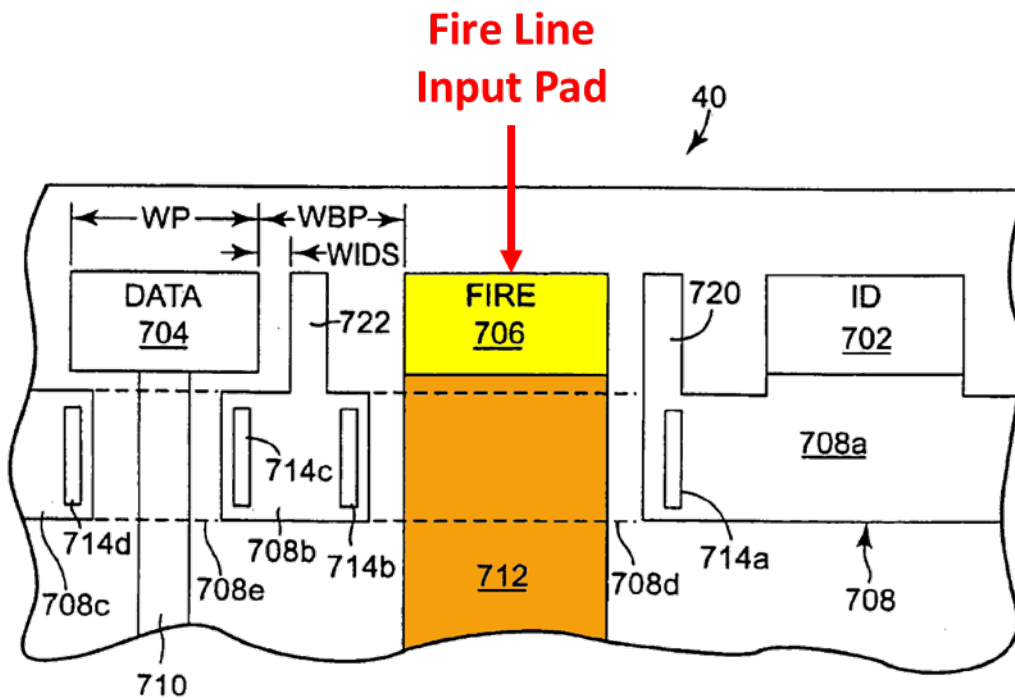


Fig. 10

Ex.1006, Figure 10 (annotated).

99. Benjamin '703 further teaches “[t]he identification signal input pad 702, data line input pad 704 and **fire line input pad 706 are formed as part of the second metal layer of printhead die 40.**” Ex.1006, 19:36-39. Benjamin '703 further teaches “[t]he **fire line input pad 706 [yellow] is electrically coupled to fire line 712 [orange] that is electrically coupled to firing cells 120 in printhead die 40.**” Ex.1006, 19:45-47. Benjamin '703 is explicit that “[f]ire line 712 receives fire signal FIRE and provides fire signal FIRE to firing cells 120 in printhead die 40.” Ex.1006, 20:4-5.

100. Similarly, Benjamin '144 teaches that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-54. For example, “[f]ire line 214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a” while “[f]ire line 214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.” Ex.1005, 70:54-55, 71:8-9.

101. Therefore, in my opinion, a PHOSITA would have appreciated that Benjamin '144 includes the claimed bondpad, or could have easily been modified to

include Benjamin '703's **fire line input pad 706** to "provide fire signal FIRE to firing cells 120 in printhead die 40" through "fire line 712."

102. Accordingly, it is my opinion the Benjamin combination discloses "a **bondpad** [e.g., fire line bond pad / fire line input pad 706] wherein the bondpad **supplies power** [e.g., energy signal FIRE1 supplied by fire line contact areas F1 sent via conductive path 2004 to contact 2006 that interfaces with printhead die via a bondpad 706 that connects to fire line Fire1] **to** at least a portion of the **first heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in D1, D3, D5, D7 (1710a-1714a-1718a-1722a) of fire group 1702a] **and** to at least a portion of the **second heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in D2, D4, D6, D8 (1712a-1716a-1720a-1724a) of fire group 1702a]."

103. Therefore, in my opinion, claim 1 is disclosed by the Benjamin Combination.

B. Benjamin Combination discloses Claim 2

104. Claim 2 depends from independent claim 1. Benjamin '144 discloses all of the limitations of claim 1 for reasons discussed above. The additional limitations of claim 2 are also disclosed by the Benjamin Combination.

105. Claim 2 states "[t]he heater chip of claim 1, further comprising a **second bondpad**, wherein the second bondpad **supplies power to another portion**

of the first heater array and to another portion of the second heater array.”

Ex.1001, cl. 2.

106. As discussed with respect to Claim 1, Benjamin '144 discloses that “the “printhead die 1700 includes data lines 208a-208h, fire lines 214a-214f [214a, 214d in orange], ink feed sources, e.g. ink feed slots 1704 [red], 1706 and 1708 and the six fire groups 1702a-1702f.” Ex.1005, 67:38-41.

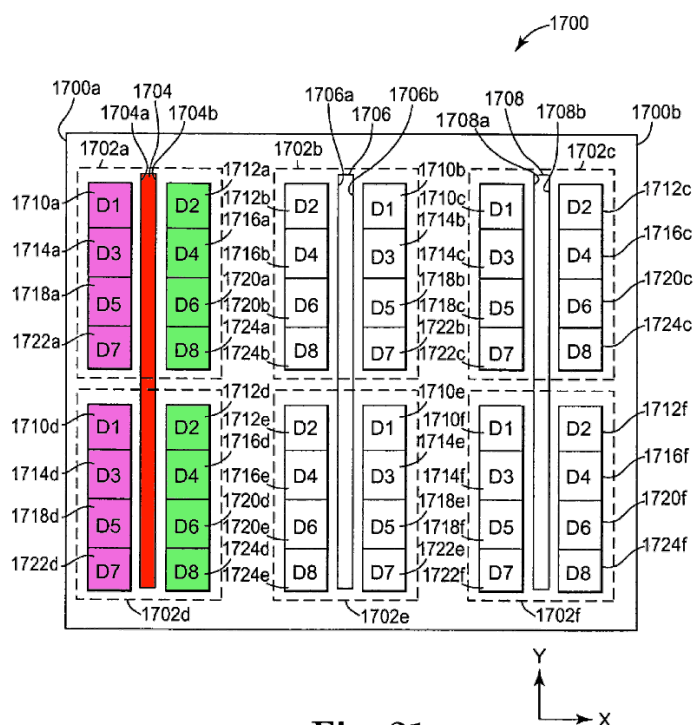
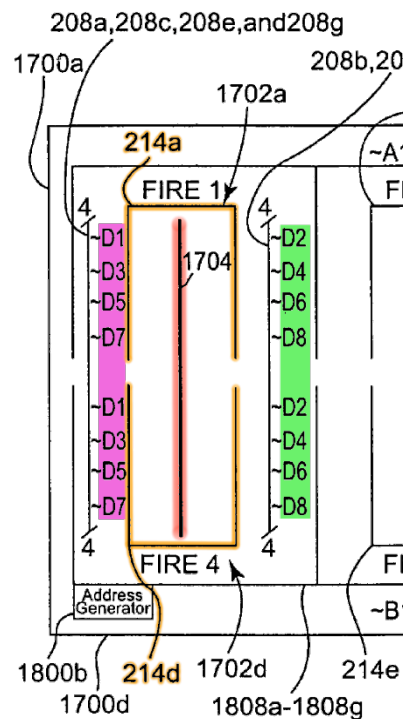


Fig. 21



Ex.1005, Figs. 21-22 (annotated and excerpted).

107. Benjamin '144 further explains that:

The conductive fire lines **214a-214f** are located along ink feed slots **1704, 1706 and 1708** to supply energy signals **FIRE1, FIRE2 . . . FIRE6** to the fire groups **1702a-1702f**, respectively. The fire lines

214a-214f supply energy to firing resistors 52 in conducting pre-charged firing cells 120 to heat and eject ink from drop generators 60. **To uniformly eject ink from each drop generator 60 in a fire group 1702a-1702f, the corresponding fire line 214a-214f is configured to uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f.** Energy variation is the maximum percent difference in power dissipated through any two firing resistors 52 in one of the fire groups 1702a-1702f. The highest amount of power is found in the first firing resistor 52 of a fire group 1702a-1702f, the firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6, as only a single firing resistor 52 is energized. The lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.

Ex.1005, 69:42-60.

108. As discussed with respect to claim 1, incorporated here, each of fire lines 214a, 214d is disposed on both sides of the ink feed slot 1704. Ex.1005, 70:17-21. As seen in Figure 22 above, fire line 214d is disposed on both sides of the bottom half of ink feed slot 1704. As also discussed with respect to claim 1, incorporated here, “[f]ire line 214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.” Ex.1005, 70:54-55, 71:8-9.

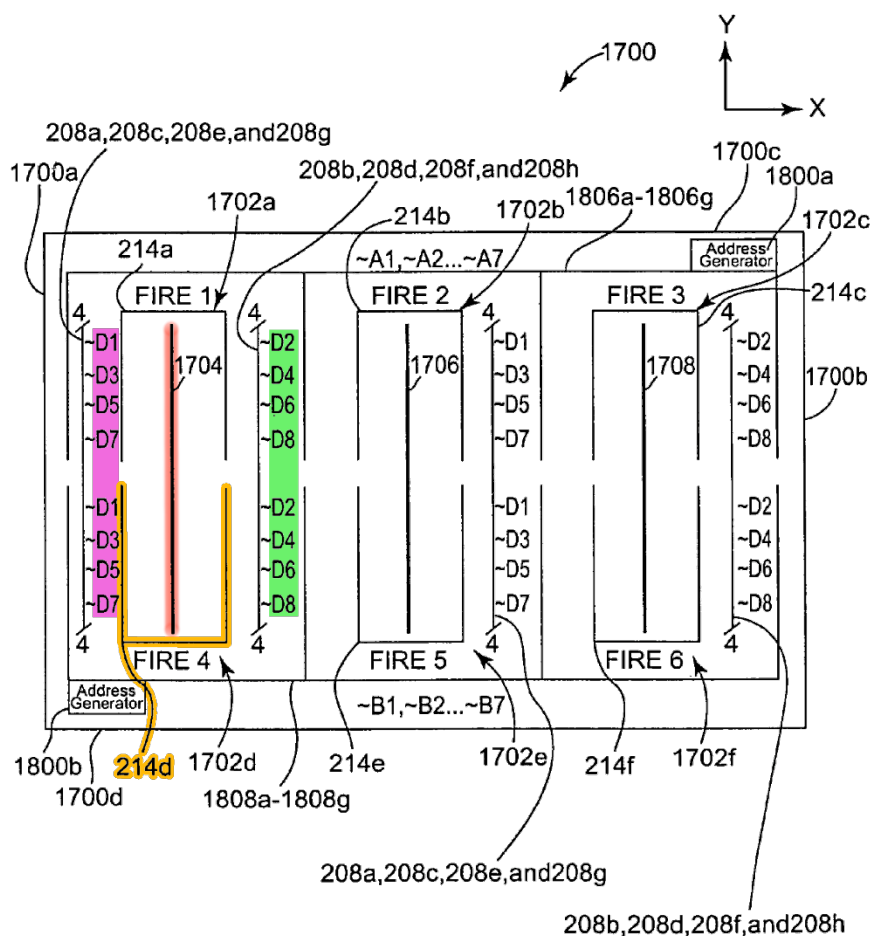


Fig. 22

Ex.1005, Figure 22

109. Thus, Benjamin '144 teaches that **U-shaped fire line 214d** located along both sides of the **bottom half** of ink feed slot 1704 supplies energy signal FIRE4 to the firing resistors 52 in fire group 1702d. In other words, fire line 214d provides energy to firing resistors located in both the first and second heater array.

110. Benjamin '144 also explains:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and

all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by **appropriate interface pads**. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12.

111. Benjamin '144 further notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group** 1702a-1702f as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal** FIRE1, FIRE2 . . . FIRE6, and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.” Ex.1005, 75:60-67 (ellipses in original).

112. Thus, Benjamin '144 teaches that a second bondpad supplies power to a least a portion of the first heater array and to at least a portion of the second heater array because the lower portion of the first and second heater array formed depicted by fire group 1702d in Figure 21 will have its own bondpad. As seen in Figures 21-22 above, FIRE4 spans both heater arrays contained within fire group 1702d.

113. To the extent Benjamin '144 is determined not to expressly disclose “**a second bondpad** wherein the second bondpad supplies power to another portion of the first heater array and to another portion of the second heater array,” in my opinion, it would have been obvious to a PHOSITA to utilize **Benjamin '703's fire**

line input pad 706 for each of Benjamin '144's fire lines 214a-214f for reasons discussed with respect to claim 1, Section IX.A.4, incorporated here. A PHOSITA would have appreciated that each of Benjamin '144's fire lines requires its own bondpad so each can receive their own respective FIRE energy signal. A PHOSITA would have further appreciated that Benjamin '144 could have easily been modified to include Benjamin '703's **fire line input pad 706** for each of its fire lines 214a-214f.

114. As such, the Benjamin Combination discloses “[t]he heater chip of claim 1, further comprising **a second bondpad** [e.g., bond pad or interface pad 706], wherein the second bondpad **supplies power to** [e.g., energy signal FIRE4 supplied by fire line contact areas F4 sent via conductive path 2004 to contact 2006 that interfaces with printhead die via a bondpad that connects to fire line 214d] **another portion** of the **first heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in D1, D3, D5, D7 of fire group 1702d] **and to another portion** of the **second heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in D2, D4, D6, D8 of fire group 1702d].” Claim 2 is therefore disclosed by the Benjamin Combination.

C. Benjamin Combination discloses Claim 3

115. Claim 3 depends from independent claim 1. Benjamin '144 discloses all of the limitations of claim 1 for the reasons discussed above. The additional limitations of claim 3 are also disclosed by the Benjamin Combination.

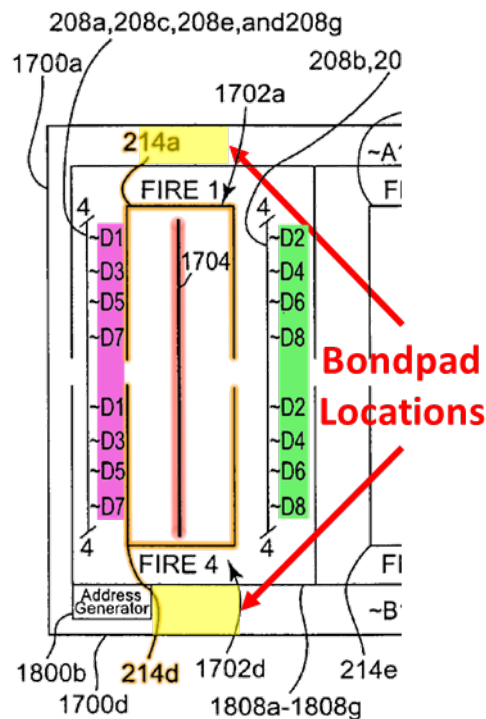
116. Claim 3 states “[t]he heater chip of claim 1, wherein **the bondpad supplies power to the first heater array and the second heater array portions by power traces physically separated proximal to the bondpad.**” Ex.1001, cl. 3.

117. As discussed in Section IX.A.4, limitation 1[C], incorporated here, each of the Benjamin Combination’s fire lines 214a-214f supplies power to the first heater array and the second heater array portions via a bondpad or fire line input pad 706.

118. Benjamin '144 disclose wherein the bondpad supplies power to the first heater array and the second heater array portions by power traces physically separated proximal to the bondpad for reasons discussed above with respect to claim 1, incorporated here. Specifically, Benjamin '144’s fire line 214a within its die corresponds to the claimed power traces, and Benjamin '144 notes that “fire lines 214a-214f are electrically coupled to external supply circuitry by **appropriate interface pads,**” and “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond**

pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6.” Ex.1005, 11:5-12, 75:60-67 (ellipses in original).

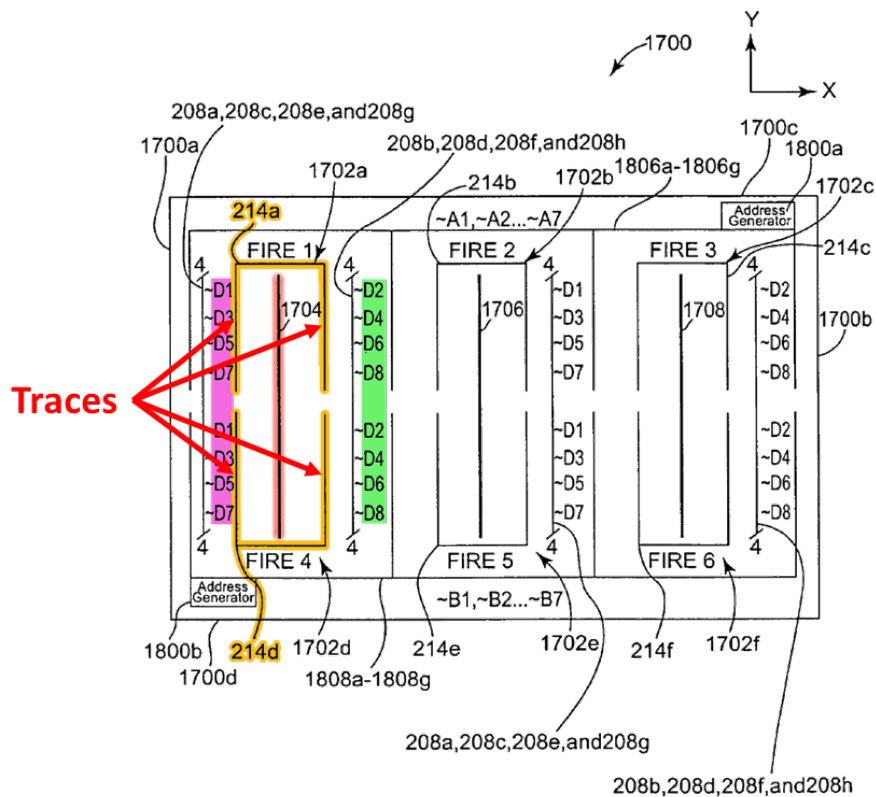
119. As shown in figure 22, below, Benjamin '144's fire lines 214a-214f are physically separated to form “a substantially U-shaped fire line” that is proximal to the bondpad.



Ex.1005, Fig. 22 (annotated and excerpted).

120. This is consistent with the '864 Patent's description of this claim limitation. The '864 Patent explains that in one embodiment, shown in Figure 3, “the power traces 326 are physically separated as they meet the bondpad 328.” Ex.1001, 5:65-66. In another embodiment, “it should also be appreciated that a single power trace may extend from the bondpad 328, and then branch into two or

more traces that extend to respective heater arrays.” Ex.1001, 6:7-10. In my opinion, Benjamin ’144 discloses the latter embodiment with its “substantially U-shaped fire line,” which “branch into two...traces that extend to respective heater arrays” proximal to the bondpad. The top of Benjamin ’144’s U-shaped fire line 214a is proximate the edge of the die where the firing signal is received at an interface or bond pad.



Ex.1005, Figure 22

121. To the extent Benjamin ’144 does not disclose “power traces physically separated proximal to the bondpad,” in my opinion, it would have been obvious based on Benjamin ’144’s disclosures. For reasons discussed in claim 1, incorporated here, it would have been obvious to use a bondpad to interface with

Benjamin '144's fire lines (e.g., fire line 214a) at contacts 2006. It also would have been obvious that the bondpad would have been placed along a side of printhead die nearest the fire line similar to Benjamin '144's data lines. Specifically, Benjamin '144 teaches "each of the data lines 208 a, 208 c, 208 e and 208 g is routed to its respective data line group from a bond pad located along the side of printhead die 1700 **nearest the data line group** in the fire groups 1702 a-1702 f." Ex.1005, 69:3-7. Benjamin '144 teaches "Data lines 208a and 208c are electrically coupled to a **bond pad along side 1700c** of printhead die 1700" Ex.1005, 69:7-8. A PHOSITA would have appreciated that Benjamin '144's fire line input pad for fire line 214a would be placed along side 1700c as well as that is the side nearest the fire line.

122. In my opinion, it would have been obvious that the bondpad for the fire lines would have been similarly placed along side 1700c and thus the power trace (fire line 214a) would have been physically separated proximal to the bondpad. This also would have been accomplished with a reasonable expectation of success as a PHOSITA could simply follow the conventional design for placement of bondpads along the edges in the modified Benjamin system.

123. Benjamin-703 teaches "[t]he **fire line input pad 706 [yellow]** is **electrically coupled to fire line 712 [orange]** that is electrically coupled to firing cells 120 in printhead die 40." Ex.1006, 19:45-47. Benjamin-703 states that "[f]ire line 712 receives fire signal FIRE and provides fire signal FIRE to firing cells 120

in printhead die 40.” Ex.1006, 20:4-5. In other words in Benjamin, the fine line input pad, 706 is connected to the fire line 712, that splits on either side of the via.

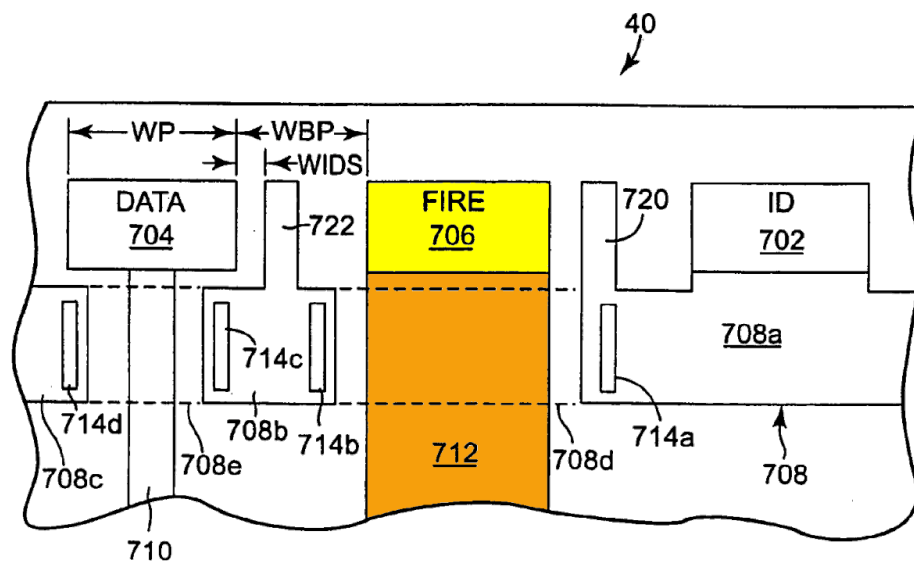


Fig. 10

Ex.1006, Figure 10

124. To the extent that Benjamin-144 does not disclose “power traces physically separated proximal to the bondpad,” it would have been obvious in view of Benjamin-703. For reasons discussed in Section IX.L, limitation 1[C], incorporated here, it would have been obvious to use a bondpad to interface with Benjamin-144’s fire lines (e.g., fire line 214a) at contacts 2006. It would have been obvious that the bondpad would have been placed along a side of printhead die nearest the fire line similar to Benjamin-144’s data lines. Specifically, Benjamin-144 teaches “each of the data lines 208 a, 208 c, 208 e and 208 g is routed to its respective data line group from a bond pad located along the side of printhead die

1700 **nearest the data line group** in the fire groups 1702 a-1702 f.” Ex.1005, 69:3-7. Benjamin-144 teaches “[d]ata lines 208a and 208c are electrically coupled to a **bond pad alongside 1700c** of printhead die 1700” Ex.1005, 69:7-8. A PHOSITA would have appreciated that Benjamin-144’s fire line input pad for fire line 214a would be placed alongside 1700c at the side nearest the fire line.

125. This would have been accomplished with a reasonable expectation of success as a PHOSITA could simply follow the conventional design for placement of bondpads taught by Benjamin-144 and Benjamin-703 along the nearest edge in the modified Benjamin system.

126. As such, the Benjamin Combination discloses “[t]he heater chip of claim 1, wherein the **bondpad [e.g., fire line bond pad / fire line input pad 706] supplies power to the first heater array [e.g., firing resistors 52 within drop generators 60 in D1, D3, D5, D7] and the second heater array [e.g., firing resistors 52 within drop generators 60 in D2, D4, D6, D8] portions [e.g., top half of each] by power traces [e.g., fire line 214a] physically separated proximal to the bondpad [e.g., U-shaped fire line 214a near side 1700c].”**

D. Benjamin Combination discloses Claim 5

127. Claim 5 depends from independent claim 1. the Benjamin Combination discloses all of the limitations of claim 1 for the reasons discussed above. The additional limitations of claim 5 are also disclosed by the Benjamin Combination.

128. Claim 5 states “[t]he heater chip of claim 1, **wherein the bondpad supplies power to the first heater array and the second heater array by at least one power trace.**” Ex.1001, cl. 5.

129. Benjamin ’144 disclose wherein the bondpad supplies power to the first heater array and the second heater array portions by at least one power trace for reasons discussed above with respect to claim 1, incorporated here. Specifically, Benjamin ’144’s fire line 214a corresponds to the claimed power trace, and Benjamin ’144 notes that “fire lines 214a-214f are electrically coupled to external supply circuitry by **appropriate interface pads,**” and “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6.**” Ex.1005, 11:5-12, 75:60-67 (ellipses in original).

130. As such, the Benjamin Combination discloses “[t]he heater chip of claim 1, wherein the bondpad [e.g., bond pad or interface pad 706] supplies power [e.g., energy signal FIRE1] to the first heater array and the second heater array [e.g., firing resistors 52 of fire group 1701a] by at least one power trace [e.g., fire line 214a].”

E. Benjamin Combination discloses Claim 6

131. Claim 6 depends from independent claim 1. The Benjamin Combination discloses all of the limitations of claim 1 for the reasons discussed above. The additional limitations of claim 6 are also disclosed by the Benjamin Combination.

132. Claim 6 states “[t]he heater chip of claim 1, **wherein the first heater array and the second heater array each include a plurality of thin film resistors.**” Ex.1001, cl. 6. Benjamin ’144 teaches that “[t]he ink is heated with small electric heaters, such as **thin film resistors** referred to herein as firing resistors,” and that “[h]eating the ink causes the ink to vaporize and be ejected through the nozzles.” Ex.1005, 1:34-37.

133. As such, the Benjamin Combination teaches “[t]he heater chip of claim 1, wherein the **first heater array** and the **second heater array** each **include a plurality of thin film resistors** [e.g., Benjamin ’144’s thin film resistors or firing resistors 52].”

F. Benjamin Combination discloses Claim 8

134. As I explain below, Benjamin ’144 discloses each and every limitation of independent claim 8.

1. Benjamin Combination discloses 8[P] “A heater chip for use in a printing device”

135. To the extent the preamble is limiting, it is identical to claim limitation 1[P] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[P]. *Supra* section IX.A.1.

2. Benjamin Combination discloses 8[A] “an ink via”

136. This limitation is identical to claim limitation 1[A] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[A]. *Supra* section IX.A.2.

3. Benjamin Combination discloses 8[B] “a first heater array and a second heater array adjacent at least a portion of the ink via wherein the ink via is positioned between the first heater array and the second heater array”

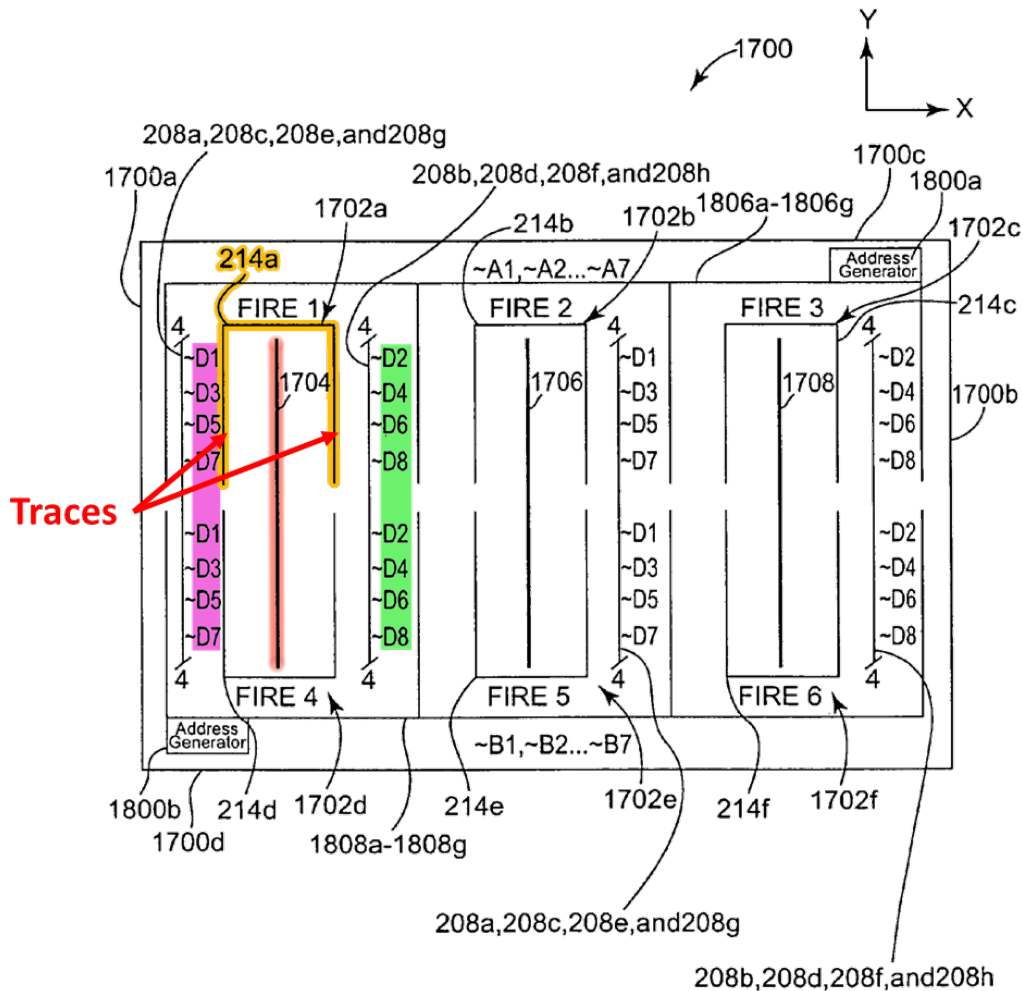
137. This limitation is analogous to claim limitation 1[B] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[B]. *Supra* section IX.A.3.

138. In particular, as seen in Figure 21 of Benjamin '144, the feed slot 1704 [red] is positioned between the first heater array [firing resistors 52 within drop generators 60 in D1, D3, D5, D7 (all in magenta)] and the second heater array [firing resistors 52 within drop generators 60 in D2, D4, D6, D8 (all in green)].

4. **Benjamin Combination discloses 8[C] “a bondpad having at least two traces stemming from the bondpad wherein at least one of the traces is operatively connected to the first heater array and at least another one of the traces is operatively connected to the second heater array”**

140. Claim 8 of the '864 Patent recites “a bondpad having at least two traces stemming from the bondpad wherein at least one of the traces is operatively connected to the first heater array and at least another one of the traces is operatively connected to the second heater array.” For the same reasons I provide above in limitation 1[C], incorporated here, the Benjamin Combination teaches a bondpad connected to the first heater array and the second heater array. *Supra* section IX.A.4. In my opinion, Benjamin '144 also discloses the remaining limitation “having at least two traces stemming from the bondpad.”

141. Specifically, the U-shaped fire line 214a corresponds to the claimed two traces stemming from the bondpad. As Benjamin '144 explains, the “U-shaped fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 **located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-59.



Ex.1005, Fig. 22 (annotated, excerpted).

142. Benjamin '144 further teaches “[f]ire line 214a is electrically coupled to all pre-charged firing cells 120 in FG1 (202a).” Ex.1005, 11:1-2. Thus, the trace on the left portion of 214a is connected to the first heater array, and the trace on the right portion of 214a is connected to the second heater array. For reasons discussed above with respect to claim 1, incorporated here, each trace of fire line 214a is connected to (i.e., stemming from) a bondpad..

143. Accordingly, it is my opinion that the Benjamin Combination discloses “a **bondpad** [e.g., fire line bond pad / fire line input pad 706] having **at least two traces** [e.g., U-shaped fire line 214a] **stemming from** the bondpad [e.g., connected to bondpad/fire line input pad 706] wherein at least **one of the traces** [e.g. trace on the left portion of 214a] is **operatively connected to the first heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in 1710a, 1714a, 1718a, 1722a, 1710d, 1714d, 1718d and 1722d] and at least **another one of the traces** [e.g. trace on the right portion of 214a] is **operatively connected to the second heater array** [e.g., vertical array of firing resistors 52 within drop generators 60 in 1712a, 1716a, 1720a, 1724a, 1712d, 1716d, 1720d and 1724d].”

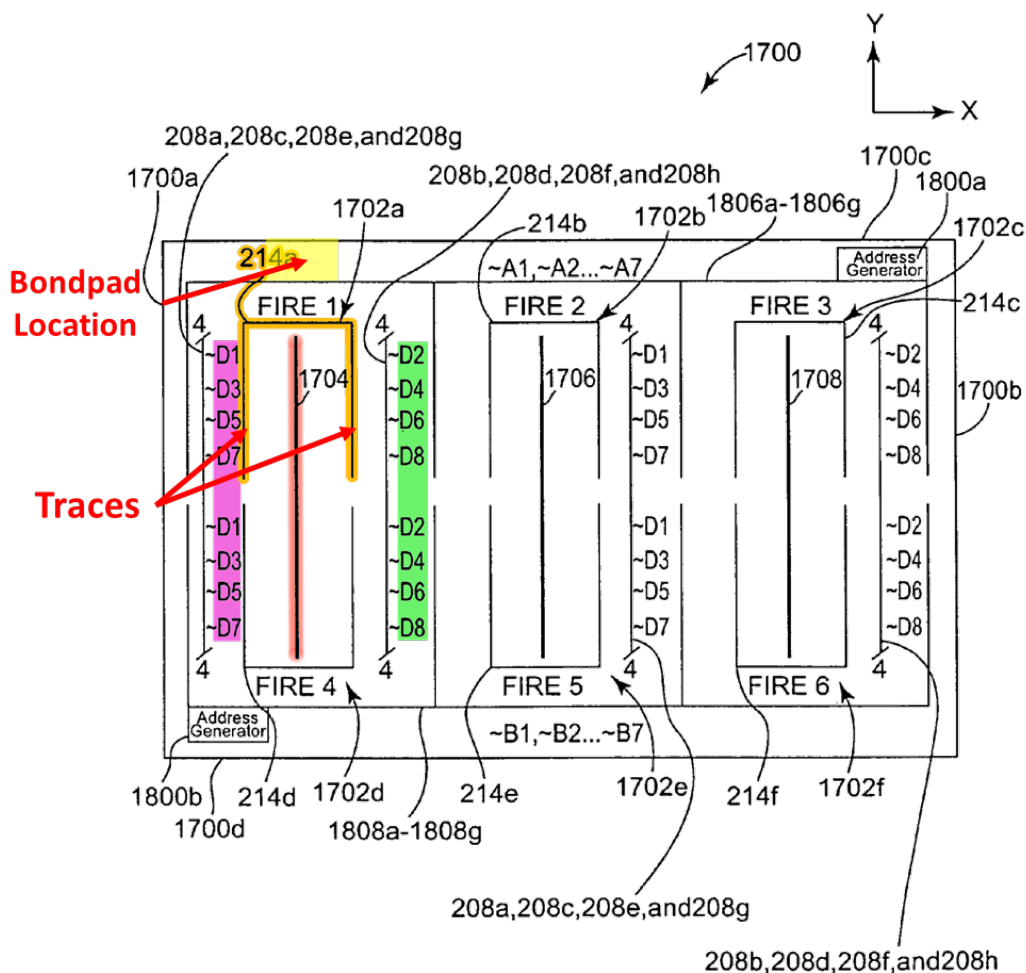
G. Benjamin Combination discloses Claim 9

144. Claim 9 depends from independent claim 8. The Benjamin Combination discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 9 are also disclosed by Benjamin '144.

145. Claim 9 states “[t]he heater chip of claim 8, **wherein the at least two traces are physically separated proximal to the bondpad.**” Ex.1001, cl. 9.

146. The additional limitations of claim 9 are broader than the limitations of claim 3 and is thus disclosed by Benjamin '144 for the same reasons I provide above. *Supra* section IX.C, incorporated here.

147. In particular, as shown in figure 22, below, Benjamin '144's fire lines 214a-214f are physically separated to form "a substantially U-shaped fire line" that is proximal to the bondpad.



Ex.1005, Fig. 22 (annotated and excerpted).

H. Benjamin Combination discloses Claim 10

148. Claim 10 depends from independent claim 8. The Benjamin Combination discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 10 are also disclosed by Benjamin '144.

149. Claim 10 states “[t]he heater chip of claim 8, wherein the first and second heater arrays include a **plurality of thin film resistors** formed, at least in part, from a material selected from the group of materials consisting of platinum, **gold**, silver, copper, **aluminum**, **tantalum**, titanium tungsten, silicon-nitrogen, silicon carbide, and diamond-like carbon.” Ex.1001, cl. 10.

150. For the same reasons I provide above in claim 6, incorporated here, Benjamin ’144 teaches the first and second heater arrays include a plurality of thin film resistors. *Supra* section IX.E. In my opinion, Benjamin ’144 also discloses the remaining limitation “formed, at least in part, from a material selected from the group of materials consisting of platinum, gold, silver, copper, aluminum, tantalum, titanium tungsten, silicon-nitrogen, silicon carbide, and diamond-like carbon.”

151. Benjamin ’144 explains “FIG. 2 is a diagram illustrating a portion of one embodiment of a printhead die 40. ... A **firing resistor 52** is positioned within vaporization chamber 56 and leads 58 electrically couple firing resistor 52 to circuitry controlling the application of electrical current through selected firing resistors. A drop generator 60 as referred to herein includes firing resistor 52, nozzle chamber or vaporization chamber 56 and nozzle opening 34.” Ex.1005, 4:54-5:10.

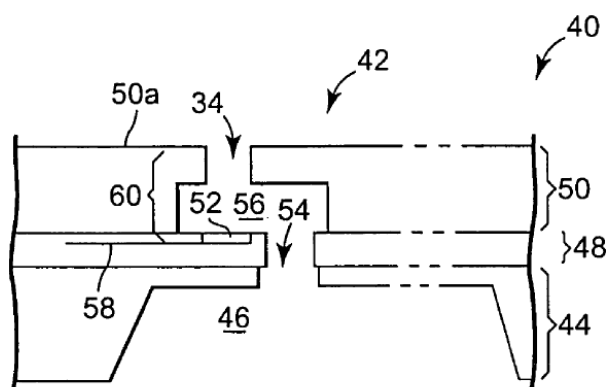


Fig. 2

Ex.1005, Fig. 2.

152. Benjamin '144 explains that “[t]hin-film structure 48, also, includes at least one conductive layer, **which defines firing resistor 52** and leads 58. In one embodiment, the **conductive layer comprises**, for example, **aluminum, gold, tantalum**, tantalum-aluminum, or other metal or metal alloy.” Ex.1005, 5:26-33.

153. Accordingly, it is my opinion that the Benjamin Combination discloses “[t]he heater chip of claim 8, wherein the first and second heater arrays include a plurality of thin film resistors formed, at least in part, from a material selected from the group of materials consisting of platinum, **gold**, silver, copper, **aluminum, tantalum**, titanium tungsten, silicon-nitrogen, silicon carbide, and diamond-like carbon.”

I. Benjamin Combination Discloses Claim 13

154. Claim 13 depends from independent claim 8. Benjamin '144 discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 13 are also disclosed by the Benjamin Combination.

155. Claim 13 states “[t]he heater chip of claim 8, wherein the first and second heater arrays each comprise a **top portion** and a **bottom portion**, and wherein **the bondpad** is operatively connected to the **top portion** of the **first heater array** and the **top portion** of the **second heater array**.” Ex.1001, cl. 13.

156. For the same reasons I provide above in limitations 1[C] and Claim 2, incorporated here, the Benjamin Combination teaches a first bondpad connected to fire line 214a and a second bondpad connected to fire line 214d. *Supra* sections IX.A.4 and IX.B.

157. As seen in Figures 21-22 below, the “printhead die 1700 includes data lines 208a-208h, fire lines 214a-214f, ink feed sources, e.g. ink feed slots 1704 [red], 1706 and 1708 and the six fire groups 1702a-1702f.” Ex.1005, 67:38-41. Each of the six fire groups are arranged into a top portion of their first and second respective heater arrays [yellow] and bottom portion [teal].

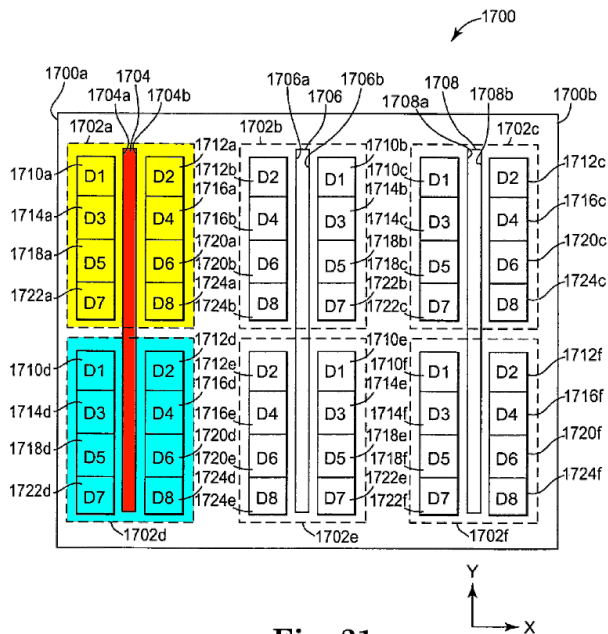


Fig. 21

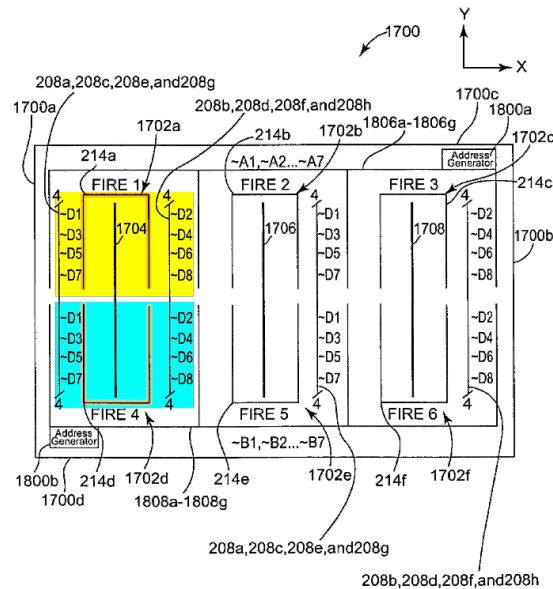


Fig. 22

Benjamin '144 at Figures 21 and 22 (annotated).

158. Benjamin '144 explains that the “fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8,” and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the first groups 1702a-1702f.” Ex.1005, 63:39-42. “Each of the pre-charged firing cells 120 in a data line group D1-D8 is electrically coupled to one data line 208a-208h.” Ex.1005, 63:42-44.

159. Benjamin '144 further explains that:

The conductive fire lines **214a-214f** are located along ink feed slots **1704, 1706 and 1708** to supply energy signals **FIRE1, FIRE2 . . . FIRE6** to the fire groups **1702a-1702f**, respectively. The fire lines **214a-214f** supply energy to firing resistors 52 in conducting pre-charged firing cells 120 to heat and eject ink from drop generators 60. To uniformly eject ink from each drop generator 60 in a fire group **1702a-1702f**, the corresponding fire line **214a-214f** is configured to

uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f. Energy variation is the maximum percent difference in power dissipated through any two firing resistors 52 in one of the fire groups 1702a-1702f. The highest amount of power is found in the first firing resistor 52 of a fire group 1702a-1702f, the firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6, as only a single firing resistor 52 is energized. The lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.

Ex.1005, 69:42-60.

160. Benjamin '144 also notes that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-54. For example, “[f]ire line **214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a**” while “[f]ire line **214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.**” Ex.1005, 70:54-55, 71:8-9.

161. Fire lines 214a and 214d are depicted in orange in annotated and excerpted Figure 22 below.

words, fire line 214d provides energy to firing resistors located in the bottom portion of both the first and second heater array.

163. Benjamin '144 also explains that:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12.

164. Benjamin '144 further notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6,** and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.”

Ex.1005, 75:60-67 (ellipses in original).

165. To the extent Benjamin '144 is determined not to expressly disclose **“the bondpad is operatively connected to the top portion of the first heater array and the top portion of the second heater array,”** in my opinion, it would have been obvious to a PHOSITA to utilize **Benjamin '703's fire line input pad 706** for each

of Benjamin '144's fire line 214a-214f for reasons discussed with respect to claim 1, Section IX.A.4, incorporated here. A PHOSITA would have appreciated that each of Benjamin '144's fire lines requires its own bondpad so each can receive their own respective FIRE energy signal. A PHOSITA would have further appreciated that Benjamin '144 could have easily been modified to include Benjamin '703's **fire line input pad 706** for each of its fire lines 214a-214f.

166. Thus, the Benjamin Combination teaches that the bondpad is operatively connected to the top portion of the first heater array and the top portion of the second heater array because, as seen in Figures 21-22 above, fire line 214a spans both heater arrays contained within fire group 1702a.

167. Accordingly, it is my opinion that Benjamin '144 discloses “wherein the **first and second heater arrays each comprise a top portion** [e.g. fire group 1702a with U-shaped fire line 214a] **and a bottom portion** [e.g. fire group 1702d with U-shaped fire line 214d], and wherein the **bondpad** [e.g., fire line bond pad / fire line input pad 706] is **operatively connected to the top portion of the first heater array and the top portion of the second heater array** [e.g. “the bond pad receiving the energy signal FIRE1” connected to fire line 214a].”

J. Benjamin Combination Discloses Claim 14

168. Claim 14 depends from dependent claim 13. Benjamin '144 discloses all of the limitations of claim 13 for reasons discussed above. The additional limitations of claim 14 are also disclosed by Benjamin '144.

169. Claim 14 states “[t]he heater chip of claim 13, further comprising a **second bondpad** operatively connected to the **bottom portion** of the **first heater array** and the **bottom portion** of the **second heater array**.” Ex.1001, cl. 14.

170. For the same reasons I provide above in limitations 1[C] and Claim 2, incorporated here, the Benjamin Combination teaches a first bondpad connected to fire line 214a and a second bondpad connected to fire line 214d. *Supra* sections IX.A.4 and IX.B.

171. As seen in Figures 21-22 below, the “printhead die 1700 includes data lines 208a-208h, fire lines 214a-214f, ink feed sources, e.g. ink feed slots 1704 [red], 1706 and 1708 and the six fire groups 1702a-1702f.” Ex.1005, 67:38-41. Each of the six fire groups are arranged into a top portion of their first and second respective heater arrays [yellow] and bottom portion [teal].

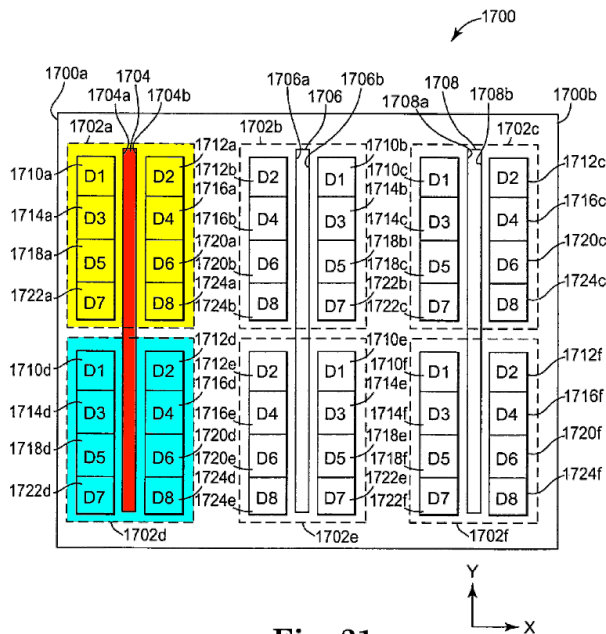


Fig. 21

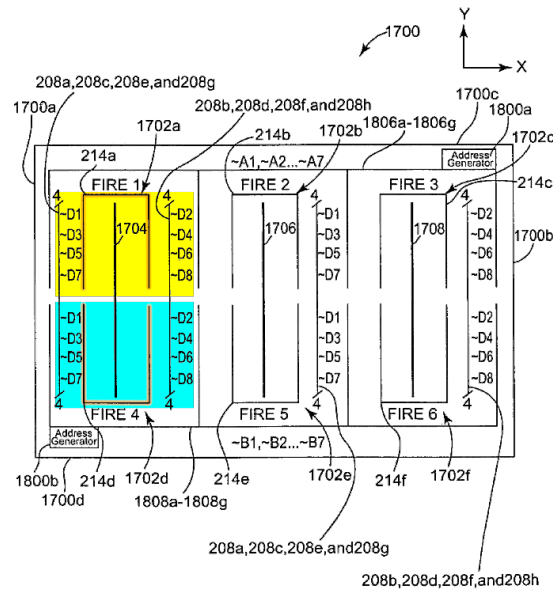


Fig. 22

Benjamin '144 at Figures 21 and 22 (annotated).

172. Benjamin '144 explains that the “fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8,” and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the first groups 1702a-1702f.” Ex.1005, 63:39-42. “Each of the pre-charged firing cells 120 in a data line group D1-D8 is electrically coupled to one data line 208a-208h.” Ex.1005, 63:42-44.

173. Benjamin '144 further explains that:

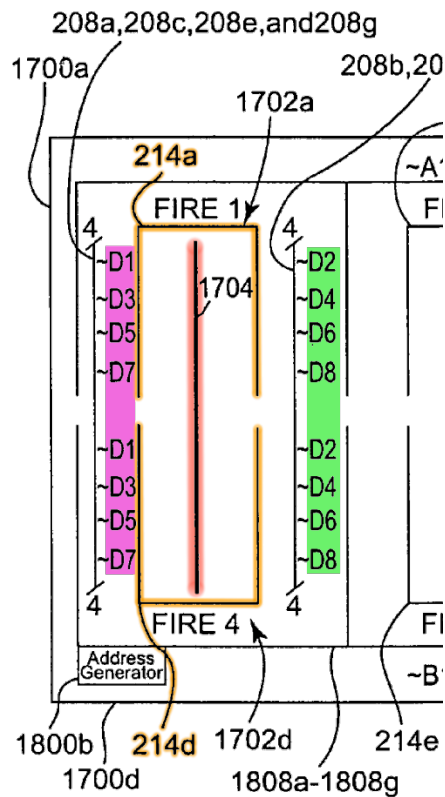
The conductive fire lines **214a-214f** are located along ink feed slots **1704, 1706** and **1708** to supply energy signals **FIRE1, FIRE2 . . . FIRE6** to the fire groups **1702a-1702f**, respectively. The fire lines **214a-214f** supply energy to firing resistors **52** in conducting pre-charged firing cells **120** to heat and eject ink from drop generators **60**. To uniformly eject ink from each drop generator **60** in a fire group **1702a-1702f**, the corresponding fire line **214a-214f** is configured to

uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f. Energy variation is the maximum percent difference in power dissipated through any two firing resistors 52 in one of the fire groups 1702a-1702f. The highest amount of power is found in the first firing resistor 52 of a fire group 1702a-1702f, the firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6, as only a single firing resistor 52 is energized. The lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.

Ex.1005, 69:42-60.

174. Benjamin '144 also notes that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-54. For example, “[f]ire line **214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a**” while “[f]ire line **214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.**” Ex.1005, 70:54-55, 71:8-9.

175. Fire lines 214a and 214d are depicted in orange in annotated and excerpted Figure 22 below.



Ex.1005, Fig. 22 (annotated and excerpted).

176. Thus, Benjamin '144 teaches that the U-shaped fire line 214a located along both sides of the top half of ink feed slot 1704 supplies energy signal FIRE1 to fire group 1702a wherein the fire line 214a supplies energy to the firing resistors 52 in this fire group 1702a. In other words, fire line 214a provides energy to firing resistors located in the top portion of both the first and second heater array. Similarly, the U-shaped fire line 214d located along both sides of the bottom half of ink feed slot 1704 supplies energy signal FIRE4 to fire group 1702d wherein the fire line 214d supplies energy to the firing resistors 52 in this fire group 1702d. In other

words, fire line 214d provides energy to firing resistors located in the bottom portion of both the first and second heater array.

177. Benjamin '144 also explains that:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12.

178. Benjamin '144 further notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6,** and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.”

Ex.1005, 75:60-67 (ellipses in original).

179. Thus, Benjamin '144 teaches that the bondpad is operatively connected to the bottom portion of the first heater array and the bottom portion of the second heater array because, as seen in Figures 21-22 above, fire line 214d spans both heater arrays contained within fire group 1702d.

180. To the extent Benjamin '144 is determined not to expressly disclose “a **second bondpad** operatively connected to the bottom portion of the first heater array and the bottom portion of the second heater array,” in my opinion, it would have been obvious to a PHOSITA to utilize **Benjamin '703's fire line input pad 706** for each of Benjamin '144's fire line 214a-214f for reasons discussed with respect to claim 1, Section IX.A.4, incorporated here. A PHOSITA would have appreciated that each of Benjamin '144's fire lines require its own bondpad so each can receive their own respective FIRE energy signal. A PHOSITA would have further appreciated that Benjamin '144 could have easily been modified to include Benjamin '703's **fire line input pad 706** for each of its fire lines 214a-214f.

181. Accordingly, it is my opinion that Benjamin '144 discloses “[t]he heater chip of claim 13, further comprising a **second bondpad** [e.g. “the bond pad receiving the energy signal FIRE4” from “contacts 2006 which provide coupling to the printhead die” via bond pad or interface pad] operatively **connected** to the **bottom portion** of the **first heater array** and the **bottom portion** of the **second heater array** [e.g. fire group 1702d with U-shaped fire line 214d that receives energy signal FIRE4].”

K. Benjamin Combination Discloses Claim 15

182. Claim 15 depends from independent claim 8. The Benjamin Combination discloses all of the limitations of claim 8 for reasons discussed above.

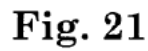
The additional limitations of claim 15 are also disclosed by the Benjamin Combination.

183. As I explain below, the Benjamin Combination discloses each and every limitation of claim 15.

1. **Benjamin Combination discloses 15[A] “The heater chip of claim 8, further comprising: another ink via disposed between a third heater array and a fourth heater array; and”**

184. Claim 15 of the '864 Patent recites “[t]he heater chip of claim 8, **further comprising: another ink via disposed between a third heater array and a fourth heater array.**” Ex.1001, cl. 15.

185. Benjamin '144 explains that Figure 21 provides “a diagram illustrating an example layout of one embodiment of a printhead die 1700.” Ex.1005, 63:20-21. The “printhead die 1700 includes six fire groups 1702a-1702f disposed along three ink fluid feed sources, here depicted as feed slots 1704, **1706 [green]** and 1708.” Ex.1005, 63:21-24. Benjamin '144 further explains that “[t]he fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8 and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the fire groups 1702a-1702f.” Ex.1005, 63:39-42.

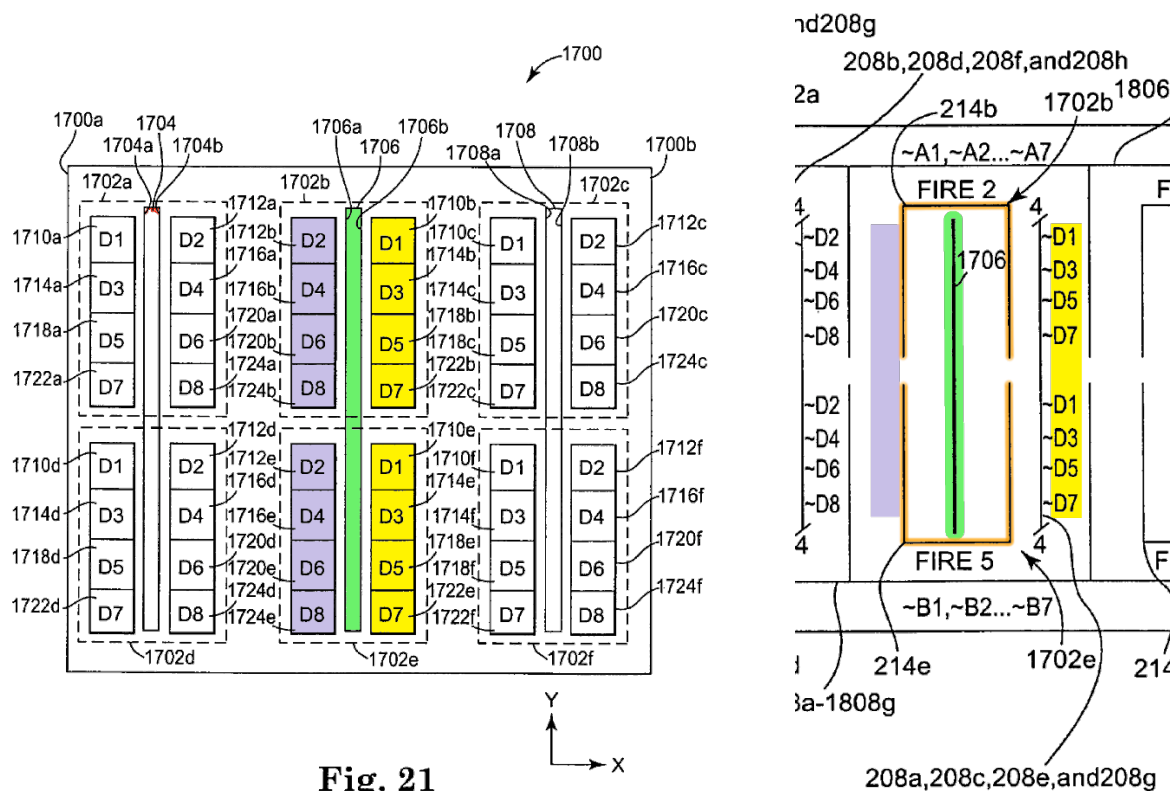


186. Accordingly, it is my opinion that the Benjamin Combination discloses “**another ink via** [e.g., in feed slot 1706] disposed **between a third heater array** [e.g., firing resistors 52 within drop generators 60 in 1712b-1716b-1720b-1724b-1712e-1716e-1720e and 1724e] and a **fourth heater array** [e.g., firing resistors 52 within drop generators 60 in 1710b-1714b-1718b-1722b-1710e-1714e-1718e and 1722e].”

2. Benjamin Combination discloses 15[B] “a second bondpad coupled to a trace that is operatively connected to the third heater array and to a trace that is operatively connected to the fourth heater array”

187. Claim 15 of the '864 Patent recites “a second bondpad coupled to a trace that is operatively connected to the third heater array and to a trace that is operatively connected to the fourth heater array.” Ex.1001, cl. 15.

188. As seen in Figures 21-22 below, the “printhead die 1700 includes data lines 208a-208h, fire lines 214a-214f [214b, 214e in orange], ink feed sources, e.g. ink feed slots 1704, 1706 [green] and 1708 and the six fire groups 1702a-1702f.” Ex.1005, 67:38-41.



Ex.1005, Figs. 21-22 (annotated and excerpted).

189. Benjamin '144 explains that the “fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8,” and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the first groups 1702a-1702f.” Ex.1005, 63:39-42. “Each of the pre-charged firing cells 120 in a data line group D1-D8 is electrically coupled to one data line 208a-208h.” Ex.1005, 63:42-44.

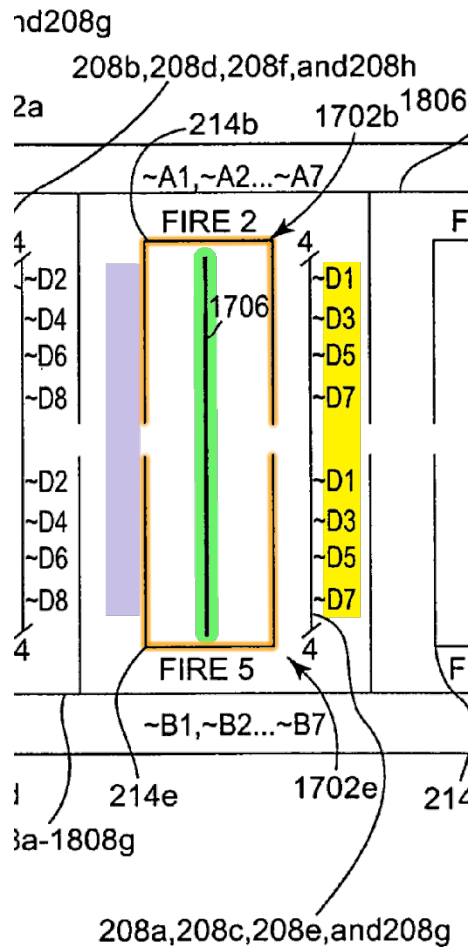
190. Benjamin '144 further explains that:

The conductive fire lines **214a-214f are located along ink feed slots 1704, 1706 and 1708 to supply energy signals FIRE1, FIRE2 . . . FIRE6 to the fire groups 1702a-1702f, respectively.** The fire lines **214a-214f supply energy to firing resistors 52** in conducting pre-charged firing cells 120 to heat and eject ink from drop generators 60. **To uniformly eject ink from each drop generator 60 in a fire group 1702a-1702f, the corresponding fire line 214a-214f is configured to uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f.** Energy variation is the maximum percent difference in power dissipated through any two firing resistors 52 in one of the fire groups 1702a-1702f. The highest amount of power is found in the first firing resistor 52 of a fire group 1702a-1702f, the firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6, as only a single firing resistor 52 is energized. The lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.

Ex.1005, 69:42-60.

191. Benjamin '144 also notes that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-54. For example, “[f]ire line **214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a**” while “[f]ire line **214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.**” Ex.1005, 70:54-55, 71:8-9.

192. Fire lines 214b and 214e are depicted in orange in annotated and excerpted Figure 22 below.



Ex.1005, Fig. 22 (annotated and excerpted).

193. Thus, Benjamin '144 teaches that the U-shaped fire line 214b located along both sides of the top half of ink feed slot 1706 supplies energy signal FIRE2 to fire group 1702b wherein the fire line 214b supplies energy to the firing resistors 52 in this fire group 1702b. In other words, fire line 214b is operatively connected to firing resistors located in both the third and fourth heater array. Similarly, the U-shaped fire line 214e located along both sides of the bottom half of ink feed slot 1706 supplies energy signal FIRE5 to fire group 1702e wherein the fire line 214e

supplies energy to the firing resistors 52 in this fire group 1702e. In other words, fire line 214e is operatively connected to firing resistors located in both the third and fourth heater array.

194. Benjamin '144 also explains that:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12.

195. Benjamin '144 further notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6,** and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.”

Ex.1005, 75:60-67 (ellipses in original).

196. Thus, Benjamin '144 teaches that a second bondpad coupled to a trace that is operatively connected to the third heater array and to a trace that is operatively

connected to the fourth heater array because, as seen in Figures 21-22 above, FIRE2 spans both heater arrays contained within fire group 1702b.

197. To the extent Benjamin '144 is determined not to expressly disclose “a second bondpad coupled to a trace,” in my opinion, this is obvious based on Benjamin '703's disclosures for reasons discussed with respect to claim 1, Section IX.A.4, incorporated here.

198. Accordingly, it is my opinion that the Benjamin Combination discloses “a **second bondpad** [e.g. fire line bond pad / fire line input pad 706 / “the bond pad receiving the energy signal FIRE2” from “contacts 2006 which provide coupling to the bond or interface pad on the printhead die”] **coupled to a trace** that is **operatively connected to the third heater array** [e.g., left side of fire line 214b] and to **a trace** that is **operatively connected to the fourth heater array** [e.g., right side of fire line 214b].”

3. Benjamin Combination discloses 15[C] “wherein the traces coupled to the second bondpad are physically separated proximal to the second bondpad.”

199. Claim 15 of the '864 Patent recites “wherein the traces coupled to the second bondpad are physically separated proximal to the second bondpad.” Ex.1001, cl. 15.

200. For the same reasons I provide above in claim 3, incorporated here, the Benjamin Combination teaches the traces coupled to the second bondpad are physically separated proximal to the second bondpad. *Supra* sections IX.C.

201. Claim 15 is therefore disclosed by the Benjamin Combination.

L. Ample Motivation Existed to Combine Benjamin '144 and Benjamin '703

202. A PHOSITA would have been motivated to combine Benjamin-144 with Benjamin-703.

203. *First*, both Benjamin-144 and Benjamin-703 are **analogous** to the claimed subject matter in the '864 Patent as they are all within the **same field of endeavor** of heater chips for inkjet printheads. *See, e.g.*, Ex.1001, Abstract; Ex.1005, Abstract, 1:20-45; Ex.1006, Abstract, 1:19-46. Further, the USPTO classified the '864 Patent, Benjamin-144, and Benjamin-703 under the same patent classification—class B41 (printing; lining machines; typewriters; stamps).

204. Benjamin-144 and Benjamin-703 also include overlapping inventors (Trudy L. Benjamin and Joseph M. Torgerson) and were filed on the same day (April 19, 2004) by the same assignee (Hewlett Packard Development Co LP). Benjamin-144 and Benjamin-703 also include many of the same figures (Figures 1-8) and significant overlap in the written specification. *Compare* Ex.1005, 3:5-15:3 *with* Ex.1006, 2:24-14:39.

205. Further, Benjamin '144 incorporates Benjamin '703 by reference: “This application is related to patent application Ser. No....11/849,078, entitled “Fluid Ejection Device With Identification Cells,” each of which are assigned to the Assignee of this application and are filed on even date herewith, and each of which **is fully incorporated by reference as if fully set forth herein.**” Ex.1005, 1:6-16. While patent application Ser. No. 11/849,078 refers to a continuation application of Benjamin '703 filed after Benjamin '144, this appears to be a typographical error intended to reference Benjamin '703. Benjamin '703 was filed on the same day as Benjamin '144 and Benjamin '703 has the same specification as its referenced child application.

206. *Second*, a PHOSITA would have been motivated to modify the Benjamin Combination to utilize Benjamin-703's fire line input pad 706 to “provide fire signal FIRE” to each of Benjamin-144's fire lines 214. Benjamin-144 explicitly teaches “**fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads.**” Ex.1005, 11:9-12. Benjamin-144 also refers to its **interface pads as bond pads.** Ex.1005, 75:63-67 (“the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6,**”). In view of Benjamin-144's express teachings, a PHOSITA would have looked to Benjamin-703, which teaches that the “printhead die 40 includes...a **fire line input pad 706.**” Ex.1006, 19:34-36. In view of these express teachings, it would have been obvious

to a PHOSITA to modify the Benjamin-144 printhead to include fire line input pad 706 as taught by Benjamin-703.

207. **Third**, even if Benjamin-144 did not provide an express motivation (which it does), then utilizing a bondpad to supply FIRE energy signals to the fire lines 214 like in Benjamin-703 would have been an obvious combination of prior art elements to yield predictable results. A PHOSITA could have combined Benjamin-703's fire line input pad 706 with Benjamin-144's printhead using known methods to yield predictable results.

208. **Finally**, a PHOSITA would have had a reasonable expectation of success in making this modification. As an initial matter, the printhead components described in Benjamin-144 and Benjamin-703 and are *the same components*. Compare Ex.1005, Fig. 1-8, 7:18-8:18 with Ex.1006, Fig. 1-8, 6:45-7:46. Further, Benjamin-144 and Benjamin-703 both acknowledge that their printhead components (e.g., thermal ink jet printing, drop generators, heaters, firing cell arrays) were well-known at the time. See, e.g., Ex.1005, 1:32-45; 1:46-48 ("As inkjet printheads have evolved, the number of drop generators in a printhead has increased to improve printing speed and/or quality."); 1:64-2:2 ("Manufacturers continue reducing the number of input pads and increasing the number of drop generators on a printhead die...a printhead with more drop generators typically prints with higher quality and/or printing speed."). As such, it would also have been straightforward for a

PHOSITA to modify Benjamin-144's printhead to utilize Benjamin-703's fire line input pad 706 to "provide fire signal FIRE" to Benjamin-144's fire lines 214. In fact, no modification would be necessary as the components are, in fact, the same.

X. GROUND 2: BENJAMIN COMBINATION IN VIEW OF CHILDERS RENDERS CLAIMS 4, 11, 12, AND 16-20 OF THE '864 PATENT OBVIOUS

209. In my opinion, the Benjamin Combination in view of Childers renders claims 4, 11, 12, and 16-20 of the '864 Patent obvious.

A. Benjamin-Childers Combination Discloses Claim 16

210. As I explain below, the Benjamin-Childers Combination discloses each and every limitation of claim 16.

1. Benjamin-Childers Combination discloses 16[P] "A heater chip comprising:"

211. Claim 15 of the '864 Patent recites "[t]he heater chip of claim 8, **further comprising: another ink via disposed between a third heater array and a fourth heater array.**" Ex.1001, cl. 15.

212. To the extent the preamble is limiting, it is broader than claim limitation 1[P] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[P]. *Supra* section IX.A.1.

2. Benjamin-Childers Combination discloses 16[A] “at least eight heater arrays wherein the at least eight heater arrays comprise four heater array pairs, and”

213. Claim 16 of the '864 Patent recites “at least eight heater arrays wherein the at least eight heater arrays comprise four heater array pairs.” In my opinion, Benjamin '144 in view of Childers discloses this limitation.

214. Benjamin '144 explains that Figure 21 provides “a diagram illustrating an example layout of one embodiment of a printhead die 1700.” Ex.1005, 63:20-21. The “printhead die 1700 includes six fire groups 1702a-1702f disposed along **three ink fluid feed sources, here depicted as feed slots 1704, 1706 and 1708.**” Ex.1005, 63:21-24. Benjamin further explains that “[t]he fire groups 1702a-1702f are divided into eight data line groups, indicated at D1-D8 and that “[e]ach data line group D1-D8 includes pre-charged firing cells 120 from each of the fire groups 1702a-1702f.” Ex.1005, 63:39-42.

215. As shown in Figure 21, below, Benjamin '144 discloses six heater arrays that comprise three heater array pairs—(magenta and green pairs).

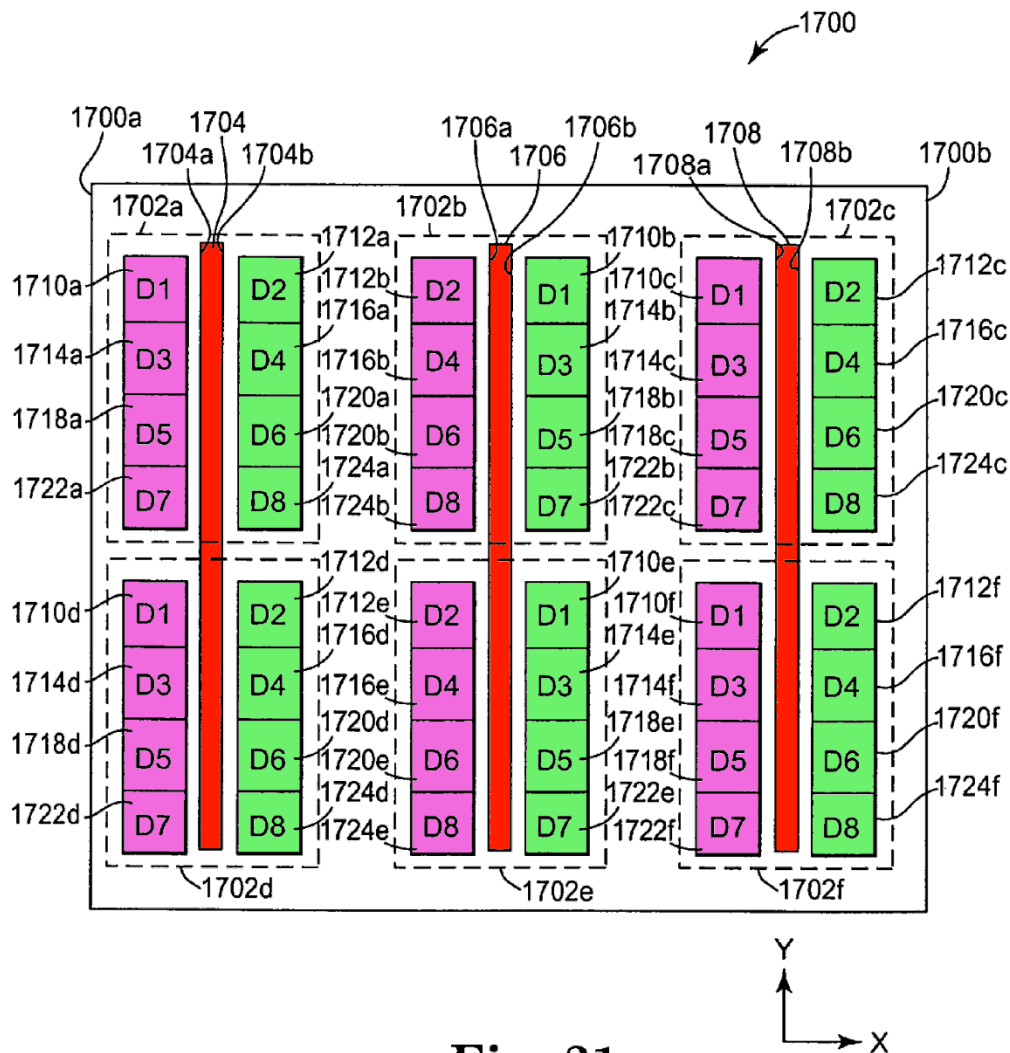


Fig. 21

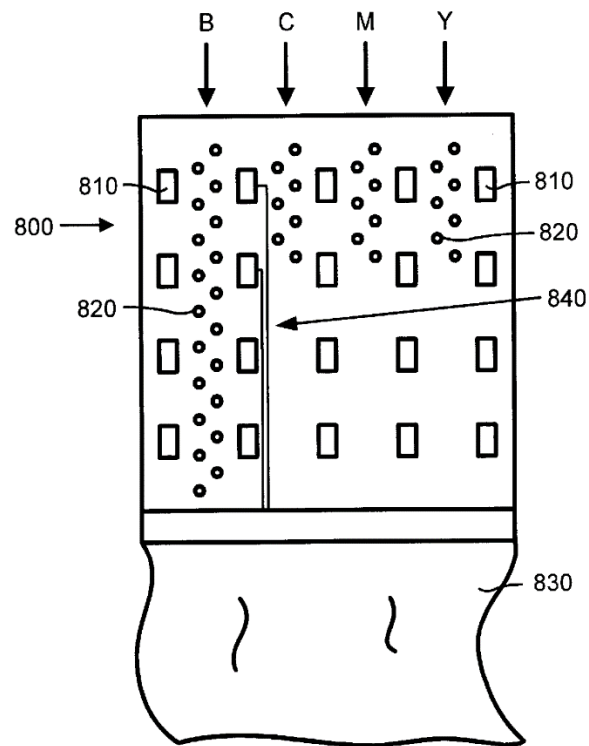
Ex.1005, Fig. 21 (annotated).

216. Benjamin '144 explicitly teaches “**the printhead die may include a fewer or greater number of fluid feed sources.**” Ex.1005, 67:35-36. Benjamin also teaches that its printhead die “can be arranged into **any suitable number of fire groups 102 a-102 n** and into **any suitable number of subgroups and data line groups.**” Ex.1005, 7:7-9.

217. In other words, while Benjamin '144 shows an exemplary embodiment including three fluid feed sources / ink vias and six fire groups, a PHOSITA would appreciate that Benjamin '144's invention could be applied to a "greater number of fluid feed sources," such as four. Benjamin '144 teaches that in its embodiment shown in Figure 21, above, "each of the ink feed slots 1704, 1706 and 1708 supplies a different color ink to drop generators 60 in fire groups 1702 a-1702 f...[or] the ink feed slots 1704, 1706 and 1708 can supply any suitably colored ink of the same or different colors." Ex.1005, 63:33-37.

218. Childers teaches "[t]he present invention relates in general to thermal ink jet (TIJ) printheads..." Ex.1007, 1:6-7. In particular, Childers teaches "the present invention is embodied in **a large array printhead** having **a large array of ink drop generators** formed on a single monolithic substrate." Ex.1007 2:13-15. Childers explains that "[t]he printhead of the present invention is suitable for **high-speed printing systems** such as large format printing systems and drum printers." Ex.1007, 3:62-65.

219. Like Benjamin '144, Childers teaches "[a] ink feed channel 400...provides ink to a plurality of firing chambers (not shown) and resistors 410." Ex.1007, 6:14-17. Childers also teaches "FIG. 8 is another embodiment of the present invention showing **a multi-chamber large array printhead** of the present invention." Ex.1007, 3:34-36.



Ex.1007, Figure 8.

220. Childers teaches that “in FIG. 8 there are **four different colors of ink** on the large array printhead 800 including black (B), cyan (C), magenta (M) and yellow (Y).” Ex.1007, 7:39-41. Childers, like Benjamin ’144, also similarly teaches “two rows of nozzles” for each orifice array, as shown in Figure 8, above.

221. For the reasons I discuss in Section X.G below, incorporated here, a PHOSITA would have been motivated to add an additional fluid feed source, as explicitly taught by Benjamin and demonstrated by Childers, to add an additional color to the printhead die. In particular, a PHOSITA would have been motivated to add a black colored ink for text printing as taught by Childers. Alternatively, a

PHOSITA would be motivated to add an additional “colored ink of the same...color” to extend the useful life of the printhead die with respect to any color that is used more frequently. In either scenario, it would have been an obvious matter to apply Benjamin’s teachings to create a printhead die with four fluid feed sources / ink vias and eight fire groups as taught by Childers.

222. In my opinion, it would have been obvious to add an additional fluid feed source to Benjamin’s printhead. This also would have been accomplished with a reasonable expectation of success as a PHOSITA could simply follow the conventional design for placement of fluid feed sources in the modified Benjamin system.

223. I have prepared an exemplary figure depicting what such a printhead would look like:

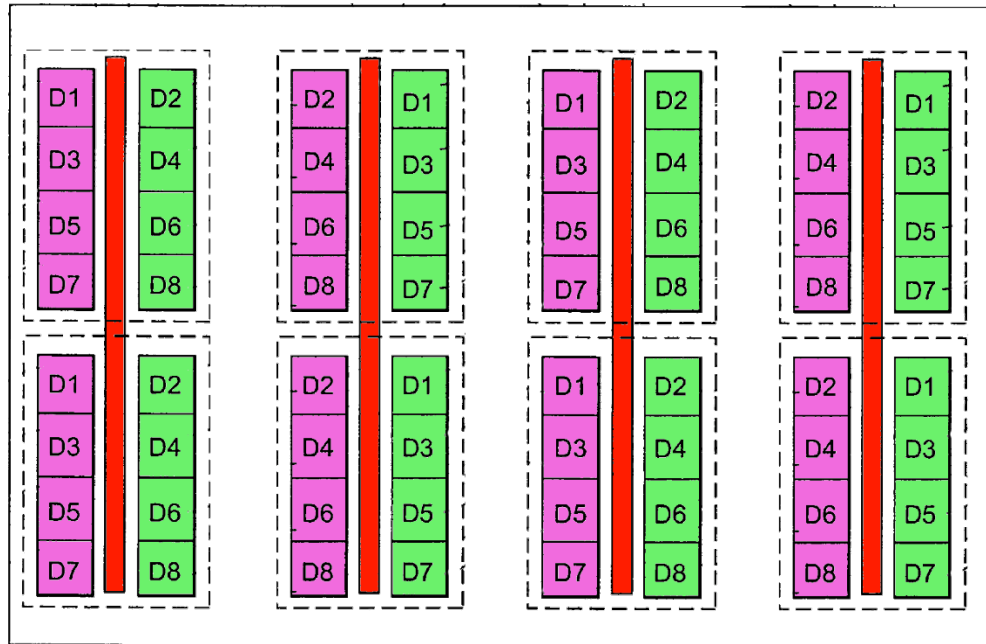
225. As a “[f]iring resistor 52 is part of a drop generator 60,” and “[t]he **firing resistors 52 of drop generators 60 are energized in a controlled sequence to eject fluid from vaporization chambers 56** and through nozzles 34 to print an image on print medium 36,” the firing resistors 52 within the drop generators 60 in data line groups D1, D3, D5, and D7 [magenta] correspond to the claimed first heater array of a heater array pair, and the firing resistors 52 within the drop generators 60 in data line groups D2, D4, D6, and D8 [green] correspond to the claimed second heater array of a heater array pair. Ex.1005, 5:64-67, 6:4-5.

226. Accordingly, it is my opinion that the Benjamin-Childers Combination discloses “at least **eight heater arrays** [e.g., firing resistors 52 within drop generators 60 in D1-D8 for each ink feed slot] wherein the at least eight heater arrays comprise four heater array pairs [e.g., firing resistors 52 within drop generators 60 in D1, D3, D5, D7 (magenta) paired with D2, D4, D6, D8 (green) for each ink feed slot].”

3. Benjamin-Childers Combination discloses 16[B] “wherein the arrays in each of the heater array pairs are disposed substantially adjacent opposing sides of at least a portion of an ink via; and”

227. Claim 16 of the '864 Patent recites “wherein the arrays in each of the heater array pairs are disposed substantially adjacent opposing sides of at least a portion of an ink via.” In my opinion, Benjamin discloses this limitation.

228. As I explained for limitation 16[A] above, incorporated here, a PHOSITA would have been motivated to add an additional fluid feed source, as taught by Benjamin and Childers, to add an additional color to the printhead die. *Supra* Section X.A.2. Such a combination is shown in modified Figure 21, below.



Ex.1005, Figure 21 (modified and annotated)

229. As shown above, the Benjamin-Childers Combination discloses eight heater arrays that comprise four heater array pairs, wherein the pairs are disposed substantially adjacent opposing sides of a portion of an ink via—(four magenta and green pairs adjacent a portion of four red ink vias).

230. As Benjamin '144 explains, “[d]rop generators 60 in data line groups **D1, D3, D5 and D7 [magenta]**, indicated at 1710a, 1714a, 1718a and 1722a, are disposed along one side 1704a of ink feed slot 1704 and drop generators 60 in

data line groups **D2, D4, D6 and D8 [green]**, indicated at 1712a, 1716a, 1720a and 1724a, are **disposed along the opposing side 1704b of ink feed slot 1704.**” Ex.1005, 64:9-14. Benjamin further notes that “[t]he pre-charged firing cells 120 in printhead die 1700 include **firing resistors 52 that are part of drop generators 60.**” Ex.1005, 64:2-4.

231. As a “[f]iring resistor 52 is part of a drop generator 60,” and “[t]he **firing resistors 52 of drop generators 60 are energized in a controlled sequence to eject fluid from vaporization chambers 56** and through nozzles 34 to print an image on print medium 36,” the firing resistors 52 within the drop generators 60 in data line groups D1, D3, D5, and D7 [magenta] correspond to the claimed first heater array of a heater array pair, and the firing resistors 52 within the drop generators 60 in data line groups D2, D4, D6, and D8 [green] correspond to the claimed second heater array of a heater array pair. Ex.1005, 5:64-67, 6:4-5.

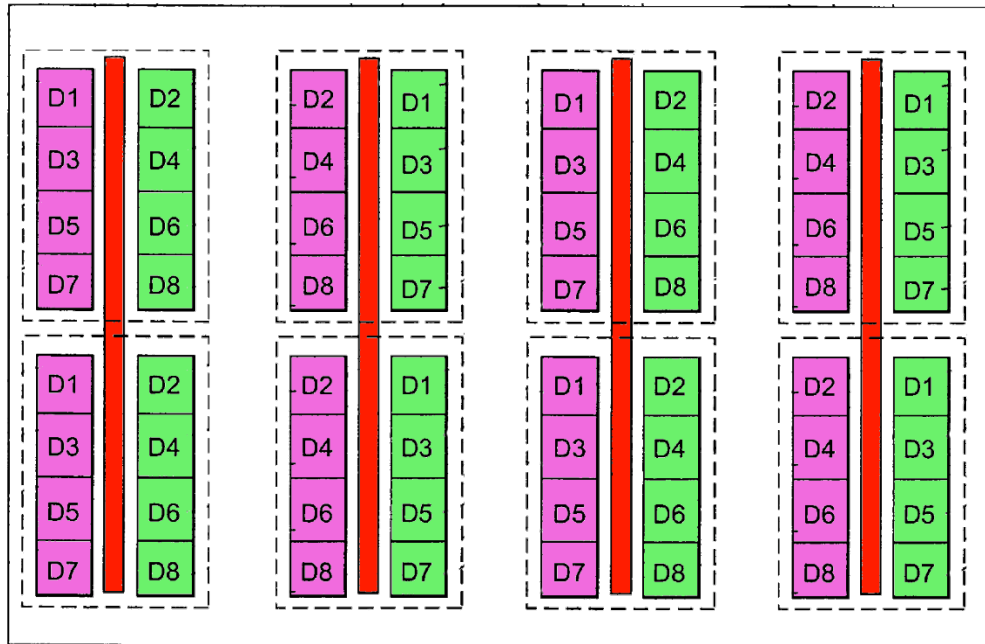
232. As seen in modified Figure 21 above, heater arrays (firing resistors 52 within drop generators 60 in data line groups D1, D3, D5, D7, magenta) are each adjacent at least a portion of one side of each ink feed slot [red]. And, their respective heater array pairs (firing resistors 52 within drop generators 60 in data line groups D2, D4, D6, D8, green) are each adjacent at least a portion of another side of the four ink feed slots [red].

233. Accordingly, it is my opinion that the Benjamin-Childers Combination discloses “wherein the **arrays** in **each** of the heater **array pairs** [e.g., firing resistors 52 within drop generators 60 in D1, D3, D5, D7 (magenta) paired with D2, D4, D6, D8 (green) for each ink feed slot] are **disposed substantially adjacent opposing sides** of at least **a portion of an ink via** [e.g., along each of four ink feed slots].”

4. Benjamin-Childers Combination discloses 16[C] “a plurality of bondpads operatively connected to the at least eight heater arrays, wherein at least one of the plurality of bondpads is operatively connected to both heater arrays within one of the heater array pairs”

234. Claim 16 of the '864 Patent recites “a plurality of bondpads operatively connected to the at least eight heater arrays.” In my opinion, Benjamin discloses this limitation.

235. As I explained for limitation 16[A] above, incorporated here, a PHOSITA would have been motivated to add an additional fluid feed source, as taught by Childers, to add an additional color to the printhead die. *Supra* Section X.A.2. As part of that modification, a PHOSITA would also have included an additional two fire groups for the additional fluid feed source. *Id.* Such a combination is shown in modified Figure 21, below.



Ex.1005, Figure 21 (modified and annotated)

236. As shown above, the Benjamin-Childers combination discloses eight heater arrays that comprise four heater array pairs, wherein the pairs are disposed substantially adjacent opposing sides of a portion of an ink via—(four magenta and green pairs adjacent a portion of four red ink vias).

237. For the same reasons I articulated in Claims 1[C] and 2 above, incorporated here, Benjamin discloses two bondpads for each pair of heater arrays—i.e., one bondpad for each fire group. *Supra* Sections IX.A.4 and IX.B.

238. Benjamin explains that:

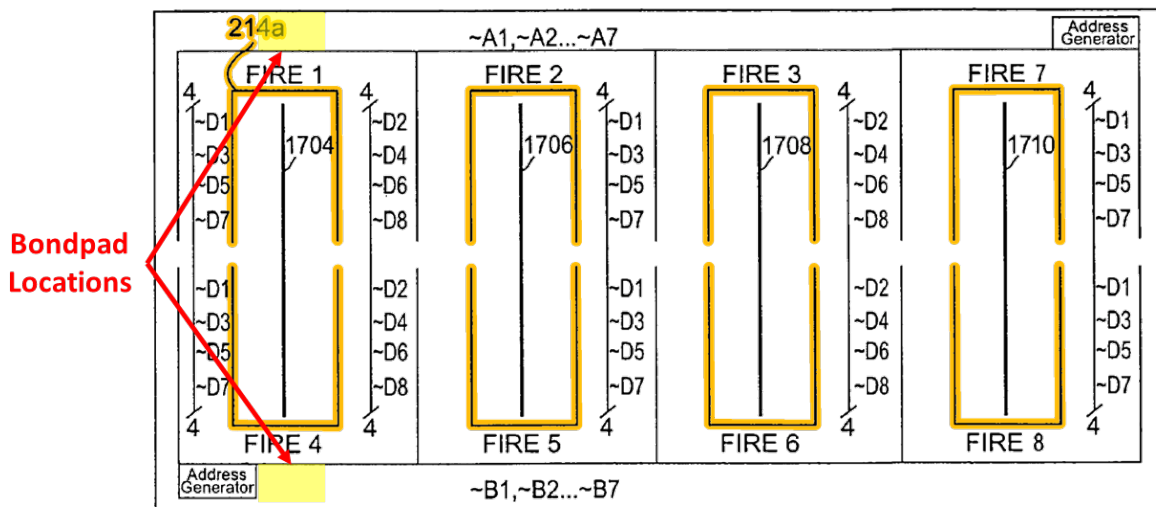
The conductive **fire lines 214a-214f** are located along ink feed slots **1704, 1706 and 1708** to supply energy signals **FIRE1, FIRE2 . . . FIRE6** to the fire groups **1702a-1702f**, respectively. The fire lines **214a-214f** supply energy to firing resistors **52** in conducting pre-

charged firing cells 120 to heat and eject ink from drop generators 60. **To uniformly eject ink from each drop generator 60 in a fire group 1702a-1702f, the corresponding fire line 214a-214f is configured to uniformly supply energy to each firing resistor 52 in the fire group 1702a-1702f.** Energy variation is the maximum percent difference in power dissipated through any two firing resistors 52 in one of the fire groups 1702a-1702f. The highest amount of power is found in the first firing resistor 52 of a fire group 1702a-1702f, the firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6, as only a single firing resistor 52 is energized. The lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.

Ex.1005, 69:42-60.

239. Benjamin '144 also notes that “[e]ach of the **fire lines 214a-214f are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.**” Ex.1005, 70:51-54. For example, “[f]ire line **214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a**” while “[f]ire line **214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.**” Ex.1005, 70:54-55, 71:8-9.

240. I have prepared an exemplary figure depicting how a PHOSITA would arrange the additional fire lines for the four ink via printhead:



Ex.1005, Fig. 22 (modified and annotated).

241. Thus, the Benjamin-Childers Combination teaches that the U-shaped fire lines located along both sides of the top half of ink feed slots supplies energy signals FIRE1-FIRE3, FIRE7 to the upper fire groups wherein the fire lines supply energy to the firing resistors 52 in the upper fire groups. In other words, upper fire lines are operatively connected to firing resistors located in each heater array located along both sides of the top half of each ink feed slot. Similarly, the U-shaped fire line located along both sides of the bottom half of ink feed slots supplies energy signals FIRE4-FIRE6, FIRE8 to the lower fire groups wherein the fire lines supply energy to the firing resistors 52 in these lower fire groups. In other words, fire lines

214d-214f are operatively connected to firing resistors located in each heater array located along both sides of the bottom half of ink feed slots 1704, 1706, and 1708.

242. Benjamin '144 also explains that:

Each of the fire lines 214a-214f is electrically coupled to all of the firing resistors 52 in the corresponding fire group 202a-202f, and all pre-charged firing cells 120 in a fire group 202a-202f are electrically coupled to only one fire line 214a-214f. The fire lines 214a-214f are electrically coupled to external supply circuitry by appropriate interface pads. (See, FIGS. 25A and 25B).

Ex.1005, 11:5-12.

243. Benjamin '144 further notes that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6**, and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.”

Ex.1005, 75:60-67 (ellipses in original).

244. Accordingly, it is my opinion that the Benjamin-Childers Combination discloses “a plurality of bondpads [e.g. “the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6” from “contacts 2006 which provide coupling to the printhead die”] operatively connected to the at least eight heater arrays [e.g. firing

resistors 52 within drop generators 60 in D1, D3, D5, D7 (magenta) and D2, D4, D6, and D8 (green) for each fluid feed source] wherein at least one of the plurality of bondpads [e.g. the bond pads for each U-shaped fire line] is operatively connected to both heater arrays within one of the heater array pairs [e.g. firing resistors 52 within drop generators 60 in D1, D3, D5, D7 (magenta) paired with D2, D4, D6, and D8 (green) via U-shaped fire line 214 for each fluid feed source].”

B. Benjamin-Childers Combination discloses Claim 17

245. Claim 17 depends from independent claim 16. Benjamin-Childers Combination discloses all of the limitations of claim 16 for reasons discussed above. The additional limitations of claim 17 are also disclosed by Benjamin-Childers Combination.

246. Claim 17 states “[t]he chip of claim 16, **wherein each of the at least eight heater arrays comprises a plurality of thin film resistors.**” Ex.1001, cl. 17.

247. The additional limitations of claim 17 are analogous to the limitations of claim 6 and is thus disclosed by Benjamin-Childers Combination for the same reasons I provide above. *Supra* section IX.E, incorporated here.

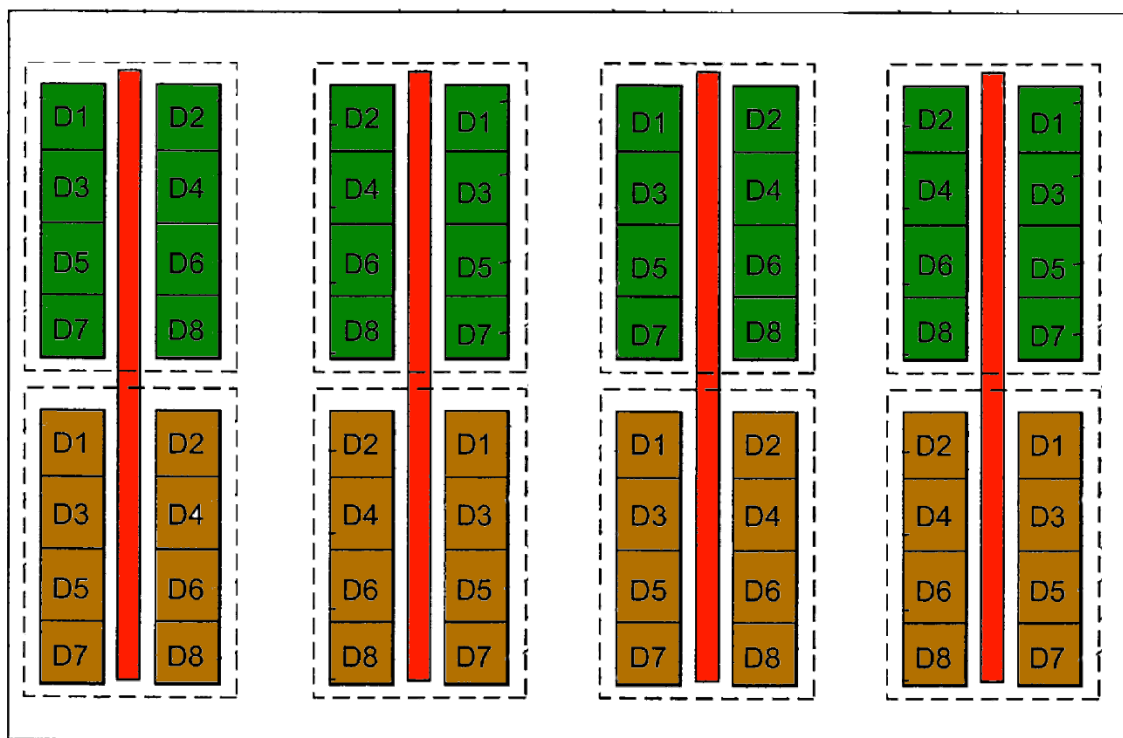
C. Benjamin-Childers Combination discloses Claim 19

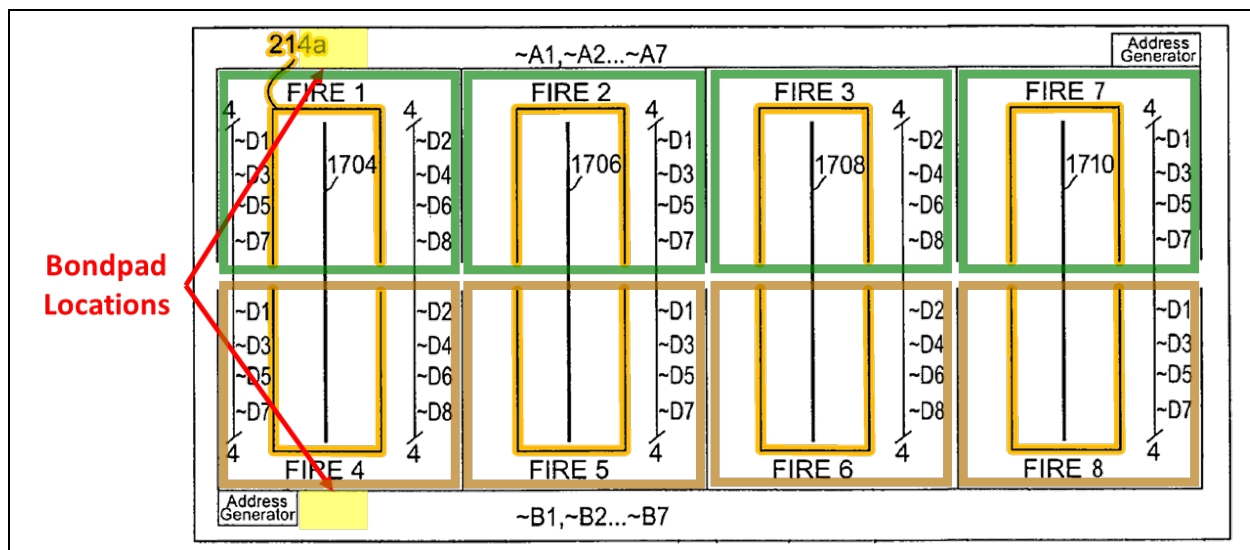
248. Claim 19 depends from independent claim 16. Benjamin-Childers Combination discloses all of the limitations of claim 16 for reasons discussed above.

The additional limitations of claim 19 are also disclosed by Benjamin-Childers Combination.

249. Claim 19 states “[t]he chip of claim 16, wherein each of the at least eight heater arrays comprises a top portion and a bottom portion, and wherein some of the plurality of bondpads are operatively connected to the top portion of one of the at least eight heater arrays and the top portion of another one of the at least eight heater arrays.” Ex.1001, cl. 19.

250. As discussed in Claim 16, incorporated here, Benjamin-Childers Combination discloses eight heater arrays that comprise four heater array pairs. As shown in modified Figures 21 and 22, below, each of the heater arrays includes a top portion (green) and a bottom portion (brown).





Ex.1005, Figs. 21 and 22 (modified and annotated)

251. In particular, Benjamin '144 teaches that “[e]ach of the **fire lines 214a-214f** are disposed on both sides of an ink feed slot 1704, 1706 or 1708 and electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f** are electrically coupled to pre-charged firing cells 120 located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.” Ex.1005, 70:51-54. For example, “[f]ire line 214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a” while “[f]ire line 214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.” Ex.1005, 70:54-55, 71:8-9.

252. For the same reasons provided in limitation 16[C], Benjamin-Childers Combination discloses a plurality of bondpads operatively connected to each of the heater array pairs. *Supra* Section X.A.4, incorporated here.

253. Further, the additional limitations of claim 19 are analogous to the limitations of claim 13 and disclosed for the same reasons provided above in Section IX.I, incorporated here.

254. For instance, Benjamin '144 teaches that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6**, and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.” Ex.1005, 75:60-67 (ellipses in original).

255. Accordingly, it is my opinion that the Benjamin-Childers Combination discloses “wherein each of the at least eight heater arrays [e.g., firing resistors 52 within drop generators 60 in D1, D3, D5, D7 and D2, D4, D6, and D8 for each fluid feed source] comprises a top portion [e.g. firing resistors 52 within drop generators 60 in D1-D8 for each top fire group (green)] and a bottom portion [e.g. firing resistors 52 within drop generators 60 in D1-D8 for each bottom fire group (brown)], and wherein some of the plurality of bondpads [e.g. “the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6” from “contacts 2006 which provide coupling to the printhead die”] are operatively connected to the top portion of one

of the at least eight heater arrays and the top portion of another one of the at least eight heater arrays [e.g. each of the top fire groups with U-shaped fire lines].”

D. Benjamin-Childers Combination discloses Claim 20

256. Claim 20 depends from claim 19 and independent claim 16. Benjamin-Childers Combination discloses all of the limitations of claims 16 and 19 for reasons discussed above. The additional limitations of claim 20 are also disclosed by the Benjamin-Childers Combination.

257. Claim 20 states “[t]he chip [sic] claim 19, wherein some of the plurality of bondpads are operatively connected to the bottom portion of one of the at least eight heater arrays and to the bottom portion of another one of the at least eight heater arrays.” Ex.1001, cl. 20.

258. As discussed in Claim 16, incorporated here, the Benjamin-Childers Combination discloses eight heater arrays that comprise four heater array pairs. As shown in modified Figure 21, below, each of the combination’s heater arrays includes a top portion (green) and a bottom portion (brown).

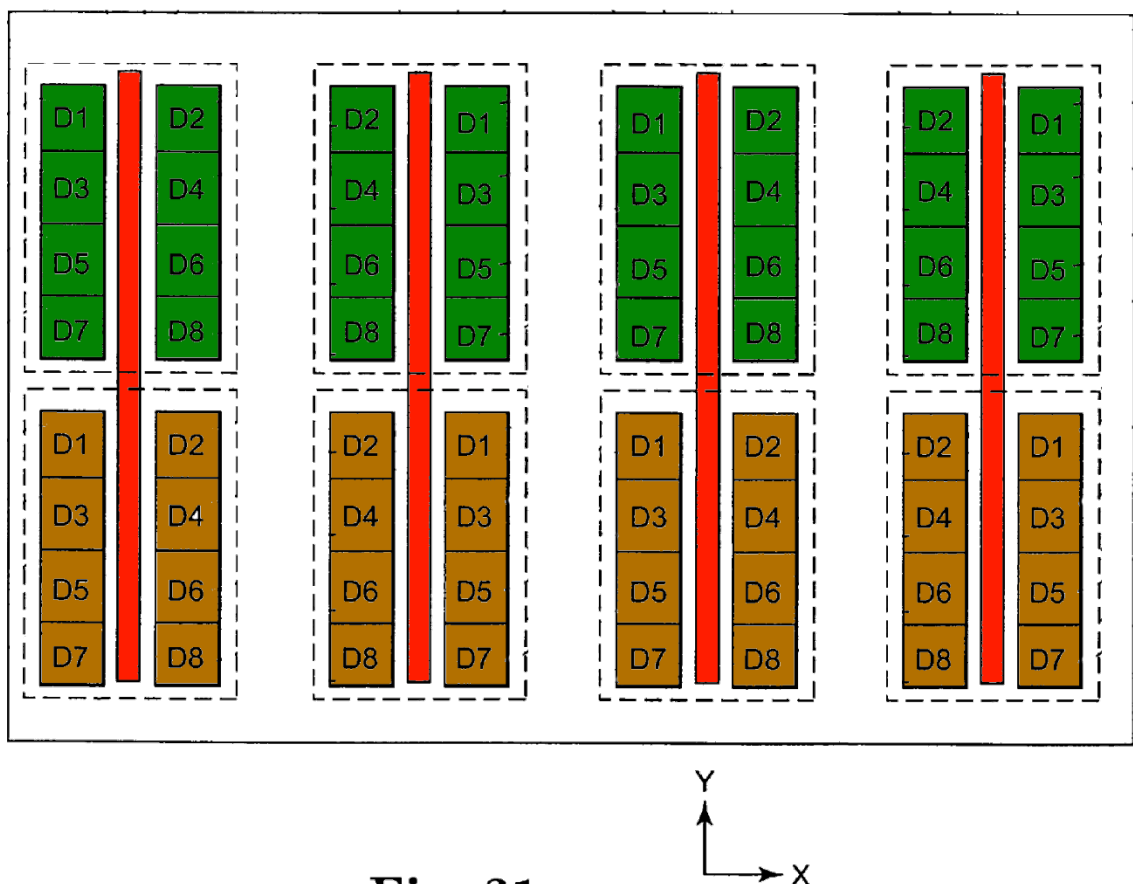


Fig. 21

Ex.1005, Fig. 21 (modified and annotated)

259. In particular, Benjamin '144 teaches that “[e]ach of the **fire lines 214a-214f** are **disposed on both sides of an ink feed slot 1704, 1706 or 1708** and **electrically coupled at one end of the ink feed slot 1704, 1706 or 1708 to form a substantially U-shaped fire line 214a-214f.**” Ex.1005, 70:17-21. “The substantially U-shaped **fire lines 214a-214f** are **electrically coupled to pre-charged firing cells 120** located along each of the opposing sides of ink feed slots 1704, 1706 and 1708.” Ex.1005, 70:51-54. For example, “[f]ire line 214a is electrically coupled to each of the pre-charged firing cells 120 in FG1 at 1702a”

while “[f]ire line 214d is electrically coupled to each of the pre-charged firing cells 120 in FG4 at 1702d.” Ex.1005, 70:54-55, 71:8-9.

260. For the same reasons provided in limitation 16[C], Benjamin-Childers Combination discloses a plurality of bondpads operatively connected to each of the heater array pairs. *Supra* Section X.A.4, incorporated here.

261. For instance, Benjamin ’144 teaches that “[t]he highest amount of power is found in the **first firing resistor 52 of a fire group 1702a-1702f** as only a single firing resistor 52 is energized, where the first firing resistor 52 is the **firing resistor 52 nearest the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6**, and “[t]he lowest amount of power is found in the last firing resistor 52 of a fire group 1702a-1702f as all firing resistors 52 in a row subgroup are energized.” Ex.1005, 75:60-67 (ellipses in original).

262. Accordingly, it is my opinion that Benjamin-Childers Combination discloses “wherein some of the plurality of bondpads [e.g. “the bond pad receiving the energy signal FIRE1, FIRE2 . . . FIRE6” from “contacts 2006 which provide coupling to the printhead die”] are operatively connected to the bottom portion of one of the at least eight heater arrays and to the bottom portion of another one of the at least eight heater arrays. [e.g. each of bottom fire groups (brown) with U-shaped fire lines].”

E. Benjamin-Childers Combination discloses Claims 4, 11, and 18

263. Claim 4 depends from independent claim 1, claim 11 depends from independent claim 8, and claim 18 depends from independent claim 16. The Benjamin Combination discloses all of the limitations of claims 1, 8, and 16 for the reasons discussed in Ground 1 above, incorporated here. *See* Sections IX.A, IX.F, and IX.L. The additional limitations of claims 4, 11, and 18 are disclosed by the Benjamin-Childers Combination.

264. Claim 4 states “[t]he heater chip of claim 1, wherein each of the first and second heater arrays comprise at least 320 heaters.” Ex.1001, cl. 4. Similarly, claim 11 states “[t]he heater chip of claim 8, wherein each of the first and second heater arrays contain at least 320 heaters.” Ex.1001, cl. 11. Claim 18 states “[t]he chip of claim 16, wherein each of the at least eight heater arrays comprises at least 320 heaters.” Ex.1001, cl. 18.

265. Benjamin ’144 teaches “[i]n one embodiment, printhead die 1700 includes 600 drop generators 60. Each of the six fire groups 1702 a-1702 f includes 100 drop generators 60.” Ex.1005, 67:24-26. Benjamin ’144 also teaches “[i]n other embodiments, **printhead die 1700 can include any suitable number of drop generators 60**, such as 400 drop generators 60 or **more than 600 drop generators 60**.” Ex.1005, 67:29-32. Benjamin ’144 is explicit that “[a] drop generator 60 as referred to herein includes **firing resistor 52**,” which is a heater. Ex.1005, 4:54-5:10.

266. Benjamin '144 explicitly teaches “a printhead with **more drop generators** typically prints with **higher quality and/or printing speed.**” Ex.1005, 1:67-2:2. Benjamin '144 also teaches “there is a need for the present invention” to address problems that arise “[a]s **drop generator densities increase** and the number of input pads decrease, printhead die layouts can become increasingly complex.” Ex.1005, 2:5-7.

267. Therefore, while Benjamin '144's exemplary embodiment discloses a printhead with 100 drop generators per fire group, Benjamin '144 explicitly teaches its invention can include “any suitable number of drop generators 60” and describes the advantages of additional drop generators/heaters as including “higher quality and/or printing speed.” In my opinion, it would have been obvious to a PHOSITA to increase the number of drop generators, and thus heaters, in order to increase the printing speed and/or to increase the print quality. Benjamin '144 explicitly teaches it was a known technique that increasing the number of drop generators resulted in “improve[d] printing speed and/or quality.” Ex.1005, (“As inkjet printheads have evolved, the number of drop generators in a printhead has increased to improve printing speed and/or quality.”). Further, Benjamin '144's invention is designed to address the complexity that results from such an increase in drop generators.

268. In view of Benjamin '144's express teaching, a PHOSITA would have been motivated to increase the number of drop generators for large format printing applications, such as those described in Childers.

269. Childers teaches "[t]he present invention relates...more specifically to **a large array printhead** having a large array of TIJ thin-film ink drop generators formed on a single monolithic substrate." Ex.1007, 1:6-9. In particular, Childers teaches "the present invention is embodied in **a large array printhead** having **a large array of ink drop generators** formed on a single monolithic substrate." Ex.1007, 2:13-15. Childers explains that "[t]he printhead of the present invention is suitable for **high-speed printing systems** such as large format printing systems and drum printers." Ex.1007, 3:62-65.

270. Like Benjamin '144, Childers teaches "[a] ink feed channel 400...provides ink to a plurality of firing chambers (not shown) and resistors 410." Ex.1007, 6:14-17.

271. As shown in Figure 3A, below, Childers teaches "[i]n a preferred embodiment, the orifice array 305 is 2.5 inches long, has staggered nozzle spacing and has a resolution of 600 dots per inch (dpi) created by **two rows of nozzles** (each row having a resolution of 300 dpi)." Ex.1007, 5:30-33. Childers further teaches that "[p]referably, there are approximately **1500 nozzles** formed on the printhead 300." Ex.1007, 5:34-35. In other words, Childers teaches an ink jet print head with 750

nozzles or drop generators in each array, and thus 750 heaters in each array. Ex.1007, 1:44-46 (“the drop generators eject ink drops through a nozzle or an orifice by rapidly heating a small volume of ink...vaporization of the ink drops typically is accomplished using an **electric heater**, such as a small thin-film (or firing) resistor.”)

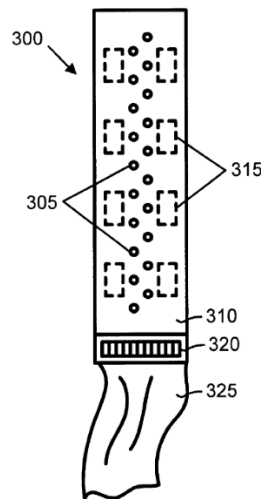


FIG. 3A

Ex.1007, Figure 3A

272. Also like Benjamin '144, Childers teaches its “large array printhead” can be “a multi-chamber large array printhead 800” with multiple ink vias. As shown in Figure 8, below, Childers teaches “FIG. 8 is another embodiment of the present invention showing a multi-chamber large array printhead 800 of the present invention. This embodiment is similar to the embodiment shown in FIGS. 3A through 3C except that there are **a plurality of chambers each containing a different color of ink.**”

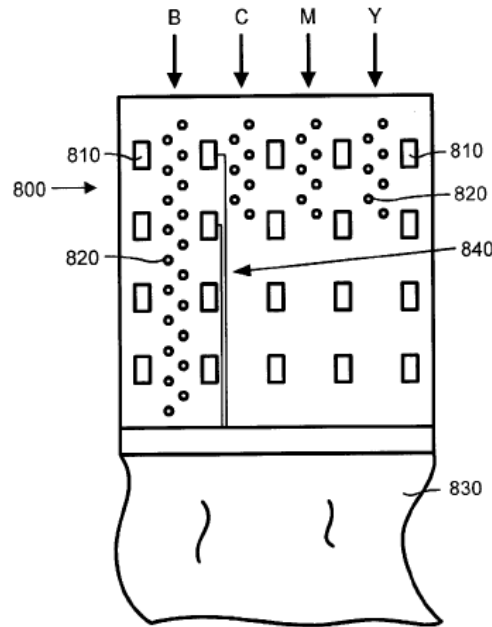


FIG. 8

Ex.1007, Figure 8.

273. It therefore would have been obvious to modify the configuration of Benjamin '144 to utilize a large array printhead with 750 heaters per array, as described in Childers, to increase the printing speed of Benjamin '144's printhead.

274. Therefore, in my opinion, the Benjamin-Childers combination discloses "[t]he heater chip of claim 1, wherein each of the **first and second heater arrays** comprise **at least 320 heaters** [i.e., 750 heaters for each array]."

F. Benjamin-Childers Combination discloses Claim 12

275. Claim 12 depends from claim 11, which depends from independent claim 8. Benjamin '144 discloses all of the limitations of claims 8 for the reasons discussed in Ground 1 above, incorporated here. *See* Section IX.F. The Benjamin-Childers Combination also discloses the limitations of claim 11 for the reasons

provided above in this ground, incorporated here. *See* Section X.E. The additional limitations of claim 12 are disclosed by the Benjamin-Childers Combination.

276. Claim 12 states “[t]he heater chip of claim 11, wherein the bondpad and the at least two traces are capable of supplying eight simultaneous fires per heater array.” Ex.1001, cl. 12.

277. As shown in Benjamin ’144 Figure 5, below, Benjamin ’144 teaches “one embodiment of an inkjet printhead firing cell array, indicated at 100.” Ex.1005, 6:37-38. Benjamin ’144 teaches “Firing cell array 100 includes a plurality of firing cells 70 arranged into n fire groups 102a-102n” and “are schematically arranged into L rows and m columns.” Ex.1005, 6:38-40, 45-46.

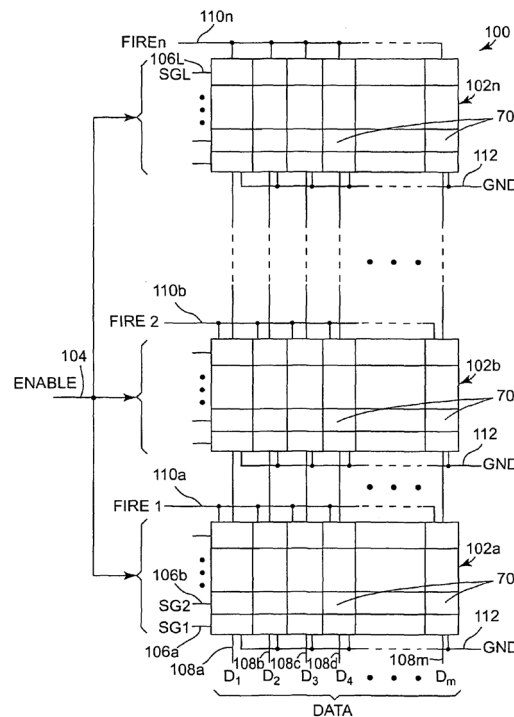


Fig. 5

Ex.1005, Figure 5.

278. Benjamin '144 teaches that “[e]ach row [L] of firing cells 70, referred to herein as a row subgroup or subgroup of firing cells 70, is electrically coupled to one set of subgroup enable lines 106a-106L... [that] receive subgroup enable signals SG1, SG2, . . . SGL that enable the corresponding subgroup of firing cells 70.” Ex.1005, 6:48-53.

279. Benjamin '144 also teaches “The m columns are electrically coupled to m data lines 108a-108m that receive data signals D1, D2 . . . Dm, respectively” and that “each of the data lines 108a-108m is electrically coupled to each of the firing cells 70 in one column, including firing cells 70 in each of the fire groups 102a-102n.” Ex.1005, 6:54-62.

280. Further, Benjamin '144 teaches “the firing cells 70 in each of the fire groups 102 a-102 n are electrically coupled to one of the fire lines 110 a-110 n...that receives fire signal or energy signal FIRE1[-FIREn].” Ex.1005, 7:18-22.

281. Benjamin '144 teaches that “[i]n operation, subgroup enable signals SG1, SG2, . . . SGL are provided on subgroup enable lines 106 a-106L to enable one subgroup of firing cells 70.” Ex.1005, 7:30-32. Benjamin '144 further teaches “[t]he enabled firing cells 70 store data signals D1, D2 . . . Dm provided on data lines 108 a-108 m...[that] sets the state of drive switch 72 in one of the enabled firing cells 70...to conduct or not conduct based on the stored data signal value.” Ex.1005, 7:32-39.

282. In operation, Benjamin '144 explains that “[a]fter the states of the selected drive switches 72 are set, an energy signal FIRE1-FIREn is provided on the fire line 110 a-110 n corresponding to the fire group 102 a-102 n that includes the selected subgroup of firing cells 70...to energize firing resistors 52 in firing cells 70 that have conducting drive switches 72.” Ex.1005, 7:40-47. “The energized firing resistors 52 heat and eject ink onto print medium 36 to print an image represented by data signals D1, D2 . . . Dm.” Ex.1005, 7:47-49.

283. Benjamin '144 teaches that “[i]n one embodiment, array 100 is arranged into six fire groups 102 a-102 n and each of the six fire groups 102 a-102 n includes 13 subgroups and eight data line groups.” Ex.1008, 7:4-6. Benjamin '144, however, is explicit that “array 100 can be arranged into any suitable number of fire groups 102 a-102 n and into **any suitable number of subgroups and data line groups**” and that “each of the fire groups 102 a-102 n can have a different number of subgroups and/or data line groups as compared to any other fire group 102 a-102 n.” Ex.1005, 7:7-14. Benjamin '144 is also explicit that “each subgroup can have a different number of firing cells 70 as compared to any other subgroup, and each data line group can have a different number of firing cells 70 as compared to any other data line group.” Ex.1005, 7:14-17.

284. As Benjamin '144 teaches its firing cell array 100 is organized into a three-dimensional matrix addressed by three wiring “lines”: n fire line groups, L row

subgroup address lines and m data lines. In the exemplary embodiment provided in Benjamin '144, there are $n = 6$ fire groups, $L = 13$ row subgroups and $m = 8$ data line groups, which can serve up to $6 \times 13 \times 8 = 624$ heaters. In my opinion, a PHOSITA would understand that the number of data lines in a particular fire group determines the number of simultaneous firings that can occur for that fire group at any one moment. That is because the data line data, a 1 or a 0, is the final determiner of whether a drop is fired and has to be correct for whatever drop generators are being selected by the other two matrix elements, the fire group lines and the row subgroup lines.

285. Therefore, based on Benjamin '144's teaching alone, 8 drop generators can be simultaneously fired in a particular fire group. This is shown schematically in figures 21 and 22, below.

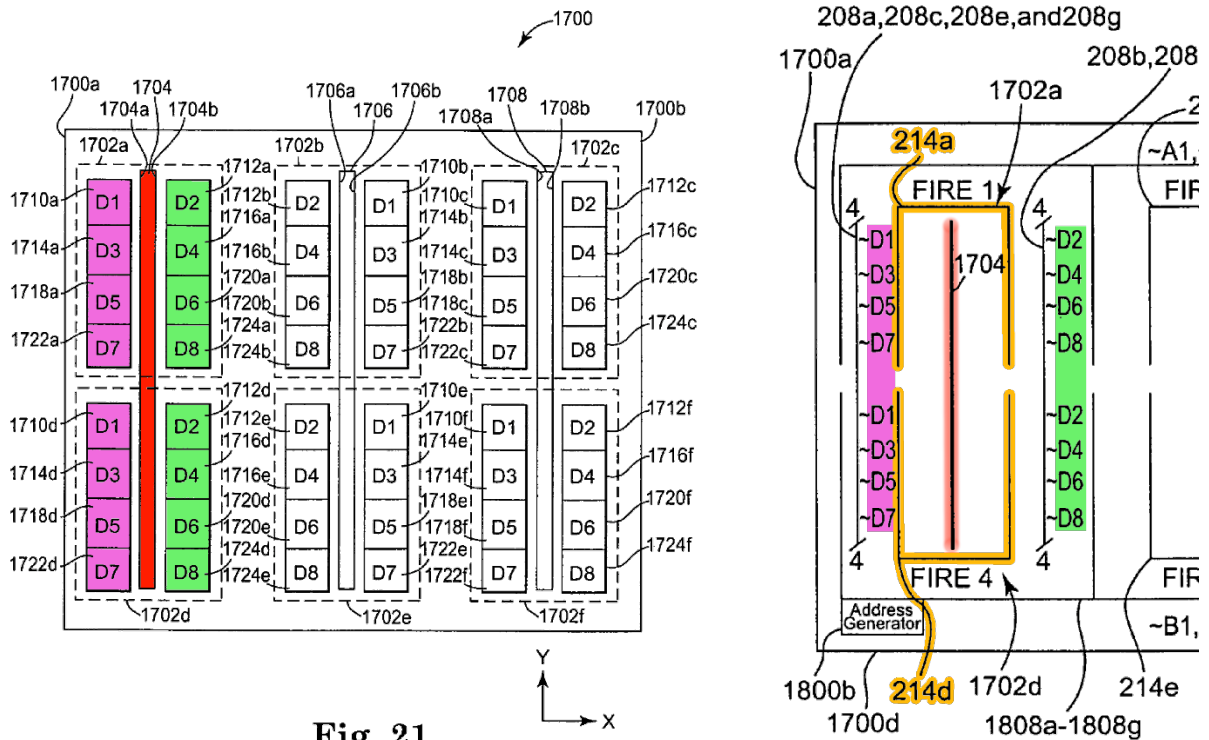


Fig. 21

Ex.1005, Figures 21 and 22.

286. Figure 21 shows that each of the six fire groups services drop generators that are connected to all eight data lines, the Dm groups. Thus, if an image required all eight drop generators to fire when one particular fire line was chosen and one particular row subgroup was chosen, Figures 21 and 22 show that there will be four firings (four Dm group members) in the left trace of the firing line U and four firings (four Dm group members) in the right trace of the firing line U.

287. For the same reasons I provide above, the Benjamin-Childers Combination discloses 750 heaters per ink via array side, 1500 heaters per ink via in total. *Supra* Section X.E, incorporated here. Keeping the structure of Benjamin '144's addressing scheme, a PHOSITA would appreciate that in order to

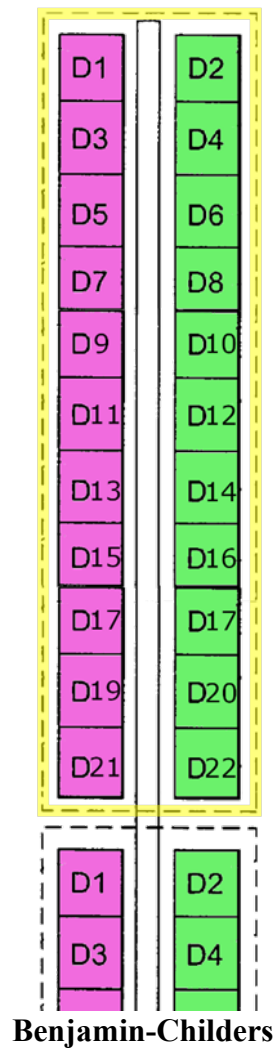
accommodate the increased number of heaters, an increase in the number of data lines and subgroups would be necessary. Such an increase is explicitly taught by Benjamin '144. Ex.1005, 7:7-9 (“array 100 can be arranged into any suitable number of fire groups 102 a-102 n and into **any suitable number of subgroups and data line groups.**”).

288. In order to accommodate 750 heaters per via side array, which is equivalent to 750 heaters per Benjamin '144 fire group, 375 heaters served by a U-shaped fire line on both sides of a via, then a PHOSITA would implement a commensurate increase in the number of data lines and row subgroups. Keeping Benjamin '144's structure of 2 U-shaped fire lines per ink via, the addressing matrix formed by m data lines and L row subgroups numbers would be chosen to support addressing at least 750 members, i.e. $(m)(L) \geq 750$.

289. Further, a PHOSITA would maintain Benjamin '144's disclosed ratio of subgroups to data lines (13:8), arriving at 35 subgroups and 22 data lines to provide sufficient capacity for 770 heaters per fire group. This would result in capacity for 22 simultaneous firings within a fire group. A PHOSITA would know to balance the 22 data groups between the two via sides of each U-shaped fire line group so as to best limit and balance the simultaneous heater firing current in the fire line. For example, by organizing 11 data groups, $D_m(\text{odd})$ or $D_m(\text{even})$, on each via side in analogous fashion to the Benjamin-114 organization of 8 data groups a

similar current balance would be realized. This arrangement would provide for 11 simultaneous heater firings on each of the right and left traces of the eight U-shaped firing lines.

290. Below is an exemplary figure showing the Benjamin-Childer's data line arrangement for a single fire group:



291. Such an arrangement would allow the Benjamin-Childers printhead to print with a swath height that was 7.5 times wider, allowing for a substantial increase in printing speed.

292. Therefore, in my opinion, the Benjamin-Childers combination discloses “[t]he heater chip of claim 11, wherein the bondpad and the at least two traces are capable of supplying eight simultaneous fires per heater array [e.g., 11 simultaneous fires on each left and right trace of the U-shaped firing line].”

G. Ample Motivation Existed to Combine Benjamin ’144, Benjamin ’703, and Childers

293. A PHOSITA would have been motivated to combine Benjamin-144 with Benjamin-703 for the reasons explained above in Section IX.L and incorporated here. A PHOSITA would have further been motivated to modify the Benjamin Combination in view of Childers for the following reasons.

294. *First*, like Benjamin-144 and Benjamin-703, Childers is also **analogous** to the claimed subject matter in the ’864 Patent and within the **same field of endeavor** of heater chips for inkjet printheads. *See, e.g.*, Ex.1007, Abstract, 1:42-52. Additionally, the USPTO classified the ’864 Patent, Benjamin-144, Benjamin-703 and Childers under the same patent classification—class B41 (printing; lining machines; typewriters; stamps).

295. *Second*, a PHOSITA would have been motivated to modify the Benjamin Combination to utilize 750 heaters per array, as described in Childers for

large format print media. Benjamin-144 explicitly teaches “a printhead with **more drop generators** typically prints with **higher quality and/or printing speed.**” Ex.1005, 1:67-2:2. Benjamin-144 also expressly teaches that “**printhead die 1700 can include any suitable number of drop generators 60**, such as 400 drop generators 60 or **more than 600 drop generators 60.**” Ex.1005, 67:29-32. In view of Benjamin-144’s express teachings, a PHOSITA would have looked to Childers, which teaches “**a large array printhead having a large array of ink drop generators** formed on a single monolithic substrate.” Ex.1007, 2:13-15. Childers teaches the advantages of thermal inkjet printers like Benjamin-144 (Ex.1007, 1:12-20) and explicitly teaches how such benefits can be applied to large format devices for large print media, “such as architectural drawings.” Ex.1007, 1:53-2:7. Childers also teaches that “[t]he printhead of the present invention is suitable for **high-speed printing systems** such as large format printing systems and drum printers.” Ex.1007, 3:62-65. Childers teaches that in its exemplary embodiment “has staggered nozzle spacing and has a resolution of 600 dots per inch (dpi) created by **two rows of nozzles**” and “[p]referably, there are approximately **1500 nozzles** formed on the printhead 300.” Ex.1007, 5:30-35. In view of these advantages, it would have been obvious to a PHOSITA to modify the Benjamin Combination printhead to include 1500 nozzles per color as taught by Childers. By making such a modification, a

PHOSITA would have understood that this could create “a dimensionally precise large array printhead suitable for high-speed printing systems.” Ex.1007, 2:1-2.

296. A PHOSITA also would have been motivated to modify the Benjamin Combination’s firing cell array to accommodate the increased number of heaters. Because a PHOSITA would have been motivated to modify the Benjamin Combination to have 750 heaters per array, a PHOSITA would have understood that these heaters would have needed to be activated in an efficient manner in order to provide the desired printing speed and density. A PHOSITA would have modified the Benjamin Combination firing cell array as described in Section X.F. Such a modification would have resulted in an approximately 2.7 times increase in the number data lines and subgroups, resulting in 22 data lines and 35 subgroups. This would provide sufficient capacity for 770 heaters per fire group and would result in capacity for 22 simultaneous firings. Such an arrangement would allow the Benjamin-Childers printhead to print with a swath height that was 7.5 times wider, allowing for a substantial increase in printing speed.

297. A PHOSITA would also have been motivated to modify the Benjamin Combination to include **Childer’s multi-chamber printhead** to facilitate color and black text printing with a single printhead. Ex.1007, 3:34-36, 7:39-41. Benjamin-144 explicitly teaches “**the printhead die may include a fewer or greater number of fluid feed sources.**” Ex.1005, 67:35-36. In my opinion, it would have been

obvious to try for a PHOSITA to increase the number of ink vias from three to four and would have yielded predictable results. There a finite number of ways a PHOSITA can add black ink printing to the Benjamin Combination's printhead: either add an additional black printhead to the printer or add a fourth black ink via to the Benjamin Combination printhead. In my opinion, the latter is preferred because it is less expensive, results in an overall smaller printing device, and a PHOSITA would have had a reasonable expectation of success (as demonstrated by Childers). Thus, a POSITA wanting a more versatile printhead, i.e., able to print black text instead of just color images, would have been motivated to modify the Benjamin Combination to include Childer's multi-chamber printhead.

298. A PHOSITA also would have been motivated to modify the Benjamin Combination's firing cell array to accommodate the additional fluid feed source. Benjamin-144 is explicit that its printhead die "can be arranged into **any suitable number of fire groups** 102 a-102 n and into **any suitable number of subgroups and data line groups.**" Ex.1005, 7:7-9. When a PHOSITA added the additional fluid feed source, he would also have been motivated to add the necessary components to eject ink from that fluid feed source, including additional fire groups and their respective U-Shaped fire lines 214 and associated fire line bondpads.

299. *Third*, even if Benjamin-144 did not provide an express motivation (which it does), then increasing the number of nozzles and fluid feed sources in the

Benjamin Combination like Childer's large array printhead would have been an obvious combination of prior art elements to yield predictable results. A PHOSITA could have combined Childer's large array 1500 nozzle per color, 4 fluid feed source printhead with Benjamin-144's printhead using known methods, and such an increase in nozzles and fluid feed sources would merely perform the same function—printing larger swaths at higher speeds—as taught by Childers. The combination, adding additional nozzles and fluid feed sources to the Benjamin Combination, would have resulted in higher printing speed and additional capability for text printing would have been predictable to a PHOSITA.

300. *Finally*, a PHOSITA would have had a reasonable expectation of success in making this modification. The printhead components described in the Benjamin Combination and Childers (e.g., thermal ink jet printing, drop generators, heaters, firing cell arrays) were well-known at the time. *See, e.g.*, Ex.1005, 1:32-45; 1:46-48 (“As inkjet printheads have evolved, the number of drop generators in a printhead has increased to improve printing speed and/or quality.”); 1:64-2:2 (“Manufacturers continue reducing the number of input pads and increasing the number of drop generators on a printhead die...a printhead with more drop generators typically prints with higher quality and/or printing speed.”); Ex.1007, 1:12-13 (“Thermal ink jet (TIJ) printers are popular and common in the computer field.”); 1:13-52; 1:53-57 (“High speed printing systems...use a large array

printhead containing arrays of ink drop generators in order to print over a wide area.”). As such, it would also have been straightforward for a PHOSITA to modify the Benjamin Combination to increase the number of drop generators and the number of fluid feed sources taught by Childers and such a system would work. A PHOSITA would have accomplished such a modification to Benjamin’s printhead with a reasonable expectation of success as a PHOSITA could simply follow the conventional design for placement of drop generators and fluid feed sources in the modified Benjamin system.

301. Therefore, motivation existed to modify the Benjamin Combination in view of Childers. Because the combined Benjamin-Childers combination discloses all limitations of claim 4, 11-12, and 16-20, those claims are rendered obvious.

XI. GROUND 3: UENISHI ANTICIPATES CLAIMS 1, 3, 5, 6, 8-10, 13 AND 15 OF THE ’864 PATENT

302. In my opinion, Uenishi discloses all of the limitations of claims 1, 3, 5, 6, 8-10, 13 and 15 of the ’864 Patent.

A. Discussion of Claim 1

303. As I explain below, Uenishi discloses each and every limitation of independent claim 1.

1. Uenishi discloses 1[P] “A heater chip for use in a printing device”

304. I have been informed by counsel that a preamble is generally not limiting unless it is necessary to give life, meaning, and vitality to the claim. I

understand that the preamble here is not limiting because it merely states the intended use of the purported invention and is not a limitation of the independent claim.

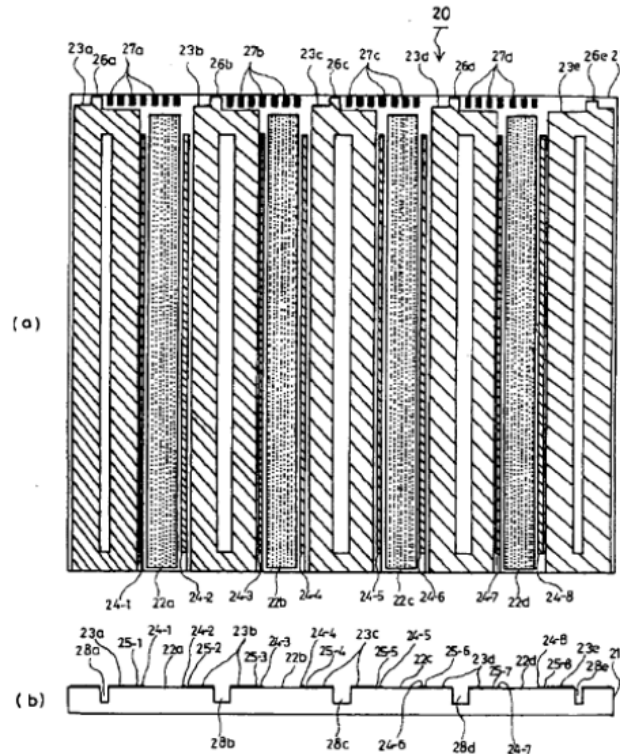
305. To the extent the preamble is determined to be limiting, in my opinion Uenishi discloses “a heater chip for use in a printing device.”

306. As Uenishi teaches in its Technological Field of the Invention “[t]he present invention relates to **thermal inkjet heads**.” Ex.1008, [0001].

307. Uenishi explains that “[i]n recent years, printers that use the **thermal inkjet** system have become the most common printer mode.” Ex.1008, [0002]. In addition, Uenishi teaches a “**thermal inkjet system heats a heater and forms nucleus bubbles on the heater surface**.” Ex.1008, [0002].

308. Uenishi also teaches “because there are many circuits, electrodes, connection terminals and the like laminated independently at each **heating head**, the **silicon chip** where these are laminated requires greater surface area, which inhibits mass production of heating heads that are formed monolithically.” Ex.1008, [0021]. Uenishi further teaches that “[its] embodiment **can shrink the chip size** without increasing the size of the **thermal inkjet head** and achieve double the conventional nozzle columns virtually without changing the conventional size.” Ex.1008, [0046]. Uenishi also teaches “[t]he number of **chips** yielded by a single silicon wafer can thus be increased 30-40%...” Ex.1008, [0053].

309. Figure 1, which provides “a plan view that shows the constitution of the thermal inkjet head in one embodiment,” is reproduced below illustrating a heater “chip” for use in a printing device.



Ex.1008, Fig. 1

310. Accordingly, it is my opinion that Uenishi discloses **a heater chip** [e.g., chip of thermal inkjet head] **for use in a printing device** [e.g., thermal inkjet printer].

2. Uenishi discloses 1[A] “an ink via”

311. Claim 1 of the ’864 Patent recites “**an ink via.**” In my opinion, Uenishi discloses this element.

312. Uenishi teaches “a thermal inkjet head...that is constituted having **a single ink supply channel installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements on both said sides.” Ex.1008, [0024].

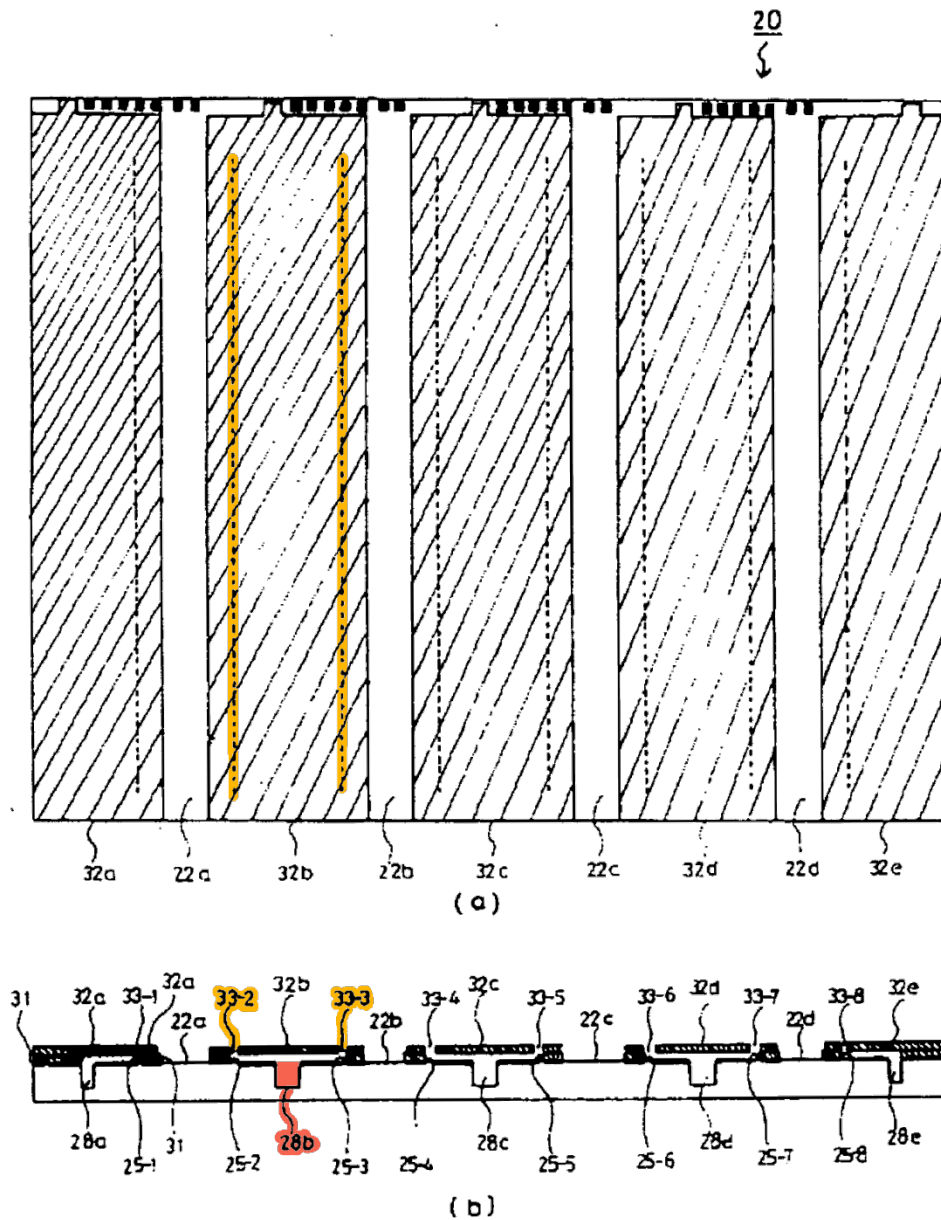
313. Uenishi further teaches a method of manufacturing its thermal inkjet head that includes “the formation of the **ink supply channel** by wet etching, sandblasting or the like...” Ex.1001, [0024]. In particular, Uenishi discloses that “the center parts in the direction of length are cut out from their respective common electrodes 23a–23e and **ink supply channels 28a–28d** are formed in their lower areas. Ink supply ports that pass through to the silicon substrate 21 to access these ink supply channels 28a–28d are formed respectively in them, although not explicitly shown.” Ex.1008, [0034].

314. Uenishi describes its thermal inkjet head 20 as “equipped with two columns of nozzles for each color for a total of eight columns of nozzles for the four colors together, and **the ink supply channel 28 that supplies ink to the nozzle ports 33** of these columns is configured of five channels, three fewer than the number of nozzle columns.” Ex.1008, [0040].

315. This arrangement Uenishi’s ink supply channel 28 and nozzle ports 33 is shown in Figure 2(a) of Uenishi, below, which depicts “a plan view that shows a finished full-color thermal inkjet head after completion of the manufacturing process

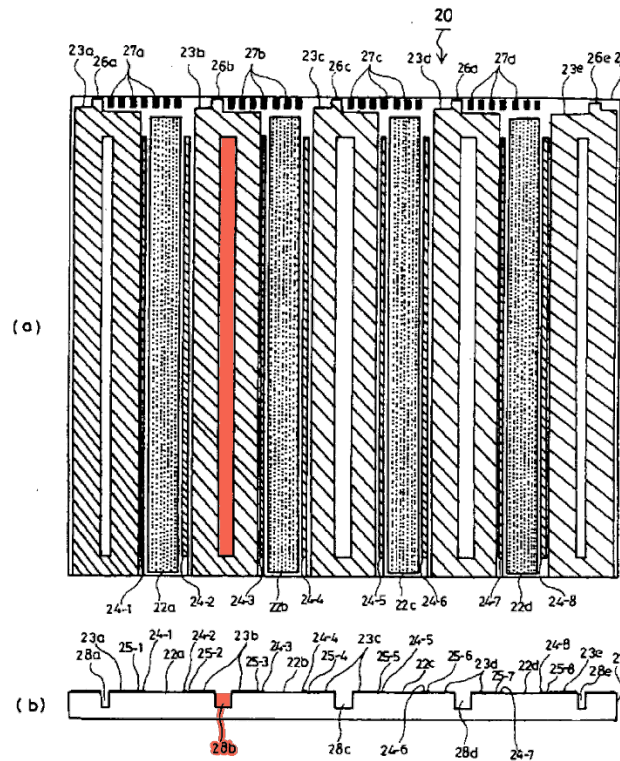
cut out as a single unit” and Figure 2(b), which “is its cross-section diagram.”

Ex.1008, p. 10. I have highlighted the ink supply channels 28 in red and the nozzle ports 33 in orange, below.



Ex.1008, Figure 2 (annotated).

316. Additionally, Figure 1 of Uenishi depicts “a plan view that shows the constitution of the thermal inkjet head in one embodiment...[in] the state up to formation of the drive circuit and its terminal on the silicon substrate, the formation of the electrodes and resistors by thin-film technology, and the formation of the ink supply channel by wet etching, sandblasting or the like...” Ex.1001, [0028]. As seen in annotated Figure 1, Uenishi’s print head includes five ink supply channels 28 [i.e ink vias] (red).



Ex.1008, Fig. 1 (annotated)

317. Uenishi states that:

The Bk ink of the first ink supply channel 28a described above is supplied to the nozzle column of the nozzle port 33-1 of the orifice plate

32a, and the Bk ink of the fifth ink supply channel 28e is supplied to the nozzle column of the nozzle port 33-8 of the orifice plate 32e.

Then, the **Y ink of the second ink supply channel 28b is supplied** to the nozzle column of the nozzle port 33-2 and the nozzle column of the nozzle port 33-3 of the orifice plate 32b, the **M ink of the third ink supply channel 28c is supplied** to the nozzle column of the nozzle port 33-4 and the nozzle column of the nozzle port 33-5 of the orifice plate 32c, and the **C ink of the fourth ink supply channel 28d is supplied** to the nozzle column of the nozzle port 33-6 and the nozzle column of the nozzle port 33-7 of the orifice plate 32d.

Ex.1008, [0038]-[0039].

318. Accordingly, it is my opinion that Uenishi discloses “an ink via [e.g., ink supply channels 28b, red].”

3. Uenishi discloses 1[B] “a first heater array adjacent at least a portion of one side of the ink via; a second heater array adjacent at least a portion of another side of the ink via”

319. Claim 1 of the '864 Patent recites “a first heater array adjacent at least a portion of one side of the ink via; a second heater array adjacent at least a portion of another side of the ink via.” In my opinion, Uenishi discloses this element.

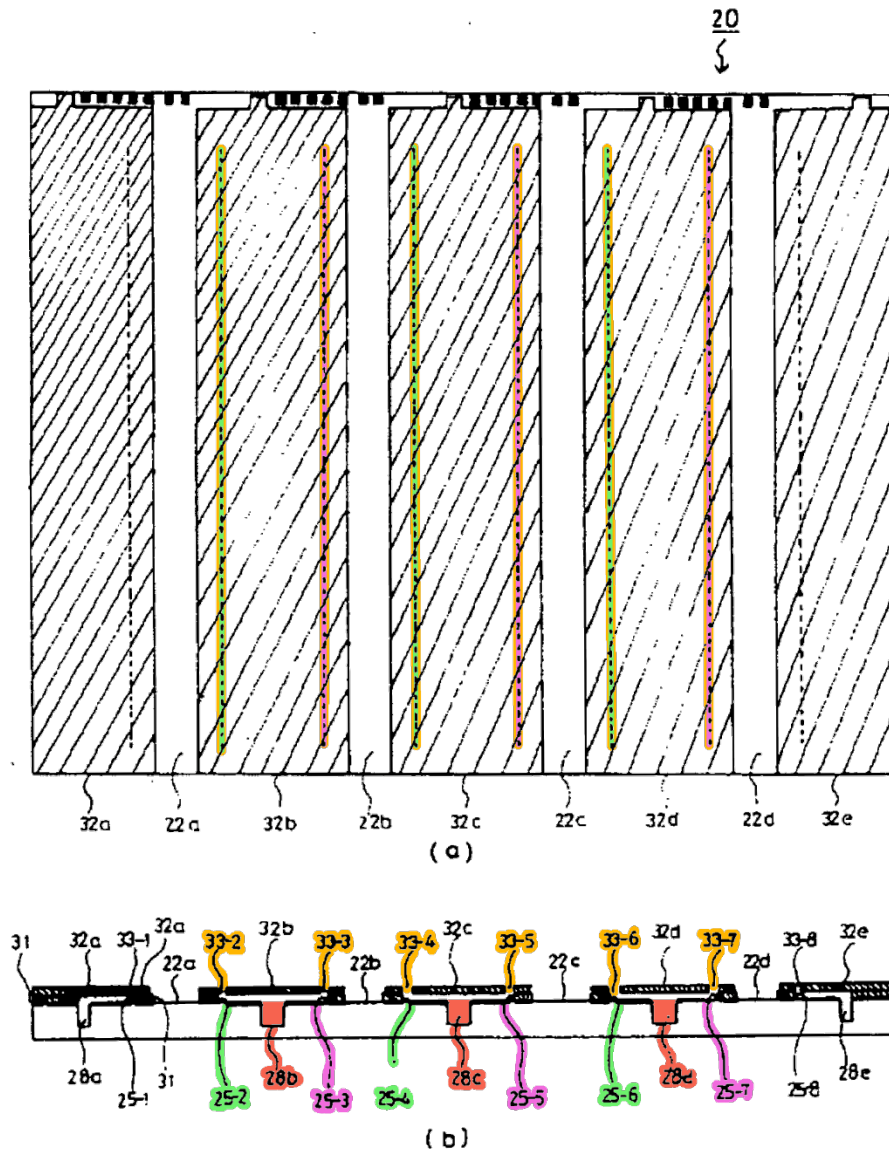
320. Uenishi teaches “a thermal inkjet head equipped with **a plurality of heating heads that disposes a plurality of heating elements in an array form...**”

Ex.1008, [0024]. Uenishi further teaches there is “a single ink supply channel [ink

via] **installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024].

321. In particular, Uenishi teaches that its “thermal inkjet head 20 forms four drive circuits 22a, 22b, 22c and 22d on the silicon substrate 21, as shown in Figs. 1(a) and (b). Ex.1008, [0029]. Uenishi explains that “[t]o the second drive circuit 22b, **a resistor 25-3 is formed connected thereto on the one side** via the individual wiring electrode 24-3 between the drive circuit 22b and the second common electrode 23b, while **a resistor 25-4 is formed connected thereto on the other side** via the individual wiring electrode 24-4 between the drive circuit 22b and the third common electrode 23c.” Ex.1008, [0030]; *see id.*, [0029], [0031]-[0032]. Uenishi identifies its resistors 25 as “heating elements.” Ex.1008, Legend (“25 (25-1, 25-2, ..., 25-7, 25-8) Resistors (heating elements)”).

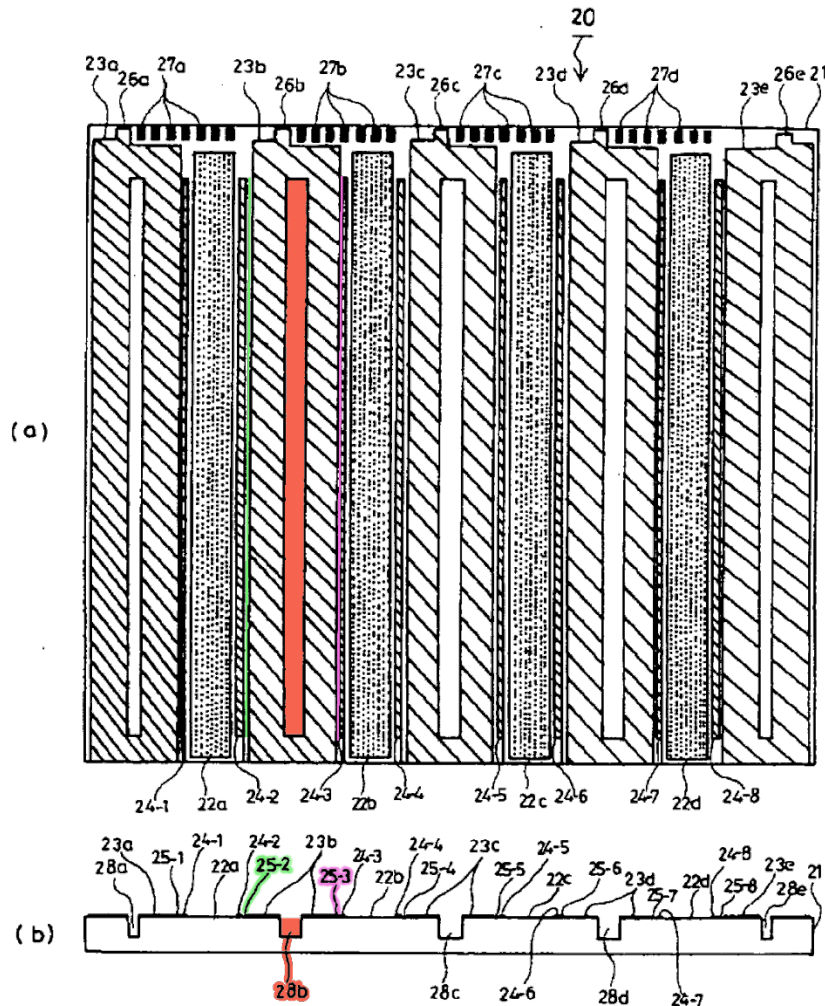
322. This arrangement of Uenishi’s heating resistors 25 and nozzle ports 33 is shown in Figure 2(a) of Uenishi, below, which depicts “a plan view that shows a finished full-color thermal inkjet head after completion of the manufacturing process cut out as a single unit” and Figure 2(b), which “is its cross-section diagram.” Ex.1008, p. 10. I have identified the ink supply channels 28 in red, nozzle ports 33 in orange, first heating resistors 25 in green, and second heating resistors 25 in magenta, below.



Ex.1008, Figure 2 (annotated).

323. As Uenishi further explains, “electrodes comprised of Ni or the like and **miniature resistors of Ta-Si-SiO or the like are formed using thin-film technology**...ports of 20–40μm are created in areas corresponding to the **miniature resistors** on the thin-plate material using an excimer laser or the like, forming numerous nozzle ports (also called orifices) in a batch.” Ex.1008, [0006].

324. As also seen in Figure 1 of Uenishi, the first heater array 25-2 (green) is adjacent at least a portion of one side of the ink via 28b (red) and the second heater array 25-3 (magenta) is adjacent at least a portion of another side of the ink via 28b.



Ex.1008, Fig. 1 (annotated)

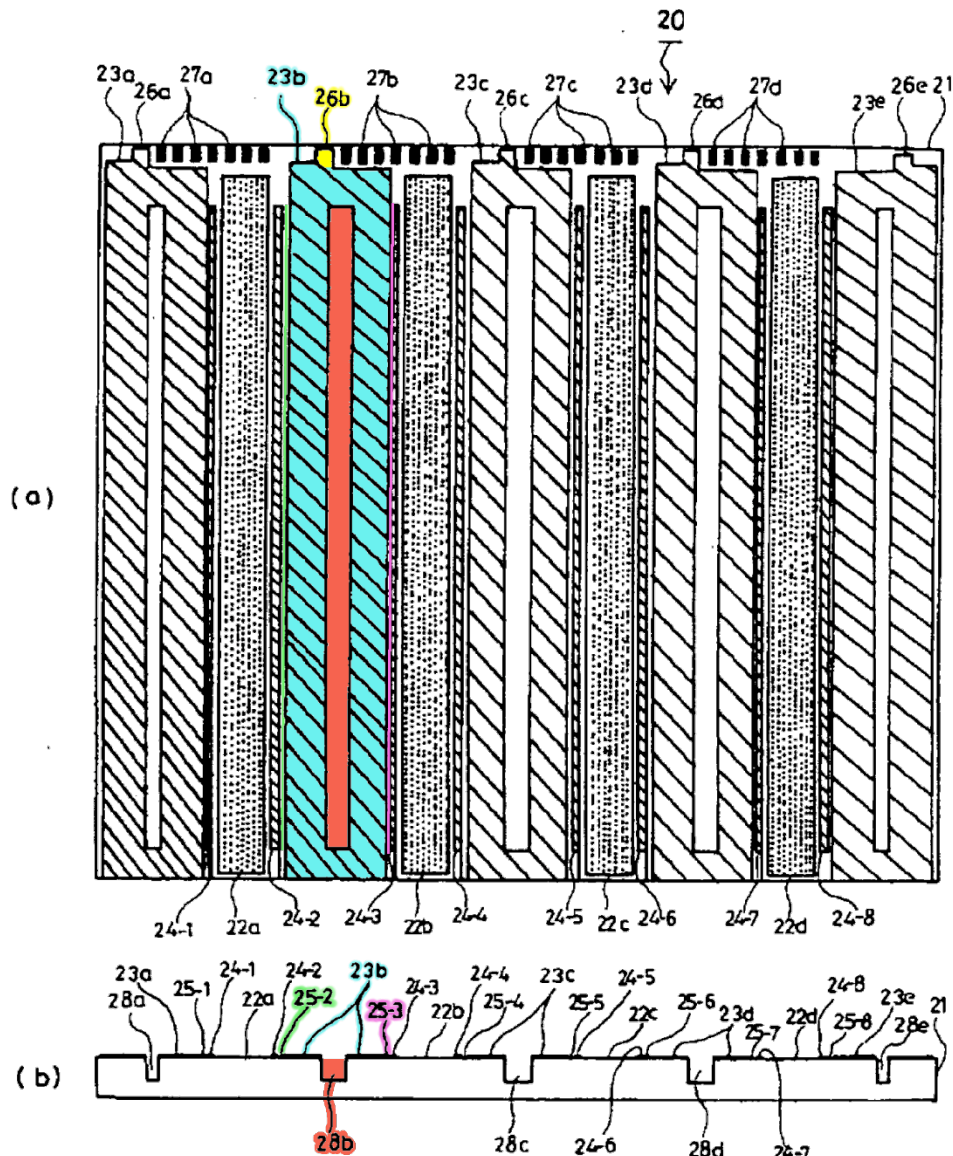
325. Accordingly, it is my opinion that Uenishi discloses “a **first heater array** [e.g., resistor array 25-2 (green)] **adjacent** at least **a portion of one side of the ink via** [e.g., to the left of ink supply channel 28b (red)]; a **second heater array**

[e.g., resistor array 25-3 (magenta)] **adjacent** at least **a portion of another side of the ink via** [e.g., to the right of ink supply channel 28b (red)].”

4. Uenishi discloses 1[C] “a bondpad wherein the bondpad supplies power to at least a portion of the first heater array and to at least a portion of the second heater array.”

326. Claim 1 of the '864 Patent recites “a bondpad wherein the bondpad supplies power to at least a portion of the first heater array and to at least a portion of the second heater array.” In my opinion, Uenishi discloses this element.

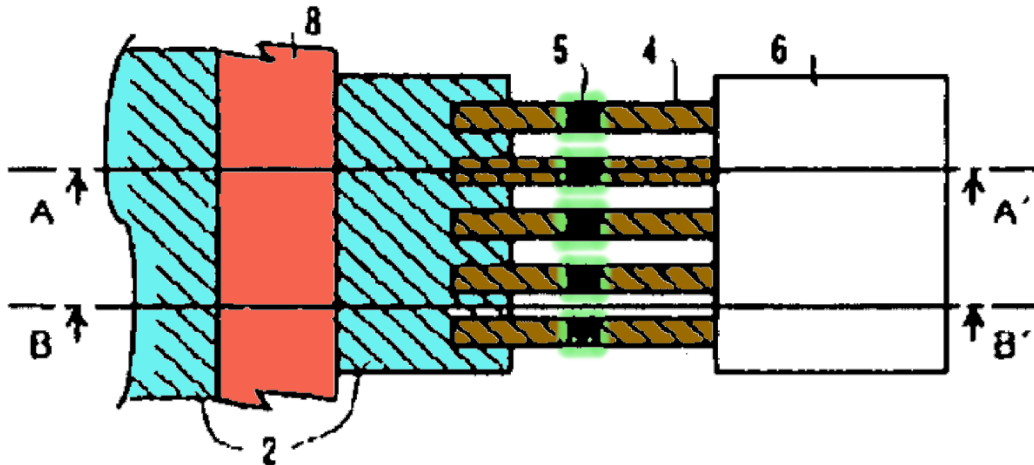
327. In Uenishi, the electricity-feed terminals 26 (yellow) supplies power to at least a portion of the first and second heater array resistor arrays 25 (green and magenta) via a common electrode 23 (teal).



Ex.1008, Fig. 1 (annotated).

328. As Uenishi explains, the thermal inkjet head 20 includes “five common electrodes 23a-23e.” Ex.1008, [0033]. Uenishi further explains that “a resistor 25-1 [green] is formed connected thereto on the one side via the individual wiring electrode 24-1 [brown] between the drive circuit 22a and the first common electrode

23a [teal].” Ex.1008, [0029]. This is shown, for example, in Uenishi’s Figure 7, below.



Ex.1008, Figure 7 (annotated and excerpted)

329. “[A] second **resistor 25-2 is formed connected thereto** on the other side via the individual wiring electrode 24-2 between the drive circuit 22a and **the second common electrode 23b...a resistor 25-3 is formed connected thereto** on the one side via the individual wiring electrode 24-3 between the drive circuit 22b and **the second common electrode 23b...**” Ex.1008, [0029]-[0030]. Uenishi further teaches “[t]o these five **common electrodes 23a–23e, electricity-feed terminals 26a–26e are formed linked respectively to them...**” Ex.1008, [0033].

330. Uenishi further teaches “that, where n is an integer, constitutes the common electrode of a column $n+1$ heating head and a column $n+2$ heating head as a single common electrode and constitutes the common electrode of a column $n+3$ heating head and a column $n+4$ heating head as another single common electrode,

and is constituted having a drive means that drives, in a time-sharing manner, the heating elements within the column n+2 heating head and the heating elements within the column n+3 heating head.” Uenishi at [0026].

331. As seen in Figure 1 of Uenishi, electricity-feed terminals 26 (yellow) supply power to the common electrodes 23 (teal), which themselves provide power to at least a portion of the first heater array 25-2 (green) and to at least a portion of the second heater array 25-3 (magenta).

332. Accordingly, it is my opinion that Uenishi discloses “a **bondpad** [e.g., electricity-feed terminal 26b (yellow)] wherein the bondpad **supplies power** [e.g., via common electrodes 23b (teal)] to at least a **portion of the first heater array** [e.g., resistor array 25-2 (green)] and to at least a **portion of the second heater array** [e.g., resistor array 25-3 (magenta)].”

B. Uenishi discloses Claim 3

333. Claim 3 depends from independent claim 1. Uenishi discloses all of the limitations of claim 1 for reasons discussed above. The additional limitations of claim 3 are also disclosed by Uenishi.

334. Claim 3 states “[t]he heater chip of claim 1, wherein **the bondpad supplies power to the first heater array and the second heater array portions by power traces physically separated proximal to the bondpad.**” Ex.1001, cl. 3. As discussed above in claim 1[c], incorporated here, Uenishi explains that the

bondpad supplies power to the first heater array and the second heater array portions. *Supra* Section XI.A.4; Ex.1008, [0026], [0029]-[0032].

335. Uenishi teaches that “the **center parts in the direction of length are cut out from their respective common electrodes 23a–23e** and ink supply channels 28a–28d are formed in their lower areas. Ink supply ports that pass through to the silicon substrate 21 to access these ink supply channels 28a–28d are formed respectively in them, although not explicitly shown.” Ex.1008, [0034].

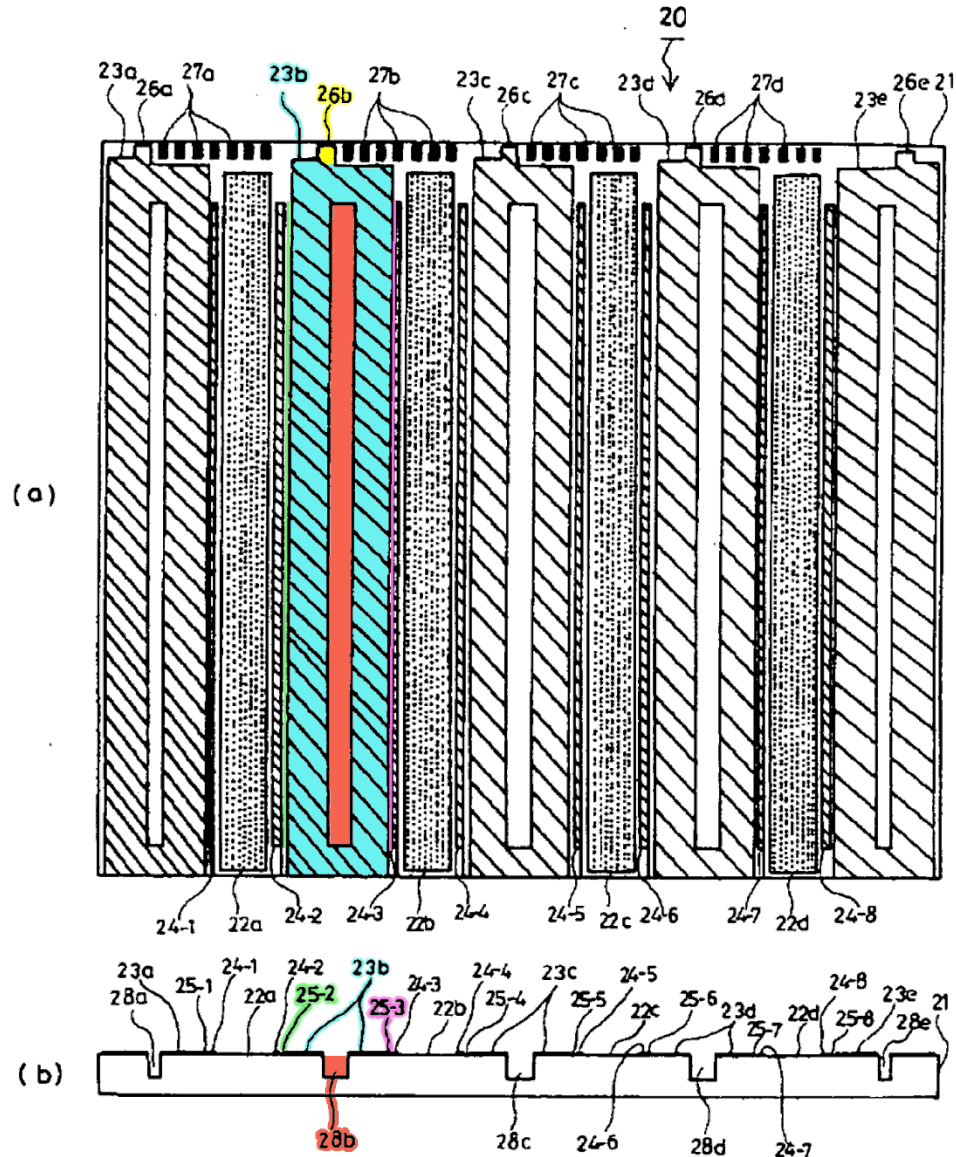
336. In other words, Uenishi teaches that its common electrode includes traces that are physically separated from one another to accommodate the ink supply channels 28.

337. Uenishi teaches its “thermal inkjet head 20 forms four drive circuits 22a, 22b, 22c and 22d on the silicon substrate 21, as shown in Figs. 1(a) and (b). Ex.1008, [0029]. Uenishi explains that “[t]o the second drive circuit 22b, **a resistor 25-3 is formed connected thereto on the one side** via the individual wiring electrode 24-3 between the drive circuit 22b and the second common electrode 23b, while **a resistor 25-4 is formed connected thereto on the other side** via the individual wiring electrode 24-4 between the drive circuit 22b and the third common electrode 23c.” Ex.1008, [0030]; *see id.*, [0029], [0031]-[0032]. Uenishi then teaches “[t]o these five common electrodes 23a–23e, electricity-feed terminals 26a–26e are

formed linked respectively to them, while the drive circuit terminals 27a–27d are formed connected to their respective four drive circuits 22a–22d.” Ex.1008, [0033].

338. In other words, electricity-feed terminals 26 supply power to the common electrodes 23, which themselves provide power to at least a portion of the first heater array on one side of the common electrode and to at least a portion of the second heater array on the other side of the common electrode.

339. As shown in Uenishi’s figure 1, below, these portions or traces of the common electrode (left and right sides) are physically separated proximal to the electricity-feed terminal 26.



Ex.1008, Fig. 1 (annotated).

340. In my opinion, the portions or traces of the common electrode 23b (teal left and right sides) are physically separated proximal to the electricity-feed terminal 26.

341. As such, Uenishi discloses “[t]he heater chip of claim 1, wherein the bondpad [e.g., electricity-feed terminals 26b (yellow)] supplies power [e.g., via

common electrodes 23b (teal)] to the first heater array [e.g., resistor array 25-2 (green)] and the second heater array [e.g., resistor array 25-3 (magenta)] portions **by power traces** [e.g., common electrodes 23] **physically separated proximal to the bondpad** [e.g., common electrode 23b splitting in two, from the cutout of the center section of common electrodes 23b, near electricity-feed terminal 26b].” Claim 3 is therefore anticipated by Uenishi.

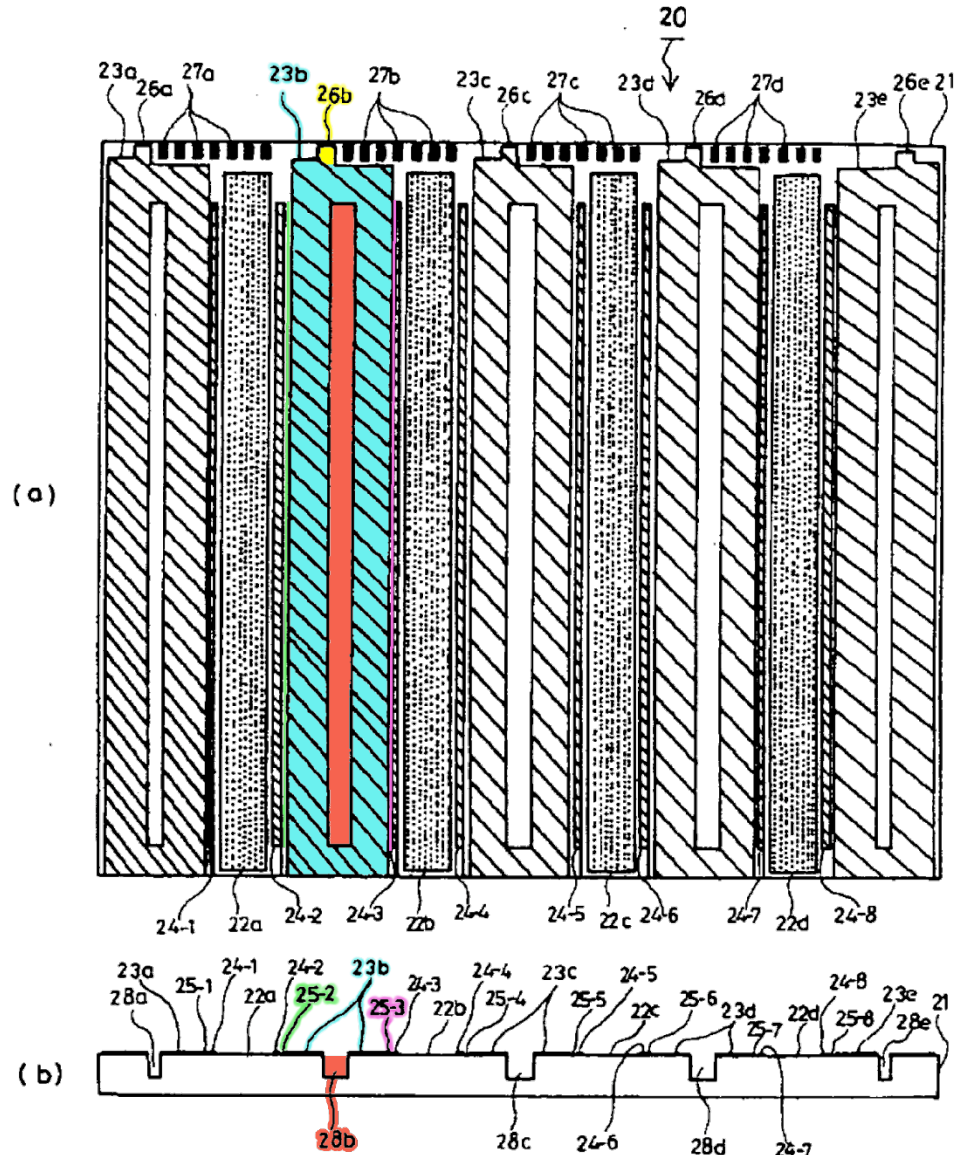
C. Uenishi discloses Claim 5

342. Claim 5 depends from independent claim 1. Uenishi discloses all of the limitations of claim 1 for reasons discussed above. The additional limitations of claim 5 are also disclosed by Uenishi.

343. Claim 5 states “[t]he heater chip of claim 1, **wherein the bondpad supplies power to the first heater array and the second heater array by at least one power trace.**” Ex.1001, cl. 5.

344. For the same reasons I provide above with respect to claim 3, incorporated here, Uenishi teaches the bondpad supplies power to the first heater array and the second heater array portions by power traces physically separated proximal to the bondpad. *Supra*, section XI.B.

345. Further, as shown in Uenishi’s figure 1, below, Uenishi teaches the bondpad (yellow) supplies power to the first heater array (green) and second heater array (magenta) by at least one power trace (teal).



Ex.1008, Fig. 1 (annotated).

346. As such, Uenishi discloses “[t]he heater chip of claim 1, wherein the bondpad [e.g., electricity-feed terminal 26b (yellow)] supplies power [e.g., via common electrode 23b (teal)] to the **first heater array** [e.g., resistor array 25-2 (green)] and the **second heater array** [e.g., resistor array 25-3 (magenta)] by **at least one power trace** [e.g., common electrodes 23b].” Claim 5 is therefore anticipated.

D. Uenishi discloses Claim 6

347. Claim 6 depends from independent claim 1. Uenishi discloses all of the limitations of claim 1 for reasons discussed above. The additional limitations of claim 6 are also disclosed by Uenishi.

348. Claim 6 states “[t]he heater chip of claim 1, **wherein the first heater array and the second heater array each include a plurality of thin film resistors.**” Ex.1001, cl. 6. Uenishi teaches “a thermal inkjet head equipped with a **plurality of heating heads that disposes a plurality of heating elements in an array form...**” Ex.1008, [0024]. Uenishi further teaches there is “a single ink supply channel [ink via] **installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024].

349. As Uenishi further explains, “electrodes comprised of Ni or the like and **miniature resistors of Ta-Si-SiO or the like are formed using thin-film technology...**ports of 20–40μm are created in areas corresponding to the **miniature resistors** on the thin-plate material using an excimer laser or the like, forming numerous nozzle ports (also called orifices) in a batch.” Ex.1008, [0006]; *id.*, [0028].

350. In particular, Uenishi teaches “printing heads of inkjet printers that print in full color by exploiting this sort of **film boiling phenomenon** to eject three

primary colors of ink (**thermal inkjet heads**) are generally manufactured using silicon LSIs and **thin-film technology**.” Ex.1008, [0004].

351. As such, Uenishi teaches “[t]he heater chip of claim 1, wherein the first heater array [e.g., resistor array 25-2 (green)] and the second heater array [e.g., resistor array 25-3 (magenta)] each include a **plurality of thin film resistors** [e.g., miniature resistors using thin-film technology].” Claim 5 is therefore anticipated.

E. Uenishi discloses Claim 8

352. As I explain below, Uenishi discloses each and every limitation of independent claim 8.

1. Uenishi discloses 8[P] “A heater chip for use in a printing device”

353. To the extent the preamble is limiting, it is identical to claim limitation 1[P] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[P]. *Supra* section XI.A.1.

2. Uenishi discloses 8[A] “an ink via”

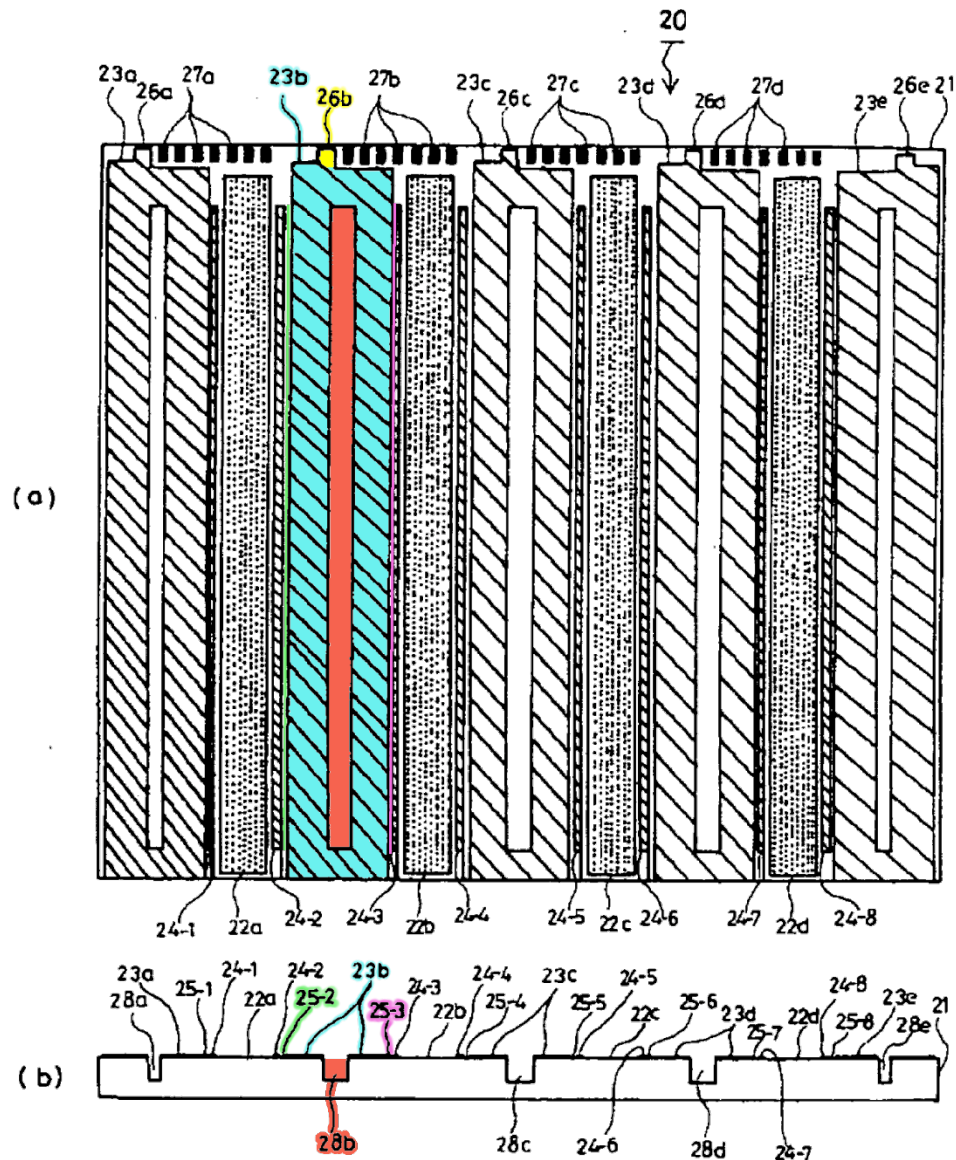
354. This limitation is identical to claim limitation 1[A] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[A]. *Supra* section XI.A.2.

3. Uenishi discloses 8[B] “a first heater array and a second heater array adjacent at least a portion of the ink via wherein the ink via is positioned between the first heater array and the second heater array”

355. This limitation is analogous to claim limitation 1[B] and is thus disclosed for the same reasons I provide above, incorporated here, regarding claim limitation 1[B]. *Supra* section XI.A.3.

356. In particular, Uenishi teaches “a thermal inkjet head equipped with **a plurality of heating heads that disposes a plurality of heating elements in an array form...**” Ex.1008, [0024]. Uenishi further teaches there is “a single ink supply channel [ink via] **installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024].

357. As seen in Figure 1 of Uenishi, the heater arrays 25-2, 25-4, and 25-6 are each first heater arrays (green) adjacent at least a portion of one side of the ink via (red) and heater arrays 25-3, 25-5, and 25-7 are each second heater arrays (magenta) adjacent at least a portion of another side of the ink via.



Ex.1008, Fig. 1 (annotated)

358. Accordingly, it is my opinion that Uenishi discloses “a first heater array and a second heater array adjacent at least a portion of the ink via wherein the ink via [e.g., ink supply channels 28b, 28c, or 28d (red)] is positioned between the first heater array [e.g., resistor arrays 25-2, 25-4, or 25-6 (green)] and the second heater array [e.g., resistor arrays 25-3, 25-4, or 25-7 (magenta)].”

4. **Uenishi discloses 8[C] “a bondpad having at least two traces stemming from the bondpad wherein at least one of the traces is operatively connected to the first heater array and at least another one of the traces is operatively connected to the second heater array”**

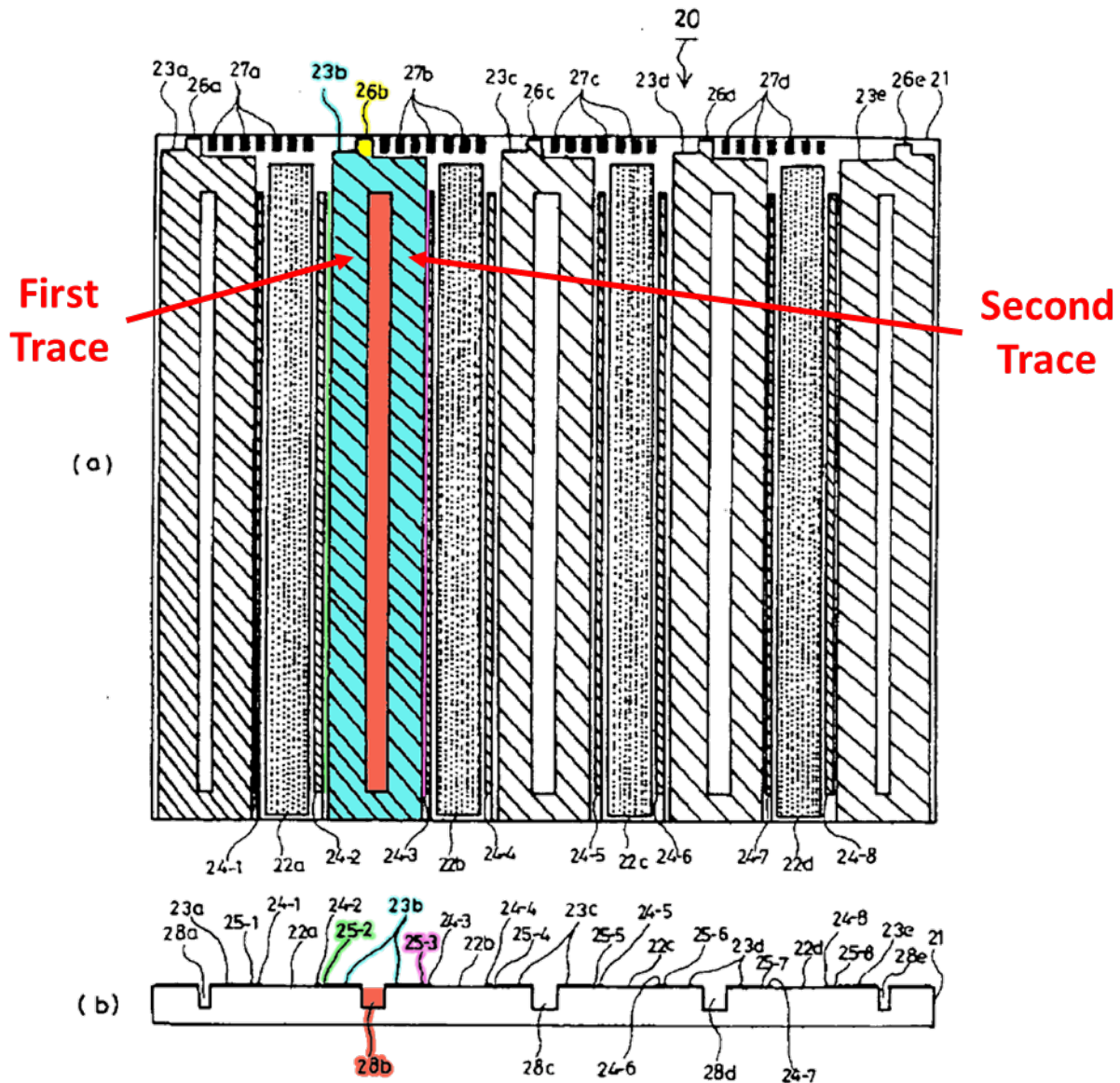
359. Claim 8 of the '864 Patent recites “a bondpad having at least two traces stemming from the bondpad wherein at least one of the traces is operatively connected to the first heater array and at least another one of the traces is operatively connected to the second heater array.” For the same reasons I provide above in limitation 1[C], incorporated here, Uenishi teaches a bondpad connected to the first heater array and the second heater array. *Supra* section XI.A.4. In my opinion, Uenishi also discloses the remaining limitation “having at least two traces stemming from the bondpad.”

360. As Uenishi explains, “a second **resistor 25-2 is formed connected thereto** on the other side via the individual wiring electrode 24-2 between the drive circuit 22a and **the second common electrode 23b...a resistor 25-3 is formed connected thereto** on the one side via the individual wiring electrode 24-3 between the drive circuit 22b and **the second common electrode 23b...**” Ex.1008, [0029]-[0030]. Uenishi further teaches “[t]o these five **common electrodes 23a–23e, electricity-feed terminals 26a–26e are formed linked respectively to them...**” Ex.1008, [0033].

361. Uenishi further teaches that “the **center parts in the direction of length are cut out from their respective common electrodes 23a–23e** and ink supply channels 28a–28d are formed in their lower areas. Ink supply ports that pass through to the silicon substrate 21 to access these ink supply channels 28a–28d are formed respectively in them, although not explicitly shown.” Ex.1008, [0034].

362. In other words, Uenishi teaches that its common electrode includes two traces to accommodate the ink supply channels 28.

363. As shown in Uenishi’s figure 1, below, these portions or traces of the common electrode (left and right sides) stem from the electricity-feed terminal 26.



365. Uenishi also teaches “that, where n is an integer, constitutes the common electrode of a column $n+1$ heating head and a column $n+2$ heating head as a single common electrode and constitutes the common electrode of a column $n+3$ heating head and a column $n+4$ heating head as another single common electrode, and is constituted having a drive means that drives, in a time-sharing manner, the heating elements within the column $n+2$ heating head and the heating elements within the column $n+3$ heating head.” Uenishi at [0026].

366. In other words, electricity-feed terminals 26 is connected to the common electrode 23, which itself is operatively connected to the first heater array on one side (once trace) and to the second heater array on the other side (second trace). As shown in Figure 1 of Uenishi, above, the electricity-feed terminals 26 (yellow) supply power to heating resistors 25 (green and magenta) via the common electrodes 23 (teal).

367. Accordingly, it is my opinion that Uenishi discloses “a **bondpad** [e.g., electricity-feed terminal 26b (yellow)] having at least **two traces** [e.g., common electrodes 23b (teal)] stemming from the bondpad [e.g., resulting from cutout of center section of common electrode 23b] wherein **at least one of the traces** is **operatively connected to** [e.g., via left branch of common electrodes 23b] the **first heater array** [e.g., resistor array 25-2 (green)] **and** at least **another one of the**

traces is operatively connected to [e.g., via right branch of common electrodes 23b] the second heater array[e.g., resistor array 25-3 (magenta)].”

F. Uenishi discloses Claim 9

368. Claim 9 depends from independent claim 8. Uenishi discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 9 are also disclosed by Uenishi.

369. Claim 9 states “[t]he heater chip of claim 8, **wherein the at least two traces are physically separated proximal to the bondpad.**” Ex.1001, cl. 9.

370. The additional limitations of claim 9 are broader than the limitations of claim 3 and is thus disclosed by Uenishi for the same reasons I provide above. *Supra* section XI.B, incorporated here.

G. Uenishi discloses Claim 10

371. Claim 10 depends from independent claim 8. Uenishi discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 10 are also disclosed by Uenishi.

372. Claim 10 states “[t]he heater chip of claim 8, wherein the first and second heater arrays include a **plurality of thin film resistors formed**, at least in part, from a material selected **from the group of materials consisting of** platinum, gold, silver, copper, aluminum, **tantalum**, titanium tungsten, silicon-nitrogen, silicon carbide, and diamond-like carbon.” Ex.1001, cl. 10.

373. For the same reasons I provide above in claim 6, incorporated here, Uenishi teaches the first and second heater arrays include a plurality of thin film resistors. *Supra* section XI.D. In my opinion, Uenishi also discloses the remaining limitation “formed, at least in part, from a material selected from the group of materials consisting of platinum, gold, silver, copper, aluminum, tantalum, titanium tungsten, silicon-nitrogen, silicon carbide, and diamond-like carbon.”

374. Uenishi teaches “a thermal inkjet head equipped with **a plurality of heating heads that disposes a plurality of heating elements in an array form...**” Ex.1008, [0024].

375. As Uenishi further explains, “electrodes comprised of Ni or the like and **miniature resistors of Ta-Si-SiO or the like are formed using thin-film technology**...ports of 20–40µm are created in areas corresponding to the **miniature resistors** on the thin-plate material using an excimer laser or the like, forming numerous nozzle ports (also called orifices) in a batch.” Ex.1008, [0006]; *id.*, [0028].

376. Accordingly, it is my opinion that Uenishi discloses “[t]he heater chip of claim 8, wherein the **first** [e.g., resistor arrays 25-2, 25-4, or 25-6 (green)] and **second** [e.g., resistor arrays 25-3, 25-5, or 25-7 (magenta)] **heater arrays** include a **plurality of thin film resistors** [e.g., miniature resistors using thin-film technology] **formed, at least in part, from a material selected from the group of** materials consisting of platinum, gold, silver, copper, aluminum, **tantalum**, titanium tungsten,

silicon-nitrogen, silicon carbide, and diamond-like carbon. [e.g., Ta-Si-SiO or the like].”

H. Uenishi Discloses Claim 13

377. Claim 13 depends from independent claim 8. Uenishi discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 13 are also disclosed by Uenishi.

378. Claim 13 states “[t]he heater chip of claim 8, wherein the first and second heater arrays each comprise a **top portion** and a **bottom portion**, and wherein the **bondpad** is operatively connected to the **top portion of the first heater array** and the **top portion of the second heater array**.” Ex.1001, cl. 13.

379. Uenishi teaches that “[a] common electrode 23a has a first orifice array resistor 25-1 connected thereto via an individual wiring electrode 24-1 between it and the common electrode 23a and a second orifice column resistor 25-2 connected thereto via an individual wiring electrode 24-2 between it and a common electrode 23b.” Ex.1008, Abstract. Uenishi then teaches “[t]o these five common electrodes 23a–23e, electricity-feed terminals 26a–26e are formed linked respectively to them, while the drive circuit terminals 27a–27d are formed connected to their respective four drive circuits 22a–22d.” Ex.1008, [0033].

380. Uenishi also teaches:

This thermal inkjet head 20 forms four drive circuits 22a, 22b, 22c and 22d on the silicon substrate 21, as shown in Figs. 1(a) and (b). To the

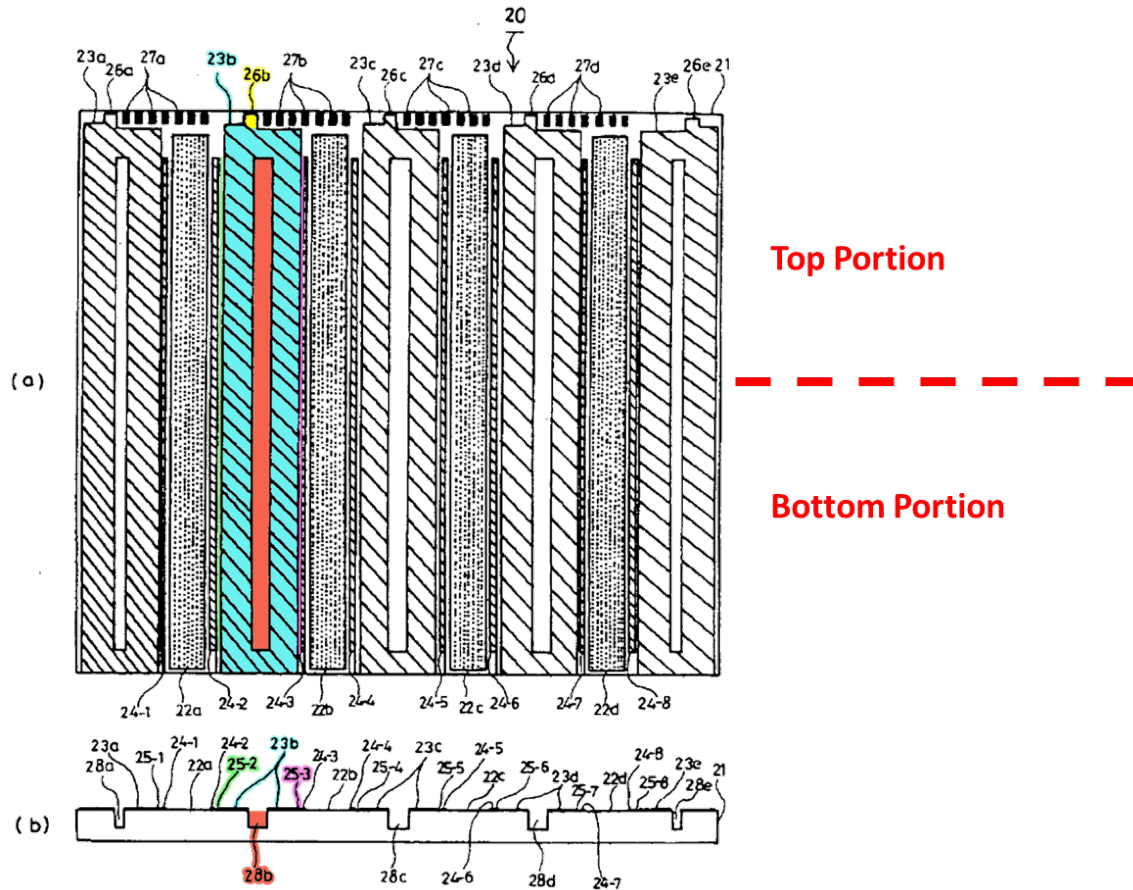
first drive circuit 22a, a resistor 25-1 is formed connected thereto on the one side via the individual wiring electrode 24-1 between the drive circuit 22a and the first common electrode 23a, while a second resistor 25-2 is formed connected thereto on the other side via the individual wiring electrode 24-2 between the drive circuit 22a and the second common electrode 23b.”

Ex.1008, [0029]; *see id.*, [0030]-[0032].

381. Uenishi further teaches “that, where n is an integer, constitutes the common electrode of a column $n+1$ heating head and a column $n+2$ heating head as a single common electrode and constitutes the common electrode of a column $n+3$ heating head and a column $n+4$ heating head as another single common electrode, and is constituted having a drive means that drives, in a time-sharing manner, the heating elements within the column $n+2$ heating head and the heating elements within the column $n+3$ heating head.” Uenishi at [0026].

382. In other words, electricity-feed terminals 26 is connected to the common electrode 23, which itself is operatively connected to the first heater array on one side (once trace) and to the second heater array on the other side (second trace).

383. As seen in Figure 1 of Uenishi, the heating resistors 25 (green and magenta) form an array comprising a top portion and a bottom portion in which the electricity-feed terminals 26 (yellow) supply power to the top portion of the array of heating resistors 25 (green and magenta) via the common electrodes 23 (teal).



Ex.1008, Fig. 1 (annotated).

384. Accordingly, it is my opinion that Uenishi discloses “wherein the **first** [e.g., resistor array 25-2 (green)] and **second** [e.g., resistor array 25-3 (magenta)] **heater arrays** each comprise a **top portion** and a **bottom portion** [e.g., top half and bottom half of each array], and wherein the **bondpad** [e.g., electricity-feed terminal 26b (yellow)] is operatively connected to the **top portion** of the **first heater array** and the **top portion** of the **second heater array** [e.g., via common electrodes 23b (teal)].”

I. Uenishi Discloses Claim 15

385. Claim 15 depends from independent claim 8. Uenishi discloses all of the limitations of claim 8 for reasons discussed above. The additional limitations of claim 15 are also disclosed by Uenishi.

386. As I explain below, Uenishi discloses each and every limitation of independent claim 15.

1. Uenishi discloses 15[A] “The heater chip of claim 8, further comprising: another ink via disposed between a third heater array and a fourth heater array; and”

387. Claim 15 of the '864 Patent recites “[t]he heater chip of claim 8, **further comprising: another ink via disposed between a third heater array and a fourth heater array.**” Ex.1001, cl. 15.

388. Uenishi teaches “a thermal inkjet head equipped with **a plurality of heating heads that disposes a plurality of heating elements in an array form...**” Ex.1008, [0024]. Uenishi further teaches there is “a single ink supply channel [ink via] **installed between adjacent heating heads** that supplies the ink in common to the heating elements of the heating elements **on both said sides.**” Ex.1008, [0024].

389. As Uenishi further explains, “electrodes comprised of Ni or the like and **miniature resistors of Ta-Si-SiO or the like are formed using thin-film technology...**ports of 20–40µm are created in areas corresponding to the **miniature**

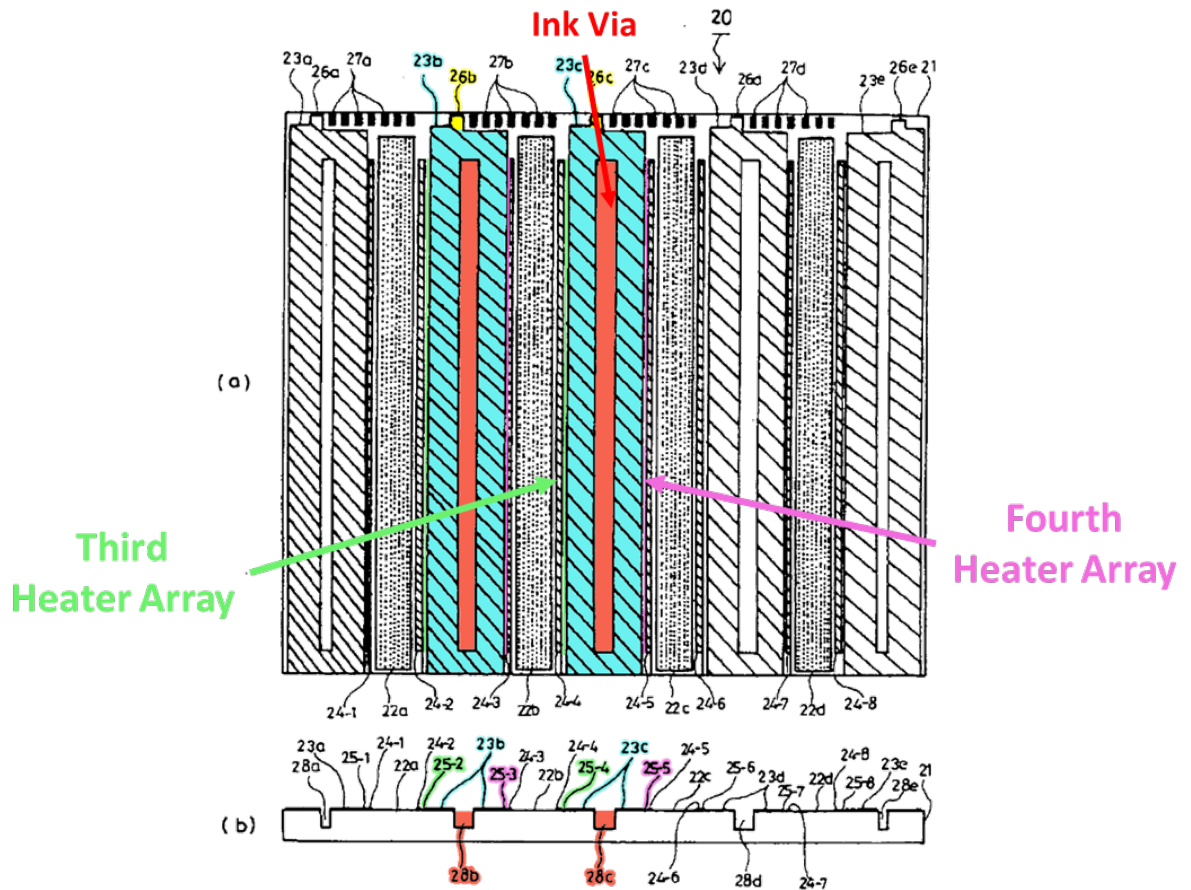
resistors on the thin-plate material using an excimer laser or the like, forming numerous nozzle ports (also called orifices) in a batch.” Ex.1008, [0006].

390. Uenishi also teaches:

This thermal inkjet head 20 forms four drive circuits 22a, 22b, 22c and 22d on the silicon substrate 21, as shown in Figs. 1(a) and (b). To the first drive circuit 22a, a resistor 25-1 is formed connected thereto on the one side via the individual wiring electrode 24-1 between the drive circuit 22a and the first common electrode 23a, while a second resistor 25-2 is formed connected thereto on the other side via the individual wiring electrode 24-2 between the drive circuit 22a and the second common electrode 23b.”

Ex.1008, [0029]; *see id.*, [0030]-[0032].

391. As seen in Figure 1 of Uenishi, a second ink supply channel 28c (red) is disposed between a third resistor array 25-4 (green) and a fourth resistor array 25-5 (magenta).



Ex.1008, Fig. 1 (annotated)

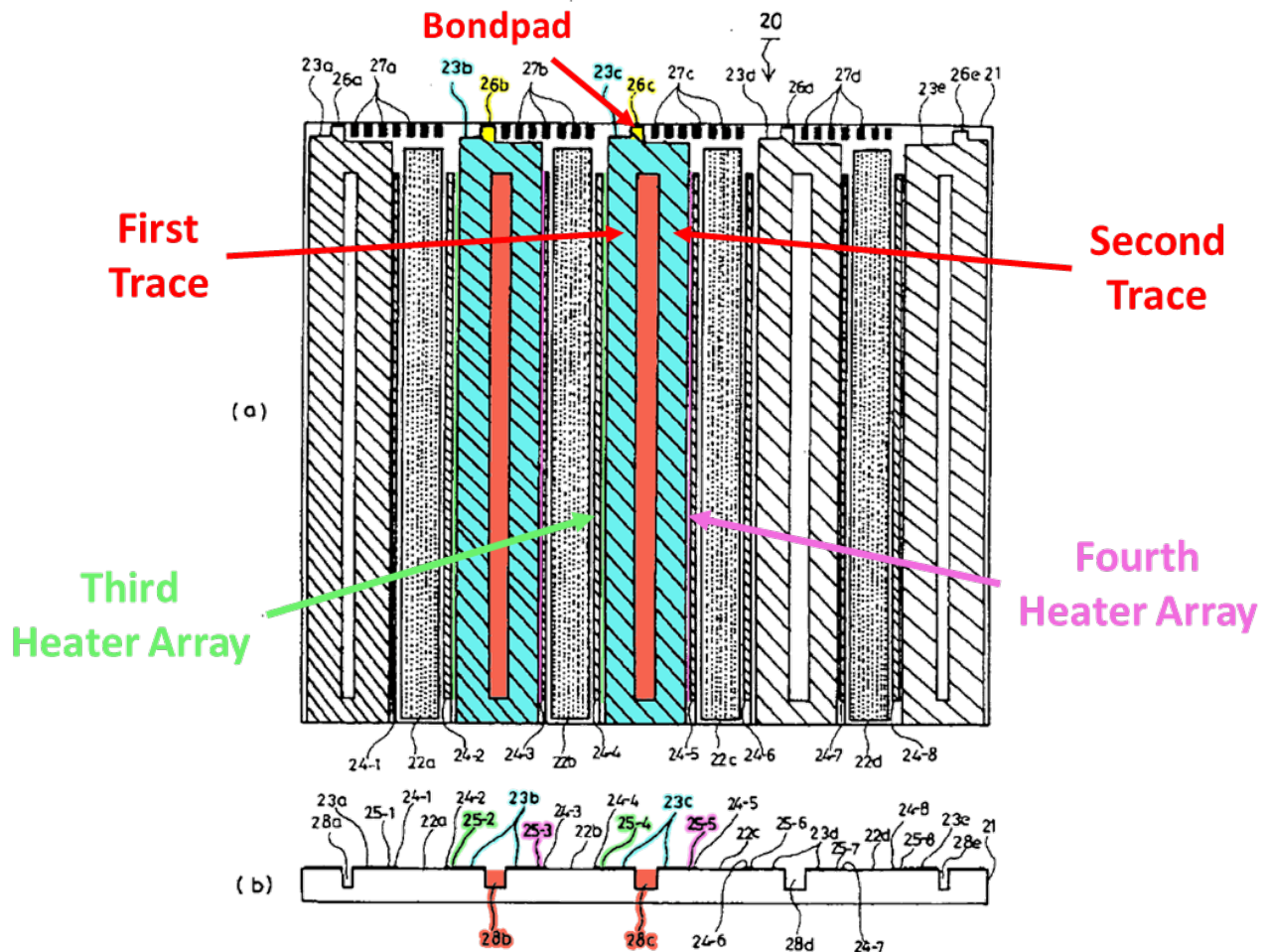
392. Accordingly, it is my opinion that Uenishi discloses “another ink via [e.g., ink supply channel 28c] disposed between a third heater array [e.g., resistor array 25-4 (green)] and a fourth heater array [e.g., resistor array 25-5 (magenta)].”

2. **Uenishi discloses 15[B] “a second bondpad coupled to a trace that is operatively connected to the third heater array and to a trace that is operatively connected to the fourth heater array”**

393. Claim 15 of the '864 Patent recites “a second bondpad coupled to a trace that is operatively connected to the third heater array and to a trace that is operatively connected to the fourth heater array.” Ex.1001, cl. 15.

394. For the same reasons I provide above in limitations 1[C] and 8[D], incorporated here, Uenishi teaches the use of multiple bondpads that are coupled to traces that are operatively connected to heater arrays adjacent to opposite sides of an ink via. *Supra* sections XI.A.4 and XI.E.4.

395. As seen in Figure 1, a second electricity-feed terminal 26c (yellow) connect to portions or traces (left and right sides) of a second common electrode 23c to supply power to heating resistors 25-4, 25-5 (green and magenta) via the common electrodes 23c (teal).



Ex.1008, Fig. 1 (annotated).

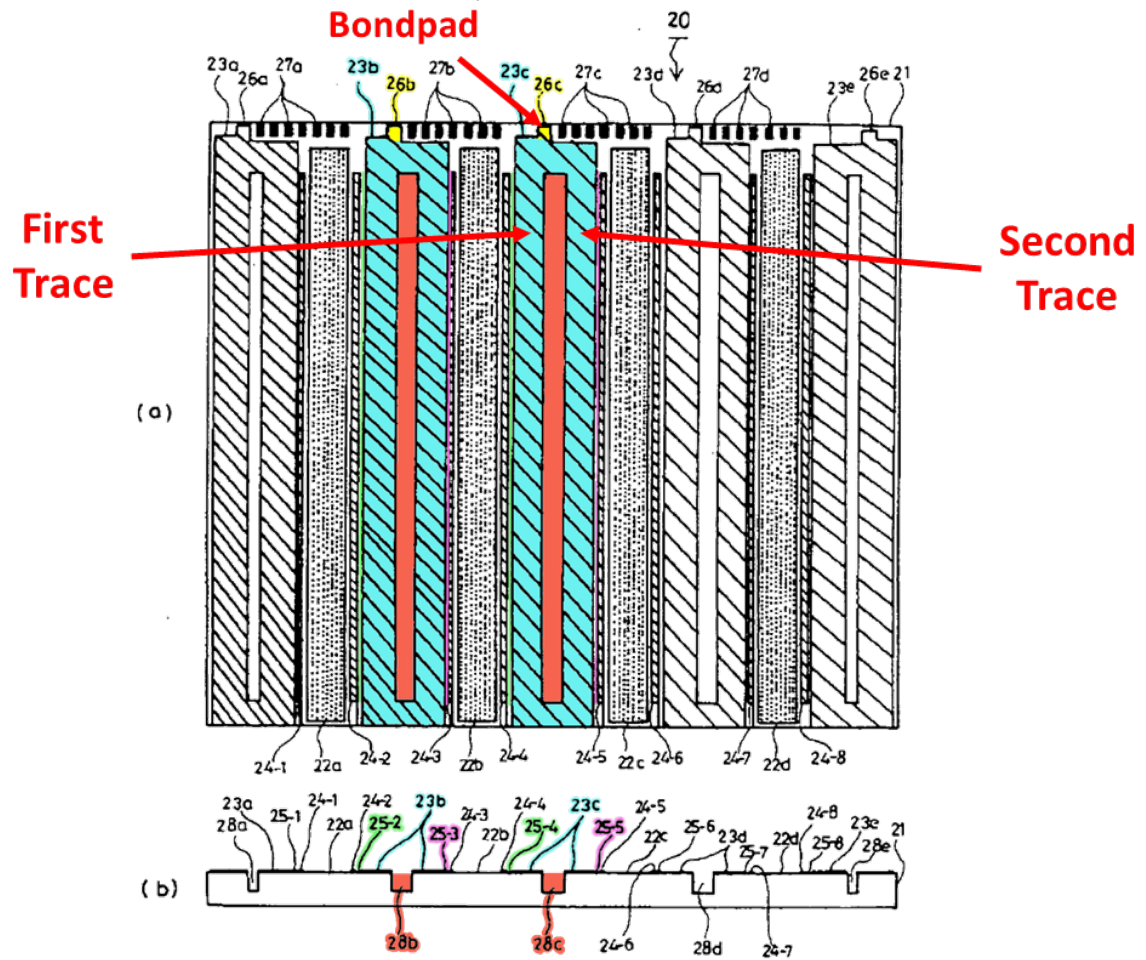
396. Accordingly, it is my opinion that Uenishi discloses “a **second bondpad** [e.g., electricity-feed terminal 26c (yellow)] **coupled to a trace** [e.g., common electrode 23c (teal)] that is operatively connected to the **third heater array** [e.g., resistor array 25-4 (green)] and **to a trace** [e.g., common electrode 23c] that is operatively connected to the **fourth heater array** [e.g., resistor array 25-5 (magenta)].”

3. Uenishi discloses 15[C] “wherein the traces coupled to the second bondpad are physically separated proximal to the second bondpad.”

397. Claim 15 of the '864 Patent recites “wherein the traces coupled to the second bondpad are physically separated proximal to the second bondpad.” Ex.1001, cl. 15.

398. For the same reasons I provide above in claims 3 and 9, incorporated here, Uenishi teaches the traces coupled to the second bondpad are physically separated proximal to the second bondpad. *Supra* sections XI.B and XI.F.

399. As shown in Uenishi’s figure 1, below, the portions or traces of the common electrodes (left and right sides) are physically separated proximal to the electricity-feed terminal 26.



Ex.1008, Fig. 1 (annotated).

400. As such, Uenishi discloses “the **traces** [e.g., common electrodes 23b, 23c, or 23d (teal)] coupled to the **second bondpad** [e.g., electricity-feed terminals 26b, 26c, or 26d (yellow)] are physically separated proximal to the **second bondpad** [e.g., resulting from cutout of center section of common electrodes 23].”

401. Claim 15 is therefore anticipated by Uenishi.

XII. GROUND 4: UENISHI IN VIEW OF HAYASKI RENDERS CLAIMS 4, 11, AND 12 OF THE '864 PATENT OBVIOUS

402. In my opinion, the Uenishi-Hayasaki combination renders obvious all of the limitations of claims 4, 11, and 12 of the '864 Patent.

A. Uenishi-Hayasaki Combination discloses Claims 4 and 11

403. Claim 4 depends from independent claim 1 and claim 11 depends from independent claim 8. Uenishi discloses all of the limitations of claims 1 and 8 for the reasons discussed in Ground 3 above, incorporated here. *See* Sections XI.A and XI.E. The additional limitations of claims 4 and 11 are disclosed by the Uenishi-Hayasaki Combination.

404. Claim 4 states “[t]he heater chip of claim 1, wherein each of the first and second heater arrays comprise at least 320 heaters.” Ex.1001, cl. 4. Similarly, claim 11 states “[t]he heater chip of claim 8, wherein each of the first and second heater arrays contain at least 320 heaters.” Ex.1001, cl. 8.

405. Uenishi teaches its heater columns include “256 nozzles in one column at a resolution of 360dpi.” Ex.1008, [0052]. However, Uenishi also teaches that “for a resolution of 720dpi, **four columns** of 256 nozzles (**1280 nozzles**) will be formed...” Ex.1008, [0016]. A PHOSITA would appreciate that 1280 nozzles distributed across four columns provided for 320 nozzles per column.

406. Uenishi also teaches that “[t]he problem of the present invention is to provide, in light of the prior art circumstances described above, **a high-resolution,**

small-volume **thermal inkjet head** that can laminate stable layers of element materials.” Ex.1008, [0023].

407. To the extent the Board finds Uenishi does not explicitly disclose 320 heaters, Hayasaki discloses this limitation. Hayasaki teaches “**in order to increase the printing speed or printing density, the number of printing elements arranged in the printhead increases**, and the density of printing elements also increases.” Ex.1009, [0015]. In particular, Hayasaki teaches “a printhead capable of **high-density, high-speed printing** can be provided **by increasing the number of printing elements** or arraying printing elements in various patterns **without changing the size and cost of the printhead.**” Ex.1009, [0032].

408. In one embodiment, Hayasaki teaches a “printhead...[that] has **352 printing elements×2 rows**, i.e., a total of 704 printing elements...” Ex.1009, [0081]. Hayasaki teaches that its “printing elements” are “heaters.” Ex.1009, [0012]. (“reference numeral 1 denotes an electrothermal transducer such as a heater provided for each printing element.”).

409. As explained in more detail below in Section XII.C, Hayasaki explains that by utilizing additional heaters or printing elements using its proposed method, **printing speed is increased without changing the size and cost of the printhead.** Ex.1009, [0032]. It therefore would have been obvious to modify the configuration of Uenishi to utilize 352 heaters per array, as described in Hayasaki, to increase the

printing speed or printing density without changing the size or cost of Uenishi's printhead.

410. Accordingly, in my opinion, Uenishi in view of Hayasaki discloses "wherein each of the first and second heater arrays comprise at least 320 heaters [e.g., 352 printing elements]."

B. Uenishi-Hayasaki Combination discloses Claim 12

411. Claim 12 depends from claim 11, which depends from independent claim 8. Uenishi discloses all of the limitations of claims 8 and 11 for the reasons discussed above, incorporated here. *See* Sections XI.A and XII.A. The additional limitations of claim 12 are disclosed by the Uenishi-Hayasaki Combination.

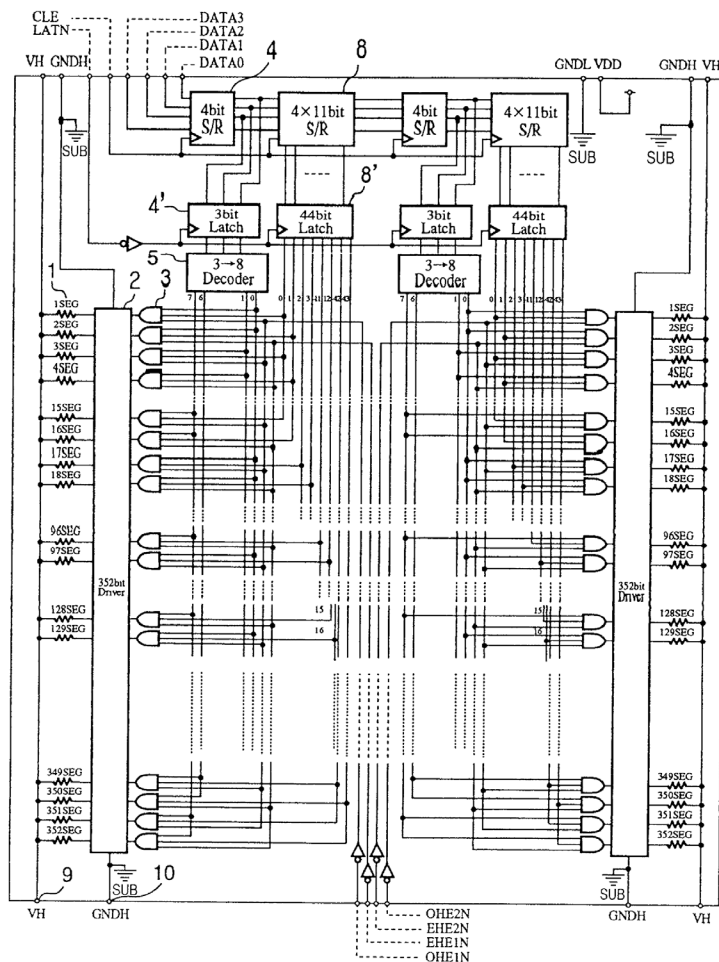
412. Claim 12 states "[t]he heater chip of claim 11, wherein the bondpad and the at least two traces are capable of supplying eight simultaneous fires per heater array." Ex.1001, cl. 12.

413. Hayasaki teaches "[t]he present invention relates to a printhead, printhead driving method, and data output apparatus and, more particularly, to a printhead which **selects a block consisting of a plurality of printing elements that can be simultaneously driven...**" Ex.1009, [0001]. Hayasaki explains its invention "can **speed up** transfer of image data and driving of printing elements **without increasing the number of signal lines and connection terminals** and a printing

apparatus using the printhead.” Ex.1009, [0026]. This is consistent with Uenishi’s goal of reducing the number of components. Ex.1008, [0023], [0040]-[0041].

414. Hayasaki teaches “[t]he printhead of this embodiment has 352 printing elements×2 rows, i.e., a total of 704 printing elements, and can drive the printing elements in the respective rows under different conditions.” Ex.1009, [0081]. As may be seen in Fig. 3, below, the two rows of 352 printing elements are controlled separately by a column of 352 AND circuits 3, each having three inputs and one output to a 352 bit driver circuit 2. Ex.1009, [0062].

FIG. 3



Ex.1009, Figure 3.

415. As described further, below, for the row of 352 printing elements 1 on the left side of Fig. 3, 1SEG-352SEG, the three inputs to each AND circuit 3, (respectively in order, upper to lower input), consist of a control line (e0 - e7) from coder 5, a data line (B0 - B43) from 44 bit latch 8', and an odd/even control line (OHE1N, EHE1N). Ex.1009, [0088]-[0091]. A PHOSITA would appreciate that a printing element 1 will fire when the AND circuit 3 controlling it has all three control

input lines activated (held logically high) and the firing power line VH 9 is energized.

416. Hayasaki teaches “[e]ach of the signals e0 to e7 can simultaneously activate 44 distributed printing elements. This signal is used as the first printing control signal.” Ex.1009, [0088]. A PHOSITA would appreciate from Figure 3 that the e0-e7 control signals organize the 352 printing elements into 22 groups of sixteen printing elements (e.g., group 1 consists of AND circuits for 1SEG-16SEG) wherein the AND circuits of the first two members of a group are connected to the e0 line, the AND circuits of members three and four are connected to the e1 line, members five and six to the e2 line, and so on, to members fifteen and sixteen to the e7 control line.

417. Hayasaki then teaches “[t]he second printing control signals generated in the circuit include BLK outputs B0 to B43” and that “[e]ach output can simultaneously activate eight printing elements.” Ex.1009, [0089]. A PHOSITA would appreciate every printing element AND circuit is connected to one of the BLK outputs, organized so that the odd numbered printing element AND circuits in the groups of sixteen that were used to organize the e0-e7 groups are connected to a first BLK line, i.e., B0, and the even numbered printing element AND circuits for that same group of sixteen are connected to the next BLK line, i.e., B1 following B0.

BLK lines B2-B43 are connected to the next groups of sixteen AND circuits in a corresponding fashion.

418. Hayasaki further teaches that “[o]dd- and even-numbered elements are respectively driven at different timings in accordance with image data corresponding to the 44 printing elements belonging to a block corresponding to each code.” Ex.1009, [0082]. A PHOSITA would appreciate the separate firing of odd and even numbered printing elements is accomplished by a third printing control line input to each of the AND circuits 3. As shown in Figure 3, the odd numbered printing element AND circuits 3 in the left column of heater resistors (A1SEG, A3SEG, A5SEG, ..., A351SEG) are connected to odd/even control line OHE1N. Also shown in Figure 3, the even numbered printing element AND circuits 3 in the left column of heater resistors (A2SEG, A4SEG, A6SEG, ..., A352SSEG) are connected to odd/even control line EHE1N. Thus, the added AND circuit control of the odd/even input lines, which are activated at different times, means that the odd and even members of each group of 44 printing elements attached to an (e0-e7) first printing control signal will be fired separately in time.

419. In combination, the three printing control inputs to the AND circuits 3 that control the firing of the 352 printing elements, provide for the simultaneous firing of 22 printing elements. 44 printing elements are enabled by a line of the first printing control signal (e0-e7), half of these, 22, are also enabled by a line of the

third printing control signal (OHE1N or EHE1N), and all are potentially enabled, based on the user's image data, by logic high signals on the 44 BLK lines input to every print element AND circuit. As Hayasaki states "[o]dd- and even-numbered elements are respectively driven at different timings in accordance with image data corresponding to the 44 printing elements belonging to a block corresponding to each code." Ex.1009, [0082]. If the image being printed were, for example, all black, then Hayasaki's circuitry of Fig. 3 would simultaneously fire 22 printing elements in each of sixteen drop firing time slots, to complete a 352 drop black printing stroke.

420. As explained in more detail below in Section XII.C, Hayasaki explains that by increasing the number of printing elements simultaneously fired using its proposed method, printing speed is increased without increasing the number of signal lines and connection terminals. Ex.1009, [0026]. It therefore would have been obvious to modify the configuration of Uenishi to provide for 22 simultaneous fires per heater array, as described in Hayasaki, to increase the printing speed without increasing the number of signal lines and connection terminals in Uenishi's printhead.

421. Accordingly, in my opinion, Uenishi in view of Hayasaki discloses "wherein the bondpad and the at least two traces are capable of supplying eight simultaneous fires per heater array."

C. Ample Motivation Existed to Combine Uenishi and Hayasaki

422. In my opinion, a PHOSITA would have been motivated to combine Uenishi with Hayasaki.

423. *First*, I understand that both Uenishi and Hayasaki are **analogous** to the claimed subject matter in the '864 Patent as they are all within the **same field of endeavor** of heater chips for inkjet printheads. *See, e.g.*, Ex.1001, Abstract; Ex.1008, [0023]; *id.* at claims 1-6; Ex.1009, [0001, 0131]. I also understand that the '864 Patent, Uenishi, and Hayasaki under the same patent classification—class B41 (printing; lining machines; typewriters; stamps).

424. *Second*, in my opinion, a PHOSITA would have been motivated to modify the heater chip of Uenishi to utilize 352 heaters per array, as described in Hayasaki. By making such a modification, a PHOSITA would have understood that this could “increase the printing speed or printing density,” without having to change the size, and thus the cost, of the printhead. Ex.1009, [0015, 0032].

425. As Hayasaki explains, by increasing the number of heaters used, it provides increased printing speed and printing density. Ex.1009, [0015]. Hayasaki further explains that this increased amount of heaters is done without increasing the chip size, and thus the cost of manufacturing the chip. Ex.1009, [0032]. This falls in line with a stated objective of Uenishi: maintaining a reduced chip size. Ex.1008, [0023]. As such, a PHOSITA would have understood that modifying Uenishi to

have the increased number of heaters per array as described by Hayasaki would have been obvious and would have provided increased printing speed and printing density without requiring increased chip size and cost.

426. A PHOSITA also would have been motivated to modify Uenishi in view of Hayasaki to have Uenishi provide for eight simultaneous fires per heater array. Because a PHOSITA would have been motivated, for reasons described above, to modify Uenishi to have 352 heaters per array, a PHOSITA would have understood that these heaters would have needed to be activated in an efficient manner in order to provide the desired printing speed and density.

427. Hayasaki notes that because of its configuration having an output that can simultaneously activate twenty-two printing elements, Ex.1009, [0001], [0026], [0089]-[0091], this “can speed up transfer of image data and driving of printing elements without increasing the number of signal lines and connection terminals” needed. Ex.1009, [0026]. A PHOSITA would have been motivated to make this same change in Uenishi with respect to the eight simultaneous fires per heater array in order to capture this speed up transfer of image data and driving of printing elements without increasing the number of signal lines and connection terminals, which would necessarily reduce the cost.

428. *Finally*, a PHOSITA would have had a reasonable expectation of success in making this modification. The printhead components described in

Uenishi and Hayasaki (e.g., thermal ink jet printing, drop generators, heaters) were well-known at the time. *See, e.g.*, Ex.1008, [0002]-[0005]; Ex.1009, [0002]-[0025]. As such, it would also have been straightforward for a PHOSITA to modify Uenishi's printhead to increase the number of drop generators taught by Hayasaki and such a system would work.

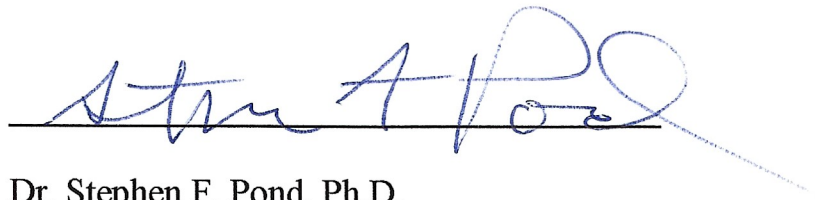
429. Making such a modification in Uenishi falls in line with its discussion of maintaining a reduced heater chip size and goal of providing "a high-resolution, small-volume thermal inkjet head." Ex.1008, [0023].

XIII. CONCLUSION

430. For the reasons set forth above, in my opinion, all of the limitations of claims 1-6, 8-20 of the '864 Patent are disclosed by the above cited combinations of prior art.

431. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

Executed on December 30, 2022.

A handwritten signature in blue ink, appearing to read "Stephen F. Pond", is written over a horizontal line. The signature is stylized with large, flowing letters and a prominent loop at the end.

Dr. Stephen F. Pond, Ph.D.