

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 STEVEN J. DIETL

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I. Introduction

I, Steven J. Dietl, declare as follows:

1. I have been retained on behalf of Slingshot Printing LLC (“Slingshot”), and its counsel, Fitch, Even, Tabin & Flannery LLP (“Fitch Even”), as an expert in this proceeding. I am personally knowledgeable about the matters stated herein and am competent to make this declaration.

2. I understand that Canon U.S.A., Inc. and Canon Inc. (“Canon”) filed a Petition for *inter partes* review regarding certain claims of United States Patent No. 7,290,864 (“the ’864 patent”), which was accompanied by the Declaration of Dr. Stephen F. Pond. I understand that the Petition in this case (IPR2023-00309) relates to certain grounds of invalidity based primarily on U.S. Patent No. 7,722,144 to Benjamin *et al.* (“Benjamin ’144”); U.S. Patent No. 7,278,703 to Benjamin *et al.* (“Benjamin ’703”); and Japanese Patent Application No. 11-245409 to Uenishi *et al.* (“Uenishi”).

3. I have been asked to analyze the references cited in the Petition, and the conclusions drawn by the Petition with respect to the knowledge and understanding of a person having ordinary skill in the art, and to provide my conclusions and bases thereof regarding several aspects of the issues in dispute. I have also been asked to review the claims at issue and the disclosures of the ’864 patent, and to provide conclusions relating to the meaning of the claims and disclosures of the ’864 patent.

This declaration provides exemplary conclusions within the scope of this assignment.

4. I receive compensation of \$230/hr. for the time I spend working on this matter, plus expenses. I have no financial interest in the patents involved in this litigation, and my compensation is not dependent on the outcome of this litigation. The conclusions I present are based on my own judgment. I am not an employee of Slingshot, Fitch Even, the inventors, or any affiliated companies.

II. Background And Qualifications

5. My qualifications for forming the opinions set forth in this declaration are summarized here and detailed in my curriculum vitae attached hereto as Ex. 2003.

6. I am currently a consultant and the owner of Pike Lake Consulting, LLC. I believe my educational and work experience, as summarized below, qualify me as an expert in the field of mechanical engineering, with an emphasis on ink jet printing design. My experience encompasses all aspects of ink jet design, development, and commercialization, including printhead and ink cartridge design and implementation. In particular, I have led development teams on ink jet printer lines and related ink cartridges for Xerox Corporation and Eastman Kodak Company.

7. I earned a Bachelor of Science degree in Mechanical Engineering from the State University of New York at Buffalo.

8. After earning my Bachelor's degree, I was employed by Xerox Corporation as a systems engineer, advanced technology development engineer, product design engineer and subsystem team leader on multiple laser electrophotography and ink jet research and development programs. I was directly responsible for multiple thermal ink jet printhead, ink cartridge, and maintenance station product subsystems.

9. While employed at Xerox, I earned a Master of Engineering degree from Rochester Institute of Technology in Systems Engineering.

10. In 1995, I became a Product Development Team Leader at Xerox, leading a team at LG Electronics in South Korea to drive completion of a delayed ink jet printer product to market. I and my team mentored the South Korean development team in best practices relating to product design, process certification techniques, and subsystem development, testing, and certification. During that assignment, I was awarded the Xerox Corporation Award For Excellence In Engineering.

11. In 1996, I became Technical Program Manager at Xerox and led development teams on printhead, ink cartridge, maintenance station, and algorithm development for next generation ink jet printer lines. In this role, I was responsible

for technology selection, subsystem development, and integration with Xerox's printer mechanism development partner located in Asia. I also led the effort to transfer these designs to mass production while controlling quality and costs.

12. In 2002, I became Director of Ink Jet Writing Systems R&D at Eastman Kodak Company. In that role I formed and led a team of scientists and engineers to bring Kodak's first consumer ink jet printers to market, and led all aspects of product development and manufacturing.

13. In 2011, I became Director of Product Design, Commercialization, Research, and Development for Eastman Kodak's Digital Print and Enterprise Division, where I drove the complete redesign of Kodak's flagship color ink jet press product. I worked closely with customers to develop solutions that improved long term reliability, image quality, and performance of ink jet printing presses.

14. In 2015, I became Director of Digital Front End Development and General Manager of Kodak Creo Servers, leading product platform development for Kodak as well as OEM customers.

15. Since 2016 I have provided consulting services to multiple companies, and also served as Vice President of Engineering and Operations at SensoDx II, LLC, leading research and development, commercialization, and manufacturing on point of care immunoassays and cytopathology in vitro diagnostics systems.

16. In 2020, I co-founded AMDX BioSystems, Inc. and led the product development and manufacturing of a breakthrough microfluidic molecular COVID-19 home test.

17. The '864 patent describes technical challenges associated with providing electrical power to a printhead for discharging ink in an inkjet printer. I believe my expertise and education in this field qualifies me to explain this technology and to address the issues of patent validity from the perspective of a person of ordinary skill in the art. I am qualified to submit expert analyses in this proceeding.

III. Materials Considered

18. The opinions expressed in this declaration are mine and were developed after studying and considering the Petition (Paper No. 1) and the following exhibits, in addition to any documents cited herein.

Ex. 1001	U.S. Patent No. 7,290,864 to King <i>et al.</i>
Ex. 1002	Declaration of Stephen F. Pond, Ph.D.
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	Japanese Patent Application Publication No. 11-245409 to Uenishi <i>et al.</i> , English Translation, and Affidavit (“Uenishi”)
Ex. 1009	U.S. Patent Publication No. 2001/0045967 to Hayasaki (“Hayasaki”)
Ex. 1010	Order Granting Stay of <i>Slingshot Printing LLC v. Canon U.S.A., Inc. et al.</i> , Case No. 2:22-cv-01852, Dkt. 42 (E.D.N.Y. Dec. 1, 2022)

Ex. 1011	Case Management Schedule for <i>Slingshot Printing LLC v. Canon U.S.A., Inc. et al.</i> , Case No. 2:22-cv-01852, Dkt. 36-1 (E.D.N.Y. Nov. 2, 2022)
Ex. 1012	Slingshot LLC's Infringement Contentions for <i>Slingshot Printing LLC v. Canon U.S.A., Inc. et al.</i> , Case No. 2:22-cv-01852, (E.D.N.Y.)
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)
Ex. 2001	Concise Oxford American Dictionary (2006) (excerpt)
Ex. 2002	Webster's II New Riverside University Dictionary (1994) (excerpt)
Ex. 2003	Curriculum Vitae of Steven J. Dietl
Ex. 2005	October 11, 2023 Deposition of Stephen F. Pond

19. My review of these materials was informed by my education, my experience in and knowledge of the industry, and my work as a consultant.

IV. Applicable Legal Standards

20. As a technical expert, I am not offering any legal opinions. Rather I am offering technical assessments and opinions. In rendering my analysis, I have been informed by counsel regarding various legal standards for determining patentability. I have applied those standards in forming my technical opinions expressed in this report.

21. The patent claims describe the invention made by the inventor and describe what the patent owner owns and what the owner may prevent others from using. I understand that an independent claim sets forth all the requirements that must be met to be covered by that claim. I further understand that a dependent claim

does not itself recite all of the requirements of the claim but refers to another claim and incorporates all of the requirements of the claim to which it refers.

22. I understand that for a claim to be anticipated under 35 U.S.C. § 102, every limitation of the claimed invention must be found in a single prior art reference, either expressly or required through inherency, as arranged in the claim.

23. I understand that for a reference to anticipate when it is silent about an inherent characteristic, that missing information in the reference may be filled by looking to extrinsic evidence. However, the extrinsic evidence must make clear that the missing information is necessarily present in the thing described in the reference, and that it would be recognized to be necessarily present by a person of ordinary skill in the art. But inherency may not be established by probabilities or possibilities. The fact that a certain thing may result from a given set of circumstances is not sufficient. Rather, the inherent characteristic must be the natural result of the design and operation as taught in the prior art reference.

24. It is my understanding that a claimed invention is unpatentable if the differences between the invention 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 person having ordinary skill in the art to which the subject matter pertains. Obviousness, as I understand it, is based on the scope and content of the prior art, the differences between the prior art and the claim, and the level of ordinary skill in the art.

25. I understand that when evaluating obviousness, one must not use hindsight when comparing the prior art to the claimed invention, nor consider what was learned only from the teachings of the patent. In particular, I understand that it is improper to use the patent claims as a road map for selecting and combining items of prior art. In other words, one should avoid using the challenged patent as a guide through the prior art references, combining the right references in the right way so as to achieve the result of the claims at issue. Instead, one must put oneself in the place of a person of ordinary skill at the time the invention was made and consider only what was known before the invention was made and not consider what was only known after the invention was made.

26. I also understand that when evaluating obviousness, it is not proper to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full appreciation of what the reference fairly suggests to a person of ordinary skill in the art. I understand that a reference must be considered for all that it teaches, including disclosures that diverge and teach away from the invention being evaluated.

27. I understand that obviousness should be considered in light of the problems known to the person having ordinary skill in the art and the complexity of the alternatives for solving the problem. That individual elements of the claimed

invention are disclosed in the prior art is not alone sufficient to reach a conclusion of obviousness.

28. I also understand that when considering the obviousness of a patent claim, one must consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand that a teaching, suggestion, or motivation may be found explicitly or implicitly: (1) in the prior art; (2) in the knowledge of those of ordinary skill in the art; or (3) from the nature of the problem to be solved. I also understand that the motivation to combine references may include logic, judgment, and common sense, but that any such motivation to combine references must still avoid the improper application of hindsight or reliance on the patentee's disclosure of his invention as found in the patent specification, drawings, and claims.

29. I understand that if the teachings of a prior art reference would lead one skilled in the art to make a modification that would render that prior art device, system, or method inoperable, then such a modification would generally not be obvious. I also understand that if a proposed modification would render the prior art device, system, or method unsatisfactory for its intended purpose, then there is strong evidence that no suggestion or motivation existed at the time of the subject invention to make the proposed modification.

30. I understand that it is improper to combine references where the references teach away from their combination. I understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. It is also my understanding that the degree of teaching away will depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant. I understand that a reference teaches away, for example, if (1) the combination would produce a seemingly inoperative device, or (2) the references leave the impression that the product would not have the property sought by the applicant or would no longer achieve the intended purpose(s) of the references being modified or combined.

31. I also understand that when considering obviousness, secondary considerations such as commercial success, long felt but unsolved needs, and the failure of others should also be considered.

V. Person Of Ordinary Skill In The Art

32. I have been asked to address the issues from the perspective of a person having ordinary skill in the art of the '864 patent ("PHOSITA"), at the time the relevant patent application leading to the '864 patent was filed. As stated in the '864

patent, the field of the invention generally relates to heater chips, and more particularly, heater chips with a reduced number of bond pads.

33. Dr. Pond contends that a person having ordinary skill in the art at the time that the application that became the '864 was filed (September 30, 2005) would have had at least a Bachelor's or Master's level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and at least two years of training or experience in the design of ink jet printheads or semiconductor circuit layout. (Ex. 1002 ¶56.)

34. I can accept Dr. Pond's description of a person having ordinary skill in the art, except that I do not view a degree in materials science as sufficient to qualify as a PHOSITA.

35. In view of the above and my curriculum vitae in Ex. 2003, I had exceeded the experience of a PHOSITA before the September 30, 2005 date of the '864 patent. As of this relevant time period, I was at least a person of ordinary skill in the relevant art, and I had direct personal knowledge of the technologies involved in the '864 patent and an understanding of what a PHOSITA with two years of training or experience in the design of printheads would know. In particular, as of that date, I had a Bachelor's degree in Mechanical Engineering and a Master's degree in Systems Engineering and significant experience with designing and commercializing ink jet printheads.

36. As a result of my education and industrial experience, I am familiar with the technology in the field of the '864 patent and also with the state of that technology in September 2005, when the application that led to the '864 patent was filed. I am capable of addressing the issues from the perspective of such a person, and I have done so in this declaration.

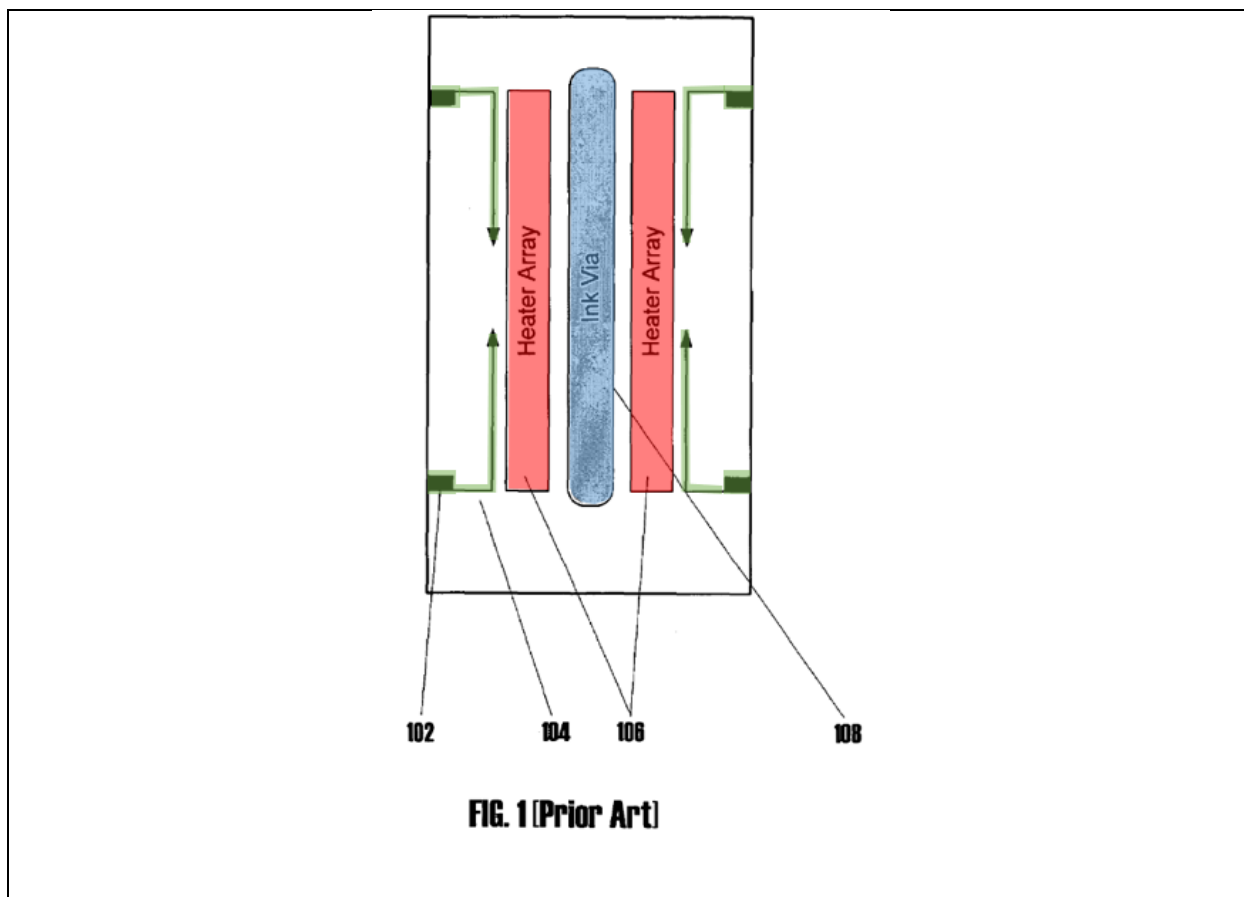
VI. Relevant Disclosures Of The '864 Patent

37. The '864 patent describes technical challenges associated with supplying power to heater chips in printing devices. (Ex. 1001 Abstract col. 1 lns 45-53.) A printhead is the device in inkjet printers that releases droplets of ink onto a sheet of paper. Many such devices utilize “heater chips” that include “heaters” to provide thermal energy that heats and causes the discharge of ink droplets. (*Id.* col. 1 lns 13-19.) These heaters may be thin film resistors that generate heat in response to electric current, providing thermal energy to ink within a chamber and causing it to discharge from a nozzle associated with the chamber. (*Id.* col. 1 lns 19-22, col. 2 lns 15-31, and col. 4 lns 1-9.) The heaters are grouped together in arrays, such as an array of 320 heaters in a typical example. (*Id.* col. 3 lns 51-56 and col. 4 lns 57-67.)

38. In order to provide power to the heaters, bondpads are provided that receive electrical current from an external electrical connection to the printhead and then transfer the current to the heater array, such as through power traces. (*Id.* col. 1 lns 19-24.) The bondpads provide surface area for external connections to interface

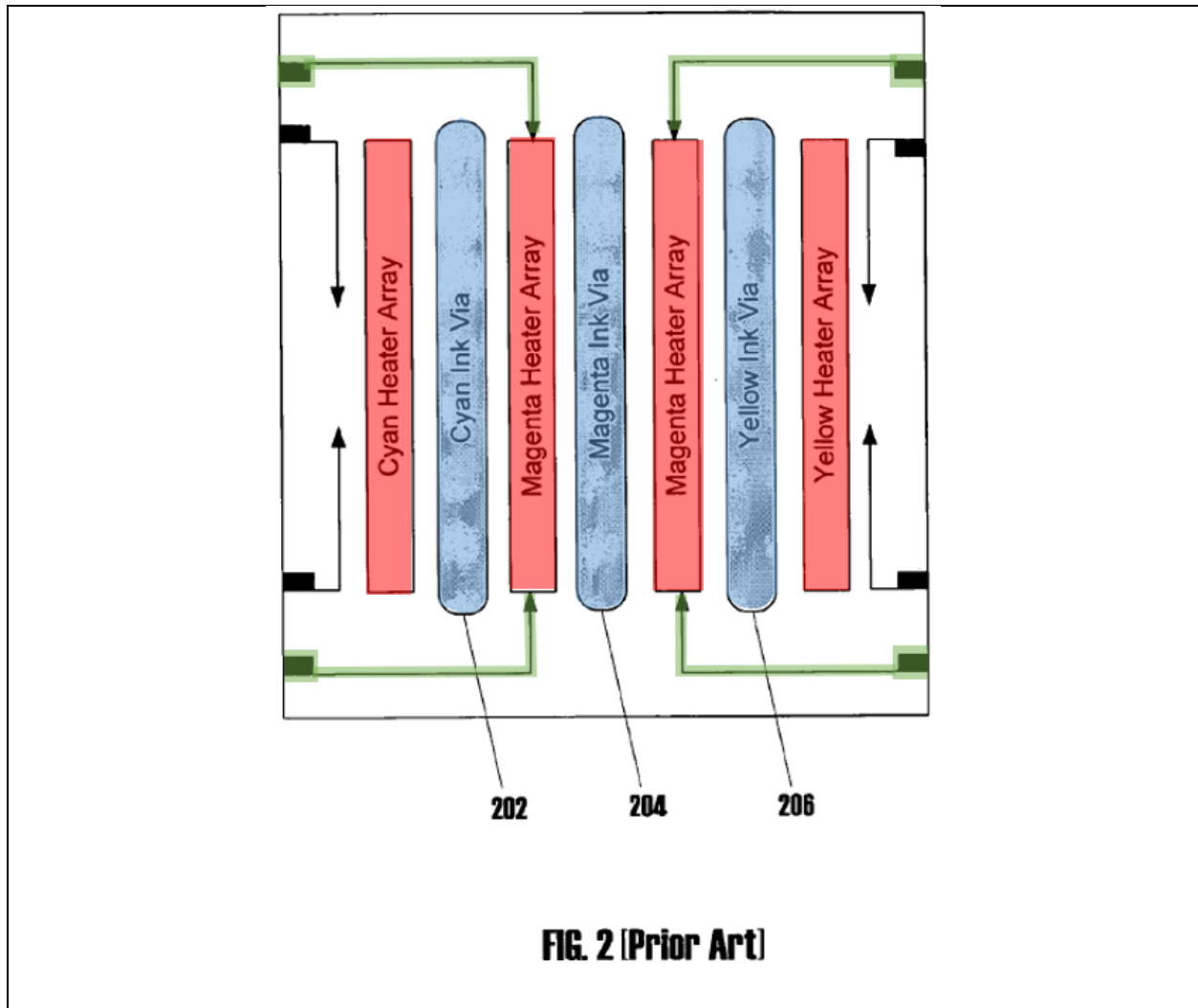
with the heater chip. The '864 patent explains that each bondpad provides only a small amount of current (typically limited to no more than about 1 Amp). (*Id.* col. 5 lns 18-20.) The heater chip must have enough bondpads to supply the amount of current required to simultaneously fire the number of heater resistors needed to achieve a desired performance in discharging ink droplets. (*Id.* col. 1 lns 25-28.) High resolution printheads typically include thousands of these heater resistors. (*See id.* col. 3 lns 33-38.) This presents particular design challenges, as each bondpad and its associated power routes consumes chip area and contributes to overall chip size. A higher number of bondpads and power routes also adds cost to the heat chip. (*Id.* col. 1 lns 34-38.)

39. Fig. 1 of the '864 patent illustrates a conventional prior art configuration of a heater chip.



The heater arrays [red], consisting of multiple heat generating resistors, are located along both sides of an ink via [blue] that supplies ink to the heater chip. (*Id.* col. 3 lns 39-43.) Per this conventional approach, four bondpads 102 and their respective power traces 104 are used to supply power needs of the two heater arrays. (*Id.* col. 3 lns 42-46.) Both the bondpads 102 and power traces 104 are highlighted in green in the annotated version of Fig. 1 above. Each bondpad and its power trace supply current to a portion of one heater array. (*Id.* Fig. 1.) Each bondpad sends current through its respective power trace only to a heater array located on the same side of the ink via as the bondpad itself. (*Id.* col. 4 lns 9-12.)

40. The heater chip shown in Fig. 2 shows another conventional design that includes multiple ink vias [blue] on a single chip with heater arrays [red] connected to bond pads and power traces [green]. (*Id.* col. 4 lns 13-22.)



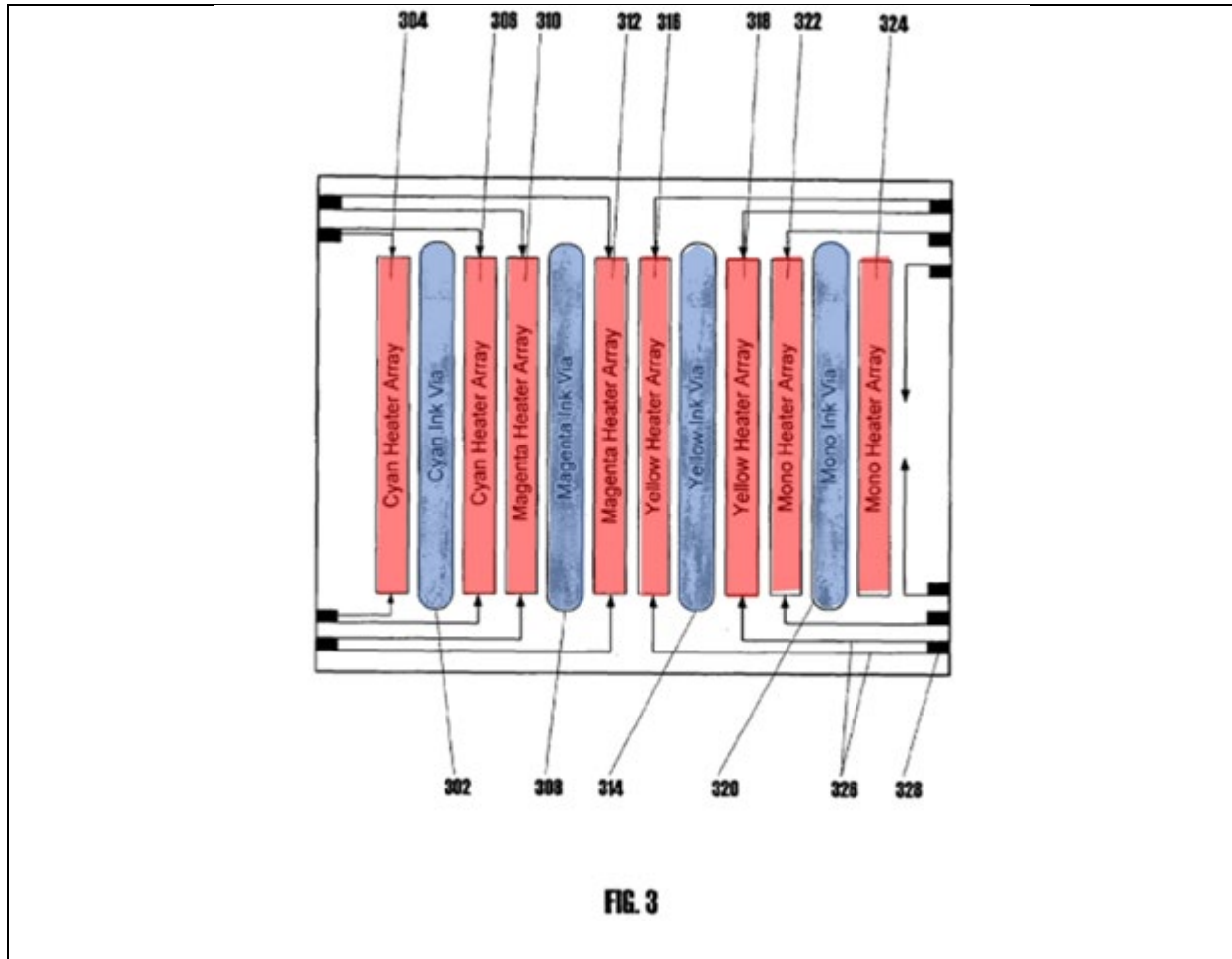
(*Id.* Fig. 2.) As in the configuration of Fig. 1, the central ink via 204 above, which supplies magenta ink to the heater chip, has associated heater arrays disposed along each of the two longitudinal sides of the ink via. Each bondpad and associated power

trace [both green] supply current to a portion of a heater array [red] along one side of an ink via [blue]. The same approach is used for the single heater array associated with the yellow ink via 206 and the single heater array associated with the cyan ink via 202. Like in the conventional heater chip of Fig. 1, each bondpad of the heater chip of Fig. 2 supplies power to only one heater array. In both designs, the heater array powered by the bondpad is on the same side of the ink via as the bondpad itself.

41. The invention of the '864 patent provides an improved power distribution approach applicable to heater chips that include ink vias with associated heater arrays positioned on both sides of a via. (*Id.* col. 1 lns 45-53.) The '864 patent further explains that a heater array may be arranged into addressable groups, with one heater of each group being fired simultaneously, and that several prior art configurations are designed to fire 16 heaters of an array simultaneously. (*Id.* col. 5, lns 3-11 and 27-30.) The number of heaters fired simultaneously from each array impacts the number of bondpads required to power the array. In the prior art configuration of Fig. 2, for example, firing 16 heaters simultaneously in each array requires two bondpads that are each capable of supplying sufficient current to fire 8 heaters. Only one of the two heater arrays associated with the magenta ink via need to be fired to emit 16 droplets of magenta ink.

42. The inventor of the '864 patent recognized that with two heater arrays per via, the number of heaters simultaneously fired from each array could be

reduced, which would in turn allow for a more efficient and less costly arrangement of bondpads and power routes for supplying the needed current. A printhead chip in accordance with the principles of the invention is illustrated in Fig. 3 below:

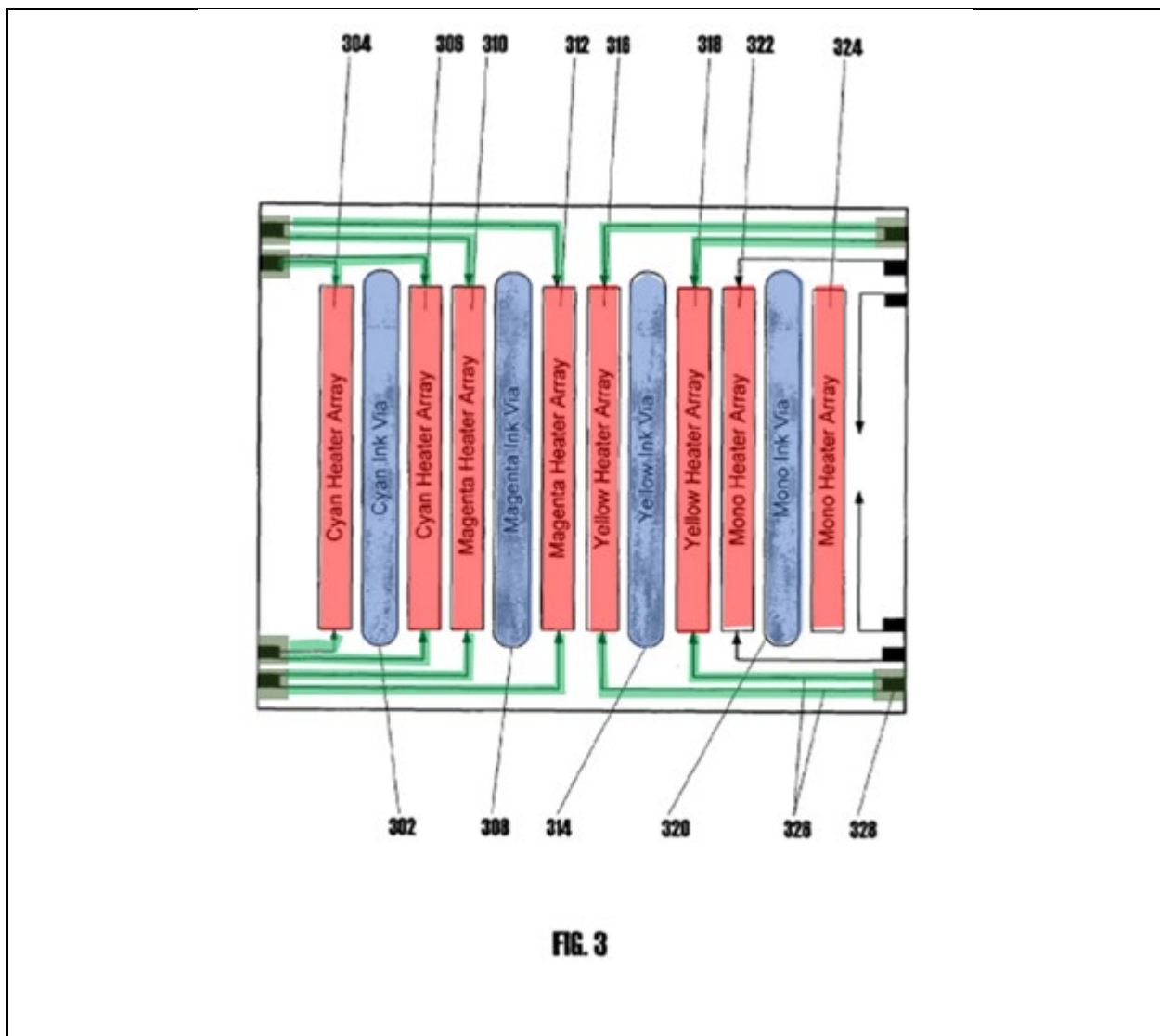


(Ex. 1001 Fig. 3.) As illustrated, the heater chip includes four ink vias [blue] each positioned between two heater arrays [red]. In particular, a cyan ink via 302 is between a first heater array 304 and a second heater array 306; a magenta ink via 308 is between a first heater array 310 and a second heater array 312; a yellow ink via 314 is between a first heater array 316 and a second heater array 318; and a

monochrome ink via 320 is between a first heater array 322 and a second heater array 324. (*Id.* Fig. 3 and col. 4 lns 30-39.) The specification teaches that the heater arrays of this embodiment may include 320 heaters grouped into 8 addressable blocks of 40 heaters such that 8 heaters are fired simultaneously (rather than 16 simultaneous fires per 320 heaters common in conventional configurations). (*Id.* col. 5 lns 24-30.) With two heater arrays per via, this approach still supports emitting 16 ink droplets simultaneously per via. By reducing the number of heaters needed to be fired simultaneously in each array, the amount of current needed to be supplied from the bondpads to each heater array is reduced to the point of requiring only one bondpad per heater array. (*Id.* col. 5 lns 12-18 and 30-33.)

43. However, with a reduced number of bond pads per array, the inventor then faced another challenge – using one bondpad to power an entire array could result in power imbalances across the heater arrays due to the series resistance of long power traces. (*Id.* col. 5 lns 36-38.) In other words, when supplying power to an elongate array of heaters, power must be balanced across the array so that those heaters furthest from a bondpad receive the same energy as heaters closer to a bondpad despite electrical current having to travel further distances along longer power traces. As a result, using a single bondpad to power an entire heater array generally requires a larger chip area to ensure adequate power balance across the heater array. (Ex. 1001 col. 5 lns 36-38.)

44. The power distribution configuration of the invention overcomes these challenges by providing a novel design for providing bondpads and power routes used to power the heater arrays. As shown in Fig. 3, the invention improves upon the conventional designs by connecting heater arrays [red] on opposite sides of an ink via [blue] to the same bondpad [dark green] by power traces [light green], as shown below.



(Ex. 1001 Fig. 3.) Heater arrays on each side of a given color ink via are connected by power traces to a common bondpad. For instance, the yellow ink via 314 has an associated heater array 316, 318 on each side, and a pair of power traces 326 connected to a single bondpad 328 to supply electrical current to portions of both heater arrays. Each bondpad is configured to supply power to a portion of a first array and a portion of a second array located toward the same end of the chip. By providing bondpads at both sides of the chip so that each bondpad need only connect to heaters toward that side of the chip (rather than connecting to heaters extending across the full array from one end of the respective ink via to the other), the portions of heater arrays connected to a given bondpad have less variation in distance from that bondpad. (*Id.* col. 5 lns 36-48.) For instance, the '864 patent recognizes that connecting a bondpad to either the top halves of multiple arrays or the bottom halves of multiple arrays reduces the number of bondpads required while minimizing the length of power traces stemming from the bondpad to maintain the maximum current at the heaters without having to increase the chip area for power balancing. (*Id.*)

45. The '864 patent also recognized that it is advantageous to utilize power traces that separate proximate to a bondpad in order to efficiently balance resistance of power traces, and that power traces from a common bondpad may be positioned closer together than conventional power traces stemming from different bondpads. (*Id.* col. 5 ln 64 through col. 6 ln 6.) The design of the '864 patent thus beneficially

reduces the number of bondpads as well as the area consumed by bondpads and power traces while maintaining the current needed to emit ink droplets at the required rate and avoiding detrimental power imbalances across the heater arrays.

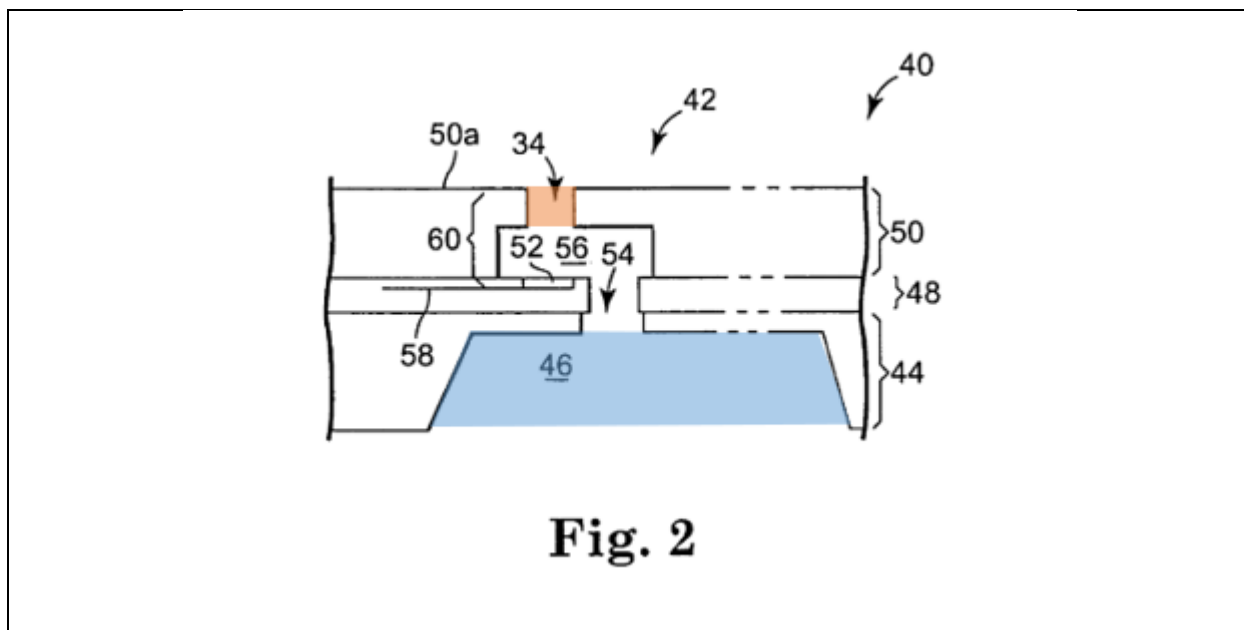
VII. Prosecution Of The '864 Patent In The USPTO

46. The application that led to the '864 patent was filed on September 30, 2005. The USPTO issued a notice of allowance on August 28, 2007 without rejecting the claims. (Ex. 1004 pp. 49-56.) The examiner determined that the claimed invention “solves the problem of minimizing the number of chip bondpads necessary to power the heater arrays on the chip and ensuring adequate power balancing to the heater arrays.” (*Id.* p. 51.)

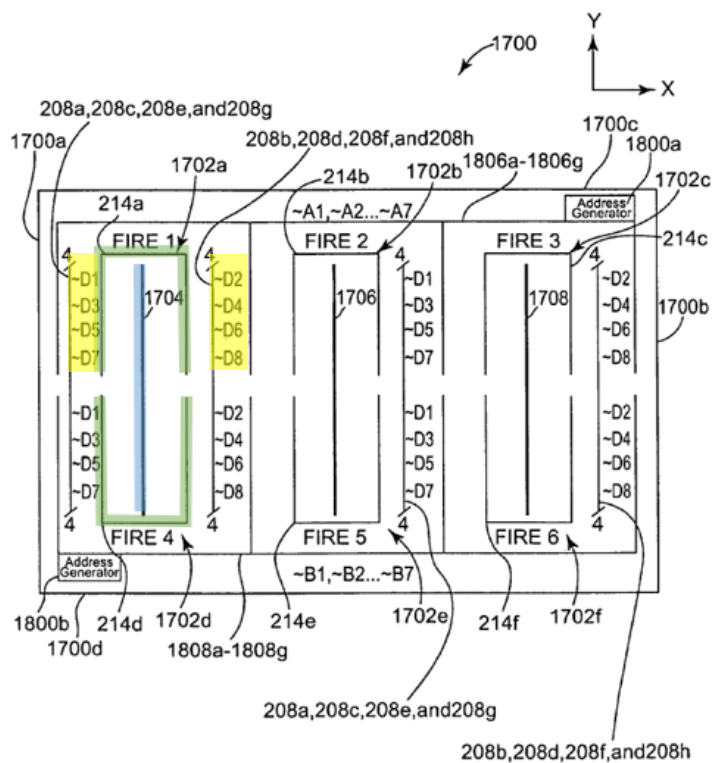
VIII. The Asserted Prior Art References

A. Summary Of U.S. Patent No. 7,722,144 to Benjamin *et al.* (Ex. 1005)

47. U.S. Patent No. 7,722,144 to Benjamin *et al.* (“Benjamin '144”) discloses a “printhead die 40 that ejects drops of ink through a plurality of orifices or nozzles 34 [orange] toward a print medium 36 [not shown].” (Ex. 1005 col. 3 lns 32-36.) An ink feed slot 46 [blue] provides a supply of ink to printing elements. (*Id.* col. 4 lns 54-56.)



48. Benjamin '144 discloses ink feed slots such as slot 1704 [blue] to provide a supply of ink and U-shaped fire lines to provide energy to drop generators controlled by data signals (e.g. D1-D8). The annotated version of Fig. 22 below illustrates a printhead die with fire lines, e.g. 1702a [green], associated with data signals, e.g. D1-D8 [yellow], transmitted along data lines 208 a-h, and an ink feed slot, e.g. 1704 [blue].



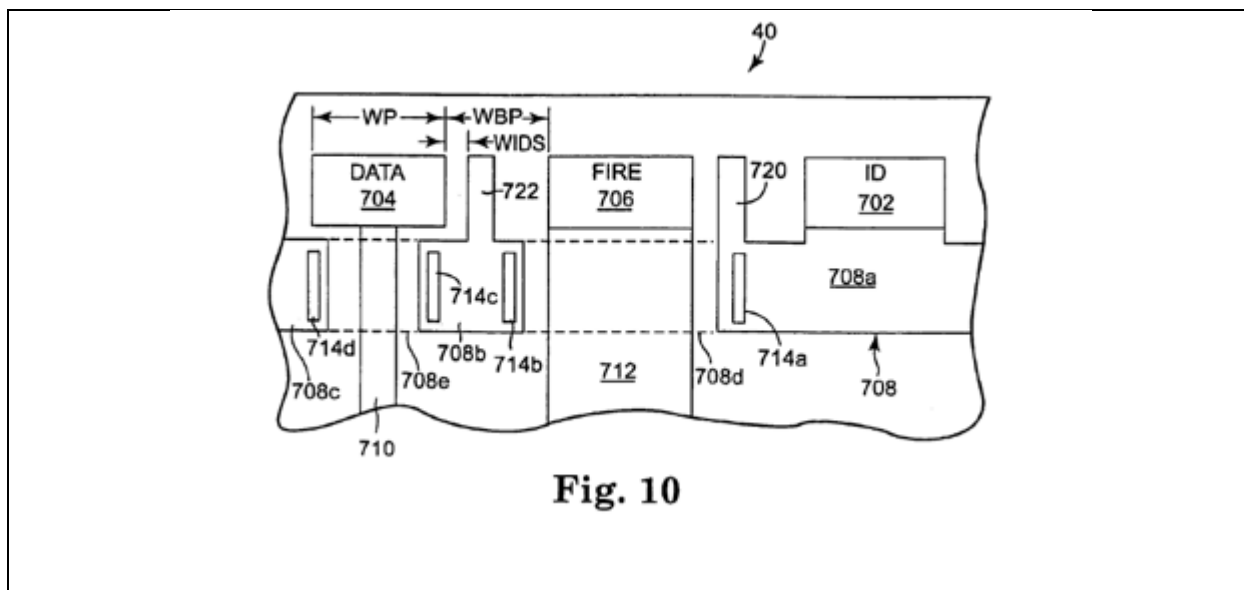
(Ex. 1005 Fig. 22 and col. 64 lns 9-21 and col. 67 ln 36-54.) However, Benjamin '144 contains relatively simplistic drawings of the printhead die that do not provide much information about the actual structure. The majority of Benjamin '144's long disclosure relates to how circuitry addresses groups of heaters in order to cause them to fire and eject ink.

49. Benjamin '144 generally discloses that a flex circuit along the side of the cartridge provides contact areas for coupling external circuitry to the printhead die through a series of conductive paths. (Ex. 1005 Figs. 25A and 25B and col. 77 ln 41 through col. 78 ln 22.) However, the reference does not disclose the physical

structures and connections for supplying power to the U-shaped fire lines from those conductive paths of the flex circuit. For instance, Benjamin '144 does not describe or illustrate the connection of the U-shaped fire lines to any other structure on or off of its heater chip. Benjamin '144 does disclose data lines (such as data line group 208a, 208c, 208e, and 208g) routed from a bondpad located along the side of the printhead die nearest to a data line group. (*Id.* col. 69 lns 3-7 and 38-41.) However, even the connection between a bondpad and its data line group is not actually shown. Further, Dr. Pond admits that data lines are not lines that supply power to heater arrays. (Ex. 2005 10:11-13.) Therefore, the presence of a bondpad associated with a data line group would not inform a PHOSITA regarding connections to fire lines on the chip of Benjamin '144.

B. Summary Of U.S. Patent No. 7,278,703 to Benjamin *et al.* (Ex. 1006)

50. U.S. Patent No. 7,278,703 to Benjamin *et al.* ("Benjamin '703") relates to various aspects of the circuitry of an inkjet printhead. Petitioners focus on Fig. 10:



(Ex. 1006 Fig. 10.) The figure shows a portion of a printhead die 40 that includes an identification signal input pad 702, a data line input pad 704 and a fire line input pad 706. The fire line input pad 706 is electrically coupled to a fire line 712 that is electrically coupled to firing cells 120. (Ex. 1006 Fig 10 and col. 19 lns 33-47.) However, the arrangement of firing cells 120 is not shown in relation to Fig. 10. The fire line 712 also is not described by Benjamin '703 as connecting to multiple arrays of heater resistors, and is not described as connecting to heater resistors on two different sides of an ink via. While Benjamin '703 shares some figures and description with Benjamin '114, there is nothing in either reference indicating that both sides of the U-shaped fire lines in Benjamin '114 connect to a single input pad, such as 706 in Benjamin '703.

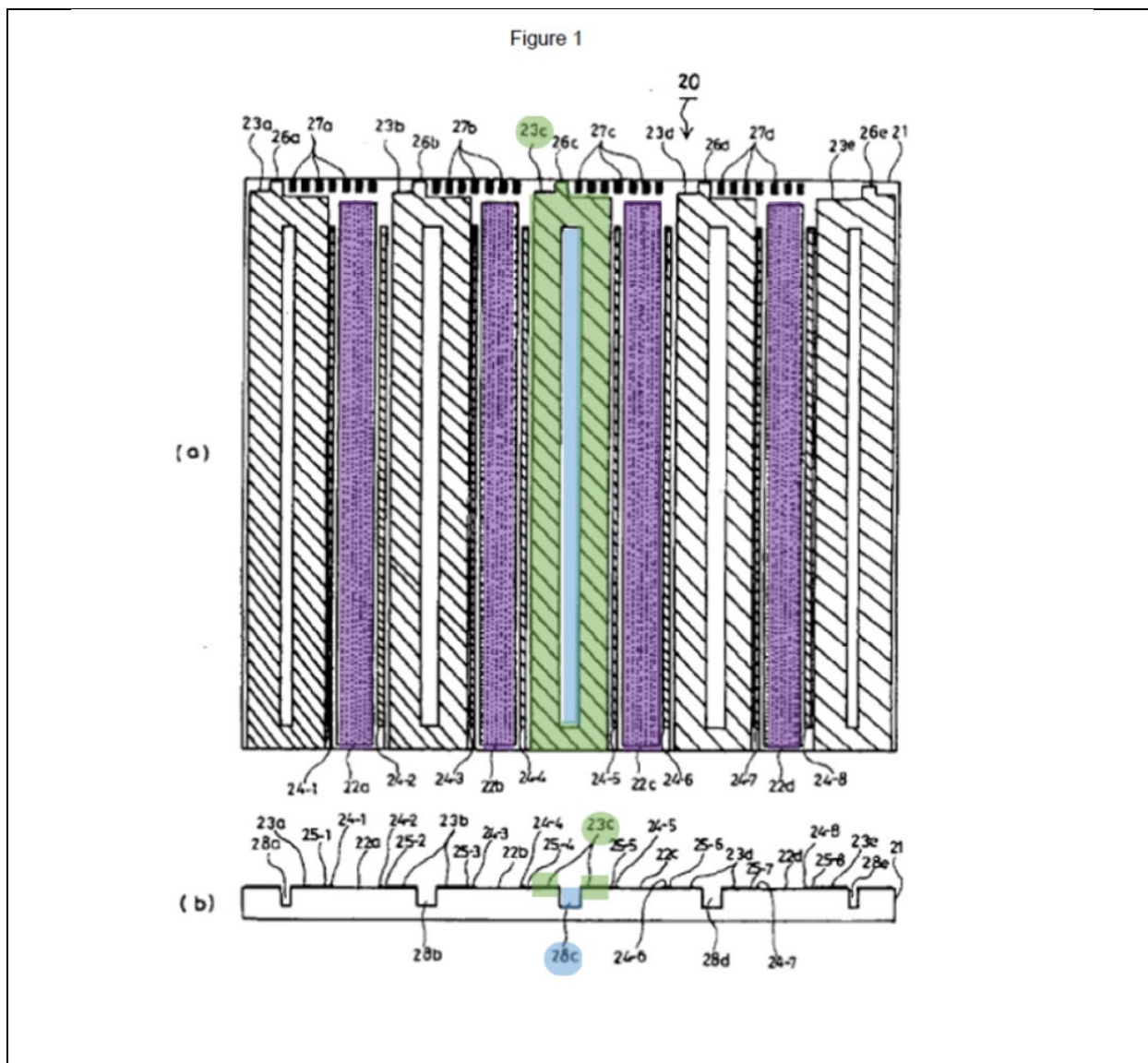
C. Summary Of U.S. Patent No. 6,582,062 to Childers *et al.* (Ex. 1007)

51. U.S. Patent No. 6,582,062 to Childers *et al.* ("Childers") discloses a

large array printer with multiplexing devices. Childers discloses a structure that is substantially different than the Benjamin references cited by Dr. Pond. For instance, Childers includes a ceramic substrate, and ink feed channels only partially pass through the thickness of the substrate. (Ex. 1007 col. 6 lns 11-30.)

D. Japanese Patent Application No. 11-245409 to Uenishi *et al.* (Ex. 1008)

52. Japanese Patent Application No. 11-245409 to Uenishi *et al.* (“Uenishi”) discloses a printhead with large common electrodes encircling ink supply channels. Fig. 1 of Uenishi is reproduced below.



(Ex. 1008 Fig. 1.) This thermal inkjet head 20 forms four drive circuits 22a, 22b, 22c and 22d [purple] on the silicon substrate 21. (*Id.* at [0029].) A common electrode 23c [green] surrounds ink supply channel 28c [blue]. A portion of the common electrode 23c forms an electricity-feed terminal 26c. (*Id.* at [0033].) Resistors 25-5 are positioned on one side of the ink supply channel 28c between drive circuit 22c and common electrode 23c. The resistors are connected by individual wiring

electrode 24-5 between the drive circuit 22c and the (heater) resistors and between the resistors and the common electrode 23c. (*Id.* at [0031].) The details of individual wiring 24-5 are shown in more detail in the manufacturing process shown in Fig. 7. (*Id.* at [0007] – [0010].) Resistors 25-4 are on the other side of the ink supply channel and are connected by individual wiring electrode 24-4 between drive circuit 22b and third common electrode 23c. (*Id.* at [0030].)

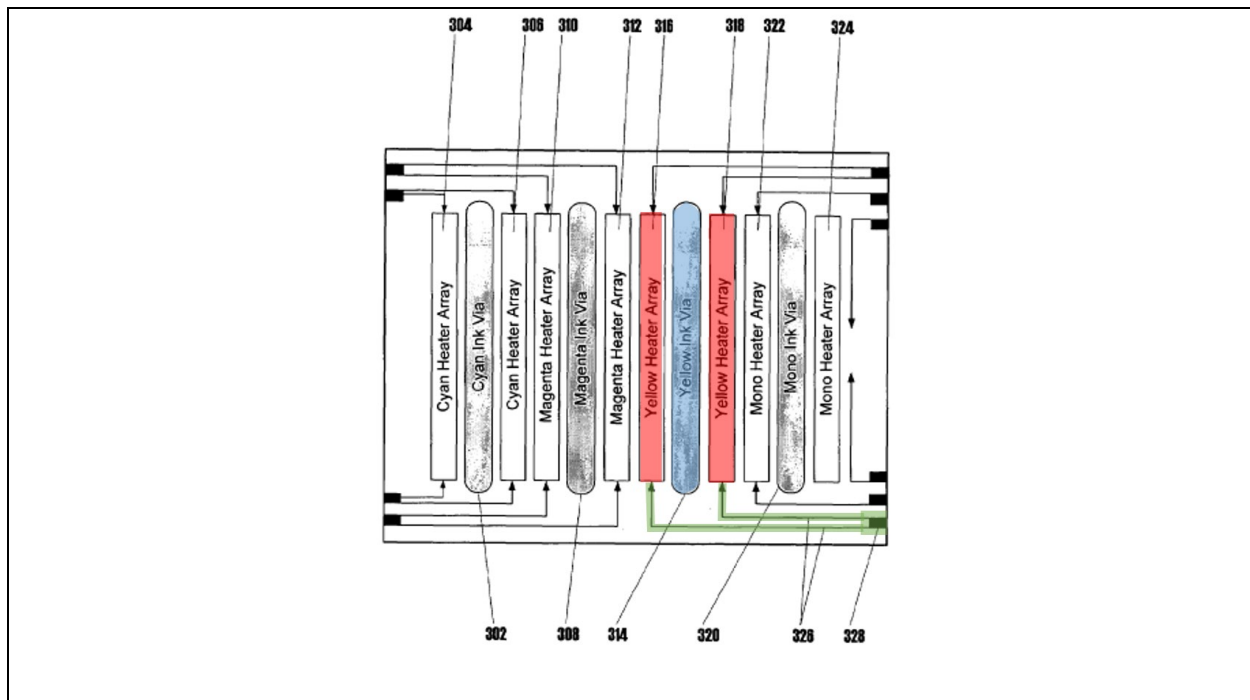
53. Uenishi’s focus is on sharing drive circuits between adjacent resistor arrays both positioned between two ink vias. In Uenishi’s printhead, power is supplied to the heater resistors by individual wiring and the wiring connects to one of the rectangular common electrodes such as common electrode 23c. Uenishi does not disclose powering heater resistors via wiring that connects back to a bondpad, and is not relevant to the challenges associated with optimizing the power circuitry in printheads that supply current to heater resistors with individual power traces that extend from a bondpad.

IX. Claims Construction

A. “Bondpad”

54. In my opinion, the term “bondpad” as used in the ’864 patent would be understood by a PHOSITA to refer to a relatively large area near the edge of a heater chip that facilitates connections to external structures. The ’864 patent shows relatively narrow “power traces -- electrical connections for supplying power – such

as power traces 326 that stem from a wider bondpad 328 [both highlighted in green below in Fig. 3] to provide power to heater arrays [e.g. 316 and 318].



(Ex. 1001 Fig. 3.) The larger bondpad assists in connecting external structures to power traces and other structures on the printhead without requiring high degree of precision, simplifying manufacturing and reducing the risk of defective printing units.

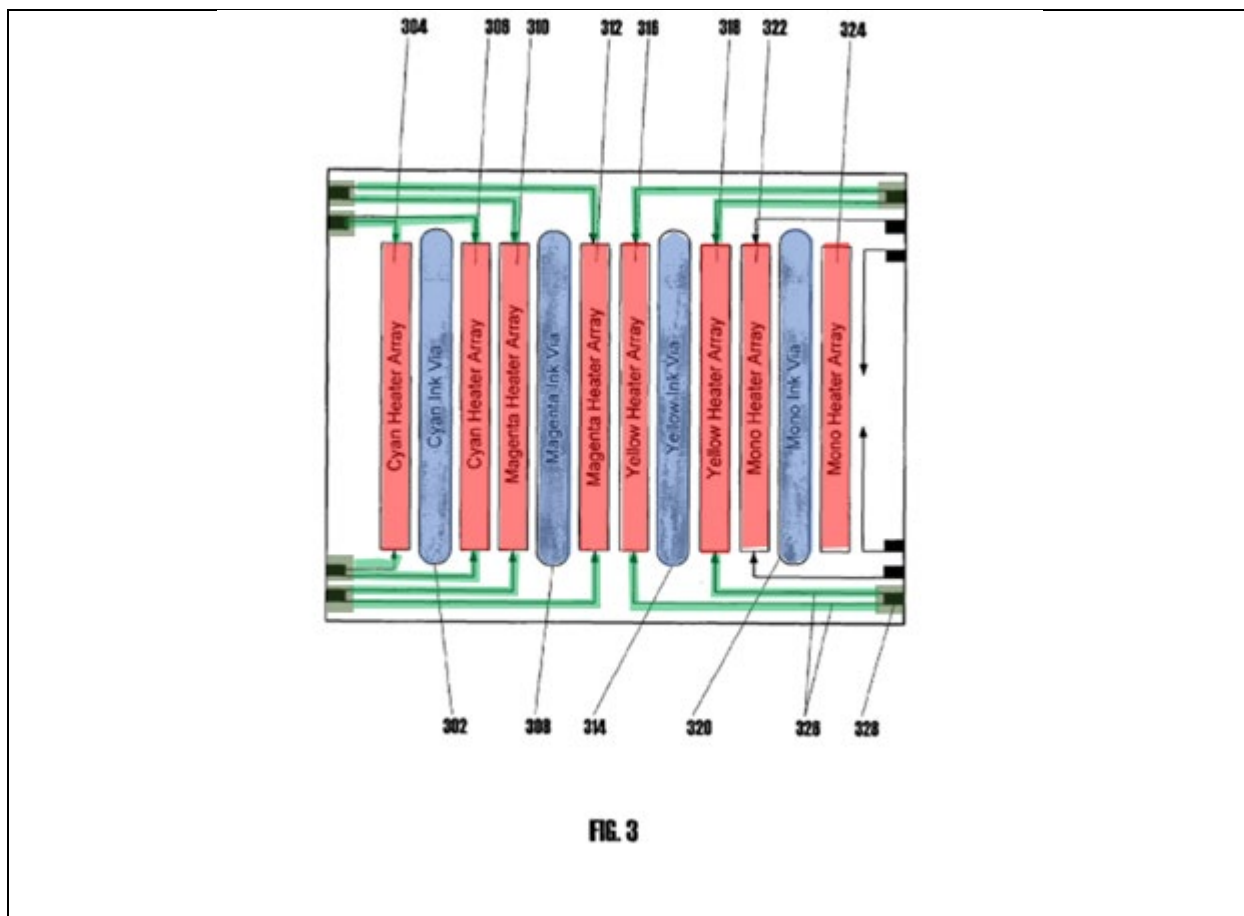
B. “Physically Separated Proximal To The Bondpad”

55. In my opinion, the term “physically separated proximal to the bondpad” would be understood by a PHOSITA to mean that the structure of a power trace diverges or separates closer to the bondpad than to the heater arrays to which it connects. This is consistent with the disclosure of the ’864 patent. Claim 1 is directed to a heater chip with a bondpad that supplies power to at least portions of first and

second heater arrays. Claim 3 indicates that the bondpad supplies power traces to first and second heater array portions by power traces. Thus, the power traces are connected at one end to the bondpad and at the other end to heater arrays.

56. The term “proximal” is related to distance from a connection or point of origin, not merely orientation. For instance, the term “proximal” has been defined as “nearest” or “near the central part of a body or a point of attachment or origin” (Ex. 2002) or “situated nearer to the center of a body or the point of attachment” (Ex. 2001). The ’864 patent describes traces that “extend from the bond pad 328” (Ex. 1001 col. 6 lns 6-10). A PHOSITA would consider the bondpad to be the point of origin of power traces, because the power traces carry electricity from the bondpad to heater arrays at their opposite ends. Consistently, the ’864 patent describes power traces as “stemming from” a bondpad. (Ex. 1001 col. 2 lns 10-11, col. 5 lns 40-46, col. 5 lns 49-52, col. 5 lns 54-56, col. 6 lns 3-6, and col. 6 lns 13-17). In fact, claim 8 specifically recites “a bondpad having at least two traces stemming from the bondpad. (Ex. 1001 col. 6 lns 66-67.) However, the “stemming from” does not seem to distinguish claim 8 from other claims, because power traces are never described by the ’864 patent as “stemming” from any other structure.

57. The ’864 patent discloses one variation of “physically separated proximal to the bondpad” as shown below, where traces are separate immediately as they leave the bondpad.



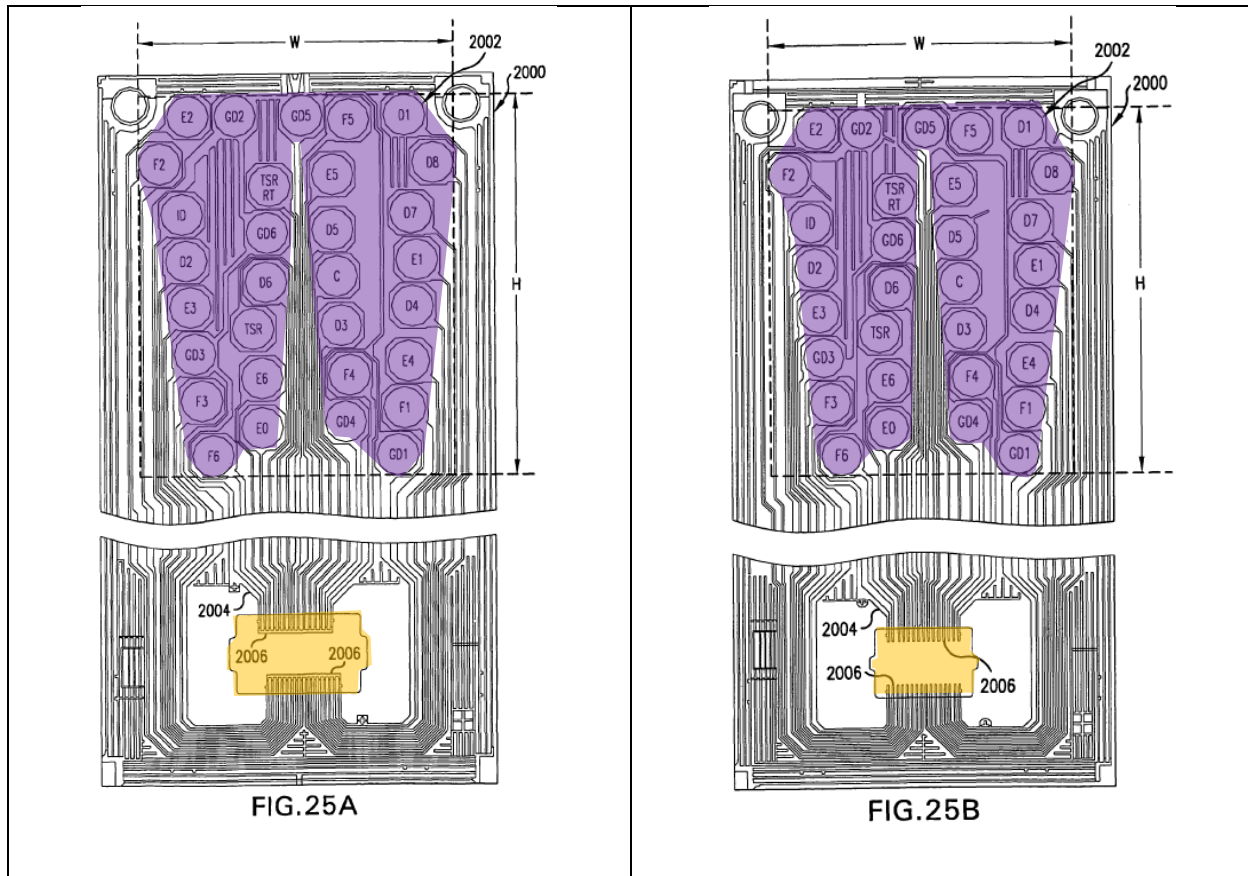
(Ex. 1001 Fig. 3.) The '864 patent states that it is advantageous to utilize power traces that separate proximal to a bondpad in order to efficiently balance resistance of power traces. (*Id.* col. 5 ln 64 through col. 6 ln 3.) On the other hand, “a single power trace may extend from the bondpad 328, and then branch into two or more traces that extend to respective heater arrays.” (Ex. 1001 col. 6 lns 6-10). Due to the word “proximal” being a relative term, a PHOSITA would understand that either of these options could involve traces that are “separated proximal to the bondpad” as long as the separation is nearer the point of origin at the bondpad, from which power is supplied compared to the opposite end that contacts arrays of heaters.

X. Claims 1-3, 5-6, 8-10, And 13-15 Would Not Have Been Obvious In View Of A Combination Of Benjamin '144 And Benjamin '703 (Ground 1)

58. Independent claims 1 and 8 of the '864 patent require that a heater chip “comprises” a bondpad that “supplies power to at least a portion of the first heater array and to at least a portion of the second heater array.” In(Ex. 1001 col. 6 lns 31-39.) Dr. Pond argues that a bondpad that supplies power to at least a portion of a first heater array and a portion of a second heater array would have been obvious in view of the U-shaped fire lines of Benjamin '144 in view of the disclosure of Benjamin '703. However, even in combination, Benjamin '144 and Benjamin '703 do not disclose a bondpad connected to heater resistors on both sides of an ink via, and Dr. Pond’s analysis depends on multiple assumptions that are untrue.

59. First, Dr. Pond states that fire lines 214 connect to firing resistors 52 that are electrically coupled to external supply circuitry via “interface pads,” citing Benjamin '144 at col. 11 lns 5-12. (Ex. 1002 ¶89.) Then, Dr. Pond argues that the terms “interface pad” and “bondpad” are used interchangeably, pointing to text stating that “[t]he highest amount of power is found in the first firing resistor...nearest the bond pad.” (Ex. 1002 ¶90; Ex. 1005 col. 75 lns 60-67.) However, even if the terms “interface pad” and “bond pad” are used interchangeably, Benjamin '144 indicates that the “interface pad” is not on the printhead die/heater chip. The portion of Benjamin '144 discussing the “interface pad” coupled to fire

lines refers to Figs. 25A and 25B. (Ex. 1005 col. 11 lns 9-12.) Figs. 25A and 25B are reproduced below, and show contact areas 2000 [purple] located on a flexible circuit 2002 that extends away from the heater chip in order to interface with external supply circuitry of the printer that is not shown. (Ex. 1005 col. 77 lns 41-46.)



(Ex. 1005 Figs. 25A and 25B.) The actual heater chip is not shown, as Dr. Pond admits, but would be placed in the area shaded yellow above. (Ex. 1005 col. 11 ln 7 - col. 12 ln 4.) While the interface pads/contact areas of the flex circuit connect to conductive paths 2004 ending in “contacts” 2006 that touch the printhead, there is no actual description in Benjamin ’144 of how or where the contacts connect to

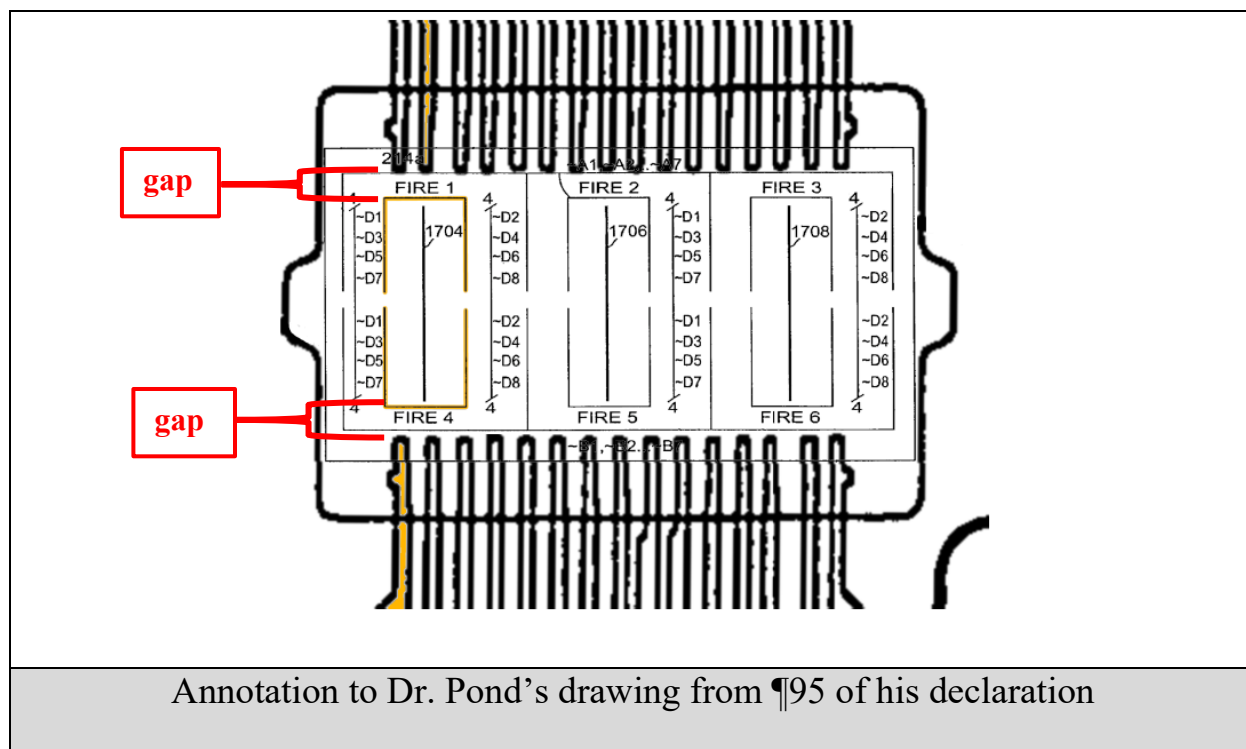
bondpads or of a connection between U-shaped fire lines and bondpads located on the heater chip itself.

60. Dr. Pond then draws a conclusion regarding the position of a bondpad based on the contacts of the flex circuit. (Ex. 1002 ¶95; *see also* Pet. p. 19 (“[a] PHOSITA would understand the approximate locations of the bondpads...match the locations of contacts 2006”).) However, without a disclosure of how one or more portions of the U-shaped fire line actually connect to contacts 2006 of the flex circuit 2000 (*see* Ex. 1005 Figs. 25A and 25B), it is not possible to determine whether the contacts of the flex circuit contact a single bondpad for each “fire line” or contact multiple bondpads that each connect to a portion of the fire line.

61. In fact, there is nothing in Benjamin ’144 that indicates that the “U-shaped fire lines” are fully U-shaped, and indeed Dr. Pond relies on the fire lines not being U-shaped.

62. At ¶95 of his Declaration, Dr. Pond created the following figure by superimposing portions of 25B to allegedly show how the contacts from the flex circuit would supply power to Fire 1 and Fire 4. (Ex. 1002 ¶95.) I do not agree that the figures were intended to be combined in this manner. However, in order to address Dr. Pond’s manipulation of the figures, I have annotated Dr. Pond’s drawing below to indicate that there is a gap between the flex circuit contacts and Fire 1/Fire 4, due to Dr. Pond’s desire to place the ends of the flex circuit along the edge of the

substrate rather than directly contacting the U-shaped fire lines Fire 1 and Fire 4:



This lack of detail in Benjamin '144 means that either the fire lines Fire 1 and Fire 4 are not actually U-shaped and contain additional structure extending toward the edge of the chip, or that the flex circuit contacts extend all the way to Fire 1 and Fire 4, eliminating any need for bondpads. If Fire 1 and Fire 4 do connect to a bondpad located on the printhead die, then the lines are not actually U-shaped, but rather Y-shaped, and the lack of detail regarding the actual shape of fire lines in Benjamin '144 means that there could be a split between the left and right sides of the fire lines that is simply not described.

63. Furthermore, the flex circuit contacts shown by Dr Pond's drawing above are quite large relative to the features on the printhead die. These contacts

could be capable of, for instance, contacting two bondpads, one for each half of the U-shape of the fire line. Again, the lack of detail with regarding to Benjamin '144's fire lines makes it impossible to determine whether the horizontal portion of the U-shape actually connects two arrays of heaters on opposite sides of an ink via, or whether they separately connect to a single connection from the flex circuit. Fire line contact areas F1 and F4 highlighted by Dr. Pond are not actually discussed in Benjamin '144, nor is their ultimate connection to the printhead die. It is notable that Dr. Pond's discussion of the connection of the flex circuit to the printhead die at ¶¶94-97 relies solely on figures, and does not cite to any discussion of how the components mentioned actually physically interact.

64. Dr. Pond also relies upon Benjamin '703 to the extent that Benjamin '144 does not expressly disclose a bondpad that supplies power to at least a portion of the first heater array and at least a portion of the second heater array. (Ex. 1002 ¶97.) However, Dr. Pond does nothing more than show that the "fire line input pad" (706) of Benjamin '703 is electrically coupled to firing cells in a printhead die. (Ex. 1002 ¶99.) Benjamin '703 does not disclose a single bondpad coupled to firing cells on one side and another side of an ink via as in the '864 patent. Therefore, there is no reason to assume that Benjamin '144's U-shaped fire lines are connected to a single bondpad rather than, for instance, two bondpads that are each contacted by a single conductive path from the flex circuit.

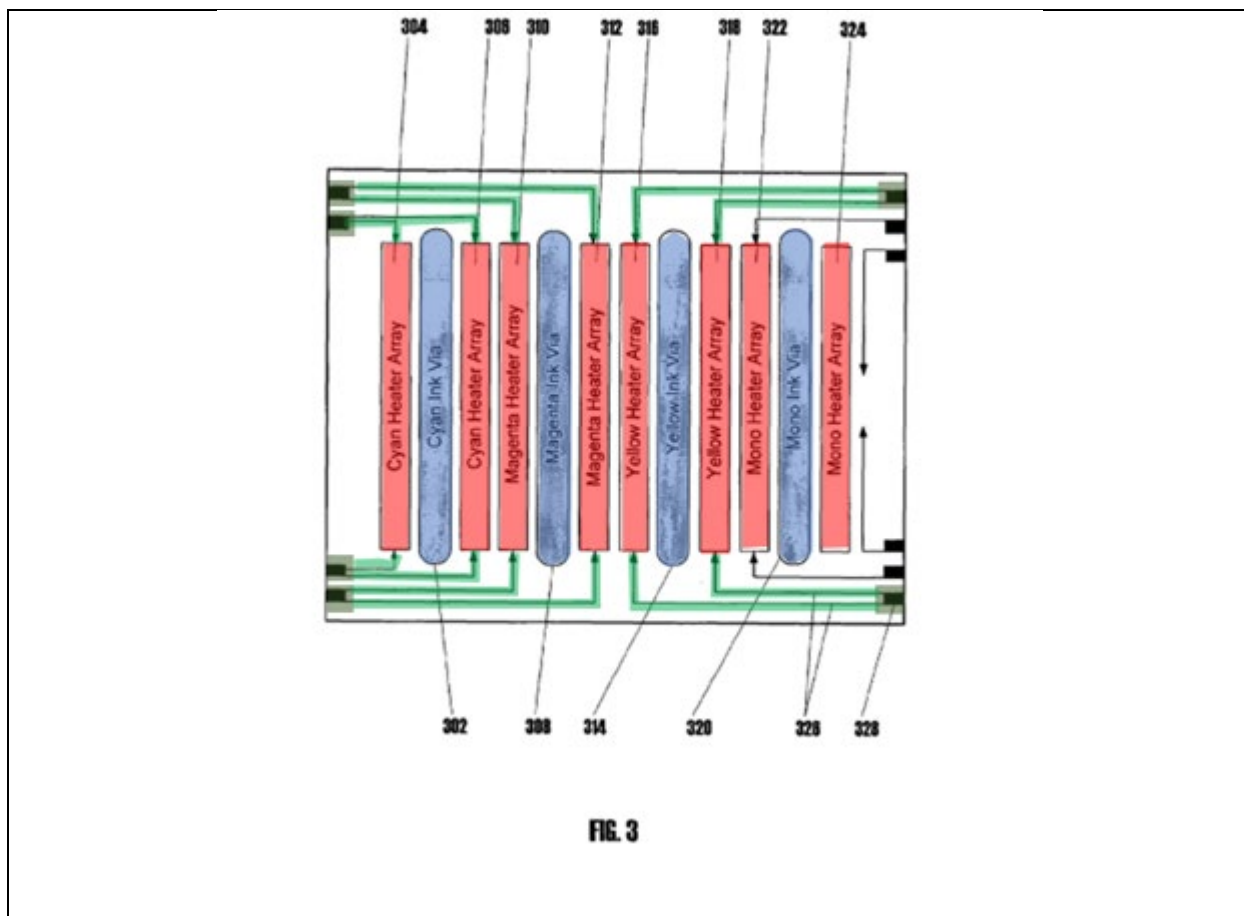
65. Dr. Pond also indicates that Benjamin '144 and Benjamin '703 are analogous art with overlapping inventors, and emphasizes that Benjamin '144 incorporates the disclosure of 11/849,078 by reference, which is a continuation of the Benjamin '703 patent. However, this does not change the fact that the disclosed printhead of Benjamin '703 relates to an entirely different printhead embodiment than Benjamin '144, and not to the embodiment of Figs. 21 and 22 of Benjamin '144. Specifically, the embodiments of Benjamin '703 do not disclose or relate to U-shaped fire lines for providing power to heater arrays on opposite sides of an ink via.

66. Regarding claim 2, Petitioners have taken the position that “each of Benjamin-144’s fire lines 214a-214f is connected to a fire line bondpad or fire line input pad 706.” (Pet. p. 24, citing Ex. 1005 at 11:9-12, 75:63-67, Figure 25B, and 77:41-46). Contrary to Petitioners’ statement, there is no such “fire line input pad 706” disclosed in relation to fire lines 214a-214f in Benjamin '144. Reference numeral 706 is used in Benjamin '144 (Ex. 1005) only to identify voltage levels in connection with the graph in Fig. 11. The passages cited by Petitioners at columns 11, 75, and 77 refer to either “interface pads” on a flexible circuit (not on the printhead), or bondpads connected to data lines (not fire lines). (Ex. 1005 col. 11 lns 9-12, col. 75 lns 63-67, and col. 77 lns 41-46.) To the extent that the Petition is referring to fire line input pad 706 of Benjamin '703, that too is not disclosed in relation to any fire lines 214a-214f. Benjamin '703 describes fire lines 214a-214f as

the embodiment disclosed in Fig. 7 as being “electrically coupled to external supply circuitry by appropriate interface pads . . .” (Ex. 1006 col. 10 lns 41-43.) Also, those fire lines 214a-214f are not disclosed as being U-shaped with fingers extending along heater arrays on either side of an ink via. Fire line input pad 706 is only mentioned in relation to fire line 712 of the separate embodiment illustrated in Fig. 10. Fire line 712 is also not disclosed as being U-shaped with fingers extending along heater arrays on either side of an ink via. (*Id.* col. 19 lns 33-47.) As I mentioned above, Fig. 25 illustrates contacts on a flexible circuit that connects between a printhead and external circuitry of a printer only (and does not show a printhead itself or bondpads located on a printhead). (Ex.1006 Fig. 25.)

67. Dr. Pond barely analyzes whether a first and second heater array are supplied with power by “power traces physically separated proximal to the bondpad,” as recited in dependent claims 3 and 15. At first, Dr. Pond merely states that that this limitation is met “for reasons discussed above with respect to claim 1.” (Ex. 1002 ¶118.) Dr. Pond then points out that the top of Benjamin ’144’s U-shaped fire line is “proximal” to a side of the printhead die where an energy signal is sent from a bondpad. (Ex. 1002 ¶119.) In my opinion, Dr. Pond’s interpretation of “proximal to the bondpad” does not make sense and would be meaningless. Dr. Pond considers only whether the portion where Benjamin ’144’s fire lines connect faces towards the bondpad. However, as I have discussed above, the term “proximal” is

related to distance from a connection or point of origin, not merely orientation. For instance, the term “proximal” has been defined as “nearest” or “near the central part of a body or a point of attachment or origin” (Ex. 2002) or “situated nearer to the center of a body or the point of attachment” (Ex. 2001). The ’864 patent describes traces that “extend from the bond pad 328” (Ex. 1001 col. 6 lns 6-10). A PHOSITA would consider the bondpad to be the point of origin of power traces, because the power traces carry electricity from the bondpad to heater arrays at their opposite ends. In fact, claim 8 specifically recites “a bondpad having at least two traces stemming from the bondpad.” (Ex. 1001 col. 2 lns 4-11.) The ’864 patent describes two options for the separation of traces stemming from a bondpad. The traces may be “physically separated proximal to the bondpad.” (Ex. 1001 col. 1 lns 57-60; col. 2 lns 40-42.) One variation of this is shown below, where traces are separate as they leave the bondpad.



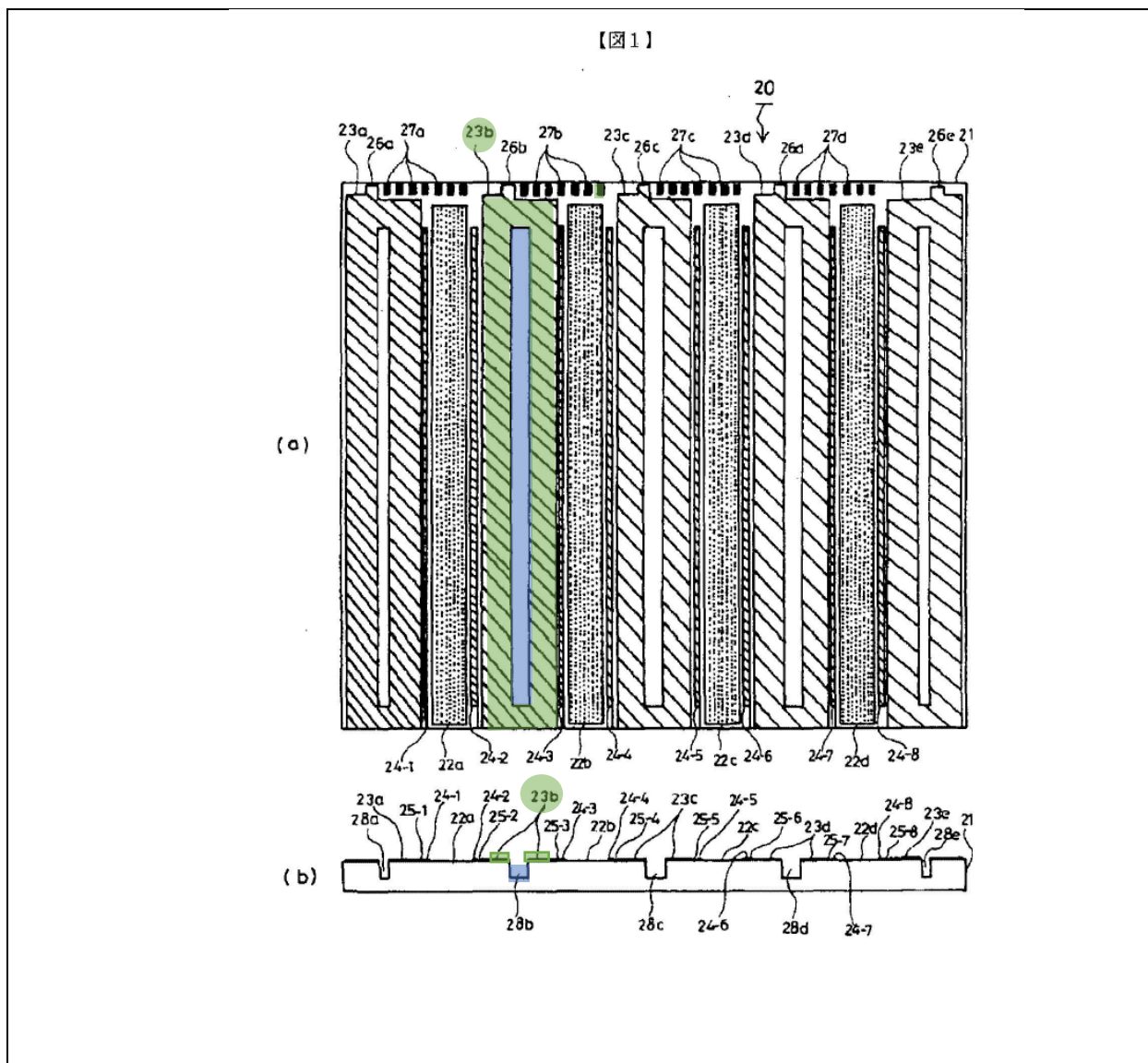
(Ex. 1001 Fig. 3.) The '864 patent states that it is advantageous to utilize power traces that separate proximal to a bondpad in order to efficiently balance resistance of power traces. (*Id.* col. 5 ln 64 through col. 6 ln 3.) On the other hand, “a single power trace may extend from the bondpad 328, and then branch into two or more traces that extend to respective heater arrays.” (Ex. 1001 col. 6 lns 6-10). Due to the word “proximal” being a relative term, a PHOSITA would understand that either of these options could involve traces that are “separated proximal to the bondpad” as long as the separation is nearer the point of origin at the bondpad, from which power is supplied, compared to the opposite end that contacts arrays of heaters.

XI. Claims 4, 11-12, And 16-20 Would Not Have Been Obvious In View Of A Combination Of Benjamin '144, Benjamin '703, And Childers (Ground 2)

68. I also disagree with Dr. Pond's conclusion that dependent claims 4, 11-12, and 16-20 would have been obvious to a PHOSITA at the time the '864 patent was filed. Childers discloses a printhead on a ceramic substrate that differs in significant ways from the printheads described in Benjamin '144 and Benjamin '703. However, Dr. Pond cites Childers for the presence of four ink vias, and argues that a PHOSITA would have been motivated to add an additional color to the printhead die in view of Childers. Childers does not disclose any relevant details regarding bondpads or connections between bondpads and heater arrays, and therefore Ground 2 does not make up for any of the shortcomings I have discussed above regarding Ground 1. Further, the supply lines in Childers are shown deriving from multiplexing circuits.

XII. Claims 1, 3, 5-6, 8-10, 13 and 15 Would Not Have Been Anticipated By Uenishi (Ground 3)

69. Dr. Pond opines that Uenishi anticipates several claims of the '864 patent. Uenishi discloses a printhead in which the heaters are connected by individual wires to large common electrodes encircling ink supply channels. Fig. 1 of Uenishi is reproduced below with annotations to show one of the common electrodes 22c [green] surrounding an ink supply channel 28c [blue]. A portion of the common electrode 23c forms an electricity-feed terminal 26c. (*Id.* at [0033].)



(Ex. 1008 Fig. 1.) In Uenishi, heater resistors 25-5 are positioned on one side of the ink supply channel 28c between drive circuit 22c and common electrode 23c. Power is supplied to the heater resistors by individual wiring and the wiring connects to one of the rectangular common electrodes. In particular, the resistors on one side are connected by individual wiring electrode 24-5 between the drive circuit 22c and the common electrode 23c. (*Id.* at [0031].) Resistors 25-4 are on the other side of the ink

supply channel and are connected by individual wiring electrode 24-4 between drive circuit 22b and third common electrode 23c. (*Id.* at [0030].)

70. Uenishi does not disclose a “bondpad” structure that supplies power to heater arrays through “traces.” It is clear from figures of the ’864 patent and corresponding text that “bondpad” is used in its ordinary sense to refer to a metalized area of the substrate to which external and internal power traces can be connected to for providing power to internal components. The specification indicates that each bondpad has connections to power traces for supplying power to heater arrays and a connection for external current to be supplied to the bondpad. (Ex. 1001 col. 3 lns 42-51.) The specification describes multiple ways of connecting one, two, or more than two power traces to a bondpad. (*Id.* col. 5 ln 64 through col. 6 ln 17.)

71. The “power traces” of the ’864 patent are relatively narrow structures. Fig. 3 of the ’864 patent shows narrower connections (326) referred to as “power traces” extending from a relatively larger bondpad (328), as shown below:

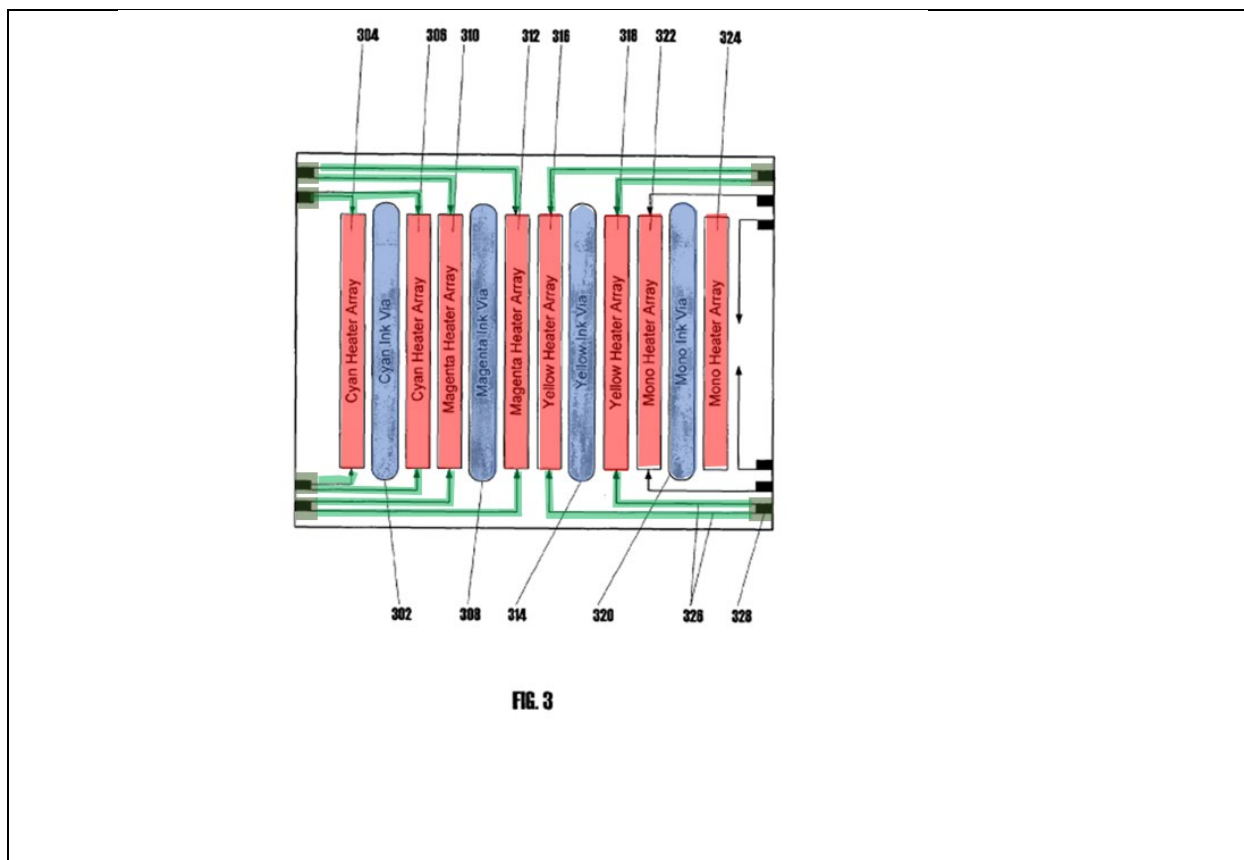


FIG. 3

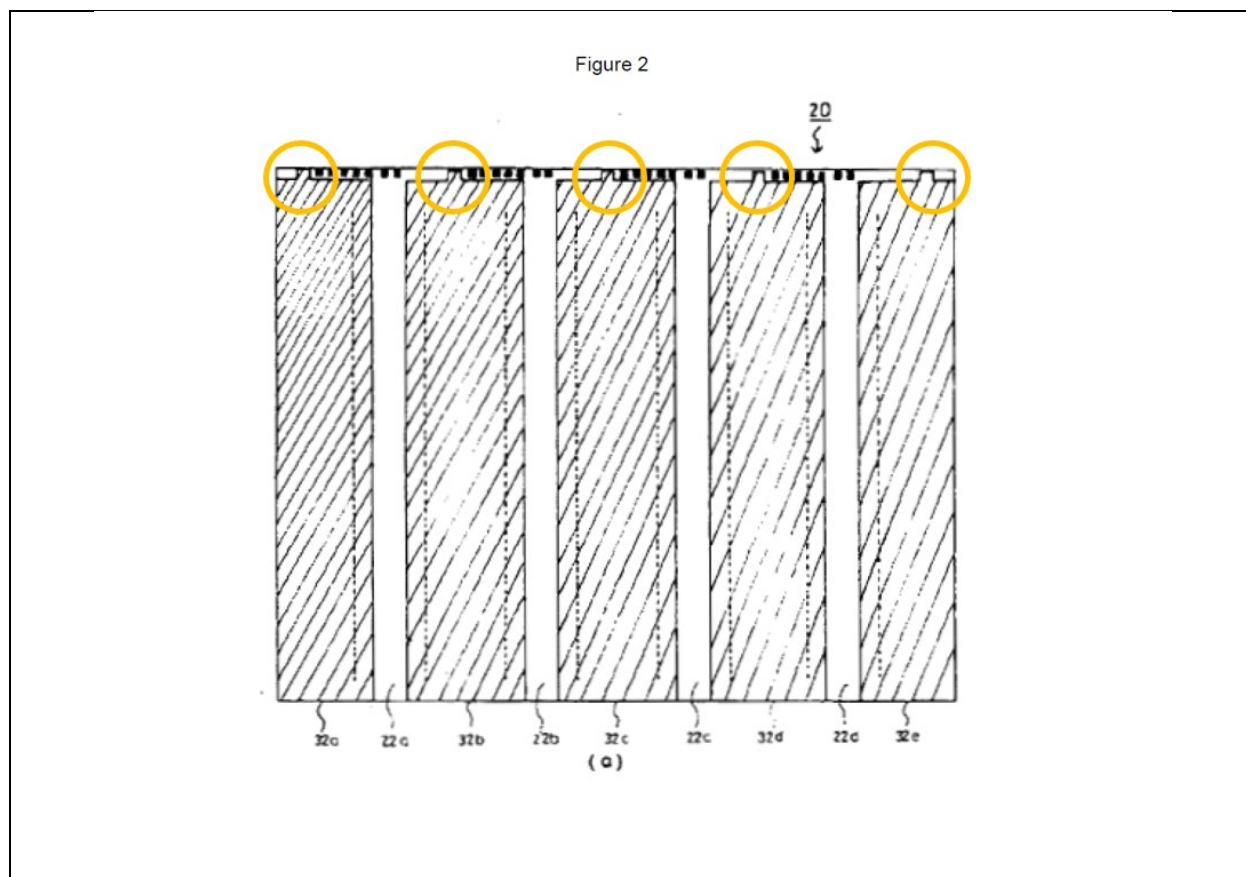
(Ex. 1001 Fig. 3.)

72. Uenishi does not disclose what terminal 26c connects to, and does not describe the terminal as a pad to which external power traces and onboard power traces can be connected to. To the extent that the large common electrode 23c can even be considered a power trace, the electricity-feed terminal 26c is a small integral portion of that large electrode, not a larger pad facilitating connections to external circuitry. As a result, a PHOSITA would not consider this small tab a “bondpad.”

73. Uenishi also does not show “power traces physically separated proximate the bondpad.” Even if terminal 26c were considered to be a bondpad, Uenishi includes only a large common electrode that fully encircles an ink via.

Uenishi's uniformly wide electrode, which is much wider than both the heaters to which it supplies power and the portion that Dr. Pond alleges is a "bondpad," would not be able to "ensure adequate power balance across the array" as described by the '864 patent.

74. Additionally, I note that Uenishi discloses orifice (nozzle) plates 32a, 32b, 32c, 32d, and 32e in Figure 2. These orifice plates show tabs, circled in yellow below, in the same position as feed terminal 26c:

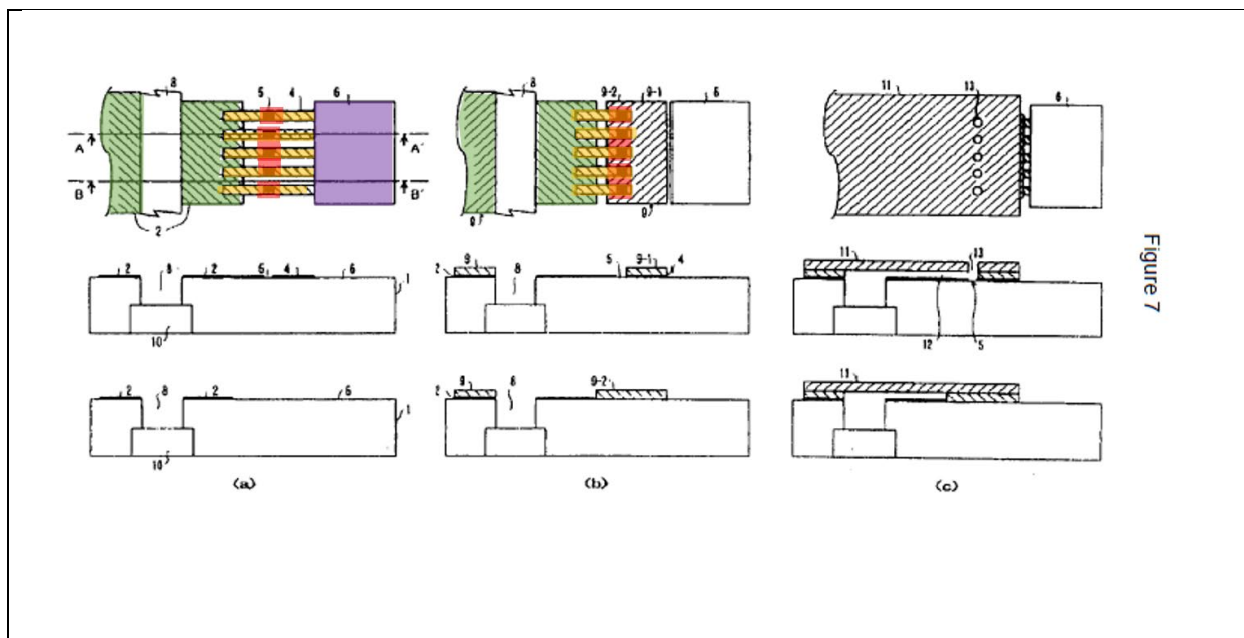


(Ex. 1008 Fig. 2.) A PHOSITA would view these tabs on the orifice plate as interfering with a connection between the underlying feed terminal and connections

from outside the printhead die, for instance from a flex circuit. For at least this reason, a PHOSITA would not understand the feed terminal 26c of Uenishi to be considered a “bondpad” within the meaning of the claims of the ’864 patent.

75. Further, even if Uenishi’s terminal 26c were considered to be a bondpad, this separation of the electrode branches cannot be considered “proximal to the bondpad” by any reasonable interpretation. As mentioned above with respect to Ground 1, any notion that “proximal to the bondpad” can refer to any position between a bondpad and heater arrays without considering relative distance between those structures ignores the ’864 patent’s teachings regarding the advantages of separating traces proximal to the bondpad, including the ability to efficiently balance resistance of power traces. (Ex. 1001 col. 5 ln 64 through col. 6 ln 3.)

76. In fact, the separation of traces in Uenishi occurs very close to the heater resistors. Although Figs. 6 and 7 of Uenishi are described as showing prior art, they show the steps of manufacturing the “heating heads” of the embodiment above that is described as Uenishi’s invention. (Ex. 1008 [0007].) Individual wiring electrodes 4 [yellow] couple the heater resistors 5 [red] to the common electrode 2 [green] and drive circuit 6 [purple], as shown below. (Ex. 1008 [0010].)



(Ex. 1008 Fig. 7.) As a result, there are no separated traces proximal to a bondpad. Even if the opening in the common electrode at the ink via and/or individual wiring electrodes are considered portions of power traces that are physically separated, which they are not, there is no separation except at the point the common electrode meets the ink via and when individual wiring electrodes extend from the common electrode very close to the heater resistors.

XIII. Claims 4, 11, and 12 Would Not Have Been Obvious In View Of Uenishi and Hayasaki (Ground 4)

77. Dr. Pond relies on Hayasiaki to show a device with 320 heaters. However, Hayasaki does not address any of the issues that I have noted above with respect to the other claims. For at least that reason, it is my opinion that a PHOSITA would not have found claims 4, 11, or 12 obvious in view of the cited prior art.

XIV. Conclusion

I hereby declare that all the statements made herein are of my own knowledge and 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.

Dated: October 30, 2023

By: 
Steven J. Dietl