

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

PATENT OWNER'S RESPONSE

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I. INTRODUCTION

Patent owner Slingshot Printing LLC respectfully submits this Response to Canon's Petition.

Petitioners fail to show that claims 1-6 and 8-20 of U.S. Pat. No. 7,290,864 (the '864 patent) are invalid under the asserted grounds. The '864 patent discloses and claims novel configurations for inkjet printheads, specifically a heater chip with a bondpad that supplies power to at least a portion of two different heater arrays located on different sides of an ink via.

Petitioners challenge the '864 patent claims as obvious, or in the alternative anticipated. Petitioners rely on one reference that discloses "fire lines" that connect to two heater arrays, but that does not disclose bondpads on the heater chip connecting to those "fire lines." Petitioners argue that one skilled in the art would connect both sides of each fire line to a single bondpad based on a second reference that discloses a bondpad connected to only a single array of heaters. On the whole, Petitioners have done nothing but use the '864 patent itself as a template to pick and choose elements from prior art references in an attempt to reconstruct the claimed invention. Their obviousness theory is based on pure hindsight and should be rejected.

Petitioners alternatively argue that a Japanese reference anticipates several claims, but that theory also has no merit because it involves reading out significant claim limitations.

II. BACKGROUND

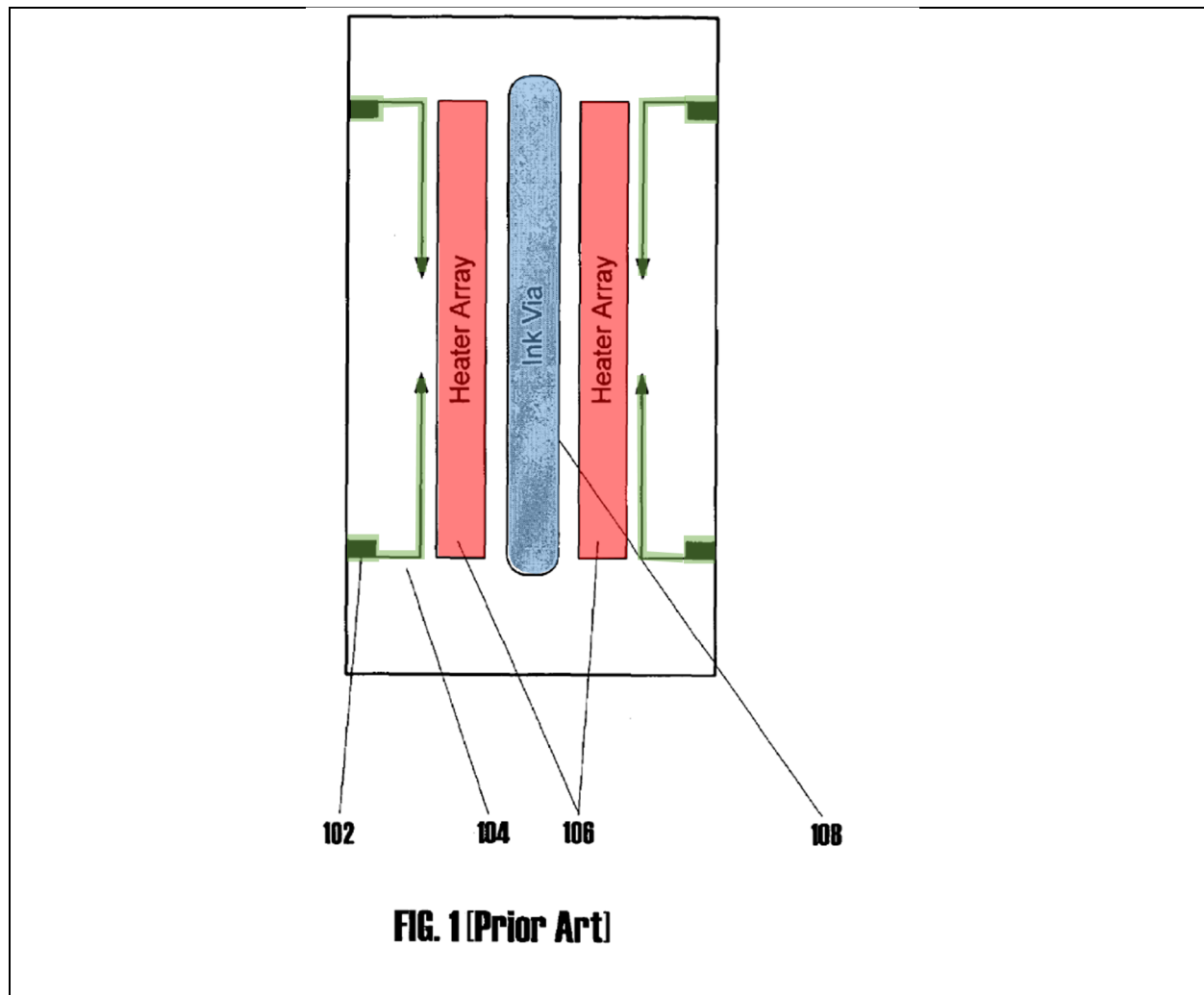
A. The '864 Patent

The '864 patent describes technical challenges associated with providing electrical power to a printhead for discharging ink in an inkjet printer. 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. (Ex. 1001 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. (*Id.* col. 3 lns 51-56 and col. 4 lns 57-67; Ex. 2004 ¶38.)

In order to provide power to the heaters, the chip also includes bondpads 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 '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; Ex. 2004 ¶38.) High resolution printheads typically include thousands of these heater resistors. (*See* Ex. 1001 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; Ex. 2004 ¶38.)

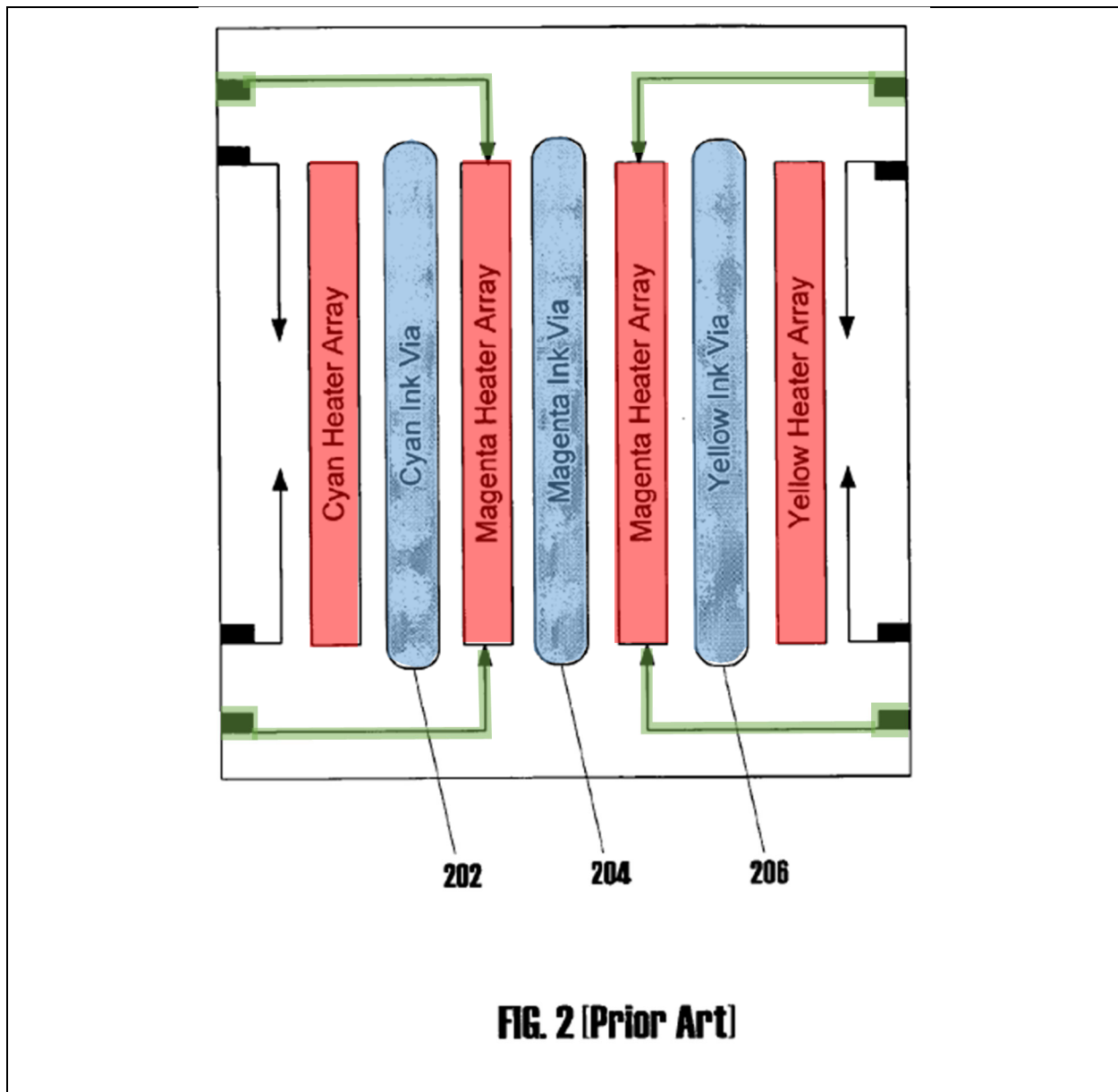
Fig. 1 of the '864 patent, reproduced below, illustrates a conventional prior art configuration of a prior art heater chip.



(Ex. 1001 Fig. 1.) 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.)

The heater chip shown in Fig. 2 shows another conventional design that includes multiple ink vias [blue] on a single chip each with heater arrays [red] connected to bondpads and power traces [green]. (Ex. 1001 col. 4 lns 13-22; Ex. 2004 ¶40.)



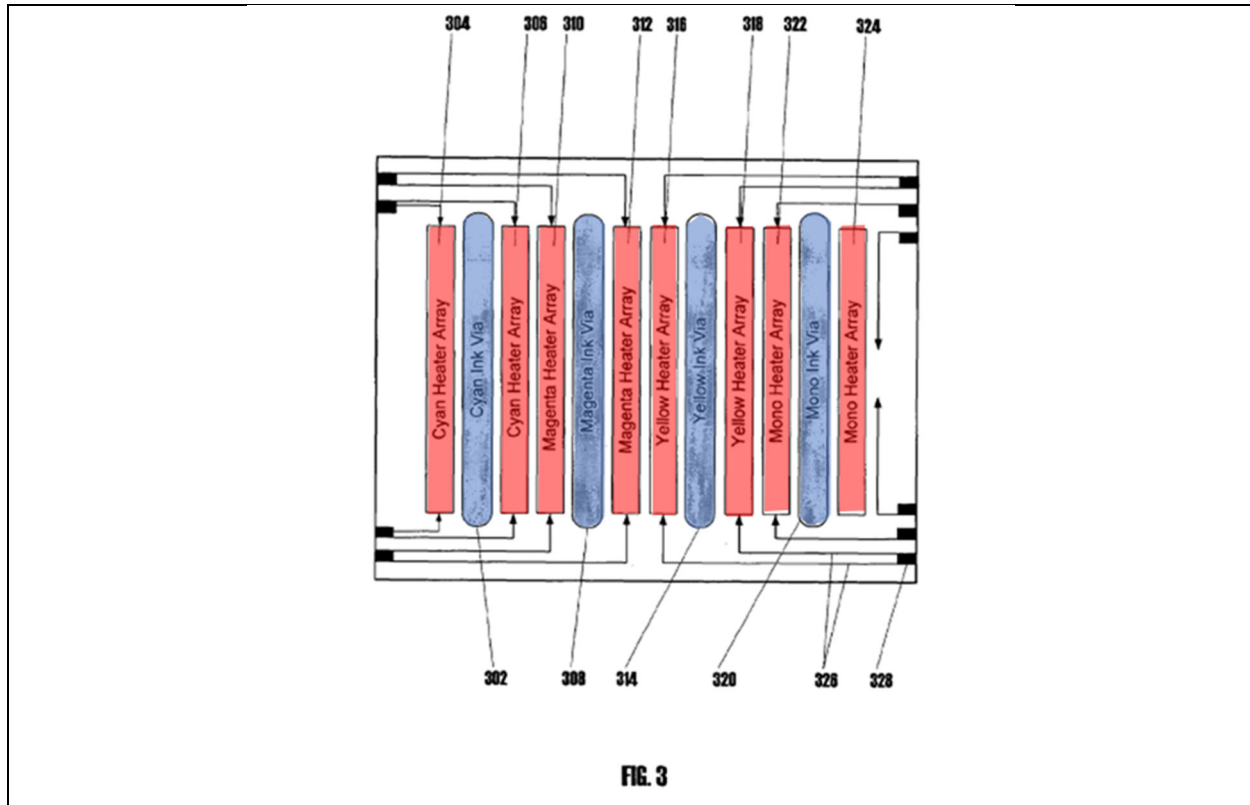
(Ex. 1001 Fig. 2.) As in the configuration of Fig. 1, the central ink via 204, which supplies magenta ink to the heater chip, has associated heater arrays disposed along each of the two longitudinal sides of the ink via. Each bondpad and associated power trace [both green] supply current to a portion of a heater array [red] along one side of an ink via [blue]. (Ex. 2004 ¶40.) 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. (Ex. 2004 ¶40.)

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. (Ex. 1001 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. (Ex. 2004 ¶41.) 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.

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 this invention is illustrated in Fig. 3 below:



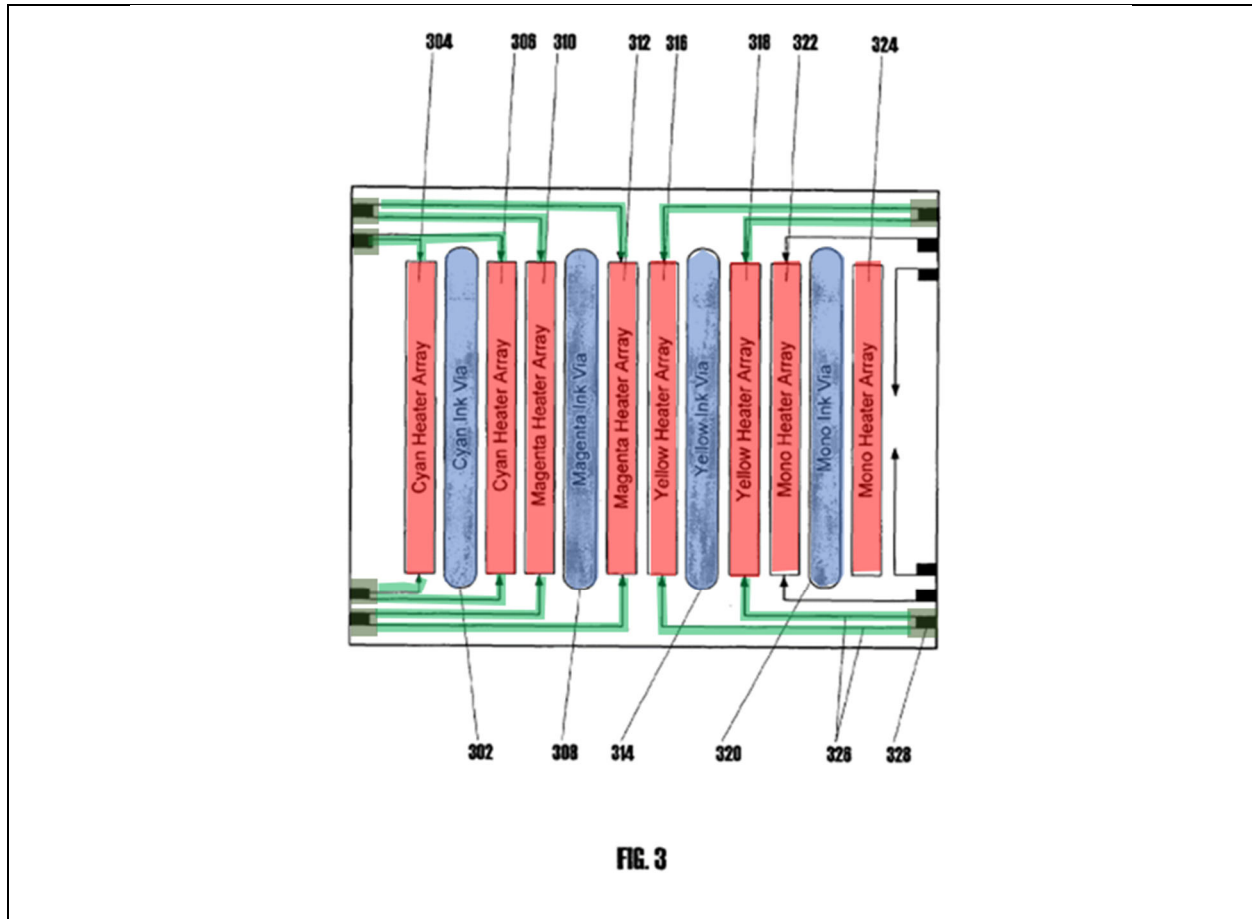
(Ex. 1001 Fig. 3.) As illustrated, the heater chip includes four ink vias [blue] each positioned between two heater arrays [red]. In particular, a cyan ink via 302 is between a first heater array 304 and a second heater array 306; a magenta ink via 308 is between a first heater array 310 and a second 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. (Ex. 2004 ¶42.) 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. (Ex. 1001 col. 5 lns 12-18 and 30-33.)

However, with a reduced number of bondpads 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. (Ex. 2004 ¶43.) 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.)

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 on opposite sides of an ink via to the same bondpad, as shown below.



(Ex. 1001 Fig. 3.) Heater arrays [red] on each side of a given color ink via [blue] are connected by power traces [light green] to a common bondpad [dark green]. 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 portion of a first array and a corresponding portion at the same end of a second array so that the portions of heater arrays connected to a given bondpad have

less variation in distance from that bondpad. (Ex. 2004 ¶43; Ex. 1001 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. (Ex. 2004 ¶43; Ex. 1001 col. 5 lns 36-48.)

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 power traces from a common bondpad may be positioned closer together than conventional power traces stemming from different bondpads. (Ex. 1001 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.

B. Prosecution History of the '864 Patent

The application that led to the '864 patent was filed on September 30, 2005. The USPTO issued a first action allowance on August 28, 2007. (Ex. 1004 pp. 49-56.) The examiner determined that the claimed invention “solves the problem of

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

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.” (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.)

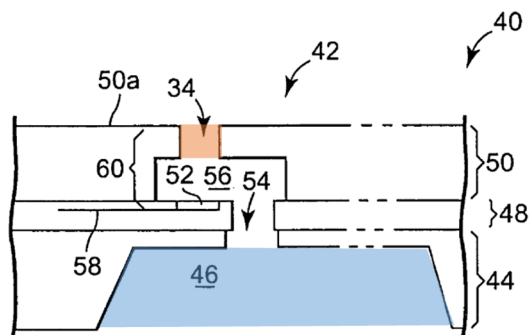
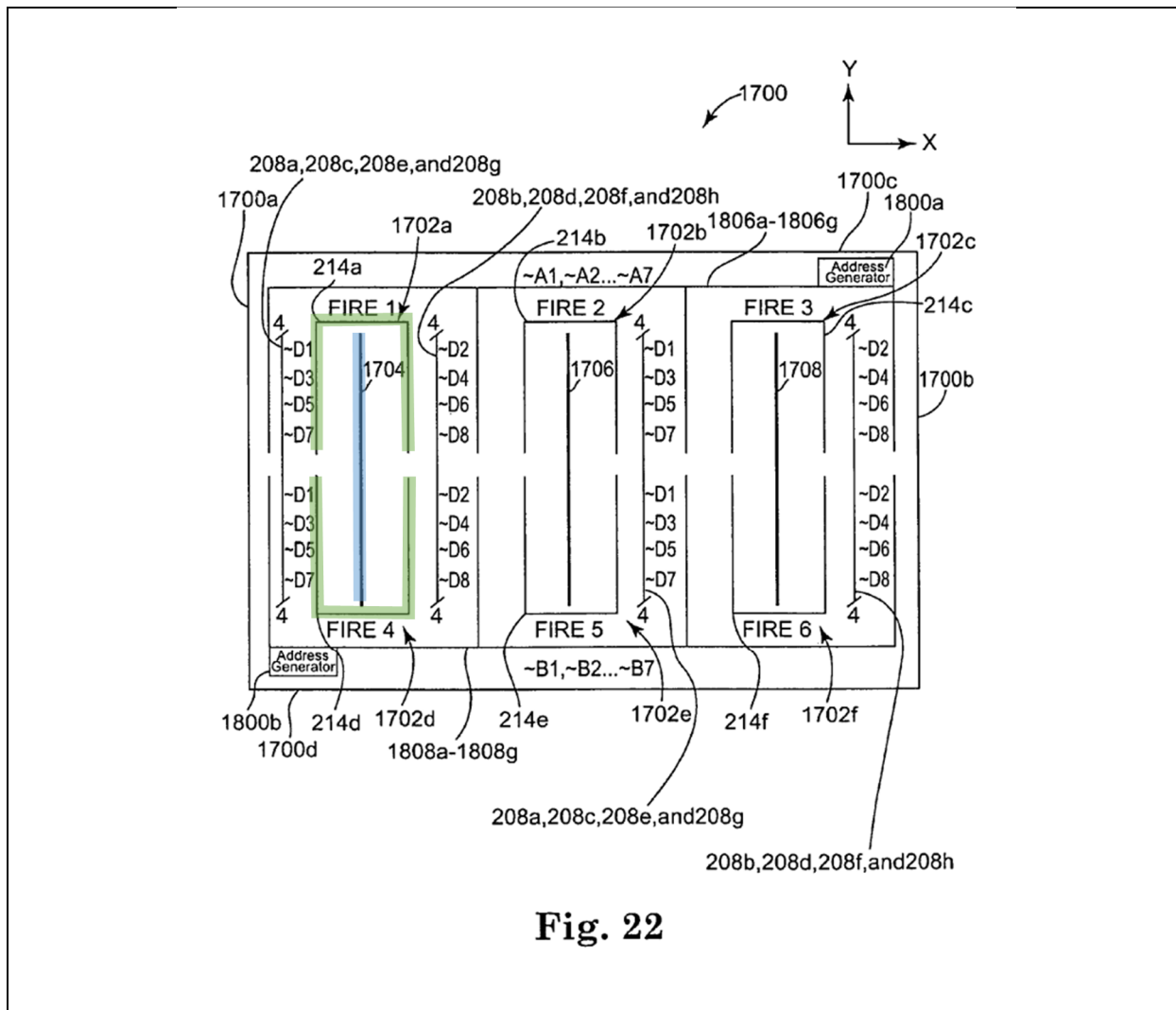


Fig. 2

(Ex. 1005 Fig. 2.) Benjamin '144 discloses ink feed slots such as slot 1704 [blue] to provide a supply of ink and U-shaped fire lines 1702a [green] to provide energy to drop generators [heaters] in groups D1-D8 on the printhead, as shown in the annotated version of Fig. 22 below.

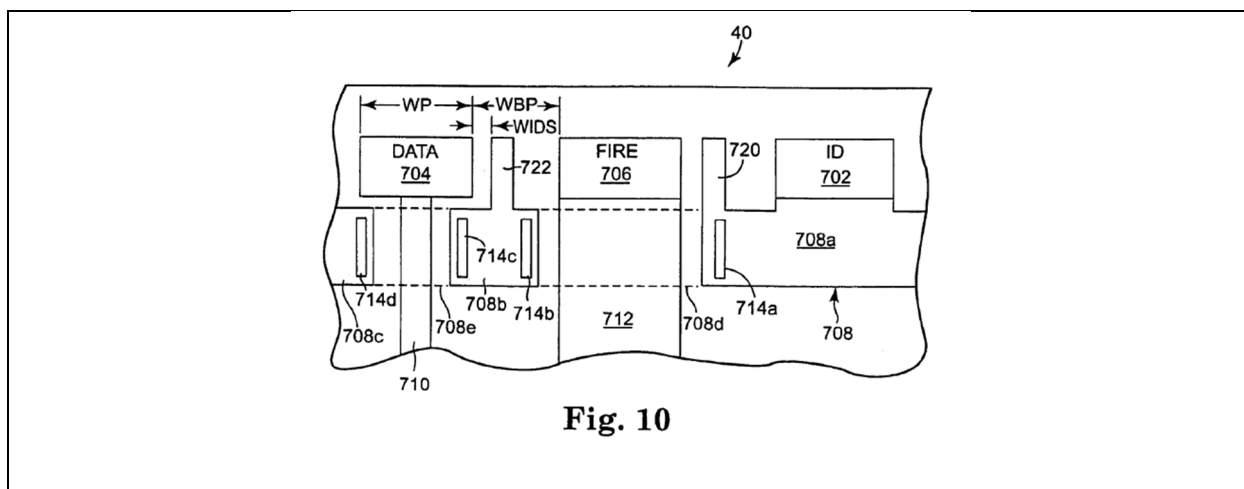


(Ex. 1005 Fig. 22 and col. 64 lns 9-21 and col. 67 lns 36-54.) Benjamin '144 generally discloses that a flex circuit along the side of the cartridge provides contact areas for coupling external circuitry to the printhead die through a series of conductive paths. (Ex. 1005 Figs. 25A and 25B and col. 77 ln 41 through col. 78 ln 22.) However, the reference does not disclose how power is supplied to the U-shaped fire lines from those conductive paths of the flex circuit. (Ex. 2004 ¶49.) 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. (*Id.*) 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. (Ex. 1005 col. 69 lns 3-7 and 38-41.) However, the connection between a bondpad and its data line group is also not shown or described, and these data lines are not lines that supply power to heater arrays.

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

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.) The fire line 712 receives fire signal FIRE and provides the signal to the firing cells 120.

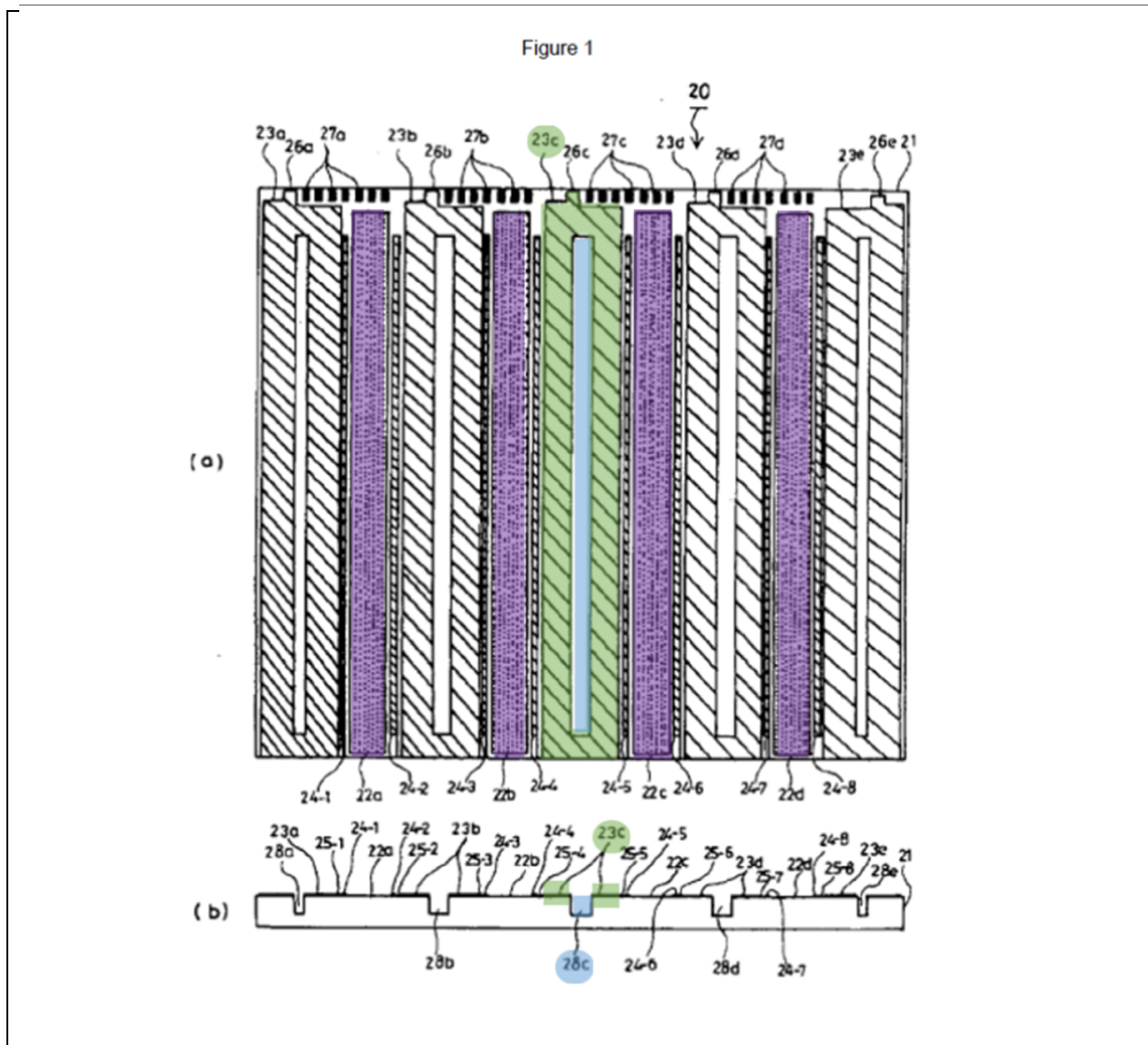
(*Id.* col. 20, lns 4-5.) The arrangement of firing cells 120 is not shown in relation to Fig. 10. The fire line 712 is not described by Benjamin '703 as connecting to multiple arrays of heater resistors, and is not described as connecting to heater resistors on two different sides of an ink via.

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

U.S. Patent No. 6,582,062 to Childers *et al.* (“Childers”) discloses a large array printhead. Petitioners rely on Childers only to show four ink vias located in a single substrate.

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

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 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].)

Thus, 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. In fact, Uenishi's large common electrode has only a very small feed terminal (26c) at one end, and thus does not have a relatively large area such as a bondpad for facilitating external connections to the printhead.

III. THE PERSON OF ORDINARY SKILL IN THE ART

Petitioners contend that a person having ordinary skill in the art ("PHOSITA") at the time of the priority date of the '864 patent would have had at least a bachelor's level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and at least two years of training or experience in the design of inkjet printheads or semiconductor circuit layout. (Pet.

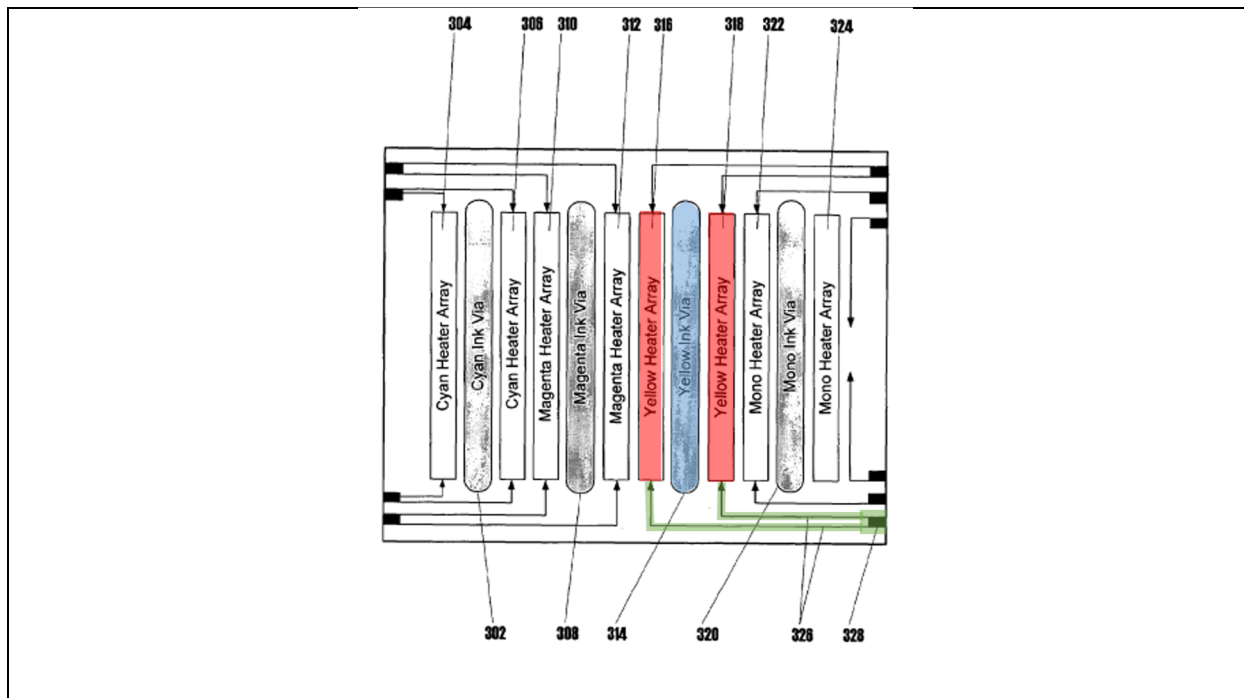
at 6). Slingshot does not dispute this characterization of the level of ordinary skill in the art.

IV. CLAIM CONSTRUCTION

Slingshot contends that all claim terms should be given their plain and ordinary meaning as used in the '864 patent. Particularly, the terms “bondpad” and “physically separated proximal to the bondpad” would be understood by a PHOSITA in view of the disclosure of the '864 patent to refer to specific structural characteristics that are consistent with uses of those terms in the inkjet printing industry.

A. “Bondpad”

The term “bondpad” should be applied consistently with the structures shown in Figs. 1-3 of the '864 patent, which illustrate traces [326] that are connections stemming from relatively large bondpads [328]. (Ex. 2004 ¶54.) The '864 patent is shown below as an example.



(Ex. 1001 Fig. 1.) The relatively large nature of a bondpad assisted in connecting external structures to power traces or other structures on the printhead without requiring a high degree of precision, simplifying manufacturing and reducing defects. (Ex. 2004 ¶54.)

B. “Physically Separated Proximal to the Bondpad”

The term “physically separated proximal to the bondpad” should be interpreted consistent with the ’864 patent to mean “separated at a location nearer to the bond pad than the heater arrays.” (Ex. 2004 ¶55.) The claim language itself suggests such a meaning. For instance, 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 further indicates that the bondpad supplies power to first and second heater array portions by power traces. Claims 9 and 15 similarly modify their independent

claim. Thus, the power traces are connected at one end to the bondpad and at the other end to heater arrays. The further recitation of “separated proximal to the bondpad” refers to the position between the bondpad and heater arrays at which the power traces separate. The term “proximal” is a relative description of positioning having a well-understood meaning of “nearest,” “near the central part of a body or a point of attachment or origin,” “closer to the point of attachment.” (Ex. 2001; Ex. 2002; Ex. 2004 ¶56.) All these meanings of “proximal” are relative, and require that a structure be closer to one element (especially a point of attachment or origin) than another element. Therefore, when the '864 patent discloses power traces that separate as they leave the bondpad (e.g. Fig. 3) and traces that branch from a single trace extending from the bondpad, both would be understood as variations of separating proximal the bond pad as long as they branch closer to the bond pad than to their opposite ends connected to heater arrays. (2004 ¶57.) Significantly, the '864 patent describes the bondpad as the point of origin of the power traces, because the power traces carry electricity from the bondpad to heater arrays at their opposite ends. (Ex. 2004 ¶56.) The '864 patent also repeatedly describes power traces as “**stemming from**” a bondpad. (Ex. 2004 ¶56; 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, col. 6 lns 13-17, and col. 6 lns 66-67 (claim 8), emphasis added.) Thus, a PHOSITA would understand that within the claims of the '864 patent, the term “separated proximal to the bondpad”

indicates that the point of physical separation between claimed power traces is closer to the bondpad than to the heater arrays at the opposite ends of the traces.

C. “Ink Via”

Slingshot does not agree that the term “ink via” should necessarily be construed in the same manner as separate proceedings relating to a different patent noted in the Petition, but Slingshot agrees with Petitioners that the meaning of “ink via” is not material to Petitioners’ analysis, and therefore no construction is necessary.

V. LEGAL STANDARDS

A. Anticipation

“[R]ejections under 35 U.S.C. § 102 are proper only when the claimed subject matter is identically disclosed or described in ‘the prior art. . . .’ The [prior art] reference must clearly and unequivocally disclose the claimed [invention] or direct those skilled in the art to the [invention] without any need for picking, choosing, and combining various disclosures not directly related to each other by the teachings of the cited reference.” *In re Arkley*, 455 F.2d 586, 587 (CCPA 1972). Thus, “unless a reference discloses within the four corners of the document not only all of the limitations claimed but also all of the limitations arranged or combined in the same way as recited in the claim, it cannot be said to prove prior invention of the thing claimed and, thus, cannot anticipate under 35 U.S.C. § 102.” *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008).

“To serve as an anticipation when the reference is silent about the asserted inherent characteristic, such gap in the reference may be filled with recourse to extrinsic evidence. Such evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.” *Continental Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1268 (Fed. Cir. 1991) (citing *In re Oelrich*, 666 F.2d 578, 581 (CCPA 1981)). “Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing *may* result from a given set of circumstances is not sufficient.” *Id.* at 1268–69 (quoting *Hansgird v. Kemmer*, 102 F.2d 212, 214 (CCPA 1939)).

B. Obviousness

Petitioners' obviousness grounds are not supported by the required § 103 analysis. Petitioners must prove that the claimed subject matter would have been obvious to a POSA at the time of the invention. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). A complete analysis requires that the Board determine (1) the scope and content of the prior art, (2) differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) relevant objective indicia of non-obviousness (also known as secondary considerations). *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17 (1966).

An invention “composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. Rather, Petitioners must show, but do not, that a POSA would have been motivated to pick out the asserted multiple references and combine them in a way the claimed invention does. *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993–94 (Fed. Cir. 2017). This showing must be made without any “hint of hindsight.” *Star Scientific, Inc. v. R.J. Reynolds Tobacco Co.*, 655 F.3d 1364, 1375 (Fed. Cir. 2011), so as to avoid “reconstruction by using the patent in suit as a guide through the maze of prior art references, combining the right references in the right way so as to achieve the result of the claims in suit.” *In re NTP, Inc.*, 654 F.3d 1279, 1299 (Fed. Cir. 2011) (internal citations omitted). A challenger cannot, as Petitioners do here, pick and choose among individual parts of assorted prior art references as a mosaic to recreate a facsimile of the claimed invention. *Akzo N.V. v. United States ITC*, 808 F.2d 1471, 1481 (Fed. Cir. 1986).

The test for obviousness is what the combined teachings of the references would have suggested to a POSA. *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991). Each reference must be evaluated in its entirety. *In re Evanega*, 829 F.2d 1110, 1112 (Fed. Cir. 1987). A reference must be considered for all that it teaches, including disclosures that teach away from the invention at hand. *In re Dow Chem. Co.*, 837 F.2d 469, 473 (Fed. Cir. 1988). A reference teaches away when a skilled artisan

would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path taken by the inventor. *Monarch Knitting Mach. Corp. v. Sulzer Morat GmbH*, 139 F.3d 877, 885 (Fed. Cir. 1998).

If a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984). Similarly, if the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to support a theory of obviousness. *In re Ratti*, 270 F.2d 810, 813 (CCPA 1959).

Petitioners must support their obviousness contentions with articulated reasoning and based on rational, factual underpinnings; conclusory statements of obviousness will not suffice. *KSR*, 550 U.S. at 418; *In re NuVasive*, 842 F.3d 1376, 1382–83 (Fed. Cir. 2016). Similarly, any expert testimony must explain in detail how specific references could be combined, which combinations of elements in specific references would yield a predictable result, and how any specific combination would operate or read on the asserted claims. *ActiveVideo Networks, Inc. v. Verizon Commc'ns, Inc.*, 694 F.3d 1312, 1327 (Fed. Cir. 2012).

VI. THE PETITION FAILS TO ESTABLISH THAT ANY OF CLAIMS 1-3, 5-6, 8-10, OR 13-15 WOULD HAVE BEEN OBVIOUS BASED ON BENJAMIN '144 IN VIEW OF BENJAMIN '703 (GROUND 1)

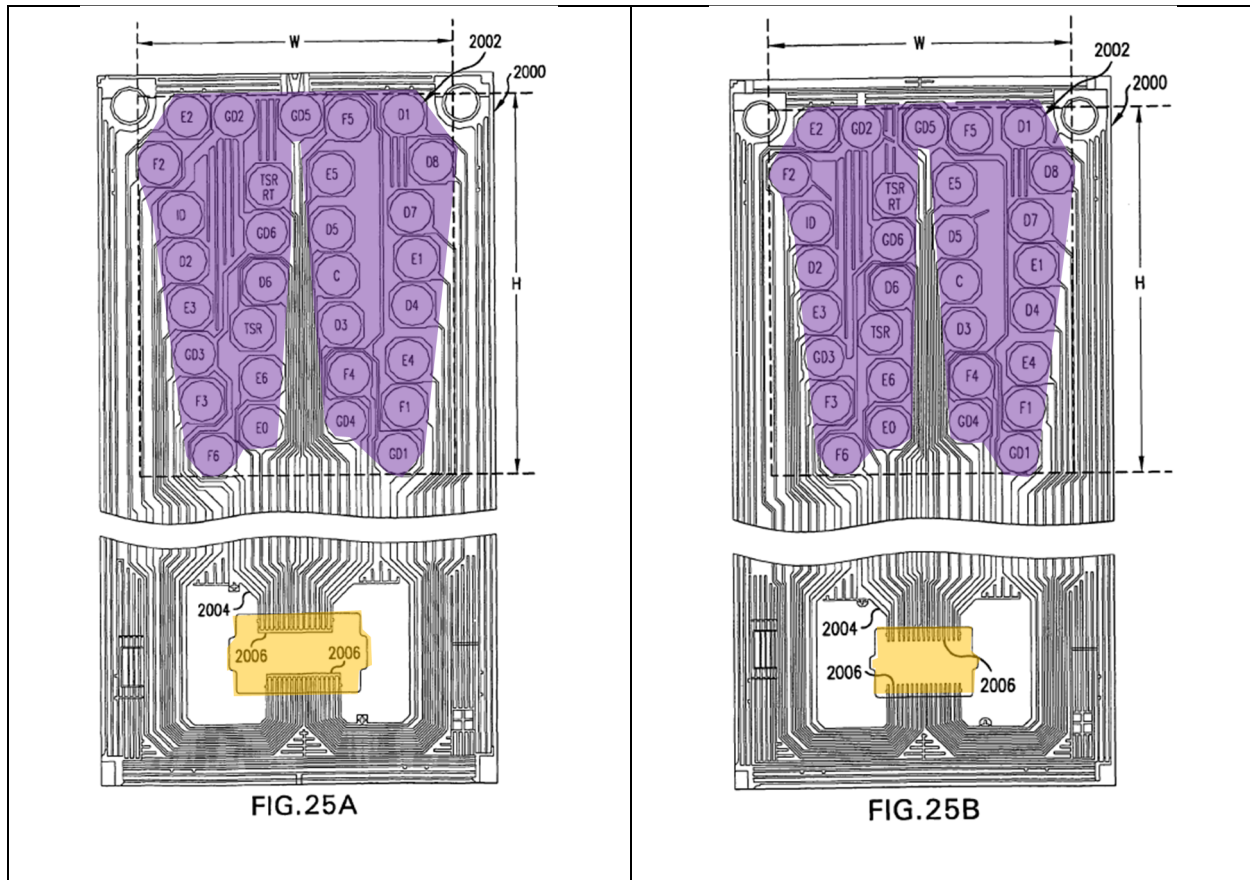
A. Claims 1 and 8

Claim 1 recites a heater chip for use in a printing device comprising an ink via, 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, and 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.” (Ex. 1001 col. 6 lns 30-39.) Claim 8 is similar but specifically requires that the bondpad have “at least two traces stemming from the bondpad” that are each connected to one of the heater arrays. (Ex. 1001 col. 6 ln 60 through col. 7 ln 3.)

The Petition argues that a PHOSITA would appreciate that Benjamin '144 discloses U-shaped fire lines that supply energy to resistors of fire groups on both sides of an ink feed slot. (Pet. pp. 16-17.) The Petition also points out that these fire lines are electrically coupled to external supply circuitry by appropriate “interface pads,” referencing the flex circuit shown in Figs. 25A and 25B. (Pet. pp. 17-18.) Petitioners then assert that the '144 patent “uses the terms interface pads and bondpads interchangeably.” (Pet. p. 17.) From the images and discussion of Benjamin '144, Petitioners argue that a PHOSITA would understand the approximate locations of bondpads associated with the fire lines, and would

understand that the bondpads are located on the printhead die or chip. (Pet. pp. 19-20.)

However, as shown below, even if the terms “interface pad” and “bondpad” are used interchangeably, Benjamin '144 indicates that the “interface pad” for the U-shaped fire lines 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. 2004 ¶59; 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.)

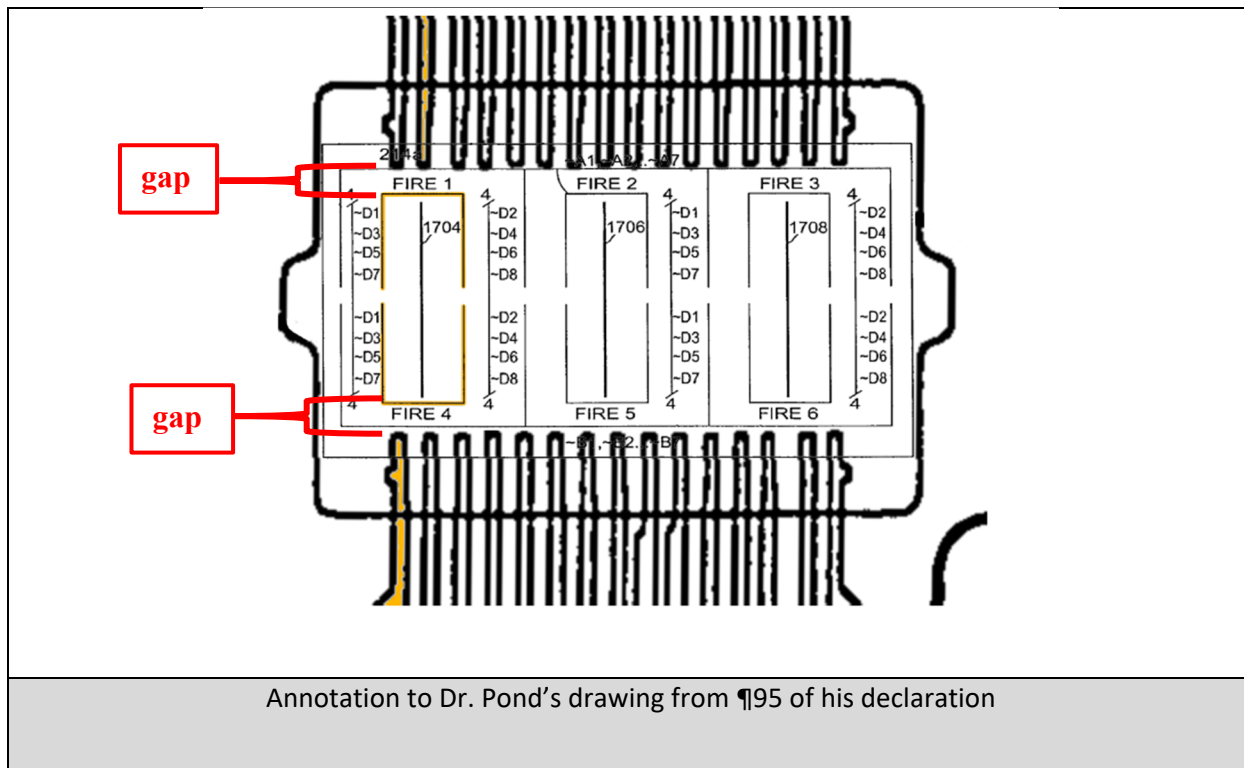


(Ex. 1005 Figs. 25A and 25B.) In fact, the heater chip is not shown at all in Fig. 25A or 25B, as admitted by Petitioners in relation to their annotated figure indicating “Die Is Positioned Here” (Pet. p. 18). Dr. Pond also admitted at his deposition that the chip is not shown at all in these figures, although there is an indication that it would be placed in the area shaded yellow above. (Ex. 005 col. 11 ln. 7 through 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. (Ex. 2004 ¶59.) Nor is there any description of a connection between U-shaped fire lines and bondpads located on the heater chip itself. (*Id.*)

Petitioners' argument that "[a] PHOSITA would understand the approximate locations of the bondpads...match the locations of contacts 2006" (Pet. p. 19) is based on assumptions regarding drawings of Benjamin '144 that require filling in significant details. 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* 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. (Ex. 2004 ¶60.) In fact, there is nothing in Benjamin '144 that indicates that the "U-shaped fire lines" are fully U-shaped. As is evident from Petitioners' arguments, the flex circuit shown in Figs. 25A-B of Benjamin '144 would not connect to the fire lines unless the fire lines were not actually U-shaped when viewed in more detail.

The drawing that Petitioners rely on when superimposing contacts of the flex circuit over a printhead die drawing (e.g. Pet. p. 20) shows a gap between the flex circuit contacts and the inboard fire lines Fire 1 and Fire 4, as shown in the reproduced and annotated figure below 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. (Ex. 2004 ¶62.)



The 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. (Ex. 2004 ¶62.) 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 this lack of detail regarding the actual shape of fire lines in Benjamin '144 indicates that there could be a split between the left and right sides of the fire lines that is simply not described much like the fire line's overall shape. (*Id.*)

Neither Petitioners nor their expert attempt to demonstrate or explain why the disclosed printhead would require one, and only one, bondpad corresponding to each

contact 2006 from the flexible circuit. The flex circuit contacts shown by Petitioner's drawing above are quite large relative to the features on the printhead die. (Ex. 2004 ¶63.) These contacts could be capable of contacting two bondpads, one for each half of the U-shape of the fire line. (*Id.*) Petitioners' arguments rely primarily on drawing conclusions from vague patent drawings, and do not cite to any discussion of how the components mentioned actually physically interact. (Ex. 2004 ¶64.)

Petitioners rely 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. (Pet. p. 20; Ex. 1002 ¶97.) However, Petitioners do 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, and therefore, even taken together, the Benjamin combination does not disclose all aspects of the claimed invention. 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. (Ex. 2004 ¶64.)

As a first step, obviousness requires showing that all elements were known in the prior art, and to invoke inherency as part of an obviousness analysis "the limitation at issue necessarily must be present, or the natural result of the

combination of elements explicitly disclosed by the prior art.” *Par Pharm., Inc. v. TWi Pharms., Inc.*, 773 F.3d 1186, 1195–96 (Fed. Cir. 2014). Thus, even though Petitioners argue obviousness based on the disclosed references, they have not shown that the combination discloses a bondpad that supplies power to at least a portion of two heater arrays on different sides of an ink via.

Further, attempting to compensate for the deficiencies in Benjamin '144 by vaguely arguing that a PHOSITA would understand the approximate locations of “the bondpads” on the heater chip of Benjamin '144 without first establishing that bondpads for fire lines would be necessarily present on the heater chip (Pet. pp. 19-20) is improper because assertions regarding knowledge of those skilled in the art may not simply be used to fill in gaps in the prior art. *See K/S HIMPP v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365–67 (Fed. Cir. 2014) (conclusory arguments and expert testimony, unsupported by any corroborating evidence, may not be used to compensate for shortcomings in the prior art); *see also Arendi S.A.R.L. v. Apple*, 832 F.3d 1355, 1361-62 (Fed. Cir. 2016) (cautioning against invoking a PHOSITA's common sense or knowledge to supply claim limitation missing from a prior art reference). Petitioners' assertions regarding the locations of phantom bondpads does not show that the claims of the '864 patent were obvious.

The motivations to combine cited by Petitioners do not establish obviousness because, for the reasons discussed above, even the combination of references does

not suggest a single bondpad providing power to heater arrays on different sides of an ink via. Further, arguments that the Benjamin references are analogous art with overlapping inventors, and even potential incorporation by reference, does not help Petitioners' argument because it is not enough that a reference discloses multiple, distinct teachings that a PHOSITA might combine. *See Net MoneyIN*, 545 F.3d at 1371. Petitioner's arguments regarding predictable results and reasonable expectation of success do not take into account the '864 patent's recognition that using a single bondpad to power a single heater array, let alone two, generally requires a larger chip area to ensure adequate power balance across the heater array. (Ex. 1001 col. 5 lns 36-38.)

B. Claim 2.

Claim 2 depends from claim 1 and further requires "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 col. 6 lns 39-42.) Petitioners' assert that claim 2 is satisfied because each ink via has two U-shaped fire lines, and essentially repeat the same arguments as they raised regarding claim 1. The cited combination therefore fails to render claim 2 obvious for at least the same reasons discussed above relative to claim 1.

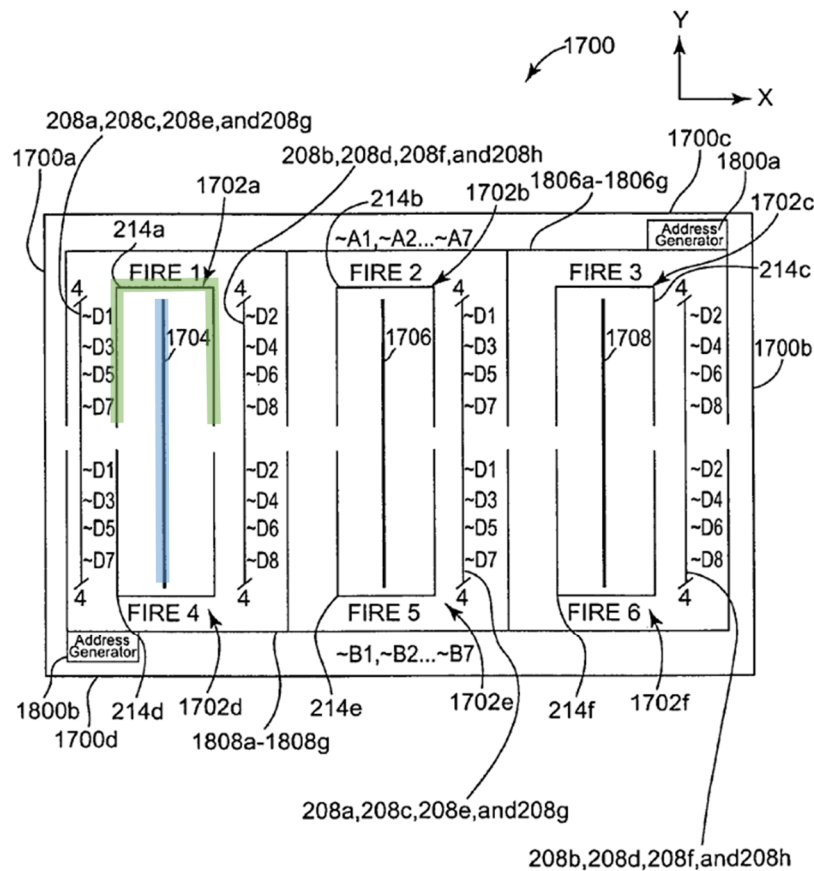
C. Claim 3.

Petitioners offer no substantive argument establishing that either of Benjamin '144 or Benjamin '703 supply power to the first heater array and second heater array portions by “power traces physically separated proximal to the bondpad,” as recited in dependent claim 3. Petitioners rely on the same logic as in claim 1, and give only fleeting thought to the language added by claim 3. (Pet. pp. 25-29.) Solely on a citation to their expert declaration, Petitioners conclude that this feature is disclosed merely because the U-shaped fire line of Benjamin '144 is similar to the branched traces of the '864 patent, without addressing the requirement that meaning of “proximal to the bondpad.” (Pet. pp. 25-27.) Neither of the Benjamin references contain any teachings like the '864 patent's teachings regarding the advantages of separating traces proximal to the bondpad rather than proximal to associated heater arrays.

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. (Ex. 2004 ¶67.) Words of a claim must be given their ordinary meaning in view of the patent, including the specification and claims. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (*en banc*). As discussed above

in the Claim Construction section, “proximal” is a relative term indicating that something is situated near to the point of attachment. (Ex. 2004 ¶56; Ex. 2001 (Concise Oxford American Dictionary, 2006, p. 714); Ex. 2002 (Webster's II New Riverside University Dictionary, p. 948).) The term indicates distance from a connection or point of origin, not merely orientation. (Ex. 2004 ¶56.) 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 and “stem” from a bondpad. (Ex. 2004 ¶56; 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).

As shown in the annotated version of Fig. 22 of Benjamin '144 below, the U-shaped fire line 1702a [green] of Benjamin '144 is very close to ink via 1704, and branching of the structure occurs proximal to the heater arrays positioned next to their associated ink via [blue] rather than proximal to any alleged placement of a bondpad.

**Fig. 22**

Because Petitioners' arguments fail to account for the requirement of power traces physically separated proximal to the bondpad as used in the specification of the '864 patent, Petitioners have failed to show a likelihood that claim 3 is invalid in view of the cited art.

D. Claims 5 and 6

Claims 5 and 6 are non-obvious for at least the reasons discussed above relative to claim 1.

E. Claim 8

Independent claim 8 is similar to claim 1, but 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. Claim 8 would not have been obvious in view of Benjamin '144 and Benjamin '703 for the same reasons discussed above regarding claim 1.

F. Claim 9

Dependent claim 9 is analogous to claim 3, and is non-obvious at least for the reasons discussed above relating to claims 1 and 3.

G. Claim 10.

Claim 10 would have been non-obvious for at least the reasons discussed above relative to independent claim 8.

H. Claim 13

Claim 13 would have been non-obvious for at least the reasons discussed above relative to independent claim 8.

I. Claim 14

Claim 14 would have been non-obvious for at least the reasons discussed above relative to independent claim 8.

J. Claim 15

Claim 15 would have been non-obvious for at least the reasons discussed above relative to independent claim 8.

VII. THE PETITION FAILS TO ESTABLISH THAT CLAIMS 4, 11-12, AND 16-20 WOULD HAVE BEEN OBVIOUS IN VIEW OF BENJAMIN '144, BENJAMIN '703, AND CHILDERS (GROUND 2)

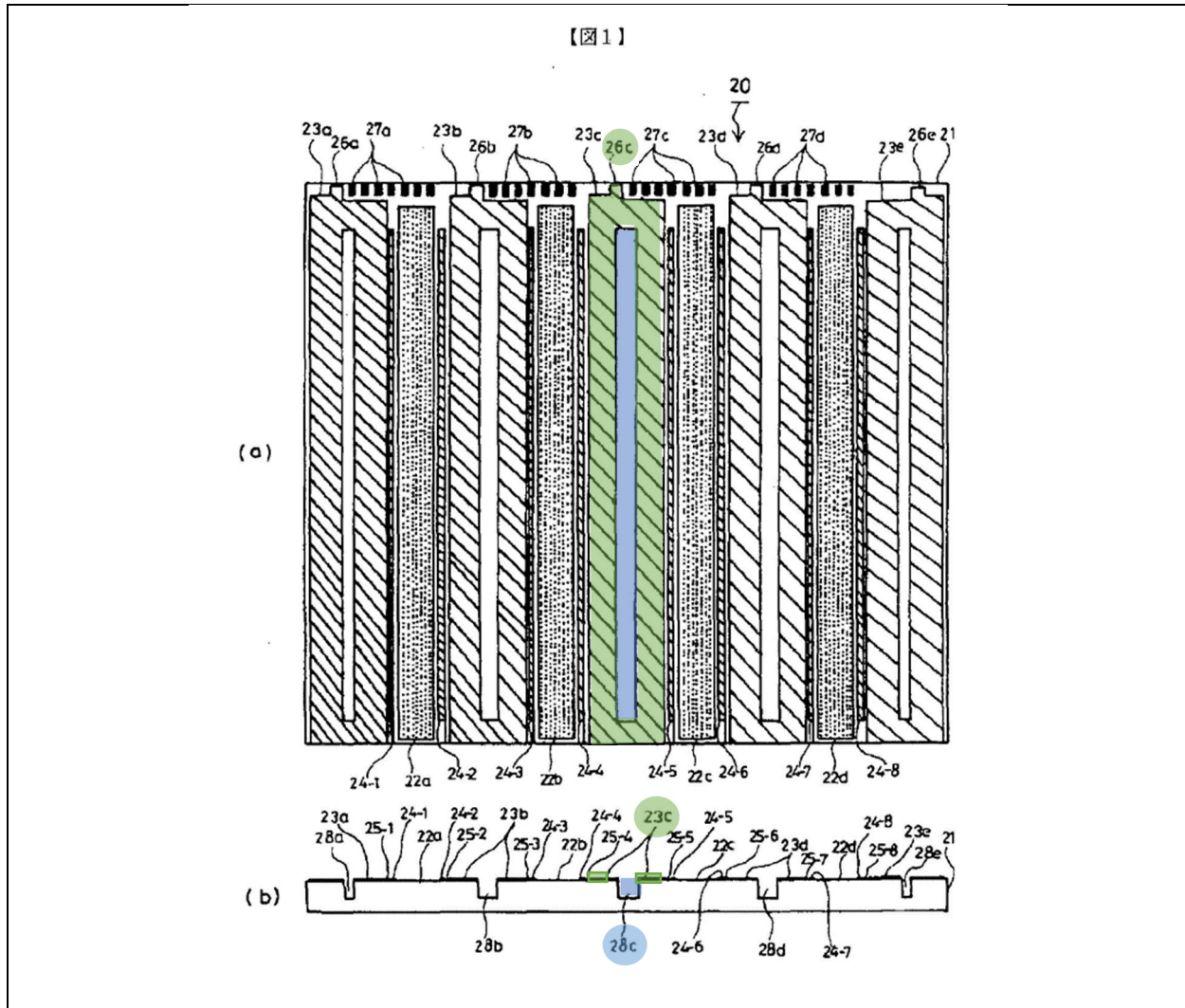
Ground 2 relies on the same arguments as Ground 1, and further argues that a PHOSITA would have found it obvious to include additional elements of dependent claims 4, 11-12, and 16-20 in view of Childers. (Ex. 1007.) For at least the same reasons discussed above relative to Ground 1, especially as to independent claims 1 and 8, the claimed inventions would not have been obvious in view of the cited art.

VIII. THE PETITION FAILS TO ESTABLISH THAT ANY OF CLAIMS 1, 3, 5-6, 8-10, 13 AND 15 ARE ANTICIPATED BY UENISHI (GROUND 3)

A. Claim 1.

Petitioners argue that Uenishi anticipates several claims of the '864 patent. Uenishi discloses a printhead in which the heaters are connected by individual wires to a 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].)

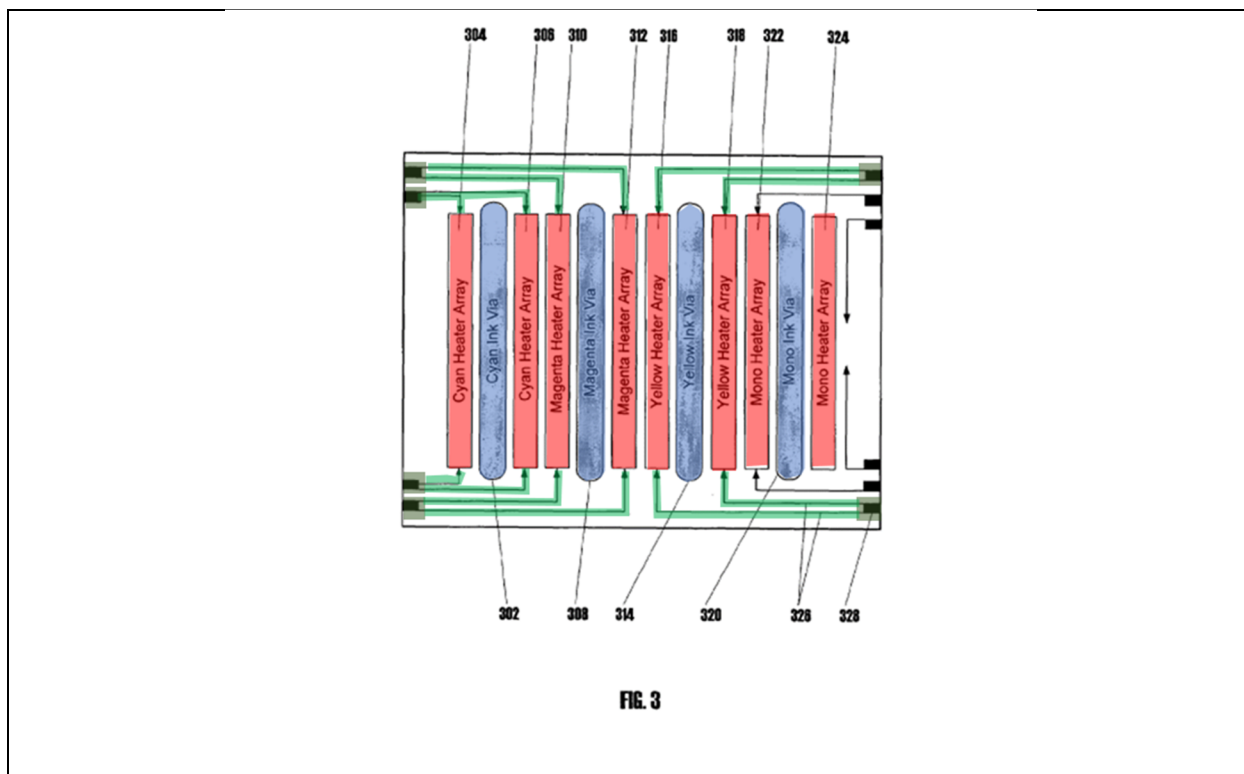


(Ex. 1008 Fig. 1.) Uenishi describes four drive circuits 22a, 22b, 22c and 22d. (*Id.* at [0029].) Heater resistors 25-5 are positioned on one side of the ink supply channel 28c between drive circuit 22c and common electrode 23c. Power is supplied to the heater resistors by individual wiring and the 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].)

Uenishi does not disclose a bondpad structure that supplies power to heater arrays. 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 provide 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.)

The “power traces” 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:

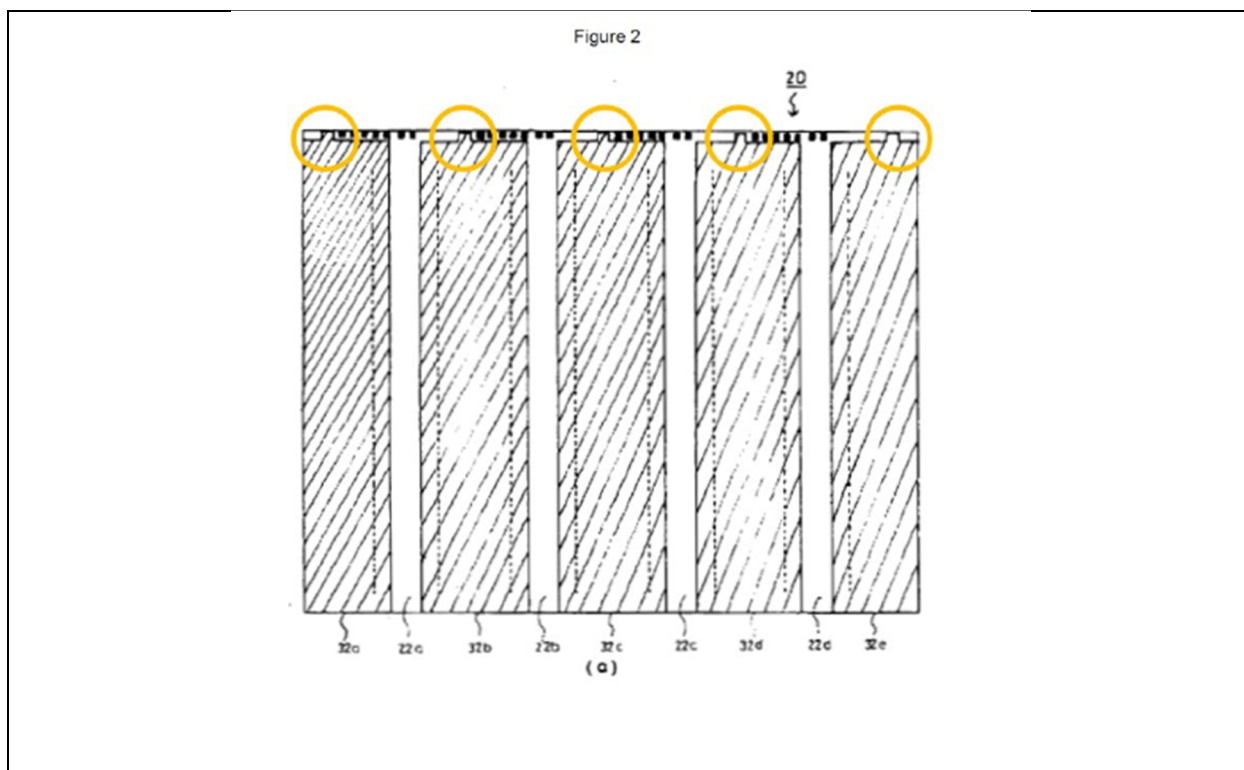


(Ex. 1001, Fig. 3.)

Uenishi does not disclose what terminal 26c connects to, and certainly does not describe the terminal as a pad to which external power traces and onboard power traces can be connected. In fact, Uenishi would not be understood to disclose a bondpad connected to power traces for reasons discussed above in the Claim Construction section. (Ex. 2004 ¶70.) 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. (*Id.*) The '864 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.) To the extent that the large common electrode 23c can even be considered a power trace, the electricity-feed terminal 26c is an integral portion of that large electrode, not a distinct component functioning as a bondpad. (Ex. 2004 ¶72.)

Further, 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. 2004 ¶74; 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. (Ex. 2004 ¶74.) For at least this additional 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.

A prior art reference cannot anticipate a claim if it does not disclose all of the limitations arranged or combined in the same way as recited in the claim. *Net MoneyIN*, 545 F.3d at 1371. As a result, Uenishi does not anticipate claim 1. Petitioners and their expert make no attempt to explain what constitutes a “bondpad” or why this portion of an electrode would be considered a “bondpad.” Even if Petitioners had argued that the electrode of Uenishi serves a similar purpose, they have not even attempted to present an obviousness analysis or explain why one skilled in the art would have found modifying Uenishi to include a bondpad to be obvious.

B. Claim 2

Petitioners concede that Uenishi does not anticipate claim 2.

C. Claim 3

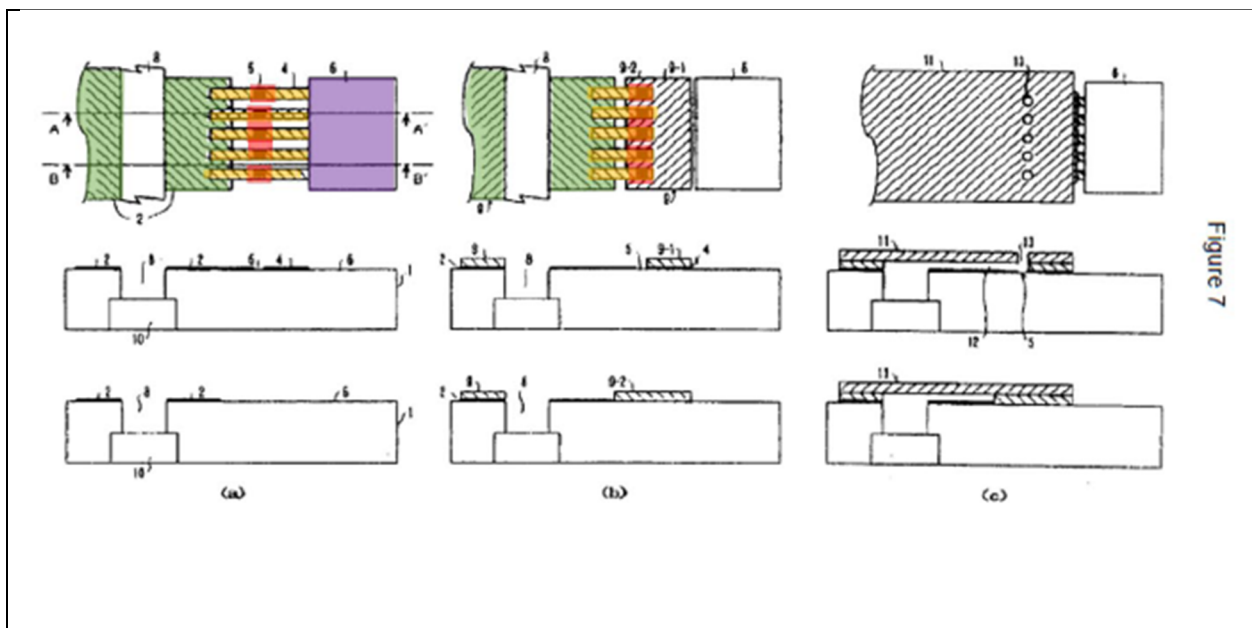
Petitioners fail to show why claim 3 would have been obvious for reasons similar to those discussed above in Ground 1. Petitioners do not explain how Uenishi supplies power to first and second heater array portions by power traces physically “separated proximal to the bondpad.” Petitioners imply that the large common

electrode of Uenishi includes portions that are separated in order to accommodate an ink supply channel. (Pet. p. 80.) While this may show that the electrode is “separated,” Petitioners improperly ignore the term “proximal to the bondpad.” As noted above, words of a claim must be given their ordinary meaning in view of the patent, including the specification and claims. *Phillips*, 415 F.3d at 1312-13.

For the reasons discussed in Ground 1, “proximal” is a relative term indicating that something is situated near to the point of attachment. (Ex. 2004 ¶56; Ex. 2001 (Concise Oxford American Dictionary, 2006, p. 714); Ex. 2002 (Webster's II New Riverside University Dictionary, p. 948).) The term indicates distance from a connection or point of origin, not merely orientation. (Ex. 2004 ¶56.) 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 and “stem” from a bondpad. (Ex. 2004 ¶56; 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.)

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. 2004 ¶75; Ex.1001 col. 5 ln 64 through col. 6 ln 3.) Separation of any aspect of Uenishi's common electrode or related structures connecting to

heater arrays occurs only very close to the heater resistors. (Ex. 2004 ¶76.) For instance, 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, the power supply is “separated” into traces only proximal to the heater arrays, not to the alleged bondpad of Uenishi. (Ex. 2004 ¶76.) 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. (*Id.*)

Because Petitioners' arguments fail to account for all of the elements of claim 3 and ignore the meaning of "power traces physically separated proximal to the bondpad" as used in the specification of the '864 patent, Petitioners have failed to show a likelihood that claim 3 is invalid in view of the cited art.

D. Claim 4

Petitioners concede that claim 4 is not anticipated by Uenishi.

E. Claim 5

Petitioners have failed to consider the requirement of a "power trace" with respect to dependent claim 5. Claim 1 already requires "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," and Petitioners attempt to show nothing more than the electrodes supplying power to two heater arrays, completely ignoring the language added by claim 5 that requires this power to be supplied "by at least one power trace." Uenishi shows a uniformly wide electrode, much wider than the heaters to which it supplies power, and much wider than the structure that Petitioners argue to be a "bondpad." As a result, Petitioners have failed to show that claim 5 is anticipated by Uenishi.

F. Claim 6

Petitioners have failed to carry their burden as to dependent claim 6 for at least the reasons discussed above relative to claim 1.

G. Claim 8

Independent claim 8 is similar to claim 1, but 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. Claim 8 would not have been obvious in view of Benjamin '144 and Benjamin '703 for the same reasons discussed above regarding claims 1 and 5.

H. Claim 9

Dependent claim 9 is analogous to dependent claim 3 and Petitioners arguments should be rejected for essentially the same reasons discussed with regard to claims 1 and 3.

I. Claim 10

Petitioners have failed to carry their burden as to dependent claim 10 for at least the reasons discussed above relative to claim 8.

J. Claim 13

Petitioners have failed to carry their burden as to dependent claim 13 for at least the reasons discussed above relative to claim 8.

K. Claim 15

Petitioners have failed to carry their burden as to dependent claim 15 for at least the reasons discussed above relative to claim 8, and additionally because Petitioners fail to show that Uenishi has a bondpad coupled to “traces” operatively connected to heater arrays wherein the traces are physically separated “proximal to the second bondpad” for the reasons discussed above in connection with claims 3 and 5.

IX. THE PETITION FAILS TO ESTABLISH ANY OF CLAIMS 4, 11, AND 12 WOULD HAVE BEEN OBVIOUS IN VIEW OF UENISHI AND HAYASAKI (GROUND 4)

Ground 4 relies on the same arguments as Ground 3, and further argues that a PHOSITA would have found it obvious to include additional elements of dependent claims 4, 11 and 12 in view of Hayasaki (Ex. 1009). For at least the same reasons discussed above relative to Ground 1, especially as to independent claims 1 and 8, the claimed inventions would not have been obvious in view of the cited art.

X. CONCLUSION

For the reasons described above, and because Petitioners have not shown why the claims of the '864 patent would have been obvious.

Respectfully submitted,
FITCH EVEN TABIN & FLANNERY LLP

Dated: October 30, 2023

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CERTIFICATE OF WORD COUNT

The undersigned hereby confirms that the foregoing Response complies with the type-volume limitation of 37 C.F.R. § 42.24(a). Excluding the items listed in 37 C.F.R. § 42.24(a) as not included in the word count, this Patent Owner's Response contains 8,625 words, calculated by the word-processing system used to prepare it.

Dated: October 30, 2023

By: /Mark A. Borsos/
Timothy P. Maloney
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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), the undersigned hereby certifies that a true copy of the foregoing PATENT OWNER'S RESPONSE was served this 30th day of October, 2023, by e-mail upon the following:

Dion M. Bregman (Reg. No. 45,645)
Amanda S. Williamson (Reg. No. 73,683)
Jason E. Gettleman (Reg. No. 55,202)
James J. Kritsas (Reg. No. 71,714)
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Petitioners have consented to service by electronic means.

Respectfully submitted,
FITCH EVEN TABIN & FLANNERY LLP

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