

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. IPR2023-00313

Patent No. 7,594,708

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. 7,594,708 (“the ’708 patent”), which was accompanied by the Declaration of Dr. Stephen F. Pond. I understand that the Petition in this case (IPR2023-00313) relates to certain grounds of invalidity based on U.S. Patent No. 7,384,113 B2 to Benjamin *et al.* (“Benjamin ’113”), U.S. Patent No. 6,612,673 to Giere *et al.* (“Giere ’673”), U.S. Patent No. 7,163,272 to Parish *et al.* (“Parish”), U.S. Patent No. 6,565,178 to Giere *et al.* (“Giere ’178”), U.S. Patent No. 5,808,640 to Yabe (“Yabe”), U.S. Patent No. 5,808,640 to Bhaskar *et al.* (“Bhaskar”), and U.S. Patent No. 6,488,363 to Torgerson *et al.* (“Torgerson”).

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 '708 patent, and to provide conclusions relating to the meaning of the claims and disclosures of the '708 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. 2002.

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 '708 patent discloses improvements in temperature sensing for thermal ink jet printheads. 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. 7,594,708 to Barkley et al.
Ex. 1002	Declaration of Stephen F. Pond, Ph.D.
Ex. 1003	File History of U.S. Patent 7,594,708
Ex. 1004	U.S. Patent No. 7,384,113 to Benjamin et al. ("Benjamin")
Ex. 1005	U.S. Patent No. 6,612,673 to Giere et al. ("Giere '673")
Ex. 1006	U.S. Patent No. 7,163,272 to Parish et al. ("Parish")
Ex. 1007	U.S. Patent No. 6,565,178 to Giere et al. ("Giere '178")
Ex. 1008	U.S. Patent No. 6,527,367 to Yabe ("Yabe")

Ex. 1009	U.S. Patent No. 5,808,640 to Bhaskar et al. (“Bhaskar”)
Ex. 1010	U.S. Patent No. 6,488,363 to Torgerson et al. (“Torgerson”)
Ex. 1011	U.S. Patent No. 6,082,854 to Axtell et al. (“Axtell”)
Ex. 1012	Excerpts of Prior Art Dictionaries – Adjacent
Ex. 1013	Oxford English Dictionary, Second Edition (2005)
Ex. 1014	U.S. Patent No. 7,131,714 to Edelen et al. (“Edelen”)
Ex. 1015	U.S. Patent No. 6,357,863 to Anderson et al. (“Anderson”)
Ex. 1016	U.S. Patent No. 6,382,773 to Chang et al. (“Chang”)
Ex. 1017	Daniel A. Kearl & Michael S. Ard, Low-Cost Plain Paper Color Inkjet Printing, Hewlett-Packard J. 43, No. 4, 64 (1992)
Ex. 1018	William A. Buskirk et al., Development of a High-Resolution Thermal Inkjet Printhead, Hewlett-Packard J. 39, No. 5, 55 (1988)
Ex. 1019	U.S. Patent No. 7,278,703 to Benjamin et al. (“Benjamin ’703”)
Ex. 1020	Curriculum Vitae of Stephen F. Pond, Ph.D.
Ex. 2001	U.S. Patent Publication No. 2003/0142159 to Askeland et al.
Ex. 2002	Curriculum Vitae of Steven J. Dietl
Ex. 2004	October 10, 2023 Deposition Transcript 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 '708 patent ("PHOSITA"), at the time the relevant patent application leading to the '708 patent was filed. As stated in the '708 patent, the field of the invention generally relates to heater chips for use with printing devices, and in particular, to structures for improving temperature sensing in thermal ink jet heater chips.

33. Dr. Pond contends that a person having ordinary skill in the art at the time that the application that became the '708 was filed (December 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 ¶ 108.)

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. 2002, I had exceeded the experience of a PHOSITA before the December 30, 2005 date of the '708 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

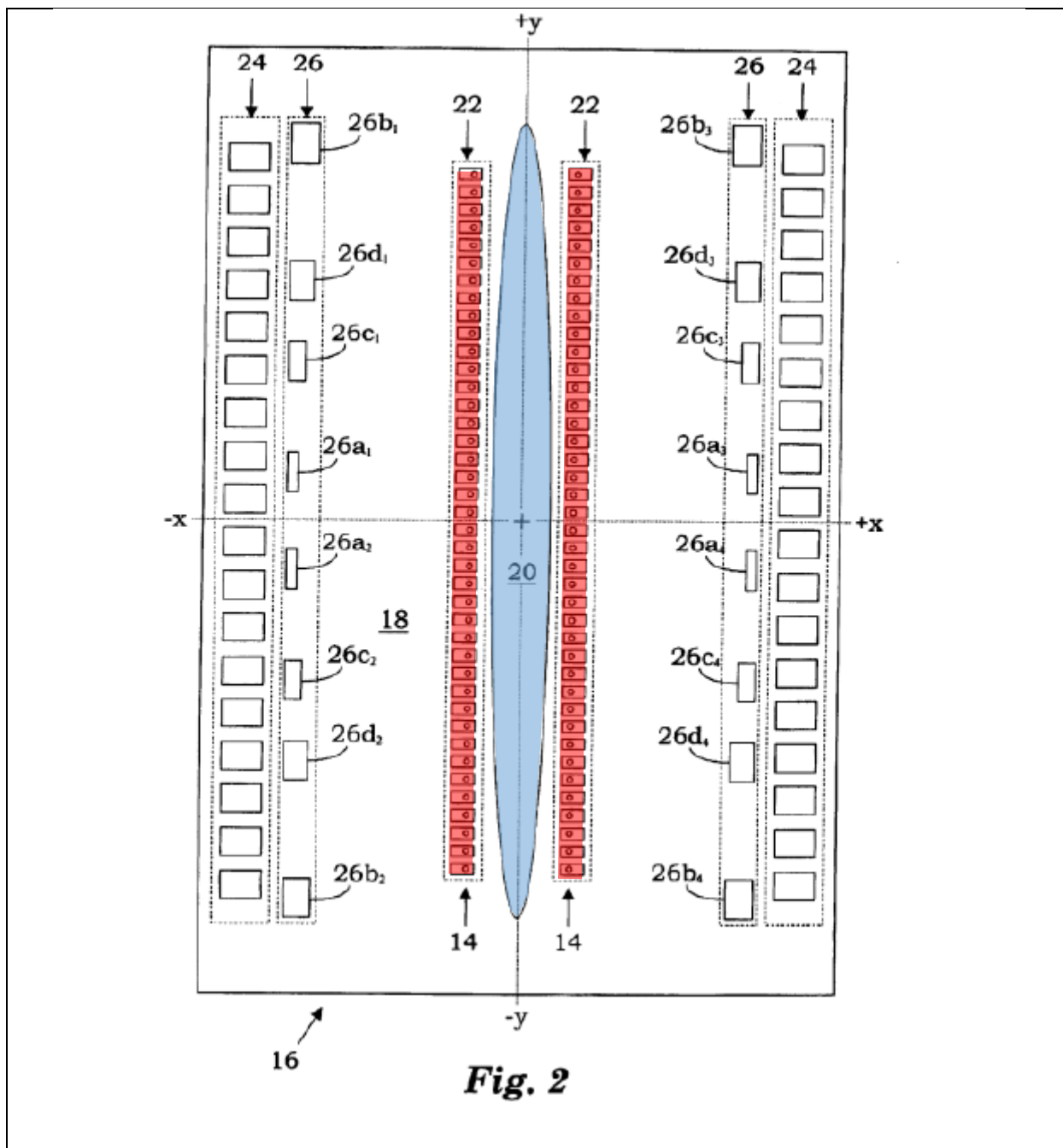
in the '708 patent and an understanding of what a PHOSITA with two years of training or experience in the design of ink jet cartridges and printheads would know. In particular, as of that date I had a Bachelor's degree in Mechanical Engineering and a Master's degree in Systems Engineering and significant experience with designing and commercializing ink jet printheads and disposable ink cartridges.

36. As a result of my education and industrial experience, I am familiar with the technology in the field of the '708 patent and also with the state of that technology in December 2005, when the application that led to the '708 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. Response To Dr. Pond's Characterizations Of The Relevant Technology

37. Dr. Pond sets forth a characterization of the background of the technology that is generally accurate. Thermal ink jet printers include a component called a "printhead" that contains components for heating and ejecting ink. The printhead is formed on a substrate, which is usually a semiconductor material such as silicon. The substrate and its components are sometimes called a "heater chip" because it is a semiconductor chip that has components for heating ink. As the ink is heated in small chambers, it is temporarily vaporized, forming a bubble that expands and ejects ink through hundreds or thousands of small holes (referred to as nozzles) in a plate that covers the outer face of the heater chip.

38. I agree with Dr. Pond that by the time of the '708 patent, many thermal ink jet printers included a "via" (ink feed slot) that allowed ink to pass from a reservoir positioned at the back of the printhead die to the front face of the printhead die. Printheads were commonly constructed on a silicon semiconductor substrate, with metal and polymer layers applied to the front face of the substrate to convey ink past heater resistors and through nozzles that would discharge the ink onto a medium such as paper. The term "ink via" was commonly understood by a PHOSITA to refer to an elongate passage cut through the silicon substrate in a direction perpendicular to the surface of the substrate. In many devices the front face of the chip contained a column of heater resistors next to, and parallel to, the ink via, and channels formed in a barrier layer on the front face of the substrate. In some cases this ink via would be substantially rectangular, while in other cases the via may be more oval shaped such as in the via (20) [blue] between columns of heater resistors (22) [red] in U.S. Patent No. 6,357,863 to Anderson.



39. Dr. Pond does not discuss, however, that another common printhead configuration included omitting a via and feeding ink to heater resistors over the edge of the silicon chip. This alternative design was commonly referred to as an “edge feed” device by those in the ink jet industry. In such a configuration, the ink

FIG. 4

Patent Owner's Response
Exhibit 2003, p. 18

flows around the edges of the Substrate 410 [yellow] and into the vaporization chambers 418 [red].” (*Id.* col. 5 lns 42-45.) Although not all of the features of Fig. 4 above are labeled in Fig. 5, I have colored the area where ink flows to the chip in blue in both figures to indicate how ink is able to travel around the edges of the silicon chip to reach the vaporization chambers. Edge feed designs were used in monochrome printheads where the same color of ink is fed to both edges, and do not readily support multiple columns of differing color nozzle arrays.

VII. Relevant Disclosures Of The '708 Patent

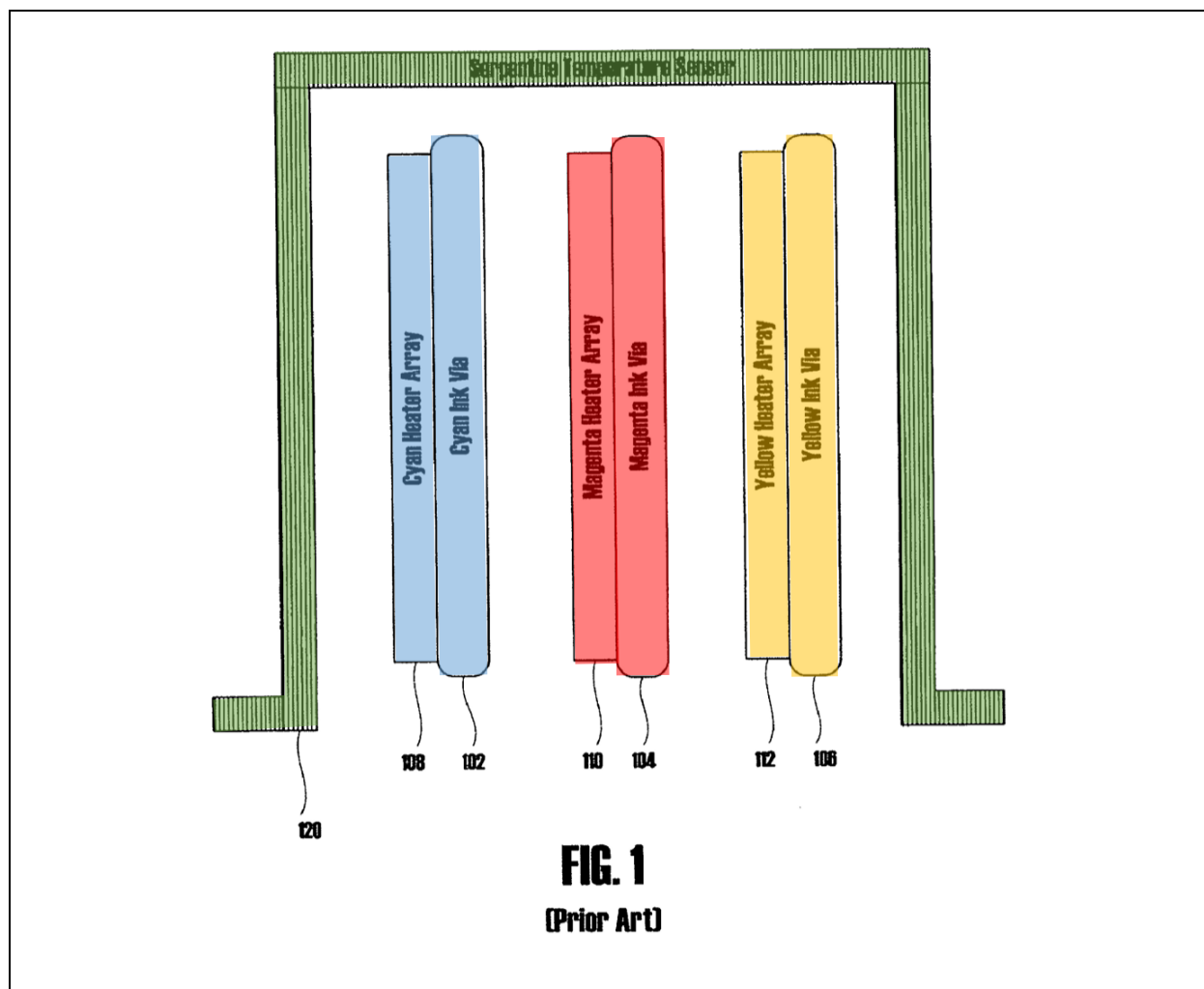
40. The '708 patent describes technical challenges associated with controlling the temperature of heater chips for discharging ink in an ink jet printer. As I explained above in connection with the background of the technology, a heater chip is a component of the printhead of the printer that discharges ink drops to form images, and includes a semiconductor substrate that may contain multiple ink vias through which ink is supplied to the heater chip. (Ex. 1001 col. 1 lns 21-26.)

41. In the type of chips relevant to the '708 patent, arrays of heater resistor elements (“heaters”) are positioned along the sides of ink vias to heat ink supplied through the vias, causing the ink to be discharged through associated nozzles. (*Id.* col. 1 lns 21-47 and col. 4 lns 58-60.) Monitoring and maintaining the silicon substrate of the heater chip at an acceptable temperature for printing avoids low temperatures that can result in formation of smaller ink drops with lower drop-

weight than required for good image quality, and avoids variations in temperature that will cause inconsistent drop-weight and resulting visible hue shifts in a printed image. (*Id.* col. 1 lns 48-55.) Once the temperature of the heater chip is measured, the temperature can be maintained at an acceptable temperature for printing. Heater chips may apply short pulses to heater arrays in order to maintain a desired temperature, or may include separate substrate heating elements to heat the silicon substrate. (*Id.* col. 2 lns 16-25.)

42. In order to control the temperature of a heater chip, a printer must be capable of measuring the temperature, or changes in temperature, on or near the chip. One way of measuring the heater chip temperature was attaching a temperature sense resistor (TSR) to the substrate and monitoring its current. As the substrate temperature of the heater chip increases, the resistance of the TSR increases, allowing a temperature measurement to be taken. (Ex. 1001 col. 6 lns 29-32.) If different portions of the TSR are in contact with portions of the substrate having different temperatures, the change in current through the TSR that is detected will reflect an average temperature along the entire length of the TSR. At the time that the application that led to the '708 patent was filed, some heater chips included a single temperature sense resistor (TSR) regardless of the number of ink vias in a chip. For instance, the '708 patent acknowledged heater chips having one ink via for each primary color (magenta, yellow, and cyan) with a single TSR positioned to

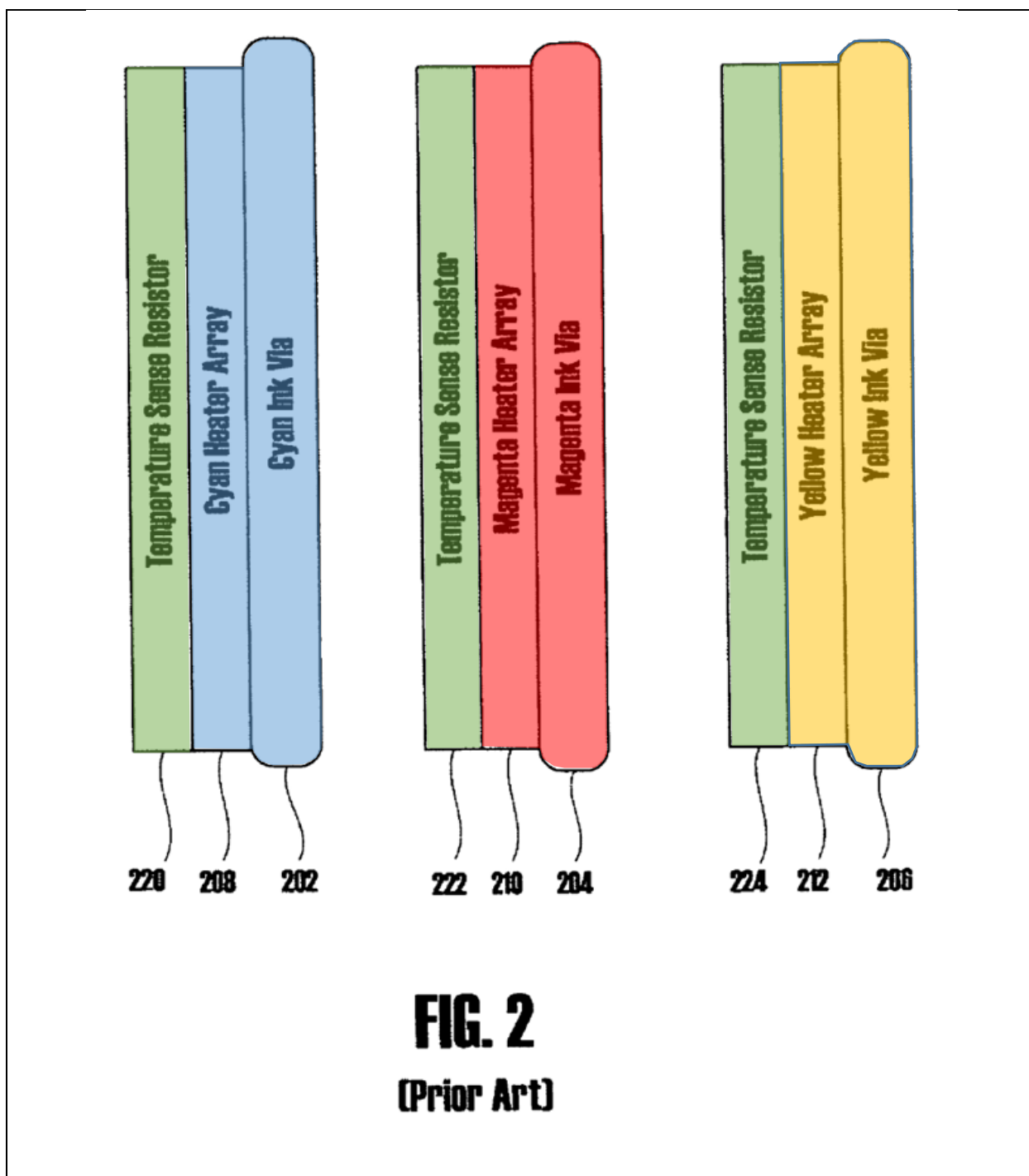
detect the heat of the chip in an area around all three ink vias, as shown below:



(Ex. 1001 Fig. 1.) As shown in Fig. 1 above, a serpentine metal TSR 120 [green] is positioned around multiple ink vias, resulting in the TSR extending along the periphery of the heater chip. This peripheral TSR measures an average temperature of the entire printhead die. (*Id.* col. 1 lns 56-62.) This configuration does not distinguish between temperatures of heaters associated with individual colors of ink and does not provide any feedback on temperature differences between one area of the heater chip versus another. Instead, the TSR provides feedback based on the

average temperature along the entire length of the TSR. The '708 patent therefore recognizes that this placement of a TSR cannot be used to control temperature on a per color or area basis. (*Id.* col. 1 lns 62-65.)

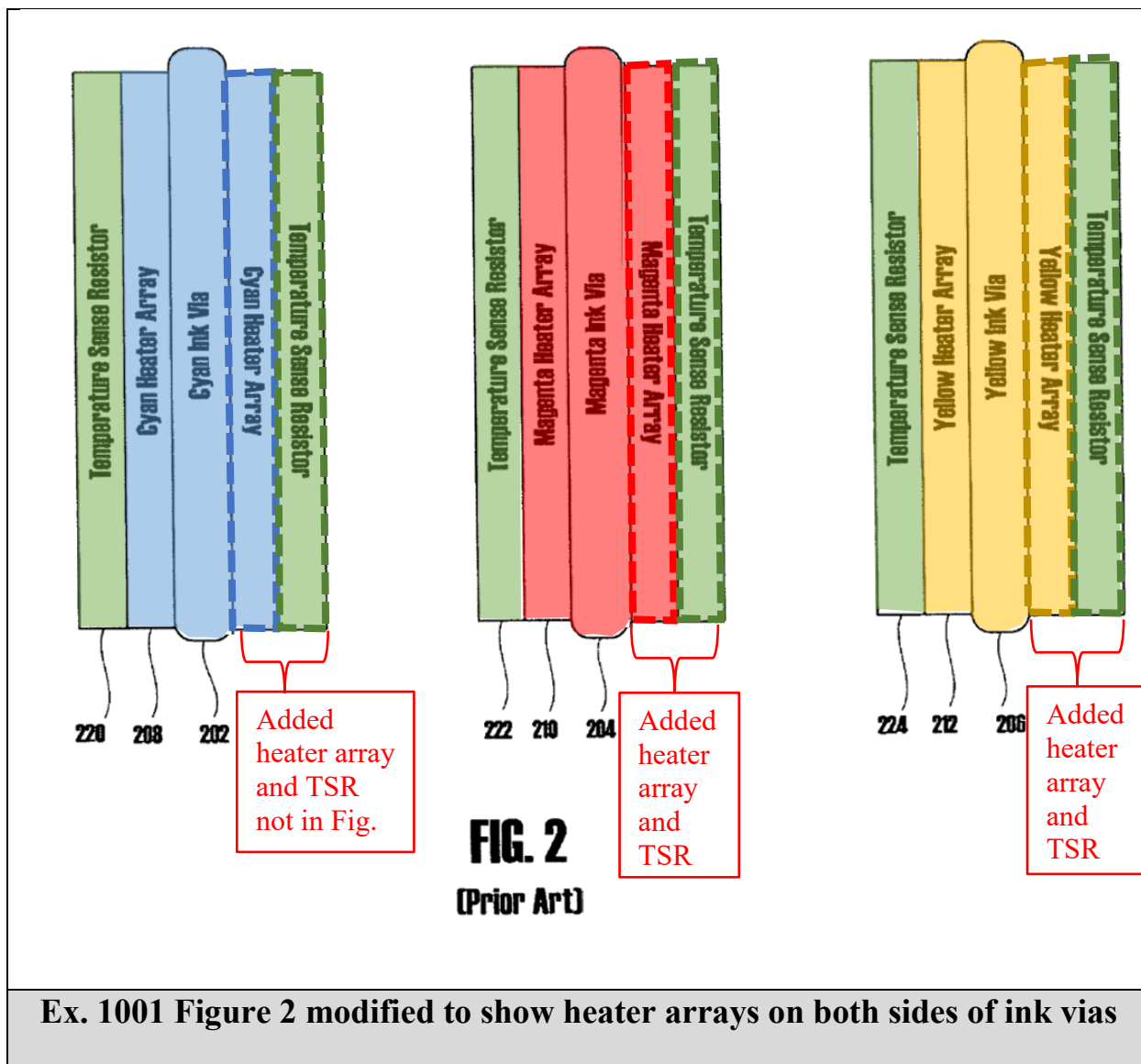
43. The heater chip shown in Fig. 2 of the '708 patent, on the other hand, includes three temperature sense resistors (220, 222, and 224), one for each heater array, and because each ink via is associated with only one heater array this configuration allows for temperature sensing on a per color basis. (*Id.* col. 2 lns 1-11.)



44. The '708 patent addresses a particular problem – when a printhead has multiple parallel ink vias for supplying multiple colors of ink and with heater arrays positioned on both sides of the ink vias, the temperature sensing and regulating

devices utilized in the prior art configurations shown in Figs. 1 and 2 do not provide adequate thermal control. (*Id.* col. 2 lns 36-38.) The temperature sensor shown in Fig. 1 determines only an average temperature over its entire length and cannot be used to determine a temperature of a specific region. (*Id.* col. 1 lns 56-67 and col. 2 lns 38-43.) The TSR arrangement of Fig. 2 is not able to regulate temperature on a per-color basis when heater arrays are positioned on both sides of each ink via. (*Id.* col. 2 lns 43-48.)

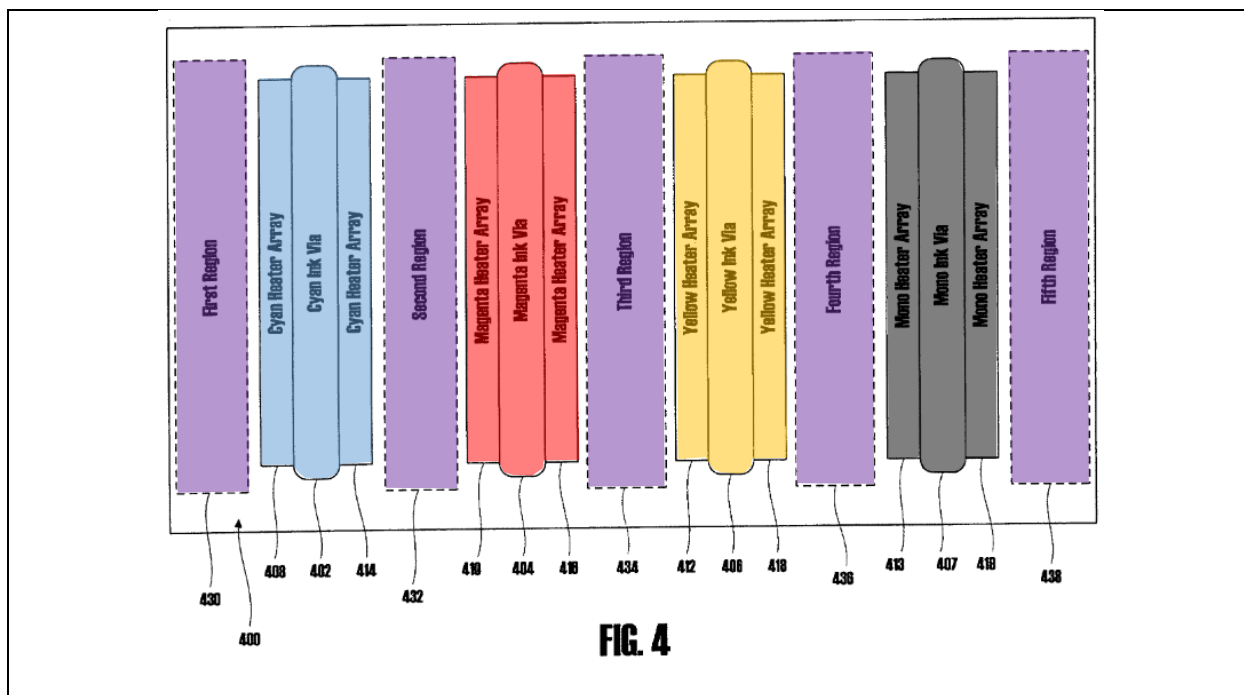
45. The '708 patent notes that an approach of placing a temperature sensor immediately adjacent each heater array in such a printhead would result in the region between adjacent vias having two different TSRs. (*Id.* col. 5 lns 35-40.) Although this configuration is not shown in the figures of the '708 patent, I have modified a version of Fig. 2 below by adding a second heater array and associated temperature sensor to each ink via (shown with dashed lines), resulting in two heater arrays and two temperature sensors in each region between different color ink vias.



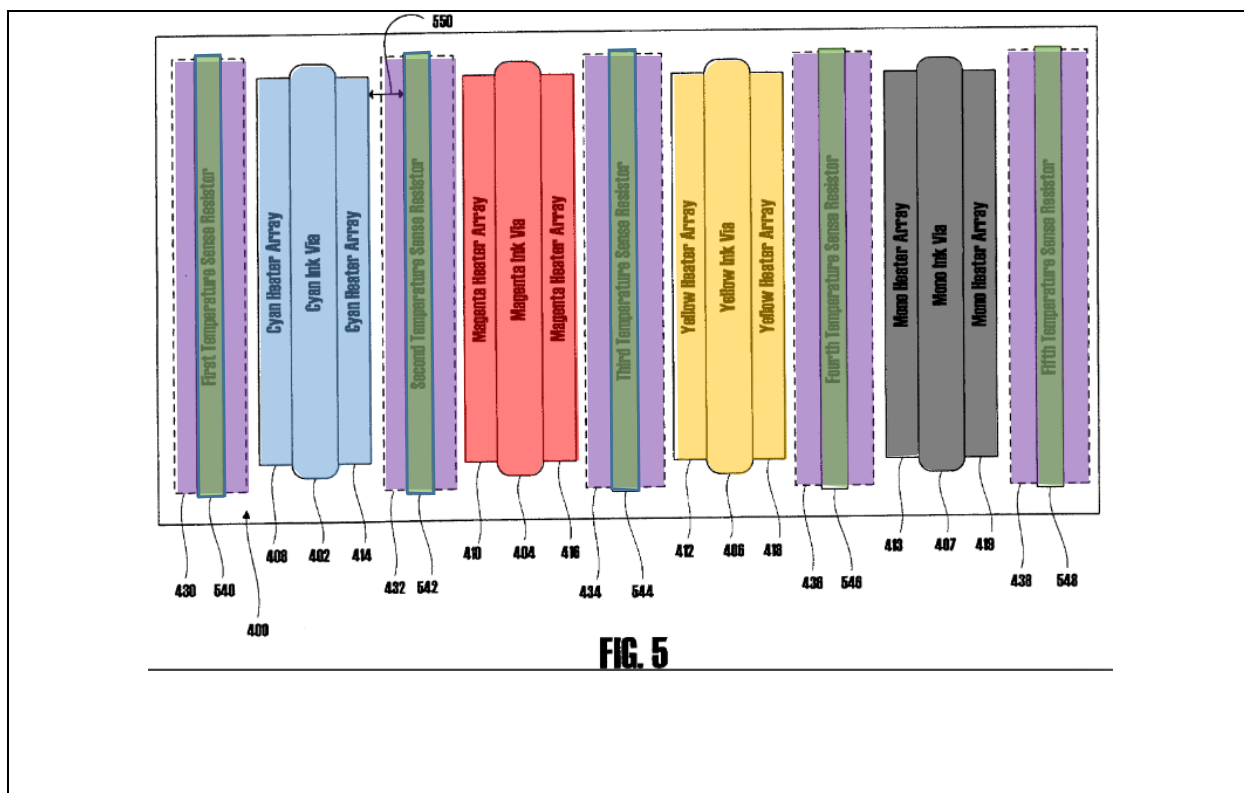
The '708 patent recognizes that this makes it difficult to accurately detect and control temperature on a per color basis. (*Id.* col. 5 lns 35-50.) For example, if a print job is heavy in yellow and light in magenta, thermal energy generated by the yellow heaters would transfer through the common silicon to the magenta TSR positioned between the yellow and magenta ink vias, providing a false high reading for magenta. (*Id.* col. 5 lns 44-48.)

46. In contrast to the prior art, the '708 patent provides temperature monitoring and regulation of regions of a heater chip between adjacent ink vias, rather than on a color-by-color basis, when heater arrays are placed on both sides of an ink via. (*Id.* col. 2 lns 51-54 and col. 5 lns 48-51.) The inventors recognized that due to high thermal conductivity of the silicon substrate, the region between the heater array of one ink via and the opposite heater array of an adjacent ink via would have an uniform temperature if the width of the region is small enough for the temperature to equalize at the firing frequency and temperature sampling rate of the temperature sense element. (*Id.* col. 6 lns 58-64 and col. 7 lns 5-16.) However, that temperature may differ from the temperature of other regions of the chip because the ink vias act as thermal insulators. (*Id.* col. 6 lns 64-67.) Based on these principles, the inventors developed a design whereby the temperature of a heater chip is monitored and regulated on a per region basis where regions are defined by their relationship to ink vias.

47. For example, Fig. 4 below shows several regions [purple] defined between heater arrays associated with ink vias of different colors or between an ink via and an edge of the heater chip.



48. As shown in Fig. 5 below, a temperature sensor (540, 542, 546, 548) [green] may be placed in each such region.



(*Id.*, Fig. 5 and col. 5 lns 35-41.) In this configuration, the temperature sense resistors sense temperature by silicon region rather than attempting to sense temperature on a per color basis. (*Id.* col. 5 lns 48-51.) The '708 patent teaches that a single temperature sense resistor in such a region can sense a temperature that represents the temperature of the two heater arrays adjacent the region if the width of the region is small enough and the temperature sampling rate of the sensor is sufficient for the firing rate of the heater arrays. (*Id.* col. 6, ln 58 – col. 7, ln 16.) Regulating the temperature of a heater chip by regions as defined by ink vias allows for each region to be regulated at its optimal operating temperature using a simplified design.

VIII. Prosecution Of The '708 Patent In The USPTO

49. The application that led to the '708 patent was filed on December 30, 2005. In the first office action, the USPTO issued a provisional double patenting rejection, and in response the applicant filed a terminal disclaimer on February 1, 2008. (Ex. 1003 pp. 216-220 and 206-207.) On the same day the applicant also submitted an amendment which altered the independent claims as follows to emphasize that the recited temperature sensing element senses a temperature that is representative of the first heater array and the second heater array:

1. (Currently Amended) A chip for use with a printing device, comprising:
 - a first heater array, positioned substantially adjacent a first via;
 - a second heater array, positioned substantially adjacent a second via;

a region, positioned between the first heater array and the second heater array; and

a temperature sensing element operable to sense ~~the~~ a temperature of the region, the temperature being representative of the first heater array and the second heater array, wherein the temperature sensing element is substantially centrally disposed with respect to the region.

10. (Currently Amended) A method of fabricating chips for use with a printing device, comprising:

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

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

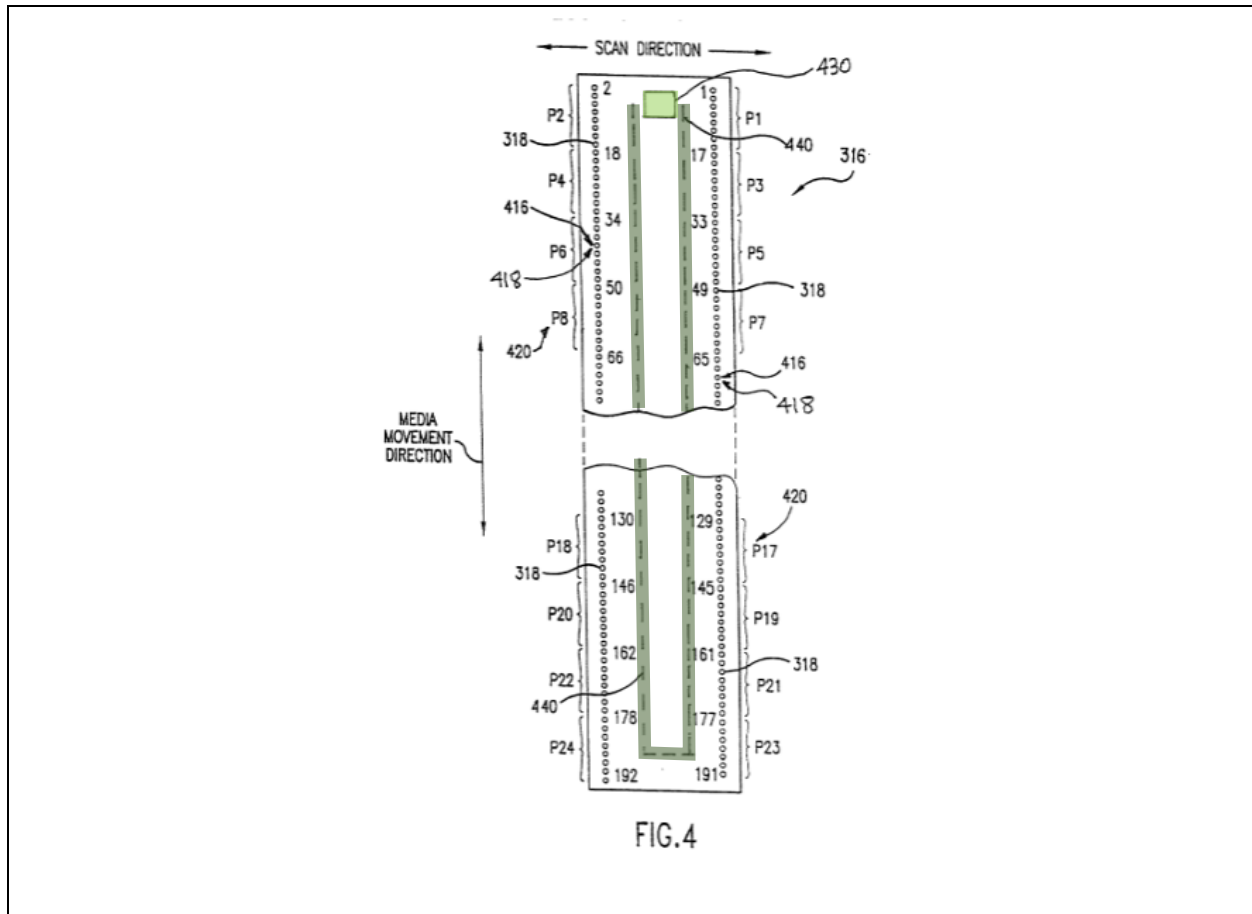
positioning a temperature sensing element in a region between the first heater array and the second heater array, wherein the temperature sensing element is operable to sense ~~the~~ a temperature of the region, the temperature being representative of the first heater array and the second heater array.

(Ex. 1003 pp. 192-193.) In the remarks of this amendment, the applicant distinguished prior art U.S. Patent Publication No. 2003/0142159:

In conventional printheads, such as U.S. Patent Publication No. 2003/0142159 to *Askeland, et al.* (hereinafter “*Askeland*”), a temperature sensing element resistor (TSR) (420) [sic] is located far from local ejection elements (416) such that “there are differences in the local temperature in ejection chambers 418 and the global temperature measured by the TSR 440.” *See* Paragraph [0044]. *Askeland* describes the difficulties in placement of a TSR close to the ejection chambers since “heat must flow from the ejection elements 416 to the TSR before it can be measured ... [t]he time required for this heat to flow to the TSR where it can be measured creates a latency in the control system.” *Id.* *Askeland* relates to an altogether different technique than described by the Applicants’ claimed invention in that *Askeland* must use the TSR temperature measurements as well as the ejection history of the driver head to estimate the local ejection chamber temperature. *See* Paragraph [0047]. Instead of using a single TSR for

pair of opposing local ejection elements, *Askeland* relates to a relatively complicated solution to measuring temperature.

(Ex. 1003 pp. 195-196.) Below is Fig. 4 of *Askeland* showing a digital temperature sensor 430 and a thermal sense resistor 440 [dark green] that “measures the global temperature of the driver head 316.” (Ex. 2001 ¶ [30].)



(Ex. 2001 Fig. 4.) In the printhead of *Askeland*, the temperature sense resistor 440 forms a loop to detect an average temperature of the entire chip similar to the prior art shown as Fig. 1 in the '708 patent. The applicant further discussed how *Askeland* differs from the claims of the '708 patent by detecting a “global” temperature of the

printhead rather than a temperature of regions between adjacent ink vias. (Ex. 1003 p. 196.)

50. On May 19, 2008, the Examiner issued a final rejection with obviousness rejections based on “admitted prior art” (Figs. 1 and 2 of the ’708 patent) and Askeland [Ex. 2001]. (Ex. 1003 pp. 175-181.) The Examiner argued that the admitted prior art shows a chip with regions positioned between first/third heater arrays (208, 210) and second/fourth heater arrays (210, 212), with first and second temperature sensing elements (222, 224) between the first/third and second/fourth heater arrays. (Ex. 1003 pp. 177-178.) The Examiner acknowledged that the admitted prior art does not teach the temperature sensing elements being substantially centrally disposed with respect to the regions, but argued that Askeland [Ex. 2001] discloses an ink jet printhead having first and second heater arrays with a temperature sensing element substantially disposed within a region between the arrays. (Ex. 1003 p. 178.)

51. After presenting a set of claim amendments on May 19, 2008 (*id.* pp. 134-141) which was not entered (*id.* pp. 121-122), the applicant filed a request for continued examination along with a new amendment cancelling all prior claims and presenting a new set of claims 20-34. Independent claim 20 read as follows:

20. (New) A chip for use with a printing device, comprising:
a plurality of ink vias arranged parallel to one another, each of
the ink via having two longitudinal sides;

a heater array disposed adjacent each longitudinal side of the ink vias;

a region disposed adjacent each heater array, wherein only one region is disposed between two adjacent ink vias; and

a single temperature sensing element disposed within each region, the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region and disposed at a predetermined distance away from adjacent heater arrays.

(*Id.* p. 115.) This claim differs from the previous independent claims at least by reciting ink vias having heater arrays adjacent each side of the vias and by calling for a single temperature sensing element disposed within each region between adjacent ink vias. Independent claim 28 recited a related method for fabricating chips for use with a printing device, including placing heater arrays adjacent each longitudinal side of a plurality of ink vias and positioning a single temperature sensing element within each region alongside each heater array.

28. (New) A method of fabricating chips for use with a printing device, comprising:

arranging a plurality of ink vias parallel to one another, wherein each of the ink via has two longitudinal sides;

placing a heater array adjacent each longitudinal side of the ink via;

defining a region adjacent each heater array such that there is only one region between two ink vias; and

positioning a single temperature sensing element within each region, wherein the temperature sensing element is operable to sense a temperature representative of the heater arrays adjacent to the region and is disposed at a predetermined distance away from adjacent heater arrays.

(Ex. 1003 p. 116.) The applicant argued that admitted prior art Fig. 2 of the '708 patent does not show a temperature sense resistor that senses the temperature of a region between adjacent heater arrays:

Fig. 2 of the prior art shows a cyan heater array 208 and a magenta heater array 210. The Examiner alleged “the region defined by the cyan heater array and the magenta heater array” as the region of the claimed invention. As shown in Fig. 2 the temperature sense resistor 222 is disposed within this “region.” However, as shown in Fig. 2, a Cyan ink via 202 present within the region (i.e., within the region defined by the cyan heater array and the magenta heater array) functions as a “thermal barrier” (thermal insulator) and prevents the temperature sense resistor 222 to sense the temperature of the adjacent heater arrays (i.e., Cyan heater array 208). See paragraph 009. Therefore, the temperature sensed by the temperature sensing element 222 is not representative of the temperature of the heater arrays adjacent to the region as in the claimed invention.

(Ex. 1003 p. 118.) The applicant also stated that if a second heater array were to be added to each color ink via in Fig. 2, then the result would be two temperature sensing elements in each region between ink vias, one for each array. (Ex. 1003 p. 118.)

52. On December 3, 2008, the Examiner issued a non-final office action rejecting claims 20-22, 24-31, and 33-34 as obvious in view of the admitted prior art (Figs. 1 and 2 of the '708 patent) and Askeland. (*Id.* 94-101.) Claims 23 and 32, which each recite an n-type implant donor thermal sensing resistor, were rejected in view of the same references and one additional reference, U.S. Patent Publication No. 2005/0052500 to Edelen *et al.* The Examiner found the applicant's arguments

regarding the prior rejections unpersuasive, reasoning that:

the temperature of a region is contributed by both heater arrays adjacent to the region. One heater array may contribute heat to the region more than that from the other. One of ordinary skill in the art thus would locate the TSR within the region so that the TSR can detect heat from both adjacent heater arrays.

(*Id.* p. 99.) The Examiner also stated that the assertion that an ink via functions as a thermal barrier is only attorney argument, not factual evidence. (*Id.* pp. 99-100.)

53. The applicant filed a response filed on March 2, 2009, amending the independent claims as follows:

20. (Presently Amended) A chip for use with a printing device, comprising:

a plurality of ink vias arranged parallel to one another, each of the ink via having two longitudinal sides;

a heater array disposed adjacent each longitudinal side of the ink vias such that each ink via is associated with two heater arrays disposed adjacent the two longitudinal sides of the ink via;

a region disposed adjacent each heater array, wherein only one region is disposed between two adjacent ink vias and wherein the region disposed between two adjacent ink vias includes two heater arrays each heater array being associated with their respective ink via; and

a single temperature sensing element disposed within each region, the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region and disposed at a predetermined distance away from adjacent heater arrays.

28. (Presently Amended) A method of fabricating chips for use with a printing device, comprising:

arranging a plurality of ink vias parallel to one another, wherein each of the ink via has two longitudinal sides;

placing a heater array adjacent each longitudinal side of the ink via such that each ink via is associated with two heater arrays placed adjacent its longitudinal sides;

defining a region adjacent each heater array such that there is only one region between two ink vias and the region between two adjacent ink vias includes two heater array each heater array being associated with its respective ink via; and

positioning a single temperature sensing element within each region, wherein the temperature sensing element is operable to sense a temperature representative of the heater arrays adjacent to the region and is disposed at a predetermined distance away from adjacent heater arrays.

(*Id.* pp. 85-91.) The applicant argued that the admitted prior art shown in Figs. 1 and 2 of the '708 patent ("APA") did not disclose all of the features of these amended claims.

Amended independent claim 20 is directed to a chip for use with a printing device that requires, inter alia, that the region disposed between two adjacent ink vias includes two heater arrays each heater array being associated with their respective ink vias. APA [admitted prior art] (Figs. 1-2) does disclose a region between two adjacent ink vias (e.g., a magenta ink via 204 and a yellow ink via 206), however the region does not include two heater arrays each being associated with their respective ink vias as required by the claimed invention. Rather, the region between the magenta ink via (204) and the yellow ink via (206) includes only a single yellow heater array (212) associated with the yellow ink via (206).

Further, claim 20 requires, inter alia, a single temperature sensing element disposed within each region, the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region. Applicants assert that the APA (Figs. 1-2) that the Examiner relied on fails to disclose or suggest this element of the claimed invention. Fig. 2 of the admitted prior art shows a cyan heater array (208) and a magenta heater array (210) such that the cyan and the magenta heater array are adjacent to the region in which a temperature sense resistor (222) is disposed. However, as shown in Fig. 2, a cyan ink via (202) is present in between the cyan heater array and the magenta heater array, and as it has been described with respect to Fig. 2 in paragraphs 0007 and 0009 of the specification that the ink via (202)

functions as a “thermal barrier” (thermal insulator) i.e., thermal barrier in between the cyan heater array (208) and the temperature sense resistor (222), therefore Applicants assert that the temperature sense resistor (222) cannot represent the temperature of the cyan heater array (208) that is rather being represented by another thermal sense resistor (220). Thus, the temperature sensed by the temperature sense resistor (222) is not representative of the temperature of both the heater arrays (208 and 210) adjacent to the region as required by the claimed invention.

(*Id.* pp. 89-90.) The secondary reference Askeland did not cure these deficiencies as it does not disclose a region between heater arrays on either side of adjacent ink vias or the claimed relationship between a temperature sensor and such a region. The applicant argued that claim 28 was allowable for similar reasons.

54. In view of the foregoing amendments and arguments, a notice of allowance issued on May 21, 2009. (*Id.* pp. 41-46.)

IX. Claim Construction

55. I have considered the claims and the specification to understand the meaning of the claim language as it would have been understood by a PHOSITA at the time of the invention. I believe the claims would be understandable by a PHOSITA based on the ordinary meaning of the claim language itself.

56. I note that Dr. Pond stated that he considers the term “ink via” to mean “a path to fluidly connect a supply of ink to one or more heaters.” However, “ink via” has a more particular meaning in the thermal ink jet printing industry and the ’708 patent, and refers to an ink passage in or through the substrate of the heater

chip. This is clear from the full context of the claim language. Independent claim 1 recites “a chip for use with a printing device” that comprises “a plurality of ink vias arranged parallel to one another.” (Ex. 1001 col. 8 lns 23-24.) Thus, “via” refers to a structural component of the chip itself, not just any path that connects a supply of ink to one or more heaters. Independent claim 9 recites “a method of fabricating chips for use with a printing device” that includes the step of “arranging a plurality of ink vias parallel to one another.” (*Id.* col. 8 lns 59-61.) In this claim as well the term “via” refers to a structure formed in the chip, not to other structures such as channels or passages formed in an adjacent layer to direct ink to heater arrays.

57. This is also confirmed by the '708 patent specification stating that in conventional heater chips for ink jet printheads “ink is supplied through one or more ink vias **in the chip**” (Ex. 1001 col. 1 lns 23-24.) In the Brief Summary of the Invention section, the specification describes the present invention as a chip that includes first and second heater arrays positioned substantially adjacent first and second vias. (*Id.* col. 2 lns 58-62.) The Detailed Description of Exemplary Embodiments of the Invention section illustrates a heater chip 300 “that includes four ink vias each disposed between two heater arrays.” (*Id.* col. 4 ln 66 – col. 5 ln 2.)

58. There are other channels in separate layers that convey ink to the heaters, but the term “via” is consistently used to describe the portion of the path

through the chip itself that delivers ink from a reservoir to the front surface of the chip where heaters are located. These structures are shown as elongated holes through the chip in the '708 patent, and are distinguishable from surface features formed in a barrier layer on top of the semiconductor substrate or ink feed paths that are not formed in the substrate (e.g. an ink feed edge at the border of the chip). When ink is fed from the far edge of a heater chip, this is consistently referred to in the art as an “edge feed” device and is not considered to have ink vias. An edge feed is also not capable of having a heater array disposed adjacent to each longitudinal side of the ink feed, because the heater chip ends at the ink feed edge. Dr. Pond agreed in his deposition that the term “via” indicates that ink is fed from some depth below the surface of a heater chip in the type of device shown in the '708 patent. (Ex. 2004 10:8 – 11:19.)

59. I also note that Dr. Pond stated that “adjacent” should be understood to mean “next to and can include” within the '708 patent. Dr. Pond states that claims 1 and 9 recite a region that is both disposed “adjacent each heater array” and also “includes two heater arrays,” but ignores that when read as a whole the meaning of the claims is clear without giving the term “adjacent” a special meaning. Claim 1 recites a plurality of parallel ink vias with heater arrays on each longitudinal side of the ink vias. The claim then recites “a region disposed adjacent each heater array” and states that a “region is disposed between two adjacent ink vias.” A PHOSITA

would understand that this refers to the layouts shown in Figures 4 and 5, in which there is a region disposed adjacent pair of heater arrays (such as 432, 434 and 436 in Fig. 4) which is part of a broader region disposed between two adjacent ink vias. Per the claim language, it is the broader “region disposed between two adjacent ink vias [that] includes two heater arrays.” Claim 9 describes essentially the same structure in the context of a method of fabricating a printing chip.

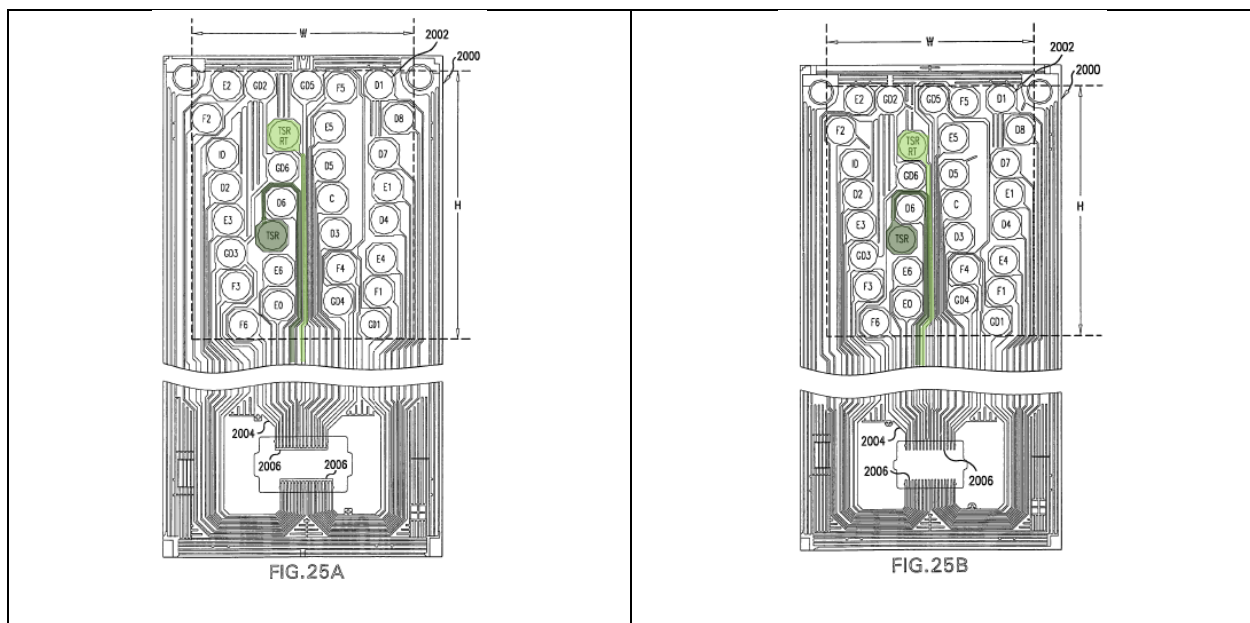
X. Responses To Dr. Pond’s Characterizations Of The Asserted Prior Art References

60. Dr. Pond’s declaration cites several passages from prior art references that he asserts are relevant to the invention of the ’708 patent. I find many of his descriptions of the references to be incomplete or inaccurate, overlooking important details of those references. The summary below explains how a PHOSITA would understand the cited prior art references when viewed in their entirety, without the benefit of hindsight in view of the invention of the ’708 patent. I also explain my points of disagreement with Dr. Pond in the claim-by-claim analysis that follows later.

A. Summary Of U.S. Patent No. 7,384,113 to Benjamin *et al.* (Ex. 1004)

61. U.S. Patent No. 7,384,113 to Benjamin *et al.* (“Benjamin”) discloses a “printhead die 40 that ejects drops of ink through a plurality of orifices or nozzles 34 toward a print medium 36.” (Ex. 1004 col. 3 lns 32-36.) In reference to Figs. 25A and 25B, which illustrate contact areas of a flex circuit that couples external circuitry

to a printhead die, Benjamin states that “[t]emperature sense resistor contact area TSR allows a printer coupled to an ink jet cartridge to determine a temperature of the printhead die, based upon a measurement of the resistor” and that “[a] temperature sense resistor return contact area TSR-RT provides a return path for signals provided at temperature sense resistor contact area TSR.” (Ex. 1004 col. 3 lns 1-3 and col. 79 lns 29-35 and 60-67.) There is no indication in Benjamin as to where this temperature sense resistor is positioned on the printhead die itself. It is clear, however, that the die includes only a single temperature sense resistor connected to a single contact area (TSR) [dark green] and a single return contact area (TSR-RT) [light green] of the flex circuit as shown below in both of the embodiments shown in Figs. 25A and 25B.



Benjamin teaches that the temperature sense resistor determines “a temperature” of the “printhead die,” not temperatures of individual regions of the die. (*Id.* col. 79 lns 60-63.)

62. Dr. Pond admits that Benjamin teaches nothing about where the temperature sensor is located on the semiconductor chip. (Ex. 1002 ¶179). Dr. Pond also admits that Benjamin does not indicate that the temperature sensor detects a specific region of the die rather than a temperature of the die as a whole. (Ex. 2004 31:19-23.)

B. Summary Of U.S. Patent No. 6,612,673 to Giere *et al.* (Ex. 1005)

63. U.S. Patent No. 6,612,673 to Giere *et al.* (“Giere ’673”) discloses a system including a controller that receives print data to predict thermal conditions of a subset of ink ejection chambers for selectively operating the corresponding heating elements of the subset. (Ex. 1005 Abstract.)

64. The temperature sensing system of Giere ’673 is intended to measure and store temperatures to a temperature logic system 606 along with past and future printing data from the logic mapping system 604 that is indicative of which ink ejection chambers 418 will be fired, and when each will be fired. (*Id.* col. 6 lns 35-46.) The temperature logic system uses these temperature and printing inputs along with other information to generate printing parameters in a closed loop system that approximates a temperature profile to improve ink drop quality. (*Id.* col. 6 lns 47-

60.)

65. Unlike Benjamin, the printhead die of Giere '673 does not include any ink vias, with ink instead flowing around the edges of the substrate and into vaporization chambers. (*Id.* col. 5 lns 42-45.) As I discussed above, in Giere '673 ink would be supplied from the spaces shaded blue below to the edge of Giere '673's substrate 410 [yellow]:

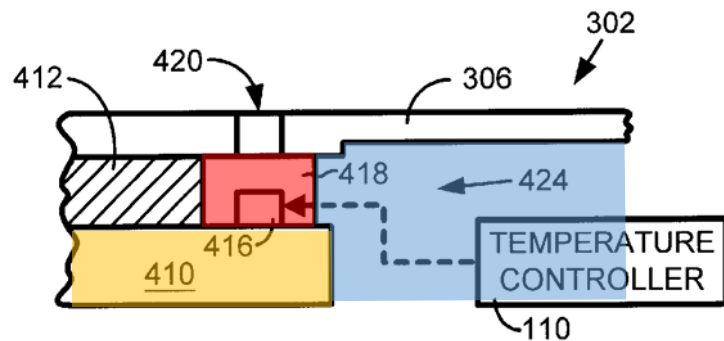


FIG. 4

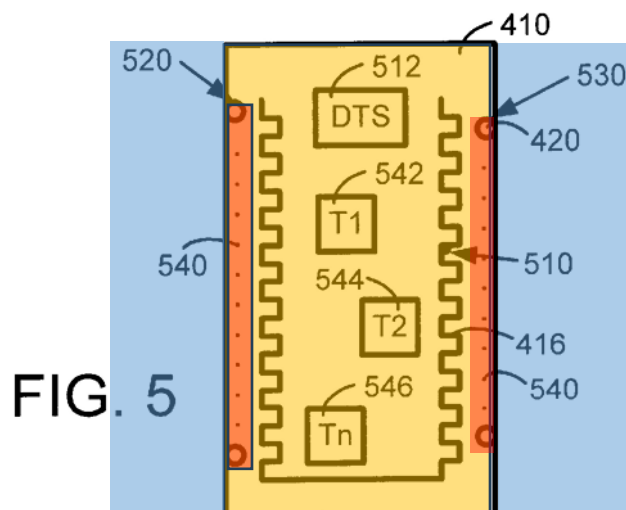


FIG. 5

(Ex. 1005 Figs. 4-5.) The TSR 510 is positioned between arrays of heaters only because those heaters are located at the edge of the chip, and therefore temperature sensing devices intended to sense the temperature of the heater chip as a whole must be located somewhere between the heater arrays [red] located at the edge of the chip underneath nozzles 540. Therefore, Giere '673 teaches nothing about where to place temperature sensors in a printhead having a plurality of ink vias with heaters arrays on both sides of the vias. Nor does Giere '673 provide any guidance suggesting that placement of a single temperature sensor between two heater arrays could permit accurately sensing a temperature representative of both adjacent heater arrays.

66. As shown in Fig. 6c, Giere's system involves maintaining a firing history of a plurality of subsets of ink ejection elements, sensing an average mean temperature of the entire printhead, processing the firing history and the average temperature to determine estimated temperatures of certain ink ejection elements of the subset, and setting conditions for the certain ink ejection elements of the subset so that the corresponding heating elements operate at an optimal temperature. (*Id.* Fig. 6c.) A fundamental aspect of the disclosed temperature controller in Giere '673 is that it is coupled to multiple temperature sensors in order to determine a mean or average temperature of the printhead substrate as well as local temperature profiles near designated ink ejection elements. (*Id.* col. 2 lns 57-62.) The system uses inputs from these multiple temperature sensors to predict thermal conditions of a subset of

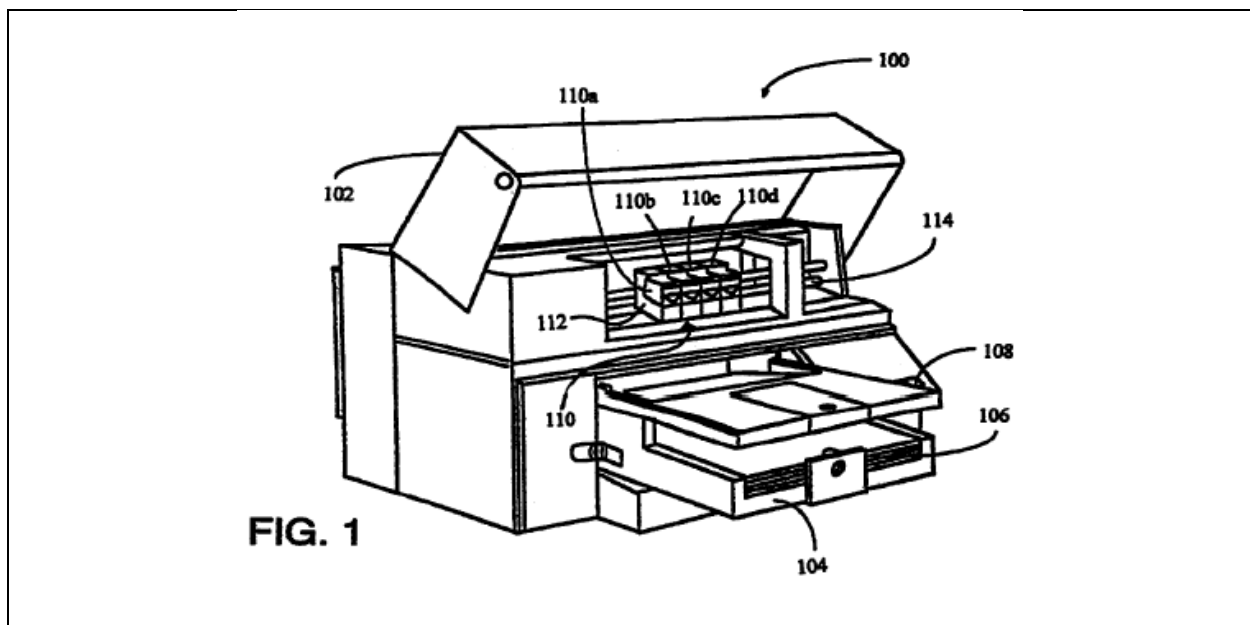
the ink ejection elements, and to establish operating conditions so that the corresponding heating elements operate at an optimal temperature. (*Id.* col. 6 lns 5-8.) In this system, a firing history of a plurality of subsets of ink ejection elements may also be maintained, so that when an average temperature of the printhead assembly is sensed, the firing history and the average temperature are processed to determine estimated temperatures of certain ones of the subset in order to set optimal temperature conditions for specific ink ejection elements. (*Id.* col. 6 lns 10-18.)

67. Giere '673 does not suggest separately monitoring the temperature of regions separated by ink vias in a multi-via heater chip using a single TSR in each region. Like the die of Benjamin discussed above, the printhead die of Giere '673 contains a single temperature sense resistor 510 for measuring an average temperature of the entire substrate. (*Id.* col. 4 lns 55-56.) However, the control system of Giere '673 uses sense resistor 510 in conjunction with additional sensors in the form of a digital temperature sensor (DTS) 512 and multiple temperature recorders 542, 544, and 546. (*Id.* at Fig. 5 and col. 5 lns 28-31, col. 6 lns 35-40.) The disclosed multi-sensor system is for detecting and controlling temperature within the same region between heater arrays, and does not relate to monitoring temperatures in different regions separated by ink vias. Also, the presence of additional temperature sensor 512 and temperature recorders 542, 544, and 546 to detect localized temperatures suggest that the temperature in the region is not uniform such

that the temperature measured by the u-shaped TSR 510 is not representative of the adjacent heater arrays.

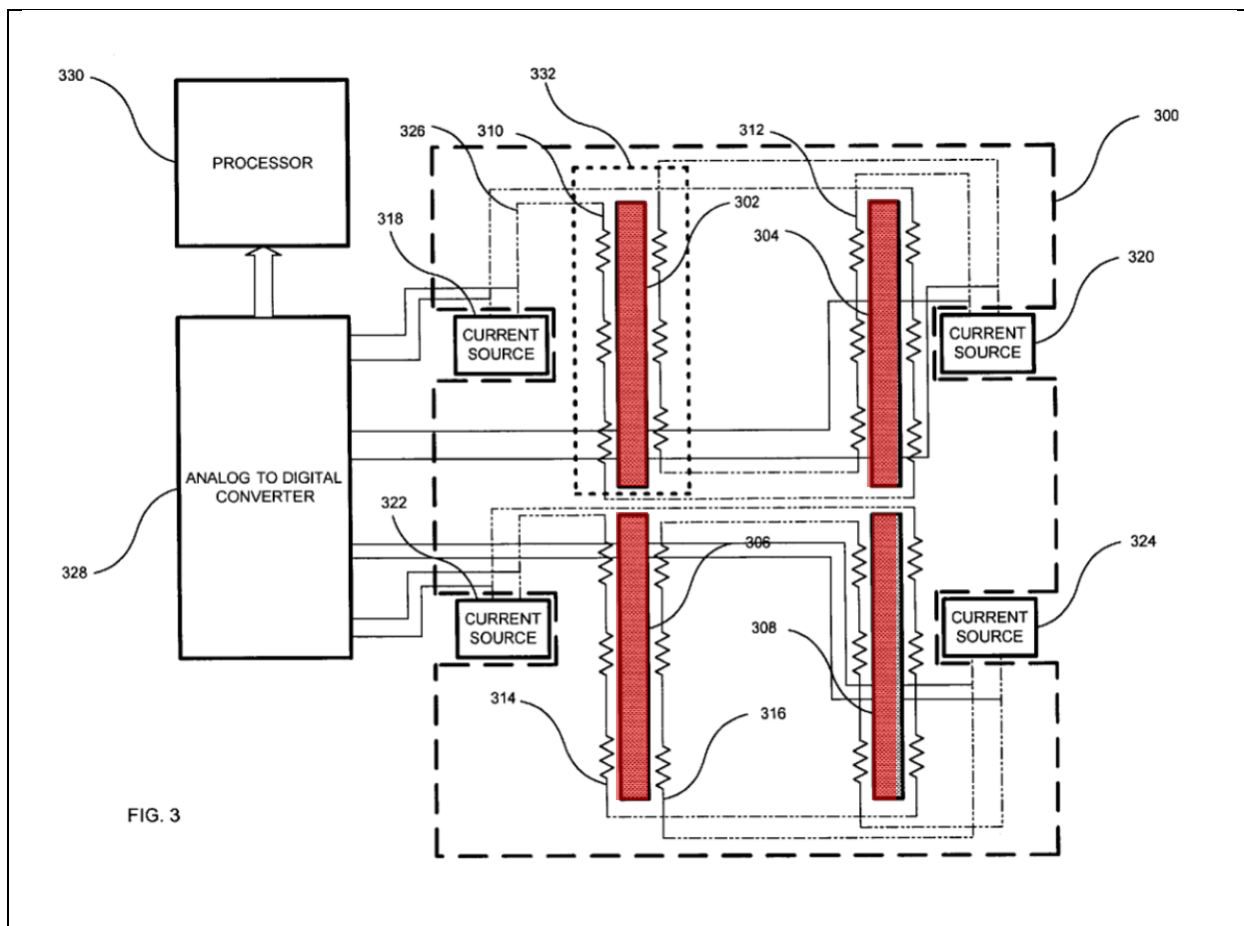
C. Summary Of U.S. Patent No. 6,565,178 to Giere *et al.* (Ex. 1007)

68. U.S. Patent No. 6,565,178 to Giere et al. (“Giere ’178”) discloses a printer with multiple cartridges 110a (cyan cartridge), 110b (magenta cartridge), 110c (yellow cartridge), and 110d (black cartridge), as shown below:



(Ex. 1007 Fig. 1 and col. 7 lns 1-17.) Each cartridge contains its own printhead that implements parts of the temperature measurement system described by Giere ’178 for a single color of ink. (*Id.* col. 7 lns 13-17.)

69. Fig. 3 of Giere ’178 below is a “high level schematic diagram” of a temperature measurement system for one of the above printheads. (*Id.* col. 8 lns 41-43.)



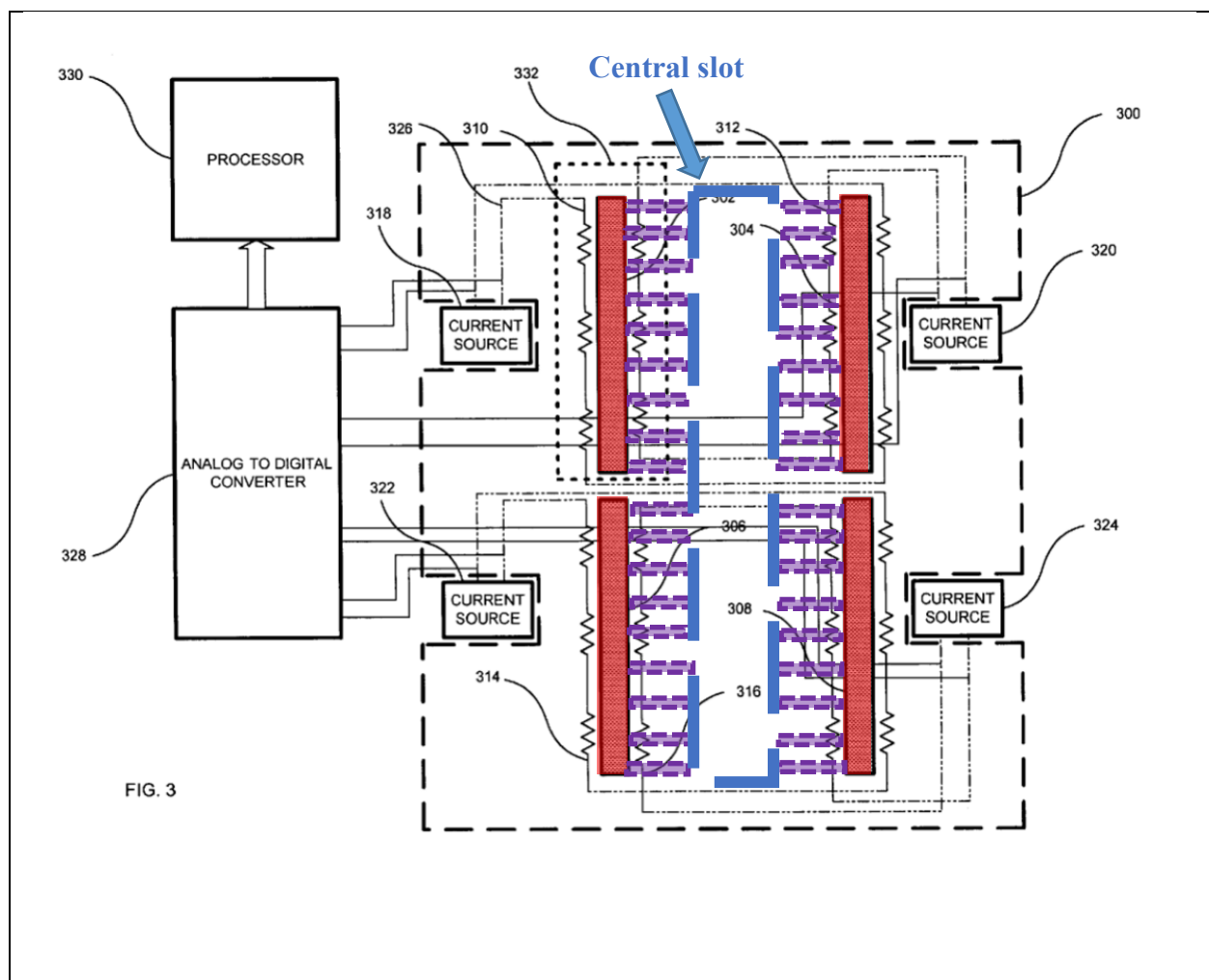
Giere '178 states that “although not shown in Fig. 3 for ease of illustration, substrate 300 includes the structures of a typical printhead such as, ink feed slots, ink ejection chambers, firing resistors, etc.” Particularly, “regions 302, 304, 306, and 308 [red above] each include an array of nozzles and associated firing resistors for ejecting ink.” (*Id.* col. 8, lns 47-49.) An ink via is not shown in the substrate of Fig. 3, however the specification states that ink is fed to the ejection chambers (*i.e.* located in regions 302/304/306/308 of Fig. 3 as indicated above) “either through an elongated hole formed in the center of the bottom of the substrate, ‘center feed,’ or around the outer edges of the substrate, ‘edge feed.’” (*Id.* col. 3 lns 34-50.) Further,

“[i]n center feed the ink then flows through a central slot in the substrate into a central manifold area formed in a barrier layer between the substrate and a nozzle member, then into a plurality of ink channels, and finally into the various ink ejection chambers.” (*Id.* col. 3 lns 40-45.) At the time that the ’708 patent was filed, these were the two common options for feeding ink to the type of devices shown in the ’708 patent and Giere ’178. Giere does not indicate any other potential placement of ink feed regions from a reservoir to the heater chip. Giere ’178 does not at any point describe ink vias or ejection actuators on opposite sides of an ink via within each of the rectangular regions 302, 304, 306, and 308.

70. I note that Fig. 3 of Giere ’178 is specifically identified as a “high level schematic diagram” (*id.* col. 8 lns 41-43), and it appears intended to convey information regarding electrical connections of TSRs positioned adjacent both sides of groups of heaters.

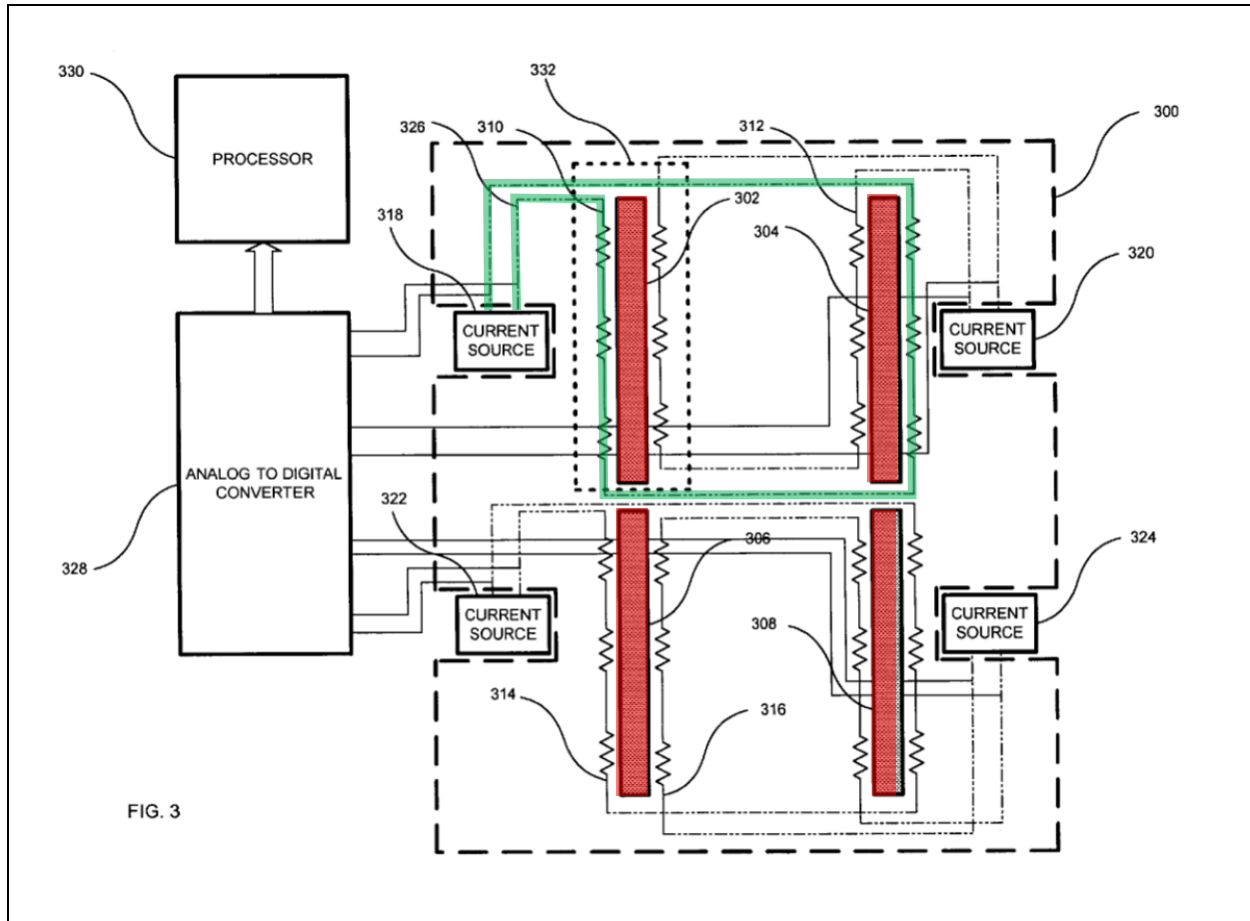
71. Fig. 3 would not be seen by a PHOSITA as conveying details regarding the ink supply structures that deviate from the two options described in the written description, summarized above. I will make use of Fig. 3 below to illustrate the information provided by Giere ’178’s written description relating to the positioning of ink vias or ink feed edges. I have added a blue rectangle to illustrate a “central slot” in substrate 300 as described by Giere ’178 between the column of nozzles and ink ejection actuators on the left (regions 302 and 306) and the column of nozzles

and ink ejection actuators on the right (regions 304 and 308). Channels that allow ink to flow from this slot [blue] to chambers associated with heaters of the heater arrays [red] have been added in purple below. While Fig. 3 is a view from above, Giere '178 describes the channels as extending from a central manifold area formed in a separate barrier layer between the substrate and a nozzle plate to supply ink to the various ink ejection chambers. (*Id.* col. 3 lns 40-45.)

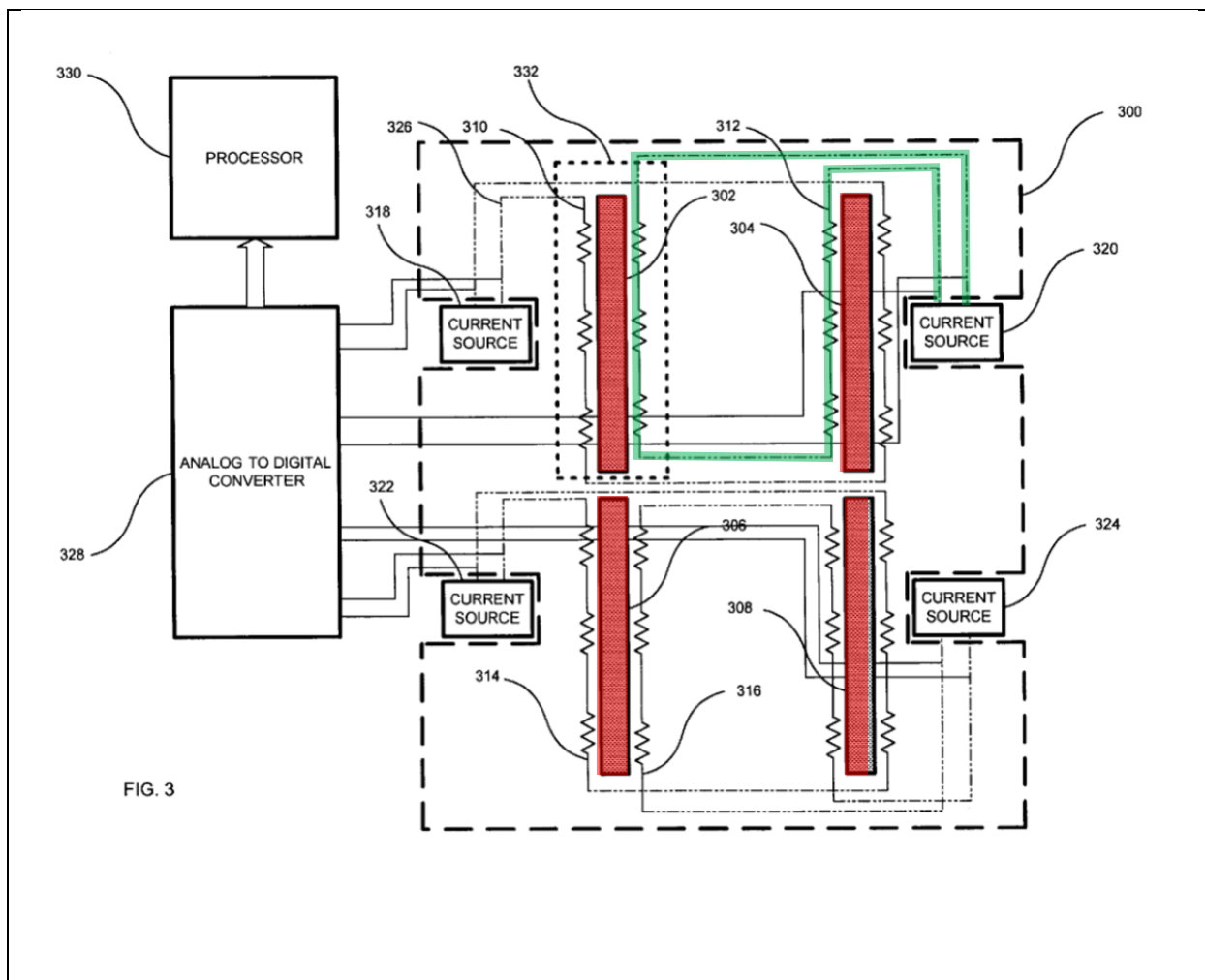


72. Giere '178 discloses resistive elements 310, 312, 314, and 316

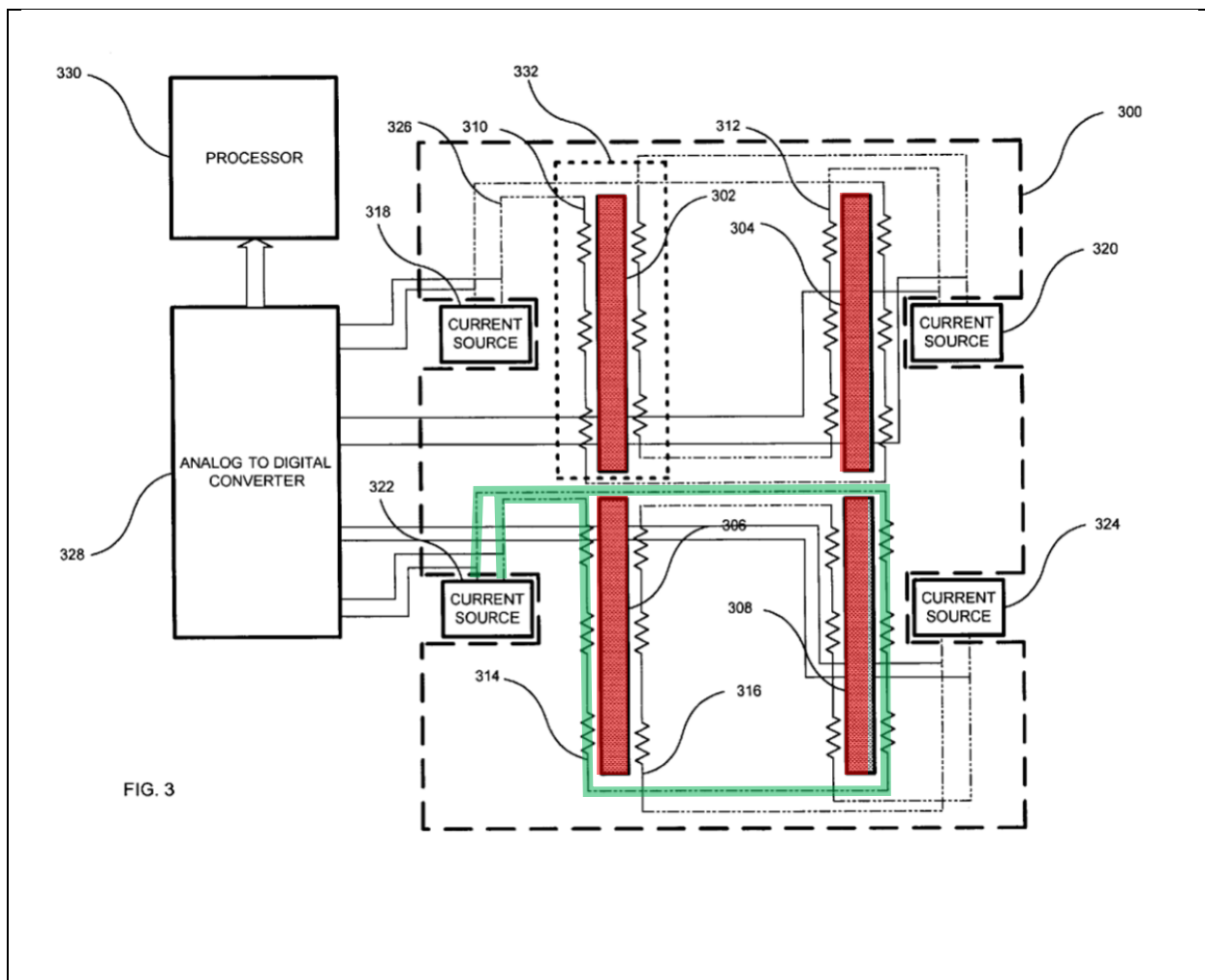
positioned along electrical traces of temperature sensor loops. Giere '178 includes four such temperature sensors. First, temperature sensor 310 [green below] extends along outside edges of the upper arrays of heating elements in regions 302/304:



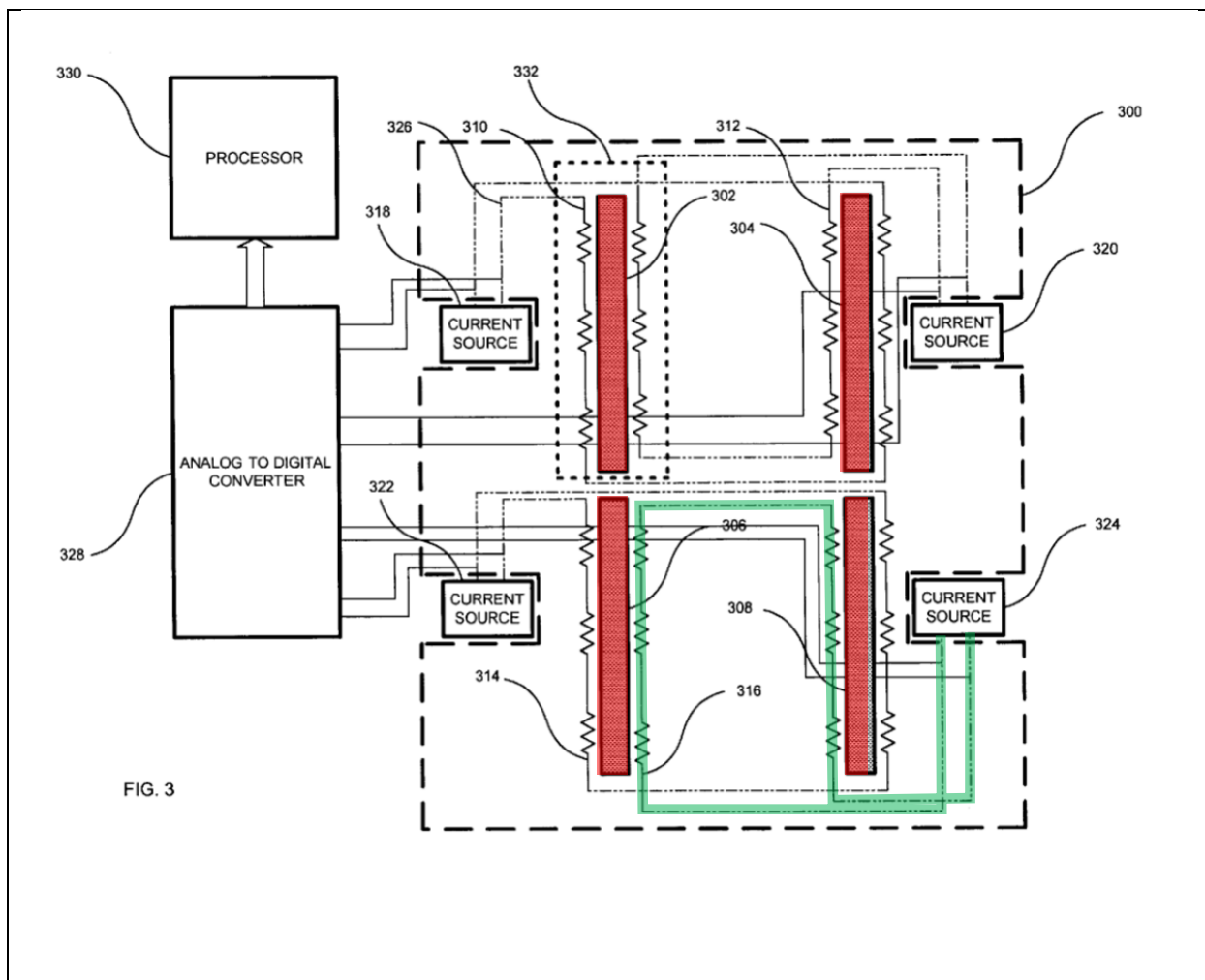
Second, temperature sensor 312 [green below] extends along inside edges of the upper arrays of heating elements in regions 302/304:



Third, temperature sensor 314 [green below] extends along outside edges of the lower arrays of heating elements in regions 306/308:



Finally, temperature sensor 316 [green below] extends along inside edges of the lower arrays of heating elements in regions 306/308:



73. Giere '178 does not disclose a printhead with multiple adjacent ink vias having heater arrays along the two longitudinal sides of each via. As such, Giere '178 does not teach any solution to the problems associated with measuring temperatures representative of the heater arrays in such a printhead design. Giere '178's design is directed to separately sensing temperature along each side of multiple heater arrays that are supplied with ink by channels extending from a single central ink via or an edge feed ink supply mechanism. Giere '178's temperature sensing circuitry is adaptable to either of those two specific ink supply approaches.

One pair of TSRs would detect temperature at a point on a side of the upper or lower heater array opposite the ink feed (312 and 316 in the case of edge feed or 310 and 314 in the case of a center feed), while the other two TSRs would detect the temperature of the side of the heater array closest to the ink feed.

74. I disagree with Dr. Pond's assertion that the rectangular boxes 302, 304, 306, and 308 in Giere '178 would have been understood by a PHOSITA to include not only heaters and nozzles, but also ink vias. (See, e.g., Ex. 1002 ¶ 272.) There is nothing in Giere '178 to support his position. Giere '178 states that "regions 302, 304, 306, and 308 each include an array of nozzles and associated firing resistors for ejecting ink" with no mention of ink vias. (Ex.1007 at 8:47-49.) This is consistent with the rest of the disclosure describing either a center feed design (with ink flowing through a central slot in the substrate and then through channels extending from a central manifold area formed in an adjacent barrier layer), or an edge feed design (with ink flowing through channels extending from the edge). (*Id.* col. 3 lns 34-50.) Neither of those ink supply approaches, which are the only approaches described in Giere '178, would include a separate via for each nozzle and firing resistor region.

75. At his deposition, Dr. Pond asserted that the phrase "for ejecting ink" indicates that all of the structures required for ejecting ink would be located within the rectangular regions shown as 302, 304, 306, and 308. (Ex. 2004 44:16 - 46:23.) I strongly disagree. A PHOSITA would know that there are many structures required

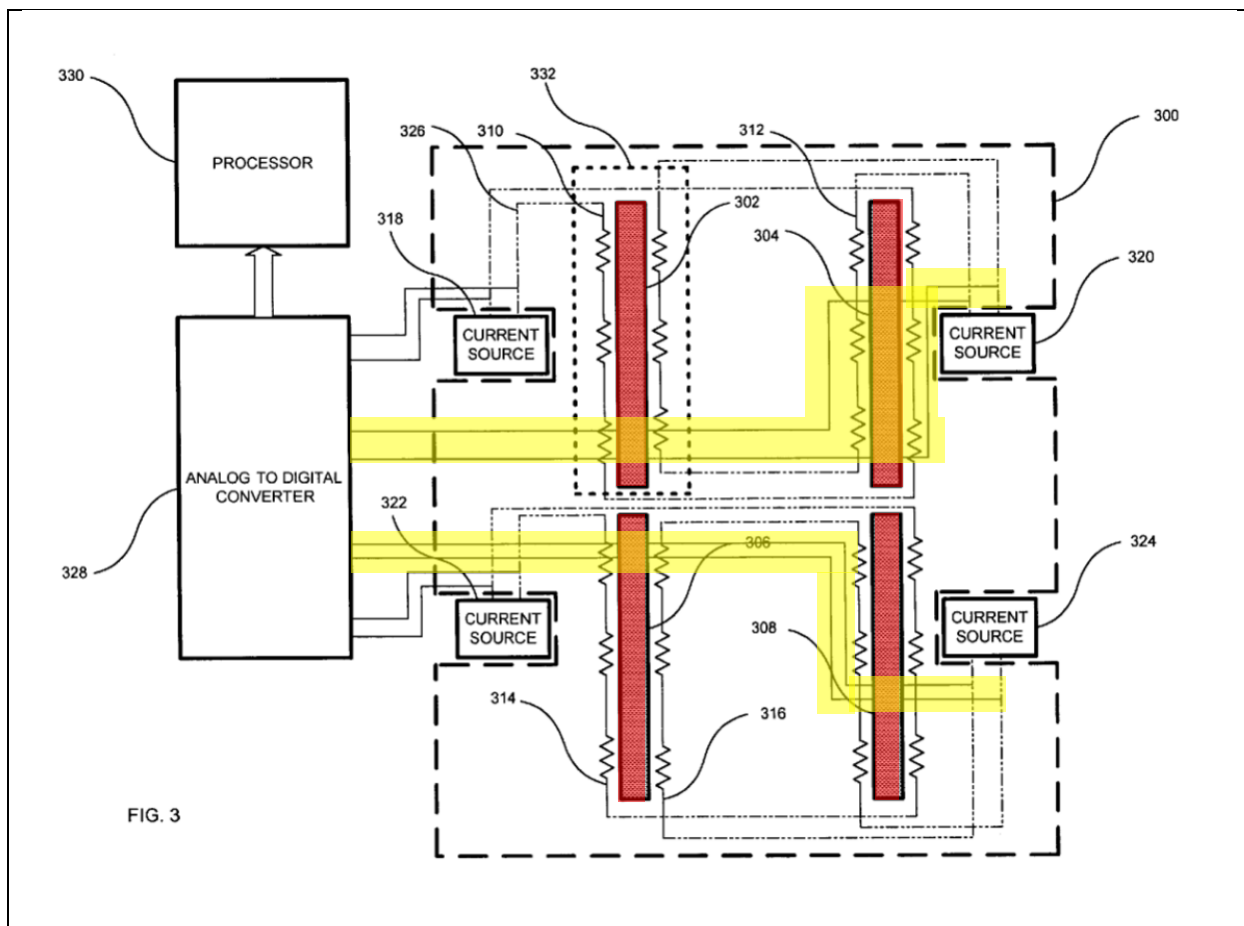
for ejecting ink, including power sources, ground lines, and drive transistors, none of which would reasonably be seen as indicated by a simple rectangular box. Furthermore, contrary to Dr. Pond's characterization, an ink via is not a structure "for ejecting ink"; it is a structure for allowing ink to flow from an ink reservoir through the substrate and into an ink distribution system. As discussed above, the only ink via contemplated by Giere '178 is a central via that supplies ink to a central manifold from where it is directed by channels to the ink ejection chambers.

76. Dr. Pond also offered opinions at his deposition that the relative dimensions of the rectangular boxes relative to the substrate and the location of current sources along the edge of the chip are not consistent with either a center feed or edge feed design. However, the dimensions would not cause one of ordinary skill to disregard Giere '178's teachings regarding ink being supplied through either a central hole or from the edges of the substrate.

77. Dr. Pond also concluded that a central ink via would not be possible in Fig. 3 because portions of the TSRs are shown as crossing the central area of the chip. (Ex. 2004 131:4 – 132:2.) However, Giere '178 describes the center feed design as including an "elongated hole formed in the center of the bottom of the substrate." (Ex. 1007 col. 3 lns 37-39.) In the chip electrical schematic depicted in Fig. 3, there are two central areas between the regions 302, 304, 306, 308 where such an elongated hole can be located without interfering with the TSR traces identified by

Dr. Pond. Giere '178 describes that the ink then flows “through a central slot in the substrate into a central manifold area formed in a barrier layer between the substrate and the nozzle member, then into a plurality of ink channels, and finally into the various ink ejection chambers.” (*Id.* col 3 lns 40-45.) Such a central manifold in an adjacent barrier layer can function to distribute ink over the region of the substrate containing the TSR traces identified by Dr. Pond. I therefore disagree that Fig. 3 is in any way inconsistent with the center feed design described in Giere '178.

78. Dr. Pond also failed to realize that his interpretation of rectangular regions 302, 304, 306, 308 as including their own individual ink vias would encounter the same issue if the vias are assumed to extend the length of those rectangular regions. In particular, connections from the analog to digital converter 328 are shown as traversing those regions as highlighted in yellow below:



At his deposition, Dr. Pond also attempted to justify his mistaken reading of Giere '178 by indicating that the rectangular regions would have called to mind earlier printhead designs not cited in his declaration or the Petition. However, one of ordinary skill in the art would not have consulted other unrelated documents when Giere '178 clearly describes the two options for ink feed positions (center feed and edge feed) applicable to the disclosed printhead chip, and provides no indication that the substrate illustrated in Fig. 3 has an entirely different structure involving separate ink vias in each of the ejector array regions. In fact, Fig. 1 of Giere '178 and the corresponding text illustrates providing a separate cartridge for each color of ink.

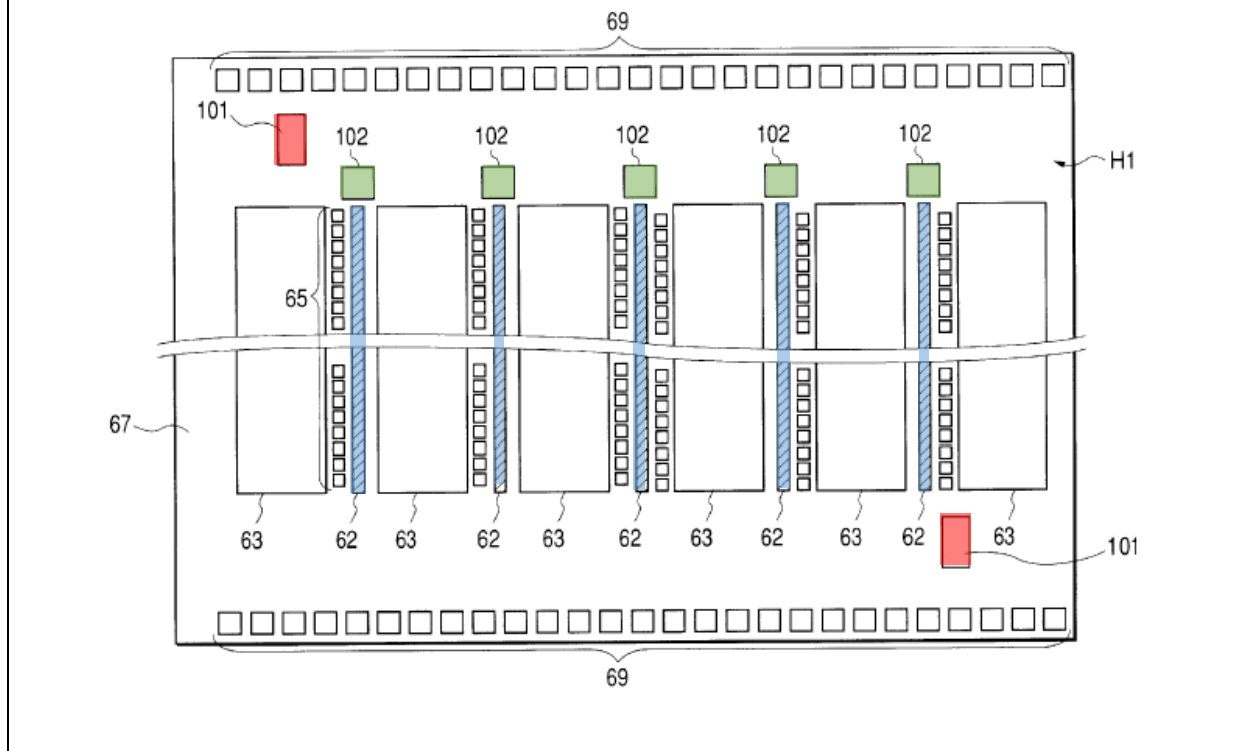
(Ex. 1007 Fig. 1 and col. 7 lns 3-12.) This is consistent with designs represented by Fig. 3 where each semiconductor chip contains only two columns of heaters (which may be separated into upper and lower halves or other groupings) for ejecting one color of ink supplied by either a central feed system or an edge feed system.

D. Summary Of U.S. Patent No. 6,527,367 to Yabe (Ex. 1008)

79. In Yabe, temperature detectors are placed to detect the temperature of the substrate as a whole, and one or more “sub-heater” devices other than ink ejection actuators are provided to heat the substrate. (Ex. 1008 col. 14 lns 27-54.) Specifically, there are “temperature detecting means for detecting the temperature of the heater board, and the heat generating resistive elements (sub-heaters) serving as means for heating the base plate in order to control temperature to make the temperature distribution of the heater board uniform in accordance with the detection result of the temperature detecting means.” (*Id.* col. 14 lns 29-37.)

80. Fig. 12, Yabe discloses a substrate with multiple temperature detecting means 102 [green below], but “each of the temperature detecting means 102 is arranged only on one side in the vicinity of each end portion of the ink supply ports 105 [blue].” (Ex. 1008 col.15 lns 51-61.)

FIG. 12



This arrangement is provided in order to “detect the temperature of the heater board H1.” (*Id.* col. 15 lns 61-64.) There is no suggestion in Yabe to position the temperature sensors between arrays of heaters or between ink supply ports [ink vias], such as in the areas occupied by driving circuits 63. Two sub-heaters 101 [red] are provided in order to keep temperature as uniform as possible. (*Id.* col. 15 lns 36-44.)

81. Alternatively, in Fig. 14 only one temperature detector 102 is arranged in the vicinity of one end of a central ink supply port because the size of the “base plate” is smaller than in Fig. 12. (*Id.* col. 16 lns 35-44.)

FIG. 14

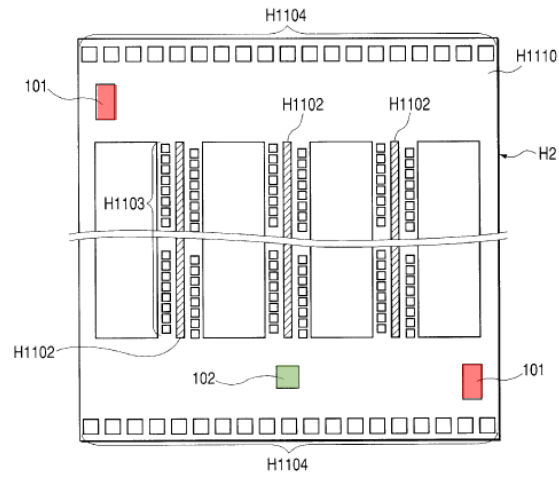
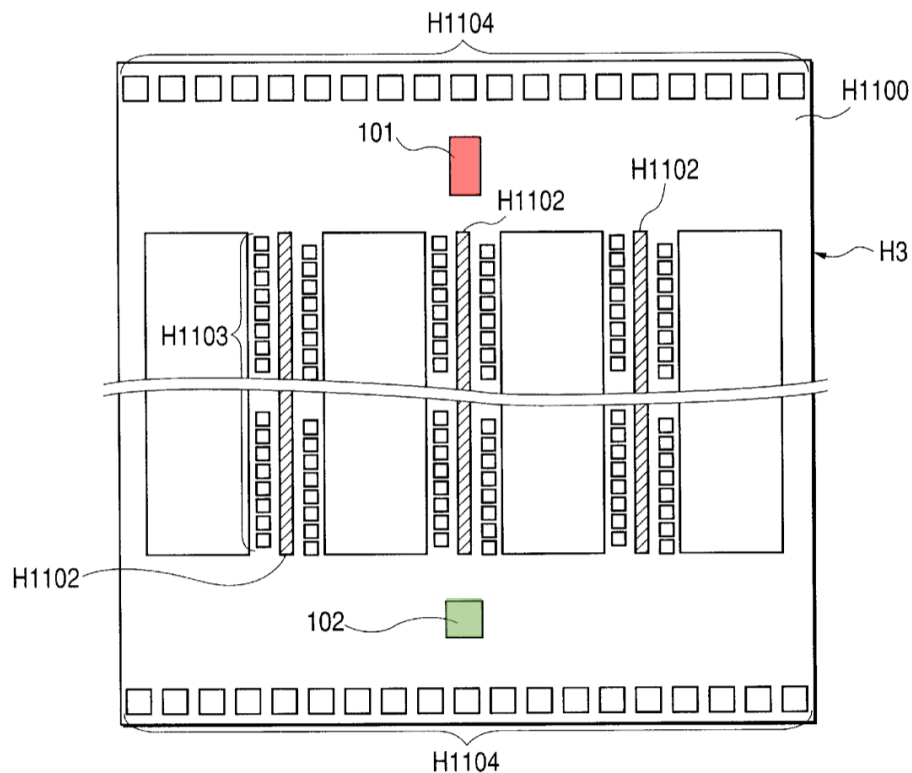


Fig. 15 alternatively shows only a single temperature detector 102 [green] and a single sub-heater [red]. (*Id.* Fig. 15 and col. 17 lns 33-36.)

FIG. 15



None of the disclosed embodiments suggest placing a temperature sensor in the region between adjacent ink vias and associated heater arrays to measure a temperature representative of the adjacent heater arrays.

XI. Claims 1-3, 5-12, And 14-15 Are Not Obvious In View Of A Combination Of Benjamin And Giere '673 (Ground 1)

82. I disagree with Dr. Pond's analysis and conclusion that claims 1-3, 5-12, and 14-15 would have been obvious in view of Benjamin and Giere '673. Neither Benjamin nor Giere '673 are directed to the challenges addressed by the '708 patent associated with improving temperature monitoring in multi-color printhead chips

containing multiple parallel ink vias with heater arrays on both sides of the vias. Benjamin discloses a single TSR at an unspecified location to measure an average temperature of a heater chip having multiple ink vias, not the region-by-region monitoring approach of the '708 patent. Giere '673 does not relate to a printhead chip having any via, let alone a chip having multiple parallel vias and heater arrays on each side of the vias. Neither reference would have led a PHOSITA to place a single TSR in each of multiple regions between parallel ink vias to separately detect a temperature in each region that is representative of the adjacent heater arrays. Dr. Pond's analysis seems like nothing more than an attempt to arrive at the invention of the '708 patent in hindsight.

83. Dr. Pond admits that Benjamin discloses only a single TSR for the substrate and does not disclose anything regarding the location of the TSR on the printhead die. (Ex. 1002 ¶¶248-252) There is no question that despite disclosing multiple ink vias on a single heater chip, Benjamin fails to disclose a fundamental aspect of the independent claim 1: “a single temperature sensing element disposed within each region [disposed adjacent each heater array], the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region . . .” For the same reason, Benjamin fails to disclose the corresponding limitation of independent claim 9.

84. I disagree with Dr. Pond's reasoning and conclusion that a PHOSITA

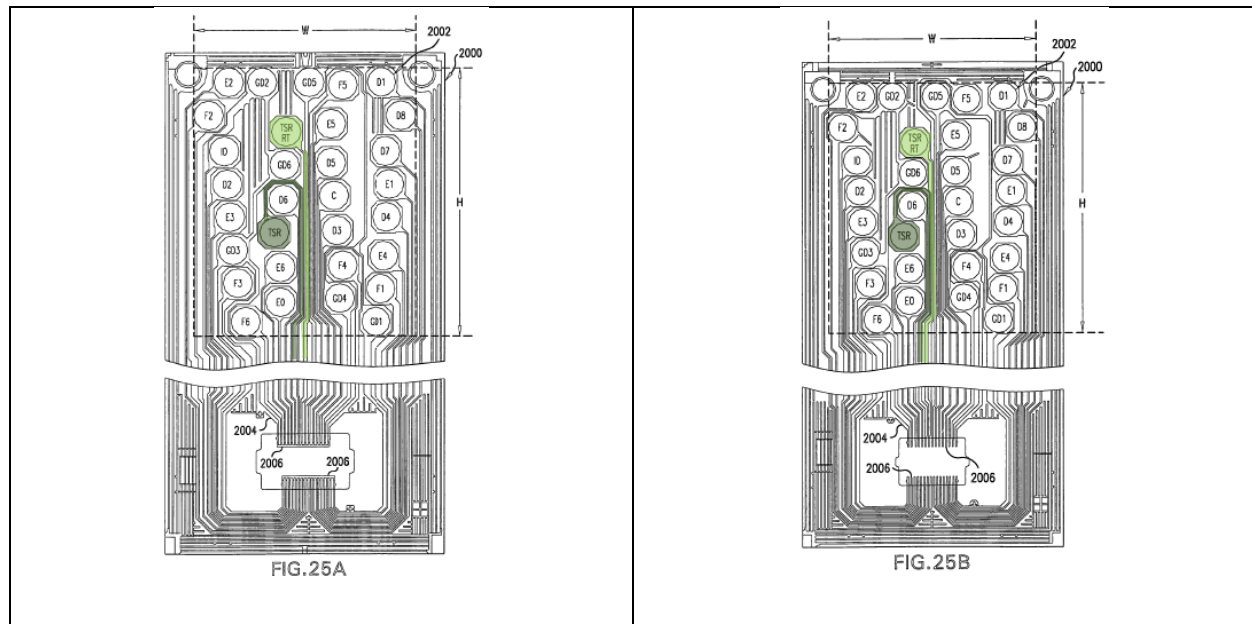
would have been led by the teachings of Giere '673 to place a single TSR in each of multiple regions separated by ink vias of Benjamin. Giere '673 does not relate to printhead chips having multiple ink vias or to monitoring temperature in such a chip. As I discussed above, the temperature monitoring and control system disclosed in Giere '673 includes a temperature sense resistor 510 to measure an average temperature, as well as digital temperature sensor 512 and multiple temperature recorders 542, 544 and 546 to measure localized temperatures within the region between adjacent heater arrays. (Ex. 1005 at Fig. 5 and col. 4 lns 55-56, col. 5 lns 28-31, col. 6 lns 35-40.) Giere '673 relates exclusively to a system that requires inputs from these multiple temperatures sensors, together with firing history data, to monitor and predict substrate thermal conditions of particular ink ejection elements and to set operating conditions so as to maintain optimal temperatures. (*Id.* col. 6 lns 5-18.) That approach does not at all suggest detecting or controlling temperature of distinct regions separated by ink vias using a single temperature sensor in each region as in the '708 patent.

85. A PHOSITA would have had no reason to modify Benjamin to include a single temperature sensor in each of the multiple regions between Benjamin's ink vias in view of Giere '673. According to Dr. Pond, these references would have led those skilled in the art to (i) dispose a single TSR within a region of Benjamin's printhead formed between two adjacent heater arrays and then (ii) position the TSR

equidistant from both heater arrays within the region but no less than approximately 680 μm inboard from the center of the heater arrays to ensure that the temperature value provided by the TSR reflects the mean temperature of the region. But the relevant teachings of Giere '673 are limited to its fundamentally different temperature monitoring circuitry employed on a chip with no vias, would not have been helpful to a PHOSITA in determining the placement of a TSR for determining the temperature of a multi-via chip as in Benjamin, and would not have suggested using only one temperature sensor to measure the temperature of each region.

86. Dr. Pond acknowledges that the end goal of the proposed combination of Benjamin and Giere '673 would be to detect a temperature representative of the printhead as a whole. (Ex. 1002 ¶¶161-162) The combined teachings of those references would not have led a PHOSITA to arrange one TSR within each region separated by ink vias and add additional circuitry to average the results detected from this collection of TSRs as suggested by Dr. Pond. (Ex. 1002 ¶¶161-162.) Benjamin discloses that only a single temperature sensor is on the printhead die and that the temperature sensor measures the temperature of the entire printhead: “[t]emperature sense resistor contact area TSR allows a printer coupled to an ink jet cartridge to determine *a temperature of the printhead die*, based upon a measurement of *the resistor*” (Ex. 1004 col. 79 lns 60-67 (emphases added).) As discussed above, the Benjamin device can accommodate only one temperature sense resistor because

there is only a single contact area (TSR) [dark green] on the flex circuit shown in Figs. 25A and 25B below, and a single return contact area (TSR-RT) [light green]. (*Id.* Figs. 25A-B and col. 79 lns 29-34 and 63-65.)



A PHOSITA would not have been motivated to employ separate regional TSRs for the purpose of monitoring a temperature representative of the entire printhead because it would unnecessarily add cost and take up space on the printhead die and/or the flex circuit shown above. In designing printheads, the space on the printhead chip and attached flex circuit were very valuable, and a PHOSITA would have been motivated to keep the size of both the chip and flex circuit to a minimum not only to reduce the size of the printhead and related ink cartridge, but also to reduce manufacturing cost and complexity.

87. Like Benjamin, Giere '673 discloses using only one TSR to detect a

temperature representative of the entire heater chip, in particular the u-shaped TSR 510 spanning a substantial portion of the chip, as shown in Fig. 5 of that reference. The combined teachings would have suggested to a PHOSITA interested in monitoring overall printhead temperature to employ a single TSR on the heater chip rather than multiple TSRs each located in a different region separated by ink vias. If a PHOSITA were somehow driven to sample the temperature in areas between ink vias, the solution consistent with the single TSR contact pad of Benjamin's flex circuit would be to employ one continuous TSR that winds between the vias, providing a single temperature value and requiring only a single temperature input and output. This would also avoid any need for having a device located on the substrate capable of averaging multiple TSR values.

88. Because Benjamin and Giere '673 disclose only a single TSR that provides a single temperature value for the printhead as a whole, the approach suggested by Dr. Pond would have been counter-intuitive to a PHOSITA at the time of the '708 patent. None of the prior art cited by Dr. Pond would have suggested to a PHOSITA that there was any value in detecting temperature on a region-by-region basis where regions are defined by areas separated by ink vias.

XII. Claims 4 And 13 Would Not Have Been Obvious In View Of A Combination Of Benjamin, Giere '673, And Parish (Ground 2)

89. I also disagree with Dr. Pond's conclusion that dependent claims 4 and 13 would have been obvious to a PHOSITA at the time the '708 patent was filed.

Parish would not have provided any further reason to include a TSR in each region adjacent heater arrays arranged along multiple vias. Neither the Petitioner nor Dr. Pond argue as much, and only cite Parish for a particular type of TSR. Therefore, claims 4 and 13 would not have been obvious for at least the reasons discussed above regarding Ground 1.

XIII. Claims 1-3, 5-12, And 14-15 Would Not Have Been Obvious In View Of Giere '178 And Knowledge Of A PHOSITA (Ground 3)

90. As discussed above, Giere '178 indicates that heaters and nozzles are arranged in the rectangular regions shown in its Fig. 3 without any mention of ink vias in those regions. The only portion of Giere '178 describing the ink feed to ejection chambers states:

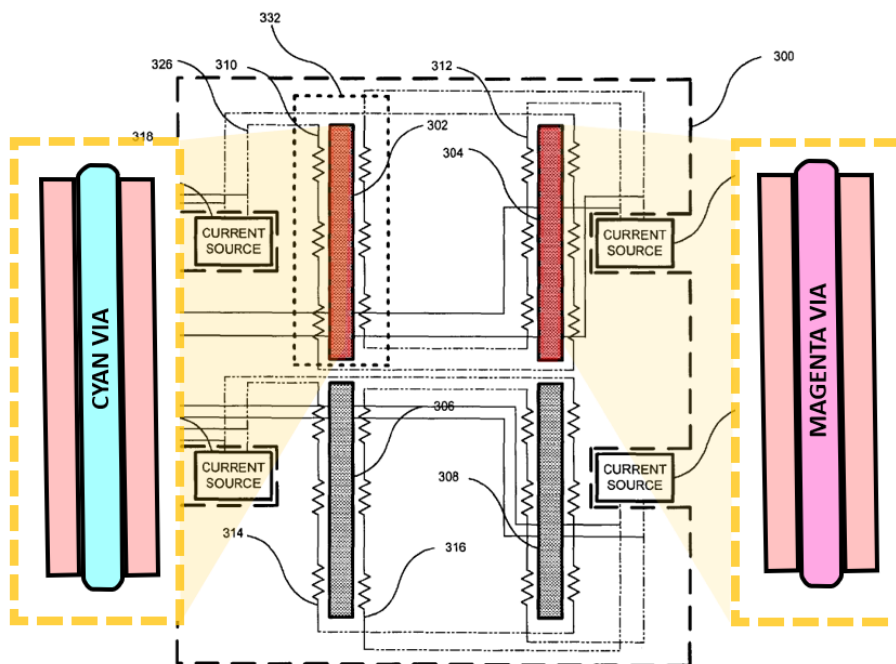
Ink is then fed to the various ink ejection chambers either through an elongated hole formed in the center of the bottom of the substrate, 'center feed,' or around the outer edges of the substrate, 'edge feed.' In center feed the ink then flows through a central slot in the substrate into a central manifold area formed in a barrier layer between the substrate and a nozzle member, then into a plurality of ink channels, and finally into the various ink ejection chambers.

(Ex. 1007 col. 3 lns 37-45.)

91. The description of an "elongated hole" formed in the center of the substrate, also described as a "central slot" in the substrate, would have been readily understood by a PHOSITA to refer to a central slot feeding both the left column (rectangular regions 302 and 304) and right column (rectangular regions 306 and 308) of heaters through a manifold and channels formed in an adjacent barrier layer.

The only disclosed alternative is a feed mechanism extending “around the outer edges of the substrate,” which would require no ink vias. Both of these designs were known and common for cartridges having only a single color (as shown in Fig. 1 of Giere ’178) at the time that the ’708 patent was filed. Giere ’178 makes no mention whatsoever of multiple ink vias on a single substrate or of vias located in the non-central regions 302, 304, 306, and 308. I disagree with Dr. Pond’s conclusion that Fig. 3 of Giere ’178 discloses four ink feed slots/ink vias each located in one of the elongated regions 302, 304, 306, and 308 with heater arrays on both sides of each via. (Ex. 1002 ¶¶ 271-272.) That interpretation is simply not supported by the figure and is contrary to all other information provided in Giere ’178.

92. Dr. Pond presents the following illustration showing his interpretation of Fig. 3 of Giere ’178:



(*Id.*) This reimagines Fig. 3 of Giere '178 as if it had disclosed four separate ink slots/vias with heater arrays positioned along both sides of each slot. A PHOSITA would not have followed any of the lines of reasoning set forth in Dr. Pond's declaration attempting to support this interpretation of Fig. 3. For instance, Dr. Pond reasons that because the rectangular regions are described as including "nozzles and associated firing resistors," that the regions must include ink ejection chambers, and that if the regions include ink ejection chambers they must also include ink feed slots/vias "because that is the structural arrangement of a typical printhead." (Ex. 1002 ¶270.) That is an unwarranted conclusion, because ink ejection chambers are often separated from ink vias by elongate channels. (*See, e.g.* Dr. Pond's discussion of the background technology at Ex. 1002 ¶¶25-30.) Giere '178 mentions this in the passage describing the center feed approach. A PHOSITA would not interpret Giere

'178 as disclosing ink slots contained in each quadrant when the reference does not indicate this in its figures or written text. Giere '178 generally describes that the substrate includes “the structures of a typical printhead” including ink feed slots and ejection chambers but only specifying that the rectangular regions contain “an array of nozzles and associated firing resistors.” (Ex. 1007 col. 8 lns 45-49.) This further reinforces that that there are no ink vias in the rectangular regions.

93. Dr. Pond also argues that vias would be located within the rectangular regions because ejection chambers are necessarily disposed “very close” to ink feed slots/vias to ensure that ink can refill a chamber quickly. (Ex. 1002 ¶270.) However, Fig. 3 is nothing more than a “high level schematic diagram” (Ex. 1007 col. 1 lns 56-57), and Dr. Pond has admitted that it cannot be assumed to be drawn to scale. (Ex. Ex. 2004 47:24 – 48:9.) Furthermore, the ejection chambers can refill quickly even when the ink via is at a location removed from the ejection chambers because there is a continuous supply of ink in the connecting elongated channels. As one ink droplet is emitted through the nozzle, the pressure differential pulls the next drop from the channel and into the chamber.

94. In Paragraphs 272-274 of his declaration, Dr. Pond contends that the layout of the temperature management system itself reveals that each of the rectangular regions 302, 304, 306, and 308 of Giere '178 include an ink via. (Ex. 1002 ¶¶272-74.) According to this reasoning, because Giere '178 discloses sensing

temperature on either side of each of the four regions and further discloses that its system can adjust firing resistor drive signals to control substrate temperature, a PHOSITA would supposedly understand that multiple arrays of firing resistors are located within each region. (*Id.* ¶¶272-73.) Dr. Pond further maintains that a PHOSITA would understand the multiple heater arrays of each region to be separated by an ink via because it is supposedly the insulating effect of the via that presents the need to measure temperature on each side of the four regions. (*Id.* ¶¶273-74.)

95. Dr. Pond's reasoning is contrary to Giere '178's express teaching that "regions 302, 304, 306, and 308 each include *an array* of nozzles and associated firing resistors for ejecting ink." (*Id.* col. 8, lns 47-49 (emphasis added).) The text that Dr. Pond quotes relates only to temperature management in general, and nothing that Dr. Pond cites from Giere '178 actually indicates that ink vias would be located within rectangular regions 302, 304, 306, and 308. None of the passages cited in Paragraphs 272 to 274 of the declaration describe the regions as having multiple heater arrays, let alone multiple heater arrays separated by an ink via. Nor is there any discussion of "independent heater arrays on either side of each region" or of a temperature monitoring system tailored to such a design.

96. A PHOSITA would not backfill in undisclosed structural details based on operational aspects of the temperature monitoring system that are also not

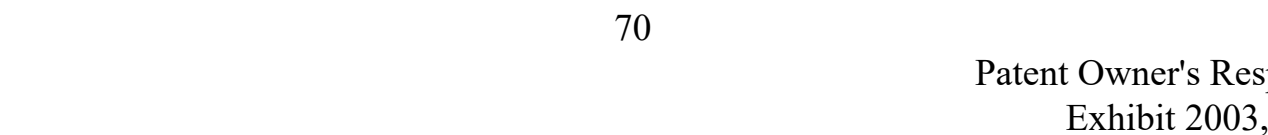
described in Giere '178. Furthermore, a PHOSITA would appreciate the operational benefits of the disclosed temperature monitoring system in the context of the substrate structure that Giere '178 does disclose. In particular, a PHOSITA understands that each array of firing resistors generates heat that contributes to substrate temperature in the adjacent regions. The temperature sensor 310 extends through two outer regions between a single heater array (302 or 304) and a substrate edge, and the temperature of each outer region is impacted mainly by the corresponding adjacent heater array. Temperature sensor 312 extends through a central region between both heater arrays 302 and 304 where the temperature is affected by heat generated by both adjacent arrays. Because the temperatures of the outer and central regions can differ, monitoring those regions separately provides useful data and Giere '178 provides a way to achieve this. Temperature sensors 314 and 316 similarly provide temperature data for the regions separated by heater arrays 306 and 308, which may differ from the data detected from the other regions. This temperature monitoring scheme provides additional utility in that it provides temperature data on the side of the array near the ink feed (310 and 314 in the case of edge feed or 312 and 316 in the case of a center feed) and separate temperature readings on the side further away from the ink feed (312 and 316 in the case of edge feed or 310 and 314 in the case of a center feed). This makes the chip readily adaptable to both of the disclosed ink supply approaches. In sum, the layout of the

temperature monitoring system disclosed in Giere '178 makes perfect sense in the context of what the reference actually discloses and would not have suggested a different chip design in which each region has two independent heater arrays supplied by an intervening ink via.

97. Neither the center feed nor the edge feed embodiments of Giere '178 would have been viewed by a PHOSITA as relevant to the invention claimed in the '708 patent because they do not have multiple parallel ink vias having heater arrays placed along both longitudinal sides of the vias. Nor does either embodiment disclose placing a single temperature sensor in each region between adjacent vias operable to sense a temperature representative of the adjacent heater arrays, as is further recited in independent claims 1 and 9.

98. Even if the printhead of Giere '178 were redesigned to include ink vias and two heater arrays in each region as Dr. Pond suggests, this would not satisfy the claims of the '708 patent. Claim 1 calls for “a region disposed adjacent each heater array,” and “a single temperature sensing element disposed within each region, the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region.” (Ex. 1001 col. 8 lns 23-40.) Claim 9 is similar. (Ex. 1001 col. 8 ln 66 – col. 9 ln 10.) If Giere '178 were as Dr. Pond suggests – (including left and right ink vias dividing the printhead die into 3 regions [purple below], or six regions if the bottom half of the chip is considered – the TSR 310

(Ex. 1007 Fig. 3.) Because the TSR 310 [green] would extend through both regions 1 and 3, it would be incapable of distinguishing between the temperature of Region 1 (to the left of area 302) and Region 3 (to the right of area 304). According to Dr. Pond's theory, regions 1 and 3 are isolated by insulating vias and their heater arrays are independently driven, and thus there is no relationship between the temperature of Region 1 (and its heater array) and Region 3 (and its heater array). As a result, the



configuration suggested by Dr. Pond would not have “a single temperature sensing element disposed *within each region*, the temperature sensing element *operable to sense a temperature representative of the heater arrays adjacent to the region*” as required by claim 1. Similarly, the configuration would not be fabricated by “positioning a single temperature sensing element disposed *within each region*, wherein the temperature sensing element is *operable to sense a temperature representative of the heater arrays adjacent to the region*” as in claim 9.

XIV. Claims 1-3, 5-12, And 14-15 Would Not Have Been Obvious In View Of Giere '178 And Yabe (Ground 4)

99. I disagree with Dr. Pond that a PHOSITA would have found claims of the '708 patent obvious in view of Giere '178 and Yabe.

100. In support of Ground 4, Dr. Pond argues that it would have been obvious to modify the printhead of Giere '178 based on Yabe to arrive at the same structure that he alleges to be shown by Giere '178 alone in Ground 3 above. To a large extent, Dr. Pond's analysis in Ground 4 is based on his incorrect reading of Giere '178. For instance, Paragraphs 372, 381 and 399 incorporate his prior opinion that Giere '178 discloses a plurality of ink vias arranged parallel to one another with heater arrays disposed adjacent each longitudinal side and regions disposed between the vias. (Ex. 1002 ¶¶ 372, 381, 399.) When discussing alleged motivations to combine Giere '178 and Yabe, Dr. Pond spends several more paragraphs arguing that the references are analogous art because both describe sensing temperature in

heater chips with multiple vias. (Ex. 1002 ¶¶ 416-423.) Paragraphs 416 through 419 repeat the erroneous assumption of Ground 3 that Giere '178 discloses multiple vias in a single chip. (*Id.* ¶¶416-419.) Then Dr. Pond argues that Yabe is analogous art because it describes a means for efficiently measuring and controlling temperature of a heater board with plural ink vias and was given the same patent classification. (*Id.* ¶¶424-425.)

101. Dr. Pond appears to also argue in the alternative that the cited combination of references would render the '708 claims obvious even if Giere '178 does not disclose a substrate having multiple parallel ink vias. After acknowledging that Giere '178 could be interpreted to not disclose the multi-via structure that he envisions (*see id.* ¶¶ 373, 382, 400), he reasons that a PHOSITA would nevertheless arrive at the claimed design by “applying [Giere '178's] temperature management system to printheads having a plurality of ink vias and adjacent heater arrays, as taught by Yabe, to maintain high print quality” (*id.* ¶ 436).

102. Dr. Pond argues that a PHOSITA would have been motivated to incorporate ink vias with multiple heater arrays as in Yabe into Giere '178 because Yabe describes advantages of having more nozzles and discharging more ink droplets from a printhead with high precision and at a faster rate. (*Id.* ¶¶426-435.) Dr. Pond also briefly argues that Giere '178 also provides express motivation to incorporate the heater arrangement of Yabe because it too relates to improving print

quality. (*Id.* ¶436.) He then asserts that Giere '178 allegedly “accommodates” a plurality of ink supply ports based on nothing more than his ability to render a graphical mock-up of Fig. 3 showing the locations of added vias and heater arrays. (*Id.* ¶437.)

103. Dr. Pond also argues that it would have been obvious to include multiple ink vias each with two columns of heater arrays because other prior art also showed such an arrangement, and that there would have been a reasonable expectation of success in adding Yabe’s ink feed slots and associated heater arrays to Giere '178 because Giere '178 describes structures of a typical printhead and acknowledges that modifications could be made. (*Id.* ¶¶438-439.) Finally, Dr. Pond again returns to the incorrect notion that Giere '178’s substrate contains multiple parallel ink vias associated with heater arrays on each side of each ink via, repeating his earlier opinions that temperature sensor layout alone somehow indicates that each region includes such a via and heater array structure. (*Id.* ¶440-442.)

104. Dr. Pond’s motivations to combine thus generally amount to an argument that the Giere '178 and Yabe references both have multiple ink vias (with occasional acknowledgment that Giere '178 may not), and that more nozzles per ink via would be advantageous. A PHOSITA would not interpret Giere '178 as disclosing the multiple ink via structure envisioned by Dr. Pond and would not have followed any of Dr. Pond’s obviousness rationales that start from Dr. Pond’s

erroneous assumptions regarding the substrate structure disclosed in Giere '178.

105. I also disagree with Dr. Pond's alternative argument that a PHOSITA would have combined the temperature management system of Giere '178 with the via and heater array structures of Yabe. (Ex. 1002 ¶ 436.) Dr. Pond cherry-picks specific aspects of Giere '178 and Yabe without any justification, and in a manner that is not faithful to the teachings of either reference. His primary justification for doing so is that Giere '178 describes generic print quality benefits of a general "temperature management system." (*Id.* ¶ 436.) Yet his selection of Giere '178's single-via temperature management system ignores Dr. Pond's own admission that "Yabe discloses a means for efficiently measuring and controlling the temperature of the heater board of a printhead having plural ink vias with associated heater arrays on either side so as to maintain high quality printing." (*Id.* ¶422.) Given that Yabe already discloses a multi-via chip and an efficient multi-via temperature management system and that the temperature management system of Giere '178 relates to an entirely different substrate design, Dr. Pond's proposal of incorporating the ink vias and heater arrays of Yabe into a four-quadrant design and temperature management system seems entirely arbitrary.

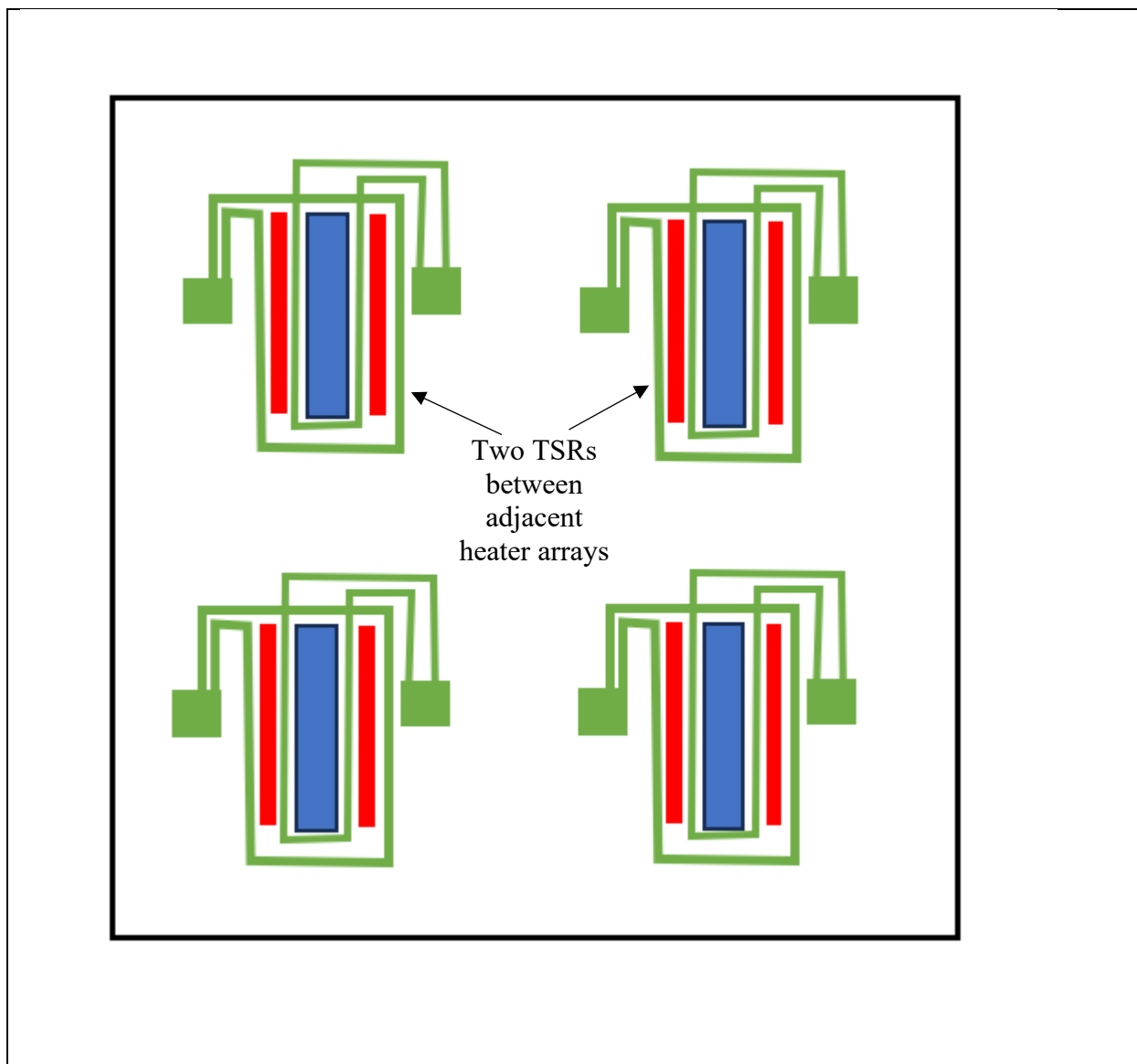
106. In addition to failing to support why a PHOSITA would adopt Giere '178's single-via temperature sensing system over Yabe's multi-via temperature sensing system, Dr. Pond's proposed combination in Ground 4 would involve

redesigning every aspect of Giere '178's substrate and related components except the layout of its temperature sensors. Dr. Pond provides only a general mock-up of Fig. 3 illustrating where the additional vias and heater arrays would be located, but fails to address any of the practical considerations associated with adding ink vias, heaters, nozzles, and all accompanying structures (ejection chamber walls, ink channels between ejection chambers and ink vias, drive transistors, logic cells, address lines, power and ground busses, *etc.*).

107. Furthermore, Dr. Pond's proposed modifications to Giere '178 are inconsistent with the temperature management principles of the reference. As explained above, Giere '178's system provides for separately sensing each side of multiple ink ejector arrays located on opposite sides of a single central ink via or between edge feed ink supply mechanisms. The specialized configuration in Giere '178 provides temperature readings indicative of areas close to an ink feed (310 and 314 in the case of edge feed or 312 and 316 in the case of a center feed) and separately provides temperature readings corresponding to areas further away from the ink feed (312 and 316 in the case of edge feed or 310 and 314 in the case of a center feed). Dr. Pond's proposed redesign of Giere '178's printhead substrate so that an ink via and two corresponding columns of ink ejectors are in each of four regions arbitrarily leaves the temperature sensors unaltered so that they no longer could measure temperature along the ink feed side and the opposite side of each

heater array.

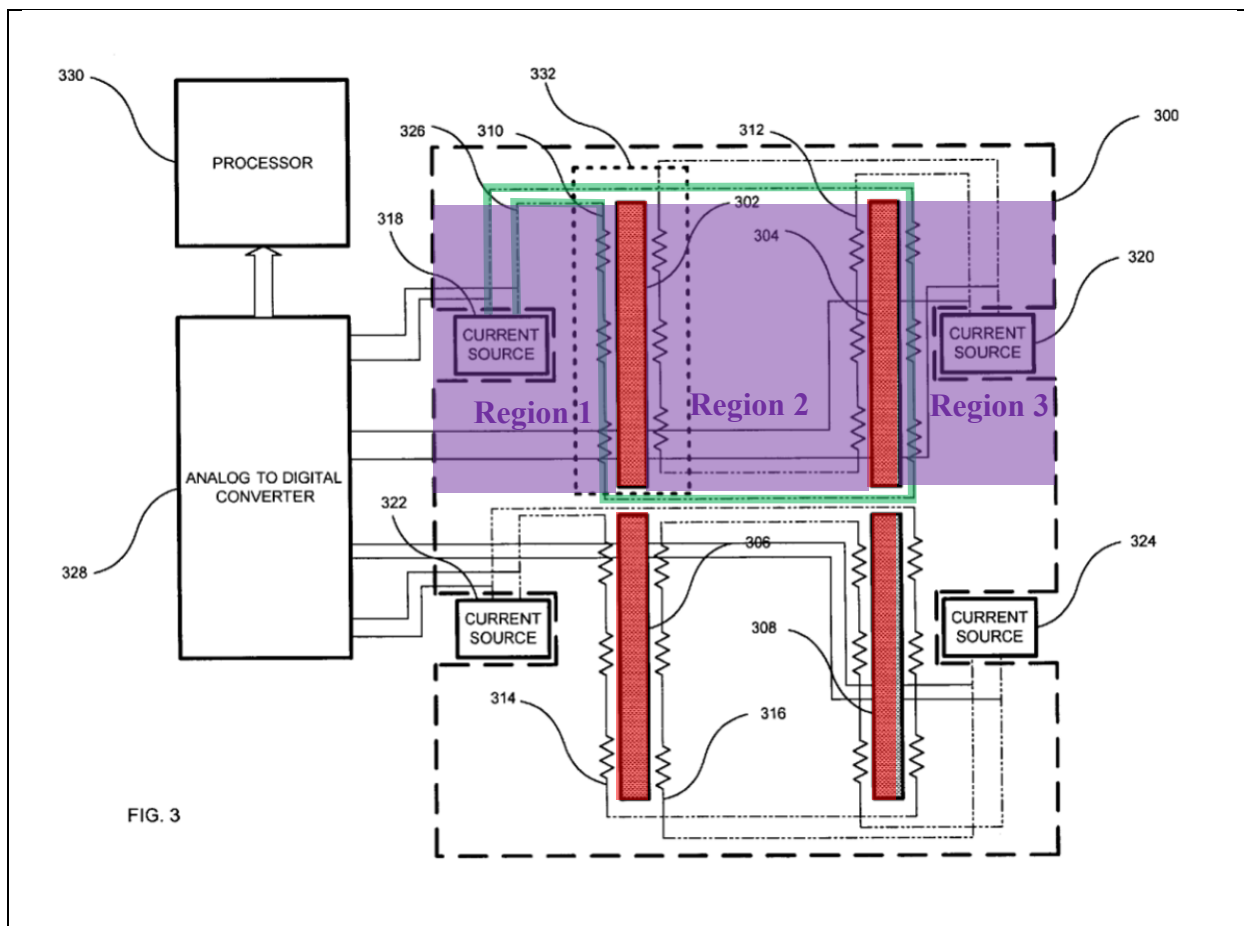
108. A PHOSITA would have had no reason to keep the TSRs of Giere '178 in place while reconfiguring almost every other aspect of the printhead substrate because this would defeat the purpose of Giere '178's temperature sensing scheme. Giere '178 recognizes that "[i]n general, the quantity of ink drops ejected from a printhead nozzle will change as *the temperature of the structure surrounding the ink ejection chamber associated with the nozzle* changes" and that "localized heating of the substrate can occur from firing nozzles at a greater frequency in a particular region of the printhead." (Ex. 1007. col. 5 lns 20-23 and 44-46 (emphasis added).) The placement of temperature sensors along both sides of each heater array comports with this stated emphasis on monitoring the temperature surrounding the ink ejection chambers. Therefore, a PHOSITA would have redesigned Giere's ink vias and heaters without making corresponding changes to the temperature sensors consistent with the objective of monitoring both sides of each heater array according the principles of Giere '178's actual design. The resulting structure would have two temperature sensors between each pair of adjacent heaters, as shown in the simplified illustration below:



The temperature sensors [green] extending along the sides of each heater array [red] adjacent the ink vias [blue] in Dr. Pond's 4-quadrant design therefore would not meet the requirement in the '708 patent claims of only a single temperature sensor in each region between adjacent heater arrays. Dr. Pond does not even attempt to explain why a PHOSITA would deploy TSRs, originally designed and located to monitor both sides of the single heater array of each region, to now monitor different

areas in the proposed modification of Giere '178 Fig 3, nor could he justify why a PHOSITA would arrive at this modification without use of hindsight.

109. The arrangement that Dr. Pond suggests in which the temperature sensor layout of Giere '178 is not altered would also not meet the claims of the '708 patent for the reasons discussed above regarding Ground 3. Modifying the structure of Giere '178 to include left and right ink vias that divide the upper half of the printhead die into 3 regions [purple below] would result in the same TSR 310 [green below] extending through both the region to the left of the left-hand ink via ("Region 1" below) and the region to the right of the right-hand ink via ("Region 3"), with this TSR being incapable of distinguishing between the temperature of Region 1 and Region 3.



(Ex. 1007 Fig. 3.) Therefore, Dr. Pond's redesign of Giere '178 would not have "a single temperature sensing element disposed within each region, the temperature sensing element operable to sense a temperature representative of the heater arrays adjacent to the region" as required by claim 1 of the '708 patent. The TSR extending through Regions 1 and 3 is incapable of distinguishing between the temperatures of the heater arrays in Region 1 from the temperatures of the heater arrays in Region 3, which may be very different due to the insulating effect of the ink vias between them. The same is true of temperature sensor 314 extending through the outer regions of the lower half of the substrate.

XV. Claims 4 And 13 Would Not Have Been Obvious In View Of Any Combination Of Benjamin, Giere '673, And Parish (Grounds 5 And 6)

110. Grounds 5 and 6 are similar to Grounds 3 and 4 but further argue that Parish would have made dependent claims 4 and 13 obvious. Parish would not have provided any further reason to include a TSR in each region adjacent heater arrays arranged along multiple vias. Petitioner and Dr. Pond only cite Parish for a particular type of TSR, and therefore claims 4 and 13 would not have been obvious for at least the reasons discussed above regarding Grounds 3 and 4.

XVI. Conclusion

111. 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 25, 2023

By: 
Steven J. Dietl