

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND SAMSUNG
ELECTRONICS AMERICA, INC.

Petitioners v.

MANUFACTURING RESOURCES INTERNATIONAL, INC.

Patent Owner

Case IPR2023-00255

Patent 9,629,287

EXPERT DECLARATION OF DR. HIMANSHU POKHARNA

I declare (or certify, verify, or state) under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

10/17/2023

Date



Himanshu Pokharna

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I, Dr. Himanshu Pokharna, declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Manufacturing Resources International, Inc. (“Patent Owner” or “MRI”) in the above-captioned *Inter Partes* Review Proceedings, to testify as a technical expert regarding the issues raised in the Petition for *inter partes* review of U.S. Patent No. 9,629,287 (the “’287 Patent”) and the declaration of Robert Smith-Gillespie (“Smith-Gillespie Declaration”). The petition challenges the validity of claims 1, 4-5, and 8-23 of the ’287 Patent (collectively the “Challenged Claims”).

2. It is my understanding that Petitioner does not contend any of the Challenged Claims are anticipated by the prior art. Petitioner instead contends that the Challenged Claims would have been obvious in view of the following combinations:

Ground	Challenged Claims	Grounds
Ground 1	12-23	Obvious over WO2007116116A1 (“Karppanen”)
Ground 2	1, 4-5, 8-12, 14-17, and 21-23	Obvious over U.S. Patent No. 6,798,655 (“Nagashima”) in view of Karppanen
Ground 3	1, 4, 5, 8-23	Obvious over Japanese Patent No. 3118907 (“Ohta”) in view of Japanese Unexamined Patent Publication H8-152604 (“Marumoto”)
Ground 4	1, 4, 5, 8-23	Obvious Ohta in view of Marumoto and Application No. GB 2402205A (“Yare”)

Ground 5	12-20	Obviousness over Japanese Unexamined Application Publication No. H8-54834 (“Kitamura”) in view of U.S. Patent No. 5,748,269 (“Harris”)
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3. As explained in detail below, it is my opinion that none of the Challenged Claims are invalid.

II. SUMMARY OF OPINIONS

4. As explained in further detail below, each prior art reference (or combination of prior art references) lacks at least one element of the Challenged Claims, and a person of ordinary skill in the art would not have been motivated to modify or combine the prior art at the time of the invention in the ways asserted by Petitioner.

III. MATERIALS RELIED UPON

5. In forming my opinions, in addition to my knowledge and experience, I have considered the following documents and things that I have obtained, or that have been provided to me, and anything cited in my declaration not explicitly listed here.:

Exhibit No. to Petition	Description
Ex. 1001	U.S. Patent No. 9,629,287 (“the ’287 Patent”)
Ex. 1002	Declaration of Robert Smith-Gillespie
Ex. 1003	Curriculum Vitae of Robert Smith-Gillespie
Ex. 1004	Certified translation of Japanese Patent No. 3118907 to Ohta (“Ohta”)
Ex. 1005	Certified translation of Japanese Unexamined Patent Application Publication No. H8-152604 to Marumoto

	("Marumoto")
Ex. 1006	International PCT Publication WO 2007/116116 to Karppanen, et al. ("Karppanen")
Ex. 1007	U.S. Patent No. 6,798,655 to Nagashima, et al. ("Nagashima")
Ex. 1008	"Exhibit 22: Infringement Claim Chart for Samsung OH-Series Outdoor Display Products," produced by Manufacturing Resources International, Inc. in <i>In re Certain Outdoor and Semi-Outdoor Electronic Displays, Products Containing Same, and Components Thereof</i> , Investigation No. 337-TA-1331
Ex. 1009	Japanese Patent No. 3118907 to Ohta ("Ohta")
Ex. 1010	Japanese Unexamined Patent Application Publication No. H8-152604 to Marumoto ("Marumoto")
Ex. 1011	Claim Construction Order (D.I. 153) dated October 3, 2018 in <i>Manufacturing Resources Int'l, Inc. v. Civiq Smartscapes, LLC, et al.</i> , Civil Action No. 17-269-RGA (D. Del.)
Ex. 1012	Memorandum Opinion (D.I. 150) dated September 27, 2018 in <i>Manufacturing Resources Int'l, Inc. v. Civiq Smartscapes, LLC, et al.</i> , Civil Action No. 17-269-RGA (D. Del.)
Ex. 1013	United Kingdom Patent Application No. 2402205A to Yare ("Yare")
Ex. 1014	File History for U.S. Patent Application No. 15/180,968
Ex. 1015	Japanese Patent Application No. 2001-209126 A to Fujimori ("Fujimori")
Ex. 1016	Japanese Unexamined Patent Application Publication No. H8-54834 to Kitamura ("Kitamura")
Ex. 1017	Certified translation of Japanese Unexamined Patent Application Publication No. H8-54834 to Kitamura ("Kitamura")
Ex. 1018	U.S. Patent No. 5,748,269 to Harris, et al. ("Harris")
Ex. 1019	U.S. Patent No. 5,991,153 to Heady, et al. ("Heady")
Ex. 1020	Excerpts from the File History of U.S. Application No. 14,508,767
Ex. 1021	U.S. Patent No. 6,825,828 ("Burke")
Ex. 1022	E. Fred Schubert & Jong Kyu Kim, <i>Solid-State Light Sources Getting Smart</i> , 308 <i>Science</i> 1274 (2005) ("Schubert")
Ex. 1023	Military Handbook: Reliability Prediction of Electronic Equipment, DEPARTMENT OF DEFENSE, MIL-HDBK-217F (1991) ("MIL-HDBK-217F")
Ex. 1024	Calculating useful lifetimes
Ex. 1025	LIAN-TUU YEH & RICHARD C. CHU, THERMAL

	MANAGEMENT OF MICROELECTRONIC EQUIPMENT: HEAT TRANSFER THEORY, ANALYSIS METHODS, AND DESIGN PRACTICES (Dereje Agonafer ed., 2002) (“Yeh & Chu”)
Ex. 1026	ALLAN W. SCOTT, COOLING OF ELECTRONIC EQUIPMENT (John Wiley & Sons, 1974) (“Scott”)
Ex. 1027	DAVE S. STEINBERG, COOLING TECHNIQUES FOR ELECTRONIC EQUIPMENT (John Wiley & Sons, 1980) (“Steinberg”)
Ex. 1028	U.S. Patent No. 6,504,713 (issued January 7, 2003) (“Pandolfi”)
Ex. 1029	U.S. Patent No. 4,327,803 issued in 1982 (“Mullejeans”)
Ex. 1030	U.S. Patent No. 5,002,118 (“Olmstead”)
Ex. 1031	U.S. Patent No. 6,244,333 (“Bergh”)
Ex. 1032	Memorandum Opinion (D.I. 181) dated March, 5, 2019 in <i>Manufacturing Resources Int’l, Inc. v. Civiq Smartscales, LLC, et al.</i> , Civil Action No. 17-269-RGA (D. Del.)
Ex. 1034	<i>Certain Outdoor and Semi-Outdoor Electronic Displays</i> , Inv. No. 337-TA-1331, Order No. 13 (May 15, 2023)
Ex. 2012	MRI-ITC-1331_0000092739
Ex. 2013	<i>Certain Outdoor and Semi-Outdoor Electronic Displays</i> , Inv. No. 337-TA-1331, Day 1 Public Hearing Tr. (June 26, 2023)
Ex. 2016	<i>Certain Outdoor and Semi-Outdoor Electronic Displays</i> , Inv. No. 337-TA-1331, Transcript, Deposition of Chris Bolton (Feb. 23, 2023)
Ex. 2022	<i>Certain Outdoor and Semi-Outdoor Electronic Displays</i> , Inv. No. 337-TA-1331, Transcript, Deposition of Robert Smith-Gillespie (Feb. 20, 2023)
Ex. 2023	<i>See IP ratings, Int’l Electrotechnical Comm’n</i> , https://www.iec.ch/ip-ratings (last visited Aug. 29, 2023) (“IEC Standards”)
Ex. 2039	Infringement Claim Chart for U.S. Patent No. 9,629,287, Samsung OH45 / OH55
Ex. 2054	Claim Chart for U.S. Patent No. 9,629,287 and MRI’s Domestic Industry Products
Ex. 2055	<i>Apple iMac “PowerPC G3” 333MHz 1999 Specs</i> , Techable (last visited April 5, 2023), https://techable.com/apple/specs/imac-g3-333-mhz-fruit-colors/
Ex. 2056	U.S. Patent No. 8,373,841 (“841 Patent”)

6. In addition to the documents above, in forming the opinions expressed below, I have also considered my own knowledge and experience based upon my education and work in the field, as described above and in my *curriculum vitae* (found appended to the end of this declaration).

IV. BACKGROUND AND QUALIFICATIONS

7. The following is a brief summary of my background and qualifications. My background and qualifications are more fully set out in my CV (found appended to the end of this declaration), which includes a list of publications I have authored, as well as a list of the patents on which I am a named inventor.

8. I am an engineer with over 25 years of global experience in a variety of leadership roles. My educational, research and work experience has revolved primarily around energy, materials, and thermal technologies, and my areas of expertise include thermal management of electronics, electronic displays—including liquid crystal displays (“LCD”), and energy systems.

9. I have expertise in creating product strategy by mapping technology competencies to emerging market opportunities. My background allows me to be comfortable in deep technical discussions with engineers to broad, board-level business deliberations. I have a proven track record of successfully introducing new mechanical, energy and thermal technologies across a broad array of

computing elements, electronic displays—including liquid crystal displays (“LCD”), energy and military/aerospace products. I am experienced in building and leading teams of engineers, technicians and businesspeople across geographies.

10. I am the Founder and currently Director of Deep Materials Inc., a company devoted to developing thermal management components such as thermal interface materials and heat sinks for computing and consumer electronic systems. In addition, I serve as a founder and board member of Inficold India Pvt. Ltd. which is developing thermal energy storage systems for refrigeration and air-conditioning equipment with emphasis on cold storage and milk cooling. I am also a principal of Deeia Inc., a consulting business providing thermal strategy support to clients such as Google, Facebook, and various startup companies.

11. I received a Bachelor of Technology and a Master of Technology (equivalent to a B.S. and an M.S. in the United States, respectively) in Mechanical Engineering from the Indian Institute of Technology, Bombay. I also earned a Ph.D. in Nuclear Energy Engineering from Purdue University in 1997. My Ph.D. thesis focused on modeling of two-phase flow dynamics in heat transfer systems and specifically developed analytical models for the simultaneous flows of water and water vapor in a system during heat absorption. Examples of such systems are

boiling water reactors. In addition, I have an MBA from the Wharton School at the University of Pennsylvania.

12. I have published more than 15 peer-reviewed scientific articles and have given numerous presentations at scientific and industrial conferences, including several keynote addresses at industry forums such as the Taiwan Thermal Management Association (“TTMA”) annual meetings, with the primary emphasis being heat-pipe development. I have over 60 issued or pending patents.

13. I have worked in various capacities in the electronics industry since 1997. My experience includes leading a team of over 25 engineers at Intel Corporation in the development of thermal management technology for laptop computers, including their electronic display screens.

14. Prior to my management responsibility at Intel, I worked on innovative fans, heat sinks, and liquid cooling of computing systems and demonstrated two-phase liquid cooling pumped loop coolers in a thin and light laptop computer. This work resulted in a keynote address to the Second International Conference on Microchannel and Minichannels held in Rochester, New York in 2004.

15. I have worked extensively on system level air cooling of various electronic products including laptops, all-in-one PCs, desktop PCs, Servers, avionic systems, among others.

V. LEGAL STANDARDS

16. I am not an attorney and offer no opinions on the law. I am, however, informed on several legal principles, summarized below, which I have used in reaching my opinions.

A. Obviousness

17. First, I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious from what was known before the invention was made. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art” and generally includes patents and printed publications (e.g., books, articles, product manuals, company publications, etc.). I understand that in this proceeding the Petitioner bears the burden of establishing invalidity by a preponderance of the evidence.

18. I understand that to establish a claim is obvious, a Petitioner must establish by a preponderance of the evidence that the differences between the subject matter of the patent 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 said subject matter pertains. I also understand that the question of obviousness requires consideration of (a) the scope and content of the prior art; (b) the level of ordinary skill in the art; (c) the

differences between the claimed invention and the prior art; and (d) secondary considerations of non-obviousness. I also understand that the scope and content of the prior art must be viewed through the perspective of a person of ordinary skill in the art at the time of the invention.

19. Because the test for obviousness is what would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains, I understand that analyses that rely on hindsight to establish obviousness are improper.

20. I understand that in forming an opinion regarding obviousness, one must consider so-called “secondary considerations” or “objective indicia” of non-obviousness, which include, for example:

- a. Whether the invention was commercially successful as a result of the merits of the claimed invention (rather than the result of design needs or market-pressure advertising or similar activities);
- b. Whether the invention satisfied a long-felt need;
- c. Whether others had tried and failed to make the invention;
- d. Whether others invented the invention at roughly the same time;
- e. Whether others copied the invention;
- f. Whether there were changes or related technologies or market needs contemporaneous with the invention;

- g. Whether the invention achieved unexpected results;
 - h. Whether others in the field praised the invention;
 - i. Whether persons having ordinary skill in the art of the invention expressed surprise or disbelief regarding the invention;
 - j. Whether others sought or obtained rights to the patent from the patent holder; and
 - k. Whether the inventor proceeded contrary to accepted wisdom in the field.
21. I understand that any secondary considerations must have some relationship or nexus to the invention claimed in the patents at issue.

B. Claim Construction

22. I understand that in this proceeding claim terms are given their ordinary and customary meaning, which is the meaning that the term would have to a person of ordinary skill in the art (“POSITA”) in question at the time of the invention and in light of the patent specification and prosecution history. I understand that, generally, the time of the invention is the effective filing date of the patent application.

23. I understand that a POSITA reads a claim term in the context of the particular claim in which it appears, the other claims of the patent, the patent specification, and the patent’s prosecution history (i.e., “intrinsic evidence”). I

further understand that not all intrinsic evidence is given the same weight. The claim language itself is given the most significant weight when construing terms. The specification and then the prosecution history can aid in determining the meaning of the term when the claim language itself is not clear on its face.

24. I understand that “extrinsic evidence”—such as treatise, dictionaries, and expert testimony—may also be helpful in ascertaining the meaning of a claim term. However, I understand that this evidence is given less weight when determining the meaning of a claim term. Further, I understand extrinsic evidence is typically considered during claim construction only where, after considering the intrinsic evidence, the meaning of the claim limitation is still not apparent.

VI. PERSON OF ORDINARY SKILL IN THE ART

25. I understand that the '287 Patent is to be viewed from the perspective of one of ordinary skill in the art. I understand that the perspective of one of ordinary skill in the art means the level of skill of an ordinarily skilled person in the art in question at the time of the claimed invention. I am informed that the Petition treats the time of the claimed invention as March 3, 2008, and I apply the same date in my analysis below.

26. I understand that several factors are considered in determining the level of ordinary skill in the art. These factors include (i) the educational level of active workers in the field; (ii) the types of problems encountered in the art; (iii)

the nature of prior art solutions to those problems; (iv) prior art patents and publications; (v) the activities of others; (vi) the sophistication of the technology involved; and (vii) the rapidity of innovations in the field.

27. In my opinion a POSITA would have the following qualifications: “A bachelor’s degree in a pertinent discipline, such as mechanical or electrical engineering, physics, applied physics, or a related field. Such a person would also have had 2-4 years of experience in working with electronic displays including thermal management associated with electronic displays. Alternatively, a POSITA would have had 4-6 years of experience in the field and would have developed a similar understanding of thermal management associated with electronic displays.”

28. I understand the Petitioner contends that a POSITA “would have possessed a bachelor’s degree in a pertinent discipline, such as mechanical engineering, physics, product design, or a related field. Such a person would also have 2-4 years of experience in working with electronic displays and have an understanding of product design issues and failure modes associated with electronic displays. Alternatively, a POSITA would have had 5–7 years of experience in the field working with electronic displays and have a similar understanding of product design issues and failure modes associated with electronic displays.”

29. I disagree with Petitioner’s proposed definition of an ordinarily skilled artisan. A person skilled only in product design would not be a person skilled in the art to understand issues of thermal management in a display system. For example, such a definition would sweep in individuals who design unrelated aspects of the product, such as the overall enclosure, computer materials, and electrical connections. Even Smith-Gillespie indicated he did not agree with his definition of a POSITA during a deposition in a related International Trade Commission Investigation. *See* Ex. 2022, Smith-Gillespie Feb. Tr. (Feb. 10, 2023), at 73:3-7 (“Q. Okay. So an industrial designer, as we just described, would not qualify based on that educational background as a person of ordinary skill in the art, under your definition; is that right? A. That's correct.”).

30. Despite my disagreement with Petitioner’s proposed definitions, I meet both parties’ definitions of a person of skill in the art given my educational background and work experience. Under either party’s definition of a POSITA, my opinions, analysis, and conclusions are the same. I am offering my opinion in this investigation based on my experience as one of at least ordinary skill in the art of the Challenged Patents at the time of the invention.

VII. CLAIM CONSTRUCTION

31. I understand that the International Trade Commission has issued a claim construction order concerning the phrases “closed loop,” “between,” and

“open loop of ambient air which passes through the housing and along the backlight” as recited in the Challenged Claims. *See* Ex. 1034, *Certain Outdoor and Semi-Outdoor Electronic Displays*, Inv. No. 337-TA-1331, Order No. 13 (May 15, 2023) (the “1331 Investigation”). For all other terms, I have applied the plain and ordinary meaning of the term as it would be commonly understood by one skilled in the art at the time of the invention.

A. “closed loop”

32. I understand that MRI argued “closed loop” should be construed according to its plain and ordinary meaning. *See*, Ex. 1034 at 42. By contrast, I understand that the Respondents (including the Petitioner in this action) argue “closed loop” should be construed as “gas pathway within a display housing containing gas that is essentially isolated from ambient air.”

33. I understand that the ALJ rejected both parties’ proposed constructions, and provided a “tentative” construction of “closed loop”: “a gas pathway, forming a complete loop, within a display housing. Ex. 1034 at 45. I have applied the ALJ’s construction of the term in this declaration. However, because the ALJ’s construction is “tentative,” I have also applied the plain and ordinary meaning and Petitioner’s proposed construction in the alternative.

B. “between”

34. I understand that MRI argued “between” should be construed according to its plain and ordinary meaning. *See*, Ex. 1034 at 30. By contrast, I understand that the Respondents (including the Petitioner in this action) argue “between” should be construed as “in the space that separates.”

35. I understand that the ALJ rejected Petitioner’s construction and held “between” was not in need of construction. Ex. 1034 at 31. The ALJ noted that “there is no clear substantive dispute regarding the meaning of this term, and ‘between’ is a commonly understood word that appears to be used in the claims in accordance with its plain and ordinary meaning.” Thus, I have applied the plain and ordinary meaning of the commonly understood word “between” in this declaration.”

C. “open loop of ambient air which passes through the housing and along the backlight”

36. I understand that MRI argued “open loop of ambient air which passes through the housing and along the backlight” should be construed according to its plain and ordinary meaning. *See*, Ex. 1034 at 51. By contrast, I understand that the Respondents (including the Petitioner in this action) argue “open loop of ambient air which passes through the housing and ***along the backlight***” should be construed as “open loop of ambient air which passes through the housing and ***is in thermal communication with the backlight.***” Essentially, Petitioner construes “***along the backlight***” to mean “***in thermal communication with the backlight.***”

37. I understand that the ALJ rejected Petitioner’s construction and held “open loop of ambient air which passes through the housing and along the backlight” should be construed according to its plain and ordinary meaning. Ex. 1034 at 54. The ALJ concluded that “[t]he intrinsic record does not support [Petitioner’s] proposal to define ‘along’ to mean ‘is in thermal communication with.’” In the 1331 Investigation, Petitioner relied on the expert declaration of Smith-Gillespie in order to support its construction, but the ALJ noted that the expert declaration was not supported by anything in the intrinsic record and was contrary to how the term “along” was used in the patent and prosecution history of a related patent. Thus, I have applied the plain and ordinary meaning of the commonly understood word “along” in “open loop of ambient air which passes through the housing and along the backlight” in this declaration.

VIII. OVERVIEW OF THE CHALLENGED PATENT

38. The ’287 Patent is entitled a “System for Using Constricted Convection with Closed Loop Cooling System as the Convection Plate,” issued April 17, 2017, and names William Dunn as the sole inventor.

39. The ’287 Patent is generally directed to a housing and cooling system for cooling an electronic display using a combination of a closed loop airflow pathway and an open loop airflow pathway. ’287 Patent, at Abstract. More specifically, the ’287 Patent describes and claims novel features of the closed loop

airflow pathway, including its location and direction within the electronic display housing. '287 Patent at Fig. 2, Fig. 3A, Fig. 3B, and claim 12.

40. Prior to the inventions disclosed in the Challenged Patent, systems for cooling electronic displays operated by removing heat from the non-display sides and electrical components of the system through the sidewalls or fins on heat sinks. *See* Exhibit 1001, '287 Patent at 1:64-2:6. However, such systems could not sufficiently cool an electronic display placed in high heat environments, such as outdoor settings in direct sunlight. '287 Patent at 2:6-17. Further, the larger size of displays used as information boards produce increased heat from the electronic display surfaces themselves. '287 Patent at 2:6-17. As a result, the cooling systems prior to the inventions claimed in the Challenged Patent failed to adequately cool such displays, and the electrical components and display would suffer damage as a result of this inadequate cooling. '287 Patent at 2:22-24; 2:30-36.

41. The Challenged Patent solves the problem of adequately cooling a larger format electronic display in locations of high thermal stress using two airflow pathways: a closed loop around the electronic display and open loop behind the electronic display. *See, e.g.*, '287 Patent at claim 12. More specifically, the '287 Patent teaches a unique configuration of the closed and open loops that transfers heat from hotter air in the closed loop to a cooler loop of ambient air. '287 Patent, 2:37-3:8. That cooler loop of ambient air travels through a channel

located behind the backlight and absorbs heat from the closed loop through a wall of the closed loop cooling chamber. '287 Patent, 2:37-3:8.

42. The '287 Patent describes an electronic display that is located within a housing 70. See '287 Patent, Figure 1.

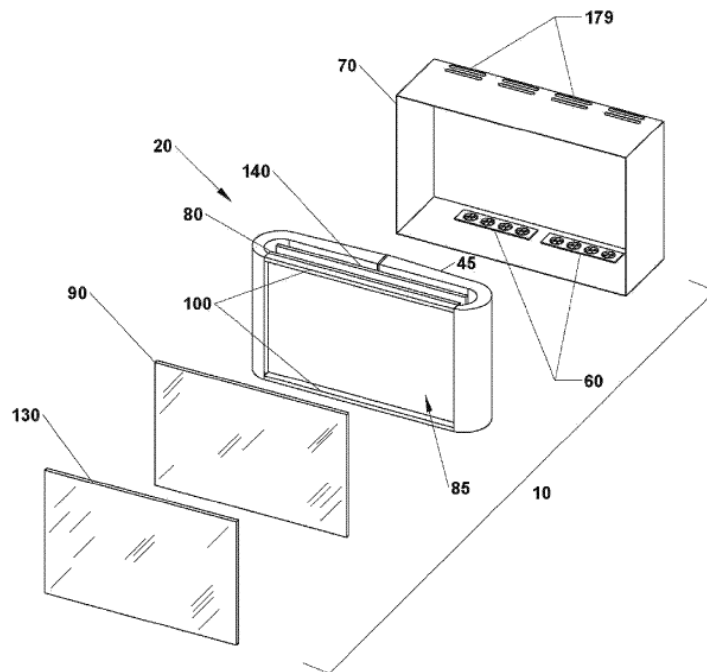


Fig. 1

43. The electronic display within the housing may be any form of display. '287 Patent, 3:35-37. Certain claims specifically contemplate an LCD as the electronic display. See, e.g., '287 Patent, claim 12 (“An electronic display assembly comprising: . . . a liquid crystal display (LCD) . . .”). In an LCD electronic display, the LCD cells create the image to be displayed by the overall electronic display. The LCD contains a backlight for the display that illuminates

the image created by the LCD cells. That backlight includes a printed circuit board, a plurality of lights (typically LEDs) mounted to the side facing the LCD cells, and a thermally conductive rear surface. '287 Patent at 4:64-5:17. "In an exemplary embodiment, the backlight 140 would ideally have a low level of thermal resistance between the side facing the electronic display 80 and the side facing the cooling plenum" of the closed loop chamber. '287 Patent at 5:2-6. "To achieve this low level of thermal resistance," the "rear surface of the backlight 140 may also be metal, or some other thermally conductive material, to further enhance the convective heat transferring properties" of the open loop. '287 Patent at 5:6-12.

44. The housing contains both the open and the closed loop. '287 Patent, claim 12.

45. The closed loop passes through an "isolated gas cooling chamber" 20. '287 Patent, 3:51-55. The cooling chamber 20 surrounds the electronic display 80—including the LCD cell stack and backlight 140 in the case of an LCD. '287 Patent at 3:55-60. The closed loop channel can be divided into two areas: (1) a "first gas chamber" 30 formed between the front surface of the electronic display and the front transparent plate 90 (e.g. glass cover of the housing), and (2) a "rear cooling chamber" 40 that passes behind the electronic display. '287 Patent, 4:4-9. The rear cooling chamber 40 contains a side wall referred to as the "plenum 45."

'287 Patent, 4:4-9. In Figure 2, the dotted arrows show the direction of closed loop airflow around the electronic display 80.

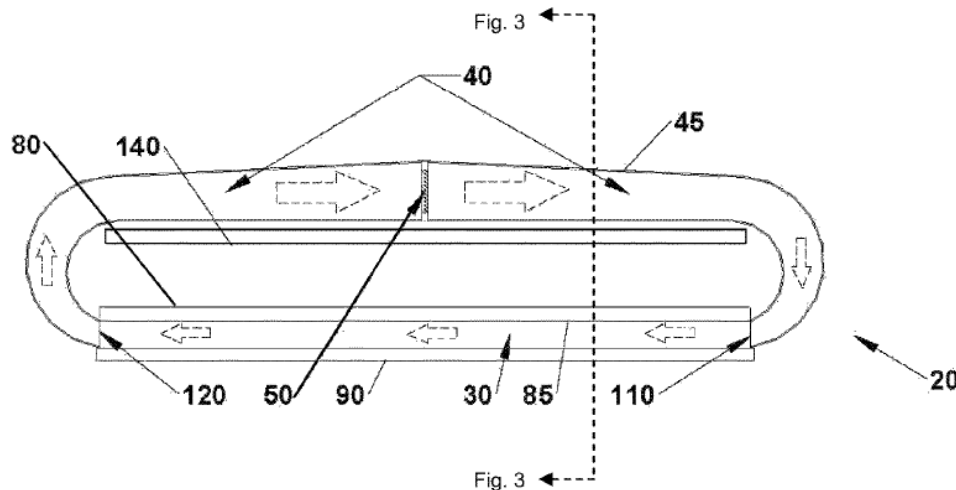


Fig. 2

46. In one embodiment, the contents of the closed loop comprise an “isolated gas.” ’287 Patent, at 4:9-11. The ’287 Patent defines “isolated gas” as gas that is essentially isolated from external air in the housing of the display. The “isolated gas cooling chamber need not necessarily be hermetically sealed from the external air.” ’287 Patent, 4:19-21. Instead, it is sufficient that the gas in the chamber is “isolated to the extent that dust and contaminants may not substantially enter the first gas cooling chamber.” ’287 Patent, 4:21-23.

47. The ’287 Patent incorporates by reference U.S. Patent No. 8,373,841 (“the ’841 Patent”). The ’841 Patent describes placing electronic components within the closed loop isolated gas cooling system. Ex. 2056, ’841 Patent, 8:22-36.

Placing the electronic components of the display in the pathway of the closed loop aids in cooling those components while also protecting them from the environment and maintaining a thin overall display structure. The electronic components may comprise several necessary devices for operating the electronic display, including circuit boards and power supplies.

48. The open loop of ambient air passes in the constricted channel formed between backlight 140 and the plenum 45 of the rear chamber 40. '287 Patent, 4:47-50. To create this channel, the backlight 140 “is placed in close proximity to the posterior rear cooling chamber 40.” '287 Patent at 4:47-48. “The close proximity of these two elements, in part, creates the constricted convection cooling of the backlight 140.” '287 Patent at 4:48-50. Fans are used to draw air “between the backlight 140 and rear cooling chamber 40.” '287 Patent at 4:50-52. It is this flow of air between the rear cooling chamber and the backlight that creates part of the increased cooling capabilities of the invention described in the '287 Patent. '287 Patent at 4:52-54. The cross section as indicated in “Fig. 3” in Figure 2 shows the intended position and direction of the open loop ambient air flow in the electronic display assembly.

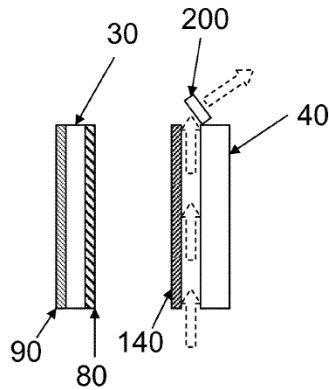


Fig. 3A

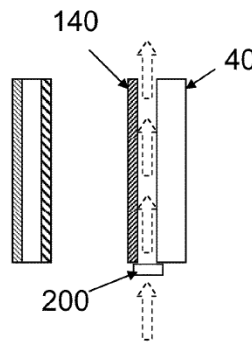


Fig. 3B

49. In Figure 3A and Figure 3B, the dotted arrows show the direction of the open loop airflow pathway through the housing of electronic display. The dotted arrows show the air that is directed through the constricted convection channel by a fan. This channel is formed between the backlight 140 and rear cooling chamber 40. '287 Patent at 5:19-21. As air passes through this channel, it travels along the surface of the backlight 140. See Figure 3A and Figure 3B.

50. The air which moves through the channel shown in Figure 3A and Figure 3B is drawn from outside of the housing. '287 Patent at 5:22-23. The contents of the open loop airflow may be either ambient air or air from a conditioning unit. '287 Patent at 5:24-26. Because this air will be cooler than the closed loop gas which has been heated by the front of the display in the first gas cooling chamber, heat will transfer from the closed loop rear cooling chamber—through the wall of the chamber—to the ambient air traveling through the open loop channel.

IX. BACKGROUND OF THE TECHNOLOGY

51. Digital displays were new to the outdoor signage market in early 2000s. Prior to the early 2000s, outdoor signs were largely made of illuminated posters. However, the paper posters contained static content and had to be changed out each time new information needed to be displayed. Electronic displays, by contrast, allowed the sign to be dynamic. The content of the outdoor sign could be changed, easily edited, and updated without requiring labor intensive changing of paper in each outdoor signage display.¹

52. Because of the advantages offered by electronic displays, the outdoor signage market began experimenting with housings that could hold electronic image assemblies instead of paper. However, the integration of electronic image assemblies into an outdoor signage housing could not be done by simply replacing the illuminated paper with the electronic image assembly or moving an indoor electronic display outside. Three new environmental stressors had to be considered in order to effectively design an electronic display that allowed that display to function properly outside: (1) additional thermal load from ambient temperature and the sun, (2) additional thermal load from the face of the electronic image assembly as the size of the displays grew, and (3) the ingress of contaminants and dust.

¹ This history and problem in the art is additionally described in Karppanen.

53. Thermal load from the sun is a primary concern in outdoor electronic displays. For example, even on cold days, the sun's radiation can cause the temperature of the liquid crystals in a liquid crystal display to increase significantly, boil, and turn black. The result is a black spot within the visible area of the LCD display that can no longer turn colors to show images. This effect is commonly referred to as solar clearing or black spotting.²

54. Additionally, because the electronic displays were being placed in outdoor environments, there is an increased exposure to dust, water, and contaminants. Cooling systems for electronic displays at the time were not designed to handle the increased presence of those contaminants because they used ambient air from the room to cool the display and electronic components. *See generally*, Nagashima (describing smaller format displays in an all in one personal computer intended for indoor use). When moving the electronic displays outdoors and in areas of high thermal stress, the front surface of the display and the electrical components had to be located in areas needing greater protection from water and dust.

55. In the early 2000s, some entities were experimenting with ways to cool the larger sized electronic display in outdoor settings, but those designs were not effective or desirable for several different reasons. Systems that convected heat

² *See, e.g.*, Ex. 2012 (draft article on the MRI products and their unique method of avoiding solar clearing).

away from the display and conducted heat out through the housing walls or over finned plates were not able to transfer enough heat out of the system. '287 Patent, 1:63-2:17. One example of such a configuration is in Karppanen, where circulating air around the electronic display is dissipated through the walls of the housing and over a heat sink or finned plate. See Ex. 1006, Karppanen at 9:4-11; 9:17-20.

56. Karppanen recognized that “in particularly hot conditions, heat transfer based merely on cooling fins may not be sufficiently efficient.” Ex. 1006 8:25-26. In those conditions, Karppanen recommended using “liquid-cooled elements or components.” Ex. 1006 8:26-27. I understand that one of the inventors of the Challenged Patent additionally experimented with a liquid cooling system for the closed loop prior to the invention of the unique configuration of the closed and open loops that allowed the invention to effectively operate in the field. Ex. 2013 (David Williams testifying) at 170:9-14.

9 Q. What cooling systems were used in the 47-inch
0 car wash?

1 A. There were several iterations of the 47-inch car
2 wash. The one in 2007 when I came onboard, Mr. Dunn was
3 working on a liquid cooled version of the 47-inch display.
4 That's the one that I'm the most familiar with.

57. As a former MRI engineer explained, the liquid cooling of the electronic display presented problems related to the pressure of the liquid, bulging of the housing, and breaking of the cover glass. Ex. 2013, 170:15-25.

```
15      Q.      Did the liquid cooling solution have any
16 problems?
17      A.      It did. No doubt about it. There was -- I
18 remember Mr. Dunn -- I can still see him back there working
19 on the 47-inch. They had problems with having maybe too
20 much pressure of the fluid passing between the cover glass,
21 LCD cover glass, as well bulging, breaking the cover glass,
22 not having enough fluid going through the system. So they
23 had to go through quite a few iterations of getting it to
24 work, but eventually, yes, they did get that system to work
25 to prevent -- excuse me -- to prevent solar clearing of the
```

58. Other entities experimented with increasing the cooling needed for the larger format, outdoor electronic displays by integrating an air conditioning unit into the housing. For example, I understand the first outdoor electronic display units designed by Chris Bolton and Vertigo used air-conditioned units. See Ex. 2016, Transcript, Deposition of Chris Bolton (Feb. 23, 2023) at 42:16-22; 103:5-13 (describing units for Phoenix and Las Vegas that utilized air-conditioning units). However, the use of air conditioning systems was not desirable as it increased condensation within the system, drew excessive energy, and could be noisier than

desired. Additionally, the air-conditioning unit takes up space within an enclosure, foreclosing the use of a thinner, more desirable housing. *See* Ex. 2016, at 133:9-18.

59. The Challenged Patent improved upon the prior art by creating novel airflow pathways for a closed loop and open loop that increased the overall cooling efficiency of the electronic display system without the need to add undesirable mechanisms such as air conditioning units.

60. First, the Challenged Patent described a novel pathway of the closed loop that travels around both the electronic display and includes the electrical components for cooling the electronic display. '287 Patent 2:44-57. The front surface of the LCD display needs to be isolated from ambient air that contains dust and contaminants as that dust can collect on the surface of the display and degrade the image. '287 Patent, 4:4-15. Additionally, the electronic components for driving the display need to be separated from the ambient air so that the same dust and contaminants cannot interfere with their function. '841 Patent, 8:22-36 (incorporated by reference in the '287 Patent). By placing both the front surface of the LCD display and the electronic components in the same closed loop isolated gas pathway, one pathway of cooling gas can be used to cool both systems—facilitating increased cooling and the creation of a thinner design which is desirable in the public information board market. As the isolated gas absorbs

energy from the display surface and electronic components, it is cooled by the shared plenum 45 wall with the open loop of ambient air.

61. Second, the Challenged Patent described a novel pathway of open loop air that directed ambient air along the backlight of the LCD module. *See* '287 Patent, claim 12. An LCD module comprises the front LCD cells which generate an image pixel-by-pixel. However, because the LCD cells themselves cannot generate light, the LCD module also comprises a light behind the LCD cells (“backlight”) that illuminates the image created at the LCD cells. The Challenged Patent recognized that “[t]he backlight can be a significant source of heat for the electronic display.” '287 Patent, 2:66-3:2. This phenomena is especially true in large format LCDs where more light sources are needed to provide sufficient illumination for the LCD cells. The rear surface of the backlight can consist of only a thermal plate with thermal surface features. '287 Patent, 5:9-14. In contrast to the front surface of the LCD cells and the electronic components for driving the LCD, this plate can be built to avoid the like electrical connections—making it suitable to be exposed to dirtier and wetter ambient air. For the first time in the art, the Challenged Patent recognized this possibility and drew external ambient air from outdoor locations directly along the backlight of the LCD module. *See* Fig. 3A, Fig. 3B, claim 12. By drawing in the cooler ambient air, the heat transfer is

increased from the backlight out of the electronic display housing and overall system.

62. This unique direction of closed loop and open loop airflow pathways was an entirely novel approach to cooling that had superior cooling capabilities from the prior art that used conduction and convection through the external housing and fins.

X. OVERVIEW OF THE ASSERTED ART

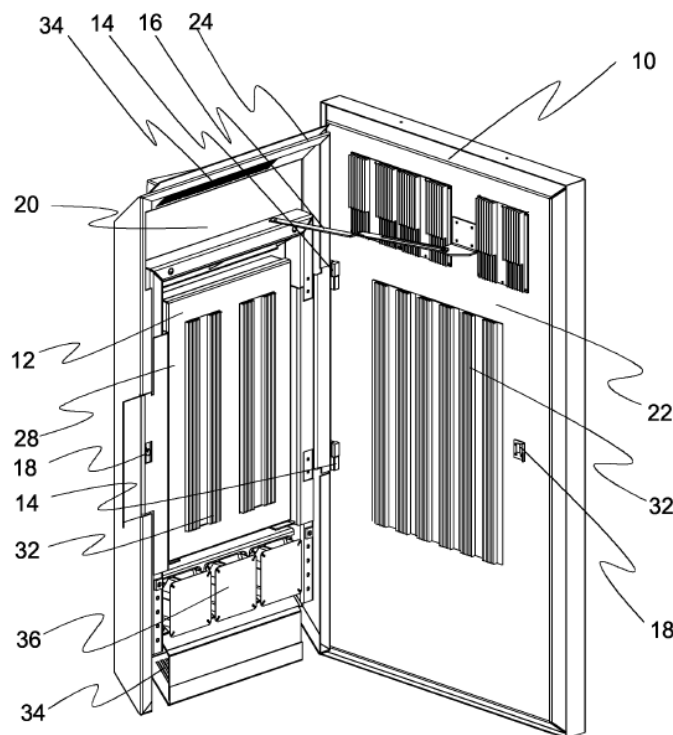
A. Karppanen

63. International Patent Application No. PCT/FI2006/050145 by Pasi Karppanen (“Karppanen”) was filed on April 12, 2006 and published on October 18, 2007. Karppanen is directed to an “electronic information board” comprising a frame 4, display such as a TFT LCD or plasma display for presenting information and electronic equipment for controlling the display. Ex. 1006, Karppanen, at Abstract. The electronic information board comprises three distinct compartments: (1) a “weatherproof” display casing 10 which contains the display; (2) a “weatherproof” device casing which contains the electronic equipment needed for controlling the display 12, and (3) a “common cooling space” 20 located between the display casing and device casing. Karppanen at Abstract, 3:38-30.

64. Karppanen describes one problem of cooling a large format electronic display is the heat generated by the surface area of the display in addition to the

heat typically generated by the electronic components for driving the display.

Karppanen at 2:18-29. In order to solve that problem, Karppanen separates the display from the electronic equipment in two separate, modular casings with a cooling chamber located between the two. Karppanen at 3:21-4:4. Figure 1 illustrates the separation of the electronic components in the closed device casing 12 from the electronic display in the closed display casing 10.



65. In Figure 1, the overall enclosure is opened at the cooling space between the two chambers. “Cooling elements 32” are located in the wall separating the display casing from the cooling space 20. Karppanen at 8:13-16.

66. Figure 2 of Karppanen shows a zoomed cross-sectional view of the cooling elements 32. The cooling elements are preferably Peltier elements—an

active electrothermal device that pumps heat from a cooler surface to a warmer surface. Karppanen at 9:19-20. The part of the cooling element 32 that extends into the cooling space contains fins that transfer heat to the air traveling within the cooling space. Karppanen 8:16-27. The part of the cooling element that extends into the display casing may use either fins for convection or a solid surface touching the display for conduction. Karppanen at 8:29-36. Such conduction and convection fins on either side of the Peltier element can be seen in Figure 2 (showing the conduction plate of cooling element 32 in the bottom cross-section and convection fins of cooling element 32 in the top cross-section). As also stated by Smith-Gillespie in his report, these cooling elements 32 also resemble typical heat sink configurations. See Smith-Gillespie '740 Declaration at ¶ 63 (“Karppanen also discloses an air-to-air heat exchanger comprising heat sinks 62 . . .”).

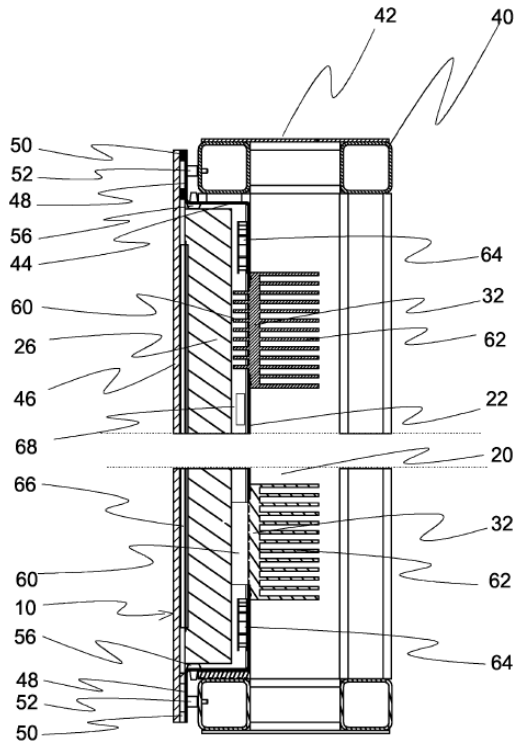
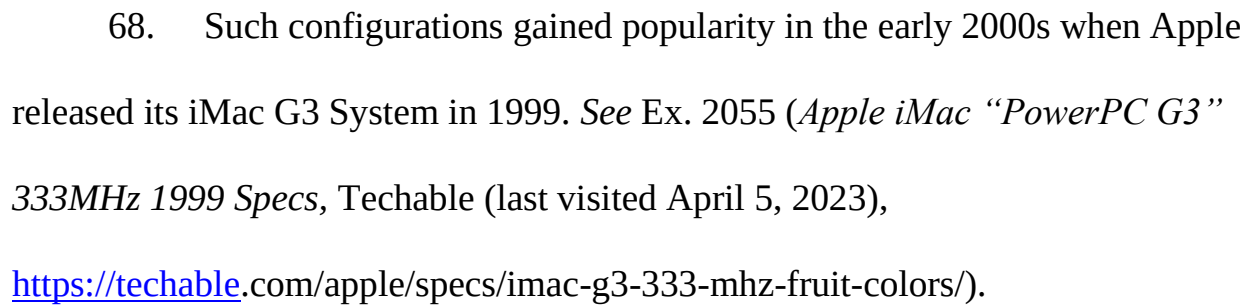


Fig. 2

B. Nagashima

67. U.S. Patent No. 6,798,655 by Kenichi Nagashima (“Nagashima”), issued on September 28, 2004. Nagashima is directed to a personal desktop computer that had an “all in one” configuration—the LCD panel for the computer and all computer hardware located in one enclosure. *See* Ex. 1007, Nagashima at Abstract. The LCD panel 5 is mounted to the front side of the enclosure chassis, and the CPU 9, memory devices (including hard disk drive 10), motherboard, and other hardware components are mounted on the other side of the chassis. Figure 1 demonstrates the overall configuration of Nagashima’s desktop computer:



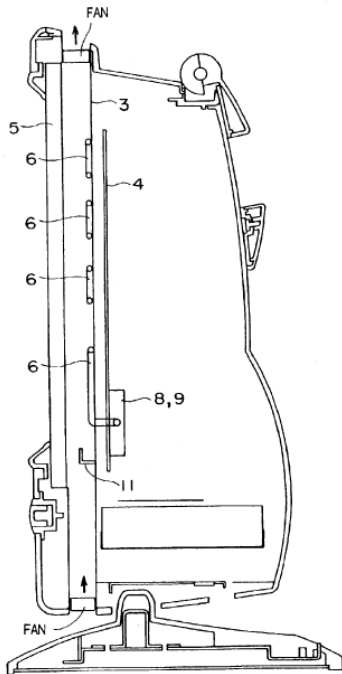
These all-in-one configurations consolidated the computer monitor with the hardware into one enclosure. With these smaller format computers, the largest source of thermal energy load came from the electronic components for driving the computer (the computer hardware). *See, e.g.*, Nagashima at 1:52-57; 4:10-14. Accordingly, traditional cooling systems used internal fans and vents within the casing to move circulating ambient air over the hardware components.



Ex. 2055 (vent viewable from the top); Nagashima at 1:41-51. Dust accumulation was not a dominant concern with these all-in-one personal computers because they were intended solely for indoor use.

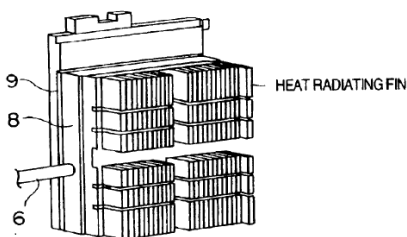
69. Nagashima made use of the conventional cooling technology used in personal computers, including an open air pathway through the hardware cooling system, and added a cooling space between the LCD and a chassis and a cooling

liquid located within a tube on the chassis and connected to the thermal components of the hardware. See Nagashima at 2: 23-46. The channel defined between the LCD panel 5 and a chassis 3 containing the liquid filled tubes 6 can be seen in Figure 10. The liquid filled tubes 6 received heat from the electrical components (including the CPU) through a heat receiving head 8.



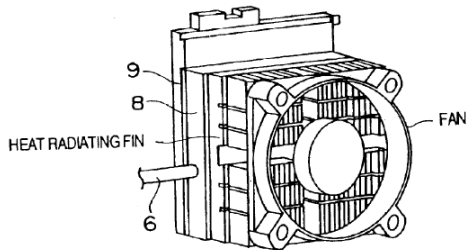
70. Figure 6A and 6B show a heat radiating fin (heat sink) located on the heat receiving head 8.

FIG. 6A



71. Figure 6B shows a fan that may be provided on the heat radiating fin.

FIG. 6B



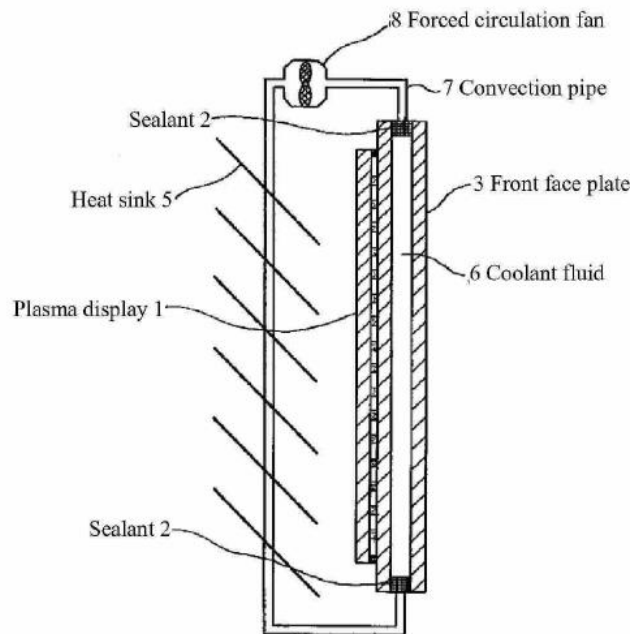
C. Ohta

72. Japanese Patent No. 3118907, by Tatsuki Ohta (“Ohta”) published on October 13, 2000. Ohta is directed to an “integrally formed” cooling device for plasma displays. *See Ex. 1004, Ohta at (0001)*. Plasma displays are a distinct form of electronic display and are different from LCDs. A plasma display contains pockets of gas that, when excited by electrical voltage, will cause light to be emitted within the visible spectrum. Because each pixel, or pocket of gas, emits its own light, each pixel can be “turned off” and produce a deeper black color. Additionally, each pixel emits light in all directions, creating a wide viewing angle and allowing the display to be viewed from the side. LCD displays, by contrast, comprise a stack of liquid crystals that will change the light passing through them to provide color to generate an image. However, unlike plasma gas, liquid crystals themselves do not create their own light. Instead, LCD stacks required a light source to be located behind the liquid crystals.

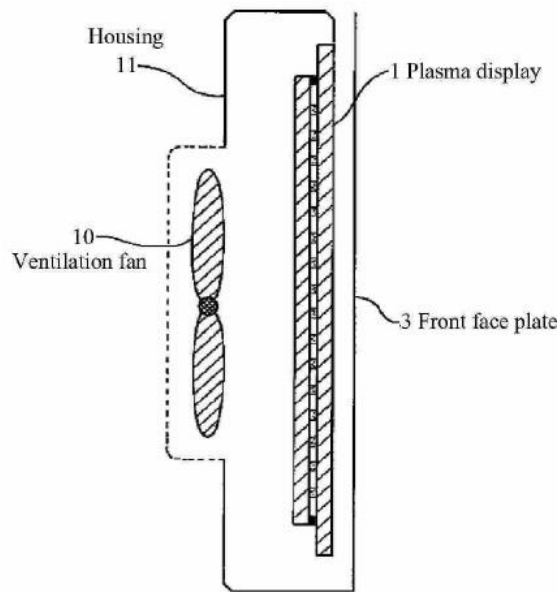
73. Ohta describes cooling systems prior to its invention as “air cooling” using a “fan to directly blow air onto the panel.” Ohta at (0002).

74. Ohta, by contrast, proposed five “example” cooling systems. The example cited by Smith-Gillespie (example 3), uses a front plate 3 that is connected to a plasma display 1 using a sealant 2 and spacer. Ohta at (0019). The spacer, front plate 3, and plasma display 1 “form[s] an airtight container between the same display face and the plasma display panel.” The two sides of the airtight space are connected by a convection tube 7 that is filled with a cooling liquid—ethylene glycol. Ohta at (0019)-(0020). When the plasma display is in operation, and a temperature setting is exceeded, a fan within the tube causes the ethylene glycol to circulate within the tube and inside of the airtight container to cool the plasma display. Ohta at (0021). Heat sinks are located along the convection tube 7 and are naturally cooled (cooled without fans). Ohta at (0019), (0024). Alternatively, forced convection may be used over the heat sinks. Ohta at (0024). Example 3 does not discuss nor disclose a housing, or location of the cooling tube within the housing.

75. Figure 3 shows an illustration of the Example 3 embodiment of Ohta.

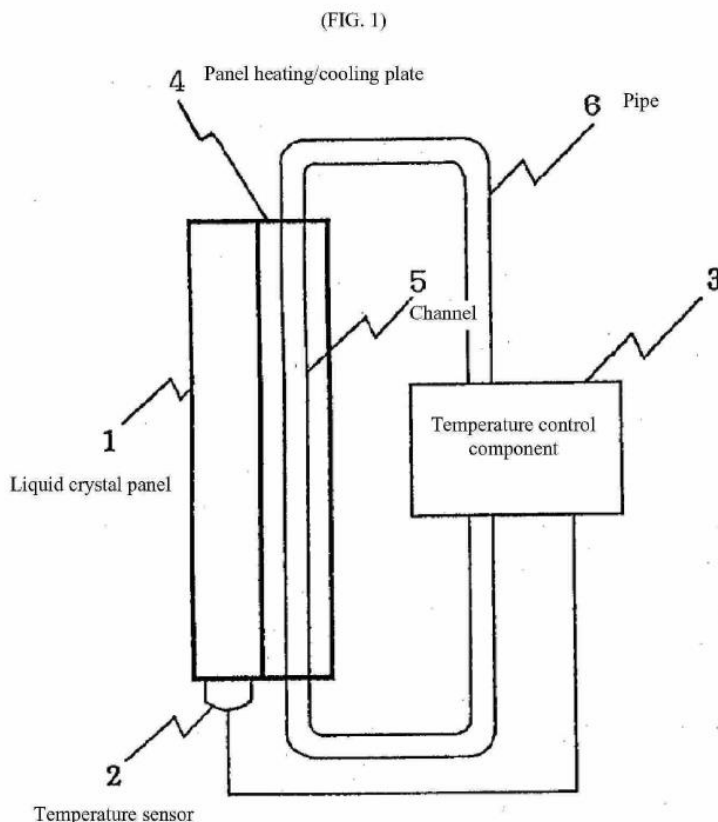


76. Smith-Gillespie also discusses one embodiment, Example 5, in Ohta that describes an ambient air pathway over the front surface of the plasma display 1 and front plate 3. Slits on the inside of a housing 11 and fans allow intake of outside air into the space between the plasma display 1 and front plate 3, cooling the front surface of the display. See Ohta at Figure 5.



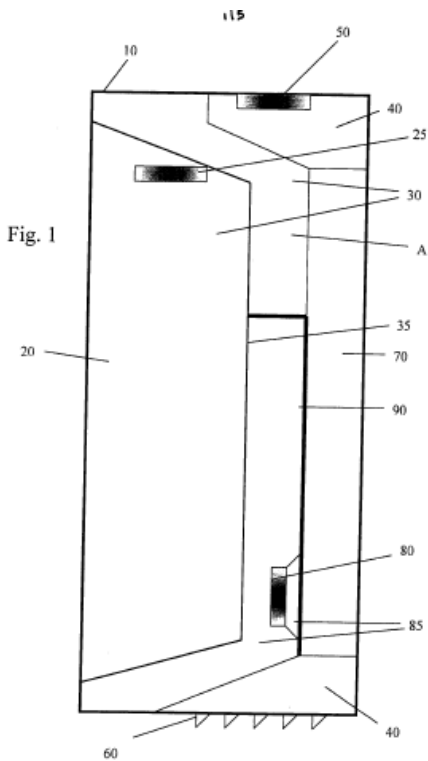
D. Marumoto

77. Japanese Patent Publication H8-152604 by Yukio Marumoto (“Marumoto”), published on June 11, 1996. Marumoto describes a heating and cooling system for liquid crystal panels. Ex. 1005, Marumoto at (0001). In Marumoto a thermal plate is bonded to the back face of an LCD panel 1. *See* Marumoto at (0011). A channel is formed between that thermal plate and another plate. Marumoto at (0006). The channel is filled with a heating/cooling material (liquid or gas) that flows through pipe 6, past a temperature control unit 3. Marumoto at (0011). This closed loop along the thermal plate can be seen in Figure 1 of Marumoto:



E. Yare

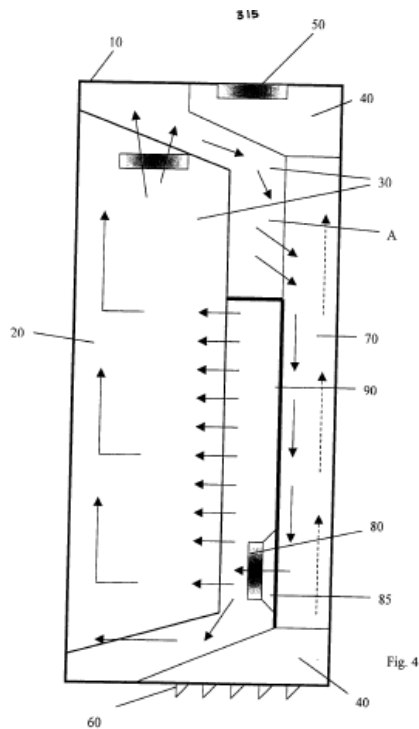
78. United Kingdom Patent Application No. GB 2402205A by Leslie John Yare (“Yare”), published on December 1, 2004. Yare describes a display cabinet 10 for display system 20 such that a large scale display can be used in public locations. Ex. 1013, Yare, Abstract, 1:4-6. The display system 20 may be a plasma display, an LCD display, or TFT display, a CRT display, an LED display, or a projection display. Yare, Abstract, 1:4-6. The cabinet 10 is intended to house any of these display systems and is designed such that it can “co-operate with the existing internal cooling systems of the display.” Yare, 2:15-17. Figure 1 shows the overall configuration of the cabinet 10 containing the display system 20.



79. The cabinet contains two compartments: an atmospheric zone 40 and a sealed zone 30. Yare, Abstract. The display system 20 is mounted inside of the sealed zone 30. As the display system creates heat, vents within the display system 20 allow air within the sealed zone to travel through the rear portion 35 of the display system to cool the internal components. Yare, 5:15-27. As a result, the air within the sealed zone makes use of the already existing internal cooling system of the display, which typically includes fans 25. Yare, 5:15-27. After air exits the display system 20, it travels to the rear portion 35 of the sealed zone to travel along the heat transfer means. Yare, 5:15-27.

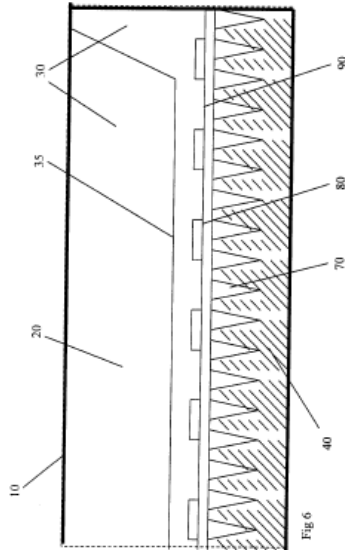
80. The atmospheric zone 40 draws air from outside of the cabinet, through vents 60, and along a heat transfer means that may include a heat exchanger 70 mounted to a baffle plate 90. Yare, 4:29-34.

81. Figure 4 illustrates the movement of air through display system 20 in the sealed zone 30 and through the atmospheric zone 40. Yare, 4:24-25. Dotted arrows show the movement through the atmospheric zone while solid arrows show the movement of air through the sealed zone. Yare, 4:25-27.



82. The heat transfer means located between the sealed zone and atmospheric zone may be a corrugated metal which forms a heat exchanger. Yare, 6:7-10. As air passes through each zone, it passes along the channels of the

corrugated heat exchanger. Yare, Abstract. Figure 6 shows a cross section of the corrugated heat exchanger.

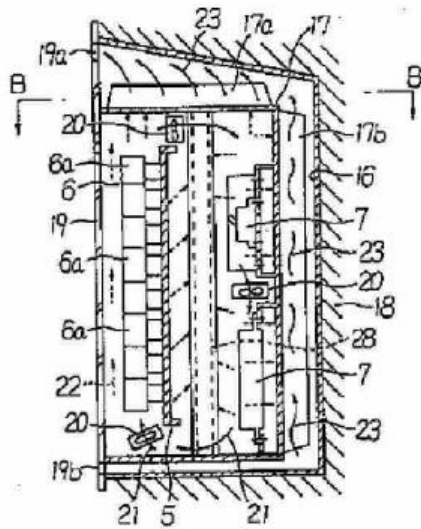


F. Kitamura

83. Japanese Patent Publication H8-54934 by, Haruo (“Kitamura”), was published February 27, 1996. Kitamura relates to a cooling method for a direct view LED display. *See* Ex. 1016, Kitamura, (0001), (0006). LED displays are distinct from LCD displays. In LED displays, the visible image is created by individual light emitting diodes.

84. The cooling system in Kitamura operates by having two housings, an inner housing and an outer housing. *See* Kitamura, (0009). This overall configuration can be seen in Figure 4 of Kitamura:

(FIG. 4)



85. The LED display is located within the inner housing 17, along with the electronic members for controlling the LED display. Kitamura, (0009).

Multiple fans 2 are located throughout the inner housing 17 to circulate air in the direction of arrows 21 around the entire inner housing. Kitamura, (0014). In the third embodiment described in Kitamura, there is also a duct 28 that travels through the interior of inner housing 17, traveling in parallel with the sides of the display walls and connecting the lower and upper channels of the outer housing.

86. The outer housing 16 surrounds the inner housing, such that there is a space filled between the two—with cooling fins (17a, 17b, etc.) provided in that space. Kitamura, (0009). Outside air is introduced into the space between the outer housing 16 and inner housing 17 through an intake port 19b located at the bottom of the housing. Kitamura, (0017). The outside air flows over the fins (17a, 17b,

etc) around the inner housing 17 and out an exhaust port 19a at the top of the housing.

G. Harris

87. U.S. Patent No. 5,748,269 by David Bennitt Harris (“Harris”), issued on May 5, 1998. Harris describes an LCD and computer system for use in “severe environments,” such as on a locomotive. Ex. 1017, Harris, 1:5-9. The LCD and computer are smaller format display systems that are intended to be mounted in a locomotive.³ Harris, 1:63-64; 4:10-13 (“The display enclosure 3 is preferably built to have a plurality of sizes (e.g., including but not limited to, approximately 13.66” wide by approximately 10.63” high by approximately 4.73” deep . . .).”). In order to survive the extreme environment of a locomotive—including high temperature, humidity, radiation, vibration/shock, and electromagnetic induction—Harris describes using a heat sink to cool the power supply, tin oxide coating for protection against electromagnetic induction, and a cooling plenum (“space”).

88. The cooling plenum 30 is constructed of aluminum and attached directly to the light source of the backlighting module. Harris, 3:18-23; 3:42-52. The light source of the backlight in Harris consists of compact fluorescent bulbs, and each bulb draws 2.4 watts for a total of 29 watts of backlighting. Harris, 3:41-60. An air intake passage 30d is located along the bottom of cooling plenum 30,

³ Though Harris describes that the LCD and computer are intended to be “permanently” mounted to the wall of the locomotive, Harris also describes a handle 7 on the LCD and computer for easily removing and carrying the display system. *Compare* 1:63-64; *with* 4:18-19.

and an air exhaust 31 is located at the top of the rear cover 4. Harris, 4:21-31. Fans 30b are used to move air through the cooling plenum. Harris, 4:45-46. Figure 30 shows an image of the cooling plenum 30 described in Harris.

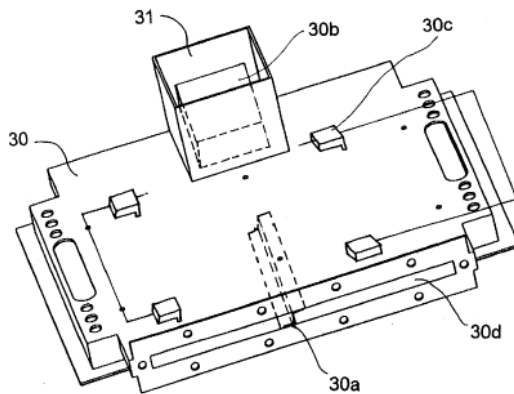


FIG.3

XI. Non-Obviousness of the '287 Patent

A. Karppanen in view of the knowledge of a person of ordinary skill in the art does not render any of the Challenged Claims obvious.

89. The Petition argues that Karppanen in view of the knowledge of a POSITA renders obvious claims 12-23 of the '287 Patent. For the reasons provided below, I disagree.

1. Karppanen does not disclose a “closed loop” of “isolated gas” as required by independent claim 12, independent claim 18, dependent claim 22, and their dependent claims.

90. Claim 12 and claim 18 recite a “closed loop of isolated gas” that aids in the cooling of the electronic display. Independent claim 21 recites a “closed

loop” of cooling gas, and its dependent claim 22 claims that the “closed loop of cooling gas **is isolated**” within a continuous loop gas cooling chamber.

91. Karppanen does not disclose a “closed loop” under Petitioner’s proposed construction, or “isolated gas” as it is defined by the lexicography in the ’287 Patent specification. Petitioner construes “closed loop” to include the limitation that the gas is “essentially isolated from ambient air.” Per the explicit disclosures of the ’287 Patent, “‘isolated gas’ refers to the fact that the gas within the isolated gas cooling chamber 20 is essentially isolated from external air.” ’287 Patent at 4:9-11. “Essentially isolated” does not require the closed loop chamber to be “hermetically sealed,” but requires the chamber to be isolated to the extent that no substantial amount of dust and contaminants may enter. ’287 Patent, 4:19-23 (“the isolated gas cooling chamber need not necessarily be hermetically sealed from the external air. It is sufficient that the gas in the chamber is isolated to the extent that dust and contaminants may not substantially enter the first gas chamber.”). Thus under either Petitioner’s construction of a closed loop, or the ’287 Patent lexicography of “isolated gas,” there is a requirement that the gas be substantially free of dust and contaminants.

92. A POSITA would understand that the measurement of the ingress of contaminants and/or particulate (such as dust, dirt, pollen, water, vapor, smoke, etc.) is determined according to the industry standard Ingress Protection (“IP”)

ratings released by the International Electrotechnical Commission. *IP ratings, Int'l Electrotechnical Comm'n*, <https://www.iec.ch/ip-ratings> (last visited Aug. 29, 2023). The IP code is comprised of two numerals, the first represents the extent to which an electrical system is closed to solid contaminants, and the second represents the extent to which an electrical system is closed to water. A person of ordinary skill in the art would look to an enclosure meeting at least the level 5 for solids (“dust protected”) and level 5 for water (“protected against water jets”) to be “substantially free from contaminants and/or particulate.” Absent a disclosure of an IP rating, a POSITA would look for terms such as “sealed” or “dust-free” to know the enclosure meets the essentially isolated from ambient air requirement.

IEC Making electrotechnology work for you.

Ingress protection (IP) ratings guide

IP ratings are represented by combining the first and second digits of the below columns

1 st numeral - solid foreign objects			2 nd numeral - water		
0	No protection		0	No protection	
1	Protected against solid foreign objects of 50 mm Ø and greater		1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects
2	Protected against solid foreign objects of 12.5 mm Ø and greater		2	Protected against vertically falling water drops when enclosure tilted up to 15°	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15° on either side of the vertical
3	Protected against solid foreign objects of 2.5 mm Ø and greater		3	Protected against spraying water	Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects
4	Protected against solid foreign objects of 1.0 mm Ø and greater		4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects
5	Dust-protected		5	Protected against water jets	Water projected in jets against the enclosure from any directions shall have no harmful effects
6	Dust-tight		6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects
Example: IP 65 → Protected against water jets → Dust-tight			7	Protected against the effects of temporary immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time
			8	Protected against the effects of continuous immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more severe than for numeral 7
			9	Protected against high pressure and temperature water jets	Water projected at high pressure and high temperature against the enclosure from any direction shall not have harmful effects

93. Karppanen does not provide sufficient disclosure as to the contents of either the display casing or device casing to teach and enable a person of ordinary skill in the art to create a seal sufficient to prevent substantial dust from entering the display. Instead, Karppanen makes only cursory reference to the casings being “weatherproof” and “closed.” See Ex. 1006, Karppanen, Abstract, 6:16-21. A person of ordinary skill in the art would not understand these disclosures as teaching Karppanen’s system as “essentially isolated from ambient air” as required.

94. For example, none of the IP ratings specially correspond to the concept of “weatherproof.” “Weatherproof” in the art is a generic term that refers to the ability to resist vertically falling water (rain). In the IP scale, this would refer at most to the 1-2 range of the second digit describing water ingress. Further, “weatherproof” is not informative regarding the first digit describing solid object ingress. There are many common objects that are considered “weatherproof” but are not rated to the extent that they prevent substantial dust and/or water from entering. For example, outdoor electrical socket protectors are marketed as “weatherproof” but only rated to the lower scale of the IP system.

95. Nor does Karppanen’s reference to “closed” casings provide any guidance regarding the composition of gas within the closed loop. When Karppanen uses the term “closed,” it refers to the position of the casing being shut,

i.e., not open for maintenance. *See, e.g.,* Karppanen, 7:7-11 (“In normal use, the display casing and the device are turning against each other to a **closed** position and locked to each other by locking means 18 on one side of the casings. In the **closed** position, there remains a cooling space 20 . . .”). Nor does the statement that Karppanen includes “vibration attenuating sealing elements” meet the essentially isolated term because those elements merely protect the front glass from normal vibration stressors for outdoor environments.

96. Further, Karppanen consistently refers to the contents of the display casing, device casing, **and** the cooling space between the two as containing air. *See* Karppanen, 8:6-7 (“enabling the circulation of **air** between the walls of the display casing and the outer surface of the display element”), 8:19 (**air** of the cooling space), 10:20-30 (describing **air** as the cooling medium in the display casing). Because there is no different description as to the contents of the three airflow pathways, there is no disclosure sufficient to enable a person of ordinary skill to create a closed loop that contains isolated gas.

97. Neither Petitioner nor its expert provides analysis as to how Karppanen teaches creating a closed loop **of isolated gas**. Nor do they provide any explanation of how Karppanen might be modified using the knowledge of one of skill in the art or in combination with a secondary reference to disclose “a closed loop **of isolated gas**.” Nor could they, as Karppanen has already claimed to have

solved the problem of cooling a display in an outdoor environment. A person of skill in the art thus would not be motivated to modify Karppanen’s design as the problem allegedly solved by the modification has already been provided by Karppanen.

2. Karppanen does not disclose “an open loop of ambient air that passes through the housing and along the backlight” as required by claim 12.

98. Independent claim 12, which specifically claims an LCD as the electronic display, recites “an open loop of ambient air that passes through the housing and along the backlight.” This claim limitation refers to the teaching in the specification that the open loop of ambient air passes directly along the backlight—or rear surface of the display in the case of other electronic display types—to provide increased and direct cooling to that heat source. *See* ’287 Patent, 4:47-54.

99. Karppanen describes an external airflow pathway located along and between the walls of the display casing and device casing. *See* Karppanen at Abstract, Figure 1. As shown in Figure 2, the wall 22 of the display casing is spaced apart from the rear of the electronic display 26. As Petitioner and its expert note, the back portion of the electronic display 26 comprises the backlight including the thermal heat plate. *See* Petition at 30-31; Smith-Gillespie Declaration at ¶ 112-14. As Petitioner and its expert annotate in Figure 2, the closed loop

airflow travels around the display, including the rear surface/backlight of the display. Petition at 33; Smith-Gillespie Declaration at ¶ 118 (annotating Karppanen Figure 2 in green to show the alleged closed loop).

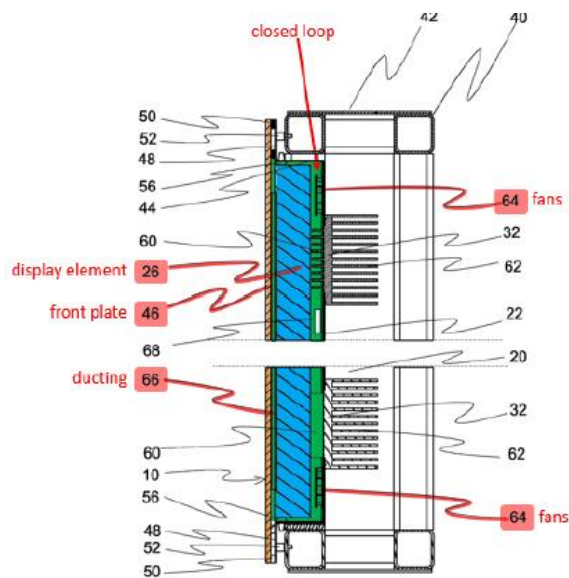
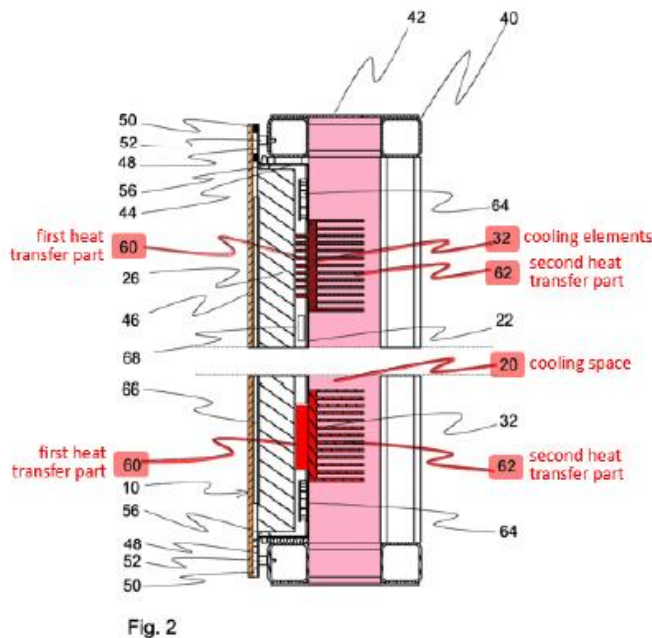


Fig. 2

100. Thus, the **closed loop** of air in Karppanen flows along the backlight/rear surface of the electronic display. The ambient airflow pathway, by contrast, flows along the walls of the display casing and device casing. Petitioner and Smith-Gillespie annotate Figure 2 in pink to show the ambient airflow pathway, flowing within cooling space (20) and along display casing wall (22). Petition at 34; Smith-Gillespie Declaration at ¶ 119 (annotating Karppanen Figure 2 in pink to show the open loop).



101. Thus, Karppanen does not teach open loop ambient air that passes along the backlight. Petitioner’s expert argues that because one side of cooling elements 32 touches the rear surface of the display, then the other side of the cooling elements 32 extends on the *other* side of the display casing wall into the cooling space, a person of skill in the art would understand the air in the cooling space travels *along* the backlight (rear surface) of the display. Smith-Gillespie Declaration at ¶ 119-20, 134, 167. I disagree, and in my opinion, a person of skill in the art would not agree with Petitioner. Rather, a person of skill in the art would not look at air traveling along fins, which are attached to a separation wall, and that separation wall is then attached to a set of another fins on the other side, and those fins touch glue (or some other thermal interface material) that affix them to a rear surface of a display on the other side to mean traveling “along” that rear surface.

There are simply too many intervening structures for a reasonable person skilled in the art to make such a conclusion.

102. Instead, Smith-Gillespie argues that the air in the cooling space 20 is “thermally connected” to the display within the display casing. Smith-Gillespie Declaration at ¶ 119-20, 123. A person of skill in the art would not read “along” to mean thermally connected, i.e., “in thermal communication with.” In fact, “in thermal communication with” is non-sensical in this context. A person of skill in the art would recognize that all components in Karppanen’s system are “in thermal communication” with each other because thermal energy will transfer from areas of high temperature to areas of low temperature within that system. This sort of heat transfer is nothing more than simple physics. “In thermal communication with” does not provide any meaning as to the extent of transfer that must occur in order to meet this limitation. Petitioner fails to provide any boundaries of that term, and Karppanen does not disclose sufficient information to teach or enable one of skill in the art to understand whether thermal energy is being transferred at a rate sufficient to meet whatever boundaries may exist for that term.

103. Petitioner and its expert have not suggested any modification of Karppanen (either in view of the knowledge of a person of ordinary skill or based on a combination with a secondary reference) that could result in a configuration where the open loop of ambient air passes directly along the backlight of the LCD

display. Nor have Petitioner and its expert suggested a motivation for such a modification. Nor could they. A person of ordinary skill would not expect such a modification/combination would be successful in maintaining the modular design of the display that allows for a separate display housing and the device casing. Instead, the display casing and device casing would be separated by only one wall, facilitating transfer of heat between the display and the electronic components and thwarting the purpose of Karppanen's invention.

3. Karppanen does not disclose “one or more electronic devices for driving the LCD positioned within the rear cooling chamber” as required by dependent claim 15

104. Karppanen explicitly teaches that the electronic components for operating the LCD are located in a separate casing—the device casing—from the display. Karppanen at 3:21-4:4. Thus, the electronic components are not located within the rear cooling chamber of the display casing—which Petitioner maps to the closed loop. The '287 Patent describes a “rear cooling chamber” as a chamber positioned behind the LCD containing the closed loop airflow pathway. *See, e.g.*, claim 14 (“a rear cooling chamber positioned behind the LCD and containing **the** closed loop of isolated gas”); 4:4-7 (“[I]n at least one embodiment the isolated gas cooling chamber 20 comprises a closed loop which includes a first gas chamber 30 and a rear cooling chamber 40”). Thus, the closed loop pathway as mapped by

Petitioner—the display casing—does not contain the electronic components for controlling the display, which are located in a separate casing—the device casing.

105. Petitioner and its expert appear to confuse the issue, arguing that a person of skill in the art would understand that elements necessary for controlling the display *must* be located in the rear cooling chamber of the display casing. See Petition at 39; Smith-Gillespie Declaration at ¶ 136. Petitioner ignores the explicit disclosure of Karppanen that requires the display to be separated from the control elements as described above. Further, Petitioner reads over and conflates the “display casing” with the “device casing”—which is not an accurate reading of Karppanen. See Petition at 39. (“Indeed, Karppanen discloses ‘the **device casing** contains at least the control unit of the information board, the power supply of the control unit and the power supply of the background light of the display.’ (Ex. 1006, 3:32-34.) A POSITA would understand this disclosure to imply that the driver for the backlight is located in the **display casing**.”).

4. Karppanen does not disclose an “intended direction of closed loop isolated gas flow [that] is substantially perpendicular to the intended direction of [the] open loop of ambient air flow” as required by dependent claim 17

106. Karppanen does not disclose a substantially perpendicular airflow between the closed loop and open loop. Indeed, Karppanen is silent as to the direction of the closed loop of gas. Though Karppanen describes horizontal flow ducts 72 through ventilator holes located on the side of the electronic display (see

Karppanen at 4:19-22), Karppanen makes no references as to air flow direction within the display casing.

107. If anything, Karppanen suggests that air in the device casing is flowing parallel to ambient air in the cooling chamber. For example, as shown in Figure 3, the ambient air flows in a horizontal direction through the chamber formed by the flow controllers 70. See Karppanen at Figure 3.

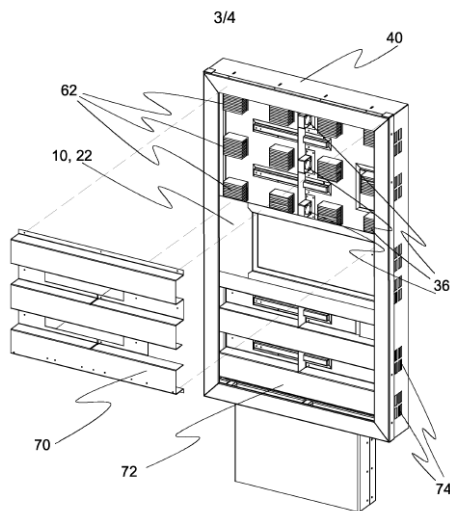
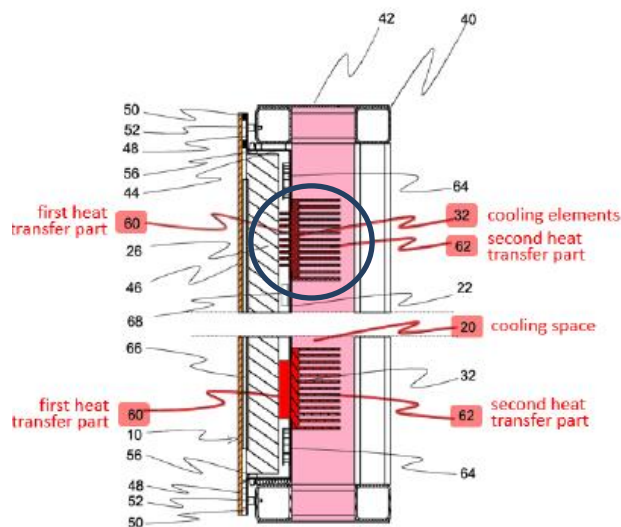


Fig. 3

108. As the air flows in this chamber, it passes horizontally along the fins of the cooling elements 32. As shown in the cross-section annotated by Petitioner, the fins are directed in the same orientation in the “first heat transfer part 60” of the cooling element,⁴ indicating that the air flows in a parallel direction. Petition at 34.

⁴ Finned plates and heat sinks such as shown here in in cooling element 32 are typically manufactured through extrusion. Extruded elements are typically manufactured to have parallel fins due to the limitation of the extrusion processes which allows for the creation of parallel features.



109. The solid “first heat transfer part 60” does not show a configuration where the fins are turned perpendicular to the line of sight. This perspective shows the “first heat transfer part 60” where it is acting as a heat sink, making physical contact with the electronic display back to conduct heat away. See Karppanen at 8:26-36 (naming this form of the “first heat transfer part” and a “conduction element”).

110. On page 34, Petitioner draws a yellow arrow around the display in Figure 2, but offers no citations to any text suggesting that airflow actually travels in this direction. Instead, these annotations are self-serving speculation, and the disclosure of Karppanen does not teach that the two airflow paths should be substantially perpendicular. Further, the mere reference that the cooling space *may* be oriented in a vertical fashion again only refers to the airflow in what Smith-Gillespie maps to the open loop. See Smith-Gillespie Declaration at ¶ 142. Smith-

Gillespie fails to identify any evidence to suggest an intended airflow direction in the display casing, and Karppanen itself is silent as to the airflow direction, as discussed.

111. Finally, Petitioner has not suggested any motivation for a modification of Karppanen that would create a substantially perpendicular airflow. Nor could it as Karppanen already discloses a cooling solution and Petitioner fails to identify any additional cooling benefits in Karppanen offered by creating perpendicular airflow.

5. No Motivation to Modify Karppanen

112. A person of ordinary skill in the art would not have been motivated to modify Karppanen to include any additional airflow features not explicitly or inherently described therein because Karppanen already alleges to have solved the issue of thermal regulation of the electronic information board. Karppanen at 3:8-19.

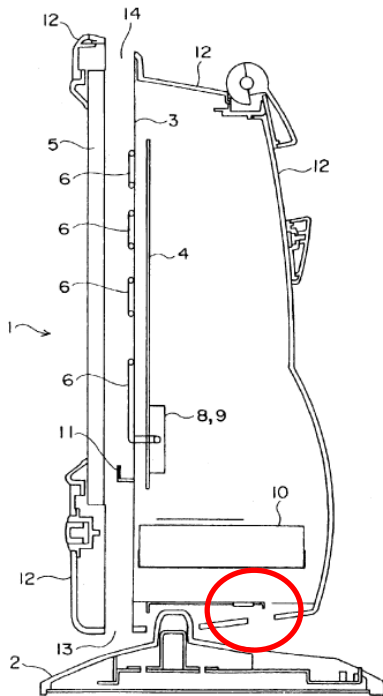
B. Nagashima in view of Karppanen does not render any of the Challenged Claims obvious.

113. In Ground 2, the Petition argues that Nagashima in view of Karppanen renders obvious claims 1, 4-5, 8-12, 14-17, and 21-23 of the '287 Patent. For the reasons provided below, I disagree.

1. Nagashima does not disclose a “closed loop” of “isolated gas” as required by independent claim 12, independent claim 1, dependent claim 22, and their dependent claims.

114. Claim 12 recites a “closed loop of isolated gas” that aids in the cooling of the electronic display. Independent claim 1 and 21 recites a “closed loop” of cooling gas. Claim 4 (which depends on claim 1) and claim 22 (which depends from claim 21) further claim that the “closed loop [of] cooling gas **is isolated**” from ambient air.

115. As discussed above, Karppanen does not disclose a “closed loop” under Petitioner’s proposed construction, or “isolated gas” as it is defined by the lexicography in the ’287 Patent specification. Petitioner and its expert map a “closed loop of isolated gas” to the area between cover 12 and chassis 3 in Nagashima. *See* Petition at 57-60, Smith-Gillespie Declaration at ¶ 213-15. However, in support of its contention that this area is “essentially isolated” from ambient air or the ingress of dust and contaminants, Petitioner focuses on the apparent lack of vents or openings in the chassis 3—only one side of the mapped area. In so doing, Petitioner ignores the clear air inlets that are drawn in the cover 12 in the Figures. *See, e.g.*, Figure 1.



116. As explained earlier, such configurations in all-in-one personal desktop computers were typical at the time because the cooling system for the internal hardware components used fans to create airflow across the heat generating devices. Nagashima at 1:41-51. Thus there would be no motivation to seal this area because it would prevent airflow over the heat generating elements of the display, and it would no longer function as desired. Indeed, Nagashima suggests that the heat radiating fins in Figure 6A, located on the heat receiving head 8 contribute to cooling the hardware components by moving air **through** the cover 12. See Nagashima at 7:27-29 (“[T]he **air cooling** effect by the heat radiating fin secured to the heat receiving head allows the computer to be operated continuously.”); see also Nagashima at 3:8-10 (“FIGS. 6A and 6B are views

illustrating configuration examples for liquid cooling and **air cooling** of a CPU according to the embodiment of the invention;”). Smith-Gillespie similarly notes that the area in the cover contains ambient air. See Smith-Gillespie Declaration at ¶ 215 (“Nagashima must also disclose a gas-containing closed loop gas cooling chamber located within the electronic display housing, because it is a gas pathway within a display housing containing gas (*i.e. ambient air*) . . . ”).⁵ See also Smith-Gillespie Declaration at ¶ 217 (acknowledging the presence of a vent for ambient air in cover 12).

117. Petitioner argues that a POSTIA would combine Nagashima’s cover 12 with the device casing of Karppanen to arrive at a cover 12 that is sealed and essentially free from external or ambient air. As I noted in my discussion of Karppanen above, “closed” and “weatherproof” is insufficient to teach an ordinarily skilled artisan that the area must be essentially free from external air and sealed from dust sufficient to interfere with the components. Further, Karppanen, a reference directed to large display formats, would not inform the structure of a small all-in-one personal desktop computer as taught in Nagashima. First, all-in-

⁵ I note an inconsistency in Smith-Gillespie’s analysis on this element. Throughout the analysis of a “closed loop” within his report, Smith-Gillespie continuously asserts that the closed loop much be “essentially isolated from external air.” However, in Paragraph 215, Smith-Gillespie maps ambient air to “essentially isolated from external air.” See Smith-Gillespie Declaration at ¶ 215 (“Nagashima must also disclose a gas-containing closed loop gas cooling chamber located within the electronic display housing, because it is a gas pathway within a display housing containing gas (*i.e. ambient air*) **that is essentially isolated from external air.**”). A person of ordinary skill would not equate “ambient air” with gas that is “essentially isolated from external air.”

one personal desktop computers are intended for indoor use where dust and contaminants are not a significant concern. Second, the heat in such systems originates from the electrical components—not the display element or environmental sources such as the sun. Thus, it was conventional knowledge that ambient air from the indoor room could be vented across the electrical components to cool the system without damaging the components with excess dust and water. Should the cover 12 be sealed as suggested by Petitioner, the cooler ambient air could not cool the electrical components of the computer and the system would overheat. Third, such all-in-one computer systems include much smaller display elements than would be found in the outdoor display system described by Karppanen. Each of these confirm my opinion that a person of ordinary skill in the art would not modify the all-in-one system described in Nagashima based on the outdoor display system described by Karppanen.

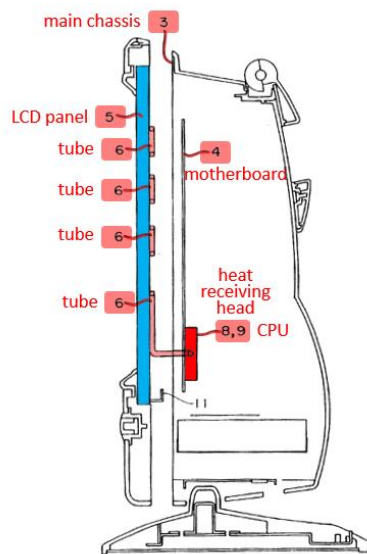
2. Nagashima does not disclose an electronic display that is “coolable by a combination” of a closed loop and an ambient loop airflow pathway as required by independent claim 12, independent claim 1, independent claim 21, and their dependent claims.

118. Independent claim 12 claims an LCD that is “**coolable by a combination**” of “a closed loop of isolated gas which circulates within the housing” and an open loop. Likewise, dependent claim 1 claims that same phenomena where an “electronic display is coolable by a combination of gas circulation within the closed loop gas cooling chamber” and the open loop of

ambient air. Claim 21 also claims the same limitation where “the electronic display is coolable by a combination of closed loop cooling gas circulation” and the open loop of ambient air.

119. Petitioner misreads the disclosure in Nagashima regarding whether the area within the cover 12 cools the LCD panel 5. Petitioner first explains that the area formed between LCD panel and chassis 3 forms a “chimney” for cooling the display. Petition at 63. Petitioner asserts that:

Meanwhile, tube 6 is in conductive thermal communication with the rear cooling chamber formed by main chassis 3 and rear cover 12.



(Nagashima, Fig. 4 (annotated).) Specifically, the tube is attached to the display, thereby transferring heat from the display to the rear cooling chamber containing a closed loop generated by the heat receiving head and fan. The closed loop thus cools the display in this embodiment.

Petition at 63-64 (internal citations omitted).

120. Petitioner fails to recognize that the tube 6 which is attached to the display is intended to ***transfer heat to the display in order to cool the electrical components in the rear compartment.*** Nagashima explicitly states that tube 6 transfers heat from the CPU 9 ***to the LCD panel 5.*** See Nagashima at 5:38-49 (“As shown in FIG. 4, this embodiment is so constructed that a tube goes through a pump, a heat receiving head, and an opening in a main chassis and is fixed on the back surface of an LCD panel ***to form a heat radiating portion. The back surface of the LCD panel is made of a metal material, and the heat of a cooling medium liquid from the tube, . . . can be transferred effectively onto the back surface of the LCD panel and radiated.***”). Thus, this disclosure does not show the tube and heat from the CPU cools the LCD panel. To the contrary, far from cooling, the tube and CPU combination ***heats*** the LCD panel.

121. Finally, the LCD panel 5 in Nagashima cannot be cooled by a combination of an open loop of ambient air⁶ and a closed loop of isolated gas because there is no closed loop of isolated gas.

3. Nagashima does not disclose an “intended direction of closed loop isolated gas flow [that] is substantially perpendicular to the intended direction of [the] open loop of ambient air flow” as required by dependent claims 17 and 5.

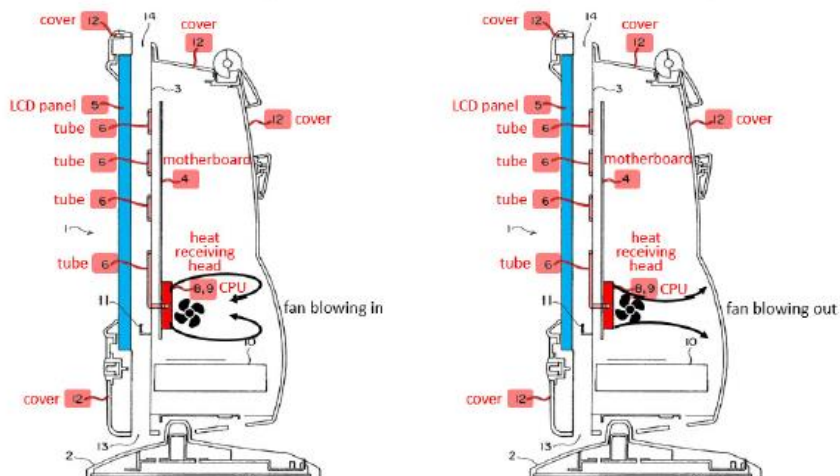
⁶ To the extent that Smith-Gillespie argues that ambient air is “in thermal communication” with the backlight, as I note above, “In thermal communication with” is overly broad and irrelevant. All components within Nagashima are “in thermal communication” with each other because thermal energy will transfer from areas of high temperature to areas of low temperature.

122. Claim 17 (which depends from claim 12) claims an “intended direction of closed loop isolated gas flow [that] is substantially perpendicular to the intended direction of [the] open loop of ambient air flow.” Claim 5 (which depends from claim 1) claims the same intended perpendicular airflow: “gas circulation within the gas cooling chamber will occur in a direction that is substantially perpendicular to the direction that ambient air will flow through the electronic display housing.”

123. Nagashima describes the direction of air flow through the channel defined between the LCD panel 5 and chassis 3. *See* Nagashima at 5:64-6:3. Nagashima does not disclose any direction of any air flow within the cover 12. Petitioner and its expert state that “air within the gas cooling chamber moves substantially in a horizontal direction” regardless of where fans are located in the electronics compartment of cover 12. *See* Petition at 66 (citing to only lines 16 and 17 in column 7 of Nagashima as support for its conclusion), Smith-Gillespie Declaration, at ¶ 232 (parroting the Petition). Nothing in lines 16 and 17 in column 7 of Nagashima indicates any direction of airflow in cover 12. *See* Nagashima at 7:16-17 (“FIG. 6B shows a construction in which a fan is further provided on the heat radiating fin on the heat receiving head.”).

124. In another section of the Petition and declaration, Petitioner and Smith-Gillespie concede that “Nagashima does not disclose the direction in which

air flows from the fan on the heat receiving head 8, . . .” Declaration at 59; Smith-Gillespie Declaration at ¶ 219 (parroting the Petition). Petitioner and Smith-Gillespie then insert a clip art image of a fan at the location of the heat receiving head and annotate the Figure to include two fans that are not shown in the original figure. Petitioner and Smith-Gillespie then includes a further annotation to suggest two possible directions of the air flow created by fans, which were not included in the original figure. See Declaration at 60; Smith-Gillespie Declaration at ¶ 219.



125. First, these are not the only two possible configurations of fan orientation and direction of airflow. Second, this annotation illustrates that there is no **intended** direction of airflow underneath the cover 12. The air flows in a circular direction as annotated by Petitioner and Smith-Gillespie in both configurations: traveling perpendicular to, parallel to, and counter to the flow of air through the channel defined by the LCD panel 5 and chassis 3. A person of skill in the art would not agree that because air travels perpendicularly in one of many

different airflow directions that the air travels *substantially perpendicularly* as required by the claim language.

126. I note another error in the drawings done by Petitioner and Smith-Gillespie of airflow in the cover 12. The chassis 3 is a plate that forms one side of the cover 12. Anytime a plate is located within an air pathway, air necessarily travels parallel to that plate. As a result, the air under cover 12 flows in a substantially parallel direction to the air in the channel between the panel and chassis 3 as it travels along that plate.

127. Even *if* the airflow under the cover 12 were sealed to the extent required by “closed loop” and “isolated gas” as discussed above, there is no intended direction of airflow, let alone a direction that is substantially perpendicular to the direction of air in the channel defined between the LCD panel 5 and chassis 3.

4. No Motivation Modify or to Combine Nagashima with Karppanen

128. A person of ordinary skill in the art would not have been motivated to combine Nagashima with Karppanen.

129. First, the two art references are directed to different fields of art. Nagashima “relates to a desk-top type computer integrated or combined with a liquid crystal display (LCD).” Nagashima at 1:8-9. Specifically, Nagashima sought to solve the problem of cooling the electrical components of the computer without

the need of extra fans which generate noise and vibration. Nagashima at 2:5-16. Karppanen, by contrast, “relates to an electronic information board . . . used by advertisers to pass on information.” Karppanen at 1:3-8. An ordinarily skilled artisan would not look across different fields to combine references.

130. Second, the thermal issues faced by large format information boards in areas of high thermal stress—like those described in the ’287 Patent—are distinct from the thermal issues faced by smaller personal computing devices. Karppanen at 1:18 (describing the size of the displays in Karppanen as “a few square meters”). In large format displays, thermal load is primarily received from ambient temperature, solar radiation when placed outside, the front surface of the electronic display, and the heat from the backlight. In smaller displays, thermal load is primarily received from the electrical components which drive the computer and display systems. Thus, an ordinarily skilled artisan would not look to the smaller format system for cooling methods for the larger format system, and vice versa, because there would be no reasonable expectation that the cooling methods would work. In fact, Nagashima teaches away from adopting the technology in Karppanen, which uses multiple fans to provide cooling needs for the electronic information board. Nagashima at 2:5-10 (advocating for a cooling system that does not use a plurality of fans).

131. Third, the intended location of the Karppanen large format displays and the Nagashima personal desktop computer are distinct. Thus, the environmental concerns of each are distinct. The Karppanen information board is intended to be used in public outdoor places. Karppanen at 1:3-28. The Nagashima desk-top computer is intended to be used in personal indoor settings. Nagashima at Abstract. Concerns for dust and contaminants in indoor, individual settings are not as significant as in public outdoor spaces, and a person of skill in the art would not be motivated to seal the cover 12 and chassis 3 to be essentially isolated from ambient air as is needed in public spaces.

132. Fourth, a person of ordinary skill in the art would not be motivated to combine Karppanen, which focuses of cooling of the display and the display casing, with Nagashima, which teaches moving heat to the display. Nagashima at 5:38-49, Figure 4.

133. Finally, contrary to Petitioner and its expert's assertions, a person of skill in the art would not believe sealing the cover 12 would lead to a successful cooling system. Petition at 77-78, Smith-Gillespie Declaration at ¶ 290. The all-in-one internal desk top computers contained air inlets and exhausts so that fans could transfer the heat from the internal hardware components outside of the computer casing. Eliminating that ambient air cooling system of the electrical components

would cause hot air to recirculate in cover 12, increasing the heat within the cover, and causing stress to the system.

134. Transforming a personal all-in-one desk top computer into a large format outdoor display capable of managing the thermal and environmental stresses of those environments would not be the application of known methods to obtain predictable results as suggested by Petitioner. Instead, such modifications take the limitations of ambient air cooling of the backlight and closed loop cooling of electrical components and apply hindsight in combining the two references to reach the Challenged Claims. In my opinion there is no motivation to make this combination for the reasons discussed above.

C. Ohta and Marumoto / Ohta and Marumoto in further view of Yare

135. In Ground 3, the Petition argues that Ohta in view of Marumoto renders obvious claims 1, 4, 5, 8-23 of the '287 Patent. For the reasons provided below, I disagree.

136. In Ground 4, the Petition argues that Ohta in view of Marumoto, and further in view of Yare, renders obvious claims 1, 4, 5, 8-23 of the '287 Patent. For the reasons provided below, I disagree.

137. As an initial matter, I note that Ohta and Marumoto, alone and in combination, fail to disclose nearly every element of the Challenged Claims. Smith-Gillespie suggests that a person of ordinary skill in the art would be

motivated to extensively modify Ohta and Marumoto in Grounds 3 and 4, including (1) adding a housing, (2) replacing a plasma display with an LCD, (3) replacing liquid with gas in a “closed loop,” (4) moving an open loop from the front surface of the display to the backlight, (5) placing electronic components for driving the display (which are not mentioned in either reference) in a newly created closed loop of gas, and (6) creating perpendicular airflow.

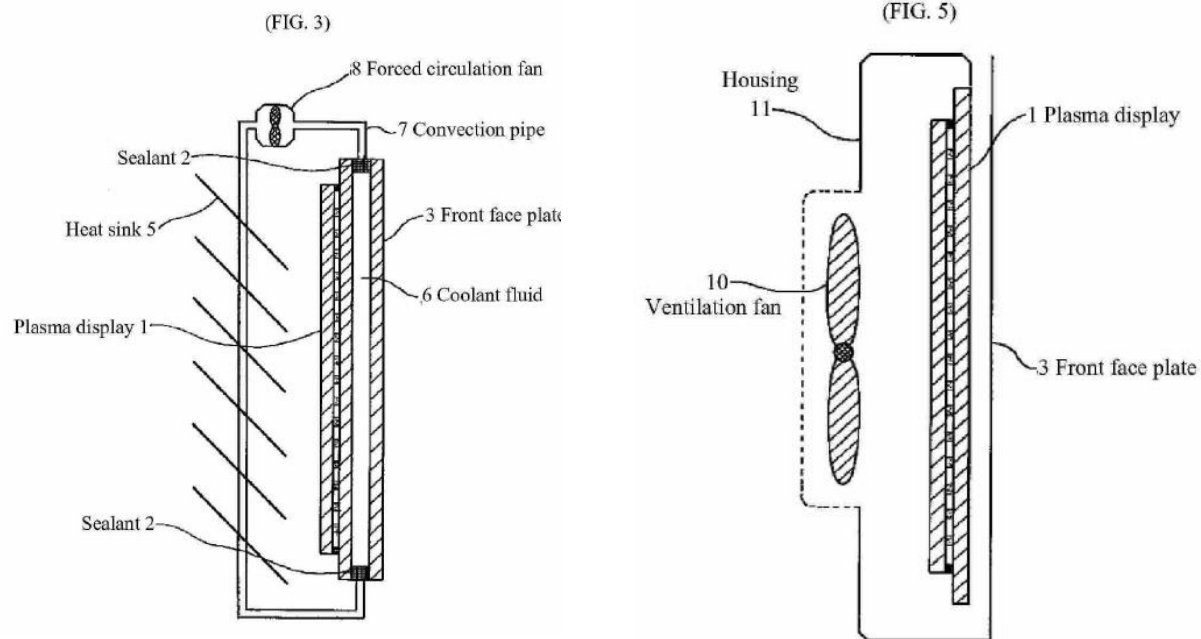
138. These extensive modifications demonstrate that Smith-Gillespie is relying upon the Challenged Claims as a roadmap to lead to his desired combination rather than relying on an independent motivation to make the combination. I understand that such a substantial redesign is evidence that the claimed invention is not obvious. In my opinion Smith-Gillespie is relying upon a hindsight rationalization using the claims as a roadmap to lead to his desired combination.

1. Ohta does not disclose “a housing” as required by independent claim 12, independent claim 18, independent claim 21, and their dependent claims.

139. Claim 12 recites a “housing” in which the LCD is positioned. Claim 1 and 21 claim the same structure: “an electronic display housing.”

140. Example 3 of Ohta does not include a housing. Petitioner does not argue example 3 discloses a housing. Instead, in Ground 3, Petitioner argues a person of skill in the art would substitute the housing 11 in example 5. Petition at

79. However, the housing as described in example 5 would not function as needed within example 3 because the housing in example 5 provides an opened space between the LCD front surface and the front glass plate for ambient air to pass over the surface of the LCD. Example 3, by contrast, requires that area to be sealed so that the liquid ethylene glycol may flow through the channel between the LCD front surface and front glass plate. *Compare* Ohta at Figure 3,⁷ *with* Ohta at Figure 5.



⁷ In paragraph 310 of his report, Smith-Gillespie states that Figure 3 of Ohta is “nearly identical” to Figure 2 of the ’287 Patent. I disagree. Figure 3 shows a convection *pipe*, with liquid flowing through the pipe that connects both sides of the sealed chamber in front of a plasma display. Figure 2 of the ’287 Patent, does not disclose a pipe but a plenum that travels around the rear surface of and LCD panel and forms a constricted channel between the backlight and surface of plenum. There is no fluid shown.

141. Integrating the housing of example 5 into example 3 would not work because the open structure of the housing at the front of the display would cause the liquid in example 3 to leak out of the system.

142. In Ground 4, Petitioner argues a person of skill in the art would combine Ohta—and the extensive suggested modifications to it—with the cabinet system in Yare. Petition at 105-107. Yare describes a cabinet for a fully formed display product. Yare at 1:4-6, 2:15-17. The fully formed display product is referred to as an electronic display assembly in the Challenged Claims, and that electronic display contains a housing and an LCD (or electronic display). *See* '287 Patent, claim 12, 1. Yare calls for a fully formed display product (or electronic display assembly) that includes its own housing and internal cooling system. Yare at 1:4-6, 2:15-17. The fully formed display product is placed into a cabinet that increases the cooling capabilities of the display product and protects it from ambient dust in a busy public space. The cabinet itself does not provide a housing for the LCD or electronic display, it is merely a protective enclosure. Thus, Yare itself does not provide any housing for an electronic display as required by the Challenged Claims.

2. Ohta does not disclose “a liquid crystal display (LCD) positioned within the housing and having a backlight” as required by claim 12.

143. Claim 12 requires an LCD—including a backlight—be positioned within the electronic display housing.

144. Ohta does not disclose an LCD with a backlight. Instead, Ohta is exclusively directed to a plasma display. Petitioner argues a person of skill in the art would be motivated to combine Marumoto—which teaches an LCD display—with Ohta. Petition at 90-91.

145. However, replacing the plasma display in Ohta requires more than a mere simple substitution of the display type. An LCD requires a backlight assembly—requiring modification of the housing and structural support elements and adding heat to the system. The colored glass and liquid in example 3 of Ohta—which passes over the front surface of the display—would reduce the visibility of the LCD display. Modifying the LCD module to include a more powerful backlight would require even more intensive modifications, including disassembling the module itself, reconfiguring the electronics for the display, and determining additional methods to cool the added heat generated by the more powerful backlight. Modifying Ohta with Marumoto would thus provide a less clear display and hotter system, which would teach a person of ordinary skill in the art away from making this combination.

146. Additionally, a person of ordinary skill in the art would not be motivated to replace a display containing a plasma display with an LCD display for

the following reasons: (1) Plasma displays during the time of the invention had superior contrast – since each pixel emits its own light, and can be turned off, it can create true black colors and better contrast than LCD TVs, which rely on a back-light and thus cannot generate true black colors (because Liquid Crystals of the LCD do not block all light) (2) Broader viewing angle – Plasma TVs at that time had much wider viewing angle than the LCD TVs. (3) Better response rate – Plasma TVs are better for handling fast moving objects—e.g. sports.

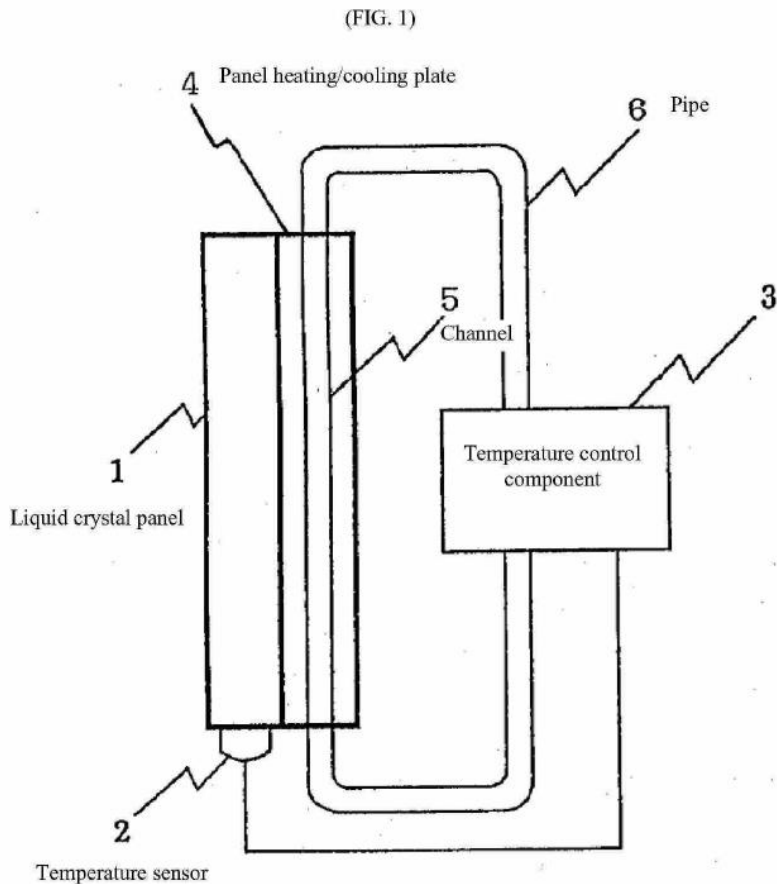
147. Further, the simple disclosure that Marumoto describes an LCD needs to be cooled does not provide a motivation to replace the plasma display in Ohta with an LCD. See Smith-Gillespie Declaration at ¶ 351. As Smith-Gillespie notes, Marumoto is directed to cooling the backlight of an LCD panel, a distinct cooling need from Ohta’s design of cooling the front surface of the plasma display. Because the cooling needs are different, a person of skill in the art would not be motivated to combine the two references which are directed to distinct cooling needs of distinct display types.

3. Ohta does not disclose “a closed loop of isolated gas which circulates within the housing” as required by independent claim 12, independent claim 1, independent claim 21, and their dependent claims.

148. Claim 12 recites “a closed loop of isolated gas which circulates within the housing.” Claim 1 recites the same closed loop gas pathway within the housing: “gas-containing closed loop gas cooling chamber located within the

electronic display housing . . .” Likewise, claim 21 claims the same internal closed loop gas structure: “a closed loop of cooling gas adapted for circulation within the electronic display housing; . . .”

149. Ohta does not disclose a closed loop of circulating gas within the housing within any of its examples. Instead, Ohta discusses only a closed loop of liquid—ethylene glycol—or an open loop of *external air* that passes over the front surface of the plasma display. *Compare* Ohta at (0018)-(0024), Figure 3, with (0030)-(0035), Figure 5. Petitioner does not argue Ohta discloses a closed loop of circulating gas. Instead, Petitioner argues that combining Ohta with Marumoto would create a closed loop gas pathway within the housing. Petition at 80-81. However, a person of ordinary skill in the art would not believe this combination would be reasonably successful because the closed loop of gas in Marumoto is configured to pass along the backlight. *See* Marumoto at Figure 1.



150. The integration of this closed loop would foreclose the ability of ***ambient air*** to pass along the backlight as also required by claim 12. See '287 Patent claim 12 (“***a combination of a closed loop of isolated gas which circulates within the housing and an open loop of ambient air which passes through the housing and along the backlight.***”).

151. Additionally, Petitioner and its expert point to no problems in either Ohta or Marumoto that would prompt a person of ordinary skill to look outside of the reference to modify either reference. Instead, Smith-Gillespie points to problems that would be created *by* combining the two references (problems with

liquid leaking and reduced visibility from the colored glass and liquid) to further modify both references. Smith-Gillespie Declaration at ¶ 306.

4. Neither Ohta nor Marumoto disclose “an open loop of ambient air which passes through the housing and along the backlight” as required by claim 12.

152. Independent claim 12, which specifically claims an LCD as the electronic display, recites a “an open loop of ambient air that passes through the housing and along the backlight.” This claim limitation refers to the teaching in the specification that the open loop of ambient air passes directly along the backlight—or rear surface of the display in the case of other electronic display types—to provide increased and direct heating to that heat source. *See* ’287 Patent, 4:47-54.

153. Ohta does not describe an open loop of ambient air that travels along the backlight of an LCD. Again, Ohta describes only a plasma display, which does not have a backlight. Ohta describes only one external airflow pathway—and that pathway flows along the front surface of the plasma display in example 5.

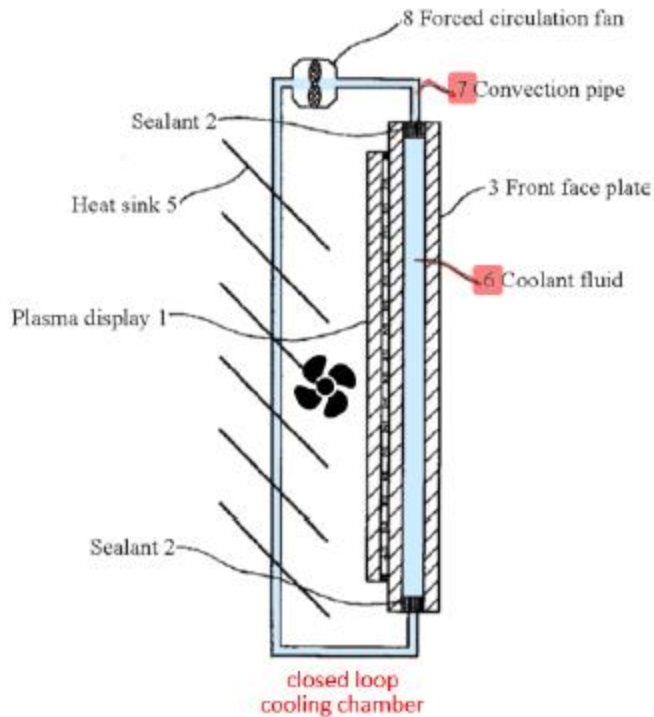
154. Petitioner and its expert point to Ohta’s disclosure that the tube 7 which contains circulating ethylene glycol may also have heat sinks 5 located along the tube. *See* Ohta at (0019); Petition, at 91-92; Smith-Gillespie Declaration at ¶ 335. Ohta describes that these heat sinks are naturally air-cooled (cooled with convection without the use of fans as described in the background). Ohta at (0024).

However, Ohta notes that “it is acceptable for the heat sink to be forcibly air-cooled.” This statement is the extent of Ohta’s disclosure as to how the heat sinks may be cooled. Ohta does not discuss the location of the heat sinks within the overall configuration of a housing (in fact it does not discuss a housing with respect to this example) and whether those heat sinks would be proximal or along the backlight or not. Ohta does not discuss whether it is ambient air or enclosed air that *may* be used in an acceptable forced cooling configuration. Such a disclosure is insufficient to provide a motivation for a person of ordinary skill to create a pathway for ambient air through a housing and along a backlight of the LCD.⁸

155. Further, Petitioner already suggested a modification of Ohta with the LCD and gas tube of Marumoto which would place the mapped closed loop of gas to the chamber directly behind the backlight—preventing ambient air from traveling along the backlight. As I explained above, this modification is unsupported and improper. In this additional modification, Petitioner and its expert again insert a clip art fan image in a self-serving location within Figure 3 and assert that a “POSITA in March 2008 would have understood this disclosure to require cooling of the heat sinks using open loop ambient air provided by a fan.”

See Petition at 83; Smith-Gillespie Declaration at ¶ 313.

⁸ I also note that there is insufficient disclosure here of any open air flow pathway. Thus there can be no disclosure of the open airflow pathway being “in thermal communication” with any backlight that is added into the Ohta system.



156. Petitioner points to no disclosure within Ohta or the knowledge of an ordinarily skilled artisan to support this leap from the minimal disclosure of Ohta to support this conclusion. Nor could they. Ohta only describes a tube for cooling the front surface of a plasma display. Though Ohta mentions in a cursory fashion that there may be a heat sink somewhere in the system, Ohta never describes where this heat sink would be located, and what kind of airflow would be directed over that heat sink. Petitioner improperly applies hindsight after reviewing the novel aspects of the '287 Patent, and assumes there would be direct ambient air cooling of the backlight in order to cool the overall display.

5. Neither Ohta nor Marumoto disclose “coolable by a combination” of a closed loop and an ambient loop airflow pathway as required by claim 12

157. Petitioner suggests many modifications of Ohta and Marumoto to arrive at a display housing with a closed loop of circulating gas within the housing and an open loop of ambient air which passes along the backlight. Petitioner and its expert omit any analysis as to how these many modifications would cool the electronic display. In my opinion Ohta, even modified with Marumoto, does not disclose a display that is coolable by both a closed and open loop system because each of the embodiments pointed to by Petitioner in Ohta and Marumoto describe either a closed loop of gas or liquid. In my opinion a person of ordinary skill in the art would recognize that none of the loops described in either of these two references are in the configuration required by claim 12, i.e., “a closed loop of isolated gas which circulates within the housing and an open loop of ambient air which passes through the housing and along the backlight.”

6. Neither Ohta nor Marumoto disclose “electronic components for driving the LCD positioned within the rear cooling chamber” as required by dependent claim 15 or dependent claim 9

158. Claim 15 (which depends from independent claim 12) claims “electronic components for driving the LCD positioned within the rear cooling chamber” of the closed loop. See Part XI.A.3. Claim 9 (which depends from claim 8, which further depends from claim 1) likewise claims electronic devices **for driving or operating** the electronic display located within the closed loop chamber:

“one or more electronic devices for operating the electronic display positioned within the sealed plenum.”

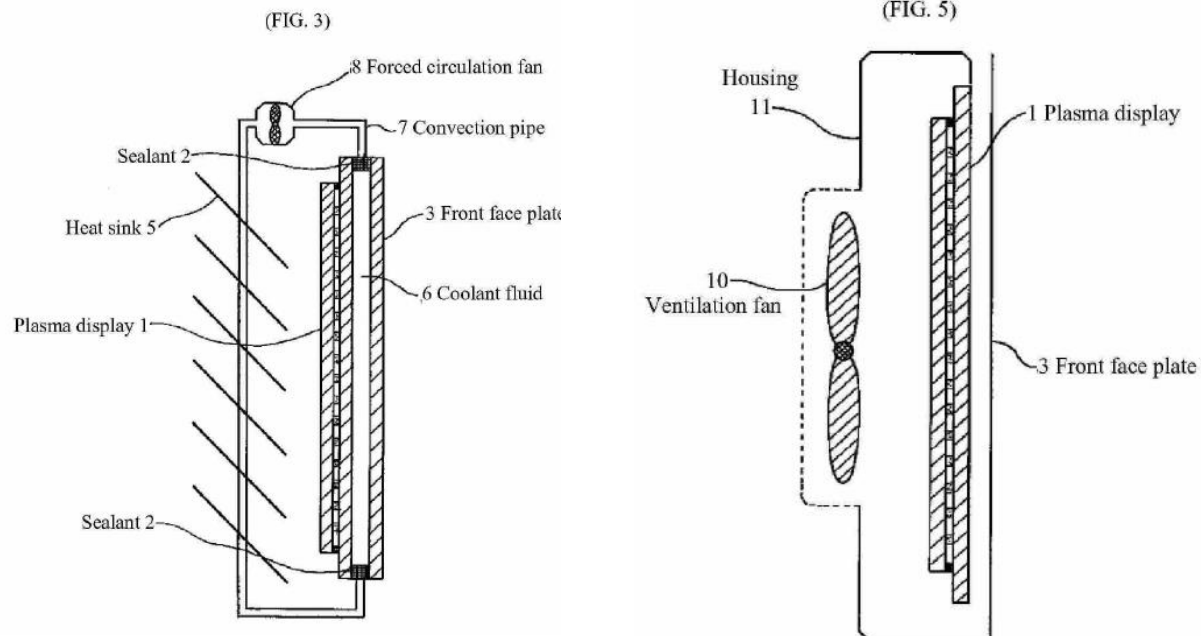
159. Ohta does not discuss the location of the electrical components for driving the plasma display (let alone an LCD display which would require distinct electrical components for controlling the backlight and light source). Ohta only mentions, in a cursory fashion, the presence of a drive circuit for the electronic display in paragraph 19: “The forced circulation fan 8 is furnished with a temperature detection device such as a thermostat or the like to detect temperature of the plasma display panel 1 and an external power supply (*which may be shared with the drive circuit of the plasma display panel*) to drive the fan.” That a power supply **is shared** with the circuitry which drives the plasma display does not inform a person of ordinary skill in the art that the circuitry which drives the display is located in the closed loop of liquid ethylene glycol. In fact, a person of skill in the art would read that the tube 7 which contains a liquid could not contain the circuitry for driving an LCD display, which requires a dry environment so that the integrity of the circuitry is maintained.

7. Ohta does not disclose “the intended direction of closed loop isolated gas flow is substantially perpendicular to the intended direction of open loop of ambient air flow” by dependent claim 17 or by the substantially similar limitation in dependent claim 5.

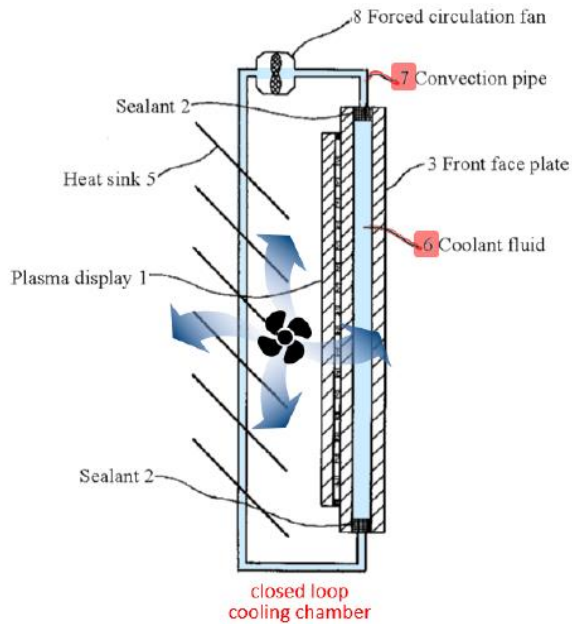
160. Claim 17 (which depends from claim 12) claims an “intended direction of closed loop isolated gas flow [that] is substantially perpendicular to the

intended direction of open loop of ambient air flow.” Claim 5 (which depends from claim 1) recites the same substantially perpendicular direction of the ambient airflow in the open loop and direction of the isolated gas in the closed loop: “the closed loop gas cooling chamber and the ambient air pathway are configured such that gas circulation within the gas cooling chamber will occur in a direction that is substantially perpendicular to the direction that ambient air will flow through the electronic display housing.”

161. As discussed above, Ohta does not disclose two airflow pathways within one embodiment. Further, even *if* there was a sufficient disclosure in Ohta to conclude there are two airflow pathways, one of which was ambient air and one of which was closed, there is zero disclosure as to the direction of any liquid or airflow pathway. *All* that is described in example 3 (Figure 3) and example 5 (Figure 5) is that ethylene glycol or air flows across the front surface of the electronic display without any indication of direction.



162. The direction of liquid or airflow could be in any potential direction, e.g., horizontal, vertical, or otherwise. Ohta is simply silent as to this issue, and Petitioner offers no support for why a specific direction would be given. Further, there is zero discussion as to the direction of “forced convection” across the heat sinks. Instead, Petitioner again draws self-serving arrows on top of Figure 3 to support its unsupported conclusion that air flows in an intended substantially perpendicular direction. Petition at 87. As noted earlier, merely because air may flow in a perpendicular fashion *at some point* does not mean the air travels in a *substantially perpendicular direction*. Substantially perpendicular direction requires a mostly perpendicular direction.



163. Marumoto is likewise silent as to the direction of airflow within the overall display product and its relation to any other airflow. Petitioner again uses the features of the claims to provide a road-map to generating a combination of references that meets the claim element. This motivation is driven by hindsight. Neither Marumoto or Ohta disclose the claimed configuration, and the Petition does not offer any reason to modify these references such that they would have this configuration.

8. No Motivation to Modify or Combine with Marumoto or Yare

164. As I initially explained, in order to teach all of the claimed limitations in the '287 Patent, Ohta and Marumoto or Ohta, Marumoto, and Yare would have to be combined *and* modified in at least five ways: (1) adding a housing, (2) replacing a plasma display with an LCD, (3) replacing liquid with gas in a closed

loop, (4) moving an open loop from the front surface of the display to the backlight, (5) placing electronic components for driving the display (which are not mentioned in either reference) in a newly created closed loop of gas, and (6) creating perpendicular airflow.

165. A person of ordinary skill in the art would not have been motivated to combine Ohta with either Marumoto or Yare. First, Ohta is directed to a different field of art than either Marumoto or Yare. Ohta “relates to a cooling device for [a] plasma display panel” needed to overcome the excess heat generated by the panel itself and the resulting low luminosity in any environment. Ohta at (0001)-(0003). Marumoto and Yare, by contrast relate to LCD panels in outdoor environments or in large information board formats. See Marumoto at (0003)-(0004); Yare at 1:4-6. The cause of thermal load in a large format outdoor LCD display is different from that of an ordinary indoor plasma screen, and a POSITA would not have been motivated to look for cooling solutions across the different classes/sizes/uses of the electronic displays. Additionally, Ohta teaches the use of a cooling liquid, ethylene glycol, that is sealed in contact with the plasma screen and used to bring heat away from the surface of the screen. In my opinion a POSITA would not have been motivated to use the same liquid coolant system with large format or outdoor displays because it would take prototyping and experimentation to get the liquid, glass, and display brightness operable for a large format outdoor display. See Part

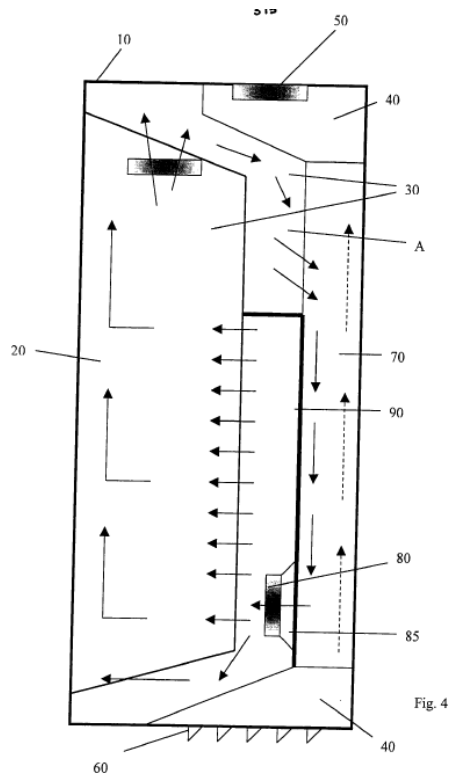
XI.C.2 above. The reasons are numerous, including (1) the difficulties performing the regular maintenance needed on those displays, (2) complying with environmental and health standards, and (3) other fundamental differences between liquid cooling systems and gaseous cooling systems. These differences teach away from making the combination and mean that a person of ordinary skill in the art would not have a reasonable expectation of success in making the combination.

166. Further, Smith-Gillespie’s assertion that the temperature control component 3 in Marumoto qualifies as an “electronical component for driving the LCD” as required by the ’287 Patent is incorrect. See Smith-Gillespie Declaration at ¶ 410. Smith-Gillespie confuses the concept that two components share a common power source with the idea that both components themselves drive the LCD or electronic display. Smith-Gillespie is incorrect that the presence of a temperature sensor—an integral part of the cooling system itself—would motivate a person of skill in the art to place the circuitry of the LCD panel within the small tube that contains the cooling liquid or gas of Marumoto. Further, a person of skill in the art would be *dissuaded* from such modification because of the disclosure in Marumoto that the cooling material may be a liquid.

167. Petitioner and its expert state a person of skill in the art would be motivated to combine Marumoto and Ohta to “protect it from solar load when placed outdoors.” Petition 105, Smith-Gillespie Declaration, at ¶ 412. Nowhere in

either Ohta or Marumoto is there any disclosure as to placing the display in an outdoor setting or including a large format display. Further, Petitioner and Smith-Gillespie’s statement that Ohta’s suggestion of forcibly cooling a heat sink “discloses a way to cool the backlight of the LCD”—where Ohta only discusses a plasma screen—is incorrect. Petition 105, Smith-Gillespie Declaration, at ¶ 412.

168. I further disagree with Smith-Gillespie that a person of ordinary skill in the art would be motivated to place Ohta as modified by Marumoto inside of the Yare cabinet. Yare describes a cabinet that includes additional structures not disclosed in either of Ohta or Marumoto—namely a heat exchanger and pressure system. Further, Yare does not disclose any ducting or tubes in the housing or its cooling systems as required by Ohta and Marumoto. Nor does Yare teach how the ambient air can be configured to move along the backlight. Instead, Yare describes an atmospheric zone that is separated from the rear surface of the display (20) (and the backlight that would be located within that display if it was an LCD) by the pressurized zone (85), baffle plate (90), and heat exchanger (70). *See e.g.*, Yare at Figure 4.



169. A person of ordinary skill in the art would not modify Yare to include tubes for gas and moving the atmospheric zone to travel along the backlight of display 20—which has its own internal cooling system. Further, Yare’s cooling system is based on circulating air. There is no suggestion in Yare that a person of ordinary skill in the art could instead use a liquid based cooling system, nor would such a system be readily combinable with Yare for the reasons I discuss above.

170. Finally, a POSITA would not have been motivated to combine or modify Ohta because Ohta already alleges to have solved the issue of thermal regulation of the plasma screen. Ohta at (0021). The same is true for Marumoto and Yare, which both claim to have solved the problem of thermal load in outdoor or large format LCD screens. Marumoto at (0015); Yare at 2:5-17.

D. Kitamura and Harris

171. In Ground 5, the Petition argues that Kitamura in view of Harris renders obvious claims 12-20 of the '287 Patent. For the reasons provided below, I disagree.

1. Kitamura does not disclose “a liquid crystal display (LCD) positioned within the housing and having a backlight” as required by independent claim 12 and its dependent claims.

172. Independent claim 12 requires that the electronic display is an LCD with a backlight: “An electronic display assembly comprising: . . . a liquid crystal display (LCD) position within the housing and having a backlight; . . .” '287 Patent, claim 12. *See also* claim 13 (“the isolated gas will cool a front surface of the **LCD**”); claim 14 (“a rear cooling chamber positioned behind the **LCD**”); claim 15 (“one or more electronic components for driving the **LCD**”).

173. Kitamura does not teach or disclose an LCD positioned within the housing and having a backlight. Kitamura exclusively relates to a direct view LED display. Petitioner argues a person of skill in the art would substitute the LCD and backlight of Harris for the LED display in Kitamura. I disagree.

174. The LCD module display described in Harris makes use of a compact fluorescent backlight. Harris at 5:41-61. The display size in Harris is small and intended for a personal computing monitor. *See*, Harris at 4:10-13. Even at such a small size, the draw of the fluorescent lighting is 29 watts. Harris at 5:55-61.

Should this LCD and backlight be substituted into the Kitamura display system, which is intended by a larger format information display (see Kitamura at (0004), (0007)) many additional light sources—with corresponding additional power and heat output—would be required. Accordingly, substituting the LED display (where each LED in the direct view emits its own light) with the LCD in Harris would require the multiplication of fluorescent light sources, increasing the thermal load on the system and drawing even more electrical energy to run the system. These changes would necessarily require significant additional cooling capacity than what is already contemplated in Harris. This would teach away from making such a combination.

175. Additionally, the change from a direct view LED display to an LCD with a fluorescent backlight would cause a decrease in brightness of the display and a slower response rate in the images. Further, the fluorescent bulbs would have a shorter life than the LEDs, causing the need for maintenance—the avoidance of which is an explicit teaching of Kitamura. Kitamura at (0007)-(0008). Each of these drawbacks would discourage a person of ordinary skill in the art from making this combination.

2. Kitamura does not disclose a “closed loop” of “isolated gas” as required by independent claim 12, independent claim 18, and their dependent claims.

176. Claim 12 and claim 18 recite a “closed loop of isolated gas” that aids in the cooling of the electronic display.

177. Petitioner and its expert state that the “inner housing 17 in Kitamura is ‘hermetically sealed’ due to the convective cooling facilitated by the fins located on the outer surface of inner housing 17 and the inner surface of duct 28.” Petition at 110; Smith-Gillespie Declaration at ¶ 435. That there are cooling fins on a surface does not teach or disclose anything regarding the content of the gas or liquid within a cooling system. Ambient air, isolated air, and even liquid can be used in forced cooling systems.⁹ The fins Petitioner points to are not located within the inner housing—the space Petitioner maps to the “closed loop.” The presence of these fins cannot inform a person of skill in the art as to the contents of an area where those fins are not located.

178. Petitioner and its expert ignore the disclosures in Kitamura that suggest external air flowing through the space between the inner and outer housing may be entering the inner housing area. See Kitamura at (0009) “an inner housing which has a opening on the front side that is covered by a screen . . . and ***ventilation ports, which are provided on the left and ride sides, top and bottom sides, an back side of the aforesaid inner housing, and which serve the ventilate the interior of the aforesaid inner housing; . . .***”); see also claim 1. This

⁹ See Ex. 1026 (Allan W. Scott, *Chapter 4 Forced Air cooling and Chapter 5 Forced Liquid Cooling*, Cooling of Electronic Equipment (1974)).

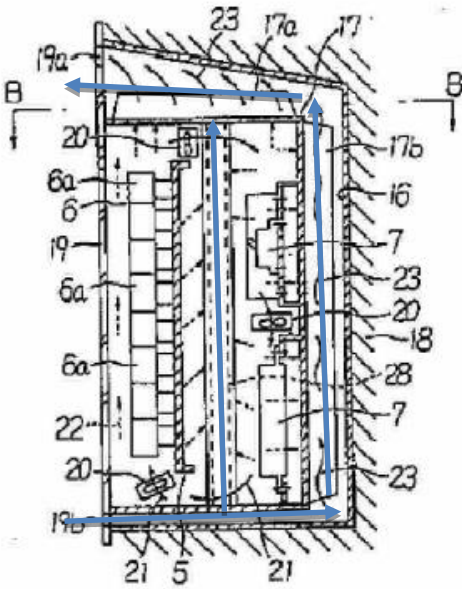
disclosure confirms that Kitamura does not disclose a “closed loop” of “isolated gas” as is required.

3. Kitamura does not disclose “an open loop of ambient air which passes through the housing and along the backlight” as required by independent claim 12.

179. Independent claim 12 claims an LCD as the electronic display, recites “an open loop of ambient air that passes through the housing and along the backlight.” This claim limitation refers to the teaching in the specification that the open loop of ambient air passes directly along the backlight—or rear surface of the display in the case of other electronic display types—to provide increased and direct heating to that heat source. *See* ’287 Patent, 4:47-54.

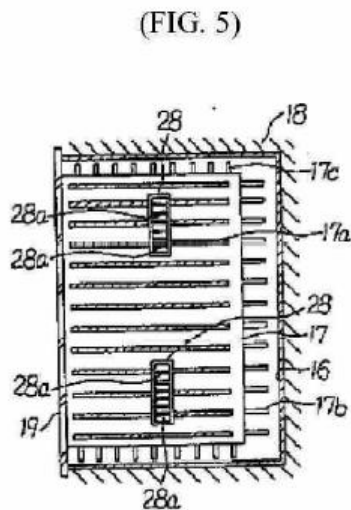
180. Kitamura does not teach an open loop of ambient air which passes along the backlight. First, Kitamura does not disclose “along the backlight,” because there *is* no backlight in an LED display—the individual LEDs provide their own source of light. Second, the only open loop air pathways travel in channels that are separated from the rear surface of the LED display (where the backlight would be located in an LCD module). One ambient air pathway passes between the inner housing (17) and outer housing (16). The second ambient air pathway travels through the rectangular ducting located in the middle, of the inner housing—spaced apart from the LED display (6) and rear surface (5). Kitamura at Figure 4 (annotated).

(FIG. 4)



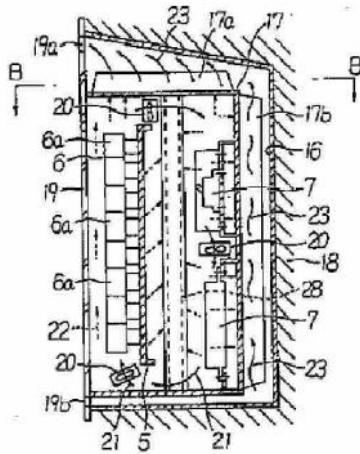
181. Petitioner suggests a person of skill would be motivated to replace the duct 28 with the cooling plenum 3 in Harris such that airflow would be located along the backlight of an LCD (which is also obtained by modifying Kitamura). Petition at 113. Petitioner also suggests further modifying the newly added cooling plenum to have a fan for directing air from between the inner and outer housing through the plenum. These modifications are not simple. Such a modification would require re-structuring the housing itself, enlarging the areas that the ducts currently occupy, and moving that area away from the center and toward the front of the display. This would separate the air in the duct 28 from the electronic components of the display which it was aiding in cooling—thus decreasing the overall cooling effect on the system and increasing the thermal load on the LCD.

182. Further, as suggested by Smith-Gillespie in Paragraph 438, Kitamura could not be easily modified to include an LCD module with a backlight that is mounted to duct 28. First, duct 28 is not a wide surface for mounting an entire backlight assembly, nor is there any disclosure that the duct is made of material that can bear substantial weight from mounting a part of the electronic display. See Figure 5 (showing a top view of the inner housing and the narrow, limited nature of duct 28).



183. Further, as showing in Figure 4, the duct 28 is spaced apart from the located of the display (which Petitioner suggests should be an LCD).

(FIG. 4)



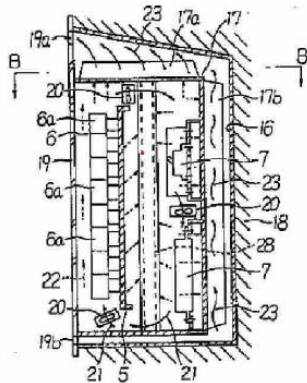
184. A person of ordinary skill in the art would not mount a backlight so far from the LCD stack in a display assembly because the light source would become too diffuse to provide adequate illumination of the liquid crystals.

185. Thus, in my opinion, a person of ordinary skill in the art would not be motivated to modify Kitamura in view of Harris as Petitioner suggests.

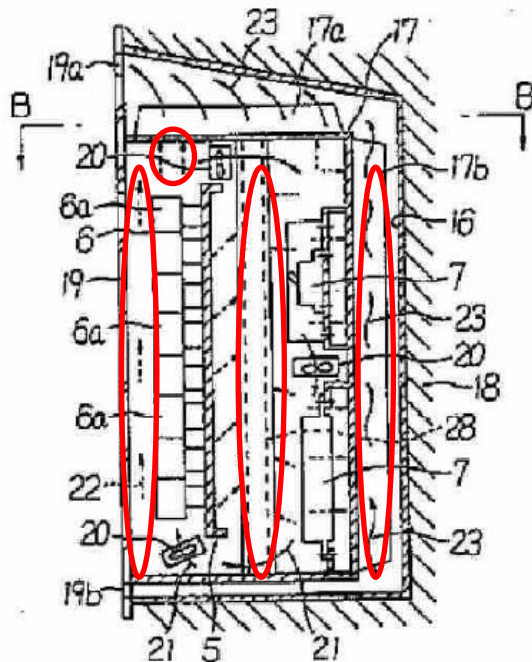
4. Kitamura does not disclose an “intended direction of closed loop isolated gas flow [that] is substantially perpendicular to the intended direction of [the] open loop of ambient air flow” as required by dependent claim 17

186. Kitamura does not disclose an open loop ambient air pathway that is substantially perpendicular to the closed loop. As shown in Figure 4, the dotted arrows show the direction of the air within inner housing (17).

(FIG. 4)



187. The fans (20) cause the air to circulate in all directions relative to the air traveling through the channel defined between the inner housing 16 and outer housing 16 (and within duct 28). This airflow pathway includes areas where air within the inner housing 16 flows in a parallel direction with the air within the alleged open loop channel. See Figure 4 (annotated).



188. I disagree with Petitioner that just because air travels in a perpendicular direction at *some* locations, that the “intended direction” is “***substantially*** perpendicular.” Further, there is no statement in Kitamura indicating that the direction of airflow in the inner housing is *intended*.

5. No Motivation to Modify or Combine with Harris

189. A person of ordinary skill in the art would not have been motivated to combine Kitamura with Harris. First, the two art references are directed to different fields of art. Kitamura “relates to an LED display device, and in particular relates to an LED display device . . . embedded in a wall 3 or like of a building.” Kitamura at (0002). Harris, by contrast, relates to a sealed environment for an LCD unit for use with a “computer for operation in severe environments.” Harris at 1:5-9. Harris describes these “severe environments” “one[s] subject to large environmental extremes due to temperature, humidity, radiation, vibration/shock, electromagnetic induction, etc.” Harris at 1:19-23. Specifically, Harris describes LCD enclosures for use in computers located onboard locomotives. Further, though Harris describes one embodiment that is permanently mounted to the locomotive, the LCD computer in Harris also has a handle for easy removal. Harris at 1:63-64; 4:18-19. The two environments, (1) permanent screens located within a wall and (2) removable screens located within severe environments, call for distinct cooling and heating needs. The Kitamura screens—being larger and in public environments

(such as window displays) where they may be facing the sun—require increased cooling to handle the solar radiation and display size. The smaller LCD display of Harris, however, requires increased cooling of the backlight because of the compact fluorescent bulbs and vibration/heat from the locomotive itself—rather than the heat on the face of the display from solar loading.

190. A POSITA would thus not be motivated to look to the two different fields of art for one application to an LCD screen used for an outdoor electronic display. Further, a POSITA would not have been motivated to combine or modify Kitamura because Kitamura already alleges to have solved the issue of thermal regulation of the display located within the wall of a building. Kitamura at (0024).

191. Kitamura discloses no problems that would motivate a person of skill in the art to look outside of the reference to solve. Petitioner states that a person of skill would be motivated to replace the LED display with an LCD display, then mount an open loop of ambient air channel along the backlight of that LCD in order to promote cooling of the LCD. Petitioner at 122. However, this problem is not stated anywhere within Kitamura. In fact, Kitamura states it has solved the problem of cooling the display within its current configuration. Kitamura at (0024). Further, Kitamura does not disclose any problems with LED displays which would motivate a person of skill to replace the LED display with another display type, let

alone a compact fluorescent backlit LCD display, which would use more energy and generate more heat.

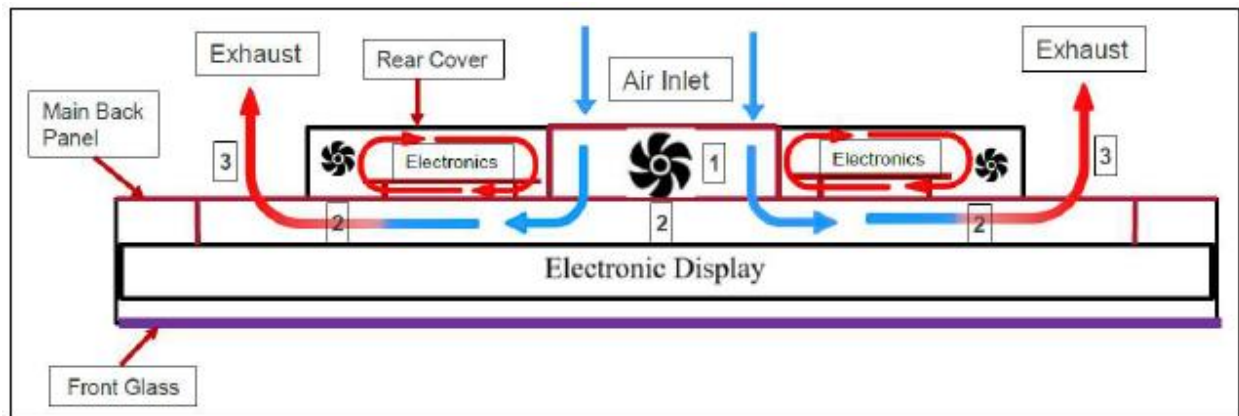
192. Petitioner's proposed combination thus relies upon the claims to provide a roadmap for the proposed combination, and improperly relies upon hindsight reasoning.

XII. SAMSUNG'S PRODUCTS PRACTICE THE '287 PATENT

193. I have reviewed and analyzed Samsung's 46- and 55-inch (Mid-Sized) OH series outdoor LCD products that MRI has accused of infringing the '287 Patent in the related ITC matter. My review and analysis included inspecting the Accused Products and reviewing Samsung's related technical documentation and CAD files. I also have reviewed and analyzed photographs of the Accused Products taken during teardowns of those products. Set forth in Exhibit 2039 in IPR2023-00255 are claim charts demonstrating how those products practice the claims of the '287 Patent. It is my opinion that these claim charts are accurate and that Samsung's 46- and 55-inch OH series displays practice the claims of the '287 Patent.

194. In particular, the schematic below demonstrates the operation of the cooling system of the Mid-Sized OH series displays. As shown in the schematic below, the Samsung products are electronic display assemblies that include a housing and an LCD positioned within the housing. The LCD includes a backlight.

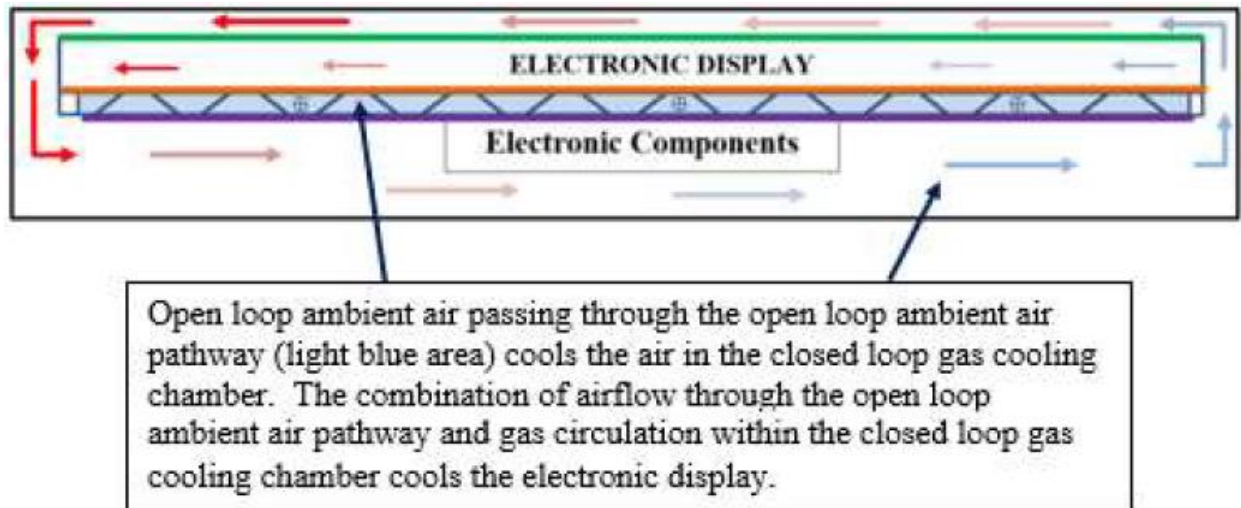
The LCD is coolable by a combination of a closed loop of isolated gas circulating within the housing and an open loop of ambient air passing through the housing and along the backlight.

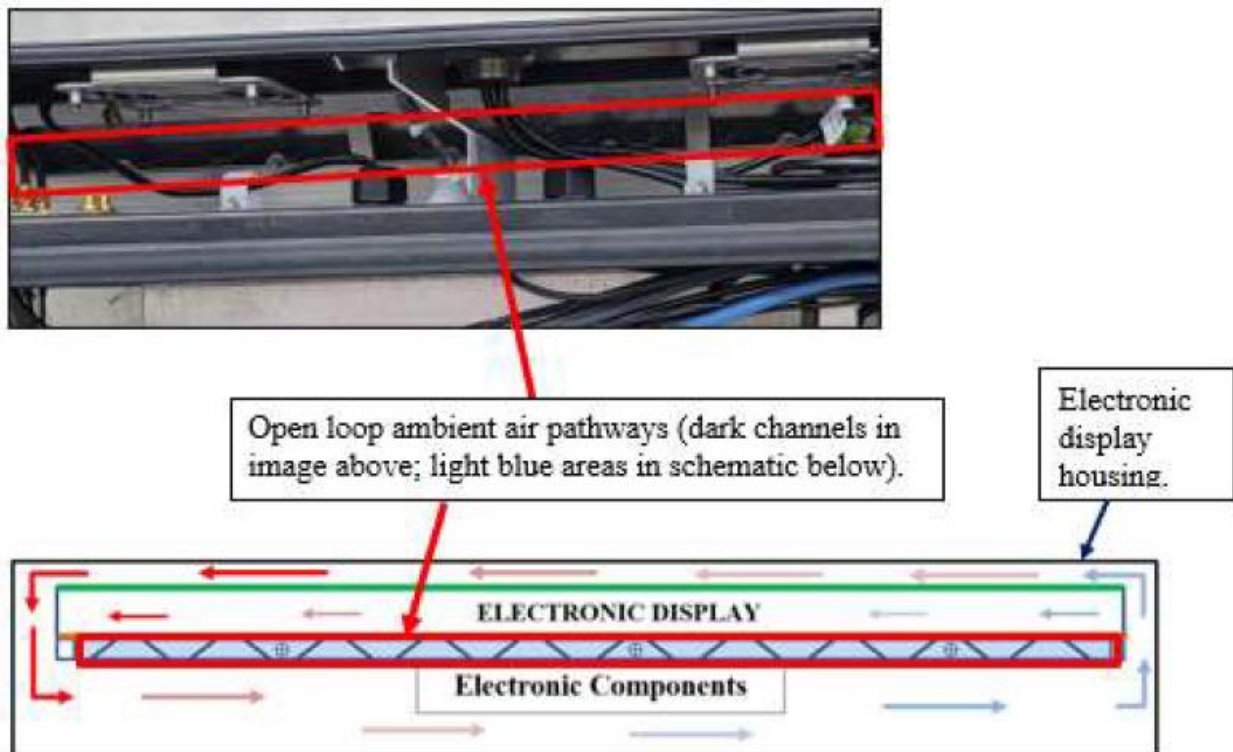


XIII. MRI'S PRODUCTS PRACTICE THE '287 PATENTS

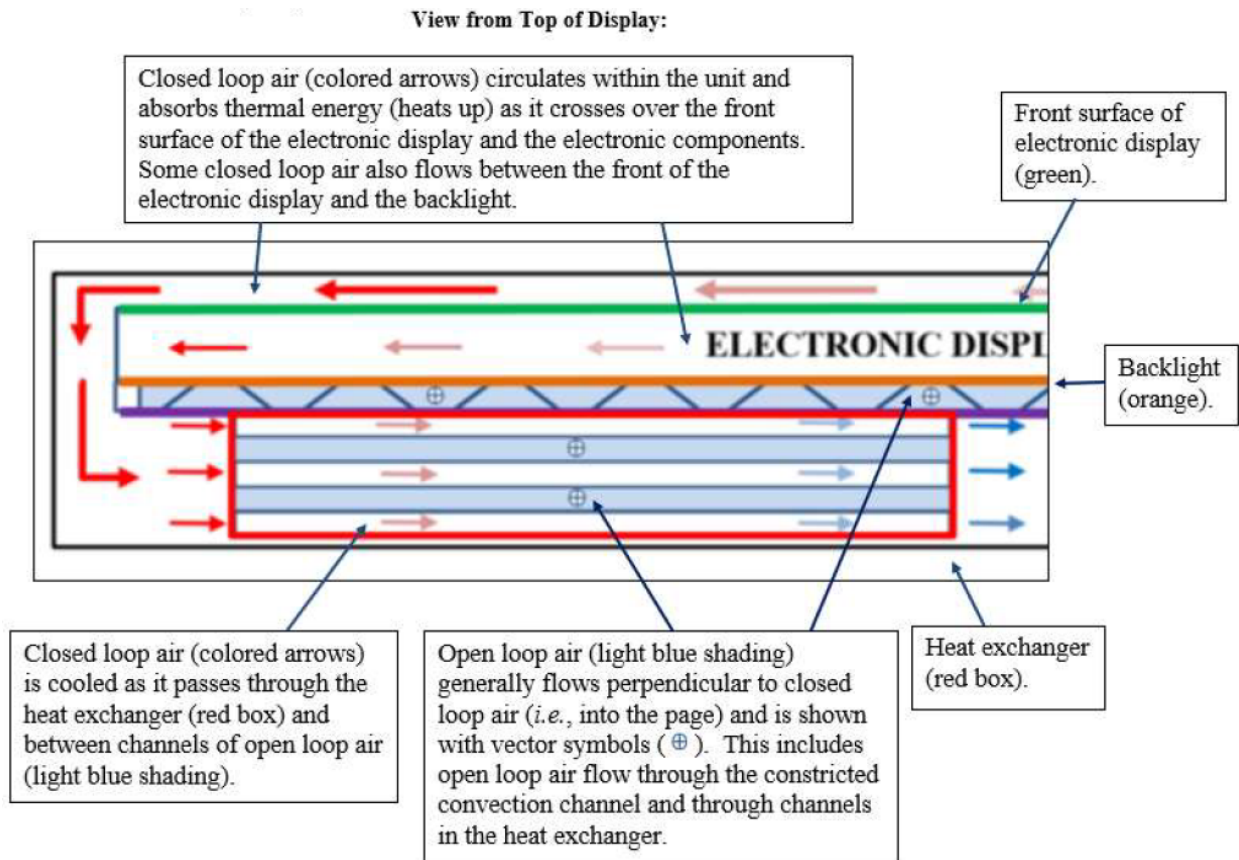
195. I have reviewed and analyzed MRI's 55-inch, 75-inch, and 85-inch outdoor LCD products that MRI has contended practice the '287 Patent in the related ITC matter. My review and analysis included inspecting MRI's products and reviewing MRI's related technical documentation and CAD file excerpts. Set forth in Exhibit 2054 in IPR2023-00255 are claim charts demonstrating how MRI's 55-inch products practice the claims of the '287 Patent. Additionally set forth in Exhibit 2054 in IPR2023-00255 are claim charts demonstrating how MRI's 75- and 85-inch products practice the claims of the '287 Patent. It is my opinion that these claim charts are accurate and that MRI's 55-inch, 75-inch, and 85-inch outdoor LCD products practice the claims of the '287 Patent.

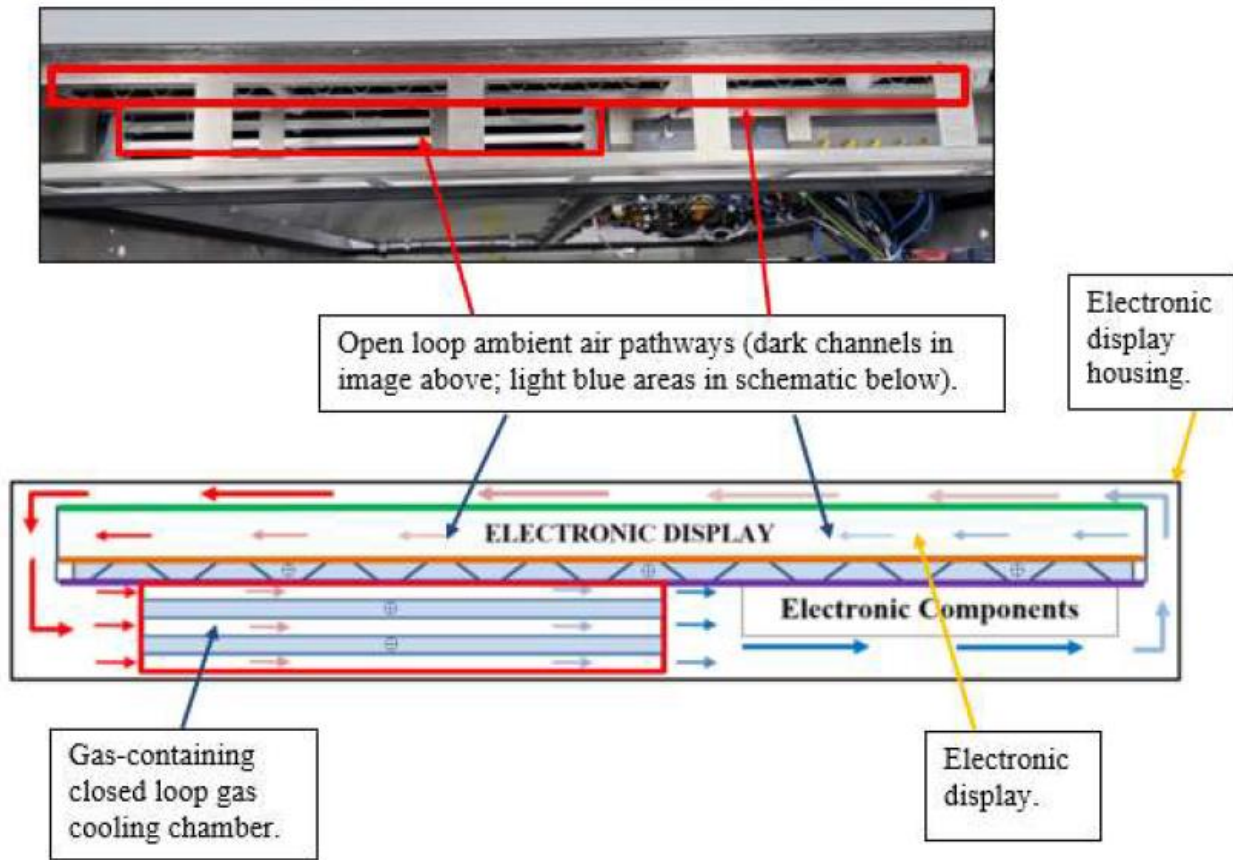
196. In particular, the schematic below demonstrates the operation of the cooling system of MRI's 55-inch displays. As shown in the schematics below, the MRI Mid-Sized products are electronic display assemblies that include a housing and an LCD positioned within the housing. The LCD includes a backlight. The LCD is coolable by a combination of a closed loop of isolated gas circulating within the housing and an open loop of ambient air passing through the housing and along the backlight.





197. Similarly, the schematic below demonstrates the operation of the cooling system of MRI's 75- and 85-inch displays. As shown in the schematics below, the MRI Large-Sized products are electronic display assemblies that include a housing and an LCD positioned within the housing. The LCD includes a backlight. The LCD is coolable by a combination of a closed loop of isolated gas circulating within the housing and an open loop of ambient air passing through the housing and along the backlight.





HIMANSHU POKHARNA, Ph.D., M.B.A.

Serial entrepreneur with 25 years of global experience in a variety of leadership roles. Emphasis on energy, materials and thermal technologies. Expertise in creating product strategy by mapping technology competencies to emerging market opportunities. Comfortable in deepest of technical discussions to board level business deliberations. Track record of successful introduction of new energy/mechanical/thermal technology in a broad array of computing, energy and Mil/aerospace products. Experienced in building and leading teams across geographies. Experienced in licensing and as an Expert Witness in patent disputes. Over 120 issued/pending patents, 5 journal publications, and many conference, industry presentations.

PROFESSIONAL EXPERIENCE**Deep-Materials Inc - Founder/CEO****03/19-Present**

A Thermal materials company with focus on high thermal conductivity dispensed silicone TIMs

- Developed a variety of thermally conductive “gels” for application in consumer electronics, computing and automotive parts. Qualified them at Google for their Home, NEST, wearable and Smartphone products. In discussions with other leading OEMs. Ramped sales in 2020 to \$1.7M. 2021 revenues expected at \$5M.
- Negotiated manufacturing contract in China. Also setup a team there to interface with customers (FATP), and provide support at Foxconn (China, Vietnam), Quanta (China, Thailand), Chicony etc.

Inficold Inc. Founder and Board Member**04/15-Present**

A startup developing and commercializing thermal energy storage products.

- Founded and raised \$3.5 M in seed and grant funding. Founding CEO, but with the company moving to India in 2017, continued the responsibility for technology and strategic direction as a board member.
- Built a 70+ people team for developing a patented energy storage product which can attach to any refrigeration system and store energy in low cost phase change media to shift power consumption to low tariff duration or enable off grid solar based cold chain for milk and fruits/vegetables.

Deeia Inc. Owner**08/10-Present**

A thermal consulting business with leading companies (Google, Xilinx, GoPro, Facebook, etc.) and startups as clients. Also developed a new Loop Thermosyphon technology for potential application in data center cooling.

- Developed thermal architecture of several products from computing to lighting, drones and robots.
- Provided expert witness services for thermal management related IP lawsuits with focus on liquid cooling.
- Developed a patent pending loop thermosyphon two phase cooling system with application in server, 5G cabinet cooling, EV system cooling, battery cooling. Loop Thermosyphon has liquid cooling performance but is a passive system with 20 year lifetime. Performance validated by a Fortune 50 company.

Sheetak Inc. Co-Founder, Board Member and VP Business Development**01/09-04/15**

A Startup applying an innovative Peltier technology for power generation, and cooling.

- Raised >\$5M in funding and licensing revenues. Raised >\$10M in non-dilutive R&D grants from US DoE (ARPA-e)/DoD. Responsible for teaming, proposal, contract negotiations, and project management.
- Licensed a cooling technology to Godrej and Boyce India for an ultra-cheap refrigerator for the masses in India. The resulting refrigerators received coverage in the *Economist*, *WSJ* and *HBR*. Responsible for end to end delivery (engineering, design, China supply chain and component cost negotiations).
- Negotiated multiple licensing deals at ~\$ 1 M in licensing fees/royalties. Customers included two PE Controlled companies (Igloo and Oasis Water Coolers), and a large appliance company in the US.

Ventiva Inc. VP Product Management/Marketing**12/08-10/09
01/14-present**

A startup developing air moving technology (no moving parts fan) with a licensing business model.

- Responsible for providing product direction, market analysis, customer analysis, & thermal engineering. Convinced the company to focus on tablet & wireless charger cooling for its first product.
- Led product evaluation (as a part of a licensing discussions) with a large Korean display maker. Currently working with the CEO and in house counsel on licensing discussions with an large consumer brand co.

k-Technology Corp. VP Product Development

07/07-12/08

Leadership role in a defense hardware company, based upon an innovative high thermal conductivity material technology. Responsible for new product development.

- Led many SBIR projects for new product applications based upon the core materials technology.
- Evaluated partnership/acquisition opportunities and eventually assisted the CEO in selling the business to a larger player in the value chain.

Intel Corporation - Mobility Group

07/00-07/07

Group Manager ('05-'07), Thermal Technology Manager ('02-'05), Staff Engineer ('00-'02)

- Overall responsibility for thermal, mechanical technology development and deployment for Intel's >\$12.5 B Mobile Products Group (now part of PC Client Group). Built and managed a cross functional team of 27 mechanical/thermal engineers and program managers across the globe (US, Taiwan, Japan, India).
- Responsible for developing team strategic plan, providing leadership, mentoring of managers and managing ~\$4 M annual budget. The team defined Intel's laptop PC thermal mechanical roadmap as well as develops, enables and communicates mechanical design of future laptop PCs. Most of the laptops today are based on the thermal/mechanical architecture originally developed by this team.
- Established Intel's mobile thermal technology advancement program. Formulated and managed collaborative development programs and investment in >15 supply chain partners for advancement in thermal component technology. The resulting products have led to 50% reduction in laptop thickness.
- Initiated heat pipe development programs with five of the leading heat pipe suppliers. Objective was to reduce evaporator and condenser resistances, reduce thickness to support thin laptops.
- Advised Intel Capital for investment in thermal, mechanical, fuel-cell and battery startups. Evaluated >15 investment opportunities. Managed Intel Capital investment in a company.
- Intel IP committee member. Responsible for evaluating for patent filing decision.
- Worked on liquid cooling solutions for a laptop computer, including demonstration in system.

Applied Materials Inc. Senior Mechanical Engineer

07/97-07/00

- Lead mechanical engineer for new product development group of low-k dielectric managing multiple hardware projects. Led cross-functional team for alpha exit of low-k CVD product.

EDUCATION

MBA, THE WHARTON SCHOOL, UNIVERSITY OF PENNSYLVANIA	2006
PhD, PURDUE UNIVERSITY, Nuclear Engineering	1997
BS, MS,¹ INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY, Mechanical Engineering	1990, 1992

DETAILS OF THE PRESENTATIONS PAPPERS, AND PATENTS

¹ The degrees were Bachelor's of Technology and Master's of Technology, equivalent to a B.S. and an M.S. in the United States, respectively.

KEYNOTE/INVITED ADDRESSES & PAPERS²,

1. Pokharna, H., "Application of Thermal Management in Energy Devices", Delivered at the Annual Taiwan Thermal Management Association Meeting in Taipei, April 2011.
2. Pokharna, H., "Solid State Energy Converters Coupled with Heat Pipes for Refrigeration and Power Generation", Fujikura Annual Forum, Nov 2010.
3. Pokharna, H., "Notebook Thermal Technology: Need for Standardized Metrology – Call to Action for Taiwan Thermal Management Association" Delivered at the Annual Taiwan Thermal Management Association Meeting in Taipei, April 10, 2007.
4. Mongia, R; Kuroda, M., and Pokharna, H., "Heat Pipe Needs in Future Mobile Platforms", Keynote address to the 14th International Heat Pipe Conference, Florianópolis, Brazil, 2007.
5. Machiroutu, S.V., Kluge, B., Kuroda, M., and Pokharna, H., "Design and Test Methodologies of Use of Heat Pipes in Laptop PCs," Keynote address to the 8th International Heat Pipe Symposium, Kumamoto, Japan, 2006.
6. *Pokharna, H , et. al. , Microchannel Cooling in Computing Platforms: Performance Needs and Challenges in Implementation", Keynote address to the second ASME-JSME International Microchannel Conference, at Rochester, NY, 2004. Published: Proceedings of the Second International Conference on Microchannels and Minichannels (ICMM2004). 10.1115/ICMM2004-2325. Page 109-118.

SELECTED JOURNAL PUBLICATIONS

7. *Mongia, R., Bhattacharya, A., Pokharna, H, "Skin Cooling and Other Challenges in Future Mobile Form Factor Computing Devices", Microelectronics Journal – vol. 39, pp. 992-1000, 2008.
8. *Ishii M., Revankar S.T., Pokharna H., et. al. Scaling of the Purdue University Multidimensional Integral Test Assembly (PUMA) for GE SBWR. Nuclear Engineering and Design, Vol. 186, 1998, pp. 177-211.
9. *Pokharna H., Mori M., and Ransom V.H., "The Particle Fluid Model and Using Lagrangian Representation in Two-Phase Flow Modeling." Nuclear Engineering and Design, Vol. 175, 1997, pp. 59-69.
10. *Pokharna H., Mori M., and Ransom V.H, "Regularization of Two-Phase Flow Models- A comparison of Mathematical and Numerical Approaches" Journal of Computational Physics, Vol. 134, July, 1997.

PRESENTATIONS AND OTHER PUBLICATIONS

11. *K. Varadarajan, R. K. Mongia, H. Pokharna, J. Pan, K. Tien and M. Wu, "Lid cooling for notebooks," 2008 11th Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, Orlando, FL, 2008, Published: *11th Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, Orlando, FL, 2008*, pp. 591-597. pp. 591-597.
12. *Mongia, R.; Machiroutu, S., Pokharna, H.; "Mobile Thermal Challenges in Future Platforms", Presented at Thermes II, Santa Fe, NM, 2007. Published: *Thermal Challenges in Next Generation Electronic Systems (THERMES II 2007)* Edited by Suresh V. Garimella, Amy S. Fleischer, Volume 39, Issue 7, Pages 929-1030 (July 2008)
13. *Machiroutu, S.V., Pokharna, H., Kuroda, M., "Challenges and Advances of Heat Pipes in Cooling Notebook Systems", Presented at Interpack Conference, Vancouver, British

² `Papers, and presentations marked with * were peer reviewed.

- Columbia, Canada, July 8-12, 2007. Published: *Proc. ASME. 42770; ASME 2007 InterPACK Conference, Volume 1. IPACK2007-33249. Pages: 677-687*
14. *Kuroda, M., Machiroutu, S.V., and Pokharna, H., "Use of Heat Pipes in Multiple Component Cooling in Laptop PCs," 8th International Heat Pipe Symposium, Kumamoto, Japan, 2006. Published:: *Heat Pipe: Science and Technology ; Proceedings of the 8th International Heat Pipe Symposium*, Edited by Hideaki Imura, Nihon-Hito-Paipu-Kyōkai September 24 - 27, 2006 Kumamoto, Japan.
 15. *Khandani,S., Pokharna, H., Machiroutu,S., DiStefano, E., "Remote Heat Pipe Based Heat Exchanger performance in Notebook Cooling", Presented at the ASME Summer Heat Transfer Conference, San Francisco, 2005. Published: *Heat Transfer: Volume 4 ():715-719. doi:10.1115/HT2005-72069* Pages – 715-719.
 16. *DiStefano, E., Pokharna, H. and Machiroutu, S.V., "Raising the Bar for Heat Pipes in Notebook Cooling," 13th International Heat Pipe Conference, Shanghai, China, September 21–25, 2004. Published: *13th International Heat Pipe Conference: September 21-25, 2004, Shanghai, China* Edited by: Zhongguo Kong, Jian Ji, Shu Yan, Jiu Yuan. China Academy of Space Technology, 2004
 17. *Pokharna-H; Ransom-VH; Mori-M "Extension of the particle-fluid model for transient analysis of bubbly two-phase flow to branched flow passages". Eighth International Topical Meeting on Nuclear Reactor Thermal-Hydraulics. NURETH-8. Published:: *New Horizons in Nuclear Reactor Thermal-Hydraulics. Atomic Energy Soc. Japan, Tokyo, Japan; 1997; vol–1 (xxi+xv+1830) pp. p.558-65.*
 18. *Pokharna H., and Ransom V. H., "Development of a Particle-Fluid Model for Transient Analysis of Bubbly Two-phase Flows in Parallel Channels." Presented at the International Mechanical Engineers Conference and Exposition, Atlanta, November, 1996. Published: *ASME FED, Vol-242.*
 19. *Pokharna H., Mori M. and Ransom V.H., "The Particle Fluid Model and Using Lagrangian Representation in Two-Phase Flow Modeling.", Presented at the Fourth US-Japan Conference in Tsukuba, July 1996.
 20. Ishii M., Revankar S.T., Pokharna H. et. al. "Scientific Design of Purdue University Multi-Dimensional Integral Test Assembly (PUMA) for GE SBWR.", NUREG/ CR-6309, (National report published by Nuclear Regulatory Commission). 1996. Published: Proceedings of the 7th International Meeting on Nuclear Reactor Thermal-Hydraulics (NURETH 7), Sep. 10-15, 1995, Saratoga Springs, New York.
 21. *Ishii M., Revankar S.T., Pokharna H., and Ransom V.H., "Scaling for Integral Simulation of Thermalhydraulic Phenomena in SBWR during LOCA.", Presented at NURETH-7, Saratoga Springs, NY, Sep10-15, 1995. Published: Proceedings of the 7th International Meeting on Nuclear Reactor Thermal-Hydraulics (NURETH 7), Sep. 10-15, 1995, Saratoga Springs, New York. Compiled by: R. C. Block, F. Feiner. pp: 1272-1290/
 22. *Pokharna H., Lele S., Wang W., Ishii M., Ransom V.H., "Investigation of Scaling Criterion Using RELAP5 for SBWR Integral Test Facility Design." Presented at ANS Annual Meeting, San Francisco, Nov14-18, 1993. Published: *Transactions of the American Nuclear Society, 540-541.*
 23. *Pokharna H. and Doshi J.B., "Analysis of Dynamic Instability in Boiling Systems.", Presented at Winter Annual Meeting of ASME, Los Angeles, 1992. Published: Proceedings of Winter Annual Meeting, Anaheim, CA, USA 11/08-13/92. Pages: 1-9.

PATENTS

Issued US patents:

Publication Number	Title
US9903621B1	Cooling system with thermal battery
US9574832B2	Enabling an aluminum heat exchanger with a working fluid
US8043703B2	Thermally conductive graphite reinforced alloys
US7494628B2	Apparatus for abatement of by-products generated from deposition processes and cleaning of deposition chambers
US7443670B2	Systems for improved blower fans
US7308931B2	Heat pipe remote heat exchanger (RHE) with graphite block
US7300244B2	Cooling fan noise reduction apparatus, systems, and methods
US7269005B2	Pumped loop cooling with remote heat exchanger and display cooling
US7243497B2	Apparatus to use a refrigerator in mobile computing device
US7288895B2	System to improve display efficiency based on recycling local heat source
US7283360B2	Enhanced flow channel for component cooling in computer systems
US7281388B2	Apparatus to use a refrigerator in mobile computing device
US7272006B2	IC coolant microchannel assembly with integrated attachment hardware
US7259965B2	Integrated circuit coolant microchannel assembly with targeted channel configuration
US7203064B2	Heat exchanger with cooling channels having varying geometry
US7193316B2	Integrated circuit coolant microchannel with movable portion
US7123479B2	Enhanced flow channel for component cooling in computer systems
US7104313B2	Apparatus for using fluid laden with nanoparticles for application in electronic cooling
US7060234B2	Process and apparatus for abatement of by products generated from deposition processes and cleaning of deposition chambers
US7048038B2	Increased thermal capability of portable electronic device in stationary or docked mode
US7031159B2	Parallel heat exchanger for a component in a mobile system
US7023697B2	Actuation membrane for application to a card slot of a system
US6958912B2	Enhanced heat exchanger
US6906919B2	Two-phase pumped liquid loop for mobile computer cooling
US6899763B2	Lid cooling mechanism and method for optimized deposition of low-K dielectric using TR methylsilane-ozone based processes
US6937472B2	Apparatus for cooling heat generating components within a computer system enclosure
US6903930B2	Parallel heat exchanger for a component in a mobile system
US6845625B1	Reversible two-phase and refrigeration loop
US6837057B2	Docking station to cool a computer
US6845008B2	Docking station to cool a notebook computer
US6837058B1	Tablet air cooling dock
US6801430B1	Actuation membrane to reduce an ambient temperature of heat generating device
US6795311B2	Method and apparatus for cooling portable computers
US6674640B2	Increased thermal capability of portable electronic device in stationary or docked mode
US6646874B2	Mobile computer system with detachable thermoelectric module for enhanced cooling capability in a docking station
US6596343B1	Method and apparatus for processing semiconductor substrates with hydroxyl radicals
US6595022B2	Computer system having a refrigeration cycle utilizing an adsorber/desorber for purposes of compression

US6528116B1	Lid cooling mechanism and method for optimized deposition of low-k dielectric using tri methylsilane-ozone based processes
US6506994B2	Low profile thick film heaters in multi-slot bake chamber
US6415612B1	Method and apparatus for external cooling an electronic component of a mobile hardware product, particularly a notebook computer, at a docking station having a thermoelectric cooler
US6358327B1	Method for endpoint detection using throttle valve position
US6255222B1	Method for removing residue from substrate processing chamber exhaust line for silicon-oxygen-carbon deposition process

Applied/Pending US Patents (Published):

Publication Number	Title
US20160133814A1	FUEL-FLEXIBLE THERMAL POWER GENERATOR FOR ELECTRIC LOADS
US20150155413A1	SOLAR THERMOELECTRIC GENERATOR WITH INTEGRATED SELECTIVE WAVELENGTH ABSORBER
US20140318152A1	METHOD AND APPARATUS FOR THERMOELECTRIC COOLING OF FLUIDS
US20130048250A1	HEAT PIPE MADE OF COMPOSITE MATERIAL AND METHOD OF MANUFACTURING THE SAME
US20090255660A1	High Thermal Conductivity Heat Sinks With Z-Axis Inserts
US20090166014A1	Enabling an aluminum heat exchanger with a working fluid
US20090135560A1	HIGH EFFICIENCY FLUID MOVERS
US20090075120A1	Thermally conductive graphite reinforced alloys
US20090002939A1	Systems and methods for fan speed optimization
US20080130221A1	Thermal hinge for lid cooling
US20070284089A1	Method, apparatus and system for carbon nanotube wick structures
US20070227707A1	Method, apparatus and system for providing for optimized heat exchanger fin spacing
US20070217147A1	INTEGRATED CIRCUIT COOLANT MICROCHANNEL ASSEMBLY WITH TARGETED CHANNEL CONFIGURATION
US20070146993A1	Method, apparatus and computer system for enhancement of thermal energy transfer
US20070177349A1	High efficiency fluid mover
US20070076376A1	Method, apparatus and computer system for providing for the transfer of thermal energy
US20070077139A1	Cooling fan noise reduction apparatus, systems, and methods
US20070076374A1	IC coolant microchannel assembly with integrated attachment hardware
US20070002541A1	Enhanced flow channel for component cooling in computer systems
US20060226539A1	Integrated circuit coolant microchannel assembly with targeted channel configuration
US20060198769A1	Apparatus for abatement of by-products generated from deposition processes and cleaning of deposition chambers
US20060131733A1	Integrated circuit coolant microchannel with movable portion
US20060152900A1	Systems for improved blower fans
US20060113066A1	Heat exchanger configuration for pumped liquid cooling computer systems
US20060113064A1	Heat pipe remote heat exchanger (RHE) with graphite block
US20050285261A1	Thermal management arrangement with channels structurally adapted for varying heat flux areas
US20050284166A1	Apparatus to use vapor compression refrigeration in a mobile computing device
US20050217278A1	Apparatus to use a magnetic based refrigerator in mobile computing device
US20050219819A1	Methods to improve heat exchanger performance in liquid cooling loops
US20050217827A1	Apparatus to use a refrigerator in mobile computing device

US20050217279A1	Apparatus to use a refrigerator in mobile computing device
US20050139345A1	Apparatus for using fluid laden with nanoparticles for application in electronic cooling
US20050141195A1	Folded fin microchannel heat exchanger
US20050146852A1	Parallel heat exchanger for a component in a mobile system
US20050145371A1	Thermal solution for electronics cooling using a heat pipe in combination with active loop solution
US20050128702A1	Heat exchanger with cooling channels having varying geometry
US20050122688A1	Enhanced flow channel for component cooling in computer systems
US20050103480A1	Enhanced heat exchanger
US20050111183A1	Pumped loop cooling with remote heat exchanger and display cooling
US20050104526A1	System to improve display efficiency based on recycling local heat source
US20050099775A1	Pumped liquid cooling for computer systems using liquid metal coolant
US20050126761A1	Heat pipe including enhanced nucleate boiling surface
US20050068724A1	Two-phase pumped liquid loop for mobile computer cooling
US20050058867A1	Integrated platform and fuel cell cooling
US20050058866A1	Integrated platform and fuel cell cooling
US20050013116A1	Actuation membrane for application to a card slot of a system
US20040261421A1	TABLET AIR COOLING DOCK
US20040223302A1	Apparatus for cooling heat generating components within a computer system enclosure
US20040201959A1	Increased thermal capability of portable electronic device in stationary or docked mode
US20040123604A1	Docking station to cool a computer
US20040123977A1	External attachable heat exchanger
US20040125562A1	Parallel heat exchanger for a component in a mobile system
US20030221621A1	Method and apparatus for processing semiconductor substrates with hydroxyl radicals
US20030123223A1	Method and apparatus for cooling portable computers
US20030066482A1	Lid cooling mechanism and method for optimized deposition of low-K dielectric using TRI methylsilane-ozone based processes
US20020190051A1	LOW PROFILE THICK FILM HEATERS IN MULTI-SLOT BAKE CHAMBER
US20030017087A1	Process and apparatus for abatement of by products generated from deposition processes and cleaning of deposition chambers
US20030002252A1	Increased thermal capability of portable electronic device in stationary or docked mode
US20030000231A1	Computer system having a refrigeration cycle utilizing an adsorber/desorber for purposes of compression
US20020186531A1	Mobile computer system with detachable thermoelectric module for enhanced cooling capability in a docking station
US20020141152A1	Docking station to cool a notebook computer

Issued/Applied/Pending International Patents (Published):

Publication Number	Title
EP1665434B1	INTEGRATED PLATFORM AND FUEL CELL COOLING INTEGRIERTE PLATTFORM UND BRENNSTOFFZELLENKÜHLUNG REFRROIDISSEMENT INTEGRE DE PLATE-FORME ET DE PILE A COMBUSTIBLE

EP1148150B1	Method and apparatus for processing semiconductor substrates with hydroxyl radicals Verfahren und Vorrichtung zur Behandlung von Halbleitersubstraten mit Hydroxylradikalen Procédé et appareillage pour le traitement des substrats de semiconducteur par des radicaux hydroxylés
EP1671218B1	REVERSIBLE TWO-PHASE AND REFRIGERATION LOOP REVERSIBLE ZWEIPHASEN- UND KÜHLSCHLEIFE BOUCLE DE REFRIGERATION ET A DEUX PHASES REVERSIBLE
EP1623612B1	AN ACTUATION MEMBRANE FOR APPLICATION TO A CARD SLOT OF A SYSTEM EINE BETÄTIGUNGSMEMBRAN ZUR VERWENDUNG IN EINEM SYSTEMSKARTENSCHLITZ MEMBRANE D'ENTRAÎNEMENT S'APPLIQUANT SUR UNE POSITION D'ENFICHAGE DE CARTE DANS UN SYSTEME
EP2807432A1	METHOD AND APPARATUS FOR THERMOELECTRIC COOLING OF FLUIDS VERFAHREN UND VORRICHTUNG ZUR THERMOELEKTRISCHEN KÜHLUNG VON FLÜSSIGKEITEN PROCÉDÉ ET APPAREIL DE REFROIDISSEMENT THERMOÉLECTRIQUE DE FLUIDES
EP1148150A3	Method and apparatus for processing semiconductor substrates with hydroxyl radicals Verfahren und Vorrichtung zur Behandlung von Halbleitersubstraten mit Hydroxylradikalen Procédé et appareillage pour le traitement des substrats de semiconducteur par des radicaux hydroxylés
EP1665434A2	INTEGRATED PLATFORM AND FUEL CELL COOLING INTEGRIERTE PLATTFORM UND BRENNSTOFFZELLENKÜHLUNG REFROIDISSEMENT INTEGRE DE PLATE-FORME ET DE PILE A COMBUSTIBLE
EP1671218A2	REVERSIBLE TWO-PHASE AND REFRIGERATION LOOP REVERSIBLE ZWEIPHASEN- UND KÜHLSCHLEIFE BOUCLE DE REFRIGERATION ET A DEUX PHASES REVERSIBLE
EP1623612A2	AN ACTUATION MEMBRANE FOR APPLICATION TO A CARD SLOT OF A SYSTEM EINE BETÄTIGUNGSMEMBRAN ZUR VERWENDUNG IN EINEM SYSTEMSKARTENSCHLITZ MEMBRANE D'ENTRAÎNEMENT S'APPLIQUANT SUR UNE POSITION D'ENFICHAGE DE CARTE DANS UN SYSTEME
EP1148150A2	Method and apparatus for processing semiconductor substrates with hydroxyl radicals Verfahren und Vorrichtung zur Behandlung von Halbleitersubstraten mit Hydroxylradikalen Procédé et appareillage pour le traitement des substrats de semiconducteur par des radicaux hydroxylés
EP1079000A1	Method for removing residue from an exhaust line Verfahren zur Entfernung von Absetzungen in einer Abgasleitung Procédé d'élimination les dépôts dans une ligne d'échappement
EP1077274A1	Method for depositing thin films in particular of a low-k dielectric Verfahren zur Abscheidung von dünnen Schichten insbesondere eines Dielektrikums mit niedrigem k-Wert Méthode de déposition des couches minces notamment d'un matériau diélectrique à faible constante diélectrique
WO2013173450A9	INTEGRATED SELECTIVE WAVELENGTH ABSORBER SOLAR THERMOELECTRIC GENERATOR GÉNÉRATEUR THERMOÉLECTRIQUE SOLAIRE AVEC ABSORBEUR DE LONGUEUR D'ONDE SÉLECTIF INTÉGRÉ
WO2013074057A1	METHOD AND APPARATUS FOR THERMOELECTRIC COOLING OF FLUIDS PROCÉDÉ ET APPAREIL DE REFROIDISSEMENT THERMOÉLECTRIQUE DE FLUIDES
WO2009035666A3	THERMALLY CONDUCTIVE GRAPHITE REINFORCED ALLOYS ALLIAGES THERMO-CONDUCTEURS RENFORCÉS PAR DU GRAPHITE
WO2009035666A2	THERMALLY CONDUCTIVE GRAPHITE REINFORCED ALLOYS ALLIAGES THERMO-CONDUCTEURS RENFORCÉS PAR DU GRAPHITE

WO2008079430A3	METHOD, APPARATUS AND SYSTEM FOR CARBON NANOTUBE WICK STRUCTURES PROCÉDÉ, APPAREIL ET SYSTÈME POUR STRUCTURES EN RÉSEAU CAPILLAIRE À NANOTUBES DE CARBONE
WO2008079430A9	METHOD, APPARATUS AND SYSTEM FOR CARBON NANOTUBE WICK STRUCTURES PROCÉDÉ, APPAREIL ET SYSTÈME POUR STRUCTURES EN RÉSEAU CAPILLAIRE À NANOTUBES DE CARBONE
WO2008079430A2	METHOD, APPARATUS AND SYSTEM FOR CARBON NANOTUBE WICK STRUCTURES PROCÉDÉ, APPAREIL ET SYSTÈME POUR STRUCTURES EN RÉSEAU CAPILLAIRE À NANOTUBES DE CARBONE
WO2008008085A3	IC COOLANT MICROCHANNEL ASSEMBLY WITH INTEGRATED ATTACHMENT HARDWARE ENSEMBLE À MICRO-CANAUX DE RÉFRIGÉRANT DE CIRCUIT INTÉGRÉ AVEC MATÉRIEL DE FIXATION INTÉGRÉ
WO2008008085A2	IC COOLANT MICROCHANNEL ASSEMBLY WITH INTEGRATED ATTACHMENT HARDWARE ENSEMBLE À MICRO-CANAUX DE RÉFRIGÉRANT DE CIRCUIT INTÉGRÉ AVEC MATÉRIEL DE FIXATION INTÉGRÉ
WO2007062208A1	HIGH EFFICIENCY FLUID MOVER DISPOSITIF DE DEPLACEMENT DE LIQUIDE A HAUT RENDEMENT
WO2007041123A1	IC COOLANT MICROCHANNEL ASSEMBLY WITH INTEGRATED ATTACHMENT HARDWARE ENSEMBLE MICROCANAL DE REFROIDISSEMENT A CIRCUIT INTEGRE AVEC MATERIEL JOINT
WO2006074447A3	SYSTEMS FOR IMPROVED BLOWER FANS SYSTEMES POUR VENTILATEURS AMELIORES
WO2005033917A8	REVERSIBLE TWO-PHASE AND REFRIGERATION LOOP BOUCLE DE REFRIGERATION ET A DEUX PHASES REVERSIBLE
WO2006074447A2	SYSTEMS FOR IMPROVED BLOWER FANS SYSTEMES POUR VENTILATEURS AMELIORES
WO2005029626A3	INTEGRATED PLATFORM AND FUEL CELL COOLING REFROIDISSEMENT INTEGRE DE PLATE-FORME ET DE PILE A COMBUSTIBLE
WO2005051065A3	PUMPED LIQUID COOLING FOR COMPUTER SYSTEMS USING LIQUID METAL COOLANT REFROIDISSEMENT POUR SYSTEMES INFORMATIQUES PAR LIQUIDE DE REFROIDISSEMENT METALLIQUE POMPE
WO2005033917A3	REVERSIBLE TWO-PHASE AND REFRIGERATION LOOP BOUCLE DE REFRIGERATION ET A DEUX PHASES REVERSIBLE
WO2005067038A1	FOLDED FIN MICROCHANNEL HEAT EXCHANGER ECHANGEUR DE CHALEUR A MICROCANAUX A AILETTE REPLIEE
WO2005033917A2	REVERSIBLE TWO-PHASE AND REFRIGERATION LOOP BOUCLE DE REFRIGERATION ET A DEUX PHASES REVERSIBLE
WO2005051065A2	PUMPED LIQUID COOLING FOR COMPUTER SYSTEMS USING LIQUID METAL COOLANT REFROIDISSEMENT POUR SYSTEMES INFORMATIQUES PAR LIQUIDE DE REFROIDISSEMENT METALLIQUE POMPE
WO2005029626A2	INTEGRATED PLATFORM AND FUEL CELL COOLING REFROIDISSEMENT INTEGRE DE PLATE-FORME ET DE PILE A COMBUSTIBLE
WO2004103048A3	AN ACTUATION MEMBRANE FOR APPLICATION TO A CARD SLOT OF A SYSTEM MEMBRANE D'ENTRAINEMENT S'APPLIQUANT SUR UNE POSITION D'ENFICHAGE DE CARTE DANS UN SYSTEME

WO2004103048A2	AN ACTUATION MEMBRANE FOR APPLICATION TO A CARD SLOT OF A SYSTEM MEMBRANE D'ENTRAÎNEMENT S'APPLIQUANT SUR UNE POSITION D'ENFICHAGE DE CARTE DANS UN SYSTÈME
DE602004008615T2	EINE BETÄTIGUNGSMEMBRAN ZUR VERWENDUNG IN EINEM SYSTEMKARTENSCHLITZ
DE112006000130B4	Lüfteranordnung für Kühlsysteme
DE112006000130T5	Systeme für verbesserte Kühleinrichtungen, wie Lüfter
DE112007001304T5	Verfahren, Vorrichtung und System für Kohlenstoffnanoröhrendochtstrukturen
JP2002064095A	METHOD AND DEVICE FOR PROCESSING SEMICONDUCTOR SUBSTRATE WITH HYDROXYL RADICAL The processing method and apparatus of a semiconductor substrate using a hydroxyl radical
JP2001140076A	IMPROVED METHOD FOR REMOVING RESIDUE FROM EXHAUST LINE OF SUBSTRATE TREATMENT CHAMBER TO DEPOSIT SILICON- OXYGEN-CARBON The method improved in order to remove residue from the gas discharge line of the substrate treating chamber which performs the deposition process of silicon silicone- oxygen-carbon
KR1024757B1	METHOD, APPARATUS AND SYSTEM FOR CARBON NANOTUBE WICK STRUCTURES The method for the carbon nanotube wick structure, and the apparatus and system.
KR715074B1	METHOD AND APPARATUS FOR PROCESSING SEMICONDUCTOR SUBSTRATES WITH HYDROXYL RADICALS METHOD AND APPARATUS FOR PROCESSING SEMICONDUCTOR SUBSTRATE WITH HYDROXYL RADICAL A method and apparatus for processing the semiconductor substrate as the hydroxyl radical.
KR696030B1	IMPROVED METHOD FOR REMOVING RESIDUE FROM SUBSTRATE PROCESSING CHAMBER EXHAUST LINE FOR SILICON-OXYGEN-CARBON DEPOSITION PROCESS METHOD FOR REMOVING RESIDUE FROM EXHAUST LINE The method for removing the residue from the substrate processing chamber exhaust line of the silicon-oxygen - carbon vapor deposition process.
KR2009009927A	METHOD, APPARATUS AND SYSTEM FOR CARBON NANOTUBE WICK STRUCTURES The method for the carbon nanotube wick structure, and the apparatus and system.
KR2006006961A	AN ACTUATION MEMBRANE FOR APPLICATION TO A CARD SLOT OF A SYSTEM The actuation membrane for applying to the card slot of the system.
KR2001021403A	METHOD FOR REMOVING RESIDUE FROM EXHAUST LINE
CN101438402A	Method, apparatus and system for carbon nanotube wick structures
CN101317265A	IC coolant microchannel assembly with integrated attachment hardware IC coolant micro-channel assembly with integrated connecting component
CN101133377A	Systems for improved blower fans
CN101015082A	Integrated platform and fuel cell cooling Cooling of integration platform and fuel cell
CN1882900A	Reversible two-phase and refrigeration loop a reversible two-phase and refrigeration loop
CN1799297A	An actuation membrane for application to a card slot of a system driving film for application to the system slot
CN101438402B	Method, apparatus and system for carbon nanotube wick structures Method, device and system for carbon nano-tube core structure.
CN1799297B	An actuation membrane for application to a card slot of a system applied to the system slot of driving film
CN101133377B	Systems for improved blower fans for improved blower fan system
CN101317265B	IC coolant microchannel assembly with integrated attachment hardware with integrated connection part of IC coolant micro-channel assembly

CN100565996C	Integrated platform and fuel cell cooling Cooling of integration platform and fuel cell
CN100447707C	Reversible two-phase and refrigeration loop Method and system for reversible switching of two-phase and refrigeration loop
TWM502162U	Composite material heat pipe
TW201309997A	Composite material heat pipe and manufacturing method thereof
TWI372138B	Heat pipe, apparatus and system with carbon nanotube wick structures
TWI324296B	Systems for improved blower fans
DE60139912D1	Verfahren und Vorrichtung zur Behandlung von Halbleitersubstraten mit Hydroxylradikalen
DE602004022566D1	REVERSIBLE ZWEIPHASEN- UND KÜHLSCHLEIFE
TWI315463B	Ic coolant microchannel assembly with integrated attachment hardware
TW200806576A	Method, apparatus and system for carbon nanotube wick structures
DE602004008615D1	EINE BETÄTIGUNGSMEMBRAN ZUR VERWENDUNG IN EINEM SYSTEMSKARTENSCHLITZ
TW200720898A	Ic coolant microchannel assembly with integrated attachment hardware
TW200629048A	Systems for improved blower fans
TWI267338B	Apparatus for cooling heat generating devices
TW200525340A	Pumped liquid cooling for computer systems using liquid metal coolant
TWI237921B	Integrated platform and fuel cell cooling
TW200526107A	Folded fin microchannel heat exchanger
TW200511637A	Integrated platform and fuel cell cooling
TW200425829A	An actuation membrane for application to a card slot of a system

EXPERT WITNESS ENGAGEMENTS

- Represented the defendant for the Case No. 3:12-cv-04498-EMC: ASETTEK HOLDINGS, INC. and ASETTEK A/S, Plaintiffs, v. COOLIT SYSTEMS INC., Defendant. Prepared expert reports for patent invalidity, patent infringement, rebuttal to opposing expert witness reports of invalidity and infringement reports. Provided testimony during three-day deposition (2014)
- Prepared IPR 2014-01172. Patent no. 8,749,968 related to server thermal management.
- Represented the defendant in a patent lawsuit involving mechanical aspects of a vapor chamber product used in computing products thermal management. Provided expert report on claim construction and testified during deposition (district court litigation 17-cv-05363-JSW).
- Prepared expert reports for IPRs (2019-00144, 2019-00146, 2019-000334, 2019-00337, 2019-00146) for three patents (US 7066240, 7100679, 7100680) related to the abovementioned lawsuit. Provided deposition testimony related to these IPRs.
- Retained by Patent owner as an expert for Ex Parte Review of a blast furnace cooling stove patent (2019).
- Prepared expert report for IPRs for a patent on liquid cooling for thermal management of electronics (IPR2019-00705). Deposition on Feb 4, 2020.
- Serving as an expert witness for the matter pending before the U.S. District Court, Northern District of California between Asetek Danmark A/S versus CoolIT Systems; case number 3:19-cv-00410-EMC. Provided claim construction report and deposition testimony for the same.

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- Represented the defendant for IPR 2020-00825, challenging patent no. 10,274,266. Deposition: Feb '21 via zoom.
 - Represented the defendant for IPR 2020-00747, challenging patent no. 9,057,567. Deposition: Feb 21 via zoom.
 - Represented the defendant Cooler Master Co., Ltd. / CMI USA Inc. in opposing a motion for contempt sanctions by Asetek Denmark A/S. (Case no. 3:13-cv-00457-JST). Provided expert declaration and deposition testimony in June 2021.
 - Provided expert report regarding infringement of US Patent no. 8,746,330; 9,057,567; and 10,274,266. Also provided expert report in response to opposition invalidity report of these patents. Deposition(s) in Jan 2022.
 - Representing the petitioner for IPR challenging US patent no. 10,599,196 B2 related to liquid cooling (IPR2021-01196). Provided expert report and likely deposition in March 2022.
 - Representing the petitioner for IPR challenging US patent no. 10,613,601 B2 related to liquid cooling (IPR2021-01195). Provided expert report and likely deposition in March 2022