

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COOLER MASTER CO., LTD.
Petitioner

v.

AAVID THERMALLOY LLC.
Patent Owner

U.S. Patent No. 7,100,680
Filing Date: August 9, 2005
Issue Date: September 5, 2006

Title: Integrated Circuit Heat Pipe Heat Spreader with
Through Mounting Holes

DECLARATION OF DR. HIMANSHU POKHARNA

TABLE OF CONTENTS

	Page
I. INTRODUCTION AND QUALIFICATIONS.....	1
A. Qualifications and Experience	1
II. MATERIALS CONSIDERED	3
III. PERSON OF ORDINARY SKILL IN THE ART	5
IV. BASIS FOR MY OPINION AND STATEMENT OF LEGAL PRINCIPLES	6
V. APPLICATION OF THE PRIOR ART TO THE CLAIMS.....	13
VI. BACKGROUND OF THE UNDERLYING TECHNOLOGY	13
VII. SUMMARY OF THE '680 PATENT	21
A. Brief Description of the '680 Patent	21
VIII. CLAIM CONSTRUCTION	23
A. "Vapor Chamber"	23
B. "Lip"	35
C. "Spacer"	38
D. "Hollow Column"	41
IX. CLAIMS 1-3 ARE OBVIOUS OVER NAKAMURA IN VIEW OF TAKAHASHI (GROUND 1)	42
A. Overview of the Prior Art.....	42
1. Overview of Nakamura (Ex.1004).....	42
2. Overview of Takahashi (Ex.1005).....	44
B. Independent claim 1	46
1. Preamble: "A heat pipe for spreading heat comprising:"	46
2. "a boundary structure including a first plate and a second plate arranged in spaced apart relation,"	47
3. "each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together"	49
a. Motivation to combine Nakamura with Takahashi regarding the "lip" limitation.....	51

TABLE OF CONTENTS **(continued)**

	Page
b. Nakamura in view of Takahashi renders obvious “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together”53 4. “so as to define an enclosed vapor chamber;”54 5. “a depression formed in said first plate which projects into said vapor chamber, is spaced from said peripheral lip, and is bonded to said second plate;”56 6. “an opening defined through said first plate depression and said second plate”59 7. “wherein said depression comprises an annular outer surface that is bonded to a corresponding annular edge surface in said second plate”60 8. “and further wherein said opening is isolated from said vapor chamber.”63 9. “at least one spacer extending between and contacting said first and second plates; and”66 10. “a wick positioned upon said confronting interior surfaces including that portion of the interior surface of said first plate that forms a surface of said depression within said vapor chamber.”69 C. Independent claim 272 1. Preamble: “A heat pipe for spreading heat comprising;”72 2. “a first plate having a circumferential edge lip bounding an inner surface and”72 a. “a first plate” and “an inner surface”72 b. “a circumferential edge lip bounding an inner surface”73	

TABLE OF CONTENTS **(continued)**

	Page
3. “at least one hollow column that is integral with said first plate and which projects outwardly relative to said inner surface;”	76
a. The ’680 patent discloses that the “hollow column” can be formed as part of a plate enclosing the “vapor chamber.”	79
4. “a second plate arranged in spaced apart confronting relation to said first plate and”	82
5. “a second plate ... including a circumferential edge lip bounding an inner surface and”	84
6. “at least one opening through said second plate”	86
7. “said edge lips of said first and second plates being bonded together”	88
8. “so as to define a vapor chamber; wherein”	89
9. “a hollow column bonded at one end to said second plate”	89
10. “so as to coaxially align said hollow column with one of said at least one openings in said second plate”	90
11. “thereby to form a mounting hole that extends through said first plate and said second plate and is isolated from said vapor chamber.”	91
D. Independent claim 3	93
1. Preamble: “A heat pipe for spreading heat comprising:”	93
2. “a first plate having a circumferential edge lip bounding an inner surface and”	93
3. “a depression which projects outwardly relative to said inner surface;”	93

TABLE OF CONTENTS **(continued)**

	Page
4. “a second plate arranged in spaced apart confronting relation to said first plate and”	95
5. “a second plate ... including a circumferential edge lip bounding an inner surface and”	95
6. “at least one opening through said second plate”	95
7. “said edge lips of said first and second plates being bonded together”	95
8. “so as to define an enclosed vapor chamber; wherein”	95
9. “said depression having an open ended tubular cross-section and an outer surface”	96
10. “a portion of which outer surface is bonded to said second plate”	98
11. “so as to coaxially align said depression with one of said at least one openings in said second plate”	99
12. “thereby to form a mounting hole that extends through said first plate depression and said second plate and is isolated from said vapor chamber.”	100
X. ENABLEMENT OF THE PRIOR ART AND REASONABLE EXPECTATION OF SUCCESS	102
XI. CONCLUSION.....	104

I, Dr. Himanshu Pokharna, declare as follows:

I. INTRODUCTION AND QUALIFICATIONS

A. Qualifications and Experience

1. I am currently the CEO of Inficold Inc., a company devoted to developing thermal energy storage systems dedicated for refrigeration and air-conditioner systems, which I founded in 2015. In addition, I serve as the principal of Deeia Inc., a consulting business with an emphasis on providing thermal design support to clients such as Google, Facebook, and startups for thermal design of consumer electronics and computing devices. I received a Bachelor's of Technology and a Master's 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 received a Ph.D. in Nuclear Energy Engineering from Purdue University in 1997. My Ph.D. thesis focused on effective 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 heat pipes, vapor chamber devices, and boiling water reactors. In addition, I have an MBA degree from the Wharton School of the University of Pennsylvania.

2. I have worked in various capacities in the industry since 1997. My experience includes leading a team of over two dozen engineers at Intel Corporation in the development of thermal management technology for laptop computers. My areas of expertise include thermal management of electronics and energy systems. I have published many peer-reviewed scientific articles and have made 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 sixty issued or pending patents.

3. My Curriculum Vitae is submitted herewith as **Exhibit A**, which provides additional details of my background, a more complete description of my work experience, and lists the presentations, articles, and other publications that I have authored or to which I have contributed.

4. I have been retained by counsel for Cooler Master as an expert witness in the above-captioned proceeding. I have been asked to provide my opinion about the state of the art of the technology described in U.S. Patent No. 7,100,680 (“the ‘680 patent” or “’680”) [**Exhibit 1001**] and on the patentability of the claims of this patent in light of certain prior art references discussed below. I am being compensated at a rate of \$400 per hour for my study and other work, and \$500 per

hour for any time spent in depositions, if any, in this matter. I am also being reimbursed for reasonable and customary expenses associated with my work in this investigation. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

5. I do not currently hold any financial interest in either Cooler Master Co., Ltd. (“Cooler Master” or “Petitioner”), CMI USA, Inc. (“CMI”), Aavid Thermalloy LLC (“Aavid” or “Patent Owner”), or Boyd Corporation, which I understand are parties in a related litigation: Aavid Thermalloy LLC v. Cooler Master Co., Case No. 3:17-cv-5363 (N.D. Cal.), for which I have also been retained by Cooler Master as an expert witness.

6. The following is my written declaration (“Declaration”) concerning the ’680 patent and related topics.

II. MATERIALS CONSIDERED

7. The analysis that I provide in this Declaration is based on my years of education, research, and experience, as well as my investigation and study of relevant materials, including the ’680 patent, which states on its face that it issued from an application filed on August 9, 2005, in turn claiming priority back to an earliest application filed on May 12, 1999. For purposes of this Declaration, I have

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

assumed May 12, 1999 as the effective filing date for the '680 patent. I have cited to the following documents in my analysis below:

Exhibit No.	Description of Document
1001	U.S. Patent No. 7,100,680
1003	File Wrapper of U.S. Patent No. 7,100,680
1004	Nakamura (Japanese Unexamined Utility Model Application Publication; Title: Heat Pipe; Year of Publication: 1975; Inventor: Kazuo Nakamura) (Translation and certificate are attached)
1005	Takahashi (Japanese Examined Utility Model Application Publication; Title: Heat Pipe; Dates of Publication: July 9, 1991 and March 27, 1996; Inventors: Tadahito Takahashi, Kaoru Hasegawa, Muneaki Sokawa) (Translation and certificate are attached)
1006	Excerpt from American Heritage Dictionary (4th ed. 2000)
1007	Excerpt from Webster's II New College Dictionary (1999)
1008	Excerpt from Declaration of Nelson J. Gernert in Connection with Claim Construction, <i>Aavid Thermalloy LLC v. Cooler Master Co., Ltd.</i> , No. 4:17-cv-05363-JSW (N.D. Cal.), dated July 13, 2018
1009	Excerpt from Merriam Webster's Collegiate Dictionary (10th ed. 1998)
1010	Excerpt from Webster's New Dictionary (1997)
1011	Excerpt from Random House Webster's Unabridged Dictionary (2nd ed. 2001)
1012	Excerpt from Prosecution History of U.S. Patent No. 6,302,192
1013	U.S. Patent No. 4,012,770
1014	U.S. Patent No. 4,165,472
1015	U.S. Patent No. 6,817,097

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

Exhibit No.	Description of Document
1016	Aavid Thermalloy LLC's Preliminary Proposed Claims Construction Pursuant to Patent L.R. 4-2, <i>Aavid Thermalloy LLC v. Cooler Master Co., Ltd.</i> , No. 4:17-cv-05363-JSW (N.D. Cal.), dated May 29, 2018
1017	Email from Kenneth M. Albridge III to Reuben Chen, Kyle Chen, dated October 31, 2017
1018	Joint Stipulated Request for Relief from Case Management Schedule and [Proposed] Order, <i>Aavid Thermalloy LLC v. Cooler Master Co., Ltd.</i> , No. 4:17-cv-05363-JSW (N.D. Cal.), dated November 14, 2017
1019	Joint Claim Construction and Prehearing Statement Pursuant to Patent L.R. 4-3, <i>Aavid Thermalloy LLC v. Cooler Master Co., Ltd.</i> , No. 4:17-cv-05363-JSW (N.D. Cal.), dated June 22, 2018
1020	Excerpts from Webster's Third New International Dictionary (2002)
1021	U.S. Patent No. 3,680,189
1022	Eastman, <i>The Heat Pipe</i> , Scientific American, 218(5):38-46 (1968)
1023	Morikawa (Japanese Examined Utility Model Application Publication; Title: Heat Pipe; Year of Publication: 1978; Inventor: Takao Morikawa, Mitsuhiko Nakata) (Translation and certificate are attached)
1024	Exhibit not used
1025	Supplemental Declaration of Dr. Himanshu Pokharna in Response to Declaration of Mr. Nelson Gernert, <i>Aavid Thermalloy LLC v. Cooler Master Co., Ltd.</i> , No. 4:17-cv-05363-JSW (N.D. Cal.), dated July 27, 2018

III. PERSON OF ORDINARY SKILL IN THE ART

8. I understand that an assessment of claims of the '680 patent should be undertaken from the perspective of a person of ordinary skill in the art as of the earliest claimed priority date, which I understand is May 12, 1999.

9. In my opinion, a person of ordinary skill in the art as of May 1999 would have earned at least a graduate degree, such as an M.S., Ph.D., or equivalent thereof, in mechanical engineering or a closely-related field and possessed at least three years of specialized experience in designing and developing heat pipes or other heat transfer devices for thermal management in electronics and computer systems.

10. My opinions regarding the level of ordinary skill in the art are based on, among other things, my over twenty years of experience in the field of thermal management and related devices, my understanding of the basic qualifications that would be relevant to an engineer or scientist tasked with investigating methods and systems in the relevant area, and my familiarity with the backgrounds of colleagues, co-workers, and employees, both past and present.

11. Although my qualifications and experience exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '680 patent have been based on the perspective of a person of ordinary skill in the art as of May 1999.

IV. BASIS FOR MY OPINION AND STATEMENT OF LEGAL PRINCIPLES

12. My opinions and views set forth in this declaration are based on my education, training, and experience in the relevant field, as well as the materials I

have reviewed for this matter, and the scientific knowledge regarding the subject matter that had existed prior to May 1999.

A. Claim Construction

13. It is my understanding that, when construing claim terms, a claim subject to *inter partes* review receives the “broadest reasonable construction in light of the specification of the patent in which it appears” for petitions filed before November 13, 2018. I have been informed my Declaration will be used to support a petition or petitions to be filed before November 13, 2018, so I have applied that standard in my analysis herein.

B. Anticipation

14. It is my understanding that in order for a patent claim to be valid, the claimed invention must be novel. It is my understanding that if each and every element of a claim is disclosed in a single prior art reference, then the claimed invention is anticipated, and the invention is not patentable according to pre-AIA 35 U.S.C. § 102 effective before March 16, 2013. In order for the invention to be anticipated, each element of the claimed invention must be described or embodied, either expressly or inherently, in the single prior art reference. In order for a reference to inherently disclose a claim limitation, that claim limitation must necessarily be present in the reference.

C. Obviousness

15. Counsel has advised me that obviousness under pre-AIA 35 U.S.C. § 103 effective before March 16, 2013 is the basis for invalidity in the petition(s) that my Declaration will support. Counsel has also advised me that a patent claim may be found invalid as obvious if, at the time when the invention was made, the subject matter of the claim, considered as a whole, would have been obvious to a person having ordinary skill in the field of the technology (the “art”) to which the claimed subject matter belongs. I understand that the following factors should be considered in analyzing obviousness: (1) the scope and content of the prior art; (2) the differences between the prior art and the claims; and (3) the level of ordinary skill in the pertinent art. I also understand that certain other factors known as “secondary considerations” such as commercial success, unexpected results, long felt but unsolved need, industry acclaim, simultaneous invention, copying by others, skepticism by experts in the field, and failure of others may be utilized as indicia of non-obviousness. I understand, however, that secondary considerations should be connected, or have a “nexus,” with the invention claimed in the patent at issue. I understand that a person of ordinary skill in the art is assumed to have knowledge of all prior art. I understand that one skilled in the art can combine various prior art references based on the teachings of those prior art references, the

general knowledge present in the art, or common sense. I understand that a motivation to combine references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Thus, one may take into account the inferences and creative steps that a person of ordinary skill in the art would employ to combine the known elements in the prior art in the manner claimed by the patent at issue. I understand that one should avoid “hindsight bias” and ex post reasoning in performing an obviousness analysis. But this does not mean that a person of ordinary skill in the art for purposes of the obviousness inquiry does not have recourse to common sense. I understand that when determining whether a patent claim is obvious in light of the prior art, neither the particular motivation for the patent nor the stated purpose of the patentee is controlling. The primary inquiry has to do with the objective reach of the claims, and that if those claims extend to something that is obvious, then the entire patent claim is invalid. I understand one way that a patent can be found obvious is if there existed at the time of the invention a known problem for which there was an obvious solution encompassed by the patent’s claims. I understand that a motivation to combine various prior art references to solve a particular problem may come from a variety of sources, including market demand or scientific literature. I understand that a need or problem known in the field at the time of the

invention can also provide a reason to combine prior art references and render a patent claim invalid for obviousness. I understand that familiar items may have obvious uses beyond their primary purpose, and that a person of ordinary skill in the art will be able to fit the teachings of multiple prior art references together “like the pieces of a puzzle.” I understand that a person of ordinary skill is also a person of at least ordinary creativity. I understand when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If these finite number of predictable solutions lead to the anticipated success, I understand that the invention is likely the product of ordinary skill and common sense, and not of any sort of innovation. I understand that the fact that a combination was obvious to try might also show that it was obvious, and hence invalid, under the patent laws. I understand that if a patent claims a combination of familiar elements according to known methods, the combination is likely to be obvious when it does no more than yield predictable results. Thus, if a person of ordinary skill in the art can implement a predictable variation, an invention is likely obvious. I understand that combining embodiments disclosed near each other in a prior art reference would not ordinarily require a leap of inventiveness.

16. I have been advised by counsel that obviousness may be shown by demonstrating that it would have been obvious to modify what is taught in a single piece of prior art to create the patented invention. Obviousness may also be shown by demonstrating that it would have been obvious to combine the teachings of more than one item of prior art. I have been advised by counsel that a claimed invention may be obvious if some teaching, suggestion, or motivation exists that would have led a person of ordinary skill in the art to combine the invalidating references. Counsel has also advised me that this suggestion or motivation may come from the knowledge of a person having ordinary skill in the art, or from sources such as explicit statements in the prior art. Alternatively, any need or problem known in the field at the time and addressed by the patent may provide a reason for combining elements of the prior art. Counsel has advised me that when there is a design need or market pressure, and there are a finite number of predictable solutions, a person of ordinary skill may be motivated to apply common sense and his skill to combine the known options in order to solve the problem. The following are examples of approaches and rationales that may be considered in determining whether a piece of prior art could have been combined with other prior art or with other information within the knowledge of a person having ordinary skill in the art:

- (1) Some teaching, motivation, or suggestion in the prior art that would have led a person of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- (2) Known work in one field of endeavor may prompt variations of it for use in the same field or a different field based on design incentives or other market forces if the variations would have been predictable to a person of ordinary skill in the art;
- (3) Combining prior art elements according to known methods to yield predictable results;
- (4) Applying a known technique to a known device, method, or product ready for improvement to yield predictable results;
- (5) Applying a technique or approach that would have been “obvious to try” (choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success);
- (6) Simple substitution of one known element for another to obtain predictable results; or
- (7) Use of a known technique to improve similar products, devices, or methods in the same way.

V. APPLICATION OF THE PRIOR ART TO THE CLAIMS

17. I have reviewed and analyzed the prior art references and materials listed above. In my opinion, the limitations of claims are disclosed by the following combinations of prior art references.

Ground	Prior Art References	Claims
1	Nakamura (Ex.1004); Takahashi (Ex.1005)	1-3
2	Nakamura (Ex.1004); Takahashi (Ex.1005); Yamamoto (Ex.1024)	1-3

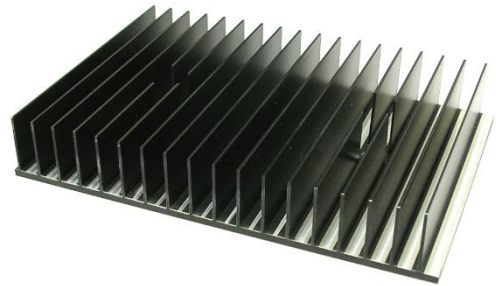
18. I understand that each of the references listed above qualifies as prior art to the '680 patent because each reference was filed and/or published before May 12, 1999, the earliest claimed filing date for the '680 patent.

VI. BACKGROUND OF THE UNDERLYING TECHNOLOGY

19. Despite vast improvements in the performance, efficiency, and size of computers and electronic components over the past decades, one issue has remained of constant concern – heat. Key components in modern computers, such as microprocessors, can generate significant amounts of heat as electricity passes through them. If this heat is not removed, electronic components such as microprocessors can overheat and malfunction, causing computer systems to fail.

20. The prior art has responded to this challenge with a number of techniques for dissipating heat from the heat producing electronic components to another medium, such as air. One of the most commonly seen techniques is to use

the ambient air surrounding the heat generating components to cool them by mounting fans near or onto the components to draw away the hot air and replace it with the cooler ambient air. Such conventional air cooling techniques can be supplemented with a device known as the “heat sink,” which often consists of a plate of a thermally conductive material (such as aluminum or copper) in contact with the heat producing components. The thermally conductive material can spread heat to a larger area onto which the fan can blow the cooler ambient air to dissipate the heat absorbed from the components. The heat sink may also include “fins” (as shown on the right) to increase the area available for heat dissipation and thereby to improve the cooling performance.



21. But as the size of the heat generating components, such as microprocessor chips, gets smaller due to technology advancements, the contact area on the components available for heat absorption also gets smaller, making heat dissipation more difficult. This is because, just like it is harder to quickly move a large amount of water through a narrow pipe, it is harder to “squeeze” a large flow of heat through the small contact area available on the heat generating components. That is why a high level of thermal conductivity of the heat sink is critical, since

the higher is the heat sink's thermal conductivity, the quicker can the heat absorbed from the contact area be spread and dissipated.

22. But common materials of which the heat sink is made, such as aluminum and copper, have become inadequate in many cooling applications despite their higher heat conductivity than many alternatives. This is because, relying on just their heat conductivity, these materials are good for transporting heat efficiently over only relatively shorter distances and thus smaller areas, rendering the heat sink ineffective when requiring much larger areas to efficiently dissipate heat into the air.

23. To combat this issue, a device known as the "heat pipe" was often used to act as the heat transporting intermediate between the small heat generating components and the ambient cooling air, or the heat sink with a large area in contact with the cooling air. The original heat pipe's operating principle was developed in the 1940s, and the modern heat pipe technology has been known to the public since the 1960s. (Ex1022 (Eastman, *The Heat Pipe*, Scientific American, 218(5):38-46 (1968).) A heat pipe, often larger in its size than the heat generating component, generally consists of a sealed, hollow metal device containing a suitable amount of heat transfer fluid that is volatile, and usually works as follows. First, the heat pipe is typically installed to be in contact with the heat generating components (e.g.,

microprocessors) on one side or one end of the heat pipe. The heat transfer fluid inside the heat pipe absorbs the heat from the components and evaporates into vapor, which quickly travels throughout the hollow space inside the heat pipe. In doing so, the vapor rapidly carries the absorbed heat and spreads it throughout a much larger area of the heat pipe, which is often located at its other side or end exposed to the cooling air or in contact with the heat sink exposed to the air. The vapor carrying heat, once cooled by the air, condenses back into liquid and, through gravity or optionally capillary actions through a “wick” structure, flows back to the small area in contact with the heat generating components. The heat transfer fluid in its liquid phase then absorbs heat and evaporates into vapor again, thus completing the heat dissipating cycle, which continues. That is, instead of relying on only its metal casing’s thermal conductivity, a heat pipe relies primarily on the evaporation and condensation cycle of the heat transfer fluid (particularly the rapid movement of its vapor inside the heat pipe) to transport heat from a small area to a much larger area. (*See, e.g., Ex.1023 S53-32387 Y at 1:32-2:7.*)

24. Heat pipes have found broad applications, from thermal management of electronics on satellites to computing systems and even solar water heaters. In fact, they are a mainstay of thermal management in mobile computers such as laptops. The heat in the laptops needs to be transported from high power

processors and other components on the motherboard to the edge of the laptops where a fan can be used to blow air past an extended surface area (such as fins) to remove and dissipate the heat into the ambient air.

25. Heat pipes come in different shapes. The original heat pipes tended to be elongated and have a somewhat linear shape. Later, heat pipes shaped like a square or rectangular plate were introduced. (See, e.g., Ex.1023 S53-32387 Y at 2:8-14.) These heat pipes may provide superior performance because they can purportedly transport heat in more directions and be used with larger heat sinks with more fins for cooling. These heat pipes have sometimes been referred to as “vapor chamber” devices in the industry. In the ’680 patent, for example, the claimed heat pipes comprises a “vapor chamber,” which is discussed in detail and construed below in **Section VIII.A**.

26. Because of their larger and flatter structures, however, these heat pipes sometimes include through hole structures located at their interior regions for mounting purposes (indicated in yellow below), as shown in an example published in the 1970s. (Ex.1023 (Examined Utility Model Application No. 253-32387 Y, published on August 11, 1978).)

FIG. 2

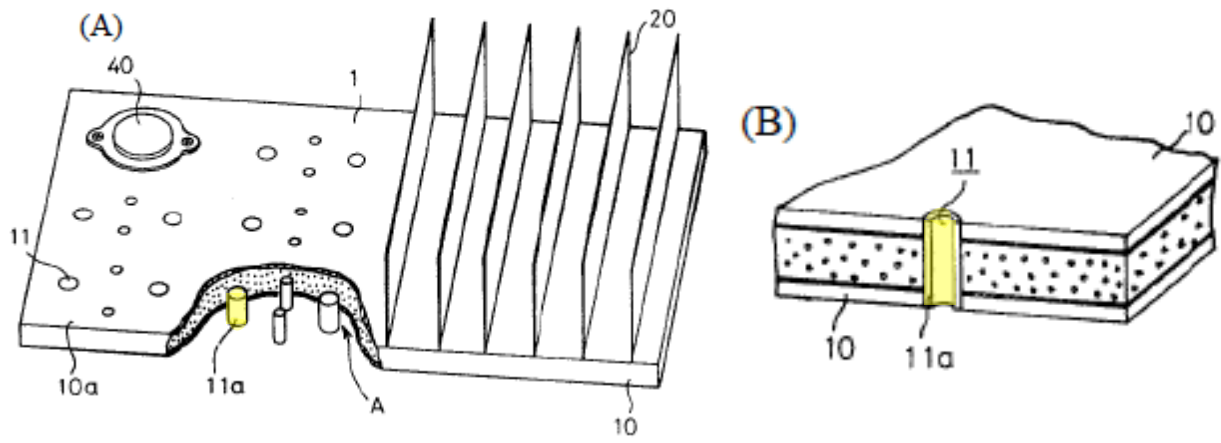
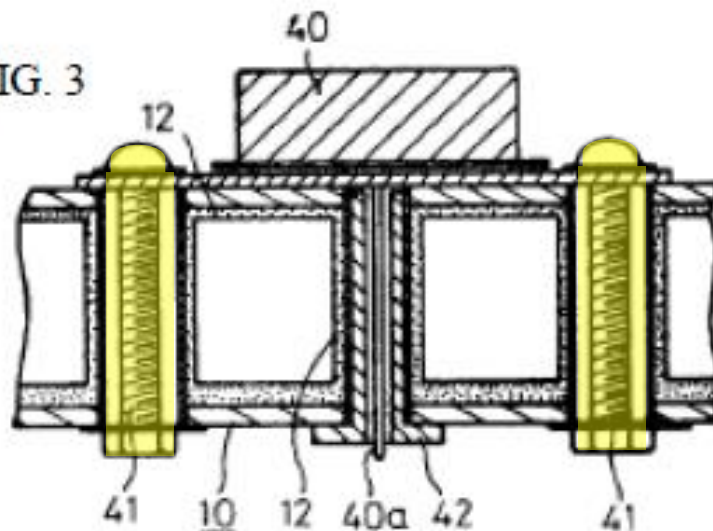


FIG. 3



27. These through mounting holes are for ease of attaching the heat pipes to, for example, the heat generating components (labeled as 40), in the example shown above. They can also function as supporting structures, known as “spacers,” to prevent collapse of the heat pipes and to maintain their shape and internal hollow space’s integrity. (See, *e.g.*, Ex.1023 S53-32387 Y at 3:51-4:41.) At the time of the filing of the ’680 patent, the technology to build through holes for mounting

purposes had existed and well-known in the industry for more than 20 years. As discussed above and in more detail below, the Utility Model Application Publication No. S53-32387 Y, published on August 11, 1978, discloses:

A shape of the heat pipe is not limited to that of a so-called pipe type, and included are a shape of a panel type and shapes of other types. Because a heat pipe of a panel type readily conforms to a space of an electronic device and can be mounted with a large number of components to be cooled, generally, this type of heat pipe is often used.

(Ex.1023 at 2:8-14.) In particular, this 1978 publication recognizes that for “this type of heat pipe[s,]” “[i]f the component can be made to directly contact the heat-pipe[’s] heating portion,” it would be the most preferable in terms of efficiency in thermal conductivity.” (*Id.*; 2:46-3:4.) But “opening a hole in the heat-pipe main body to fix the component to be mounted is impermissible due to an air-tight sealed-gas structure of the heat pipe[.]” (Ex.1023 at 2:30-36.) To solve this problem, this 1978 publication teaches “disposing a *through path* blocked from an interior of a heat pipe by a metal pipe in a heat-pipe heating portion and directly mounting and fixing a component to be cooled to the heat-pipe heating portion by a nut and bolt through the through path[.]” as shown below. (Ex.1023 at 3:9-14.) (See Figures 2-3 of Ex. 1023 reproduced and annotated on p. 9 of this Petition and again below.) In these figures, “each through path 11 is communicated to both surfaces of a panel by a metal pipe 11a provided inside the panel.” (Ex.1023 at

3:25-28.) “Accordingly, a panel interior, a so-called heat-pipe interior, and the through path 11 are completely blocked by this metal pipe 11a, and there is no fear of interior liquid and vapor escaping therethrough.” (Ex.1023 at 3:28-32.) Here, “[a] component 40 to be cooled such as a transistor element is fixed to a surface of the main-body heating portion by nuts and bolts using the through paths 11.”

(Ex.1023 at 3:32-35.) The 1978 publication further discloses:

In this manner, by adopting the heat-pipe structure of the present invention, the component can be directly mounted and fixed to the heat-pipe heating portion. Therefore, compared to a conventional structure of mounting to an installation plate, an efficiency in thermal conductivity improves remarkably and a weight of the heat pipe is reduced according to a weight of the installation plate in the conventional structure.

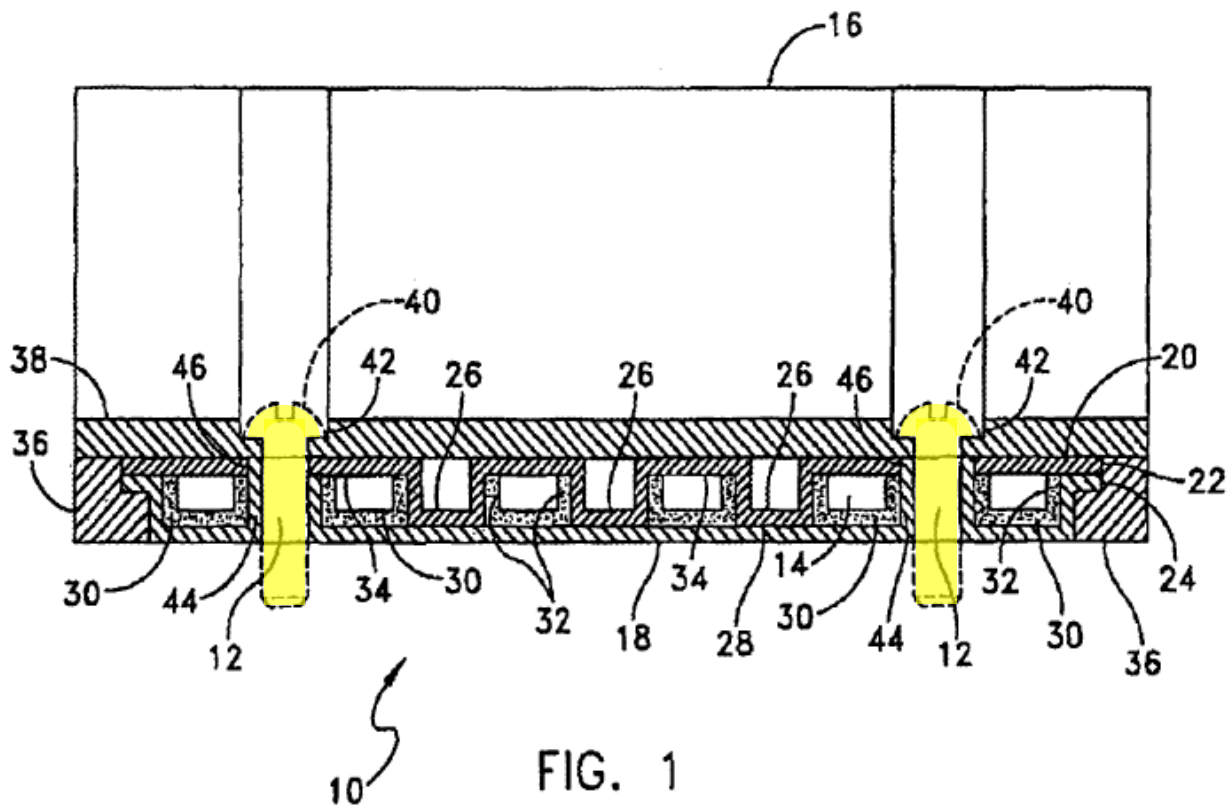
Furthermore, because the structure is one where the large number of through paths 11 is communicated by the metal pipes 11a, these metal pipes 11a also function as spacers of the enclosure panel and provide an effect of a reinforcing material.

(Ex.1023 at 3:43-55.)

VII. SUMMARY OF THE '680 PATENT

A. Brief Description of the '680 Patent

28. The '680 patent, entitled "Integrated Circuit Heat Pipe Heat Spreader with Through Mounting Holes," relates generally to heat pipes with "through holes" for fasteners located at the interior region of the heat pipes for "mounting" purposes, as indicated in yellow below.



29. These through mounting holes are for ease of attaching the heat pipes to, for example, the heat generating components and/or the heat sinks. The specification describes purported techniques for creating such "through holes"

while maintaining the sealed integrity of the heat pipes' internal hollow space that the claims refer to as the "vapor chamber" of the heat pipes. In particular, the '680 patent describes heat pipes with two plates that are bonded at their edges to isolate the inside space of the heat pipes, i.e., the "vapor chamber," from the outside world. Depressed areas on at least one of the two plates, referred to by the '680 patent as "depressions," can be formed at the interior region of the heat pipes. The two plates are also bonded *within* the area of the "depressions," wherein the "through holes" can be formed such that they go through only the *bonded* area within the depressions without breaching the sealed integrity of the heat pipes' "vapor chamber" inside. Alternatively, columns can be placed at the interior region of the heat pipes, with the top and bottom ends of such columns bonded to the two plates, respectively. The "through holes" can therefore go through these columns and the portions of the two plates respectively bonded to the two ends of the column without breaching the sealed integrity of the heat pipes' "vapor chamber" inside. These columns with the "mounting holes" going through them are recited as "hollow columns" in the claims of the '680 patent. The term "hollow column," however, does not appear and is not otherwise explained in the specification, which describes only certain "columns."

VIII. CLAIM CONSTRUCTION

A. “Vapor Chamber”

30. One of ordinary skill in the art would have understood, at the time of the alleged invention in the '680 patent, the term “vapor chamber” in the context of the '680 patent, as well as the state-of-the-art or background information in connection with the patent and the related field(s), to mean an “enclosed and sealed cavity in which a heat transfer fluid is present to be evaporated (or vaporized) and condensed to transport or spread heat.” I understand that in the district court litigation, Patent Owner proposed a competing construction that is much narrower: “[a] vacuum sealed chamber, wherein a heat transfer fluid is evaporated and condensed and capillary forces are utilized to spread heat.” (Joint Claim Construction and Prehearing Statement (Ex.1019) at 3.) Based on both intrinsic and extrinsic evidence, my proposed construction should be adopted, as explained below.

31. There are three main differences between my and Patent Owner’s proposed constructions: (1) my proposed construction requires that the “vapor chamber” be “enclosed and sealed,” while Patent Owner’s proposed construction requires that the “vapor chamber” be “vacuum sealed”; (2) my proposed construction explains that the “chamber” in “vapor chamber” means a “space or

cavity,” while Patent Owner’s proposed construction includes the word “chamber” itself and does not explain what it means; and (3) my proposed construction does not include the limitation, “capillary forces are utilized,” which is in Patent Owner’s proposed construction. As explained below, my construction is correct and helpful and should therefore be adopted, while Patent Owner’s proposed construction is incorrect and/or unhelpful, and thus should not be adopted.

32. First of all, the specification of the ’680 patent does not recite and, moreover, does not explain the phrase “vacuum sealed” included in Patent Owner’s proposed construction, wherein the word “vacuum” is confusing due to its multiple meanings. For example, the American Heritage Dictionary at 1897-98 (4th ed. 2000) (Ex.1006) defined “vacuum” as “[a]bsence of matter,” “[a] space empty of matter,” “[a] space relatively empty of matter,” “[a] space in which the pressure is significantly lower than atmospheric pressure,” “[a] state of emptiness; a void,” or “[a] state of being sealed off from external or environmental influences; isolation.” (See also Webster’s II New College Dictionary at 1217 (1999) (Ex.1007), which defined “vacuum” the same way.) Among all of these meanings, only the last one, “[a] state of being sealed off from external or environmental influences; isolation” is consistent with how a person of ordinary skill in the art would have understood the word “vacuum” as used in the ’680 patent. All of the other possible meanings

are actually inappropriate in the context of the '680 patent, making the phrase "vacuum sealed" confusing, as further explained below.

33. The "vapor chamber" in the '680 patent is not associated with the following definitions of "vacuum": "[a]bsence of matter," "[a] space empty of matter," and "[a] state of emptiness; a void." This is because at least "a heat transfer fluid" is present inside the "vapor chamber," as both my and Patent Owner's proposed constructions recognize. That is, the vapor chamber contains at least a "fluid" matter and thus is *not* empty. In addition, both my and Patent Owner's constructions also agree that this "fluid" may be "evaporated," which a person of ordinary skill in the art would have understood generates vapor that fills up the vapor chamber and may cause the pressure inside the chamber to be even greater than the atmospheric pressure outside. Thus, in my opinion, the meanings of "[a] space relatively empty of matter" and "[a] space in which the pressure is significantly lower than atmospheric pressure" for "vacuum" also do not apply in the context of the '680 patent.

34. The specification does mention that the "vapor chamber" is "evacuated" ('680, 2:12-16) and that "[h]eat pipe 10 is then evacuated to remove all non-condensable [*sic*] gases and a suitable quantity of heat transfer fluid is placed within it" ('680, 3:37-39). But in my opinion, neither of these statements make any

of the meanings for “vacuum” correct in the context of the ’680 patent for the same reasons stated above.

35. In summary, because of all of these possible yet inappropriate meanings for “vacuum,” the use of the word “vacuum” in the construction for “vapor chamber” in the context of the ’680 patent is confusing and should be avoided, in my opinion.

36. One of ordinary skill in the art would have understood that, in the context of the ’680 patent, the word “vacuum” simply means the vapor chamber is in “[a] state of being sealed off from external or environmental influences” or in “isolation,” which is the last meaning for “vacuum” in the American Heritage Dictionary at 1897-98 (Ex.1006) mentioned above. Reproduced below are all instances of the word “vacuum” appearing in the specification for the ’680 patent, all consistent with this last meaning, as would have been understood by a person of ordinary skill in the art:

The spacers also make it possible to provide holes into and through the vapor chamber, an apparent inconsistency since the heat pipe vacuum chamber is supposed to be *vacuum tight*. This is accomplished by bonding the spacers, if they are solid, to both plates of the heat pipe, or, if they are embossed in one plate, *bonding* the portions of the depressions which contact the opposite plate to that opposite plate. With the spacer bonded to one or both plates, a through hole can be formed within the spacer and it has no effect on the *vacuum integrity* of the heat pipe vapor chamber, from which the hole is completely *isolated*.

(’680, 2:36-46 (emphasis added).)

Holes 12 penetrate heat pipe 10 without destroying its *vacuum integrity* because of their unique location. Holes 12 are located within sealed structures such as solid columns 44, and since columns 44 are *bonded* to cover plate 20 at locations 46, holes 12 passing through the interior of columns 44 have no affect [*sic*] on the interior of heat pipe 10.

(’680, 4:25-30 (emphasis added).)

The only requirement for forming hole 50 within a depression 26 is that the bottom of depression 26 must be *bonded* to inner surface 28 of contact plate 18 to *prevent loss of vacuum* within the heat pipe. Of course, the region of the peripheral edges is also a sealed structure since *bonding* between lips 22 and 24 is inherent because heat pipe 11 must be *sealed* at its edges to *isolate* the interior from the outside atmosphere.

(’680, 4:46-53 (emphasis added).)

37. Reading the above passages, one of ordinary skill in the art would have understood that, in the context of the ’680 patent, the word “vacuum” simply means the vapor chamber is in “[a] state of being sealed off from external or environmental influences” or in “isolation,” as mentioned before. Thus, to avoid the confusion caused by the other inappropriate meanings for “vacuum” in the context of the ’680 patent, the phrase in my proposed construction simply requiring the “vapor chamber” to be “enclosed and sealed” should be adopted instead of Patent Owner’s confusing phrase requiring the “vapor chamber” to be “vacuum sealed.”

38. I understand that in the district court litigation, Patent Owner insisted that the phrase “vacuum sealed” in the construction for “vapor chamber” is necessary to convey that the “seal” of the “vapor chamber” is “airtight.” (See Declaration of Nelson J. Gernert (Ex.1008), at ¶20.) I do not dispute that the “vapor chamber” is airtightly (or hermetically) sealed, but in my opinion, (1) “vacuum” is not the right word to describe such airtight seal for the reasons explained above, and (2) it is unnecessary to state that the “seal” is airtight in the context of both the claim language of the ’680 patent and the term’s broadest reasonable interpretation. For example, claim 1 of the ’680 patent recites:

a boundary structure including a first plate and a second plate arranged in spaced apart relation, each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together so as to define an enclosed *vapor chamber*;

(’680, 5:31-38 (emphasis added).)

39. The claim language simply describes the “first plate” and the “second plate” are “bonded together so as to define an enclosed *vapor chamber*[.]” In reading the word “sealingly,” one of ordinary skill in the art would have understood that the “vapor chamber” is airtightly (or hermetically) sealed. Indeed, as explained above, “the vapor chamber is in ‘[a] state of being sealed off from external or environmental influences’ or in ‘isolation,’” which supports my understanding that the “space or

cavity” is airtightly (or hermetically) sealed. The word “hermetic” is a commonly used word by a person of ordinary skill in the art to describe a seal that is airtight. Indeed, “hermetic” is defined as “a: AIRTIGHT <~ seal> b: impervious to external influence” by Merriam Webster’s Collegiate Dictionary at 543 (10th ed. 1998) (Ex.1009) and “a. of alchemy: sealed” by Webster’s New Dictionary at 142 (1997) (Ex.1010).

40. Second, the word “chamber” in the term “vapor chamber” needs to be defined for clarity and consistency, and should mean the enclosed and sealed “space or cavity” as proposed by me. This is because, while stating that “[t]he internal structure of the heat pipe is an evacuated vapor chamber with a limited amount of liquid and includes a pattern of spacers extending between and contacting the two plates or any other boundary structure forming the vapor chamber” (’680, 2:12-16), the specification expressly acknowledges an apparent inconsistency as follows:

The spacers also make it possible to provide holes into and through the vapor chamber, *an apparent inconsistency since the heat pipe vacuum chamber is supposed to be vacuum tight*. This is accomplished by bonding the spacers, if they are solid, to both plates of the heat pipe, or, if they are embossed in one plate, bonding the portions of the depressions which contact the opposite plate to that opposite plate. With the spacer bonded to one or both plates, a through hole can be formed within the spacer and it has no effect on the vacuum integrity of the heat pipe vapor chamber, from which the hole is completely isolated.

(’680, 2:36-46 (emphasis added).)

41. Given this apparent inconsistency, it is important to clarify what the word “chamber” in the phrase “vapor chamber” actually means in the context of the ’680 patent such that the “through holes” can be “completely isolated” from the “chamber.” One of ordinary skill in the art would have understood the word “chamber” in the phrase “vapor chamber” to mean the enclosed and sealed “space or cavity” without including the plates, the spacers, or the depressions enclosing and sealing such “space or cavity” in the context of the claims of the ’680 patent. The applicable definition of the word “chamber” in the Merriam-Webster’s Collegiate Dictionary at 190 (10th ed. 1998) (Ex.1009) supports this understanding by a person of ordinary skill in the art: “a natural or artificial enclosed space or cavity.” The Random House Webster’s Unabridged Dictionary at 343 (2nd ed. 2001) (Ex.1011) provides a similar definition: “a compartment or enclosed space; cavity: a chamber of the heart.” The Webster’s II New College Dictionary at 185 (1999) (Ex.1007) provides another similar definition: “[a]n enclosed space or compartment: CAVITY[.]” and so does the American Heritage Dictionary at 308 (4th ed. 2000) (Ex. 1006) “[a]n enclosed space or compartment[.]”

42. That is, in my opinion, the “chamber” includes *only* the “space or cavity” enclosed and sealed by the bonded plates, the spacers, and/or the depressions, *without* these enclosing and sealing structures. This is because the

“through holes” are formed on the plates, the spacers, and/or the depressions, and thus by definition cannot be “completely isolated” from the plates, the spacers, and/or the depressions. That is, if any of those structures are part of the definition for the “chamber,” the “through holes” cannot be completely isolated from them. In other words, the definition of the word “chamber” must not include the plates, the spacers, or the depressions in which the “through holes” are formed because the “chamber” must be “completely isolated” from the “through holes.” That is, it is only physically possible for the “through holes” to be “completely isolated” from the “chamber” if the “chamber” does not include its surrounding plates, spacers, and depressions enclosing and sealing it.

43. My claim construction proposal for “chamber” is further supported by element 14 in

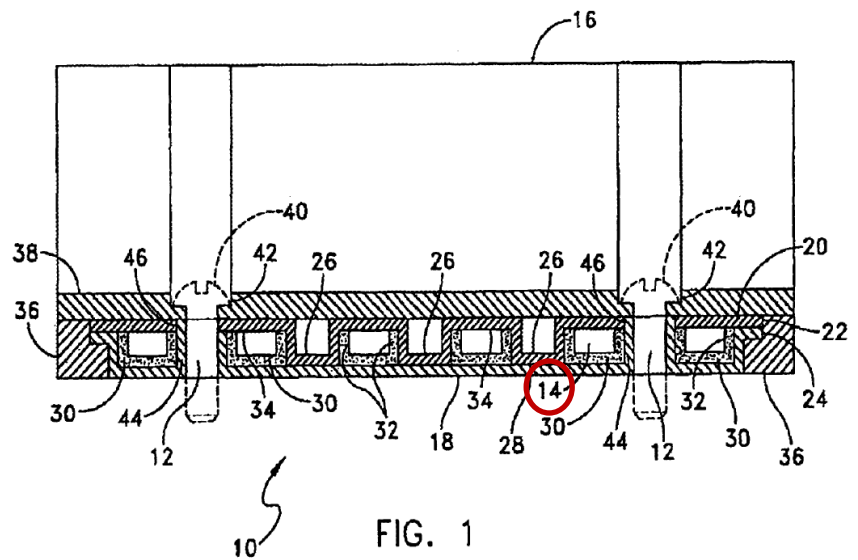


FIG. 1

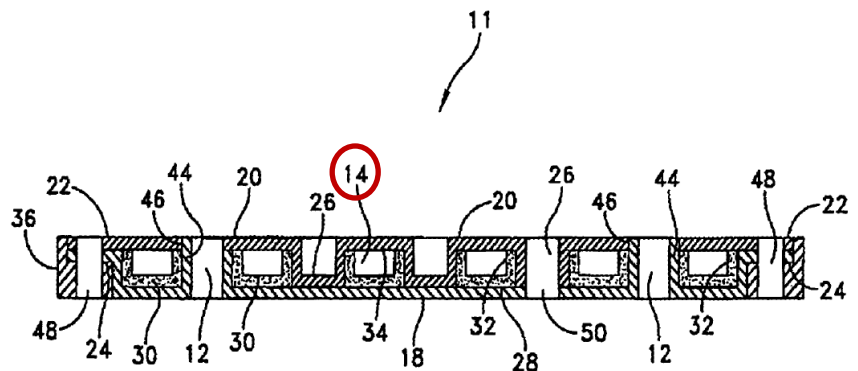


FIG. 2

Figures 1 and 2 of the '680 patent, "which is a cross section view of the preferred embodiment of a flat plate heat pipe 10 of the invention with through holes 12 through its vapor chamber 14 and in contact with finned heat sink 16" ('680, 3:13-16). As shown in Figure 1, "vapor chamber 14" refers to the enclosed and sealed "space or cavity" inside "heat pipe 10." Similarly, Element 14 in Figure 2 also refers to the enclosed and sealed space or cavity."

44. The claim language further confirms the correctness of Petitioner's proposed construction for the term "vapor chamber." For example, claim 1 of the '680 patent recites: "[a] heat pipe for spreading heat comprising: a boundary structure including a first plate and a second plate arranged in spaced apart relation ... which are bonded together so as to define an enclosed vapor chamber." ('680, 5:31-38.) The claim further recites that "said opening is isolated from said vapor chamber." But this "opening" is formed by "an open first end that opens through said first plate and an open second end that opens through said second plate." Thus, it is not physically possible for this "opening" to be "isolated from" the "first and second plates that define [the] enclosed vapor chamber" because the "opening" actually "opens through" the "first and second plates." That is, if the "vapor chamber" were to include the "first and second plates," then the "opening" cannot

be “isolated from” the “vapor chamber” as required by the claim language. Thus, the “vapor chamber” must exclude the “first and second plates.”

45. Third, the limitation in Patent Owner’s proposed construction requiring that “capillary forces [be] utilized” is unnecessarily and incorrectly restrictive, especially under the broadest reasonable interpretation of the term “vapor chamber.” This is because there was no such requirement either in the context of the ’680 patent nor in the general art at the time around the purported invention. A person of ordinary skill in the art would have understood that typically a structure known as a “wick” in heat pipes would have been required to generate and utilize capillary forces. But at that time, there had indeed existed “wickless” heat pipes that had not utilized or otherwise required capillary forces. (See, e.g., Takahashia at 4:48-64 (Ex.1005).) The original parent application for the ’680 patent that ultimately issued as the ’192 patent also had claims that did not include a “wick.” (See Prosecution History of the ’192 patent (Ex.1012), original claims 1-5.) A person of ordinary skill in the art would have understood that a “wick” might have been present in the claimed “heat pipe” in the ’680 patent, but only as an additional and optional structure. It is such additional and optional “wick” that would have generated and utilized the “capillary forces” to help with the function of transporting and spreading heat. (Ex.1023 (S53-32387 Y) at 1:36-41, 2:2-7.) But

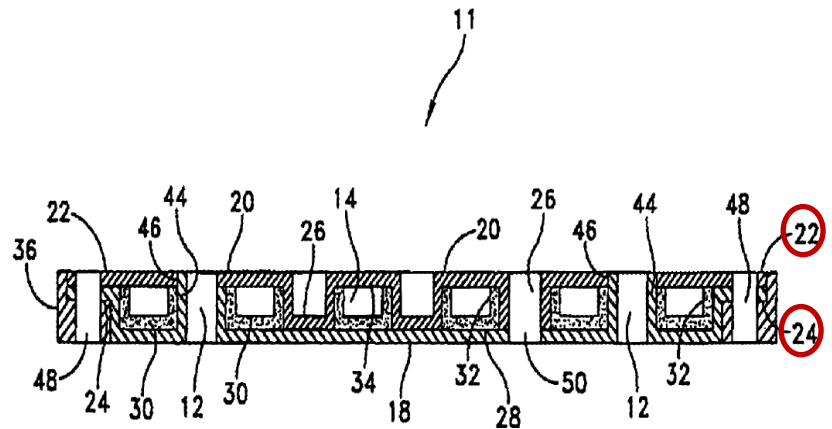
this “wick” had not always been present in all heat pipes that had existed at the time of the purported invention, nor was it required. (*See, e.g.*, Takahashi at 4:48-64 (Ex.1005); U.S. Pat. No. 4,012,770 at 13:53-63 (Ex.1013); U.S. Pat. No. 4,165,472 at 1:53-60, 4:23-30, 6:60-7:7 (Ex.1014); U.S. Pat. No. 6,817,097 at 3:1-10, 3:22-36 (references 113, 413) claim 7 (Ex.1015).) In a heat pipe without a wick, capillary forces would not have been utilized to spread or transport heat. Thus, in my opinion, Patent Owner’s proposed construction incorrectly reads in an unnecessary limitation of “capillary forces [be] utilized” for the term “vapor chamber.

46. The claim language again further confirms Petitioner’s proposal. For example, some of the independent claims 2, 3, and 4 include a “vapor chamber,” but do not recite a “wick,” thus no associated capillary forces are necessarily utilized in the claimed “vapor chamber” therein. But claims 1 and 5 (claim 5 depends from claim 1) each recite *additionally* a “wick,” demonstrating that such “wick” is *optional* to the “vapor chamber” claimed in the independent claims, and thus the utilization of any capillary forces would also be optional. In summary, the correct construction of “vapor chamber” should not read in an optional feature of utilizing capillary forces as a required limitation..

B. “Lip”

47. One of ordinary skill in the art would have understood, at the time of the purported invention in the '680 patent, the term “lip” to mean the “portion of the plate comprising a region bonded to another plate” in the context of the '680 patent. I have been informed that in the district court litigation, Patent Owner proposed a competing construction for the term “lip”: the “[p]ortion of the plate defined by the bonded region of the plate’s inner or interior surface.” (Ex.1019 at 5.) Based on both intrinsic and extrinsic evidence, my proposed construction should be adopted, as explained below.

48. In describing Figure 1, the specification of the '680 patent states: "[c]ontact plate 18 and cover plate 20 are sealed together at their peripheral lips 22 and 24 by conventional means, such as soldering or brazing, to form heat pipe 10." ('680, 3:34-37.) Thus, the meaning of the term "lip" in the context of the '680 patent



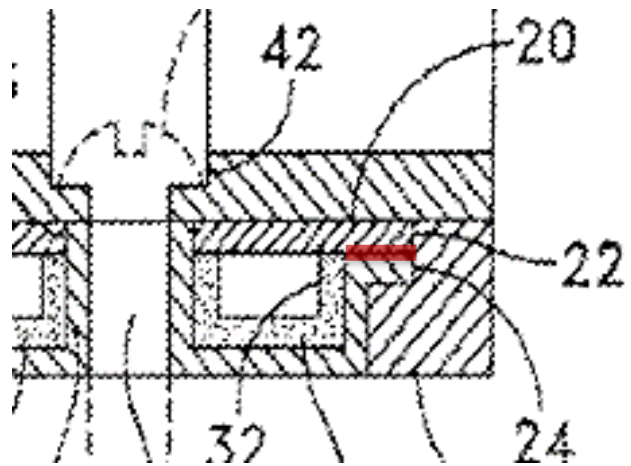
(10th ed. 1995) (Ex.1009) defined “lip” as “the edge of a hollow vessel or cavity.”

And, as “bonding between lips 22 and 24 is inherent because heat pipe 11 must be sealed at its edges,” a person of ordinary skill in the art would have understood the term “lip” in the context of the ’680 patent to simply mean the “portion of the plate comprising a region bonded to another plate” as proposed by me.

49. Patent Owner’s proposed construction is problematic because it construes the term “lip” to be only the “[p]ortion of the plate defined by the *bonded region* of the plate’s inner or interior surface.” (Ex.1019 at 5 (emphasis added).)

But the “inner or interior” surface, in the context of the ’680 patent, means a surface on the inside of the heat pipe, and thus the “bonded” region simply cannot be part of the plate’s “inner or interior surface,”

as shown on the right by the red portion. The reason is because this “bonded region” is no longer “inside” the heat pipe, and thus cannot be “the plate’s inner or interior surface.” Thus,



the “bonded region of the plate’s inner or interior surface” is by definition self-contradictory and cannot exist. Patent Owner’s construction therefore is wrong and should not be adopted.

C. “Spacer”

50. One of ordinary skill in the art would have understood the term “spacer,” at the time of the alleged invention for the ’680 patent, to simply mean the “structure used to maintain a space or clearance between the plates” recited in the claims. I have been informed that in the district court litigation, Patent Owner proposed a competing construction: “A structure, apart from the separately claimed depression, that is configured to maintain a space or clearance between the plates and provides support for a capillary wick.” (Ex.1019 at 5-6.) Based on both intrinsic and extrinsic evidence, my proposed construction should be adopted, as explained below.

The language from the specification of the ’680 patent reads:

The internal structure of the heat pipe is an evacuated vapor chamber with a limited amount of liquid and includes a pattern of spacers extending between and contacting the two plates or any other boundary structure forming the vapor chamber. The spacers prevent the plates from bowing inward

(’680, 2:12-18.) Reading the above passage, one of ordinary skill in the art would have understood that, in the context of the ’680 patent, the word “spacer” simply meant a structure used to create or maintain space between the plates. This understanding of spacer is further confirmed by definition found in contemporary dictionaries at that time. For example, the Webster’s Third New International

Dictionary at 2180 (2002) (Ex.1020) defined “spacer” as “a device or piece for holding two members at a given distance from each other” In the context of the ’680 patent, the “two members” (or “two things”) are the two plates enclosing the vapor chamber. Further, prior art, such as JP S53-32387 Y (3:51-4:41 (Ex.1023)), published in 1978, supports my proposal.

51. The definition proposed by Patent Owner is problematic because it adds other requirements such as the spacer not being the separately claimed depression and being able to provide support for a capillary wick. A person of ordinary skill in the art would have understood, however, that the claimed “depression” could have functioned as a “spacer.” In fact, the specification of the ’680 patent supports this position: “These spacers can be solid columns, embossed *depressions* formed in one of the plates or a mixture of the two.” (’680, 2:18-20 (emphasis added).) Patent Owner’s construction of “spacer” as “a structure, apart from the separately claimed depression” is inconsistent with the specification of the ’680 patent. In my opinion, “spacer” is simply a structure that is used to maintain a space or clearance between the plates, especially under the term’s broadest reasonable interpretation. (See, e.g., JP S53-32387 Y at 3:51-4:41.)

52. The additional limitation in Patent Owner’s proposed construction requiring that a spacer “provide[] support for a capillary wick” is also unnecessarily

restrictive because there is no such requirement either in the context of the '680 patent nor in the general art at the time around the purported invention. Indeed, as discussed above, there had then existed heat pipes that had not included any capillary wick, let alone any spacer providing support for such non-existent capillary wick. (See, e.g., Takahashi at 4:48-64 (Ex.1005); U.S. Pat. No. 4,012,770 at 13:53-63 (Ex.1013); U.S. Pat. No. 4,165,472 at 1:53-60, 4:23-30, 6:60-7:7 (Ex.1014); U.S. Pat. No. 6,817,097 at 3:1-10, 3:22-36 (references 113, 413) claim 7 (Ex.1015).) The original parent application for the '680 patent that ultimately issued as the '192 patent also had claims that did not include any "wick" at all. (See Prosecution History of the '192 patent (Ex.1012), original claims 1-5.) A person of ordinary skill in the art would have understood that a spacer might have played an additional and optional role of providing support for the capillary wick, *if* present. But a spacer would not have been required to provide support for capillary wicks in all heat pipes that had existed at the time of the purported invention. (See, e.g., U.S. Patent No. 3,680,189 at 2:50-64, 5:20-59, Figs. 7-9 (Ex.1021).)

53. In summary, to one of ordinary skill in the art, there is no requirement for the spacer to be "apart from the separately claimed depression" or to "provide support for a capillary wick." Therefore, the term "spacer," under its broadest

reasonable interpretation, should simply mean a “structure used to maintain a space or clearance between the plates,” as proposed by me.

D. “Hollow Column”

54. In the district court litigation, Patent Owner proposed that the term “hollow column” have a plain and ordinary meaning, and that if a construction is necessary, the term mean “a columnar structure defining an unfilled or empty space.” (Ex.1019 at 6.) Under the term’s broadest reasonable interpretation, I find Patent Owner’s proposal for this term acceptable for purposes of this Declaration.

**IX. CLAIMS 1-3 ARE OBVIOUS OVER NAKAMURA IN VIEW OF TAKAHASHI
(GROUND 1)**

A. Overview of the Prior Art

1. Overview of Nakamura (Ex.1004)¹

55. I have been informed that Nakamura is a “Japanese Unexamined Utility Model Application Publication” that was filed on September 18, 1973 and published in 1975.

56. Similar to the '680 patent, Nakamura, entitled “Heat Pipe,” relates generally to heat pipes with through holes located at the interior region of the heat pipes for mounting purposes. In particular, Nakamura describes a “heat pipe” characterized by a “a sealed container made of thermally conductive metal plates” that primarily uses a “refrigerant to absorb heat from a high-temperature body and transmit this heat to a low-temperature body to be dissipated[.]” (Nakamura at 2.) “That is, at one end portion (heating portion) of the heat pipe, the refrigerant enclosed in the heat pipe robs an external high-temperature body of heat, is vaporized, and passes through the hollow portion of the heat pipe to move to another end portion

¹ Exhibit 1004 includes a translated version of Nakamura, which is relied upon here, along with a Certificate of Translation and a copy of the original publication in Japanese.

(cooling portion). At this cooling portion, the refrigerant is cooled by air cooling and condenses, and the condensed refrigerant is refluxed back to the heating portion through the wick by the capillary action.” (Nakamura at 2.)

57. Moreover, “a portion of one or both of opposing upper and lower surfaces of the sealed container has a molded concavity and a hole for component installation is provided in a concavity joining surface where the concavity and a flat surface opposing the concavity or an opposing concavity are joined together.” (Nakamura at 4.)

Figures 3-6 of Nakamura (reproduced at right) best demonstrate this disclosed “heat pipe” with the “hole” 11 “for component installation.” “In th[ese] figures, 7 is a sealed container, 8 is a wick, 9 and 13 are concavities, 9a is a concavity joining surface, 10 is a component to be cooled, 10a is

Figure 3

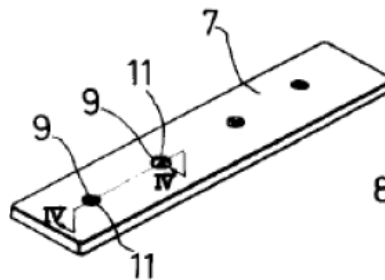


Figure 4

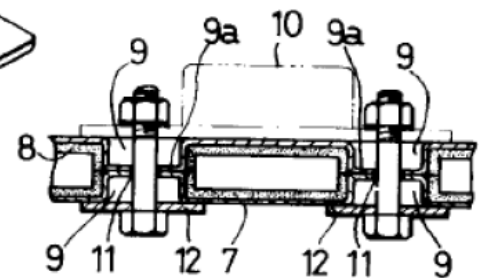


Figure 5

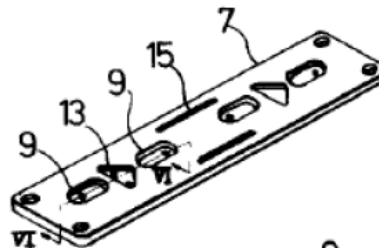
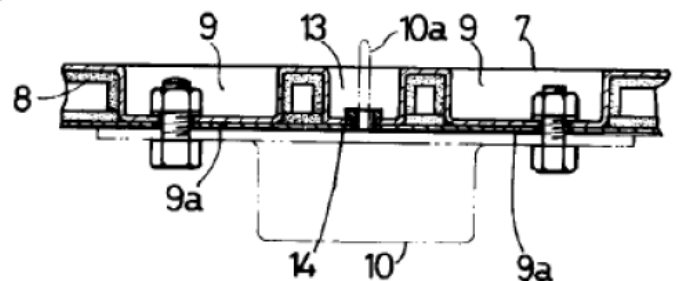


Figure 6



a terminal, 11 is a hole for component installation, 12 is a washer, and 14 is a bushing.” (*Id.* at 8.)

2. Overview of Takahashi (Ex.1005)²

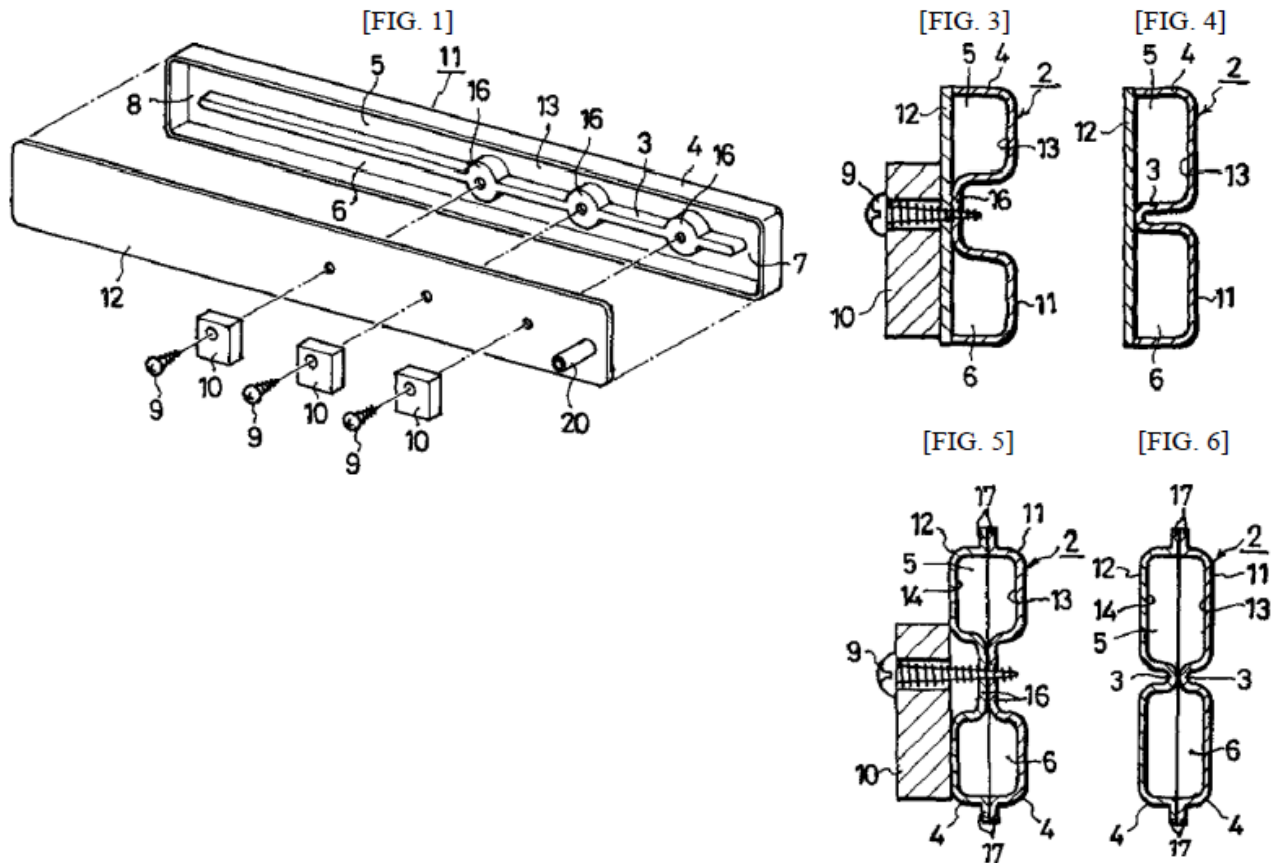
58. I have been informed that Takahashi is a “Japanese Examined Utility Model Application Publication” that was filed on November 8, 1989 and published on July 9, 1991.

59. Similar to the ’680 patent and Nakamura, Takahashi, entitled “Heat Pipe,” relates generally to heat pipes with “through holes” located at the interior region of the heat pipes for “mounting” purposes. In particular, Takahashi discloses “[a] heat pipe, wherein the inside of a square tube container (2) with both ends sealed, in which a hydraulic fluid is stored, is divided into a gas-phase hydraulic fluid passage on the upper side (5) and a liquid-phase hydraulic fluid passage on the lower side (6) by an intermediate partition wall (3)[.]” (Takahashi at 1:2-7.) In particular, “screws (9) used to mount heating elements (10), such as transistors, or the like, are thrust into a container (2) in this intermediate partition wall (3) portion.” (*Id.* at 2:1-3.)

² Exhibit 1005 includes a translated version of Takahashi, which is relied on here, along with a Certificate of Translation and a copy of the original publication in Japanese.

“The screws (9) for mounting heating elements (10), such as transistors, or the like, are directly fastened into the container (2) in the junction portion for mounting heating elements (16) in an intermediate partition wall (3), allowing the heating elements (10) to be in direct contact with the wall surfaces of the container (2).” (*Id.* at 5:28-33.) Figures 1, 3 and 4 best demonstrate this disclosed “heat pipe” in Takahashi. In these figures, the numbers denote the following elements of the heat pipe: “(2) ... a container, (3) ... an intermediate partition wall,” (4) ... “a peripheral wall[,]” “(5) ... a gas-phase hydraulic fluid passage, (6) ... a liquid-phase hydraulic fluid passage, (7) ... a gas-phase hydraulic fluid passage portion, (8) ... a liquid-phase hydraulic fluid passage portion, (9) ... a screw, (10) ... a heating element, such as a transistor, or the like, (11) ... a first plate member, (12) ... a second plate member, (13) and (14) ... concave parts for hydraulic fluid passages.” (*Id.* at 8:21-28, 4:65-5:4.) “A junction for mounting heating elements (16) having a wide circular area as seen from three front sides is provided at the portion of the intermediate partition wall (3) on the evaporator side of the first plate member (11).” (*Id.* at 5:4-8.) “The tips of the peripheral walls (4) and (4) of both plate members (11) and (12) are provided with flanges (17) and (17), respectively, where ... the flanges (17) and (17) at the tips of the peripheral walls (4) and (4) of both plate members (11) and (12)

... are joined to each other by a vacuum brazing method to form a [sealed] container (2).” (*Id.* at 6:14-22.)



B. Independent claim 1

1. Preamble: “A heat pipe for spreading heat comprising:”

Grounds 1 & 2:

60. To the extent the preamble is limiting, Nakamura discloses this preamble: “[A] heat pipe is a heat transport system that uses [a] refrigerant to absorb

heat from a high-temperature body and transmit this heat to a low-temperature body to be dissipated.” (Nakamura at 2.)

2. **“a boundary structure including a first plate and a second plate arranged in spaced apart relation,”**

Grounds 1 & 2:

61. Nakamura discloses this limitation by teaching “a sealed container made of thermally conductive metal plates” with “opposing upper and lower surfaces[.]” (Nakamura at 1 (underlining added).) In particular, the “sealed container” in Nakamura corresponds to the “boundary structure” in claim 1 of the ’680 patent because Patent Owner conceded in the district court litigation that a “boundary structure” is simply a “structure forming a boundary” (Patent Owner’s Proposed Constructions, (Ex.1016), at 8), which is disclosed by Nakamura as the “sealed container” in Figure 3. As shown below right, the “thermally conductive metal plates” with “opposing upper and lower surfaces” disclosed in, e.g., Nakamura’s

Figure 4 correspond to “a first plate and a second plate arranged in spaced apart relation” in claim 1 of the '680 patent.

Figure 3

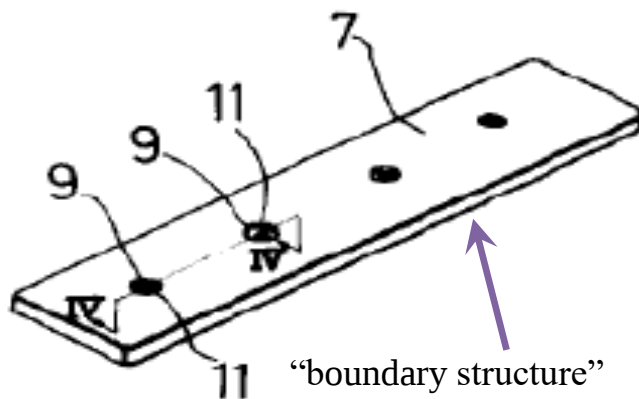
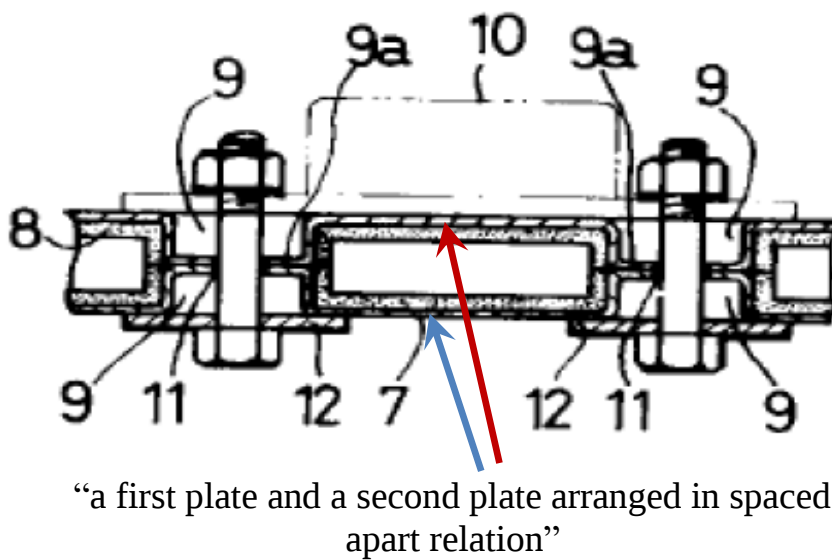


Figure 4

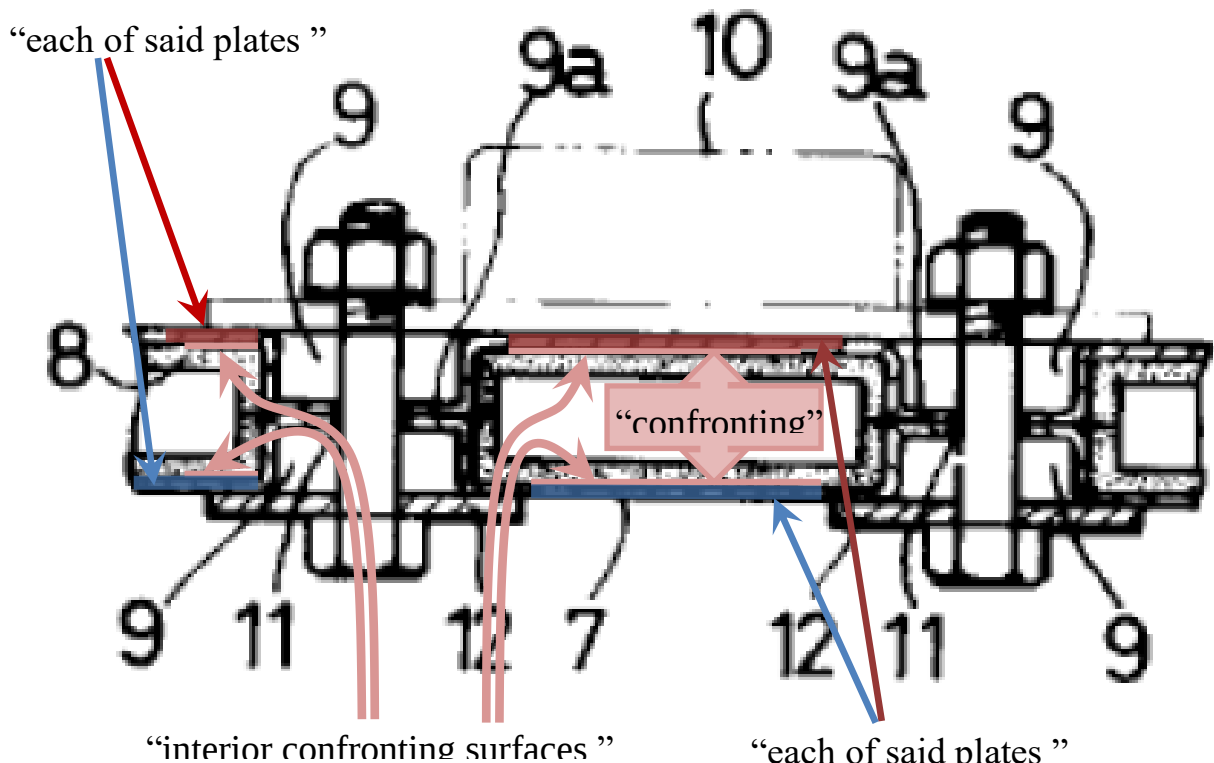


3. “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together”

Grounds 1&2:

62. First, Nakamura discloses “each of said plates including interior confronting surfaces” by teaching “a sealed container made of thermally conductive metal plates” with “opposing upper and lower surfaces[.]” (Nakamura at 1.) As shown below, “each of said plates” disclosed by Nakamura’s Figure 4 (pointed to by red and blue arrows, respectively) includes “interior confronting surfaces” (pointed to by pink arrows).

Figure 4



Ground 1:

63. Further, a person of ordinary skill in the art would have found “a peripheral lip located at an edge of said boundary structure” obvious in view of Nakamura at least under Petitioner’s proposed construction for “lip,” which is the “portion of the plate comprising a region bonded to another plate.” The “peripheral lip” in the ’680 patent, under its

broadest reasonable interpretation, is nothing more than a lip located at a periphery, edge, or circumference of the “boundary structure” discussed above in **Section IX.B.2**. The ’680 patent acknowledges that “the region of the peripheral edges is also a sealed structure since *bonding between lips 22 and 24 is inherent* because heat pipe 11 must be sealed at its edges to

isolate the interior from the outside atmosphere.” (’680, 4: 49-53 (emphasis added).) As discussed, Nakamura discloses that the “sealed container” is “of an airtight structure.” (Nakamura at 2.) That is, the first plate and the second plate arranged in

Figure 3

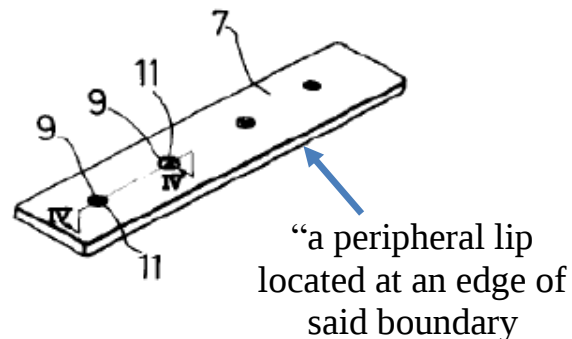
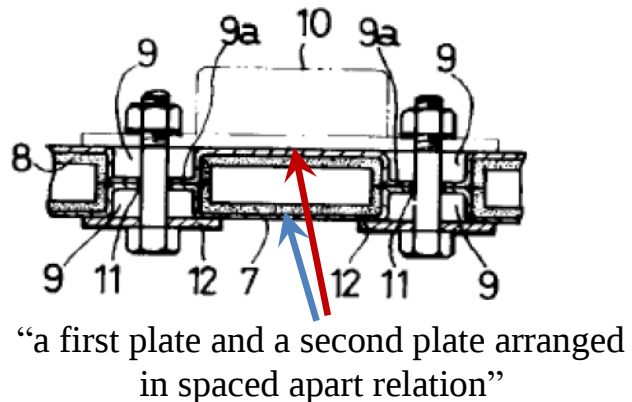


Figure 4



the spaced apart relation in Nakamura must each have a “portion of the plate comprising a region *bonded* to another plate” located at the periphery, edge, or circumference of the boundary structure to form the “sealed container of an airtight structure.” (Nakamura at 2.) In other words, a person of ordinary skill in the art would have found “a peripheral lip located at an edge of said boundary structure” obvious in view of Nakamura at least under Petitioner’s proposed construction for “lip.” For the same reasons stated above, Nakamura also renders it obvious that “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure ... are bonded together.”

Ground 2:

64. Additionally, it would have been obvious for a person of ordinary skill in the art to combine Nakamura with Takahashi to create “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together,” as explained below.

a. Motivation to combine Nakamura with Takahashi regarding the “lip” limitation

65. A person of ordinary skill in the art would have been motivated to combine Nakamura and Takahashi in connection with the related features of “lips” located at the periphery, circumference, or edge of the plates in the heat pipe’s sealed

container. As an initial matter, both Nakamura and Takahashi disclose heat pipes that include through holes located at the interior regions of the heat pipes for securing them onto the heat generating elements. Thus, in general, a skilled artisan would have been motivated to combine the features in the two references already.

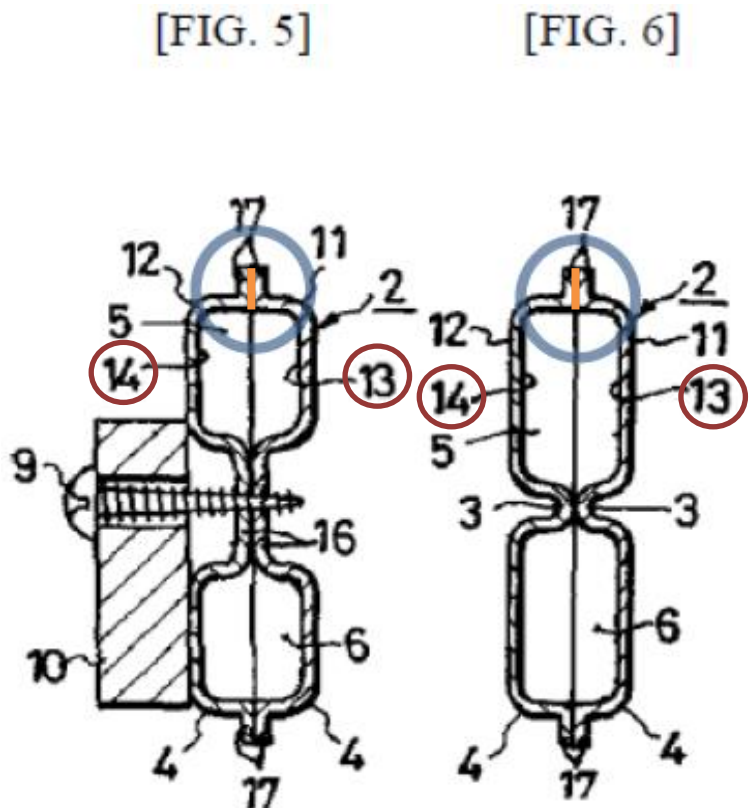
66. Specifically, both Nakamura and Takahashi describe related manufacturing processes of “pressing” and “brazing” for sealing the heat pipe’s container that would have motivated a skilled artisan to combine them. In particular, Nakamura discloses that “[o]n both surfaces of the sealed container 7, a concavity 9 ... is provided via *pressing*” and that the “sealed container where thin plates of a material with favorable thermal conductivity such as copper or aluminum are formed into a sealed configuration by soldering, *brazing*, or the like.” (Nakamura at 5 (emphasis added).) Similarly, Takahashi discloses an embodiment in its Figures 5 and 6 having the “first and second plate members (11) and (12)” of the “sealed [tube]” built by a “*press-mold[ing]*” process “with both ends sealed,” and that “[t]he tips of the peripheral walls (4) and (4) of both plate members (11) and (12) are provided with *flanges* (17) and (17), respectively, where ... the *flanges* (17) and (17) at the tips of the *peripheral walls* (4) and (4) of both plate members (11) and (12) ... are joined to each other by a vacuum *brazing* method to form a [sealed] container (2).” (Takahashi at 6:4-22(emphasis added).) Thus, a person of ordinary skill in the art

would have been motivated to combine these related features in Nakamura and Takahashi when reading both references together.

- b. Nakamura in view of Takahashi renders obvious “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together”**

67. The combination of Nakamura and Takahashi disclose the “lip” limitation in the ’680 patent and “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together.” In particular, the “flanges (17) and (17)” in Takahashi correspond to the limitation of “lips” in the ’680 patent under both Petitioner’s and Patent Owner’s claim construction

proposals. Under Petitioner’s proposal, the “flanges (17) and (17)” each have a “portion of the plate comprising a region bonded to another plate” (circled in light blue in Figures 5 and 6 of Takahashi). (Ex.1019 at 5.) Under Patent Owner’s



proposal, the “flanges (17) and (17)” also each have a “portion of the plate defined by the bonded region of the plate’s inner or interior surface” (indicated in orange). (Ex.1019 at 5.) The “flanges (17) and (17)” are also located at the periphery, circumference, or edge of the sealed container in Takahashi, thus corresponding to the “peripheral lip” claimed in the ’680 patent. Further, Takahashi discloses “the concave parts (13) and (14) facing inwards” that opposing inner surfaces that correspond to the “confronting interior surfaces” as claimed in the ’680 patent. (Takahashi at 6:17-18, Figs. 5-6.) Thus, Nakamura in view of Takahashi discloses “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together.”

4. “so as to define an enclosed vapor chamber;”

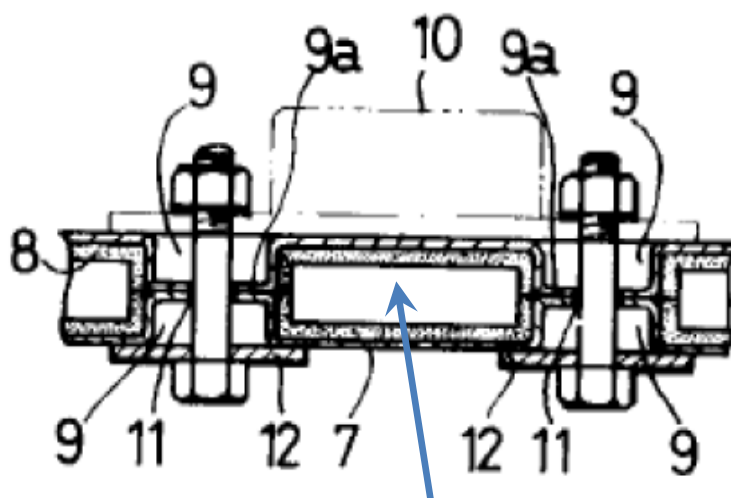
Grounds 1&2:

68. Nakamura discloses the limitation of “so as to define an enclosed vapor chamber” regardless of whether the term “vapor chamber” is construed under Petitioner’s or Patent Owner’s proposal. Under Petitioner’s proposal, Nakamura discloses the “enclosed and sealed space or cavity in which a heat transfer fluid is present to be evaporated (or vaporized) and condensed to transport or spread heat” as the “sealed container” in each of Figures 3 and 5 that encloses and seals a cavity. To the extent that the “space or cavity” needs to be “air-tightly (or hermetically) sealed,”

Nakamura discloses a “sealed container of an airtight structure.” (Nakamura at 2.) Nakamura also discloses “a heat transfer fluid is present [in the enclosed and sealed space or cavity] to be evaporated (or vaporized) and condensed to transport or spread heat” as “an appropriate amount of refrigerant.” (Nakamura at 2.) In particular, Nakamura discloses that “at one end portion (heating portion) of the heat pipe, the refrigerant enclosed in the heat pipe robs an external high-temperature body of heat, is vaporized, and passes through the hollow portion of the heat pipe to move to another end portion (cooling portion).” (Nakamura at 2.) “At this cooling portion, the refrigerant is cooled by air cooling and condenses, and the condensed refrigerant is refluxed back to the heating portion through the wick by the capillary action.” (*Id.*) This disclosure also teaches the “vacuum sealed chamber, wherein a heat transfer fluid

is evaporated and condensed and capillary forces are utilized to spread heat” under Patent Owner’s proposal. In particular, Nakamura discloses the “vacuum sealed chamber” by teaching the “heat pipe

Figure 4



“enclosed vapor chamber”

... has a wick with a capillary action affixed to an inner wall of a sealed container of an airtight structure ... after air is extracted therefrom.” (Nakamura at 1-2.)

5. **“a depression formed in said first plate which projects into said vapor chamber, is spaced from said peripheral lip, and is bonded to said second plate;”**

Grounds 1&2:

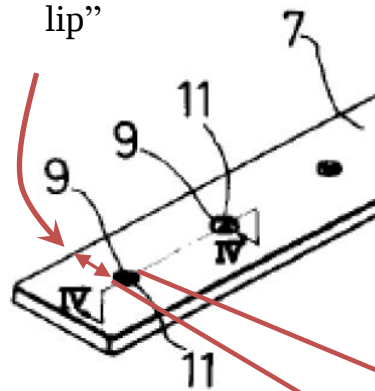
69. Nakamura discloses this limitation as follows. As shown below, Nakamura discloses the limitation of “a depression formed in said first plate which projects into said vapor chamber” with its “concavity” labeled as “9,” which corresponds to the “depression” in the ’680 patent. As shown below, the “concavity” labeled as “9” (indicated as a red, bowl-like structure) also “projects into said vapor chamber” (as indicated by the large, pink arrow pointing down). This is because the “concavity” labeled as “9” in Nakamura protrudes into the inside “space or cavity” of the “sealed container” labeled as “7” in Nakamura, which corresponds to the “said vapor chamber” limitation. As also shown in Nakamura’s Figure 3 reproduced below, the “concavity” labeled as “9” is also spaced apart from the edge of the “sealed container” labeled as “7,” thus meeting the limitation that the “depression ... is spaced from said peripheral lip ... [of] said first plate” in the ’680 patent.

70. Nakamura also teaches that “[a] concavity joining surface 9a of the concavity 9 is finished flat after pressing is completed and is applied in advance to

preliminary soldering” and that “[t]he concavity joining surfaces 9a can then be

“is spaced
from said
peripheral
lip”

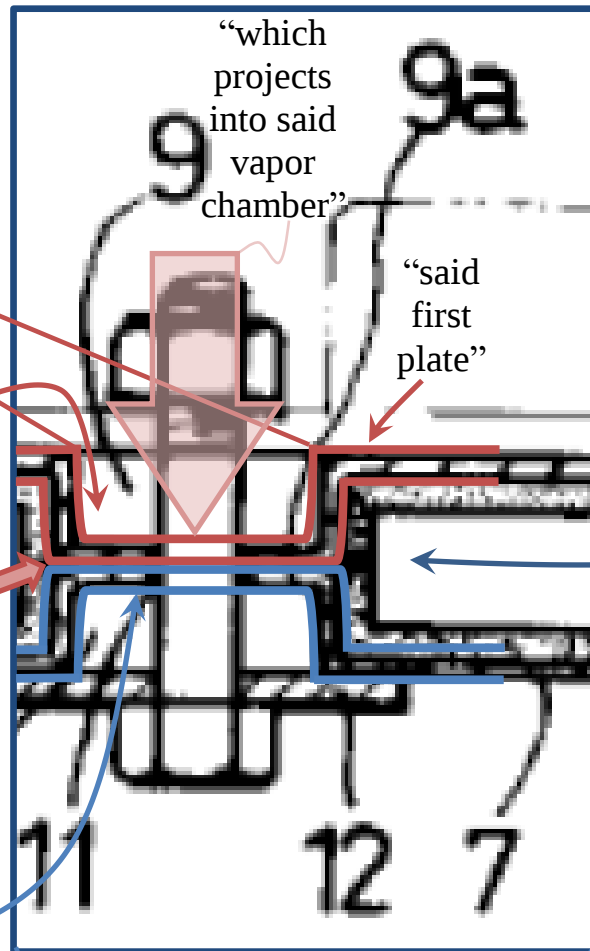
Figure 3



“a depression
formed in said first
plate”

“is bonded to said
second plate”

“said second plate”

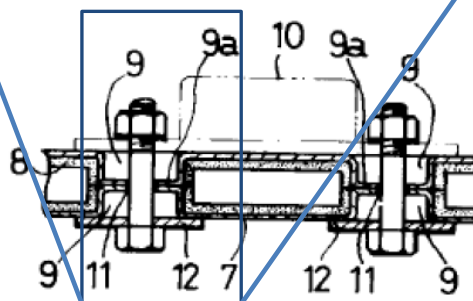


“which
projects
into said
vapor
chamber”

“said
first
plate”

“said vapor
chamber”

Figure 4

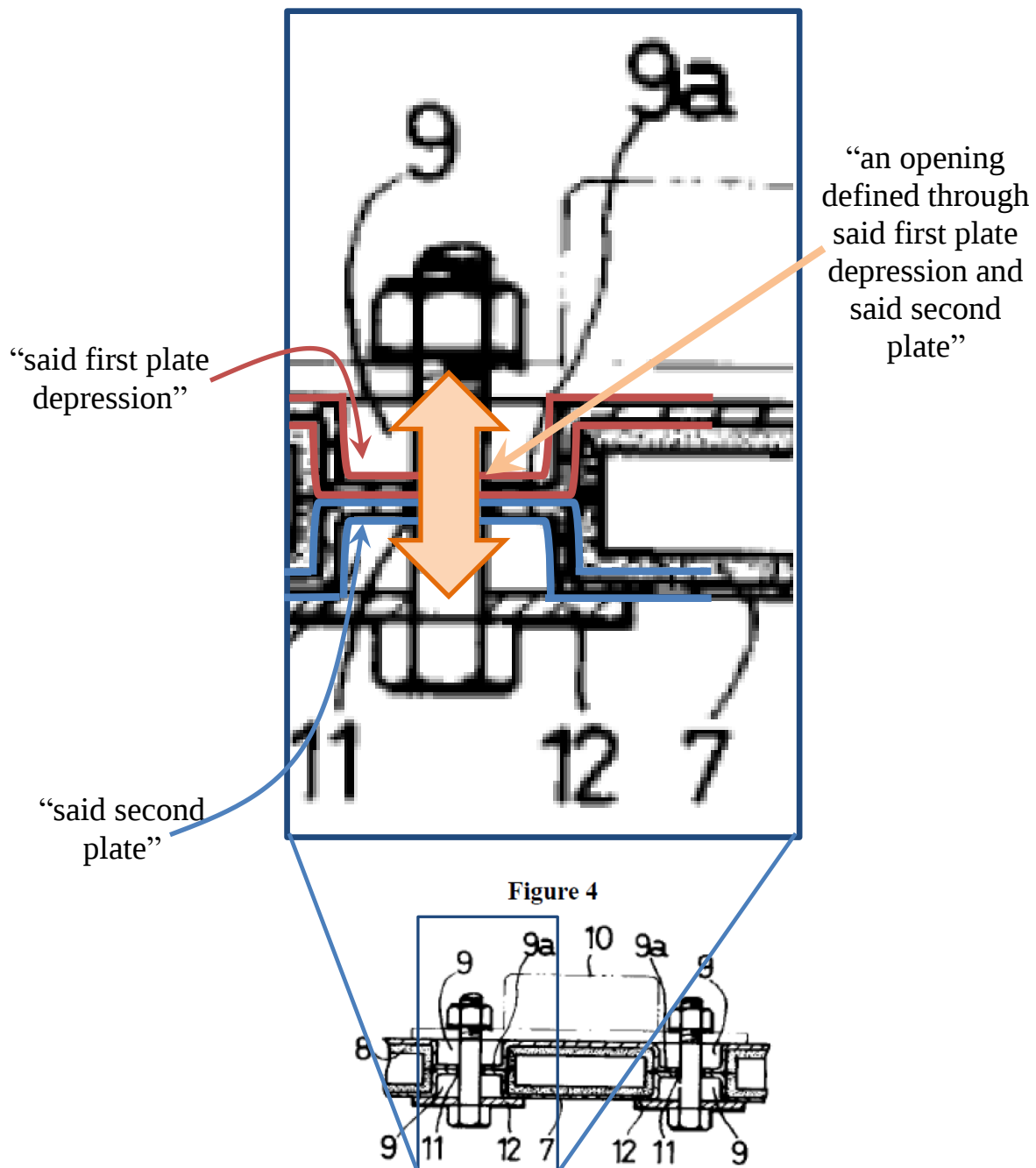


Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.) Thus, Nakamura discloses that the “depression” in the ’680 patent “is bonded to said second plate.”

6. “an opening defined through said first plate depression and said second plate”

Grounds 1&2:



71. Nakamura discloses this limitation as shown below. The “opening” is indicated by the double-sided orange arrow above and is “defined through said first plate depression and said second plate,” which are indicated by the red and blue structures, respectively, as shown above.

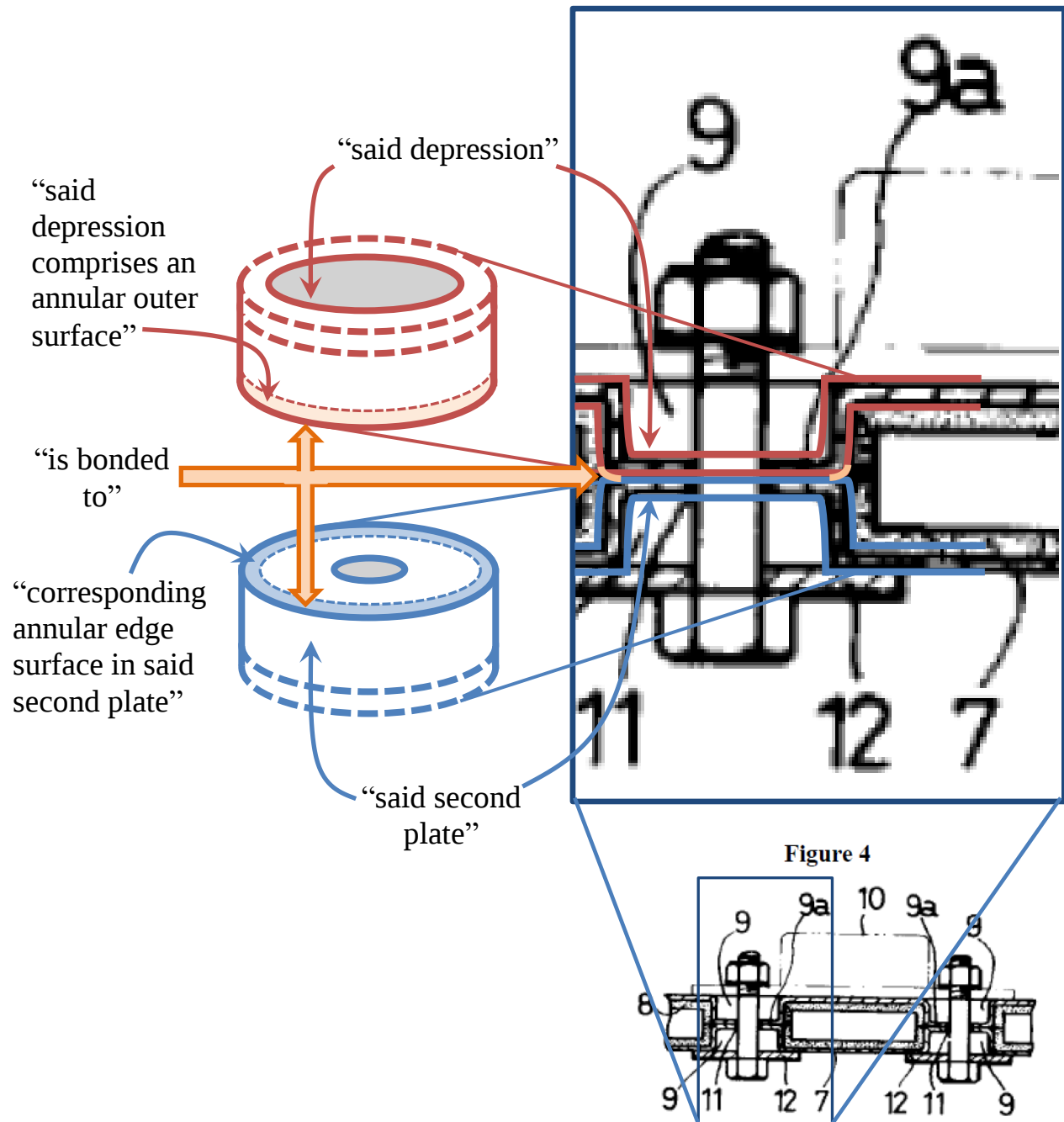
7. **“wherein said depression comprises an annular outer surface that is bonded to a corresponding annular edge surface in said second plate”**

Grounds 1&2:

72. Nakamura discloses this limitation as follows. The structure indicated in red below corresponds to “said depression,” which “comprises an annular outer surface.” This is because, as shown below, the “annular outer surface” is located towards the bottom of “said depression” (indicated in red) and is the ring-shaped surface located at the bottom rim of “said depression” that is relatively “outer” to the center of “said depression.” As also shown below, the structure indicated in blue corresponds to “said second plate,” which comprises a “corresponding annular edge surface.” This is because, as shown below, the “annular edge surface” in “said second plate” (indicated in blue) is the ring-shaped surface located at the top rim of the blue structure and is “corresponding” to the “annular outer surface” of “said depression” over the blue structure. Further, as indicated by the orange four-way arrows, the “annular outer surface” of “said depression” (indicated in red) “is sealingly bonded

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

to” (indicated in light orange) the “corresponding annular edge surface in said second plate” indicated in blue. This is because Nakamura teaches that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.)

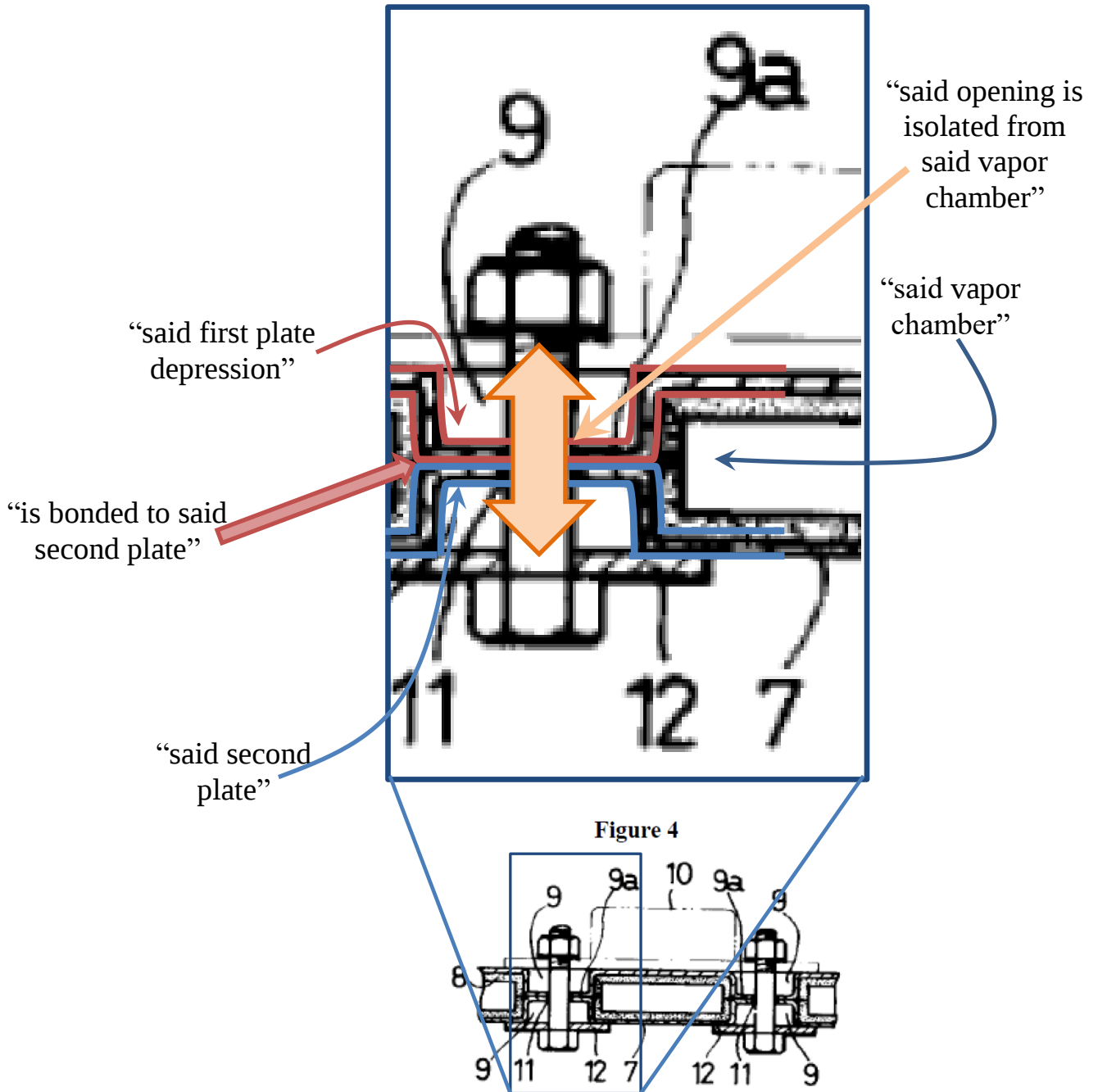


8. “and further wherein said opening is isolated from said vapor chamber.”

Grounds 1&2:

73. Nakamura discloses this limitation. As discussed above, Nakamura discloses the “an opening defined through said first plate depression and said second plate.” Nakamura also teaches that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.) That is, Nakamura further discloses that the “depression” in the ’680 patent is sealing

“bonded to said second plate.” Thus, the “said opening is isolated from said vapor

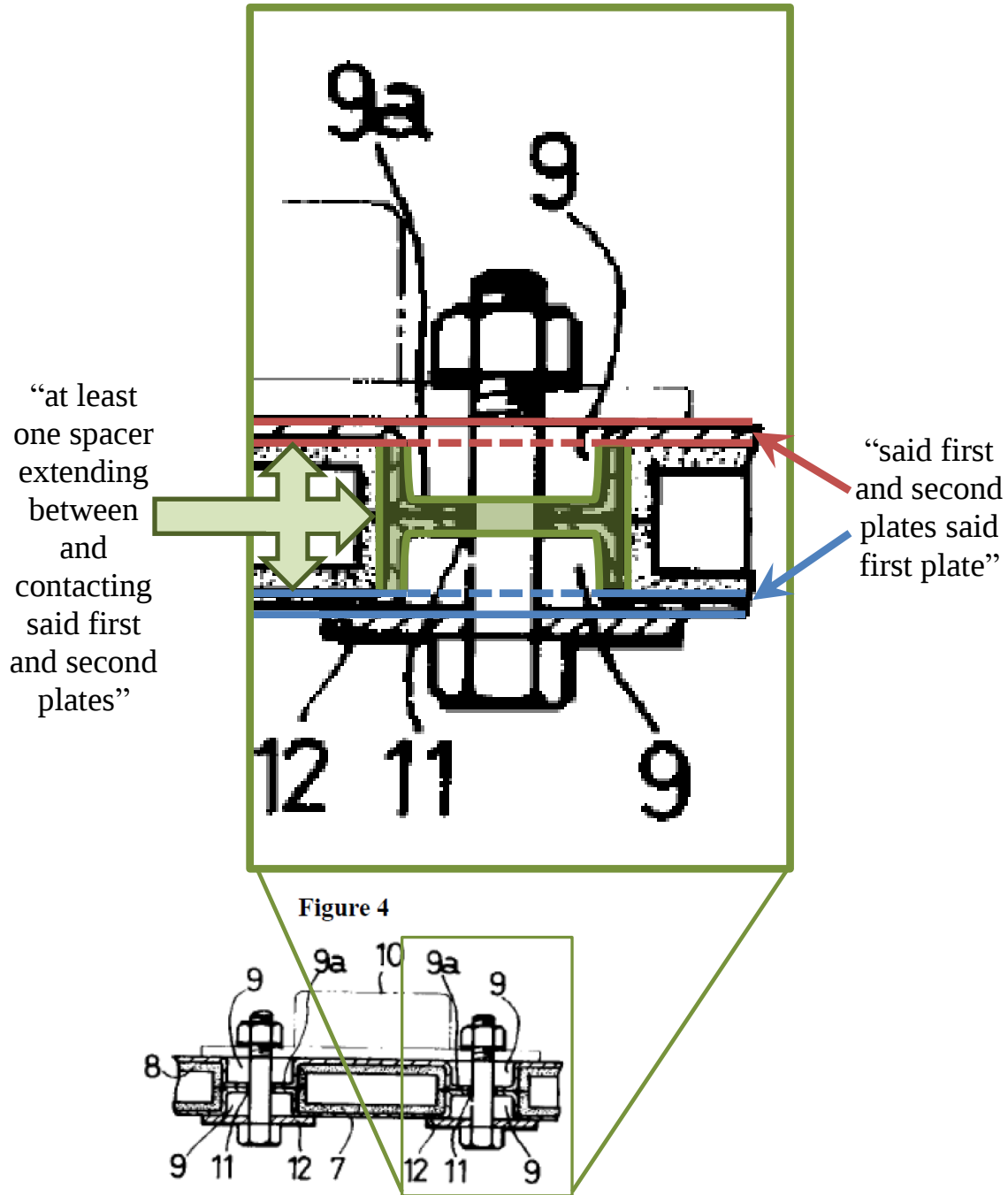


chamber,” as shown below.

9. “at least one spacer extending between and contacting said first and second plates; and”

Grounds 1&2:

74. Nakamura discloses the “at least one spacer extending between and contacting said first and second plates” as follows. As shown below, a second set of “concavity” labeled as “9” and a “concavity joining surface” labeled as “9a” are disclosed in Figure 4 of Nakamura. Together, these elements form a structure with an H-shaped cross-section (indicated in green) that is “between and contacting said first and second plates” (indicated in red and blue, respectively). This structure with an H-shaped cross-section corresponds to the “at least one spacer” limitation under both Petitioner’s and Patent Owner’s claim construction proposals for “spacer.” Under Petitioner’s proposed construction, this structure with an H-shaped cross-section is a “structure used to create or maintain space between the plates.” This is because Nakamura discloses that, the “outer wall does not deform” since the “concavity” labeled as “9” is “installed.” (Nakamura at 7.)



75. Indeed, the specification of the '680 patent acknowledges that the “spacers *extending between and contacting the two plates* ... prevent the plates from

bowing inward, and ... can be ... embossed *depressions* formed in one of the plates” (’680, 2:12-20 (emphasis added)). Nakamura discloses such “embossed depressions” functioning as “spacers extending between and contacting the two plates” to “prevent the plates from bowing inward.” In Nakamura’s Figures 5 and 6 (reproduced below), the “the concavity 9 is provided only in a lower surface of the sealed container 7” and because of the “provi[sion]” of this “concavity ..., the outer wall does not deform.” (Nakamura at 6-7.) Thus, Nakamura discloses the limitation of “at least one spacer extending between and contacting said first and second plates” under the term’s broadest reasonable interpretation as proposed by Petitioner.

Figure 5

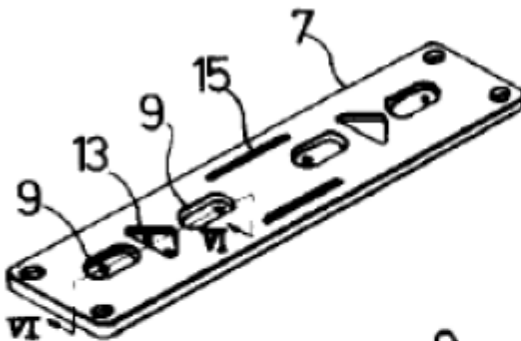
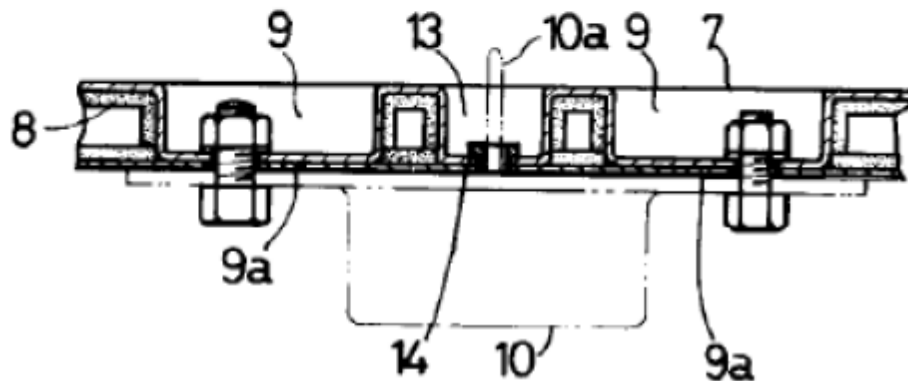


Figure 6



76. Nakamura also discloses this limitation under Patent Owner's proposed construction for "spacer": "A structure, apart from the separately claimed depression, that is configured to maintain a space or clearance between the plates and provides support for a capillary wick." (Ex.1019 at 5-6.) As shown above, Nakamura's "sealed container" has multiple "depressions," thus one of them "apart from the separately claimed depression" can satisfy the "spacer" limitation. Also, as shown in Nakamura's Figures 3-6, all the concavities labeled as "9" (i.e., depressions) "provide support for a capillary wick" labeled as "8." Therefore, Nakamura discloses the limitation of "at least one spacer extending between and contacting said first and second plates."

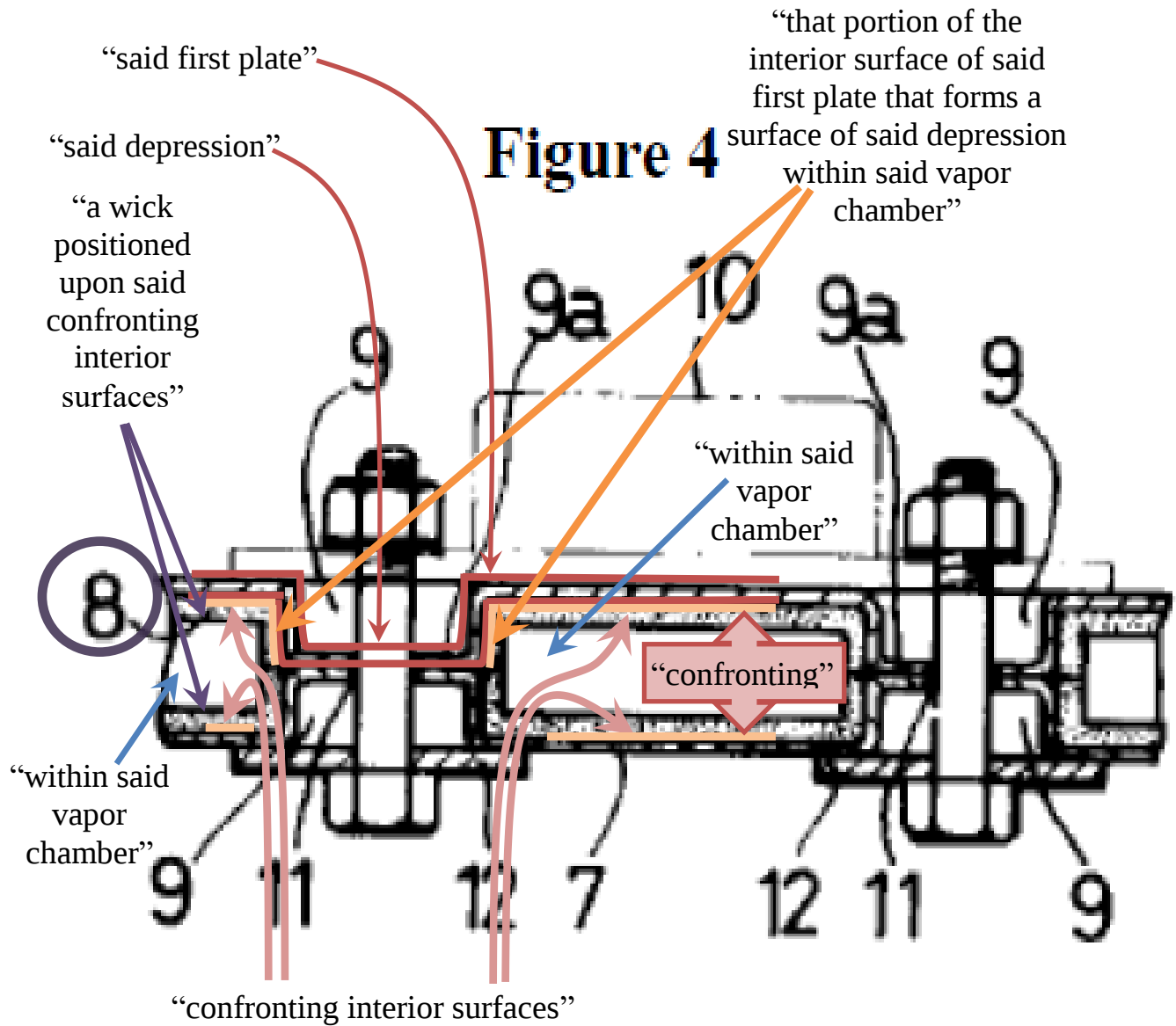
10. **"a wick positioned upon said confronting interior surfaces including that portion of the interior surface of said first plate that forms a surface of said depression within said vapor chamber."**

Grounds 1&2:

77. Nakamura discloses this limitation as follows. In particular, Nakamura discloses that element "8" is a "wick" that provides "a capillary action." (Nakamura at 1-2, 5, and 7-8.) As shown below, Nakamura discloses "a wick" labeled as "8" (indicated by purple arrows) that is "positioned upon said confronting interior surfaces" (indicated by light orange and pointed to by pink arrows). As also shown below, Nakamura discloses that "said confronting interior surfaces" includes "that

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

portion of the interior surface of said first plate that forms a surface of said depression within said vapor chamber.” This is because “that portion of the interior surface of said first plate that forms a surface of said depression” (indicated in light orange and pointed to by the orange arrows) is located “within said vapor chamber” (as indicated by the blue arrows).



C. Independent claim 2

1. **Preamble: “A heat pipe for spreading heat comprising:”**

Grounds 1&2:

78. See Section **IX.B.1** above.

2. **“a first plate having a circumferential edge lip bounding an inner surface and”**

Grounds 1&2:

- a. **“a first plate” and “an inner surface”**

Grounds 1&2:

79. For the same reasons as stated above in Sections **XI.B.2** and **XI.B.3**, Nakamura teaches “a first plate” and “an inner surface,” as shown below.

b. “a circumferential edge lip bounding an inner

Figure 3

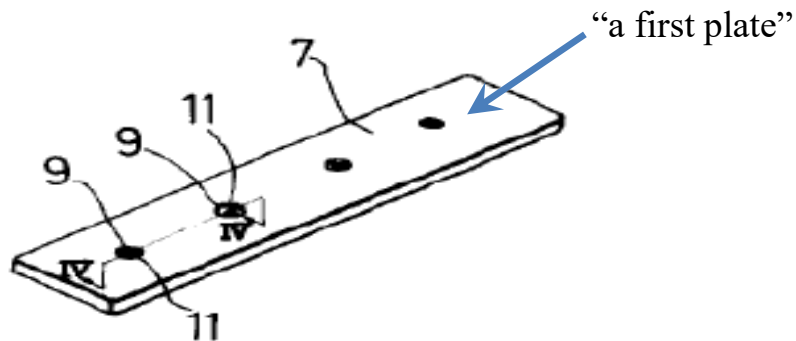
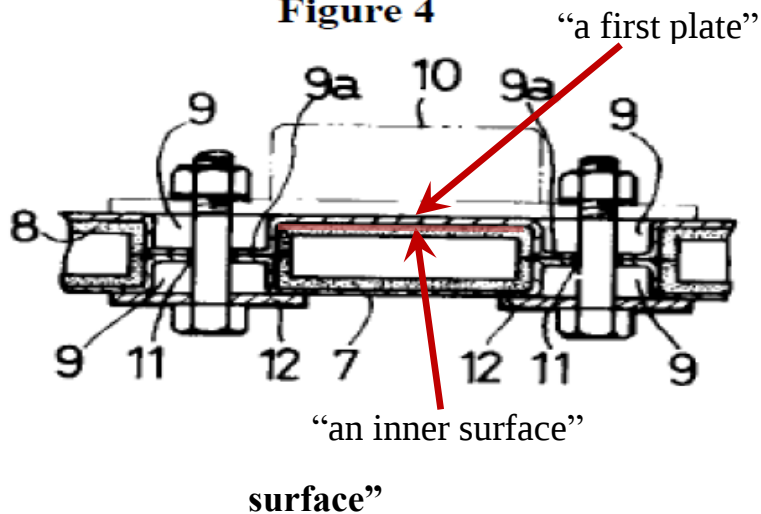


Figure 4



Ground 1:

80. A person of ordinary skill in the art would also have understood and found it obvious that the “circumferential edge lip” is “bounding an inner surface” in view of Nakamura at least under Petitioner’s proposed construction for “lip,” which

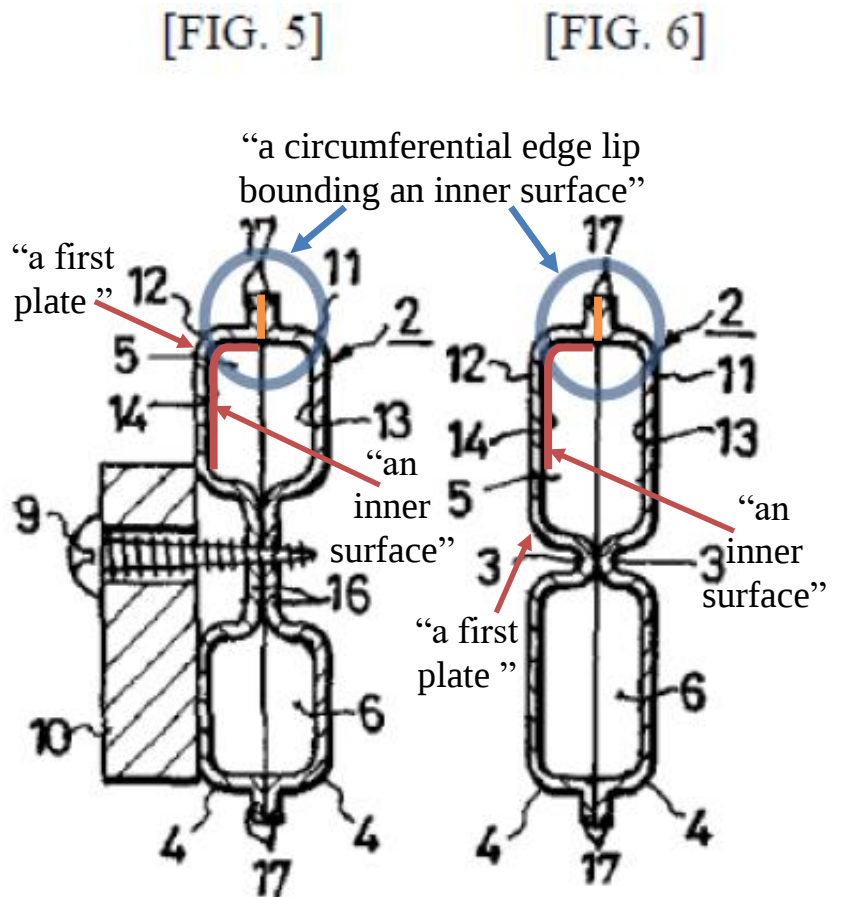
is the “portion of the plate comprising a region bonded to another plate.” Here, a “circumferential edge lip” is nothing more than a “lip” located at a “circumferential edge” of the “first plate” by the term’s broadest reasonable interpretation. The ’680 patent acknowledges that “the region of the peripheral edges is also a sealed structure since *bonding between lips 22 and 24 is inherent* because heat pipe 11 must be sealed at its edges to isolate the interior from the outside atmosphere.” (’680, 4:49-53 (emphasis added).) As discussed, Nakamura discloses that the “sealed container” is an “air-tight structure.” (Nakamura at 2.) That is, the first plate of the sealed container in Nakamura must provide the boundary of an inner surface by the “portion of the plate comprising a region bonded to another plate” located at the circumferential edge of the “sealed container of an air-tight structure.” (Nakamura at 2.) In other words, Nakamura inherently discloses, or a POSTIA would understand that it would be obvious to have “a first plate having a circumferential edge lip bounding an inner surface.”

Ground 2:

81. Further, it would have been obvious for a skilled artisan to combine Nakamura with Takahashi to create “a circumferential edge lip bounding an inner surface.” As discussed above, a person skilled in the art would have been motivated to combine Nakamura and Takahashi in connection with the “lip” limitation. (See Section IX.B.3.a “Motivation

to combine Nakamura with Takahashi regarding the ‘lip’ limitation” above.) Takahashi discloses that “[t]he tips of the peripheral walls (4) and (4) of both plate members (11) and (12) are provided with flanges (17) and (17), respectively, where ... the flanges (17) and (17) at the tips of the peripheral

walls (4) and (4) of both plate members (11) and (12) ... are joined to each other by a vacuum brazing method to form a [sealed] container (2).” (Takahashi at 6:14-22.) As shown above, this “flange” (i.e., the “circumferential edge lip” in the ’680 patent)



provides a boundary of the “inner surface” under both Petitioner’s and Patent Owner’s claim construction proposals for “lip.” Thus, Nakamura in view of Takahashi discloses or renders obvious “a first plate having a circumferential edge lip bounding an inner surface”

3. **“at least one hollow column that is integral with said first plate and which projects outwardly relative to said inner surface;”**

Grounds 1&2:

82. Nakamura discloses this limitation as follows. As shown below, Nakamura discloses “at least one hollow column that is integral with said first plate” as the “concavity” labeled as “9” (indicated in red). As also shown below, Nakamura discloses that this “hollow column ... projects outwardly relative so said inner surface” (indicated by the red arrow pointing down). This is because the “concavity” labeled as “9” in Nakamura extends downwardly in the direction that “said inner surface” (indicated in light orange and pointed to by the orange arrow) is facing towards, i.e., “outwardly relative to said inner surface,” as shown below. Thus,

Declaration of Dr. Himanshu Pokharna
Petition for *Inter Partes* Review of
U.S. Patent No. 7,100,680

Nakamura discloses “at least one hollow column that is integral with said first plate

and which projects outwardly relative to said inner surface.”

Figure 3

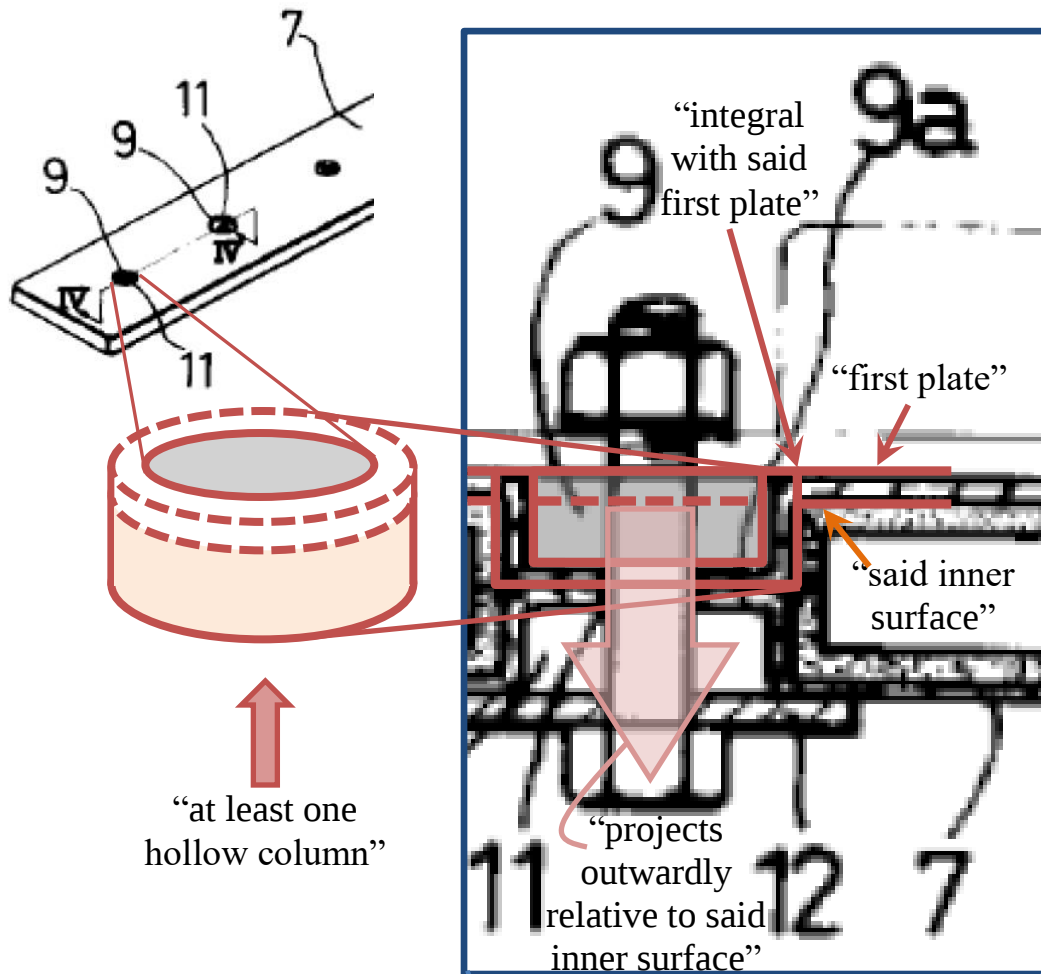
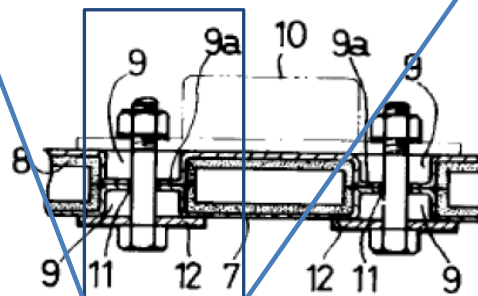
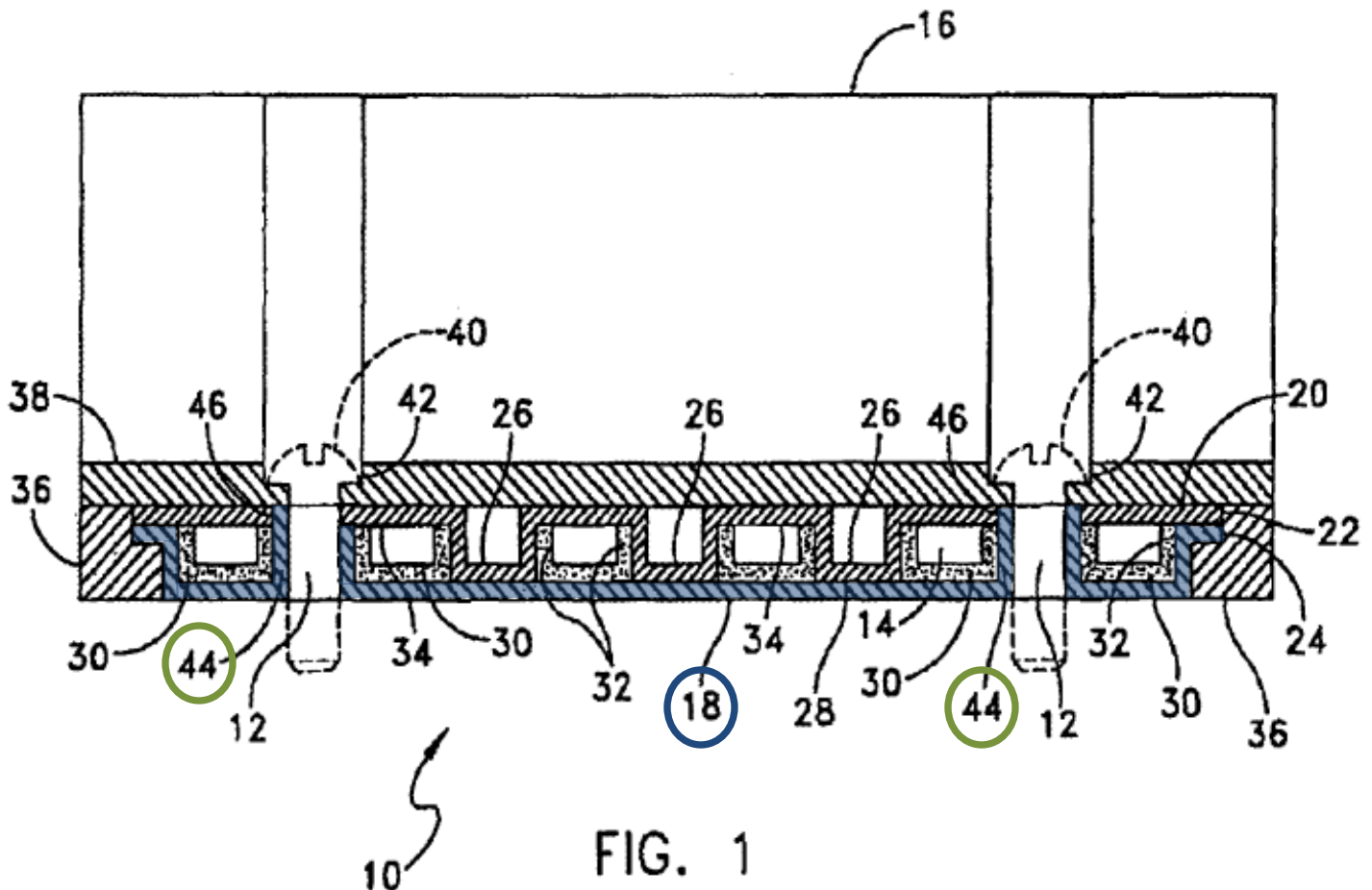


Figure 4



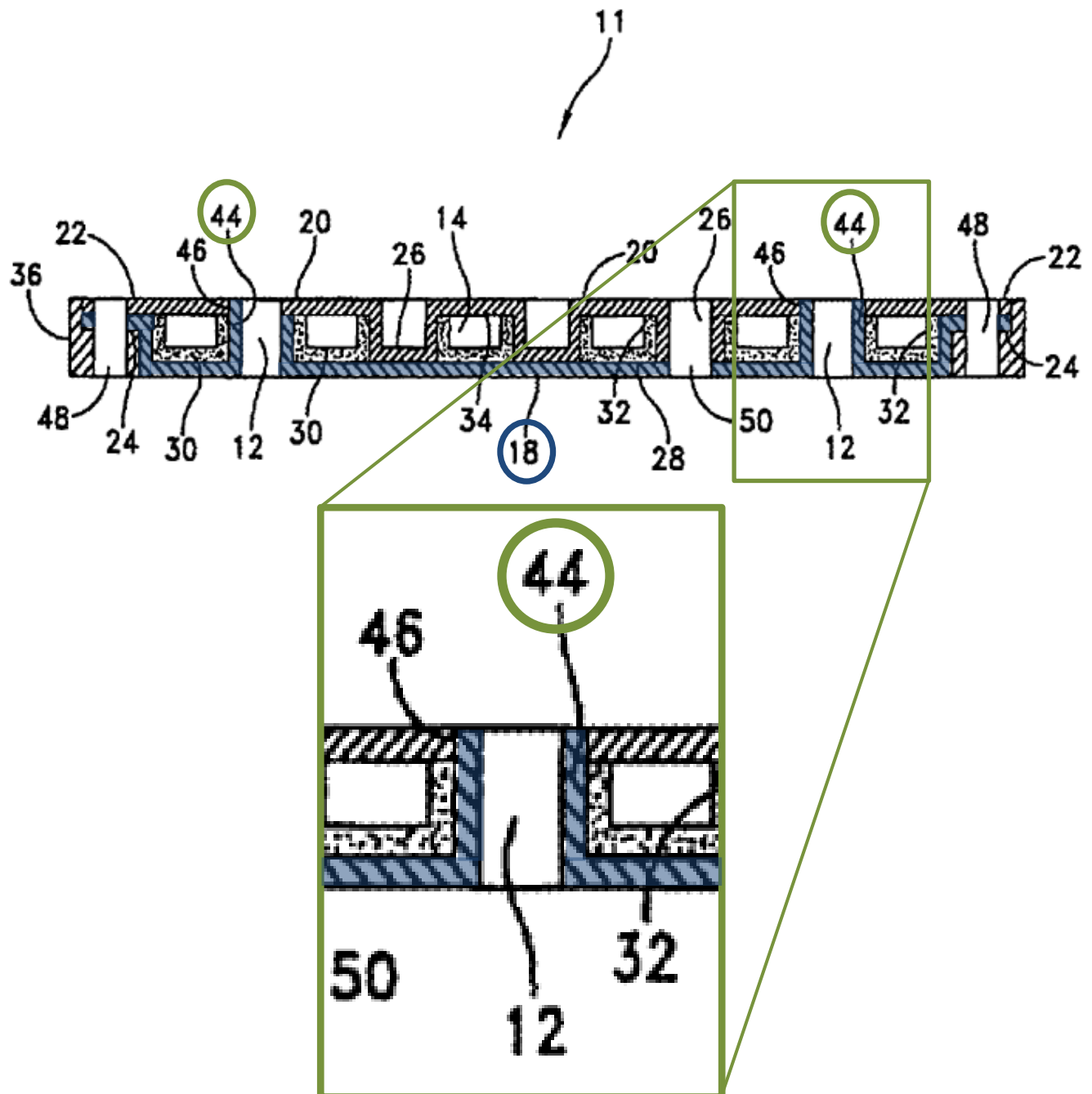
a. The '680 patent discloses that the “hollow column” can be formed as part of a plate enclosing the “vapor chamber.”

83. I note that the “hollow column” limitation can be met by a structure formed by one or both of the heat pipe’s plates, as disclosed in the '680 patent. In particular, the '680 patent discloses the hollow column as “columns 44” in which “holes 12” are located, as follows: “Holes 12 are located within sealed structures such as solid columns 44, and since columns 44 are bonded to cover plate 20 at locations



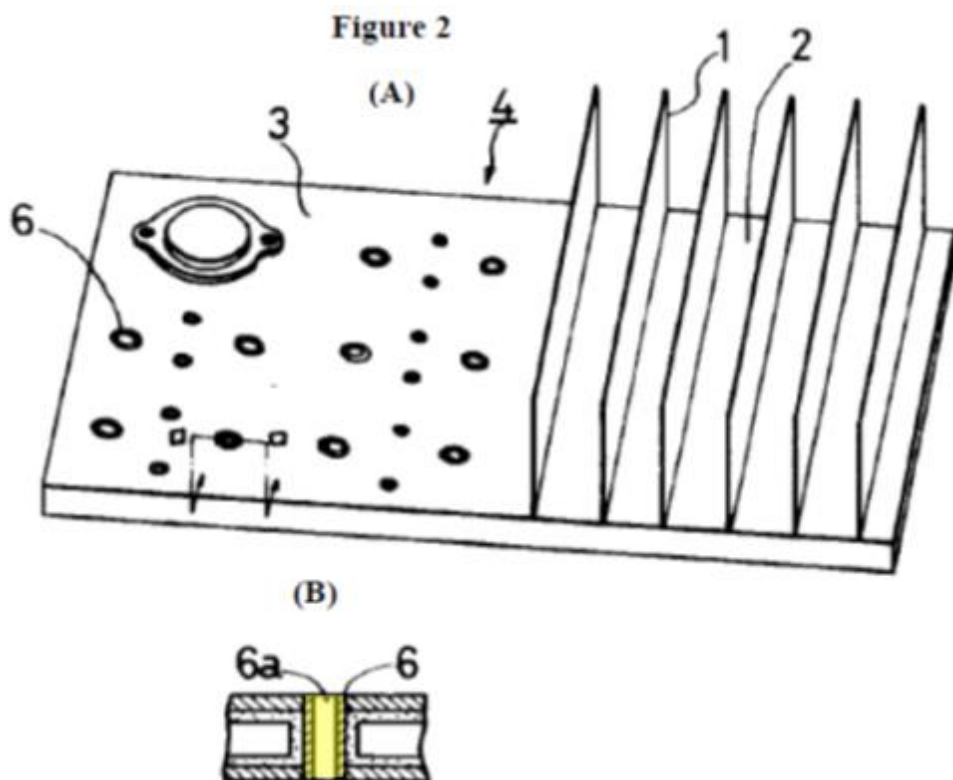
46, holes 12 passing through the interior of columns 44 have no affect [sic] on the interior of heat pipe 10.” (’680, 4:25-30, Fig. 1.)

84. As can be seen above in Figure 1 of the ’680 patent (reproduced and annotated above), columns “44” (circled in green) are formed as part of the (lower)



contact plate “18” (indicated in blue). Figure 2 of the ’680 patent (reproduced below), again, shows column “44” (circled in green) is formed as part of the (lower) contact plate “18” (indicated in blue). Thus, similarly, the upper plate in Nakamura can form “a columnar structure defining an unfilled or empty space” to meet the “hollow column” limitation.

85. I also note that Nakamura discloses another embodiment that meets the “hollow column” limitation in the ’680 patent, as indicated in yellow below. Specifically, Nakamura discloses that “as illustrated in Figure 2, a method of providing a through path 6a, blocked from an interior of the heat pipe by a metal pipe 6, in the heating portion 3 of the heat pipe 4 and directly mounting the component to



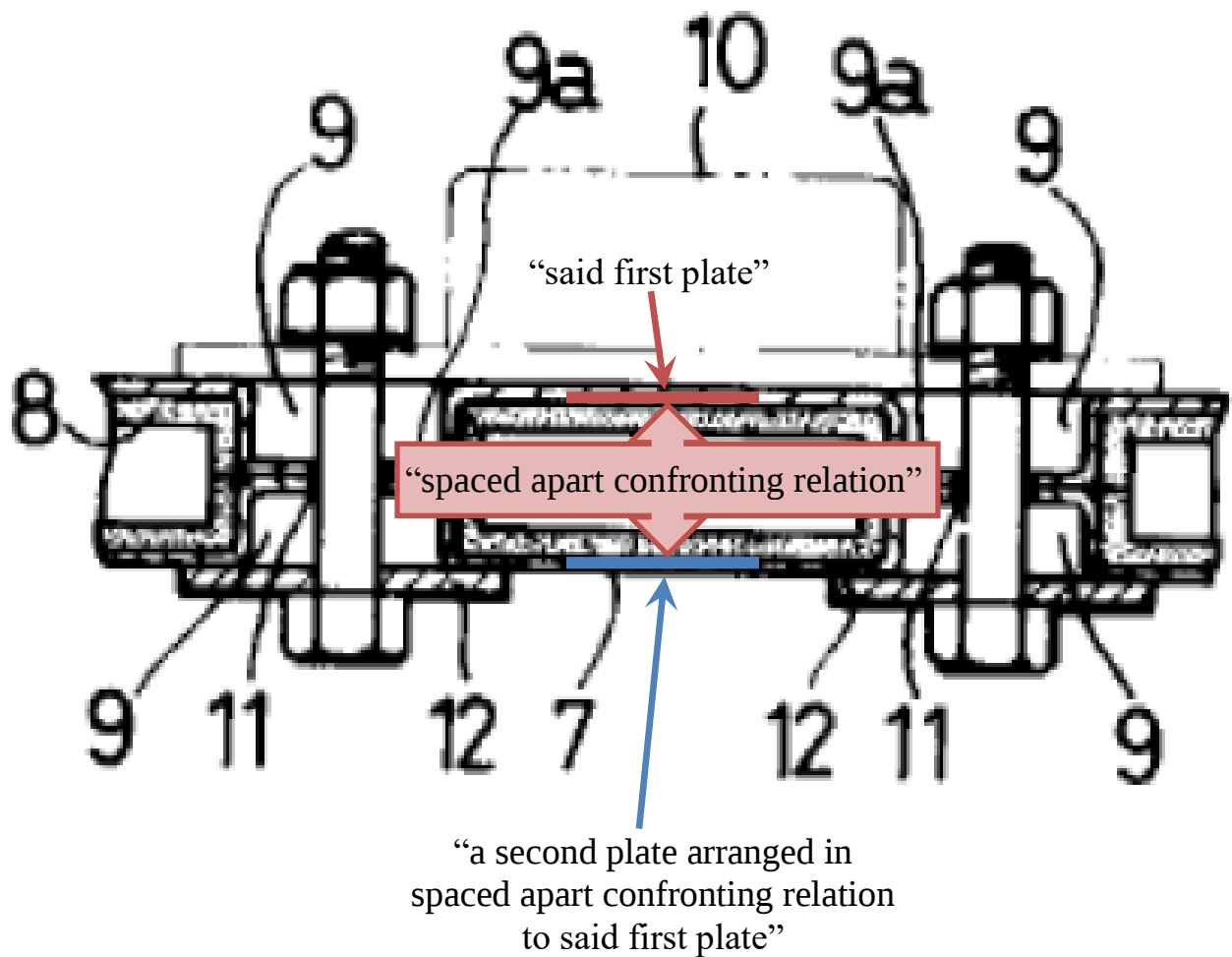
be cooled to the heating portion 3 using the through path 6a is previously proposed by the present applicant as a ‘Heat Pipe’ (JP S48-63915).” (Nakamura at 3.) I am not relying on this embodiment in Figure 2 directly as a separate ground to meet the “hollow column” limitation, but my discussions in **Section V** above show this embodiment has been known in the industry since the 1970s.

4. **“a second plate arranged in spaced apart confronting relation to said first plate and”**

Grounds 1&2:

86. As shown below, Nakamura discloses this limitation by teaching “said first plate” (indicated in red) and “a second plate” (indicated in blue) that is “arranged in spaced apart confronting relation to said first plate.”

Figure 4



5. “a second plate ... including a circumferential edge lip bounding an inner surface and”

Ground 1:

87. For the same reasons as discussed in **Section X.C.2** above, a skilled artisan would have understood and found obvious “a second plate ... including a

Figure 3

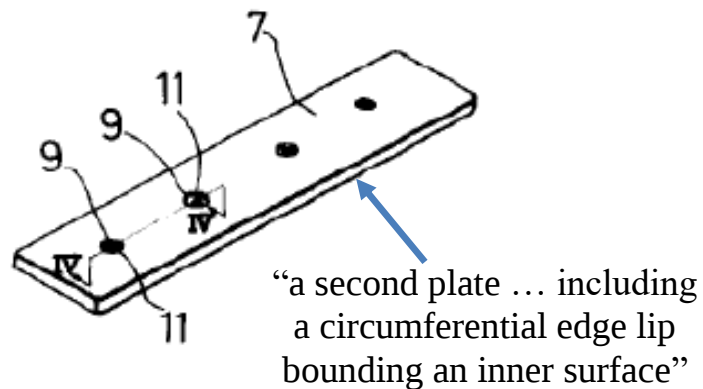
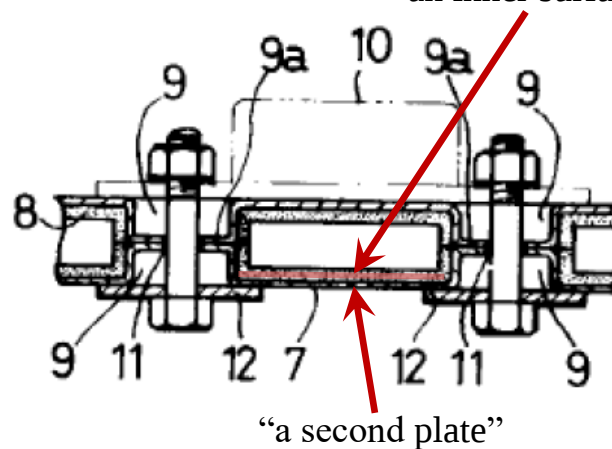


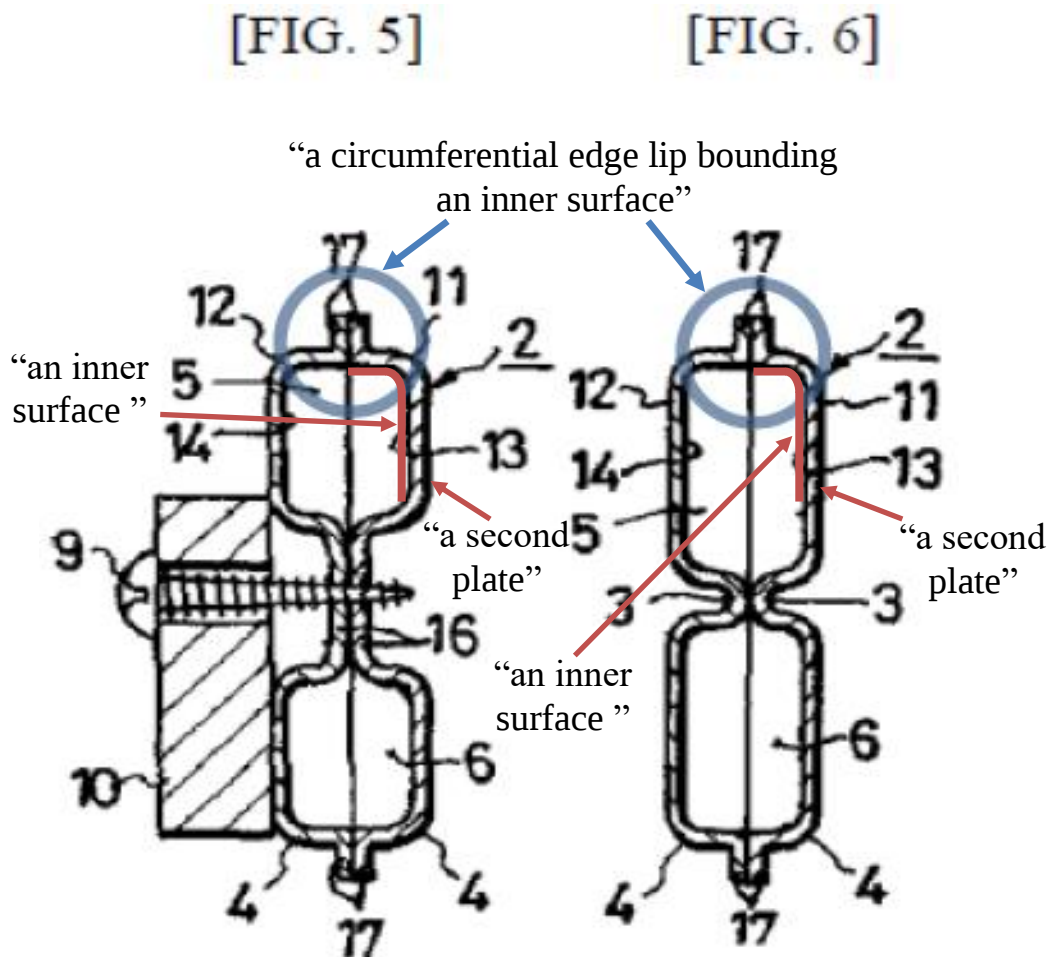
Figure 4 “an inner surface”



circumferential edge lip bounding an inner surface” in view of Nakamura at least under Petitioner’s proposed construction for “lip,” as shown below.

Ground 2:

88. For the same reasons stated in **Section X.C.2** above, it also would have

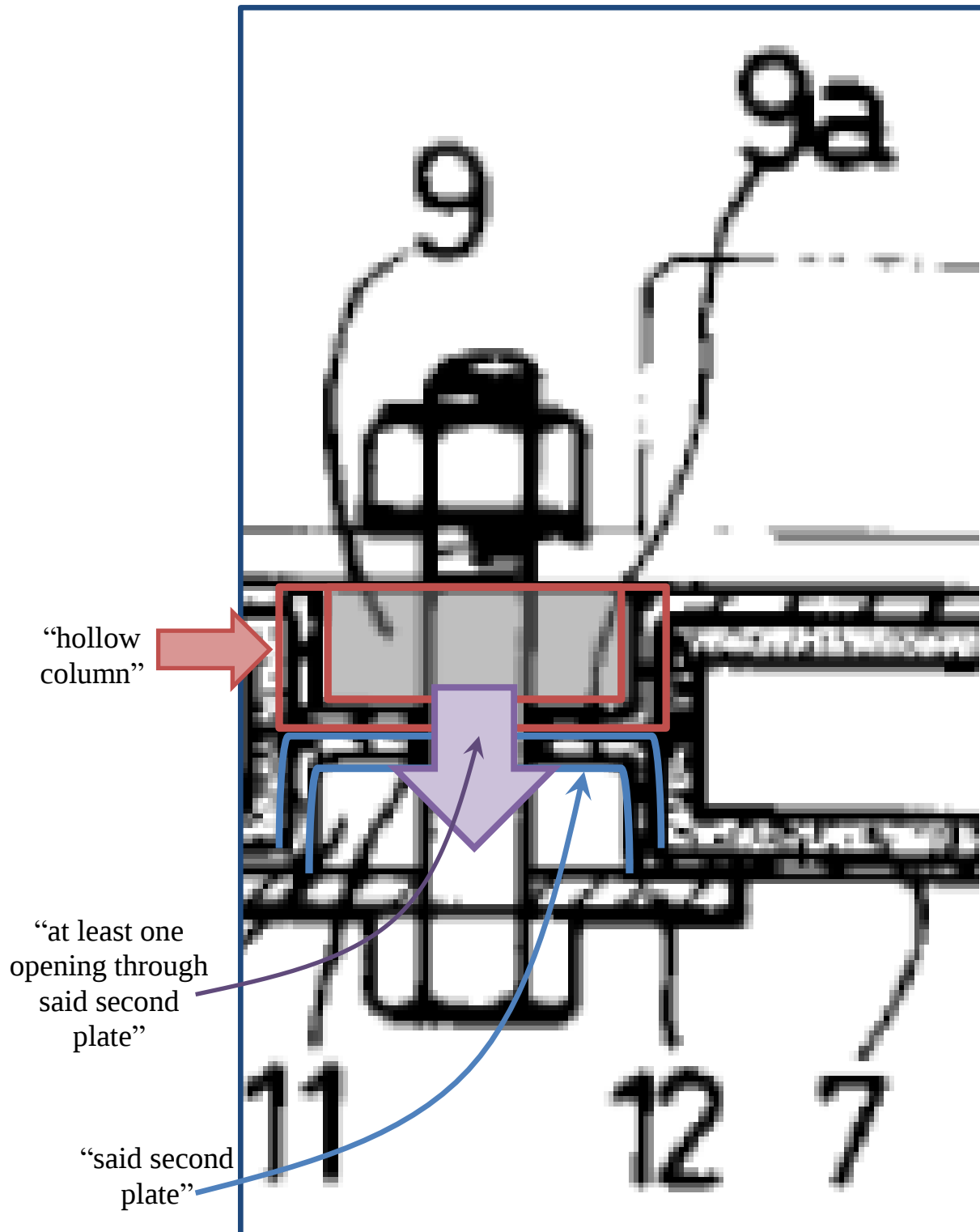


been obvious for a skilled artisan to combine Nakamura with Takahashi to disclose this limitation under both Petitioner’s and Patent Owner’s claim construction proposals for “lip,” as discussed above.

6. “at least one opening through said second plate”

Grounds 1&2:

89. Nakamura discloses this limitation. As shown below, Nakamura discloses that its “hollow column” (the cylindrical, bowl-like structure in red) has “at least one opening” (in purple, facing down) that opens “through said second plate” (as indicated by the light purple arrow pointing down). The “said second plate” limitation is satisfied by the bottom plate in Nakamura (colored in blue).



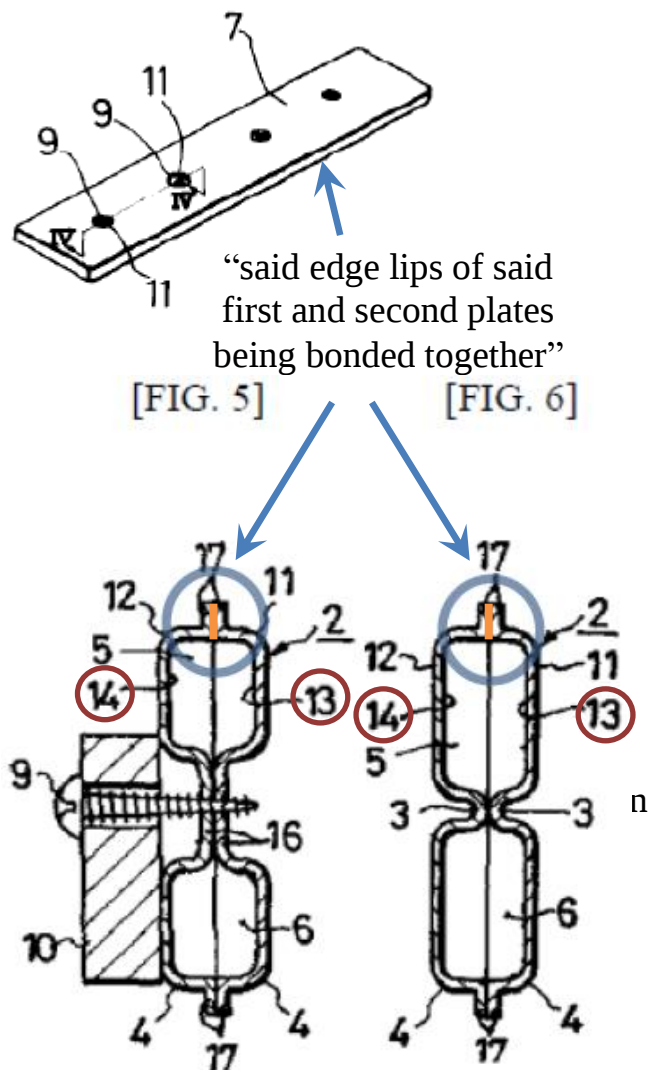
7. “said edge lips of said first and second plates being bonded together”

Grounds 1&2:

90. A skilled artisan would have found it obvious that Nakamura alone or Nakamura in view of Takahashi discloses this limitation for the same reasons as stated above in **Section IX.B.3**

concerning “each of said plates including interior confronting surfaces and a peripheral lip located at an edge of said boundary structure which are bonded together.” See Nakamura at Figure 3 and Takahashi at Figs. 5-6.

Figure 3



8. “so as to define a vapor chamber; wherein”

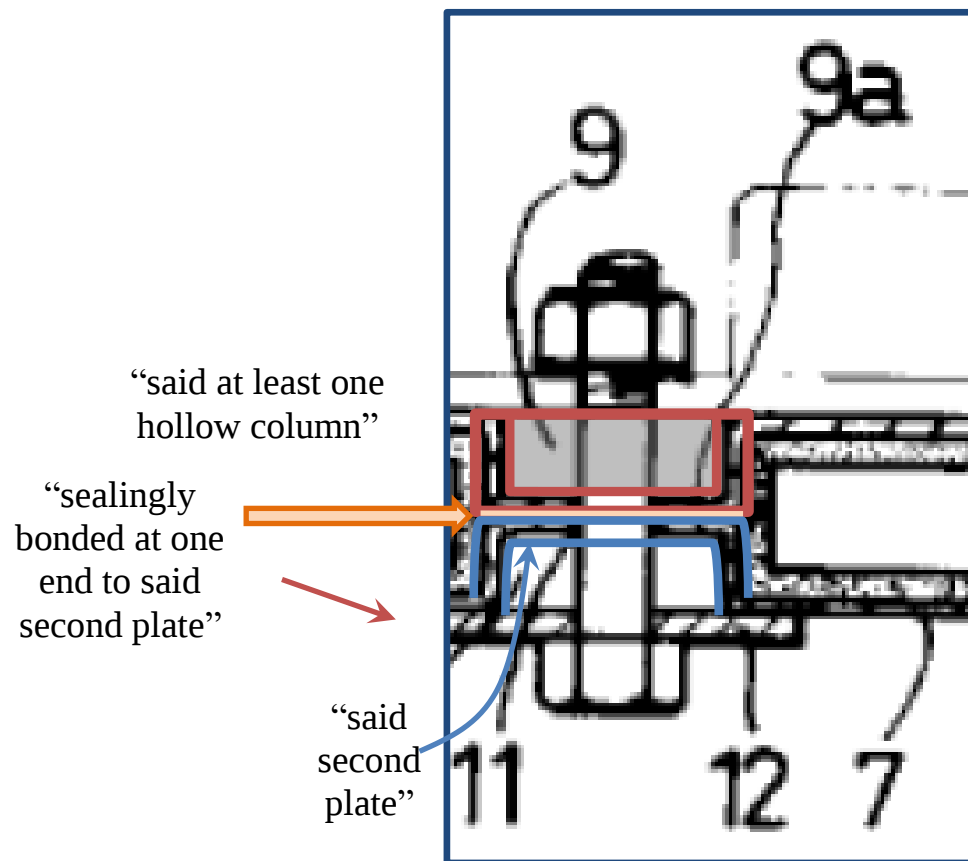
Grounds 1&2:

91. See Section IX.B.4 above.

9. “a hollow column bonded at one end to said second plate”

Grounds 1&2:

92. Nakamura discloses this limitation as follows. Nakamura discloses that



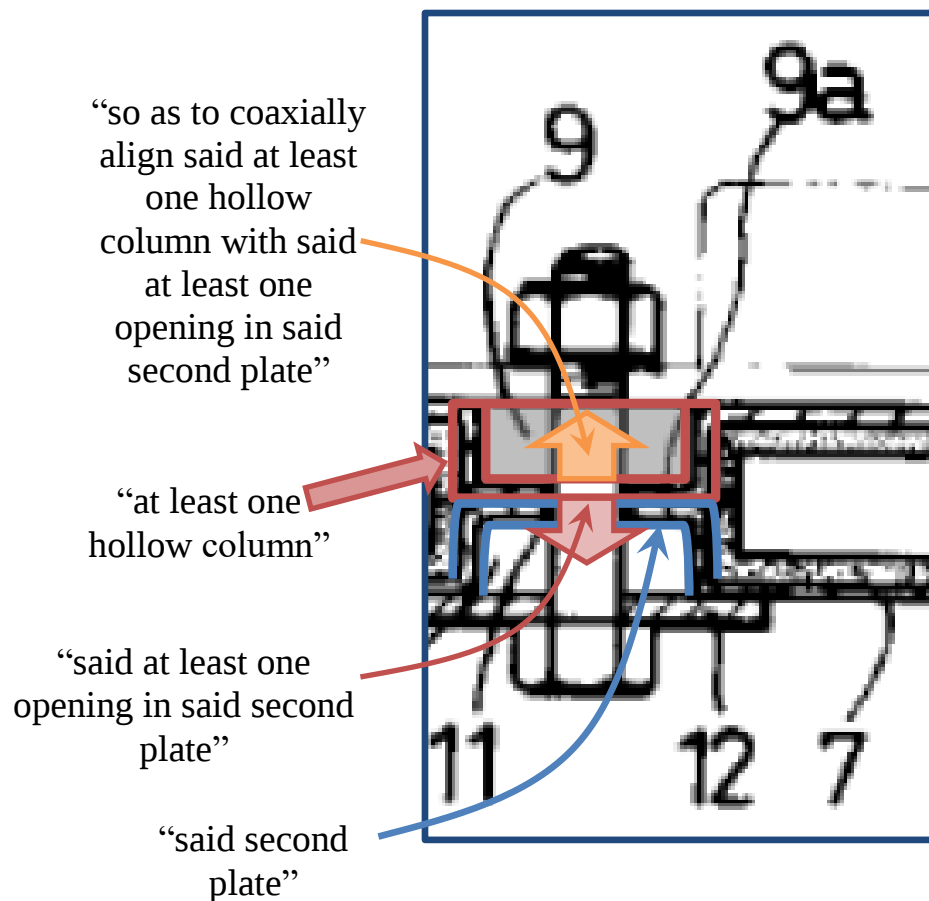
“said at least one hollow column” (indicated in red above) is “sealingly bonded at

one end” (indicated in light orange above) “to said second plate” (indicated in blue above) by teaching that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.)

10. **“so as to coaxially align said hollow column with one of said at least one openings in said second plate”**

Grounds 1&2:

93. Nakamura discloses this limitation as follows. As shown below, “said



at least one hollow column” (indicated in red) is bonded to “said second plate”

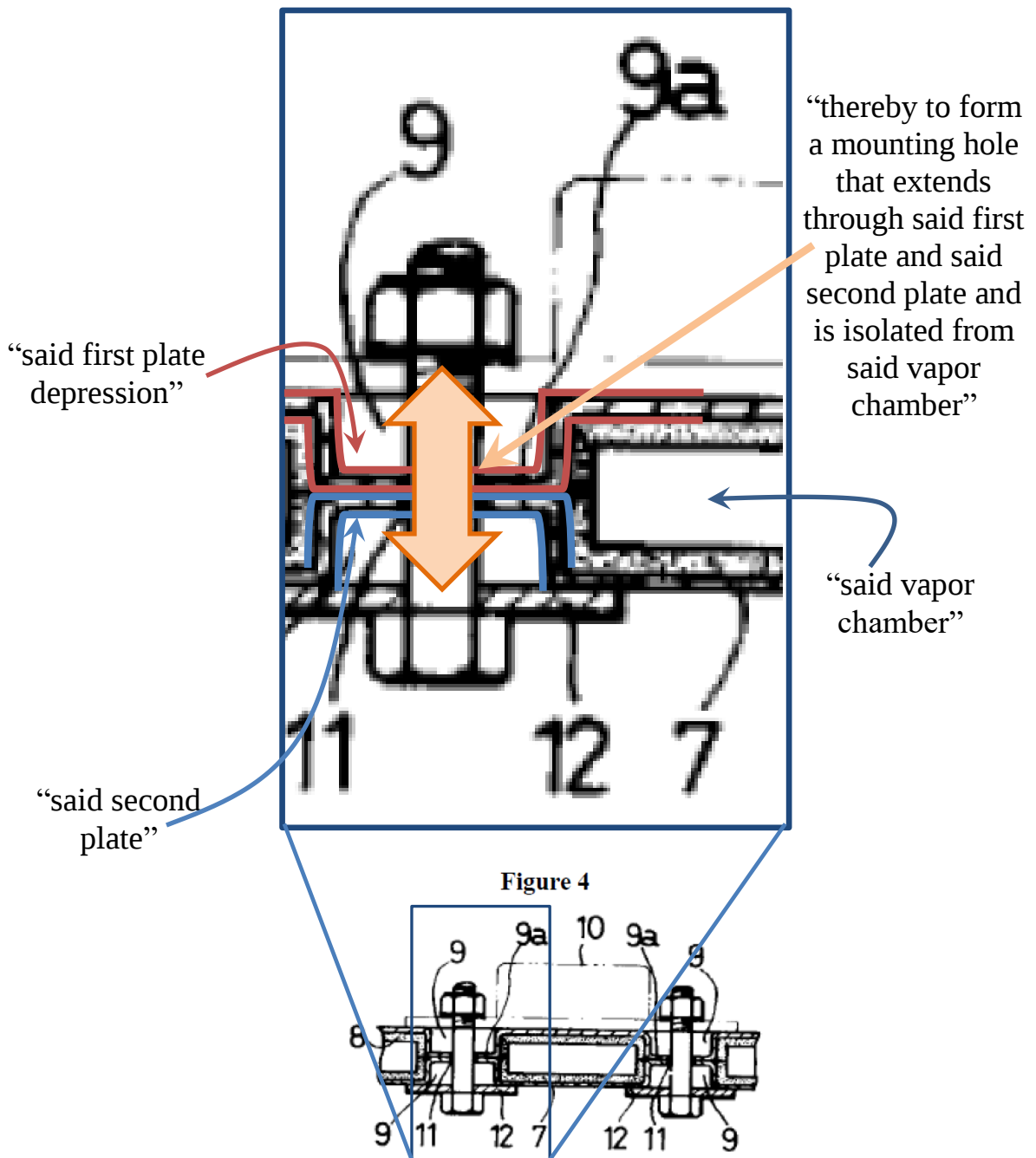
(indicated in blue) “so as to coaxially align said at least one hollow column with said at least one opening in said second plate.” This is because, as Nakamura discloses, “holes 11 ... can be drilled into the concavity joining surfaces 9a and installation can be performed via a bolt or the like.” (Nakamura at 6.) Thus, the “concavity joining surfaces” labeled as “9a” must be bonded to coaxially align the “concavity” labeled as “9” with the hole “11” for “component installation” on the second plate (indicated in blue). In other words, a POSITA would have understood and found it obvious to coaxially align said hollow column with one of said at least one openings in said second plate.

11. **“thereby to form a mounting hole that extends through said first plate and said second plate and is isolated from said vapor chamber.”**

Grounds 1&2:

94. Nakamura discloses this limitation as follows. As shown below, the hole “11” for “component installation” in Nakamura extends through “said first plate” (indicated in red) and “said second plate” (indicated in blue). Further, Nakamura teaches that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.) Thus, the hole “11” for “component installation” is isolated from the inside space of Nakamura’s

“sealed container” labeled as “7.” That is, Nakamura discloses that “a mounting hole that extends through said first plate and said second plate and is isolated from said vapor chamber” (indicated below by the dark blue arrow on the right).



D. Independent claim 3

1. **Preamble: “A heat pipe for spreading heat comprising:”**

Grounds 1&2:

95. See **Section IX.C.1** above.

2. **“a first plate having a circumferential edge lip bounding an inner surface and”**

Grounds 1&2:

96. See **Section IX.C.2** above.

3. **“a depression which projects outwardly relative to said inner surface;”**

Grounds 1&2:

97. Nakamura discloses this limitation because its “concavity” labeled as “9” (indicated in red below) corresponds to the “depression” in the ’680 patent and extends downwardly in the direction that “said inner surface” is facing towards. That is, Nakamura’s “concavity” labeled as “9” extends “outwardly relative to said inner surface” (indicated by the red arrow pointing down), as shown below. Thus, Nakamura discloses “at least one depression which projects outwardly relative to said inner surface.”

Figure 3

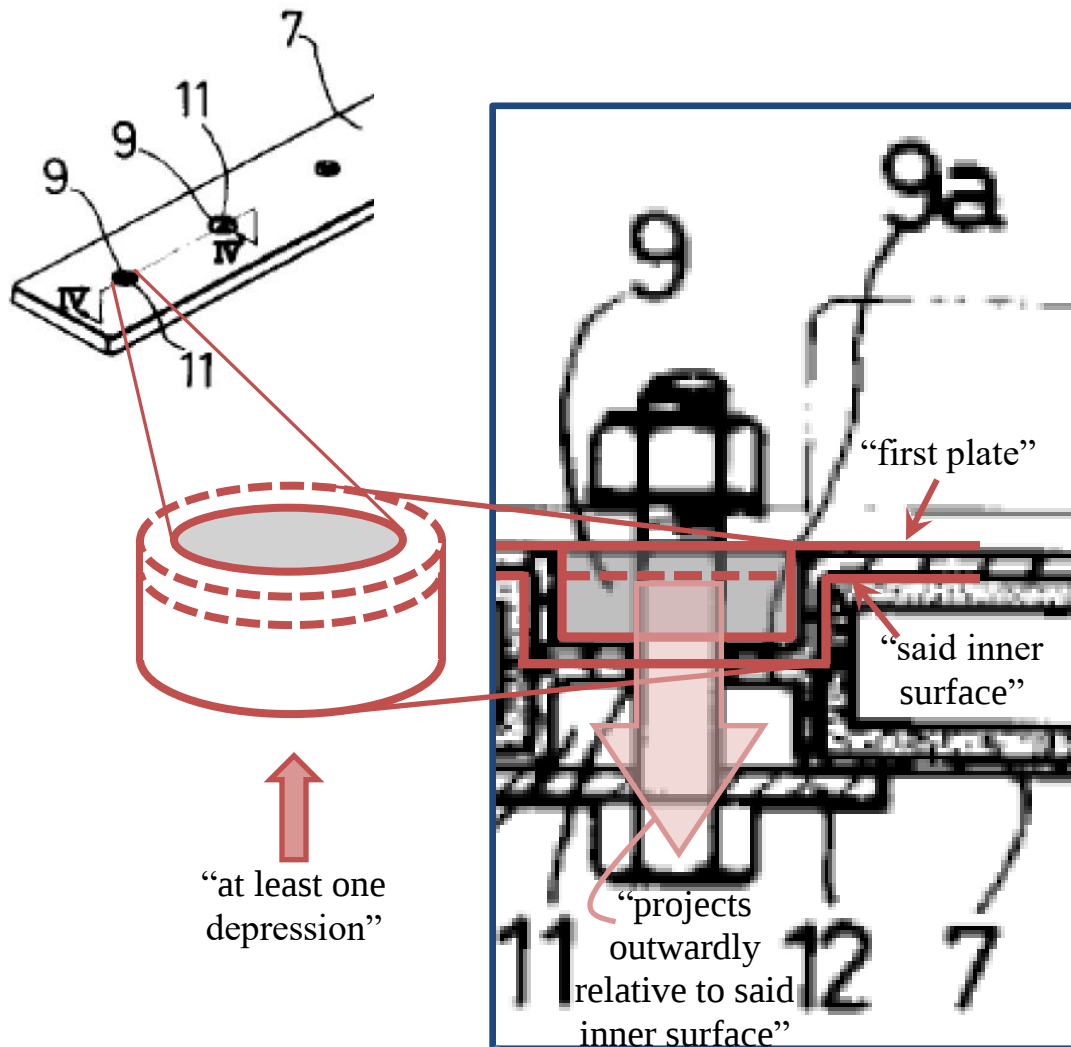
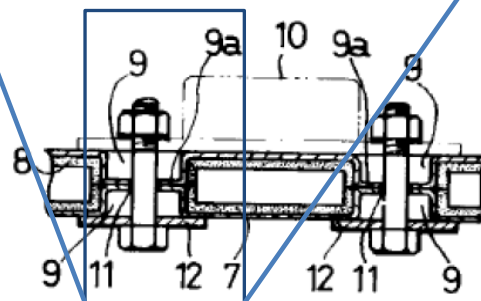


Figure 4



4. **“a second plate arranged in spaced apart confronting relation to said first plate and”**

Grounds 1&2:

98. See Section IX.C.4 above.

5. **“a second plate ... including a circumferential edge lip bounding an inner surface and”**

Grounds 1&2:

99. See Section IX.C.5 above.

6. **“at least one opening through said second plate”**

Grounds 1&2:

100. See Section IX.C.6 above.

7. **“said edge lips of said first and second plates being bonded together”**

Grounds 1&2:

101. See Section IX.C.7 above.

8. **“so as to define an enclosed vapor chamber; wherein”**

Grounds 1&2:

102. See Section IX.C.8 above.

9. **“said depression having an open ended tubular cross-section and an outer surface”**

Grounds 1&2:

103. Nakamura discloses this limitation as follows. As shown below, Nakamura discloses that “said at least one depression” (indicated in red below) has an “open ended tubular cross-section” (indicated in red below) and “an outer surface” (indicated in light orange). As shown below, the structure forming the “concavity” labeled as “9” (indicated in red) has a “tubular cross-section” because the structure (indicated in red) is shaped like a cylindrical bowl, thus having a cross-section shaped like a tube. Further, its top end of the structure is “open” upward, and its “outer surface” (in light orange) is relatively “outer” with respect to the inside of the structure forming the “concavity” labeled as “9.” Thus, the “depression” disclosed by Nakamura below “has an open ended tubular cross-section and an outer surface.”

Figure 3

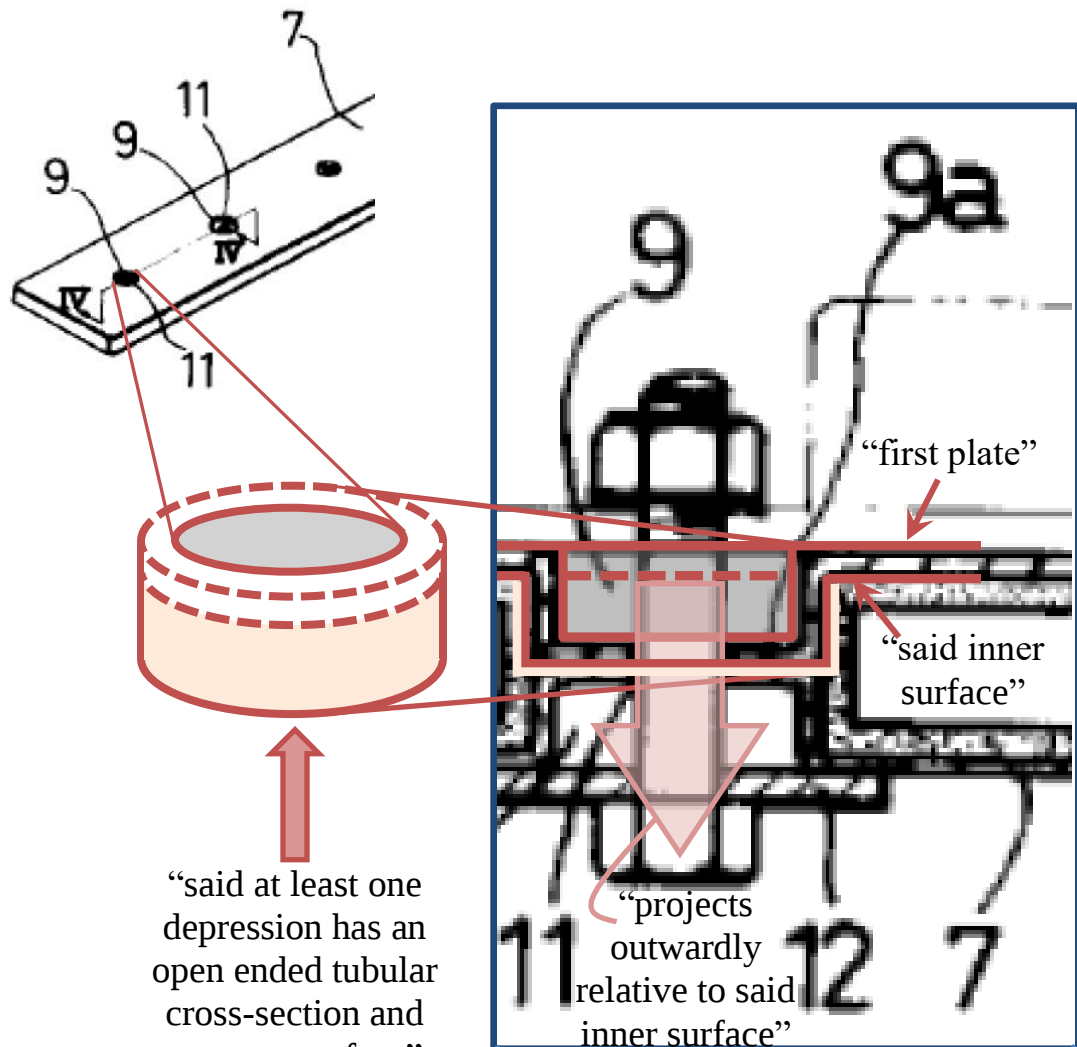
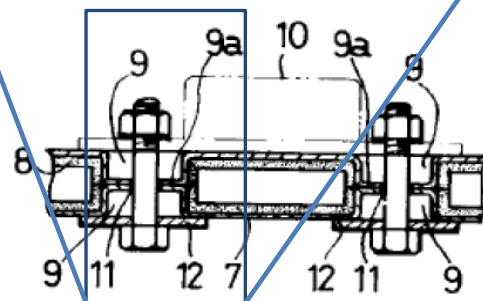


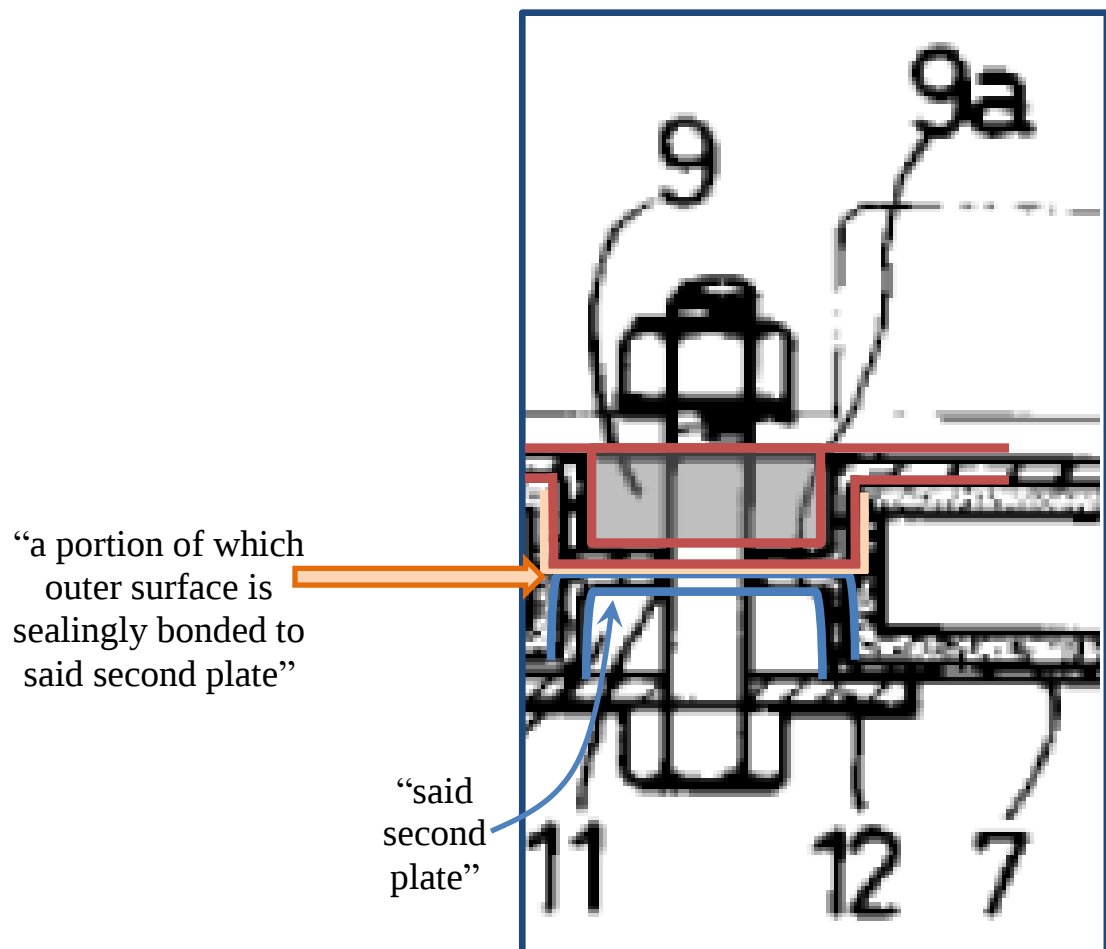
Figure 4



10. **“a portion of which outer surface is bonded to said second plate”**

Grounds 1&2:

104. Nakamura discloses this limitation as follows. As shown below, at least the bottom part of the “outer surface” is “sealingly bonded to said second plate” (indicated in blue). This is because Nakamura teaches that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated



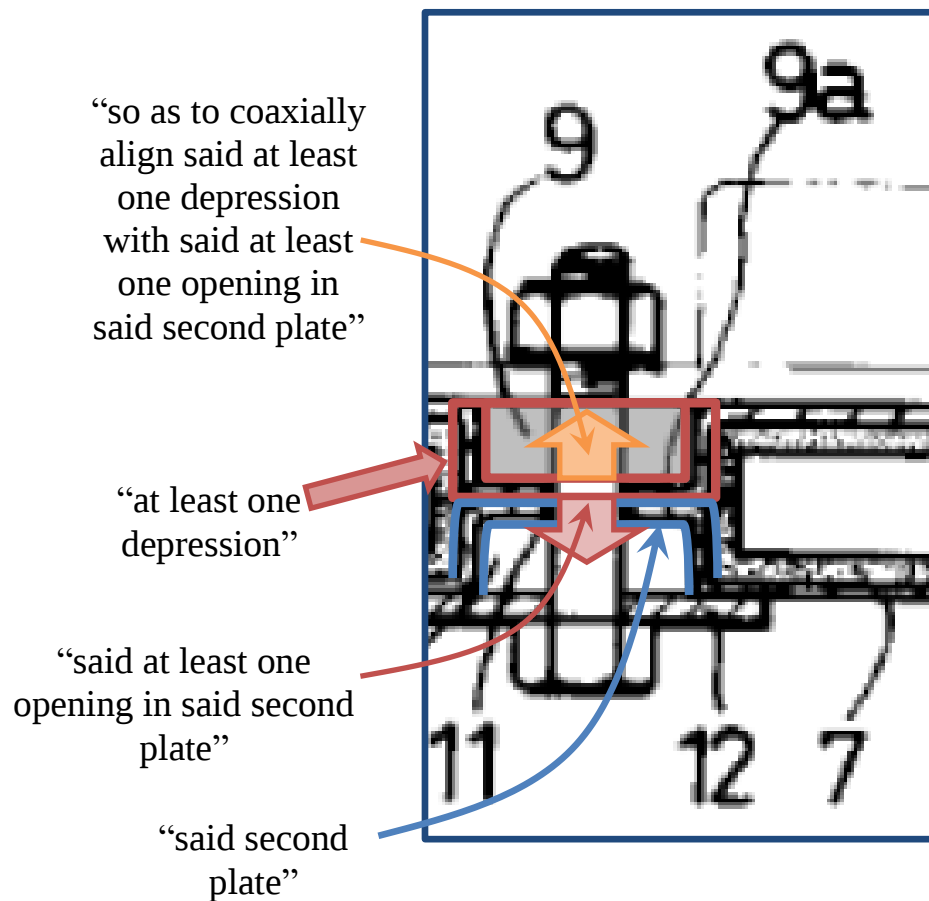
before and after work of forming the sealed container 7 by soldering or the like.”

(Nakamura at 5.) Thus, Nakamura discloses this limitation.

11. **“so as to coaxially align said depression with one of said at least one openings in said second plate”**

Grounds 1&2:

105. Nakamura discloses this limitation as follows. As shown below, “said



at least one depression” (indicated in red) is bonded to “said second plate” (indicated in blue) “so as to coaxially align said at least one depression with said at least one opening in said second plate.” This is because, as Nakamura discloses, a bolt must

be able to “pierc[] the Hole 11” that goes through both the first and the second plates in the “concavity” labeled as “9” in Nakamura. Thus, the “concavity joining surfaces” labeled as “9a” must be boned to coaxially align the “concavity” labeled as “9” with the hole “11” for “component installation” on the second plate (indicated in blue). In other words, a POSITA would have understood and found it obvious to “coaxially align said depression with one of said at least one openings in said second plate.”

12. **“thereby to form a mounting hole that extends through said first plate depression and said second plate and is isolated from said vapor chamber.”**

Grounds 1&2:

106. Nakamura discloses this limitation as follows. As shown below, the hole “11” for “component installation” in Nakamura extends through “said first plate depression” (indicated in red) and “said second plate” (indicated in blue). Further, Nakamura teaches that “[t]he concavity joining surfaces 9a can ... be readily and reliably adhered by being pressurized and heated before and after work of forming the sealed container 7 by soldering or the like.” (Nakamura at 5.) Thus, the hole “11” for “component installation” is isolated from the inside space of Nakamura’s “sealed container” labeled as “7.” That is, Nakamura discloses that “a mounting hole

that extends through said first plate depression and said second plate and is isolated from said vapor chamber” (indicated below by the dark blue arrow on the right).

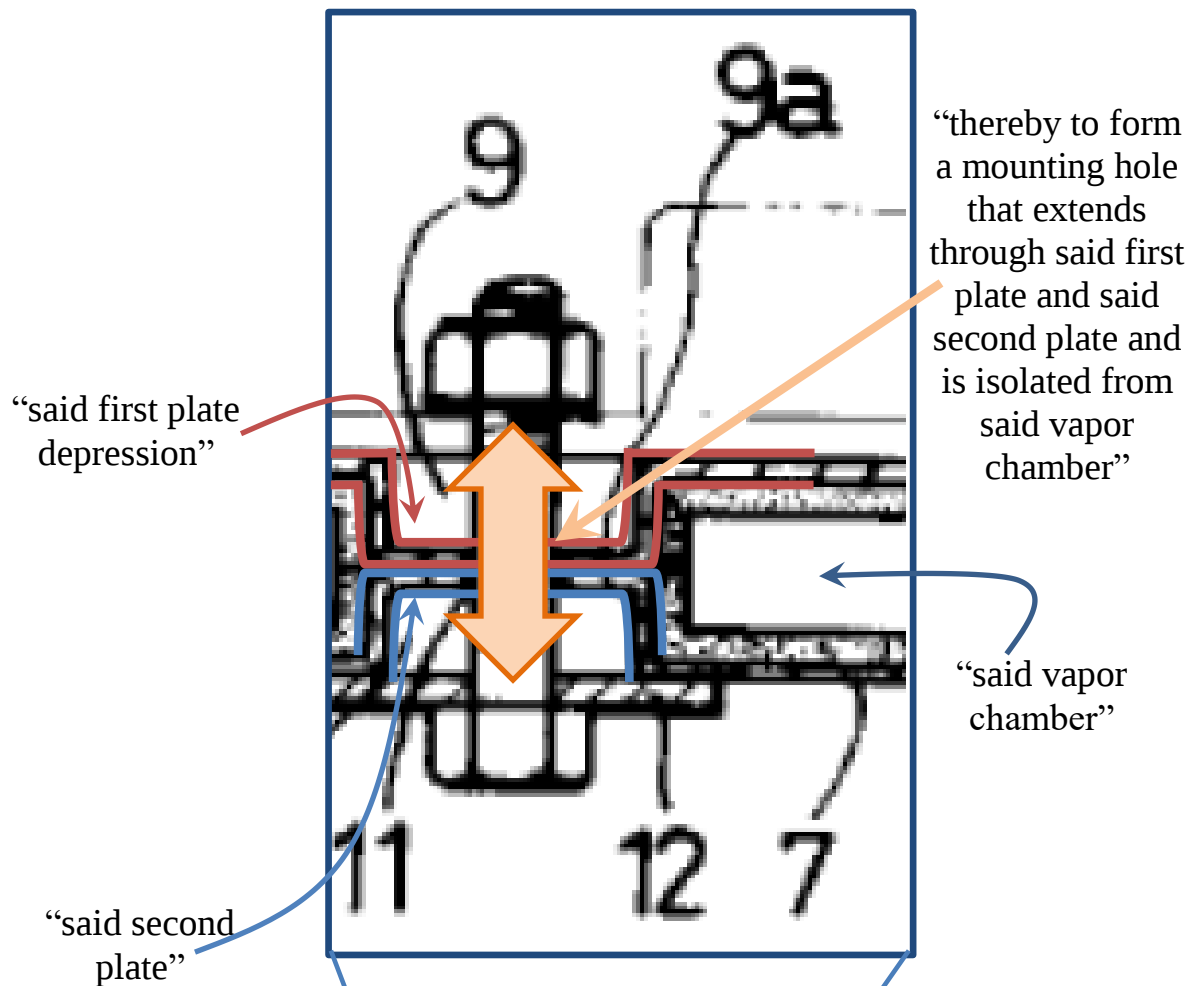
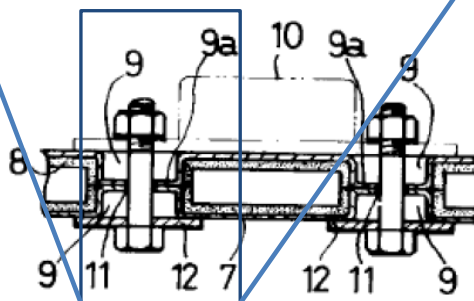


Figure 4



X. ENABLEMENT OF THE PRIOR ART AND REASONABLE EXPECTATION OF SUCCESS

107. I am informed that to show obviousness in *inter partes* review proceedings, the petitioning party does not have a burden to show that the prior art is enabling. Nevertheless, in my opinion, the prior art references cited in my Declaration provide sufficient detail to enable a person of ordinary skill in the art to practice the limitations of the challenged claims without undue experimentation. These same details, discussed below, show why the person of ordinary skill in the art would have a reasonable expectation of success in combining the prior art in the manner I have proposed above.

108. I am informed that the following factors are relevant to whether a prior art reference is enabling: (1) the breadth of the claims; (2) the nature of the alleged invention; (3) the state of the prior art; (4) the level of one of ordinary skill in the art; (5) the level of predictability in the art; (6) the amount of direction provided by the inventor; (7) the existence of working examples; and (8) the quantity of experimentation needed to make or use the invention based on the content of the disclosure.

109. As I have explained in my discussion of a person of ordinary skill in the art and technical background, the technological underpinnings of the challenged

patent claims were firmly in place well before May 1999. The '240 patent itself confirms that the underlying technology is not sophisticated or unpredictable. The techniques described in the patent were well-known and would have been well within the knowledge and experience of a person of ordinary skill in the art.

110. My opinions are further enhanced by the high degree of predictability in the art, and the relatively minimal level of direction provided in the '240 patent's written description, which includes only five columns of text (not counting the claims). The techniques in the prior art that I rely upon could have been combined without materially changing their purpose or the way in which they operate, either alone or together. The end result of that combination would not be an unexpected or unpredictable result.

111. By May 1999, each aspect of the disclosures that I have cited from the prior art was already well-known and was the subject of extensive public documentation. A person of ordinary skill would not have required disclosures any more detailed than the disclosures in the prior art to apply the prior art teachings in the manner described in this Declaration. And for the same reasons, a person of ordinary skill in the art would have had every expectation that the combinations would have been successful.

XI. CONCLUSION

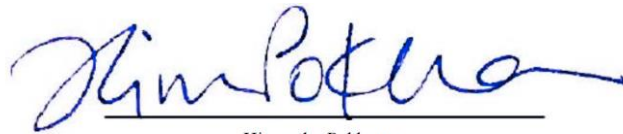
112. In signing this Declaration, I recognize that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the U.S. Patent and Trademark Office. I also recognize that I may be subject to cross-examination in this proceeding. If required, I will appear for cross-examination at the appropriate time. I reserve the right to offer opinions relevant to the invalidity of the '680 patent claims at issue and/or offer testimony in support of this Declaration.

113. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

Dated: October 31, 2018

Respectfully submitted,

Dr. Himanshu Pokharna



Himanshu Pokharna

EXHIBIT A

HIMANSHU POKHARNA, PhD (PURDUE), MBA (WHARTON)

Phone: 408-464-8007

Email: pokharna@gmail.com

21 years of progressive experience in a variety of leadership roles in large companies as well as entrepreneurial environments with emphasis on energy 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 and can span from technology to strategy and P&L. Technologist with track record of successful introduction of new mechanical/thermal technology in a broad array of computing, consumer, energy and Mil/aerospace products. Experienced in building and leading teams across geographies.

PROFESSIONAL EXPERIENCE

Inficold Inc. Founder and CEO

04/15-Present

A seed funded startup developing and commercializing thermal energy storage products.

- Founded and raised \$1.67 M in seed and grant funding. Responsible for all aspects of the company
- Attracted a very capable board with a multi-billion dollar company CEO and an ex-Google VP/US Acting Undersecretary of Energy as members.
- Built a 30 people team for developing a patented product which can attach to any air conditioning system and store energy in low cost phase change media to shift power consumption to low tariff duration.
- Developed relationships with the Indian policy setting bodies for milk cooling. Product is undergoing testing at a few of the largest dairies in India. Also negotiating demonstration projects with dairies in Africa.

Deeia Inc. Principal (Owner)

01/09-Present

A thermal design, consulting and sourcing business with leading companies (Google, GoPro, Facebook, etc.) and startups as clients.

- Services focused on the characterization, development and enhancement of thermal design of systems including VR headsets, drones, data centers, servers, smart phones, tablets, networking and LED systems.
- Assisting overseas manufacturers with strategic sales activities for products such as pyrolytic graphite sheets in consumer electronics.
- Developed thermal architecture of several products for startup companies (LED, drone, action camera).

Sheetak Inc. Co-Founder, Board Member and VP Business Development

01/09-04/15

A Series B funded company applying an innovative material for creating solid state energy converters with application in power generation, cooling and heat pumping products.

- Raised >\$5M in venture 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.
- Identified a new product based upon our technology and deep analysis of refrigeration market. Licensed it to a leading conglomerate in their ultra-cheap refrigerator for the masses in India. The resulting low cost refrigerators in have received coverage in the *Economist*, *WSJ* and *HBR*. Responsible for end to end delivery (engineering, design, Chinese supply chain and component cost negotiations).
- Negotiated multiple licensing deals (~\$ 1 M in upfront fees and royalties). Negotiated collaboration agreements with a large appliance manufacturer and a large automotive supplier.
- Responsible for developing internal processes for financial controls, reporting, auditing, and personnel policies. Attracted and hired a very capable team in US as well as built the company office in India.

Ventiva Inc. VP Product Management and Marketing 12/08-10/09
Strategic Advisor / Part-Time VP of Thermal Engineering & Products 10/14-present

Ventiva is a top tier VC (Foundation Cap., DCM) funded startup focused on commercializing solid state fans.

- 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.
- Created customer and supplier relationships in Korea, Japan and Taiwan with mobile/PC customers and other ecosystem partners.

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/Director ('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 and evaluate new technologies such as lighter materials. Also hired a statistician to develop a training course to educate the vendors on use of statistical process control tools as a means to optimize performance and improve yields.
- Advised Intel Capital for investment in thermal, mechanical, fuel-cell and battery startups. Evaluated >25 investment opportunities. Managed Intel Capital investment in a company.
- Intel IP committee member. Responsible for evaluating employee disclosures for filing as patents.

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.
- Developed and patented an innovative chamber end point detection methodology.

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

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.

SELECTED PUBLICATIONS AND PRESENTATIONS²

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.
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.
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 Columbia, Canada, July 8-12, 2007. Published: *Proc. ASME. 42770; ASME 2007 InterPACK Conference, Volume 1. IPACK2007-33249. Pages: 677-687*

² Publications and presentations marked with * were peer reviewed.

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.

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PATENTS AND PATENT APPLICATIONS

Issued US Patents:

Patent 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

Patent Number	Title
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

Pending US Patent Applications (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

Publication Number	Title
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

Publication Number	Title
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 International Patents / Pending International Patent Applications (Published):

Patent or Publication Number	Title
EP1665434B1	INTEGRATED PLATFORM AND FUEL CELL COOLING INTEGRIERTE PLATTFORM UND BRENNSTOFFZELLENKÜHLUNG REFROIDISSEMENT 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'ENTRAINEMENT 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'ENTRAINEMENT 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

Patent or Publication Number	Title
EP1079000A1	Method for removing residue from an exhaust line Verfahren zur Entfernung von Absetzungen in einer Abgasleitung Procédé d'élimination des 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

Patent or Publication Number	Title
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'ENTRAINEMENT S'APPLIQUANT SUR UNE POSITION D'ENFICHAGE DE CARTE DANS UN SYSTEME
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.

Patent or Publication Number	Title
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

Patent or Publication Number	Title
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 ENGAGEMENT

- Expert witness for Defendant in ASETTEK HOLDINGS, INC. et al. v. COOLIT SYSTEMS INC., Case No. 3:12-cv-04498-EMC: Prepared expert reports for invalidity and non-infringement; testified in deposition.

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