IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

AOS HOLDING COMPANY and A.O. SMITH CORPORATION, Plaintiffs, v. BRADFORD WHITE CORPORATION, Defendant.	:	C.A. No. 18-412-LPS **REDACTED PUBLIC VERSION (ISSUED** 4/6/21)

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OPINION

March 31, 2021
Wilmington, Delaware

STARK, U.S District Judge:

A.O. Smith Corporation and AOS Holding Company (collectively, "A.O. Smith," "AOS," or "Plaintiffs") sued Bradford White Corporation ("Bradford White," "BW," or "Defendant") for patent infringement based on Bradford White's sales and marketing of its Commander Series of gas-fired water heaters. (D.I. 15) A.O. Smith alleges that the sale and installation of Bradford White's accused products infringe U.S. Patent No. 8,375,897 (the "'897 Patent"). (*Id.*) Bradford White contends that it does not infringe the '897 Patent and, moreover, that the '897 Patent is invalid due to anticipation and obviousness. (*See* D.I. 169 Exs. 2D, 3D) The Court held a five-day remote bench trial (using videoconferencing technology) in August 2020. (*See* D.I. 188-92) ("Tr.")[1] Thereafter, the parties submitted post-trial briefing (D.I. 193, 195, 202, 204, 211-12) and proposed findings of fact (D.I. 194, 196, 203, 205).

Pursuant to Federal Rule of Civil Procedure 52(a), and having considered the entire record in this case and the applicable law, the Court concludes that: (1) Bradford White infringes the '897 Patent, both directly and indirectly, (2) Bradford White's infringement is not willful, (3) A.O. Smith is entitled to damages of $4,544,461 due to indirect infringement during the damages period at issue during trial and $1 in nominal damages for direct infringement, and (4) the '897 Patent is not invalid for anticipation or obviousness.

The Court's findings of fact and conclusions of law are set forth in detail below.

[1] This was the undersigned Judge's first entirely virtual trial. All proceedings were conducted on Zoom. When what was scheduled to be a jury trial was cancelled due to the coronavirus pandemic, the parties agreed to convert to a remote bench trial, in which no one (other than the Judge) came to the courtroom. While no one would contend the video trial was "better" than a "live" trial in court, all involved made effective presentations and the Court obtained all of the evidence and assistance it required in order to resolve the parties' disputes.

FINDINGS OF FACT

This section contains the Court's findings of fact ("FF") on disputes raised by the parties during trial, as well as facts stipulated to by the parties. The Court adopts the parties' Stipulated Facts (D.I. 169 Ex. 1) ("SF"), which are repeated in part below. Certain findings of fact are also provided in connection with the Court's legal analysis later in this Opinion.

I. Introduction

This patent infringement action arises out of Bradford White's sale of certain accused water heaters that are marketed and sold as the "Commander Series™ Atmospheric Vent Models." This includes the following seven models (referred to collectively hereinafter as "Commander" or "Accused Products"): UCG-80H-125-3N, UCG-80H-199-3N, UCG-80H-270-3N, UCG-80H-399-3N, UCG-100H-199-3N, UCG-100H-270-3N, and UCG-100H-399-3N. (SF at 1(A)) While all of the Accused Products are designed to operate in the same manner (Stafford Tr. 179),[2] BW identified Model No. UCG-100H-199-3N as "a representative Commander [S]eries water heater." (PTX-035 at 10)

II. Patent-in-Suit

1. U.S. Patent No. 8,375,897 is entitled "GAS WATER HEATER." (SF ¶ 4; *see also* JTX-002 ('897 Patent)) The '897 Patent was issued by the United States Patent and

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[2] Citations to the trial transcript (D.I. 188-92) are in the form: "([Witness last name] Tr. [page number])."

Christopher Stafford, a Bradford White engineer, did not testify live at trial. Instead, A.O. Smith read portions of Mr. Stafford's deposition transcript (through page 71) into the record on August 14, 2020. (Stafford Tr. 133-85) The Court read the remaining designated portions of his deposition transcript (pages 71 onward) during a break. (Tr. 182-84) In referring to Mr. Stafford's testimony, references to "Stafford Tr." are to portions read onto the record during trial (i.e., to the trial transcript page where they were read) while references to "Stafford Dep. Tr." are to portions read by the Court during break (and are references to the pertinent deposition transcript page).

Trademark Office ("USPTO") on February 19, 2013 to inventors Herbert Edward Smith and Gordon Stretch. (JTX-002) It "relates to a gas water heater" and specifically "a gas water heater that utilizes a power burner and an exhaust plenum to permit natural convection exhaust of products of combustion." (JTX-002 at 1:12-15; *see also* Tanbour Tr. 229; D.I. 169 (Final Pretrial Order) at 3)

2. The '897 Patent is entitled to an effective priority date of no later than August 16, 2006, by virtue of a claim of priority to U.S. Patent Application No. 11/464,998. (SF ¶ 5)

3. The '897 Patent is owned by AOS Holding Company, which is a wholly-owned subsidiary of A.O. Smith Corporation. (SF ¶ 11; Heideman Tr. 34) AOS Holding Company and A.O. Smith Corporation are the only entities permitted to practice and/or profit from the invention embodied in the '897 Patent. (SF ¶ 11) A.O. Smith Corporation makes all the decisions and controls all the functions of AOS Holding Company. (Heideman Tr. 34)

4. The '897 Patent contains a single claim, claim 1, which is reproduced below:

> A method of interfacing a natural convection vent construction with a water heater,
>
> the method comprising: providing a water heater having a burner, a blower, and a flue;
>
> creating products of combustion with the burner;
>
> forcing the products of combustion into the flue under positive pressure with the blower;
>
> interposing an exhaust plenum between the flue and the natural convection vent construction;
>
> dropping the pressure of the products of combustion to near atmospheric pressure within the plenum;
>
> and permitting the products of combustion to rise out of the plenum and into the natural convection vent construction

substantially entirely under the influence of natural convection

wherein the natural convection vent construction includes a draft hood, the method further comprising mixing ambient air with the products of combustion as the products of combustion flow into the draft hood.

(SF ¶ 6)

5. The '897 Patent discloses an embodiment of a water heater 10 including a power burner 60. Power burner 60 includes a premix burner 83 and a blower 90. Burner 83 creates three products of combustion by burning a mixture of fuel and air. Blower 90 forces the products of combustion into a flue tube 65 under positive pressure. Flue tube 65 extends through water tank 15 and into a plenum 70. (SF ¶ 7)

6. Portions of this embodiment are depicted in Figure 2 of the patent, which is reproduced below and further described in ensuing findings of fact.

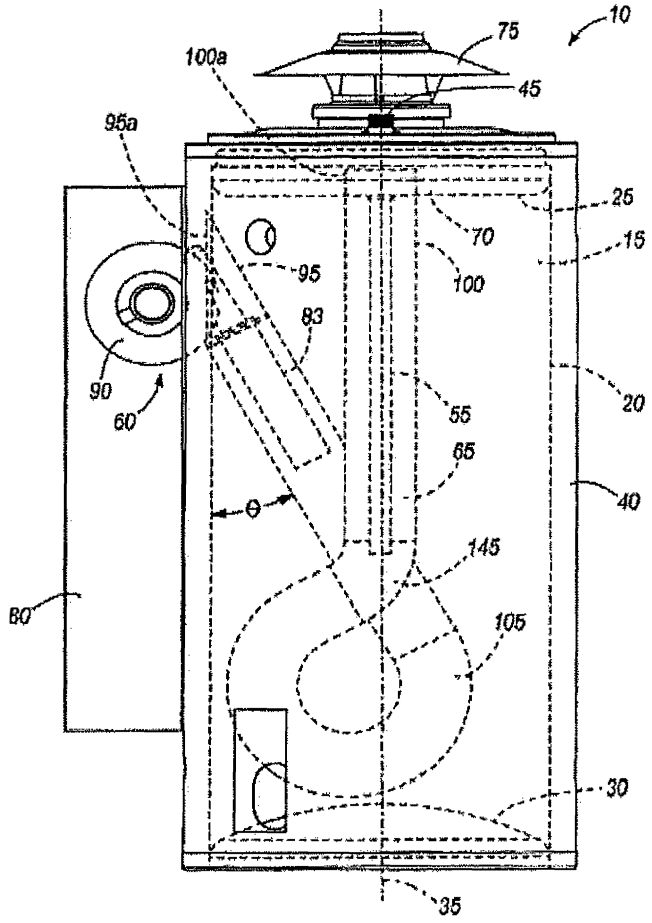

FIG. 2

7. The '897 Patent further discloses a baffle 110 may be positioned inside flue tube 65 to reduce the velocity and pressure of the products of combustion as they approach the outlet end of flue tube 65. (SF ¶ 8) This is depicted in Figure 3 of the patent, which is reproduced below and further described in ensuing findings of fact.

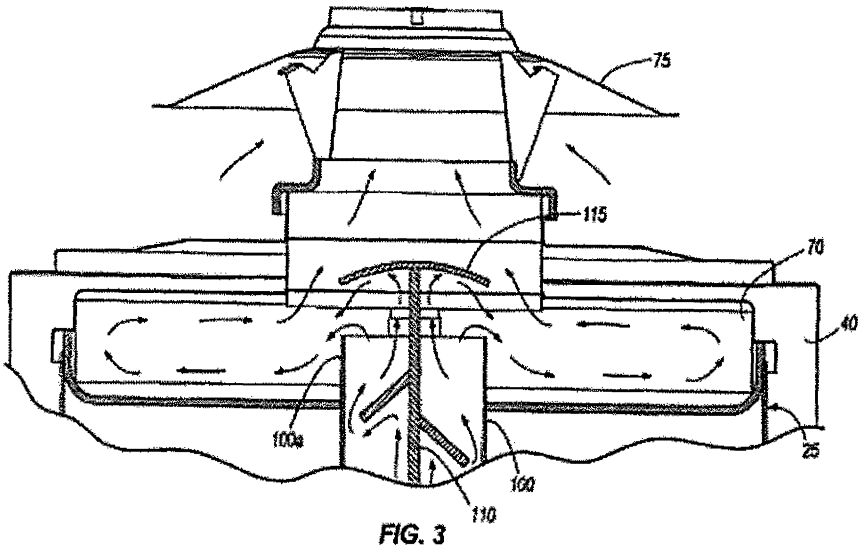

FIG. 3

8. The '897 Patent discloses that baffle 110 may be designed to reduce velocity and pressure of the products of combustion, such that the products of combustion creep over the outlet end of flue tube 65 and "spill" into the plenum 70. (SF ¶ 9)

9. The '897 Patent discloses that, in the plenum 70, the pressure of the products of combustion drops to near or below atmospheric pressure, and the products of combustion are therefore able to rise out of the plenum 70 and into a draft hood 75 substantially entirely under the influence of natural convection. In this regard, the plenum 70 and baffle 110 may be said to uncouple the flow of the products of combustion from the power burner 60. In other words, the products of combustion enter the plenum 70 under the influence of the power burner 60, but exhaust from the plenum 70 without the influence of the power burner 60. Thus, the water heater 10 can be retrofitted into a Category I venting system despite the fact that the water heater 10 utilizes a power burner 60. A water heater according to the invention of the '897 Patent can replace an existing atmospheric water heater without the need to modify the exhaust structure. (SF ¶ 10)

10. Plaintiffs have not marked any products, product manuals, literature, advertisement, or website with the number of the '897 Patent. (SF ¶ 12)

11. Given the '897 Patent's relationship with Category I compliance, the pressures referred to in the '897 Patent are static pressures, as opposed to stagnation or total pressures. (SF ¶ 39)

12. As the Court stated in one of its (two) claim construction opinions issued in this case, "one of the purposes of the invention is to retrofit a power burner water heater with a Category I venting system (exhaustion by natural convection)." (D.I. 77 at 9; JTX-007 at 9)

13. The Court has also explained, in another of its claim construction opinions, that the asserted claim involves a sequence of steps; that is, "'near atmospheric temperature' relates to the state of the products of combustion at an earlier step than 'near or below atmospheric temperature.'" (D.I. 61 at 7; JTX-006 at 7)

14. From the perspective of a person of ordinary skill in the art ("POSA"), the "technology described in the '897 Patent is really aimed at allowing a water heater with [a power burner] to be retrofitted into [a] Category I application." Reynolds Tr. 92-93, 95; *see also* Smith Tr. 114; Tanbour Tr. 229-30; SF ¶ 10)

15. The specification of the '897 Patent refers to "flow" 12 times. (*See* D.I. 202 at 6 n.2; *see also, e.g.*, JTX-002 at Abs., 1:30-31, 4:3-5)

16. Figure 3 of the '897 Patent depicts the flow of combustion products by showing arrows inside the water heater. (*See* JTX-002 at 4:3-5)

17. The '897 Patent goes into detail regarding the areas of "smooth flow" and "turbulent flow" within various embodiments. (*Id.* at 4:46-60)

18. The '897 Patent uses related terms like "rise," "creep," "spill," or "mix" to describe the movement (i.e., flow) of combustion products within the water heaters. (*E.g.*, *id.* at 3:59-62, 4:5-11)

19. Plaintiffs' expert, Dr. Emad Tanbour, relied exclusively in each of his tests on measurements of pressure and not measurements of flow. (Tanbour Tr. 363)

20. From the perspective of a POSA, a gas water heater that uses "a Category I vent system" is "using the natural buoyancy of the byproducts of combustion to vent through that system." (Reynolds Tr. 84-85)

21. From the perspective of a POSA, the plenum is critical to the functionality of the '897 Patent because the plenum "allow[s] natural convection to take over." (Smith Tr. 115-16; *see also* Reynolds Tr. 92; Tanbour Tr. 234-35)

22. From the perspective of a POSA, there is in the plenum of the '897 Patent a "change from the positive pressure that's influenced by the burner" to reliance on "natural convection" that "actually pull[s] the flue gases out of the plenum and up into the vent." (Smith Tr. 115, 118; *see also* Reynolds Tr. 79; Tanbour Tr. 234-35)

23. From the perspective of a POSA, if the products of combustion leaving the plenum of the '897 Patent – "exiting the water heater" – "were still under the influence of the power burner," a Category I venting system could not be used. (Smith Tr. 114-16; *see also* Reynolds Tr. 92-93; Tanbour Tr. 234-35, 296-97, 316-17)

24. From the perspective of a POSA, the "dropping" and "permitting" steps of claim 1 would be analyzed by "measuring pressure" – not velocity – which is consistent with industry standards and Category I requirements. (Reynolds Tr. 87-92; Tanbour Tr. 244-46, 294-95, 322-23; Stafford Tr. 179-81; *see also* PTX-031 at 1, 3 (depicting pressure measurements))

25. From the perspective of a POSA, analyzing pressure "is a definitive way" of determining whether the products of combustion are substantially entirely under the influence of natural convection. (Tanbour Tr. 244-46, 294-95, 322-23)

26. The claimed invention allows for a "water heater to be retrofitted into a Category I venting system despite the fact that the water heater utilizes a power burner." (SF ¶ 10; *see also* Tanbour Tr. 232; Bero Tr. 508; JTX-002 5:1-3 ("A water heater according to the present invention provides greater tank capacity in a smaller tank and footprint than known water heaters."))

III. Witnesses

A. A.O. Smith's Expert Witnesses

27. Dr. Emad Y. Tanbour earned his Ph. D. in mechanical engineering at the University of Iowa in 1997 before working at HNI Corporation for eight years and A.O. Smith Corporation for five years.[3] He later joined the faculty at Central Michigan University and then Eastern Michigan University, where he is now an associate professor of mechanical engineering. He is a named inventor on ten applications or patents. (Tanbour Tr. 223-25)

28. Richard Bero earned his Bachelor of Business Administration in accounting and finance at the University of Wisconsin-Madison. He is a certified public accountant accredited in business valuation. As the head of The Bero Group, Bero has testified in over 150 matters, ranging from contracts to patents to construction. (Bero Tr. 495-99)

[3] As is noted throughout this Opinion, the Court found Dr. Tanbour's testimony to be credible and persuasive. The Court recognizes that he is a former employee of Plaintiffs. Nonetheless, given his credentials and overall experience, as well the especially detailed testing and analysis he conducted in this case, his former affiliation with one side of this case did not undermine the Court's confidence in him or his testimony.

B. Bradford White's Expert Witnesses

29. Dr. John P. Abraham earned his Ph. D. in mechanical engineering at the University of Minnesota in 2002. Later that year he joined the University of St. Thomas faculty as a professor, where he remains today. He is published in the field of thermal science and has consulted on the same with various companies. (Abraham Tr. 673-80)

30. Glenn Newman earned a Master of Business Administration in economics and finance from West Chester University in 1992. He has testified in approximately 150 matters regarding economic damage calculations, is published in the *Journal of Accountancy*, and is a certified public accountant and certified fraud examiner. (Newman Tr. 841-44)

C. Fact Witnesses

31. Kevin Field is a lab manager at A.O. Smith Corporate Technology Center, where he has worked for the past ten years. He is responsible for laboratory testing of A.O. Smith products, including set-up, installation, and equipment use. (Field Tr. 188-89)

32. Dr. Robert Heideman received his Ph. D. in materials engineering in 2015 from the University of Wisconsin-Madison. He is currently the Senior Vice President and Chief Technology Offer at A.O. Smith Corporation, where he is responsible for product engineering (including design and certification), technology development, and intellectual property protection. (Heideman Tr. 32-34)

33. Greg Reynolds is Vice President of Engineering for North American Water Heating at A.O. Smith Corporation and is responsible for the company's product development in commercial and residential water heating. In his work at A.O. Smith, he has overseen the development of A.O. Smith's BTL line of water heaters. (Reynolds Tr. 75-77)

34. John Matthew Schulz is the senior product manager for commercial products at A.O. Smith Corporation and is responsible for overseeing products, including the BTL water heater. (Schulz Tr. 434-35)

35. Herbert Edward Smith is a staff engineer at A.O. Smith Corporation, where he has worked since 1991. He is a named inventor on four patents, including the patent-in-suit. (Smith Tr. 109-11)

36. Christopher Stafford is a Bradford White engineer who led development of the Commander Series water heaters. (Stafford Tr. 134) He is a named inventor on U.S. Patent 9,429,337. (JTX-003 ("'337 Patent")) BW's Accused Products are embodiments of the claims of the '337 Patent. (SF ¶ 21)[4]

37. Bruce Hill is the Vice President of Engineering at Bradford White Corporation, where he leads the engineering department, specifically focusing on commercial water heaters. (Hill Tr. 582-83)

38. Paul Balon is the Senior Vice President of Corporate Administration at Bradford White Corporation and is responsible for general administration of the company, legal risk management, and intellectual property maintenance. (Balon Tr. 605)

IV. Person Of Ordinary Skill In The Art

39. The Court agrees with Dr. Tanbour that a person of ordinary skill in the art of the '897 Patent would have a degree in mechanical engineering or a related field, or a technical

[4] As already noted, Stafford did not testify live at trial. Instead, portions of his deposition transcript were made part of the record. AOS suggests the Court should find significance in Stafford's absence from trial. (*See, e.g.*, D.I. 212 at 17 n.11; D.I. 195 at 1 (noting Stafford was "interestingly unavailable at trial")) The Court is not persuaded there is any evidentiary value to the fact that BW did not bring Stafford to trial. On the merits, however, the Court is not persuaded by the doubts BW casts on the meaning of certain of Stafford's testimony (*see, e.g.*, D.I. 202 at 29-30) and finds, instead, that this testimony supports AOS.

degree, and five years of experience in the field of design, testing, and development of gas-fired appliances, such as gas water heaters; or an equivalent level of education, training, and experience. (Tanbour Tr. 237-40)

40. To qualify as a POSA, a person should have testing experience, because – given the "highly regulated" nature of the water heater industry – testing is fundamental to design and development in this field. (Tanbour Tr. 238-39; *see also* Reynolds Tr. 87-93) That is, a POSA here would "absolutely" have testing experience, which is part of the "development process of gas-fired water heaters, and all appliances." (Tanbour Tr. 237-38; *see also* Reynolds Tr. 87-93)

41. A "manager of product development-engineering in the field of gas water heaters in 2005 and 2006" would not have assigned "design testing and development of a gas water heater to an engineer or technician having no experience in the field of gas-fired appliances." (Tanbour Tr. 238-39) Because the industry is highly regulated and "involves a lot of understanding of the entire construction," "testing, certification and safety issues" must all be appreciated in order to have "a global understanding of the entire system of water heaters." (*Id.*)

42. Dr. Tanbour was a person having at least ordinary skill in the art at the time of the invention of the '897 Patent. (Tanbour Tr. 223-26, 236-37)

43. A POSA would also have been familiar with the 2006 National Fuel Gas Code ("NFGC") at the time of invention. (Abraham Tr. 799; *see also* PTX-091)

44. Prior to this case, and unlike Dr. Tanbour, Dr. Abraham had "never been involved in the testing of a gas water heater," "never been involved in the regulatory testing of water heaters," "never designed [n]or developed a gas water heater," and "never worked in the field of gas water heaters." (*Id.*)

45. Nor, prior to this case, had Dr. Abraham read the 2006 NFGC. (*Id.*)

46. Dr. Tanbour, Mr. Reynolds and Mr. Stafford each have experience consistent with Dr. Tanbour's proposed level of ordinary skill in the art. In particular, each has been involved in the testing of a gas water heater; each has been involved in the regulatory testing of water heaters; each has designed or developed a gas water heater; and each has worked in the field of gas water heaters. (*See* Tanbour Tr. 237; Reynolds Tr. 75-77, 80, 85-87; Stafford Tr. 134-39, 143-45; Stafford Dep. Tr. 74-76, 103-04; *see also* Hill Tr. 596-98 (agreeing that Stafford is a POSA))

47. Each of Dr. Tanbour, Mr. Reynolds, and Mr. Stafford were familiar with regulatory codes, including the NFGC, in testing and designing commercial water heaters before this litigation commenced. (Tanbour Tr. 238-40; Reynolds Tr. 87-93; Stafford Tr. 159; Stafford Dep. Tr. 100-01)

48. Each party's expert testified that their opinions presented would not change if the other party's understanding of the level of ordinary skill in the art were adopted. (Tanbour Tr. 240; Abraham Tr. 691)

V. The Water Heater Market And Regulatory Background

49. Bradford White and A.O. Smith Corporation are competitors in the market for water heaters. (SF ¶ 13)

50. Particular markets, such as certain counties in California and other regions of the United States, have adopted standards for levels of NOx emissions from water heaters. For example, the South Coast Air Quality Management District ("SCAQMD") is an air pollution control agency for southern California counties and regulates NOx emissions. As of January 1, 2012, SCAQMD lowered the permitted NOx emissions and required new Category I gas water heaters to have NOx emissions to be less than 14 ng/J (i.e., nanograms per joule). (SF ¶ 15)

51. The four primary manufacturers of ultra low NOx ("ULN") water heaters sold in the United States, and primarily in California, are (a) A.O. Smith, (b) Bradford White, (c) Rheem, and (d) American Standard. (SF ¶ 41)

52. For the period up through May 2019, the majority of the Accused Products have been sold in California. (SF ¶ 20)

53. The NFGC and the ANSI Z21.10.3 standard provide guidance regarding installation and certification of gas-fired appliances, such as commercial gas water heaters, to ensure that they operate safely, without spillage of combustion products into the building or space around where the water heater is installed. (Reynolds Tr. 85-86)

54. The NFGC is used to determine "whether a water heater is compliant with Category I venting." (Reynolds Tr. 86; *see generally* PTX-091)

55. The ANSI Z21.10.3 standard is also used to determine Category I compliance and confirm that the product itself is operating safely. (Reynolds Tr. 85-86; *see generally* DTX-096b)

56. Both the NFGC and ANSI Z21.10.3 are used to "design . . . test and certify" gas water heaters. (Reynolds Tr. 87-90) ("[T]here is a whole host of tests that we have to perform to make sure that the product is doing what it needs to do.")

57. The 2006 NFGC defines a Category I vented appliance as "an appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent." (SF ¶ 35)

58. The 2006 NFGC defines a Category II vented appliance as "an appliance that operates with a nonpositive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent." (SF ¶ 36)

59. The 2006 NFGC defines a Category III vented appliance as "an appliance that operates with a positive vent static pressure and with a vent gas temperature that avoids excessive condensate production in the vent." (SF ¶ 37)

60. The 2006 NFGC defines a Category IV vented appliance as "an appliance that operates with a positive vent static pressure and with a vent gas temperature that may cause excessive condensate production in the vent." (SF ¶ 38)

61. "Category I [venting] . . . is the most popular venting system existing. And it's the least complex and the least expensive venting system. So in the replacement market and legacy installation, Category I is still the most competitive and the most wanted." (Tanbour Tr. 235-36) The benefits of Category I are different from Category III and Category IV because with Category I one does not need to "seal the vent system;" nor is there any "condensation" with Category I. (*Id.*)

62. In conducting tests based on the NFGC and ANSI Z21.10.3, including to determine categorization, the "concept of velocity of the products of combustion" is not a consideration. (Reynolds Tr. 87-88; *see also* Tanbour Tr. 246, 295)

63. In conducting tests based on the NFGC and ANSI Z21.10.3, measurements are taken at several locations. (Reynolds Tr. 88-89)

64. One location where pressure measurements are taken in such tests to determine categorization is in the "vent system." (Reynolds Tr. 88)

65. The measurement in the vent system is taken "outside the water heater" itself. (*Id.*)

66. "Pressure measurements" are the "primary determination for making sure that [a] water heater is safe and not causing spillage into the room," which makes it "important to take

the measurement at the top of the water heater," a primary location where spillage would be expected to occur. (Reynolds Tr. 89-90; *see also* Tanbour Tr. 243 (explaining why pressure should be taken at "exit to the plenum"); *id.* at 286, 307, 338 (addressing spillage))

67. According to ANSI Z21.10.3, "spillage" is "any sort of products of combustion that go around the outside of the draft hood and may come into the environment around the water heater itself." (Reynolds Tr. 89)

68. Spillage also includes "leakage though the connections between the pieces of a vent system if you were to have positive pressure in the vent system." (Reynolds Tr. 89-90; *see also* Tanbour Tr. 286, 307, 338; DTX-096b at § 5.4.5)

69. Spillage of the products of combustion means that carbon monoxide and NOx compounds are spilling into the environment around the water heater, creating a "safety situation" which can lead to "carbon monoxide poisoning" – making the "design and safety of commercial water heaters a significant concern for any manufacturer." (Reynolds Tr. 93-94; *see also* Tanbour Tr. 286, 307, 338)

70. Spillage can occur if the products of combustion "are under the influence of the power burner as they exit the plenum" – that is, "if there is positive pressure coming out of the top of the unit." (Reynolds Tr. 90; *see also* Smith Tr. 114)

71. Under the ANSI Z21.10 standard, and to determine whether there is positive pressure, there is a tolerance measurement of 0.005 inches of water column. (Reynolds Tr. 91; DTX-096b at 4 (noting that "a differential pressure gage that can be read directly to 0.005 inch water column (1.24 Pa) pressure shall be attached to the piezo ring to measure static pressure"))

72. If the pressure of the products of combustion is 0.005 inches of water column or lower then, "at least according to the standard," a POSA "wouldn't be able to discern that there was positive pressure in the vent system." (Reynolds Tr. 91)

73. Spillage can be avoided by designing the water heater to transition the "positive pressure [of the products of combustion] from the power burner to negative [pressure] before it is exhausted out of the unit." (Reynolds Tr. 90; *see also* Smith Tr. 122-23 (describing design of BTL water heater in relation to natural convection))

VI. A.O. Smith's Water Heater Product

74. The transition of positive pressure emerging from the power burner to negative pressure before the products of combustion are exhausted out of the unit is practiced by AOS's BTL units, which are commercial embodiments of the '897 Patent. (Reynolds Tr. 79-80, 90; Smith Tr. 122-23; Tanbour Tr. 297)

75. In the BTL units, the "purpose of the plenum" – which is the "area inside the water heater where th[e] transition happens from positive to negative" pressure – is to transition or reduce the pressure. (Reynolds Tr. 90; Smith Tr. 114, 122-23; Tanbour Tr. 234-35, 344-45)

76. The BTL units' design manages the "safe rise of the products of combustion out of the water heater" by "taking the positive pressure from the power burner at the bottom of the unit," allowing the flues to then absorb the energy, and then having the products of combustion go into the plenum – where the pressure transitions from positive to negative – leading to the result that "the products of combustion will exit out of the unit itself and into the vent system." (Reynolds Tr. 91-92; *see also* Smith Tr. 122-23; Tanbour Tr. 243, 363; D.I. 187 (Notice of Proposed Corrections) at 1 (correcting Reynolds' testimony))

77. The products of combustion rise out of the unit under the influence of "natural buoyancy," creating "negative pressure that has the products of combustion rise through the vent

system and out of the building." (Reynolds Tr. 92; *see also* Smith Tr. 114, 122-23; Tanbour Tr. 234-35)

78. At the point at which the "products of combustion exit out of the unit itself," those products of combustion are no longer "under the influence of the power burner." (Reynolds Tr. 92-93; *see also* Smith Tr. 114-16, 122-23 (stating that products of combustion are decoupled in plenum and are no longer "influenced by the [power] burner and start relying on natural convection to actually pull the gases out of the plenum and up into the vent"); Tanbour Tr. 316-17)

VII. Bradford White's Water Heater Product

79. On November 27, 2013, Bradford White applied for a patent entitled "Water Heater Having A Down Fired Combustion Assembly," which covers the Accused Products. That application issued as the '337 Patent on August 30, 2016. (SF ¶ 16)

80. Christopher P. Stafford is an inventor of the '337 Patent. (SF ¶ 17)

81. The Accused Products practice the invention of the '337 Patent. (SF ¶ 21)

82. The Accused Products are Category I compliant. (SF ¶ 22)

83. The Accused Products vent atmospherically. (SF ¶ 23)

84. The Accused Products operate with a non-positive vent static pressure as determined in accordance with testing for Category I compliance. (SF ¶ 24)

85. Bradford White's specification sheets for the Accused Products claim "Up to 82% Thermal Efficiency" and "Ultra Low NOx Construction (14 ng/J NOx emissions) – Natural gas models only." (SF ¶ 25)

86. The Accused Products include a down-fired power burner comprising a burner and a blower, which at least initially directs products of combustion under positive pressure

when they leave the power burner into a single first-pass flue tube. The products of combustion then pass through an expansion chamber and through multiple second-pass flue tubes. (SF ¶ 26)

87. In normal operation, the Accused Products perform the following sequence of operation:

SEQUENCE OF OPERATION

1. Thermostat starts with heating cycle
2. Blower ON
3. Blower pre-purge
4. Spark rod sparks to the burner and gas valve opens – burner ignition
5. Main burner ON
6. Flame signal confirmed
7. Thermostat satisfied
8. Gas valve closes - Main burner OFF
9. Blower post-purge

(SF ¶ 27) (excerpting PTX-030 at 26)

88. The Accused Products are water heaters having a burner, a blower, and a flue. (SF ¶ 28)

89. The Accused Products create products of combustion with the burner. (SF ¶ 29)

90. The Accused Products force the products of combustion into the flue under positive pressure with the blower. (SF ¶ 30)

91. The Accused Products include an exhaust plenum within the water heater, between the flue and a draft hood. (SF ¶ 31)

92. The Accused Products, at least after installation to a natural convection vent construction, include an exhaust plenum between the flue and the natural convection vent construction. (SF ¶ 32)

93. The products of combustion have a negative static pressure within the outlet of the plenum of the Accused Products. (SF ¶ 33)

94. In the draft hood associated with the Accused Products, ambient air is mixed with the products of combustion. (SF ¶ 34)

VIII. Other Competing Products

95. Based on the record presented to the Court, Rheem's GNU water heaters appear to be commercial embodiments of the '897 Patent. (*E.g.*, Tanbour Tr. 297)

96. The GNU water heaters are sold and shipped with a draft hood and are Category I compliant. (Tanbour Tr. 251; PTX-125 at 1; PTX-126 at 5; PTX-128)

97. The GNU water heaters perform a method of interfacing a natural convection vent construction with a water heater, practicing each of the steps recited in claim 1 of the '897 Patent. (Tanbour Tr. 249-52, 263-64, 297 (analyzing design and functionality of GNU water heaters); PTX-122; PTX-125; PTX-126; PTX-128)

98. Based on the record presented to the Court, American Standard's ULN water heaters appear to be commercial embodiments of the '897 Patent. (Tanbour Tr. 297)

99. The ULN water heaters all share the same general design and functionality. (*See generally* PTX-123 (ULN manual); PTX-124 (ULN specifications))

100. The ULN water heaters are sold and shipped with a draft hood and are Category I compliant. (Tanbour Tr. 251; PTX-123 at 11; PTX-127 at 15 (photo of ULN water heater showing labelling as Category I compliant))

101. The ULN water heaters perform a method of interfacing a natural convection vent construction with a water heater, practicing each of the steps recited in claim 1 of the '897 Patent. (Tanbour Tr. 249-52, 261-63, 297 (analyzing design and functionality of ULN water heaters); *see generally* PTX-121 (ULN test data); PTX-123 (ULN manual); PTX-124 (ULN specifications); PTX-127 (photographs of ULN unit))

IX. Additional Facts Relating To Infringement

A. Testing

102. Plaintiffs' expert, Dr. Tanbour, inspected, tested, and witnessed operation of two of Defendants' Accused Products; specifically, the Commander Series UCG 100H1993N and UCG 80H1253N models. (Tanbour Tr. 246-48; *see generally* PTX-148 (photographs from inspection and testing); PTX-149 (same))

103. Dr. Tanbour also inspected and tested a Rheem GNU water heater: the GNU100-200 model. (Tanbour Tr. 249; *see generally* PTX-128 (photographs from inspection and testing))

104. Dr. Tanbour inspected and tested an American Standard ULN water heater as well: the ULN-100-199 model. (Tanbour Tr. 249; *see generally* PTX-127 (photographs from inspection and testing))

105. In conducting his tests, in order to measure pressure Dr. Tanbour "used a regular pressure tap, which is a 1/8-inch standard steel tube which is common and standard in the industry." (Tanbour Tr. 254; *see also* Field Tr. 193-95, 197)

106. The pressure taps Dr. Tanbour used in his tests "extended outside the water heater and connected through a flexible tube as to a pressure transducer which [was] mounted on the measurement [cart];" they were read by data acquisition hardware made by National Instrument Company. (Tanbour Tr. 254; *see also* Field Tr. 194-95, 197)

107. A "thermocouple," also made by National Instrument Company, was "wired from the location of the measurement to [the] data acquisition hardware." (Tanbour Tr. 254; *see also* Field Tr. 194-95, 197)

108. All the measurements were sent through the data acquisition hardware into LabVIEW, which is also made by National Instrument Company. (Tanbour Tr. 254-55; *see also* Field Tr. 194-95, 197)

109. The data acquisition software processes and conditions the testing data and then "send[s] them to spreadsheets," which allowed Dr. Tanbour to see and study the data in Excel spreadsheets. (Tanbour Tr. 255; *see also* Field Tr. 194)

110. In terms of testing procedures, all of the units being tested were: (a) "set-up according to the manufacturer's requirements and exactly as they are intended to be installed in the field;" (b) "set-up consistently in [a] similar way," including having water, natural gas, and venting "supplied to them in the same fashion" for all models; and (c) connected to electricity. (Tanbour Tr. 253; *see also* Field Tr. 191-92)

111. Dr. Tanbour's tests included "measuring combustion product pressure and combustion product temperature, the pressure of the supplied natural gas into each unit, as well as the ambient temperature." (Tanbour Tr. 253)

112. On each of the five models tested – UCG 100H1993N, UCG 80H1253N, BTL200, GNU 100-200, ULN-100-199 – pressure measurements were taken at three locations: location 1 [referred to as P1], location 2 [P2], and location 3 [P3]. (Tanbour Tr. 253)

113. Dr. Tanbour's P1 pressure probe was positioned "below the entrance of the flue tube" of each tested unit. (Tanbour Tr. 253-54, 428-31; *see also* Field Tr. 191-92, 194-95, 199)

114. Dr. Tanbour measured static pressure at the P1 location in each unit tested. (Tanbour Tr. 277-78; Abraham Tr. 685-86)

115. Dr. Tanbour's P2 pressure probe was located in each tested unit "at the entrance to the plenum, when the combustion products are just being introduced to the plenum." (Tanbour Tr. 254; *see also* Field Tr. 195, 199)

116. More specifically, Dr. Tanbour's P2 measurements were taken "at the plane . . . that is representing the bottom of the plenum and at the very entrance to the plenum." (Tanbour Tr. 273-74, 361-62; *see also* Field Tr. 195, 199)

117. Dr. Tanbour's P2 probes were "positioned . . . at the wall, pointing downward, at the inner wall of the flue tubes as the combustion products are entering the plenum." (Tanbour Tr. 273-74, 429-30, 432; *see also* Field Tr. 195, 200; PTX-085 (top view of flue tubes); PTX-127 at 23 (same))

118. At the wall of the flue, the "velocity diminishes so the measure of the [total] pressure is the same as the static pressure," because "the total pressure" is "the summation of the static pressure and the dynamic pressure" and "the dynamic pressure diminishes when velocity diminishes." (Tanbour Tr. 275-76; *see also* Field Tr. 195-96, 200, 203)

119. "Velocity didn't materially affect" Dr. Tanbour's P2 measurements. (Tanbour Tr. 276-77; *see also* PTX-148 at 34 (showing flue walls); PTX-149 at 30 (same))

120. Dr. Tanbour's P3 pressure probe was located "right outside whe[re] the combustion products are leaving the plenum" of each tested unit. (Tanbour Tr. 254; *see also* Field Tr. 193, 195, 199)

121. Dr. Tanbour's P3 probes were positioned "one to two inches just outside the plenum, [at the point] when the combustion products are leaving the plenum." (Tanbour Tr. 272; *see also* Field Tr. 193, 195, 199; PTX-084; PTX-127 at 22)

122. Dr. Tanbour measured static pressure at the P3 location in each unit tested. (Tanbour Tr. 272-73; *see also* Field Tr. 193-95, 201)

123. Defendant's expert, Dr. Abraham, used a pitot-static tube to measure both pressure and velocity within the Accused Products. (Abraham Tr. 718-19)

124. Dr. Abraham supported his use of pitot-static tube measurements by also using a separate and independent instrument, a hot wire anemometer, to confirm that his velocity measurements were accurate. (Abraham Tr. 720)

125. Dr. Tanbour opined that there is a "general flow" direction within the Accused Products. (Tanbour Tr. 273, 277-78)

126. Dr. Tanbour further opined that "the velocity cannot be used to judge the influence of the blower because the velocity can also be a product of both natural convection and anything else." (Tanbour Tr. 246)

127. Dr. Tanbour "didn't need to" isolate the power burner influence from the influence of natural convection to reach his conclusion on infringement. (Tanbour Tr. 408-09) This is because influence is measured by pressure, which accounts for whether or not influence is due to the power burner (positive pressure) or due to natural convection (negative pressure). (Tanbour Tr. 313-15)

128. Dr. Tanbour did not measure velocity in the Accused Products. (Tanbour Tr. 245-46, 363)

B. Infringement

1. "Dropping" Limitation

129. In the Accused Products, the static pressure of the products of combustion at the entrance of the plenum (P2) is "always satisfactorily positive." (Tanbour Tr. 291; *see also id.* at 242, 274-75, 294-95, 326-27; Stafford Dep. Tr. at 115; JTX-003 at 4:13-15)

130. During A.O. Smith's in-house testing of the UCG 100 Accused Product, the total pressure of the products of combustion (measured away from the wall of the flue tube) at the entrance of the plenum was approximately +0.08 inches of water column. (Field Tr. 190, 193-95; DTX-059 at 5; *see also* PTX-043 at 5)

131. During Dr. Tanbour's testing of the UCG 100 Accused Product, the static pressure of the products of combustion at the entrance of the plenum (P2) averaged +0.048 inches of water column. (Tanbour Tr. 273-77, 291-92; *see also* Field Tr. 194-97, 203; Tanbour Tr. 257; D.I. 187 at 1 (Tanbour numbers corrections)) The lowest value recorded for P2 was +0.03 while the highest value was +0.06 inches of water column. (Tanbour Tr. 292)

132. During Dr. Tanbour's testing of the UCG 80 Accused Product, the static pressure of the products of combustion at the entrance of the plenum (P2) averaged +0.025 inches of water column. (Tanbour Tr. 273-77, 292; *see also* Field Tr. 194-97, 203; Tanbour Tr. 258; D.I. 187 at 1 (Tanbour numbers corrections)) The lowest value recorded for P2 was +0.01 while the highest value was +0.05 inches of water column. (Tanbour Tr. 292; *see also id.* at 258)

133. Dr. Abraham does not disagree that the products of combustion have a positive static pressure at the entrance of the plenum (P2) of the Accused Products. Dr. Abraham did not opine that the pressure at P2 would be nonpositive. (Abraham Tr. 823)

134. BW's Mr. Stafford agrees that the products of combustion are under positive pressure when they enter the plenum of the Accused Products and do not drop to negative or nonpositive pressure before that point. (Stafford Dep. Tr. at 115, 123-26; *see also* Tanbour Tr. 294)

135. The pressure of the products of combustion at the entrance of the plenum (P2) of the Accused Products is "well above the margin of error allowed by CSA" testing and is a

pressure that would not be compatible with the use of a Category I venting system. (Tanbour Tr. 292-93; *see also* Reynolds Tr. 91; PTX-031 at 3; DTX-096B at 4)

136. From the perspective of a POSA, in the Accused Products the products of combustion are "still under the influence of the power burner" as they enter the plenum. (Tanbour Tr. 293; *see also id.* at 276-77, 292-94; Stafford Dep. Tr. at 115, 131; Smith Tr. 114; JTX-003 at 4:13-15)

137. In the Accused Products, the static pressure of the products of combustion leaving the plenum (P3) is "consistently negative." (Tanbour Tr. 242, 273, 291, 294-95, 326-27; Abraham Tr. 811; *see also* Field Tr. 190, 193-94; DTX-059 at 5; SF ¶¶ 33, 39)

138. During Dr. Tanbour's testing of the UCG 100 Accused Product, the static pressure of the products of combustion leaving the plenum (P3) averaged -0.0146 inches of water column. (Tanbour Tr. 272-73, 294; *see also id.* at 257; Field Tr. 193-96) The lowest value recorded for P3 was -0.021 while the highest value was -0.009 inches of water column. (Tanbour Tr. 294)

139. During Dr. Tanbour's testing of the UCG 80 Accused Product, the static pressure of the products of combustion leaving the plenum (P3) averaged -0.01125 inches of water column. (Tanbour Tr. 272-73, 294; *see also id.* at 258; Field Tr. 193-96) The lowest value recorded for P3 was -0.021 while the highest value was -0.001 inches of water column. (Tanbour Tr. 294)

140. Dr. Abraham agrees that, in the Accused Products, the static pressure of the products of combustion is negative when they leave the plenum. He measured negative static pressure in the plenum and plenum outlet where products of combustion were being exhausted (Abraham Tr. 811; *see also* Tanbour Tr. 326-27)

141. The pressure of the products of combustion leaving the plenum (P3) of the Accused Products is "at the level that can be permitted to be vented according to natural convection," allowing compliance with "Category I venting" requirements. (Tanbour Tr. 295; *see also id.* at 294-97, 316-17, 326-27; Reynolds Tr. 91-92; Smith Tr. 114-16; Stafford Dep. Tr. at 131; PTX-029 at 5; SF ¶¶ 21-24, 33; JTX-003 at 4:25-31, 7:11-14)

142. The pressure drop within the plenum of the Accused Products can be determined by comparing the pressure measured at the entrance to the plenum and the pressure measured at the exit of the plenum, which were measured by Dr. Tanbour's probes at P2 and P3, respectively. (Tanbour Tr. 242-43)

143. The positive static pressure of the products of combustion entering the plenum (P2) and the negative static pressure of the products of combustion leaving the plenum (P3) of the Accused Products demonstrate that the pressure of the products of combustion is dropping within the plenum to a pressure sufficient to allow them to rise out of the plenum substantially entirely under the influence of natural convection. (Tanbour Tr. 242-43, 273-75, 291, 295-97, 316-17, 326-27; *see also* Smith Tr. 115-16; Abraham Tr. 811, 824)

144. In the plenum of the Accused Products, the flow of the products of combustion slows down and the pressure converts from positive to near atmospheric to negative, which means that natural convection has taken over by the time the combustion products leave the plenum. (Tanbour Tr. 234-35, 291, 295-97, 307-10, 316-17, 326-27, 425; Stafford Dep. Tr. at 119-20, 127, 129-31; Reynolds Tr. 91-92; Smith Tr. 114-16; Abraham Tr. 811, 824)

145. The Accused Products perform the "dropping" step recited in claim 1. (Tanbour Tr. 242, 291, 326-27; Abraham Tr. 692, 824)

2. "Permitting" Limitation

146. BW's Stafford agrees that if the pressure of the products of combustion is negative by the time those products leave the plenum of the Accused Products, those products of combustion are no longer under the influence of the power burner. (Stafford Dep. Tr. at 129-31; Tanbour Tr. 297)

147. From the perspective of a POSA, in the Accused Products the products of combustion are "no longer under the influence of the power burner" as those products of combustion leave the plenum. (Tanbour Tr. 296-97, 316-17, 326-27; *see also* Stafford Dep. Tr. 131; Reynolds Tr. 92; Smith Tr. 114)

148. From the perspective of a POSA, if the products of combustion were "still under the influence" of the power burner as they leave the plenum of the Accused Products, there would be positive pressure in the vent system and, therefore, potential for "spillage in and around the draft hood" and "leakage in [the] vents." (Smith Tr. 114; *see also* Reynolds Tr. 89-90, 93-94; Tanbour Tr. 296-97, 316-17)

149. From the perspective of a POSA, if the products of combustion were "still under the influence" of the power burner as they leave the plenum of the Accused Products, the Accused Products could not be certified as Category I compliant and, consequently, a Category I venting system could not be used. (Tanbour Tr. 296-97, 316-17; *see also* Reynolds Tr. 90-93; Smith Tr. 114)

150. To a POSA considering the Accused Products, the negative static pressure of the products of combustion leaving the plenum (P3) and Category I certification demonstrate that the products of combustion rise out of the plenum and into the draft hood (and vent system) at a pressure near or below atmospheric pressure and without the influence of the power burner, such that a Category I venting system can be used. (Smith Tr. 115-16; Tanbour Tr. 242-43, 257-58,

273-75, 291, 294-97, 316-17, 326-27; Stafford Tr. 157-59; Stafford Dep. Tr. at 131; Abraham Tr. 811, 824; JTX-003 at 4:25-31, 7:11-14; SF ¶¶ 21-24; PTX-141 at 5; PTX-031 at 1, 3)

151. The Accused Products perform the "permitting" step recited in claim 1. (Tanbour Tr. 296-97, 326-27)

C. Direct Infringement By Bradford White

152. Certain of the Accused Products have been tested by Bradford White. (SF ¶ 18)

153. The Accused Products are delivered to customers with a draft hood. (SF ¶ 19)

154. Before production, the Accused Products were subject to "life cycle testing," with the units made operational, hooked up to gas and water, and with the draft hood and an atmospheric vent pipe installed. (Stafford Dep. Tr. at 93-96, 108-09)

155. When life cycle testing is conducted, the units are run "7 days a week, 24 hours a day." (Stafford Dep. Tr. at 94)

156. Before production, the Accused Products were subject to "environmental testing." (Stafford Dep. Tr. at 95-96, 109)

157. Environmental testing involves placing the units in rooms that were hot, cold, dusty, and dirty. (Stafford Dep. Tr. at 96) (explaining that such testing subjects unit to "anything we can . . . throw[] at it")

158. The Accused Products are further subjected to Ultra Low NOx certification testing, which is initially conducted by BW's "inhouse testing" team; then the units are tested by a third party, which involves the unit being shipped for "off-site testing." (Stafford Dep. Tr. at 109)

159. The Accused Products are further subjected to pilot runs and related testing. (PTX-021 at 4; Stafford Dep. Tr. at 107)

160. The warranty for the Accused Products is "only valid" if the products are "installed, maintained and operated in accordance with the instructions" in BW's installation manual. (Stafford Dep. Tr. at 139)

161. According to Mr. Stafford, samples of the Accused Products "might be tested every six or nine months." (Stafford Dep. Tr. at 86-87)

162. Bradford White does not sell products directly to consumers. (Balon Tr. 606)

163. BW primarily sells to wholesale distributors, who then sell to professional installers, who are responsible for installing the Accused Products. (*Id.*)

164. BW trains installers at a "training center" (Stafford Dep. Tr. at 133-34), thus ensuring that installers of BW's Accused Products "operate [a] unit to make sure it's working" before installation is complete. (*Id.* at 139-40 (Stafford confirming that installers verify installation using process where they "flip the power switch on and see if it ignites [and] heats water"); *see also, e.g.*, PTX-091 at 88 § 12.7.1 (2006 NFGC requiring appliances to be connected "in accordance with the manufacturer's installation instructions"))

D. Indirect Infringement: Inducement

165. BW learned of the '897 Patent on September 20, 2017, when Bruce Hill received a letter from Dr. Heideman. (Balon Tr. 606-07; Hill Tr. 645-46; PTX-230 (Notice Letter))

166. BW advertises the Accused Products, particularly targeting the California market, and in doing so it highlights benefits of its products. For example, a Commander Series brochure touts that the product "meets California Ultra Low NOx Requirements," has the "Smallest footprint of all Ultra Low NOx Commercial gas models in its class (28.25 inch width)," and includes "EcoFriendly" badging. (PTX-029; *see also* PTX-143; PTX-138; PTX 144; PTX-145; PTX-037; PTX-028)

167. BW markets the Commander Series water heaters as a "replacement to traditional atmospherically vented commercial water heaters." (PTX-037 at 1)

168. According to BW's marketing literature, the Commander Series features a "downfired premix power burner" and "achieves excellent thermal efficiencies and meets the most stringent air quality standards for allowable NOx emissions." (PTX-029 at 4)

169. BW's specification sheets claim "Up to 82% Thermal Efficiency" and "Ultra Low NOx Construction (14 ng/J NOx emissions) – Natural gas models only." (PTX-037 at 3)

170. The Accused Products are delivered to customers "fully assembled," and then an installer (typically a plumber) will "connect the gas lines . . . water lines, vent and electricity." (Stafford Dep. Tr. at 139-40) End-user customers then use the units after installation. (*Id.* at 139)

171. All of the Accused Products are "installed according to the manufacturer['s] instruction, . . . the way they are expected and intended to operate and installed in the field." (Tanbour Tr. 285-86)

E. Facts Relating To Willfulness

172. On September 5, 2013, Mr. Stafford, Bradford White's Principal Design Engineer, received a Project Definition Request, which expressly referenced BW's competitor products that were already on the market. (PTX-021 at 1)

173. Specifically, the Project Definition Request stated: (a) "PRODUCT TO COMPETE AGAINST: American Standard, AO Smith and Rheem" and (b) "PERFORMANCE: 82% Thermal Efficiency and NOx emissions equal to, or below, SCAQMD." (*Id.* at 1-2)

174. By October 2013, the BW design was already sufficiently developed that BW was able to issue a "tooling release," to enable mass production of the Accused Products. (PTX-021 at 4) In other words, the product was developed and manufactured within about one month.

175. BW launched the Accused Products in January 2014, just four months after Stafford had received the Project Definition Request. (Stafford Tr. 151)

176. According to Stafford, the Accused Products were developed by making modifications to one of BW's existing products, the EF Series water heaters, which had also featured a down fired power burner. (Stafford Dep. Tr. at 112-14, 141-42)

177. In particular, the Accused Products were "based off the EF series," which had a three-pass flue system. Stafford "removed the middle pass" flue tubes, resulting in the Accused Products' two-pass flue system. Removing the middle pass flue tubes lowered the amount of heat exchange, transforming the product "from condensing to noncondensing." Stafford then adjusted the amount of baffling to achieve the required pressure of combustion products. (*Id.* at 113)

178. Redesigning the existing EF series product allowed Bradford White to use some of the same tooling for the Accused Products that it already had available from the EF Series. (*Id.* at 113, 142)

179. At least as early as August 7, 2018, after BW had learned of the '897 Patent in September 2017, BW performed testing on the Accused Products, which caused BW to conclude that its power burner influenced flow as the products of combustion exited the Accused Products. As part of its testing, BW determined that the power burner of the Accused Products created flow even when the burner portion was off, thereby demonstrating (in Bradford White's view) that the Accused Products do not operate "without the influence of the power burner." (PTX-035 at 9-10)

180. BW relied on this testing as purportedly confirming its position regarding non-infringement. (Hill Tr. 598-601)

181. BW's Mr. Hill is an electrical engineer, "not an attorney," and has received no "legal training." (*Id.* at 602, 622)

182. Stafford testified that it was BW's "standard procedure" to perform some "due diligence" in the course of developing new products. (Stafford Tr. 174-75)

183. Stafford also testified he had no reason to believe a patent search was not performed as part of BW's due diligence, adding that he would only have been notified of the results of such searches if something relevant had been found. (*Id.* at 175)

184. BW's view was that the '897 Patent is focused on "a completely different area" than BW's '337 Patent. (Hill Tr. 652)

185. The '337 Patent is directed to the design of an expansion chamber on the bottom of the water heater, to create a multi-pass heat exchanger with multiple flue tubes. (Hill Tr. 652-53; JTX-003 at 8:24-42)

186. Since learning of the '897 Patent, BW has made no changes to the design or operation of the Accused Products based on the '897 Patent. (SF ¶ 55)

X. Facts Relating To Damages

187. Both AOS and BW sell products in domestic and international markets. (Schulz Tr. 457; Bero Tr. 529-38)

188. In the domestic ULN market, BW has the largest market share, holding 35-40% of the market; AOS's market share is around 30%. (Bero Tr. 513)

189. The typical customer for ultra-low NOx water heaters of AOS and BW is the wholesaler. (Schulz Tr. 462-63; Balon Tr. 606)

190. The Accused Products do not perform the claimed method of the '897 Patent prior to installation and operation (other than if they are being tested). (Bero Tr. 558)

191. BW's U-Series water heaters are not an acceptable alternative to commercial embodiments of the '897 Patent, as evidenced by the fact that the U-Series was a product failure. (Stafford Dep. Tr. at 98-99; PTX-021)

192. High-Efficiency water heaters are not an acceptable alternative to commercial embodiments of the '897 Patent because, although they are "capable of meeting the ultra-low NOx" standard, these "products sell at a higher price," in part because they require "new venting." (Bero Tr. 508; *see also* Reynolds Tr. 82) These higher efficiency water heaters are unacceptable alternatives for the further related reason that they require "the Category IV closed CPVC or PVC Category IV venting, and there's costs associate[d] with" such venting. (Bero Tr. 522-23)

193. Tankless heaters are not an acceptable alternative to commercial embodiments of the '897 Patent because of all of the additional work and expense required for retrofitting. (Reynolds Tr. 82-83 ("[Y]ou also have to change the vent system for tankless water heaters . . . [and] the gas connections, the water connections, so they're even more involved in the change . . . ."); Schulz Tr. 445-46)

194. BW's damages expert, Mr. Newman, relied on a proposed design-around, specifically a modification of the Accused Products to incorporate a flapper valve. (*See* Bero Tr. 527-28) The flapper valve design-around is not an acceptable substitute because (a) there is no evidence of the flapper design being "available" on the ULN market; (b) there is no evidence of the flapper design being acceptable to customers; and (c) there is no evidence of "how much [the flapper design] would have cost" or how long it would have taken to design. (*Id.* at 528)

195. AOS incurred lost profits damages of approximately $ [redacted] in 2018 as a result of BW's induced infringement of the '897 Patent, based on BW selling [redacted] units of the

Accused Products that year. (PDX-004-19;[5] *see also* PTX-180 at 2, 4 (underlying data for PDX-004))

196. AOS incurred lost profits damages of approximately $[redacted] in 2019, through May of that year, as a result of BW's induced infringement of the '897 Patent, based on BW selling [redacted] units of the Accused Products in the first five months of that year. (PDX-004-19; PTX-180 at 2, 4)

197. Sales of AOS's products and BW's Accused Products have gone up "year after year," "creating a brand-new product line . . . for both companies," confirming strong demand for these products. (Bero Tr. at 508-09, 518)

198. BW failed to show that there are any acceptable alternative water heaters that would achieve "ultra low NOx by a power burner without having to replace the Category I vent system." (Reynolds Tr. 83)

199. AOS had manufacturing capacity to meet manufacturing, distribution, and marketing demands that would have arisen had BW not infringed the '897 Patent. (Bero Tr. 529-38; Schulz Tr. 457) "A.O. Smith is the largest North American water heater manufacturer." (Bero Tr. 531; *see also* Schulz Tr. 435, 456-57)

200. AOS makes "commercial gas water heaters . . . in McBee, South Carolina, and . . . in 2018, for example, they made almost 89,000 water heaters at that facility." (Bero Tr. 531; *see also* Schulz Tr. 456)

201. The "most" Accused Products "sold in any particular year was [redacted] in 2018, which would have required approximately a 4 percent increase in production" if AOS were to

[5] While PDX-004 is a demonstrative exhibit, pursuant to the Court's September 24, 2020 order (D.I. 198 at 2 n.2): "The Court and the parties may rely upon and make reference to [specified] portions of PDX-4," including PDX-004-019.

have satisfied that demand. (Bero Tr. 531; *see also* Schulz Tr. 457) Manufacturing an additional "[redacted] units would be within [AOS's] normal variations in production annually." (Bero Tr. 531-32; *see also* Schulz Tr. 457)

202. From January 2014 through May 2019, BW sold [redacted] units. (Bero Tr. 539; PTX-180 at 1-4)

203. From January 2014 through May 2019, the average incremental cost of A.O. Smith's water heaters was about $1,400 per unit. (Bero Tr. 540)

204. There is no evidence in the record (including from BW's damages expert, Newman) that controverts Bero's lost profits calculations. (Newman Tr. 878-81)

XI. Facts Relating To Invalidity

A. Prior Art

1. U.S. Patent No. 5,228,413 (Tam)

205. U.S. Patent No. 5,228,413 to Tam ("Tam"), which issued more than one year prior to the earliest filing date of the '897 Patent, is prior art to the '897 Patent under 35 U.S.C. § 102. (SF ¶ 42)

206. The '897 Patent issued from a continuation application. The Examiner had relied on Tam as a basis for rejection during examination of the '897 Patent's parent application. (SF ¶ 43)

207. Under MPEP 609.02, the "examiner of the continuing application will consider information which has been considered by the Office in the parent application" and "[a] listing of the information need not be resubmitted in the continuing application unless the applicant desires the information to be printed on the patent." (SF ¶ 44)

208. A.O. Smith Corporation did not submit an information disclosure statement identifying Tam during prosecution of the continuation application that issued as the '897 Patent. (SF ¶ 45)

209. Tam was not relied on by the Examiner as a basis for rejection during the examination of the continuation application that became the '897 Patent. (SF ¶ 46)

210. Tam does not appear on the face of the '897 Patent. (SF ¶ 47)

211. Tam discloses a water heater having a power burner, flue tubes, and a plenum, with a draft hood positioned on top of the water heater. (SF ¶ 48)

212. Draft hoods have been used on atmospherically vented water heaters. (SF ¶ 49)

213. Figure 2 of Tam discloses an embodiment of a water heater having a burner, a blower, and a flue. (SF ¶ 50)

214. Tam teaches that the embodiment in Figure 2 creates products of combustion with the burner. (SF ¶ 51)

215. Tam teaches that the embodiment in Figure 2 forces products of combustion into the flue under positive pressure with the blower. (SF ¶ 52)

216. Tam teaches that the embodiment in Figure 2 includes an exhaust plenum between the flue and a draft hood. (SF ¶ 53)

217. Tam does not expressly disclose the dropping limitation – i.e., dropping the pressure of the products of combustion to near atmospheric pressure within the plenum. (SF ¶ 54)

2. General Knowledge Of A POSA

218. The 1991 Assessment is a publication of the Gas Research Institute prepared at the request of the U.S. Department of Energy, and contains information relating to the setting of guidelines for energy efficiency improvements in gas-fired water heaters. (Hill Tr. 631) The

1991 Assessment is unclassified and, as such, was publicly available as of the time of its creation. (*Id.* at 631-32)

219. The NFGC Handbook provides guidance on the installation and venting of gas appliances to conform to the requirements of the NFGC. (Hill Tr. 627-28) Designers of gas appliances, such as water heaters, would be familiar with and have access to the NFGC Handbook. (*Id.* at 628)

B. Additional Facts Relating To Anticipation

220. Plaintiffs' expert, Dr. Tanbour, testified that there would be a drop in pressure of products of combustion as they transition from flue columns 30 into the plenum 34 of Tam. (Tanbour Tr. 419) In fact, according to Dr. Tanbour, it is specifically the role of the plenum to provide an "expansion area" to "allow these combustion products to drop their pressure." (Tanbour Tr. 234-35) Dr. Tanbour agreed that this pressure drop is also due to Tam's sharp-edged exit, which is "a well-known concept." (Tanbour Tr. 416-17; *see also* Abraham Tr. 771-73)

221. Dr. Tanbour added that the pressure of products of combustion in Tam would reach near atmospheric pressure by the time they leave the baffling to enter the plenum. (Tanbour Tr. 335, 337-38)

222. Consequently, the rise of combustion products out of the plenum of Tam will be at a pressure near or below atmospheric pressure. This is shown by Tam's use of a draft hood 60, as well as Tam's depiction of airflow into the draft hood. The airflow into the draft hood is induced by the pressure of Tam's products of combustion being near or below atmospheric pressure. (Abraham Tr. 774-76)

223. A Category I venting system can be used to vent the embodiment in Figure 2 of Tam. (Tanbour Tr. 337-38; Abraham Tr. 777)

224. Dr. Abraham admitted that in Tam the pressure of the products of combustion could be negative in the flue tubes, before even entering the plenum. (Abraham Tr. 826)

225. From the perspective of a POSA, if the pressure of the products of combustion is already negative by the time they leave the flue tubes, the pressure cannot thereafter (i.e., further downstream) drop to a level sufficient to allow them to rise out of the gas collector substantially entirely under the influence of natural convection because they have already dropped sufficiently to the point that they are permitted to be vented using Category I venting. (Tanbour Tr. 337-38)

C. Additional Facts Relating To Obviousness

226. A POSA would understand that it is important for a water heater to be able to vent according to Category I, because Category I venting is the most prevalent type of venting installation in the market, and the most desired. (Tanbour Tr. 235) Thus, a POSA would want to ensure that the water heater in Figure 2 of Tam satisfies Category I requirements. (Abraham Tr. 785)

227. Two factors are considered in determining whether a water heater complies with Category I: whether the water heater vents with positive or non-positive vent static pressure, and whether the water heater vents at a sufficiently high temperature to avoid forming condensation. (Hill Tr. 629; Abraham Tr. 681, 683; DTX-96B at 6; JTX-18 at 105; DTX-156 at 21) To satisfy Category I requirements, water heaters must vent with nonpositive pressure and without forming condensation (i.e., be non-condensing). (Tanbour Tr. 236; Hill Tr. 636-38; DTX-96B at 6; JTX 18 at 105; DTX-156 at 21)

228. A POSA would also want to ensure that the water heater in Figure 2 of Tam is non-condensing, for the additional reason it is desirable to avoid the possibility of corrosion in the vent, which can be caused by condensation. (Tanbour Tr. 236; Abraham Tr. 781-83)

229. At least in view of the 1991 Assessment and the NFGC Handbook, a POSA would understand that flue gas temperature affects whether a water heater is condensing, and whether a water heater satisfies Category I requirements. To ensure that a water heater is non-condensing, a POSA relying on the teachings of the 1991 Assessment and the NFGC Handbook would want to increase flue gas temperatures, i.e., make sure that combustion products are hot enough in the draft hood and vent to avoid condensation. (Hill Tr. 629, 638; Abraham Tr. 782, 785; DTX-96B at 6; DTX-156 at 21)

230. A POSA would know that flue gas temperatures in the water heater of Tam could be increased by using less restrictive baffles, something a POSA might consider. (Abraham Tr. 785-86)

231. However, in 2006, the prevailing common knowledge regarding "control" of the pressure of products of combustion for Category I venting purposes was to "overbaffle[]" – that is, make the baffling more restrictive. (Tanbour Tr. 343; *see also id.* at 335-37 (stating it was "common practice" to establish negative pressure before products of combustion leave baffling in flue tubes))

232. The "dropping" limitation was not common knowledge at the time of the invention of the '897 Patent. (Tanbour Tr. 331, 343)

233. A POSA would view the absence of the "dropping" limitation from the prior art as a significant gap because use of the plenum for the purpose of dropping the pressure of the products of combustion to permit Category I venting has important benefits that had not previously been appreciated in the art. (Tanbour Tr. 234-35, 343-45)

234. Use of the plenum for the purpose taught in the '897 Patent was not slight, minor, or trivial. (Tanbour Tr. 234-35, 331, 344-45) (describing use of the plenum as "very unique" and a "breakthrough")

235. The '897 Patent and Tam are directed to different purposes, provide different benefits, and their plenums are designed to serve different purposes. (Tanbour Tr. 336-38) (comparing plenums)

LEGAL STANDARDS

I. Infringement

A. Burden Of Proof

The patent owner has the burden of proving infringement by a preponderance of the evidence. *See SmithKline Diagnostics, Inc. v. Helena Lab. Corp.*, 859 F.2d 878, 889 (Fed. Cir. 1988). This same burden of proof applies to direct infringement, indirect infringement, and willful infringement. *See SRI Int'l, Inc. v. Cisco Sys., Inc.*, 930 F.3d 1295, 1308 (Fed. Cir. 2019) (willfulness); *Manville Sales Corp. v. Paramount Sys., Inc.*, 917 F.2d 544, 553 (Fed. Cir. 1990) (induced infringement); *SmithKline*, 859 F.2d at 889 (direct infringement).

B. Direct Infringement

A patent is infringed when a person "without authority makes, uses, offers to sell, or sells any patented invention, within the United States . . . during the term of the patent." 35 U.S.C. § 271(a). Courts employ a two-step analysis in deciding infringement. *See Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995). First, a court must construe the asserted claims. *See id.* Next, the trier of fact must compare the properly-construed claims to the accused infringing product. *See id.* Infringement occurs when "every limitation set forth in a patent claim [is] found in an accused product, exactly." *Southwall Techs., Inc. v. Cardinal IG Co.*, 54 F.3d 1570, 1575 (Fed. Cir. 1995).

In the context of a method claim, like claim 1 of the '897 Patent, infringement occurs "when the claimed process is performed, not by the sale of an apparatus that is capable of infringing use." *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006). However, one may nonetheless be held directly liable for infringement when an entity "conditions participation in an activity or receipt of a benefit upon performance of a step or steps of a patented method and establishes the manner or timing of that performance," *TravelSentry, Inc. v. Tropp*, 877 F.3d 1370, 1376 (Fed. Cir. 2017) (internal quotation marks omitted), provided there is evidence of behavior beyond mere provisioning of instructions, *F'real Foods, LLC v. Hamilton Beach Brands, Inc.*, 457 F. Supp. 3d 434, 445 (D. Del. 2020) ("[I]nstructions by themselves do not satisfy *Akamai's* 'conditioning receipt of a benefit' standard."); *see also Akamai Techs., Inc. v. Limelight Networks, Inc.*, 797 F.3d 1020, 1022 (Fed. Cir. 2015).

C. Indirect Infringement: Inducement

A plaintiff asserting a claim of induced infringement must show, in addition to direct infringement, that "the alleged inducer knew of the patent, knowingly induced the infringing acts, and possessed a specific intent to encourage another's infringement of the patent." *Vita-Mix Corp. v. Basic Holding, Inc.*, 581 F.3d 1317, 1328 (Fed. Cir. 2009).

D. Willful Infringement

To prove willful infringement, a patentee must prove that an accused infringer took actions with knowledge of the patent and with the intent of infringing the patent. *See Halo Elecs., Inc. v. Pulse Elecs., Inc.*, 136 S. Ct. 1923, 1932-36 (2016); *SRI Int'l, Inc.*, 930 F.3d at 1308; 35 U.S.C. § 284. As the Federal Circuit has explained, "willful infringement can simply be 'deliberate' infringement." *Eko Brands, LLC v. Adrian Rivera Maynez Enters., Inc.*, 946 F.3d 1367, 1379 (Fed. Cir. 2020). Factors that may be considered in assessing whether infringement

was intentional and deliberate include whether the defendant intentionally copied a product covered by the patent, whether the defendant reasonably believed it did not infringe the patent, whether the defendant made a good-faith effort to avoid infringement, and whether the defendant tried to cover up its infringement. *See id.*

E. Damages

A patentee who proves infringement is to be "award[ed] . . . damages adequate to compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer." 35 U.S.C. § 284. The burden of proving damages falls on the patentee, who must meet this burden by a preponderance of the evidence. *See Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1324 (Fed. Cir. 2009). Any damages theory must be based on "sound economic and factual predicates." *LaserDynamics, Inc. v. Quanta Comput., Inc.*, 694 F.3d 51, 67 (Fed. Cir. 2012).

A patentee can seek two, alternative categories of compensation for infringement: lost profits or the reasonable royalty she would have received through arms-length bargaining. *See Lucent Techs.*, 580 F.3d at 1324.

Whether lost profits are available is a question of law. *See DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1333 (Fed. Cir. 2009). A party seeking lost profits must show that, but for the infringement, it would have made sales that the infringer made. *See Rite-Hite Corp. v. Kelley Co., Inc.*, 56 F.3d 1538, 1545 (Fed. Cir. 1995) (*en banc*). One "useful, but non-exclusive" method to assess a patentee's entitlement to lost profits is to consider the four *Panduit* factors: (1) demand for the patented product; (2) absence of acceptable non-infringing alternatives; (3) manufacturing and marketing capability to exploit the demand; and (4) the amount of profit that the patent-holder would have made but for the infringing

sales. *See Mentor Graphics Corp. v. EVE-USA, Inc.*, 851 F.3d 1275, 1284-85 (Fed. Cir. 2017); *see also Panduit Corp. v. Stahlin Bros. Fibre Works, Inc.*, 575 F.2d 1152, 1156 (6th Cir. 1978). Only the patentee can recover lost profits, and only for products that it sells. *See Mars Inc. v. Coin Acceptors, Inc.*, 527 F.3d 1359, 1367 (Fed. Cir. 2008).

A standard method for determining a reasonable royalty is the hypothetical negotiation approach, which "attempts to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before infringement began." *Lucent Techs.*, 580 F.3d at 1324. One common way to determine a reasonable royalty is through the application of the *Georgia-Pacific* factors. *See Georgia-Pac. Corp. v. U.S. Plywood Corp.*, 318 F. Supp. 1116, 1120 (S.D.N.Y. 1970); *see also Uniloc USA, Inc. v. Microsoft Corp.*, 632 F.3d 1292, 1317 (Fed. Cir. 2011) (noting that Federal Circuit has sanctioned use of *Georgia-Pacific* factors to frame reasonable royalty inquiry).

"[A] patentee 'must in every case give evidence tending to separate or apportion the defendant's profits and the patentee's damages between the patented feature and the unpatented features, and such evidence must be reliable and tangible, and not conjectural or speculative . . . .'" *Virnetx, Inc. v. Cisco Sys., Inc.*, 767 F.3d 1308, 1326 (Fed. Cir. 2014) (quoting *Garretson v. Clark*, 111 U.S. 120, 121 (1884)). "[W]here multi-component products are involved, the governing rule is that the ultimate combination of royalty base and royalty rate must reflect the value attributable to the infringing features of the product, and no more." *Ericsson, Inc. v. D-Link Sys., Inc.*, 773 F.3d 1201, 1226 (Fed. Cir. 2014).

II. Invalidity

A. Burden Of Proof

An issued patent is presumed to be valid. *See* 35 U.S.C. § 282. Therefore, invalidity of a patent claim must be proven by clear and convincing evidence. *See Procter & Gamble Co. v.*

Teva Pharm. USA, Inc., 566 F.3d 989, 994 (Fed. Cir. 2009). Clear and convincing evidence is evidence that "proves in the mind of the trier of fact an abiding conviction that the truth of [the] factual contentions [is] highly probable." *Intel Corp. v. ITC*, 946 F.2d 821, 830 (Fed. Cir. 1991) (internal quotation marks omitted; first alteration in original).

B. Anticipation

A claim is anticipated under 35 U.S.C. § 102(a)(1) if "the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent." 35 U.S.C. § 102(a) (pre-AIA). For a patent claim to be invalid due to anticipation, each and every claim limitation must be found, either expressly or inherently, in a single prior art reference. *See Schering Corp. v. Geneva Pharm.*, 339 F.3d 1373, 1377 (Fed. Cir. 2003). Whether a claim is anticipated is a question of fact. *See Eli Lilly & Co. v. Zenith Goldline Pharm., Inc.*, 471 F.3d 1369, 1375 (Fed. Cir. 2006).

C. Obviousness

A patent may not issue "if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." 35 U.S.C. § 103(a). Obviousness is a question of law based on underlying factual findings concerning: (1) the scope and content of the prior art; (2) the differences between the claims and the prior art; (3) the level of ordinary skill in the art; and (4) objective considerations of non-obviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966).

To prove that a patent is obvious, a party must demonstrate "that a skilled artisan would have had reason to combine the teaching of the prior art references to achieve the claimed

invention, and that the skilled artisan would have had a reasonable expectation of success from doing so." *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1069 (Fed. Cir. 2012) (internal citation and quotation marks omitted); *see also Amgen, Inc. v. F. Hoffman-La Roche Ltd.*, 580 F.3d 1340, 1362 (Fed. Cir. 2009) ("An obviousness determination requires that a skilled artisan would have perceived a reasonable expectation of success in making the invention in light of the prior art."). While an analysis of any teaching, suggestion, or motivation to combine known elements is useful to an obviousness analysis, the overall obviousness inquiry must be expansive and flexible. *See KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 415, 419 (2007).

Obviousness determinations cannot rely on hindsight. *See id.* at 421 (cautioning against "the distortion caused by hindsight bias" and obviousness "arguments reliant upon *ex post* reasoning"). To protect against the improper use of hindsight in a determination that an invention would have been obvious, the Court is required to consider objective (or "secondary") considerations of non-obviousness, such as commercial success, failure of others, unexpected results, and long-felt but unmet need. *See, e.g.*, *Leo Pharm. Prods., Ltd v. Rea*, 726 F.3d 1346, 1358 (Fed. Cir. 2013). Objective considerations "may often be the most probative and cogent evidence in the record" relating to obviousness. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983).

DISCUSSION

I. AOS Has Proven Direct And Indirect Infringement, But Not Willful Infringement

A.O. Smith seeks judgment that Bradford White's Commander Series water heaters, when tested or after they are sold and installed, infringe claim 1 of AOS's '897 Patent. The Court finds that AOS has proven, by a preponderance of the evidence, that BW directly and indirectly infringes the '897 patent. AOS has failed, however, to prove that BW's infringement was willful.

A. Direct Infringement

The parties agree that Bradford White's Commander Series water heaters consist of a burner, a blower, and a flue. (FF ¶¶ 86, 88) It is further uncontested that the burner creates products of combustion (FF ¶ 86, 89, 90), the blower forces those products of combustion into the flue under positive pressure (FF ¶ 5), and an exhaust plenum is present after (i.e., downstream of) the flue and before (i.e., upstream of) a natural convection vent construction (FF ¶¶ 91-92). The parties further agree that, when installed, the Commander Series water heaters connect to a natural convection vent construction with a draft hood, which mixes ambient air with products of combustion as those products flow into the draft hood. (FF ¶ 94)

When these agreements are mapped onto claim 1, then, it is uncontested that the Accused Products perform nearly all of the claim limitations. BW disputes only three limitations: (1) "dropping the pressure of the products of combustion to near atmospheric pressure within the plenum;" (2) "permitting the products of combustion to rise out of the plenum and into the natural vent construction substantially entirely under the influence of natural convection;" and (3) "interposing an exhaust plenum between the flue and the natural convection vent

construction." AOS has proven that the Accused Products, when installed and in operation (and when tested, including by BW itself), practice these three disputed limitations.

1. The "Dropping" Limitation

The "dropping" limitation of claim 1 requires "dropping the pressure of the products of combustion to near atmospheric pressure within the plenum."[6]

As an initial matter, it is not even clear that there is a genuine dispute as to whether the Accused Products meet the dropping limitation. Bradford White's expert, Dr. Abraham, was asked at trial: "In the Commander Series products, you do not disagree that the pressure of the products of combustion are dropping to near atmospheric pressure within the plenum; correct?" His answer was: "Correct." (Abraham Tr. 824) As A.O. Smith's expert, Dr. Tanbour, also opines that the Accused Products meet the dropping limitation, the Court's analysis, arguably, could end there.

Nevertheless, both at trial and in the briefing, Defendant raises numerous objections to the conclusion that it meets the dropping limitation. The Court will address them here.

The parties disagree as to what the pressure must be as the products of combustion ***enter*** the plenum. According to BW, the pressure of these products as they enter the plenum could be positive or negative, as long as whatever that pressure is ***drops*** within the plenum. (*See, e.g.*, D.I. 193 at 6-8; D.I. 202 at 21; *see also* Tr. 960) To BW, either a positive or negative pressure could decline within the plenum and either such event would satisfy the claim limitation. A.O.

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[6] As the NFGC (PTX-091) explains, atmospheric pressure is "pressure of the weight of air on the surface of the earth, approximately 14.7 pounds per square inch (psia) (101 kPa absolute) at sea level." (PTX-091 § 3.379.1) References to pressure, "[u]nless otherwise stated, [are] expressed in pounds per square inch above atmospheric pressure." (*Id.* § 3.379.1) Therefore, the Court understands a negative pressure to be one that is below atmospheric pressure, while a positive pressure is one above atmospheric pressure.

Smith's view, by contrast, is that the pressure of the products of combustion must be positive as they enter the plenum.[7]

The Court agrees with Plaintiffs: the pressure of the products of combustion cannot be negative before they enter the plenum. (*See, e.g.*, D.I. 204 at 14-17) The claim language requires that the pressure drop "to ***near*** atmospheric pressure within the plenum;" dropping to ***below near atmospheric pressure*** (i.e., negative pressure) ***before*** entry into the plenum would not meet this claim limitation.

In arguing to the contrary, Defendant misreads the Court's construction of "near atmospheric pressure." While the Court construed that term as "a pressure sufficient to allow the products of combustion to rise out of the plenum substantially entirely under the influence of natural convection," this does not mean that any and all pressures that allow the products of combustion to do so necessarily also meet the "dropping" limitation. That is, the term "near atmospheric pressure" cannot be divorced from the other requirements of the "dropping" limitation.

Defendant points to a portion of the ***specification*** stating: in the plenum, "the pressure of the products of combustion drops near or ***below atmospheric pressure, and*** the products of combustion ***are therefore able to rise out of the plenum 70 and into the draft hood 75 substantially entirely under the influence of natural convection***." (D.I. 211 at 3) (quoting JTX-002 at 4:5-9) (emphasis added by BW) This is not, however, what the ***claim*** says; the claim requires a drop "to ***near*** atmospheric pressure ***within*** the plenum," not a drop to below atmospheric pressure ***before*** the plenum. A POSA would not say that the pressure drops "***to*** near

[7] BW contends that "the parties dispute the construction of this step." (D.I. 202 at 21) To the extent this is correct, the Court rejects Defendant's proposed claim construction.

atmospheric pressure within the plenum," as the claim requires, if the pressure is already ***at*** "near atmospheric pressure" ***even before*** entering the plenum. (*See* Tanbour Tr. 337 (agreeing that if pressure was already negative when products of combustion leave flue, POSA would not characterize them as dropping in pressure within plenum); *see also id.* at 307))

This conclusion is supported by the patent's disclosures that the products of combustion "enter the plenum 70 under the influence of the power burner 60, but exhaust from the plenum 70 without the influence of the power burner 60." (JTX-002 at 4:14-17) As the power burner influences the products of combustion by application of ***positive*** pressure, its influence at the entrance of the plenum is felt in the form of those products having ***positive pressure at the entrance of the plenum.*** (*See* FF ¶¶ 22, 126-27) The plenum removes that influence by causing the pressure of the products to drop from positive pressure to near atmospheric pressure. (*See* FF ¶¶ 9, 21-22)

Bradford White contends that portions of the specification – those that reference a "creep and spill" embodiment[8] and an embodiment without any plenum – undermine the conclusions the Court has reached. (*See, e.g.*, D.I. 211 at 5; *see also* JTX-002 at 1:33-36; FF ¶ 8) The Court disagrees. These embodiments are not within the scope of the claim. *See TIP Sys., LLC v. Phillips & Brooks/Gladwin, Inc.*, 529 F.3d 1364, 1373 (Fed. Cir. 2008) ("[R]ead in the context . . ., the claims of the patent need not encompass all disclosed embodiments. . . . Our precedent is replete with examples of subject matter that is included in the specification, but is not claimed."). The claim plainly requires a plenum; the dropping limitation cannot be performed without one. And, as already explained, the pressure of the products of combustion must be positive when

[8] According to Dr. Abraham, "creeping and spilling flow is flow that has very little, if any, energy, and that would include pressure." (Abraham Tr. 694-95; *see also* FF ¶ 18)

they enter the plenum, as the claim requires that pressure to drop "to near atmospheric pressure ***within*** [and not before] the plenum."

Having determined that the claim requires positive pressure at the entrance of the plenum and a drop to near atmospheric pressure to occur within the plenum, the Court further finds that the extensive testing by Dr. Tanbour proves that this is precisely what occurs to the products of combustion in the Accused Products. Dr. Tanbour crafted a series of tests based on the NFGC and ANSI standards and measured the pressure at various points within the Bradford White Commander Series water heater. (FF ¶ 102) The tests Dr. Tanbour undertook, with the assistance of AOS employee Kevin Field, were (in the words of Field) "all absolutely routine testing," and entirely consistent with tests POSAs conduct on hot water heaters all the time, outside of litigation. (Field Tr. 197; *see also* Tanbour Tr. 328-29 (stating his testing in this case was consistent with how he would have tested for commercial purposes at pertinent time))

To conduct his tests, Dr. Tanbour first set up Commander Series water heaters according to manufacturer instructions and industry procedures. (FF ¶ 110) Using a pressure tap (1/8-inch steel tube) which extended through the water heater, a pressure transducer, a thermocouple, and LabVIEW data acquisition software, Dr. Tanbour obtained measurements of the pressure and temperature within the Commander water heaters. (FF ¶¶ 105-09, 111) Probes were placed at three locations: (1) below the entrance of the flue tube (P1) (FF ¶ 113); (2) at the entrance to the plenum (P2) (FF ¶¶ 112, 115-16); and (3) outside the plenum (P3) (FF ¶¶ 120-21). In each location, Dr. Tanbour obtained static pressure readings. (FF ¶¶ 114, 122)

By taking pressure readings at both the entrance and exit of the plenum, Dr. Tanbour demonstrated that the pressure dropped in the plenum, as the products of combustion travelled from the entrance of the plenum, P2, to its exit, P3. (FF ¶¶ 141-43) The average of Dr.

Tanbour's readings, shown below, establishes that the pressure dropped from positive at the entrance to negative at the exit of the plenum:

Heater Tested	**Average Pressure at P2 Location**	**Average Pressure at P3 Location**
UCG 100	+0.048 inches of water column (FF ¶ 131)	-0.0146 inches of water column (FF ¶ 138)
UCG 80	+0.025 inches of water column (FF ¶ 132)	-0.01125 inches of water column (FF ¶ 139)

Bradford White disputes these findings by attacking Dr. Tanbour's testing methodology.[9] These attacks fail.

Bradford White contends that Dr. Tanbour's probes at P2 were oriented to point into the flow of the products of combustion, resulting in a measure of ***total pressure***, when they should have been oriented perpendicular to the flow, in order to measure ***static*** **pressure.** (*See, e.g.*, D.I. 195 at 14 n.6; *see also* D.I. 202 at 24-25) Yet Dr. Tanbour testified credibly that the way he conducted his testing of the Accused Products was, in all respects – including at P2 – consistent with how he has tested products throughout his career and how such tests are performed in industry. (Tanbour Tr. 328-29; *see also* FF ¶¶ 115-19)[10] Moreover, regardless of how Dr.

[9] Dr. Abraham's trial testimony about the orientation of Dr. Tanbour's pressure probes during his testing is the subject of Plaintiffs' post-trial motion to strike. (*See* D.I. 213-15, 219) The Court hereby GRANTS the motion to strike for the reasons stated by Plaintiffs in their letter briefs. Nonetheless, the Court heard and considered Dr. Abraham's testimony and has discussed it in various places in this Opinion. Were the Court to have instead denied Plaintiffs' motion, and permitted the challenged evidence to remain part of the record, no outcome on any issue decided by the Court would have differed.

[10] Defendant's assertion that "Plaintiffs lack credible evidence" to support Dr. Tanbour's testimony about his testing at P2 is wrong. (D.I. 202 at 23; *see also id.* at 26 ("[T]he record does not reveal any credible reason why Plaintiffs oriented their probe to measure total pressure at the P2 location.")) The Court found Dr. Tanbour credible, including on this issue.

Tanbour took his P2 measurement, Dr. Abraham, BW's infringement expert, never opined that the static pressure at P2 in the Accused Products is ***not*** positive. (*See* D.I. 212 at 9) ("[N]owhere does BW proffer evidence that is contrary to Dr. Tanbour's testing at the P2 location and positive pressure measurements as the products of combustion exit the flue tubes of the Accused Products.") Dr. Abraham himself took no measurements of pressure at P2. The record does not reveal a genuine dispute of fact as to whether the pressure of the products of combustion in the Accused Products is positive at the entrance to the plenum. It is.

BW criticizes the precise locations at which Dr. Tanbour placed P2 and P3, contending "Dr. Tanbour did not measure pressure ***at the entrance*** to the plenum; he measured pressure within his probe ***inside the flue tube***, at some unspecified distance upstream (i.e., below) the entrance to the plenum," and "Dr. Tanbour did not measure pressure ***at the exit*** of the plenum; he measured pressure with his measurement probe downstream of (approximately ***two inches above***) the exit of the plenum)." (D.I. 202 at 28) These criticisms, too, are unavailing. Again, Dr. Tanbour explained, credibly, that he placed his probes exactly where he would have for testing a product to bring to market or to pass a regulatory inspection. (*See, e.g.*, Tanbour Tr. 328-29, 385-88) Moreover, again, there is no dispute that the pressure of the products of combustion is positive entering the plenum. (FF ¶¶ 129-35) The Court is persuaded that a POSA seeing the method and results of Dr. Tanbour's testing would understand them to prove that the pressure is positive at the entrance to the plenum and drops to negative by the exit of the plenum, reflecting a drop in pressure occurring within the plenum.[11]

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[11] Other evidence supports these conclusions, in addition to Dr. Tanbour's testing. (*See, e.g.*, Stafford Dep. Tr. at 119-20, 124, 129-31 (BW's designer of Accused Products agreeing that pressure is positive at plenum entrance); Abraham Tr. 811 (agreeing pressure is negative at

BW observes that Dr. Tanbour's testing shows only minute differences of approximately hundredths of an inch in pressure differences, therefore showing barely any drop of pressure occurring in the plenum. (*See* D.I. 202 at 26-29) But a drop of even hundredths of an inch is a drop, fulfilling the claim requirement. The margin of error for Dr. Tanbour's tests was consistent with how a POSA would conduct these tests for certification and product development purposes, rendering them sufficiently precise for assessing infringement as well. (*See* Tanbour Tr. 292-93, 313-15; *see also* FF ¶¶ 71-72)

Taken together, then, the record evidence establishes, by a preponderance of the evidence, that the Accused Products satisfy the dropping limitation.

2. The "Permitting" Limitation

The '897 Patent requires "permitting the products of combustion to rise out of the plenum and into the natural convection vent construction substantially entirely under the influence of natural convection."

A.O. Smith has shown that the Commander Series water heaters perform the "permitting" limitation. In the Accused Products, the products of combustion exhibit negative static pressure after they exit the plenum, which permits "atmospheric" "Category I venting" to occur "using the natural buoyancy of the byproducts of combustion to vent." (FF ¶¶ 20, 75) Dr. Tanbour's testing of the Accused Products supports the Court's conclusion. Dr. Tanbour found that the products of combustion leave the plenum under negative pressure and from there enter the natural convection vent construction. (FF ¶¶ 137-44; *see also* FF ¶ 93) The negative pressure at the plenum exit means that there is no longer any significant power burner influence on the

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plenum exit); JTX-003 at 2:18-21, 4:25-31 (indicating that embodiments, including Accused Products, have negative pressure at plenum exit))

products of combustion at that point. (FF ¶¶ 144-47) If there were still significant power burner influence, the products of combustion would be under positive pressure at the exit of the plenum, resulting in spilling, leakage, and an inability to obtain Category I compliance. (FF ¶¶ 67-71, 149) The evidence demonstrates that a POSA would understand that there is no longer, at that point, any remaining significant influence from the power burner on the products of combustion; natural convection has taken over such that Category I compliance can be achieved. It is undisputed that the Commander Series has been certified to be compliant with Category I venting standards. (FF ¶¶ 81-84)

Defendant's contention that the Accused Products do not practice the permitting limitation rests, first, on the mistaken view that the patent's claim is concerned with flow as opposed to pressure. (*See, e.g.*, D.I. 202 at 4-7; Abraham Tr. 736 (testifying to his understanding that "the patent instructs us to look at flow")) As support, Defendant points to the portion of the "permitting" limitation that refers to "permitting the products of combustion to ***rise out*** of the plenum," which according to Defendant "describes their movement, i.e., their flow, not their pressure." (D.I. 202 at 4) (emphasis added) The Abstract notes that "the products of combustion ***flow*** into the draft hood substantially entirely under the influence of natural convection." (JTX-002 at Abs. (emphasis added); FF ¶ 17) Most especially, Defendant emphasizes the following several sentences from the specification:

> In this regard, the plenum 70 and baffle 110 may be said to ***uncouple the flow*** of the products of combustion from the power burner 60. In other words, the products of combustion enter the plenum 70 under the influence of the power burner 60, but exhaust from the plenum 70 without the influence of the power burner 60.

(*Id.* at 4:12-17 (emphasis added); *see also, e.g.*, D.I. 202 at 5-6 & n.2 (stating that '897 Patent refers to "flow" or "velocity" total of 12 times; FF ¶¶ 15, 18)

For several reasons, however, none of this means that the patent is concerned with flow as opposed to pressure. First, it is important to note that Defendant's contention rests on language from the specification, which is missing from the claim itself. As Plaintiffs correctly state, "Dr. Abraham's velocity-focused analysis is not only inconsistent with the Court's claim construction orders, it is inconsistent with the '897 Patent, pertinent regulatory standards, and the general understanding of persons having ordinary skill in the art." (D.I. 195 at 22; *see also* D.I. 212 at 5)

Second, multiple witnesses – not just Dr. Tanbour, but also Messrs. Reynolds and Smith – explained at length during trial that the patent is concerned with pressure, not flow. (*See, e.g.*, Reynolds Tr. 87-92; Tanbour Tr. 244-46, 294-95, 322-23; Stafford Tr. 179-81) The patent is about enabling Category I venting, and the standards for Category I venting turn on pressure – and not at all on flow or velocity. (*E.g.*, FF ¶¶ 24-25; *see also* D.I. 202 at 20 (BW acknowledging: "Category I requirements do not test for or consider flow")) Dr. Tanbour – who, unlike Dr. Abraham, would have qualified as a POSA at the priority date of the '897 Patent – opined credibly and persuasively that a POSA reading the patent would understand it to be about pressure, not flow. Dr. Abraham's mistaken view of the patent as being about flow and not pressure is a reason the Court has not placed great weight on his analysis.

Additionally, as AOS points out, the portion of the specification highlighted by Defendant begins "'[i]n this regard' and uses the phrase 'may be said,'" indicating it is "a characterization of the conversion from positive pressure to near or below atmospheric pressure that occurs within the plenum, which is what allows a 'Category I venting system' to be used." (D.I. 212 at 2-3) Moreover, a POSA would recognize the two sentences excerpted by BW follow immediately after the two sentences the Court will reproduce below, which expressly

reference pressure and indicate to a POSA that even the two sentences preferred by Defendant also reflect the pressure focus of the patent:

> In the plenum 70, the ***pressure*** of the products of combustion drops near or below atmospheric ***pressure***, and the products of combustion are therefore able to rise out of the plenum 70 and into the draft hood 75 substantially entirely under the influence of natural convection. In the draft hood 75, the products of combustion mix with ambient air (as represented by the additional arrows [in Figure 3] around the draft hood 75).

(JTX-002 at 4:5-11 (emphasis added); *see also id.* at 1:36-42 (noting "the ***pressure*** of the products of combustion are reduced as they exit the heat exchanger, and the products of combustion exhaust from the water heater") (emphasis added); FF ¶ 16)

Another premise of Bradford White's defense is yet another misunderstanding of the claims as construed. Defendant wrongly and repeatedly insists that "[t]he teachings of the '897 Patent compel a POSITA to look beyond pressure to determine whether the power burner has ***any influence on the flow*** of combustion products rising out of the plenum." (*E.g.*, D.I. 202 at 3 (emphasis added); *see also id.* at 7 (asserting "Plaintiffs must prove the absence of ***all*** influence – including flow") (emphasis added; capitalization altered); Tr. at 946 ("Dr. Tanbour failed, however, to understand that the claim requires the ***elimination*** of the power burner influence.") (emphasis added))[12] As Plaintiffs rightly point out, however, Defendant's characterization of "without the influence of the power burner" portion of the Court's construction is improperly "absolutist," mistakenly assuming that "any" remaining influence from the power burner downstream of the plenum compels a conclusion of non-infringement. From its earliest claim construction decision, the Court explained that "'without the influence of the power burner' does

[12] As set out in the Findings of Fact (*see, e.g.*, FF ¶¶ 22-25, 125-28) and in this section of the Discussion, Defendant has failed to prove its contention that "***substantial*** power burner influence is present during operation of the Accused Products." (D.I. 202 at 42 n.7) (emphasis added)

not ignore potential 'other influences' in the combustion products. Instead, as Plaintiffs explain and a POSA would understand, other than natural convection, ***nothing else is going to be a significant influence.***" (D.I. 61 at 7) (internal citation and quotation marks omitted; emphasis added) When the parties returned to the Court for additional claim construction, the Court – in the course of construing "natural convection" as "fluid motion compatible with use of a Category I venting system" – reiterated its view by noting "the claim language '***substantially*** entirely' is inconsistent with Defendant's absolutist position of '***only*** due to temperature.'" (D.I. 77 at 9-10) (emphasis in original) Evidence that something other than natural convection may be exerting ***insignificant*** influence on the pressure of the products of combustion as they exit the plenum does not show non-infringement.

In other words, to prove infringement, A.O. Smith is not required "prove the absence of ***all*** influences of the power burner" (D.I. 202 at 8) (emphasis added), as Bradford White suggests – only that the system is capable of reducing pressure to a point such that natural convection can occur. It is, thus, inconsequential whether "Dr. Tanbour[] relied exclusively on measurements of pressure and not measurements of flow" (FF ¶ 19), acknowledged the existence of a "general flow" within the water heaters (FF ¶ 125), did not "isolate the power burner influence from the influence of natural convection" (FF ¶ 127), and did not measure velocity (FF ¶ 128). To a POSA, "velocity cannot be used to judge the influence of the blower." (FF ¶ 126)

It is further inconsequential whether, as Dr. Abraham determined, there is some flow occurring during the water heater pre-purge operation (which has no products of combustion present). (*E.g.*, Abraham Tr. 730-31; FF ¶ 179) Even if some flow is occurring, that flow is not

determinative of "influence of a power burner."[13] As Dr. Tanbour explained, the operation of the Accused Products during pre-purge does not accurately reflect the dynamics of the system when products of combustion are being created. (Tanbour Tr. 269-71) The far more pertinent evidence is that obtained by someone with the qualifications of a POSA, who tested the Accused Products during their steady-state, intended operation; here, that type of evidence is offered only by AOS, principally through the testimony of Dr. Tanbour.

Thus, A.O. Smith has proven that Bradford White's Accused Products practice the permitting limitation.

3. The "Interposing" Limitation

Bradford White devotes slightly under two pages of its post-trial briefing to arguing that Plaintiffs have not established that BW performs the interposing step of claim 1. Dr. Abraham did not dispute this claim limitation at trial. Nor did BW indicate at trial that it was challenging Plaintiffs' proof on this element.

Likely due to the scant and belated attention paid to this defense, it is somewhat difficult to follow. The claim limitation requires "interposing an exhaust plenum between the flue and the natural convection vent construction." The Court believes it is undisputed (and, in any event, it was certainly proven) that BW's Accused Products have an exhaust plenum which is located downstream of the flue and upstream of the vent – that is, between the flue and the natural convection vent construction. Indeed, in the context of its anticipation case, BW appears to contend that a prior art reference, Tam, meets the "interposing" limitation merely because "Tam

[13] BW's Hill testified that it is possible to attain Category I compliance even if there is still influence from the burner downstream of the plenum. (*See* Hill Tr. 603; *see also* Tr. 946 (closing argument)) Even if this is correct, it is no more consequential to the infringement analysis than is Dr. Abraham's "cold flow" testing.

discloses that water heater 10 includes a plenum 34 which is interposed between flue columns 30 and draft hood 60." (D.I. 193 at 6) If that is all that is required to meet the limitation then, indisputably, the Accused Products are water heaters in which a plenum is interposed between flue columns and a draft hood.[14]

It seems, then, BW is suggesting AOS failed to prove that the Accused Products have a "natural convection vent construction," or at minimum that AOS failed to do so in connection with any instance of BW conducting its own testing of its own products. (*See, e.g.*, D.I. 202 at 31-32) ("Plaintiffs have not produced evidence that, during BWC's testing, it connects the Accused Products to a Category I vent construction.")

In fact, however, Plaintiffs did produce evidence sufficient to support a finding that BW meets the interposing limitation when it tests the Accused Products. BW's Stafford testified that Bradford White performed in-house testing involving making the units operational, including being hooked up to gas and water and with the draft hood and atmospheric vent pipe installed. (*E.g.*, FF ¶¶ 152-59; *see also* Stafford Dep. Tr. at 95) Stafford added that for testing, Bradford White connects its products to an "atmospheric vent construction," which is synonymous with Category I venting. (Stafford Dep. Tr. at 95; *see also id.* at 33)[15]

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[14] If further evidence were needed, there is more. Dr. Tanbour testified that he tested and observed the Accused Products and observed that "they do interpose an exhaust plenum between the flue and the natural convection vent." (Tanbour Tr. 289) AOS has proven that a draft hood is a type of natural convection vent construction (FF ¶ 94, 212) and the Commander Series products include a draft hood (located downstream of the plenum and even further removed from the flue). (FF ¶ 153)

[15] As Defendant points out, Stafford also testified that during certain tests BW does not connect its products to a Category I vent construction and instead simply "vent[s] directly into the room." (Stafford Tr. 145-46; *see also* D.I. 202 at 32) Weighing the evidence credited by the Court, the Court finds, nonetheless, that on at least some occasions, Defendant's in-house testing involved connecting to a Category I vent construction. To the extent Stafford's testimony on this point is

Thus, Plaintiffs have proven that BW's testing involves practicing the interposing limitation.

4. BW's Testing Constitutes Direct Infringement

Because claim 1 of the '897 Patent is a method claim, the Court's conclusion that the Accused Products meet the "dropping" and "permitting" limitations (and, to the extent contested, the "interposing" limitation) is not a determination that Bradford White itself performs all asserted steps of the method claim. However, the Court also finds that AOS has proven, by a preponderance of the evidence, that BW does at times during testing perform all of the steps of the method of claim 1. Therefore, BW is liable for direct infringement.

In order to obtain regulatory certification of the ULN status of the Commander Series models, Bradford White had to assemble and test the Accused Products, and in doing so BW directly infringed claim 1 of the '897 Patent. (FF ¶¶ 152, 154) For example, BW undertakes "life cycle testing" prior to production, in which the units being tested are run around the clock. (FF ¶¶ 154-55) This testing of the Accused Products requires BW to practice the patented method of claim 1. So, too, does BW's "environmental testing," which involves subjecting Commander Series water heaters to testing in a range of operating conditions at different temperatures and air quality. (FF ¶¶ 156-57) Bradford White also regularly conducts "pilot runs" with associated testing. (FF ¶ 159) In sum, the evidence establishes that BW conducts both pre-production and post-production testing of the Accused Products which constitutes direct infringement.

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ambiguous, the Court finds that a preponderance of the evidence supports Plaintiffs' contentions with respect to this dispute.

Bradford White correctly notes that the record evidence relating to its testing is non-specific and, arguably, amounts to merely *de minimis* infringement. Stafford, for instance, testified that certain post-production testing of the Accused Products may occur only approximately "every six or nine months." (*See, e.g.*, FF ¶ 161) There is, however, no *de minimis* exception to infringement, at least when such infringement is for commercial reasons. *See, e.g.*, *Minitube of Am., Inc. v. Reproduction Provisions, LLC*, 2014 WL 1761317, at *16 (E.D. Wis. May 1, 2014) ("[T]he doctrine [of de minimis infringement] is generally applied only in non-commercial contexts. Seeing as all of the defendants' activities were directed to commercial ends . . . the Court simply cannot employ the doctrine, here."); *see also Embrex, Inc. v. Serv. Eng'g Corp.*, 216 F.3d 1343, 1352-53 (Fed. Cir. 2000) ("[T]his court has not tolerated the notion that a little infringement – *de minimis* infringement – is acceptable infringement or not infringement at all."). Bradford White's contentions about the amount of its direct infringement may have an impact on the appropriate measure of damages (a matter discussed later in this Opinion), but they do not make out a meritorious non-infringement defense. *See Embrex*, 216 F.3d at 1353 ("[T]he statute accommodates concerns about *de minimis* infringement in damages calculations.").

Accordingly, the Court concludes that AOS has proven by a preponderance of the evidence that BW's Accused Products infringe claim 1 of the '897 Patent when tested by Bradford White.

B. Indirect Infringement

A.O. Smith has also proven by a preponderance of the evidence that Bradford White is liable as an active inducer of infringement, beginning in September 2017. "Whoever actively

induces infringement of a patent shall be liable as an infringer." 35 U.S.C. § 271(b). To prove active inducement, A.O. Smith must establish each of the following:

1. Bradford White's installers and/or customers infringed claim 1 of the '897 Patent.

2. Bradford White aided, instructed, or otherwise acted with the intent to cause acts by its installers and customers that would constitute direct infringement of the patent.

3. At that time, Bradford White knew of the '897 Patent, or showed willful blindness to the existence of the patent.

4. Bradford White knew, or showed willful blindness in not knowing, that the actions of the installers and customers would infringe at least one claim of the patent.

See DSU Med. Corp. v. JMS Co., Ltd., 471 F.3d 1293, 1305-06 (Fed. Cir. 2006).

In the preceding section, the Court has already found that use of the Accused Products as they are intended to be used – that is, in the manner BW sometimes tests them itself and the manner in which BW instructs its end users to operate them – meets all of the limitations of the method of claim 1. That same evidence establishes that Bradford White's installers and customers infringe claim 1. AOS has also proven the other three elements of its induced infringement claim, as explained below.[16]

1. BW Actively Induced Installers' And Customers' Infringement

There is substantial evidence that Bradford White acted with the intent to cause direct infringement of the '897 Patent. Bradford White advertises the Commander Series water heaters as meeting California ULN standards and as a "replacement to traditional atmospherically vented

[16] There is much overlap between the arguments each party makes in connection with Plaintiffs' induced infringement and willful infringement claims. The Court follows the parties' practice and discusses some overlapping issues in the inducement section of this Opinion and others in the willfulness section. The pertinent parts of each section should be considered incorporated by reference in the other section.

commercial water heaters." (FF ¶¶ 166-67) BW's marketing literature and specification sheets focus on the thermal efficiencies obtainable through use of a "downfire premix power burner." (FF ¶¶ 85, 168-69) The Accused Products are delivered "fully assembled" to be installed "according to the manufacturer's instructions" and in accordance with "the way they are expected and intended to operate." (FF ¶¶ 170-71) BW also trains installers working with its products at BW's own training centers. (FF ¶ 164)

All of this evidence establishes that BW undertook affirmative acts to encourage infringement.

2. BW Had Knowledge Of The '897 Patent From September 2017

AOS has proven that as of September 20, 2017, Bradford White knew of the '897 Patent. On September 20, 2017, BW's Bruce Hill received a letter from AOS's Dr. Heideman, providing BW with notice of the patent. (FF ¶ 165) This date and receipt of this notice is not disputed by BW. (SF ¶ 55)

AOS has failed to prove that Bradford White had actual knowledge of the patent prior to September 2017. It has also failed to establish that A.O. Smith was, in that period prior to September 2017, willfully blind to the existence of the '897 Patent.

To prove willful blindness, AOS must show that: (1) Bradford White had a subjective belief in a high probability that a fact exists, i.e., that AOS had a patent that might cover its Accused Products; and (2) Bradford White took deliberate actions to avoid learning that fact. *See Global-Tech Appliances, Inc. v. SEB S.A.*, 563 U.S. 754, 769 (2011). AOS makes numerous arguments in trying to meet its burden, but to no avail.

A.O. Smith's argument for willful blindness rests basically on its theory that Bradford White was determined to rush into the California ULN market, knowing it was trailing its

competitors (AOS, Rheem, and American Standard), and despite being aware of a high probability that A.O. Smith had a patent on its successful BTL product, Bradford White deliberately avoided learning of that patent, principally by choosing not to conduct a patent search, in noncompliance with its general policy. AOS has not proven that its portrayal of BW's conduct is accurate.

While AOS insists that the evidence shows BW did not undertake a patent search in the course of developing the Commander Series product, the Court believes it is more likely than not that such a search was conducted – or, even if it was not conducted, that such a search would not have found the '897 Patent in any event. The record establishes that it was "standard procedure" at Bradford White to perform "due diligence" when developing new products. (FF ¶ 182) Stafford testified he had no reason to believe a patent search was not performed in connection with development of the Commander Series and prosecution of BW's own '337 Patent. (FF ¶ 183) The lack of documentary evidence for such a search is more likely the result of nothing relevant having been found than proof the search was never done. (FF ¶ 183-85) Furthermore, as BW observes, "While Mr. Hill testified that he was not aware of such a search, he began employment with BW in January 2014, ***after*** BW had applied to patent the Accused Products." (D.I. 202 at 37-38)

Moreover, the '897 and '337 Patents have different focuses. The '337 Patent is directed to the design of an expansion chamber on the bottom of the water heater to create a multi-pass heat exchanger with multiple flue tubes. (FF ¶ 185) That is a "completely different area" than the concern of the '897 Patent, which is a Category I-retrofittable water heater that utilizes a power burner. (FF ¶ 184; Hill Tr. 652 ("Its focus is in a completely different area from the intellectual property we were pursuing on the Commander Series, which had much more to do

with the heat exchanger in the way in which we designed the expansion chamber on the bottom of that appliance to take advantage of that first pass between the first pass heat exchanger and the second pass, and transfer heat effectively to the bottom of the tank.")) Hence, AOS has not established that a patent search relating to the '337 Patent (and its embodiment, the Commander Series) would necessarily have turned up the '897 Patent. AOS's patent search contentions, then, do not prove willful blindness.

The Court further agrees with Defendant that "[n]one of the evidence relied on by Plaintiffs would have given BW any reason to believe that there was a high probability that Plaintiffs had a patent covering the California market for ULN water heaters." (D.I. 202 at 35) (internal quotation marks omitted) California's imposition of ULN requirements – creating the impetus for Bradford White wanting to be able to meet new market demands – began in January 2012, but the '897 Patent did not issue until February 2013, a timeline diminishing (rather than supporting) Plaintiffs' logic that knowledge of the regulatory requirements leads inexorably to knowledge of its patent. (*See id.* at 36)[17] Moreover it is undisputed that Defendant knew the California ULN market included competitors of AOS; specifically, Rheem and American Standard. The Court agrees with Defendant that the "continuing presence" of three competitors in this market would have led BW to believe "that no one had a right to exclude anyone else from the market." (*Id.*)

[17] While the application that became the '897 Patent was published on March 18, 2010 (*see* JTX-002 at 1), there is no evidence in the record that anyone at BW knew or should have known of the application at any point prior to its issuance as a patent in 2013. This conclusion is further supported by the fact that AOS, for its part, did not learn of BW's '337 Patent until 2017. (Heideman Tr. 41-44) This is despite AOS's efforts to monitor its competitors in the water heater market (*id.*), despite the '337 Patent application being published on May 28, 2015, and despite the '337 Patent issuing on August 30, 2016 (JTX-003 at 1).

Hence, the Court finds that AOS has proven BW had actual knowledge of the '897 Patent as of September 20, 2017. AOS has failed, however, to prove that, prior to this date, BW had either actual knowledge of the '897 Patent or was willfully blind to the existence of the patent.

3. BW Knew Of Infringement From September 2017

AOS has also proven that, as of September 20, 2017, BW knew or should have known that its actions would induce direct infringers to infringe claim 1 of the '897 Patent. Along with his letter to BW's Hill, AOS's Heideman included claim charts detailing how the Commander Series meets all the limitations of claim 1 of the '897 Patent. AOS developed its understanding of the Commander from the '337 Patent, of which the Commander is an embodiment.

BW did not respond to the letter from AOS with any explanation as to why it does not infringe. BW was not obligated to do so. Still, the lack of response in this case is part of the overall evidentiary mix which, on the whole, leads the Court to find that BW did not have a good faith belief of non-infringement. Further supporting the Court's conclusion are the facts that BW had only a non-attorney, Hill, review the letter (FF ¶ 181), and BW did not test the Commander Series products for infringement until August 2018 (FF ¶¶ 179-80), almost a year after receipt of the letter.

For all the reasons already given above in explaining that AOS has not proven that BW was willfully blind to the existence of the '897 Patent, AOS has likewise failed to prove that BW was willfully blind to infringement of that patent prior to September 2017. Accordingly, again, while A.O. Smith has proven indirect infringement from September 20, 2017, it has not proven indirect infringement for the period prior to that date.

C. Willful Infringement

To prevail on a claim of willful infringement, a patentee must prove that an accused infringer took actions with knowledge of the patent and with the intent of infringing the patent. *See Halo Elecs.*, 136 S. Ct. at 1932-36; *see also bioMerieux, S.A. v. Hologic, Inc.*, 2020 WL 759546, at *11 (D. Del. Feb. 7, 2020). Intentional infringement, therefore, requires proof of actions taken "with the intent of infringing the patent." *bioMerieux*, 2020 WL 759546, at *11. In assessing whether an accused infringer has willfully infringed, the Court may consider, among other factors, "whether the defendant intentionally copied a product covered by the patent, whether the defendant reasonably believed it did not infringe, and whether the defendant made a good-faith effort and cover up." *Id.*

As an initial matter, the Court has already found in the context of Plaintiffs' induced infringement claim that BW only came to know of the '897 Patent on September 20, 2017. Prior to that date, Bradford White lacked actual knowledge of the patent and also was not willfully blind to its existence. Therefore, as with Plaintiffs' induced infringement claim, its willful infringement claim must fail for the period prior to September 20, 2017.

Consequently, an additional problem for A.O. Smith's willful infringement claim is that essentially all of the actions it alleges constituted willful infringement ***predate*** the date that BW knew or should have known of the '897 Patent. AOS's main contention is that Bradford White purportedly created the Commander Series water heaters by copying competitor products, enabling it to meet an uncharacteristically (for BW) compressed schedule and quickly replace the U-Series products, which were failing in the California ULN market. (*See, e.g.*, Tr. 897-99; *see also* D.I. 195 at 38 (describing BW's supposed "goal of obtaining competitive advantage in 2013" and desire to "race[] to market" in 2014)) As support, A.O. Smith points to a BW

September 5, 2013 Project Definition Request that "expressly referenced Bradford White's competitor products on the [California ULN] market" and requested development of a new product to compete with those products. (FF ¶¶ 172-73) One month later, in October 2013, Bradford White launched a "tooling release," which permitted production of the Commander Series water heaters. (FF ¶ 174) So BW began to develop the Accused Products in just one month and launched them into the marketplace after a total of only four months. (FF ¶¶ 174-75)

The Court does not agree with A.O. Smith that "[t]he most reasonable explanation from the uncontested evidence is that BW used the teachings of the '897 Patent" to develop the Accused Products. (D.I. 195 at 2) To the contrary, it appears that Bradford White was able to develop the Commander Series so quickly because it did so by modifying its own already-existing EF product, a separate, Category IV product made by Bradford White. (Stafford Dep. Tr. 112-14) (FF ¶¶ 176-78) As Stafford explained, he started with the EF product, removed certain flue tubes, and modified the baffling to permit use of a power burner. (FF ¶¶ 176-77) This enabled Bradford White to reuse available tooling and move swiftly through development and launch of the Commander Series. (FF ¶ 178)[18]

Other evidence supports the Court's conclusion that the Commander was developed by BW based on its EF series products and is not a copy of AOS's BTL product or of the patent. AOS did not mark the BTL product with the '897 Patent, so there is no reason to believe that any inspection BW undertook of it would have yielded knowledge of the patent.[19] Nor does the

[18] Although Bradford White's normal timeframe for product development appears to be six months (PTX-020 at 2), no one testified that four months was an implausibly short period in which to have completed the design and testing of the Commander Series. (*See generally* Tr. 899)

[19] Although marking is not required for method patent claims, the absence of marking bears on knowledge by Bradford White.

record contain any marketing or other publications by AOS indicating that the BTL practices patented technology. (FF ¶ 10) The mere existence on the market of A.O. Smith's product does not amount to proof of knowledge of the '897 Patent by market participants. Plaintiffs' copying allegations, therefore, are unproven.[20]

All of this is not to say that Plaintiffs have failed to present ***any*** evidence of willful infringement. The Court's finding from the indirect infringement discussion that Bradford White did not, after September 20, 2017, form a good faith belief in noninfringement carries over to the willful infringement context. It is also true that Bradford White has not changed the design or operation of the Commander Series water heaters since learning of the patent, including during the six months between learning of its existence and being sued for infringement. (FF ¶ 186) Even so, in view of the overall record, and weighing the evidence the Court credits, the Court does not find by a preponderance of the evidence that Bradford White deliberately, subjectively intended to infringe (and cause others to infringe) A.O. Smith's patent. *See WCM Indus., Inc. v. IPS Corp.*, 721 F. App'x 959, 970 (Fed. Cir. 2018) (even post-*Halo*, willfulness looks to "totality of the circumstances presented in the case") (quoting *Shiley, Inc. v. Bentley Labs., Inc.*, 794 F.2d 1561, 1568 (Fed. Cir. 1986)); *Gustafson, Inc. v. Intersystems Indus. Prods., Inc.*, 897 F.2d 508, 510-11 (Fed. Cir. 1990) (willfulness is determined "from all the circumstances").

Accordingly, AOS has failed to prove its claim for willful infringement.[21]

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[20] Likewise for AOS's allegations of "concealment and cover up" (*id.* at 39), which are predicated on the purported failure by BW to undertake patent searches in 2013 and 2014. Not only has the Court found that such searches may well have occurred (as already discussed), but this conduct (or failure to act) predates BW's knowledge of the '897 Patent.

[21] Thus, the Court need not consider AOS's request that the Court enhance damages by trebling them. (*See, e.g.*, D.I. 195 at 3)

II. A.O. Smith Is Entitled To Lost Profits Damages For Bradford White's Indirect Infringement As Well As Nominal Damages For Direct Infringement

A.O. Smith, through its damages expert, Mr. Bero, offered several different theories of damages. Its preferred position is that the Court award lost profits damages of $11.6 million (using BW's average incremental profit of $[redacted] per unit) to $12.5 million (using AOS's average incremental profit of $[redacted] per unit) for all of BW's sales of the Accused Products, beginning in January 2014 and running through May 2019.[22] (*See* D.I. 195 at 41) AOS also presented alternative damages theories, including several based on a market share analysis and some seeking reasonable royalties, which seek somewhat smaller damages awards. (*See id.* at 41-42)

Unfortunately, neither party, nor their experts, provided careful analysis as to the damages that should be awarded if the Court found (as it has) limited direct infringement due to BW's testing and indirect infringement beginning only on September 20, 2017.[23] Given this reality, and the record the parties created, the Court has concluded that A.O. Smith is entitled to lost profits damages of $4,544,461, based on the indirect infringement for which it proved damages occurring after September 20, 2017 (which includes $1 of nominal damages for infringement in 2017), plus $1 of nominal damages for direct infringement.

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[22] The parties agreed they will supplement damages-related discovery for the period after May 2019. (*See* D.I. 177 at 13-14) The Court will confer with the parties for their positions on what additional damages should be awarded to AOS for sales of the Accused Products occurring after this date.

[23] Although it did not have Bero address this potential outcome, nor did it brief it, counsel for AOS did address this possibility during closing arguments. There he told the Court that if it were to find that "direct infringement is the testing of presumably Unit No. 1, but . . . were to believe that defendants didn't learn of [the] patent until some time later," then the Court "can't begin the damage period until it is established that the defendant was aware of the claim because it is a method claim." (Tr. 914-15)

A. Lost Profits Damages Are Warranted

A.O. Smith has proven that lost profits damages are warranted because it has proven, by a preponderance of the evidence, each of the *Panduit* factors. *See Panduit*, 575 F.2d at 1156; *see also Pall Corp. v. Micron Separations, Inc.*, 66 F.3d 1211, 1222 (Fed. Cir. 1995). The first of the *Panduit* factors – demand for commercial embodiments of the patent – is not disputed (and is well-supported in the record). (*See* D.I. 202 at 44 (focusing on *Panduit* factors (2) and (3); *see also* FF ¶ 197 (showing year-over-year increase in sales of both AOS BTL units and BW Commander units))

AOS has also proven the second *Panduit* factor: the absence of any acceptable, available non-infringing alternatives. None of the six purported non-infringing alternatives identified by Bradford White suffices. (FF ¶ 198) Instead, as AOS writes, "[t]here are no acceptable non-infringing alternative water heaters that would achieve ultra-low NOx by a power burner without having to replace the Category I vent system." (D.I. 195 at 43) Specifically:

(1) Bradford White's U-series water heater was transitioned out of the market for failure to meet customer demand, so it was both not available at the pertinent date and, more importantly, not shown to be acceptable to relevant end users. (FF ¶ 191)

(2) High efficiency and (3) tankless water heaters are not acceptable alternatives, as each requires Category IV venting and, relatedly, each is significantly more expensive than Category I-compliant water heaters practicing the '897 Patent. (FF ¶¶ 192-93)

(4) Rheem's and (5) American Standard's competing ULN products are not acceptable alternatives because they are not non-infringing. Dr. Tanbour tested the Rheem and American Standard products using the same methods he employed in persuading the Court that the BW Commander Series products infringe. (FF ¶¶ 103-04) His test results show that, as with the

Commander Series products, the products of combustion in both the Rheem and American Standard products have a positive pressure at the P2 location (plenum entrance) and a negative pressure at the P3 (plenum exit) location, and also interface with a draft hood. (FF ¶¶ 95-101) Both products are also Category I compliant. (*See* FF ¶¶ 96, 100) On this record, then, the Court is persuaded that these competing products are not non-infringing.[24]

(6) The Court is also not persuaded that BW's proposed design-around would have been available and, more importantly, acceptable to end users.[25] BW argues that it could have modified the Accused Products to place a flapper valve at the exit port of the blower system and replaced the draft hood. (*See* D.I. 202 at 46; *see* also Abraham Tr. 656) There is no persuasive evidence in the record that this design would have been acceptable to end users, either in terms of price or performance. (FF ¶ 194)

Turning to the third *Panduit* factor, AOS has also shown that it had the manufacturing and marketing capacity to satisfy the additional demand it would have confronted had BW's

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[24] The Court is not, of course, finding that Rheem and American Standard are liable for patent infringement. A.O. Smith has not even asserted the '897 Patent against Rheem or American Standard. (*See* Tr. 921) Neither Rheem nor American Standard is a party to this litigation; they did not (and were not required to) appear in this case or mount a defense. No doubt the record would be very different if these two companies were joined to this case and defended against the allegations of infringement. In any event, the important point for this Opinion is that AOS has adequately shown, for purposes of damages, that the Rheem and American Standard products are not available, acceptable non-infringing alternatives – notwithstanding the possibility that, were it ever to be more fully litigated, a reasonable factfinder might find that Rheem and/or American Standard do not infringe.

[25] The Court recognizes that non-existing but conceivable design-arounds can potentially be found to be acceptable, available non-infringing alternatives. *See, e.g.*, *Micro Chem., Inc. v. Lextron, Inc.*, 318 F.3d 1119, 1122-23 (Fed. Cir. 2003) ("[A] technology not on the market at the time of infringement can, in certain circumstances, constitute an available, noninfringing alternative."). Defendant's failing is not that it is wrong on the law but that it has failed to produce sufficient evidence. Defendant has failed to show that its proposed design-around, or any of its other purported alternatives, would have been available, acceptable, ***and*** non-infringing.

infringing product not been on the market. A.O. Smith is the largest North American water heater manufacturer. (FF ¶ 199) In 2018, it produced over 89,000 water heaters at a single facility in South Carolina. (FF ¶ 200) It maintains extensive distribution networks in California, the primary market for ULN water heaters. (FF ¶¶ 199-200) An increase in sales of approximately 3,500 units in a year (the highest number of Accused Products Bradford White sold any year between 2014 and 2019) would have only required a 4% increase in production, well within A.O. Smith's capacity. (FF ¶ 201) Notwithstanding BW's claims to the contrary, A.O. Smith would also have had the marketing capacity to handle the increased demand, as it could have leveraged its already-existing marketing and distribution channels to capture the additional customers. (FF ¶ 199; *see also* Schulz Tr. 435, 456-57; Bero Tr. 531)

B. Calculating A.O. Smith's Lost Profits

Turning to the fourth and final *Panduit* factor, A.O. Smith has also shown an established amount of profits it would have made but-for Bradford White's infringement.

Bradford White is liable for lost profits damages on all units it sold of the Accused Products after learning of the '897 Patent on September 20, 2017. This is because Bradford White has been found to be liable for indirect infringement from that date forward. However, Plaintiffs' damages expert, Mr. Bero, did not distinguish between direct and indirect infringement, and presented theories of damages predicated on a finding that BW is liable for damages on all sales of the Accused Products, from January 2014 onward. This complicates the task of calculating the damages to award A.O. Smith.[26]

[26] As does the facts that BW does not discuss in its post-trial brief what the Court's damages analysis should be if it finds, as it has, that AOS is entitled to lost profits damages.

AOS correctly points out that BW has not cited any case supporting its contention that a damages analysis is required to apportion damages as between direct and indirect infringement. (*See, e.g.*, D.I. 212 at 11) Even so, the Court cannot here conflate direct infringement with indirect infringement, given the vastly different extent and timing of each of these types of infringement proven by AOS. While indirect infringement occurred from September 20, 2017 through at least May 2019, and its harm is fairly measured by the sales of thousands of units of Accused Products that occurred over this period, the only direct infringement proven was sporadic testing of units that were not proven to have been sold. Because the Court must in every case be careful to award damages that are based on the harm the patentee actually suffers from the infringement – no more and no less – the Court is unpersuaded by Bero's suggestion that sales of all units following the earliest of BW's infringing tests is a sound measure of AOS's damages.[27]

With respect to indirect infringement, AOS's lost profits are measured by the number of units sold for the period during which Bradford White induced infringement. Having determined that no non-infringing alternatives were available in that period, the Court concludes that AOS would have made all of BW's sales during that period. The Court is further persuaded by Bero's analysis as to the number of such units and the amount of profits AOS lost on each such unit. Bero presented sales and profit data on an annualized basis, which allows the Court to readily determine damages for 2018 and 2019 (through May). (*See* PTX-180 at 2, 4; PDX-004-19; FF

[27] To accept A.O. Smith's and Bero's analysis – which appears to be that "because the Accused Products are certified, and in order to sell them they must be certified[,] which requires testing," and that testing constitutes direct infringement, so therefore AOS is entitled to damages (perhaps even lost profits) on every unit BW sold after conducting that testing (D.I. 195 at 42) – would threaten to eviscerate the distinction between direct and indirect infringement. It would also reward A.O. Smith far beyond the damages it actually proved.

¶¶ 195-96) Based on the record evidence before it, the Court determines that A.O. Smith lost profits of $2,981,160 in 2018 and $1,563,300 in 2019 through May of that year. (*Id.*)

As to 2017, AOS did not create a record permitting the Court to determine its damages. Bradford White's indirect infringement began on September 20, 2017, so AOS would be entitled to its lost profits on all BW sales of the Accused Products from then until the end of the year (essentially the fourth quarter of 2017). The Court cannot find anything in the record permitting it to make a finding as to how many such units BW sold in that period. (*See, e.g.*, PTX-180 at 2, 4) (depicting loss profits only on annual basis) Given that the burden of proof is on AOS, it follows that AOS has failed to prove its actual lost profits damages for 2017, and the Court cannot award them.

Instead, the Court will award A.O. Smith only nominal damages of $1 for Bradford White's indirect infringement in 2017.[28] While the patent damages statute provides that a patentee is "in no event" to be awarded "less than a reasonable royalty for the use made of the invention by the infringer," 35 U.S.C. § 284, this does not absolve a patentee of its obligation in litigation to meet its burden of proof. When, as here, it fails to do so, the floor must be nominal damages. *See Apple, Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1328 (Fed. Cir. 2014), *overruled in part on other grounds by Williamson v. Citrix Online, LLC*, 792 F.3d 1339 (Fed. Cir. 2015) ("[T]he fact finder must still determine what constitutes a reasonable royalty from the record evidence. Certainly, if the patentee's proof is weak, the court is free to award a low, perhaps

[28] There is "limited authority, much of it quite old, providing that nominal damages may be awarded in patent infringement actions." *Am. Infertility of N.Y., P.C. v. Deep Blue Health N.Z. Ltd.*, 2020 WL 4218261, at *5 (S.D.N.Y. July 23, 2020) (citing *Black v. Thorne*, 111 U.S. 122, 124 (1884); *Mayor, Aldermen & Commonalty of City of New York v. Ransom*, 64 U.S. 487, 488 (1859); *Am. Can Co. v. Goldee Mfg. Co.*, 31 F.2d 492, 493 (E.D.N.Y. 1927), *aff'd*, 31 F.2d 494 (2d Cir. 1929)).

nominal, royalty, as long as that royalty is supported by the record."); *see also Lindemann Maschinenfabrik GmbH v. Am. Hoist & Derrick Co.*, 895 F.2d 1403, 1407 (Fed. Cir. 1990) (stating court may award patentee "far less than the amount it demanded" and even may label those damages "nominal"); *cf. Blake v. Robertson*, 94 U.S. 728, 734 (1876) (awarding nominal damages when actual damages not proven). The Federal Circuit has further explained:

> Although we have not upheld a zero royalty rate in a case with an affirmative infringement finding – and have stated that it is 'unlikely' that a hypothetical negotiation would result in a zero royalty rate – we have previously stated that "in a case completely lacking any evidence on which to base a damages award, the record may well support a zero royalty award."

TecSec, Inc. v. Adobe Inc., 978 F.3d 1278, 1291-92 (Fed. Cir. 2020). Here, then, because the record is completely lacking in evidence allowing the Court to determine, among other things, the number of infringing units sold by BW in the infringing period of 2017, the Court will award only nominal damages of $1 for this portion of the infringement.

The Court's conclusion and reasoning is the same with respect to direct infringement damages. In this case, A.O. Smith has proven that Bradford White has directly infringed claim 1 of the '897 Patent with its internal testing of the Accused Products. A.O. Smith has not, however, proven any specific instance of such testing, quantified the amount of the testing, or articulated a sound theory of how A.O. Smith was financially damaged by that testing. Therefore, the Court is left with nothing in the record to justify awarding AOS anything more than an additional $1 of nominal damages for direct infringement.

TecSec is instructive. There, "TecSec presented no evidence of damages caused by Adobe's direct infringement." 978 F.3d at 1291. "TecSec's only damages evidence relied on 'sales of accused products.'" *Id.* But where, as was the case in *TecSec* and is here as well, "direct infringement occurs only after [the product] is installed," "[s]ales . . . cannot be a measure

of damages for direct infringement, [but] only for [AOS's] indirect infringement theory, which relies on infringement by [BW] customers." *Id.* at 1291-92.

A.O. Smith argues that "the damages caused by BW's direct infringement through in-house testing is properly quantified by the sales of the Accused Products, which could have never occurred without the performance of that testing." (D.I. 212 at 11) This is incorrect. Instead, as was true in *TecSec*, "sales cannot be a measure of damages for direct infringement" when infringement only occurs after installation. *TecSec*, 978 F.3d at 1291-92.

Plaintiffs offer one other theory that they might be contending supports their claim to greater damages. Plaintiffs cite to *TravelSentry, Inc. v. Tropp*, 877 F.3d 1370, 1376 (Fed. Cir. 2017), which held that "when an alleged infringer conditions participation in an activity or receipt of a benefit upon performance of a step or steps of a patented method and establishes the manner or timing of that performance," the infringer may be liable for direct infringement committed by the end user. Plaintiff does not offer the Court much assistance on this theory, and basically none in the context of damages. The entirety of AOS's analysis is as follows:

> [T]he evidence establishes that the Accused Products' design and control system dictates that they perform the method of claim 1 during operation. And they must be installed and operated according to BW's instructions to obtain the benefit of BW's warranty, not to mention the benefit of hot water, which is the reason the customer bought an Accused Product. Thus, the performance of the method by BW's installers and customers is properly attributable to BW.

(D.I. 212 at 11-12 n.7) (internal citations to record evidence omitted)

The Court is not persuaded that *TravelSentry* provides a basis for awarding Plaintiffs greater damages. *TravelSentry* is properly invoked "[w]here more than one actor is involved in practicing the steps" of the claim. *Akamai*, 797 F.3d at 1022. In such a case, "a court must determine whether the acts of one are attributable to the other such that a single entity is

responsible for the infringement." *Id.* AOS presents no evidence that this is a divided infringement case involving partial action by Bradford White. In fact, AOS's entire induced infringement case (which requires predicate showings of direct infringement) is premised upon ***non-divided*** infringement. That is, AOS's theory of infringement is that Bradford White's installers – and/or, thereafter, the end user customers of those installers – perform every step of the method of claim 1.

Even if *TravelSentry* nonetheless applies here, AOS presents insufficient evidence upon which the Court can find imputation of direct infringement. What is needed is "evidence that a third party hoping to obtain access to certain benefits can only do so if it performs certain steps identified by the defendant, and does so under the terms prescribed by the defendant." *TravelSentry*, 877 F.3d at 1380. But AOS's proffer of two benefits (warranty service and hot water) obfuscates what, exactly, is the precise benefit it believes is sought by Commander purchasers. Nor has AOS proven ***how*** whichever benefit customers are "hoping to obtain" is ***only*** obtained if those customers "perform[] certain steps identified by the defendant." *Id.*

In sum, each of A.O. Smith's damages theories are premised upon ***sales*** of the Accused Products, but no sales occur as part of Bradford White's direct infringement. Where, as was the case in *TecSec*, that theory is "ultimately speculative and insufficiently grounded in evidence," *TecSec*, 978 F.3d at 1292, then the law "does not require an award of damages." *Id.* at 1291. Accordingly, then, A.O. Smith is only entitled to nominal damages for direct infringement.

There are no further sales for which the Court must consider the parties' competing evidence regarding reasonable royalties. *See Crystal Semiconductor Corp. v. TriTech Microelecs. Int'l, Inc.*, 246 F.3d 1336, 1354 (Fed. Cir. 2001) ("A patentee receives a reasonable royalty for any of the infringer's sales not included in the lost profit calculation."). Having

awarded lost profits on 2018 and 2019 sales, and nominal damages (in the form of a non-zero royalty) for 2017 and for direct infringement, the Court has accounted for all damages A.O. Smith can be awarded on the infringement it has proven (through May 2019).

Therefore, the Court will award A.O. Smith lost profits damages of $4,544,460 plus $2 of nominal damages, for a total damages award of $4,544,462.

III. Invalidity

Bradford White contends that A.O. Smith's '897 Patent claim 1 is invalid due to anticipation and obviousness. BW has failed to prove, by the requisite clear and convincing evidence, that claim 1 is invalid on either of these grounds.

A. Preliminary Obstacles To Both Of Bradford White's Theories Of Invalidity

In addition to the requirement that it prove its case by clear and convincing evidence, Bradford White's anticipation and obviousness theories confront additional obstacles, which it fails to overcome. They are:

(1) BW's invalidity case is based almost entirely on Dr. Abraham's analysis of the '897 Patent and his analysis of Tam. As explained in detail already in this Opinion, however, Dr. Abraham was not a POSA and the Court has not placed much weight on his opinions, on any issue. (*See* D.I. 204 at 10) ("Dr. Abraham has never been involved in the testing of a gas water heater, never been involved in the regulatory testing of water heaters, never designed or developed a gas water heater, never worked in the field of gas water heaters, and never read the 2006 National Fuel Gas Code prior to this case.") (internal quotation marks omitted)

(2) The Court agrees with Plaintiffs that the purported anticipating reference, Tam, was known to and presumptively considered by the Examiner, making it even more difficult for Defendant to meet its burden of proof by clear and convincing evidence. *See PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1304 (Fed. Cir. 2008). "When no prior art other than that

which was considered by the PTO examiner is relied on by the attacker, he has the added burden of overcoming the deference that is due to a qualified government agency presumed to have properly done its job, which includes one or more examiners who are assumed to have some expertise in interpreting the references and to be familiar from their work with the level of skill in the art and whose duty it is to issue only valid patents." *Id.* (internal quotation marks omitted).

While Tam is not identified on the face of the '897 Patent as having been considered during examination of the patent, it was relied on by the Examiner during examination of the '897 Patent's parent application. (*See* PTX-079 at 2 (identifying Tam as a reference cited); *see also* FF ¶ 206) Under MPEP 609.02, the "examiner of the continuing application will consider information which has been considered by the Office in the parent application," although such information may not be listed on the child patent. (FF ¶ 207-10) Tam would, therefore, have been considered by the Examiner during prosecution of the '897 Patent, triggering Bradford White's "added burden."

B. Anticipation

In addition to the deficiencies already noted that affect both of Bradford White's theories of invalidity, BW's attempt to invalidate claim 1 by anticipation falters for at least two other reasons.

First, the anticipation defense turns on the "dropping" limitation of claim 1 of the '897 Patent,[29] but even BW admits that the dropping limitation is not disclosed in its purportedly anticipating prior art reference, Tam. (*See, e.g.*, D.I. 211 at 7 ("The parties agree that Tam does not identify the location where combustion products first reach near atmospheric pressure."); *see*

[29] Dr. Tanbour identified only the "dropping" limitation of claim 1 as being absent from Tam. (Tanbour Tr. 331; *see also* FF ¶ 211)

also Abraham Tr. 824-27)[30] Instead, BW asserts that the dropping limitation is inherent in the embodiment of Figure 2 of Tam, which means BW must prove (by clear and convincing evidence) that the pressure of the products of combustion necessarily drops to near atmospheric pressure within the plenum of Tam every time one practices the purportedly invalidating embodiment of Tam; it is not sufficient to prove (even by clear and convincing evidence) merely that this embodiment is capable of doing so. *Bettcher Indus., Inc. v. Bunzl USA, Inc.*, 661 F.3d 629, 639 (Fed. Cir. 2011). Probabilities do not suffice; the prior art relied on must "necessarily function[] in accordance with, or include[], the claimed limitations." *Bettcher Indus., Inc. v. Bunzl USA, Inc.*, 661 F.3d 629, 639 (Fed. Cir. 2011); *see also Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc.*, 344 F.3d 1186, 1192 (Fed. Cir. 2003). Defendant has failed to prove what it must.

Tam does ***not*** disclose that the pressure of the products of combustion is positive before entering the plenum, which is required by claim 1 of the '897 Patent and is necessary in order for the dropping limitation to be performed. Instead, as even Dr. Abraham acknowledged, the pressure in the flue tubes of Tam could be negative. (FF ¶ 224) If so, then the "dropping" limitation is not met: if the pressure were negative in the flue tubes, before the products of combustion enter the plenum, the pressure of these products could not thereafter drop ***to*** "near atmospheric pressure" in the plenum. (FF ¶ 225)

Dr. Tanbour persuasively explained that, as AOS summarizes the analysis in its brief:

> A POSITA would understand that the conversion from positive to negative pressure in Figure 2 [of Tam] would take place in the flue tubes [***before*** entering the plenum], not within the flue gas collection area 34. In fact, Tam's specification states that "[t]he

[30] Nor did BW attempt to prove that its secondary references, the 1991 Assessment or the 1992 NFGC Handbook, teach the dropping limitation. Dr. Tanbour described the use of the plenum in claim 1 as "very unique" and a "breakthrough." (Tanbour Tr. 234, 344)

> flue gases rise up through the flue columns 30" in Figure 2 "as in the case shown in FIG. 1," which confirms to a POSITA that both embodiments are relying on natural convection forces to cause the products of combustion to rise up out of the flue tubes [even though the embodiment of Figure 1 of Tam does not have a power burner to impart positive pressure].

(D.I. 204 at 9) (citing Tanbour Tr. 335) In short, as Plaintiffs correctly state, "BW cannot meet its burden of clear and convincing evidence that a static pressure drop 'necessarily' occurs in Tam's plenum." (D.I. 204 at 14) (emphasis omitted)

Second, BW repeatedly emphasizes that its defense largely turns on claim construction disputes. (*See, e.g.*, D.I. 211 at 6 ("Plaintiffs' arguments against anticipation are based on their incorrect interpretation of 'near atmospheric pressure.'"); *id.* at 16 ("[T]he parties' primary dispute regarding anticipation is based less on the disclosure of Tam, and more on the proper interpretation to be given the 'dropping' step . . . .")) But, as was already explained in connection with infringement, the Court disagrees with BW's claim construction position and agrees with A.O. Smith's (i.e, the pressure of the products of combustion must be positive when those products enter the plenum). Therefore, by BW's own logic (*see, e.g.*, D.I. 211 at 2) ("[T]he question of anticipation can be largely resolved by determining the correct interpretation of the 'dropping' step."), having rejected BW's construction of "dropping," the Court must also reject BW's effort to prove anticipation.

C. Obviousness

In addition to the flaws noted above, Bradford White has failed to prove claim 1 is invalid due to obviousness for additional reasons.

First, BW has not proven, by clear and convincing evidence, that a POSA would have found it obvious to modify Tam such that the pressure of the products of combustion drop to near atmospheric pressure within the plenum. According to BW and Dr. Abraham, a POSA

would have modified Tam to use less restrictive baffles, in order to increase flue gas temperatures and ensure Category I compliance by avoiding condensation while maintaining the negative pressure of the exhaust (and while also meeting the dropping limitation). (*See, e.g.*, D.I. 193 at 13-15) The Court does not agree. Instead, as Dr. Tanbour explained, in 2006 a POSA – even one who was motivated to modify Tam to be Category I compliant[31] – would have followed then-conventional wisdom and preferred "over baffling" to manage a pressure drop for Category I venting. (Tanbour Tr. 343) Defendant seeks to diminish this opinion by saying it is "unsupported by evidence." (D.I. 211 at 14) But Dr. Tanbour's opinion ***is*** evidence, evidence the Court has (in light of all the evidence presented by both sides at trial) credited.[32]

Second, even were a POSA to have found it obvious to make Defendant's proposed modification to Tam, such a POSA would not have had a reasonable expectation of success in doing so. *See In re Cyclobenzaprine*, 676 F.3d at 1069 (noting that party seeking to invalidate claim as obvious must show POSA would have had reasonable expectation of success). As Dr. Tanbour opined, "use of the plenum for the purpose of dropping the pressure of the products of combustion to permit Category I venting has important benefits that had not previously been appreciated in the art." (FF ¶¶ 232-233) Hence, Defendant has failed to prove a reasonable expectation of success.

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[31] BW must also prove that a POSA would have been motivated to make these modifications to Tam. *See Wyers v. Master Lock Co.*, 616 F.3d 1231, 1238-40 (Fed. Cir. 2010). Given all the other failings in Defendant's obviousness claim, the Court need not resolve the parties' dispute over whether the tremendous market appeal of Category I venting would have supplied such a motivation (Defendant's view) or whether, instead, Tam's compatibility with Category I even without any modification would have resulted in no motivation to modify (Plaintiffs' view).

[32] Likewise, Defendant's attack on Plaintiffs' arguments it characterizes as "based primarily on nothing more than the unsupported testimony of its former employee," i.e., Dr. Tanbour, is unavailing. As the Court has repeatedly stated, it found the testimony of Dr. Tanbour credible and persuasive.

Finally, A.O. Smith has established several objective considerations of non-obviousness, which further support the Court's conclusion that BW has not proven obviousness. AOS proved a nexus[33] between claim 1 of the '897 Patent and Bradford White's failure with its U-Series product, and likewise proved a nexus between the commercial success of AOS's BTL Series – as well as the commercial success of BW's Commander Series and Rheem's and American Standard's products that appear to be embodiments of claim – and the patent. That is, Plaintiffs proved that the success or failure of these various products was due to whether the products practice the method of claim 1 when installed and operated in accordance with their instructions.[34] This objective evidence confirms the correctness of the Court's rejection of Defendant's obviousness theory.[35]

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[33] "The commercial success of a product is relevant to the non-obviousness of a claim only insofar as the success of the product is due to the claimed invention." *Geo. M. Martin Co. v. Alliance Machine Systems Intern. LLC*, 618 F.3d 1294, 1304 (Fed. Cir. 2010). The nexus was proven by Dr. Tanbour's testimony that the invention of claim 1 is the "entire system;" that is, the benefits of retrofitting to have a commercial water heater compliant with Category I venting result from constructing a product as claimed in claim 1 and operating it according to the method of claim 1. (*See, e.g.*, Tanbour Tr. 230-33) BW argues that the benefits identified by AOS are not captured in the claim (*see* D.I. 211 at 18-19), but AOS correctly observes that "BW presented no evidence of acceptable alternative water heaters on the market that would achieve ultra-low NOx by a power burner without having to replace the Category I vent system." (D.I. 204 at 24) (internal quotation marks omitted)

[34] In forming his opinion on obviousness, Dr. Abraham did not consider the failure in the marketplace of the U-Series, which did not practice the invention of claim 1. (*See* Abraham Tr. 829-30) "[F]ailing to account for objective evidence" may render an expert's analysis "incomplete, and ultimately insufficient to establish obviousness by clear and convincing evidence." *InTouch Techs., Inc. v. VGo Commc'ns, Inc.*, 751 F.3d 1327, 1352 (Fed. Cir. 2014).

[35] The Court does not believe Plaintiffs proved the objective consideration of non-obviousness of copying.

CONCLUSION

During trial, both A.O. Smith and Bradford White presented a great deal of evidence on both sides of the multiple disputes they put before the Court for resolution. On most issues, AOS amassed a greater amount of credible and persuasive evidence. In particular, Plaintiffs proved, by a preponderance of the evidence, that Defendant directly infringed claim 1 of A.O. Smith's '897 Patent – through its in-house testing – and indirectly infringed the claim, by actively inducing direct infringement by third-party installers and end users of water heaters. While AOS failed to prove willful infringement, it did establish its entitlement to lost profits for the indirect infringement that occurred in 2018 and through May 2019 (and, subject to further proceedings, perhaps beyond), plus nominal damages for indirect infringement in 2017 and for direct infringement. Finally, Bradford White did not prove, by the requisite clear and convincing evidence, that claim 1 of the '897 Patent is invalid due to anticipation or obviousness.

An appropriate Order follows.

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

AOS HOLDING COMPANY and A.O. SMITH CORPORATION,	:	
Plaintiffs,	:	
v.	:	C.A. No. 18-412-LPS
BRADFORD WHITE CORPORATION,	:	
Defendant.	:	

ORDER

At Wilmington this **31st** day of **March, 2021**, for the reasons set forth in the Opinion issued this date, **IT IS HEREBY ORDERED** that:

1. Plaintiffs have proven by a preponderance of the evidence that Defendant directly infringed claim 1 of U.S. Patent No. 8,375,897 (the "'897 Patent").

2. Plaintiffs have proven by a preponderance of the evidence that Defendant indirectly infringed claim 1 of the '897 Patent.

3. Plaintiffs have failed to prove by a preponderance of the evidence that Defendant willfully infringed claim 1 of the '897 Patent.

4. Plaintiffs have proven by a preponderance of the evidence they are entitled to lost profits damages in the sum of $ 4,544,460, plus $1 of nominal damages, for Bradford White's indirect infringement.

5. Plaintiffs are entitled to nominal damages in the sum of $1 for Bradford White's direct infringement.

6. Defendant has failed to prove by clear and convincing evidence that claim 1 of the '897 Patent is invalid due to anticipation or obviousness.

7. The parties shall meet and confer and submit, no later than **April 7, 2021**, a joint status report, providing their position(s) on what additional proceedings, if any, should now occur and on what schedule, and shall also submit a proposed order to permit the Court to enter judgment consistent with its Opinion. (*See generally* D.I. 185)

8. Because the Opinion has been issued under seal, the parties shall meet and confer and, no later than **April 5, 2021**, submit a proposed redacted version, as well as a supporting memorandum justifying any redactions they propose. Should the parties fail to comply or fail to persuade the Court any portion of the Opinion should be redacted, the Court will unseal the entire Opinion.

IT IS FURTHER ORDERED that Plaintiffs' motion to strike certain testimony of Defendants' expert (D.I. 213) is **GRANTED**.

HONORABLE LEONARD P. STARK
UNITED STATES DISTRICT JUDGE