

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

EDWARDS LIFESCIENCES CORPORATION AND
EDWARDS LIFESCIENCES LLC
Petitioner,

v.

COLIBRI HEART VALVE LLC,
Patent Owner.

IPR2022-00611
Patent 10,390,945 B2

Before JEFFREY N. FREDMAN, LYNNE H. BROWNE, and
ERIC C. JESCHKE, *Administrative Patent Judges*.

BROWNE, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Petitioner, Edwards Lifesciences Corp. and Edwards Lifesciences, LLC, filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–10 of U.S. Patent No. 10,390,945 B2 (Ex. 1001, “the ’945 patent”). Patent Owner, Colibri Heart Valve LLC, filed a Preliminary Response (Paper 6, “Prelim. Resp.”).

Having considered the arguments and evidence of record, for the reasons explained below, we deny institution of *inter partes* review.

A. *Real Parties in Interest*

Petitioner states that “Edwards Lifesciences Corporation and Edwards Lifesciences LLC are the real parties-in-interest.” Pet. 23.¹ Patent Owner states that it, Colibri Heart Valve LLC, is the real party in interest. Paper 5, 2.

B. *Related Matters*

Petitioner states that it “is not aware of any other judicial or administrative matter involving the ’945 Patent that would affect, or be affected by, a decision in this proceeding.” Pet. 23. Patent Owner agrees. Paper 5, 2.

C. *The ’945 patent*

The ’945 patent relates to “a method of making a percutaneously implantable replacement heart valve.” Ex. 1001, 1:21–22. The ’945 patent discloses that one problem that can develop in heart valves is “stenosis, in which a valve does not open properly, and/or insufficiency, also called regurgitation, in which a valve does not close properly.” *Id.* at 2:32–35.

¹ We note that the pages following page 22 of the Petition are not numbered. We have numbered them pages 23–70.

Such problems “are treated by surgical repair of valves, although often the valves are too diseased to repair and must be replaced.” *Id.* at 2:56–58. One type of replacement heart valve is a tissue valve that is “constructed by sewing the leaflets of pig aortic valves to a stent to hold the leaflets in proper position, or by constructing valve leaflets from the pericardial sac of cows or pigs and sewing them to a stent.” *Id.* at 3:45–48. However, “[t]he pericardium is a thin and very slippery [membrane], which makes it difficult for suturing in a millimetrically precise way.” *Id.* at 3:52–54. The ’945 patent purports to solve this problem in the making of a replacement heart valve that includes tissue by using “a process that includes drying and compressing the pericardium using photo-mechanical compression in such a way that makes it possible to handle and fold the material more easily.” *Id.* at 3:54–59.

Figures 3A and 3B of the ’945 patent depict a procedure for folding the pericardium tissue starting material to create the replacement heart valve and are reproduced below.

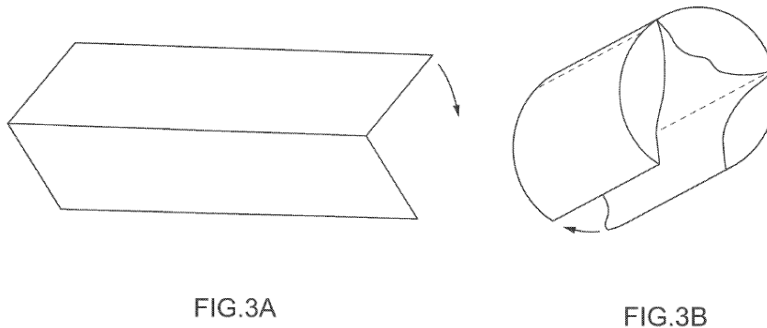


Figure 3A and 3B “depict the way the sheet of heart valve starting material is folded” in which “[t]he starting material is preferably a flat dry sheet, which can be rectangular or other shaped” as shown in Figure 3A. *Id.* at 8:60–63. The cusp or leaflet portion of a valve means is formed by folding of the pericardium material used to create the valve as depicted in Figure 3B.

Id. at 8:58–60. The '945 patent discloses that “[t]he leaflet forming portion is a single, continuous, uncut layer affixed to the interior of the cuff layer to form the leaflets/cusps, unlike prior efforts that have involved suturing of three separate leaflet/cusp portions onto the main valve body portion” and is created by a configuration of folds (as particularly depicted in Figures 9A–9C). *Id.* at 9:1–7.

Figure 5 of the '945 patent depicts an exemplary replacement heart valve device and is reproduced below.

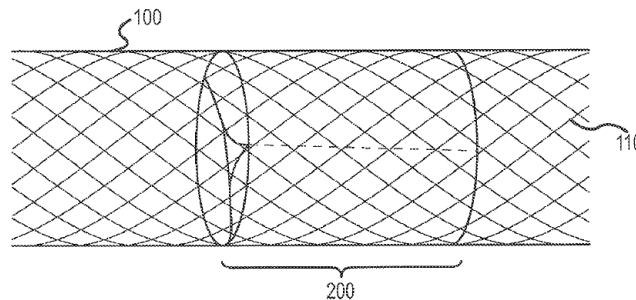


FIG.5

Figure 5 shows a side view of a replacement heart valve device that includes a self-expanding stent in the expanded position. *Id.* at 6:41–44. The replacement heart valve device comprises stent member 100 and flexible valve means 200. *Id.* at 6:66–7:1. Stent member 100 includes wire 110 “formed in a closed zigzag configuration” and “is preferably self-expanding, although balloon-expandable stents can be used as well, and has a first polygonal shape in its compressed or collapsed configuration and a second, larger polygonal shape in its expanded configuration.” *Id.* at 7:1–5, 44–46. Valve means 200 comprises generally tubular portion 210 and is preferably “a peripheral upstanding cusp or leaflet portion 220” (shown in Figure 1). *Id.* at 7:5–8. Valve means 200 is disposed within cylindrical stent member

100 with tubular portion 210 “transverse of and at some acute angle relative to the stent walls.” *Id.* at 7:8–10. The preferred material for valve means 200 “is mammal pericardium tissue.” *Id.* at 8:46–48.

The ’945 patent discloses that in order to make the valve, “the biocompatible tissue material is isolated and all the fat tissue and extra fibers are removed.” *Id.* at 9:43–44. “Cleaning is preferably accomplished by using a hydromechanical force-based cleaning device to separate tissue layers and hydration with distilled water to remove unwanted layers.” *Id.* at 9:44–49. “Once the pericardium is completely clean, it is subjected to photo-mechanical compression, then the valve is formed and placed in sequential solutions of isopropyl alcohol of about 70–100%, ethanol of about 70–100%, glycerol and glutaraldehyde preferably at a concentration of about 0.07-25% for about 36 hours, respectively.” *Id.* at 9:49–55. “The material is preferably photomechanically compressed to remove lipids and produce protein coagulation to make the surface smoother and more compact and biocompatible, decreasing the molecular distance of collagen fibers.” *Id.* at 9:55–59. “[E]xposure to light and mechanical compression cause[s] protein denaturation making the material stronger and more homogeneous and biocompatible. Gas sterilization can also be used to sterilize the tissue membrane material.” *Id.* at 9:59–63. The valve is then “formed by taking a flat sheet of the material and folding it in such a way that forms a three-leaflet or desired number of leaflet[s].” *Id.* at 9:64–65.

The ’945 patent discloses that in order to make the pericardium material less slippery and easier to fold, “the pericardium is dried, preferably with artificial light using a multi-watt lamp with the pericardium or other biocompatible membrane material placed in a flat aluminum surface to dry it homogeneously.” *Id.* at 10:21–25. “A photomechanical drying machine can

also be used” and “[t]he final result is a homogeneous tissue that looks like plastic paper and makes it easy to manipulate to fold and suture the valve.” *Id.* at 10:25–28.

D. Illustrative Claims

Petitioner challenges claims 1–10. Pet. 1. Claims 1 and 6 are independent. Ex. 1001, 14:8–54.

Claims 1 and 6, with Petitioner’s limitation numbering included, are reproduced below.² Pet. App. A.

[1[p]] 1. A replacement heart valve device, comprising:
[1[a]] a stent member, the stent member configured to be compressible and expandable; and
[1[b]] a dry valve directly sutured to the stent member,
[1[c]] wherein the dry valve includes two to four leaflets made of a treated mammalian pericardium tissue,
[1[d]] wherein the treated mammalian pericardium tissue has been treated with glutaraldehyde, glycerol and gas sterilized, and
[1[e]] wherein the treated mammalian pericardium tissue forming the dry valve has been subjected to light and mechanical compression to decrease the molecular distance of collagen fibers.

Ex. 1001, 14:8–19.

[6[p]] 6. An assembly for percutaneous and transluminal delivery of a medical implant, comprising:
[6[a]] a delivery and implantation system including a flexible catheter; and
[6[b]] a replacement heart valve device residing within the flexible catheter and configured for delivery by the flexible catheter, the replacement heart valve device including:

² We have reproduced each limitation as a separate paragraph to aid the reader.

[6[c]] a stent member, the stent member configured to be compressible and expandable; and

[6[d]] a dry valve directly sutured to the stent member,

[6[e]] wherein the dry valve includes two to four leaflets made of treated mammalian pericardium tissue,

[6[f]] wherein the treated mammalian pericardium tissue has been treated with glutaraldehyde, glycerol, and gas sterilized, and

[6[g]] wherein the treated mammalian pericardium tissue forming the dry valve has been subjected to light and mechanical compression to decrease the molecular distance of collagen fibers.

Ex. 1001, 14:28–46.

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–10	103	Scott, ³ Chen ^{4,5}
2, 5, 7, 10	103	Scott, Chen, Andersen ^{6,7}

³ Scott et al., U.S. Patent Publication No. 2003/0212454 A1, published November 13, 2003 (Ex. 1010) (“Scott”).

⁴ Chen et al., U.S. Patent 6,534,004 B2, published March 18, 2003 (Ex. 1009) (“Chen”).

⁵ The Petition lists “[k]nowledge of a PHOSITA [(person of ordinary skill in the art)]” as prior art relied upon in this challenge. The knowledge of a person of ordinary skill in the art is not a patent or printed publication, and thus, not proper grounds for a petition for *inter partes* review. 37 C.F.R. § 42.104. Accordingly, we understand the grounds to be based on the combined teachings of Scott and Chen.

⁶ Andersen et al., U.S. Patent 5,411,552, published May 2, 1995 (Ex. 1006) (“Andersen”).

⁷ As noted above, “[k]nowledge of a PHOSITA” is not a patent or printed publication. Accordingly, we understand this ground to be based on the combined teachings of Scott, Chen, and Andersen.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–10	103	Paniagua ⁸ , Chen, Scott

Pet. 25. In addition to the references listed above, Petitioner relies on the Declaration of Michael J. Scott, Ph.D. (Ex. 1003).

II. ANALYSIS

A. *Level of Ordinary Skill in the Art*

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. United States*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner proposes that a person of ordinary skill in the art “would have been a medical device engineer or scientist with a working knowledge of the chemical treatment of biological tissue used in bioprosthetic heart valves and the design of bioprosthetic heart valves.” Pet. 37–38 (citing Ex. 1003 ¶¶ 25–29). Patent Owner “does not dispute Petitioners’ definition of a person of ordinary skill in the art.” Prelim Resp. 3 (citing Pet. 37–38).

For purposes of this Decision, we adopt Petitioner’s proposal as reasonable and consistent with the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

⁸ Paniagua et al., U.S. Patent Publication No. 2003/0130729 A1, published July 10, 2003 (Ex. 1011) (“Paniagua”).

B. Claim Construction

For petitions filed on or after November 13, 2018, the “broadest reasonable interpretation” standard has been replaced with the federal court claim construction standard that is used to construe a claim in a civil action under 35 U.S.C. § 282(b). This is the same claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny.

In accordance with *Phillips*, the claim terms are generally given their ordinary and customary meaning as would have been understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and even extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

The meaning of the claim term “dry” as it applies to the claimed valve is at issue in this proceeding. Petitioner asserts that “[f]or the purposes of this IPR, the terms should be given their ordinary and customary meaning.” Pet. 35. In the next paragraph, however, Petitioner proposes a definition of the term “dry.” *Id.* Petitioner quotes several portions of the specification of the ’945 patent that discuss the drying process or dried tissue, then asserts that a person of ordinary skill in the art “would have understood that the plain and ordinary meaning of ‘dry’ is ‘free or relatively free from water or liquid.’” *Id.* at 35–37. Immediately after setting forth this definition, Petitioner contends that a person of ordinary skill in the art “would have

understood that the term ‘dry’ as that term is used in the ’945 patent claims to describe a heart valve is where the tissue is substantially free from water,” which is a different definition of the claim term “dry” than the preceding definition. *Id.* at 37 (citing Ex. 1003 ¶ 87).

Patent Owner agrees with the former definition, but not the latter. Prelim. Resp. 11. Specifically, Patent Owner does not agree that the cited passages of the ’945 patent “limit the drying process to the removal of water only.” *Id.* Rather, Patent Owner asserts that these passages “instead describe methods that remove both water and other liquids from the tissue.” *Id.* at 11–12 (citing Pet. 46–47 (quoting Ex. 1001, 5:58–60, internal citation omitted)).

Regarding drying of the material from which the valve is made, the ’945 patent states that

Once the pericardium is completely clean, the material is dried in order to make it easier to handle and fold. Preferably, this drying is done by exposing the biocompatible membrane material to photomechanical compression to remove all lipids from the pericardium or other biocompatible membrane material and to cause protein denaturalization, transforming the material into a stronger and more homogeneous surface.

Ex. 1001, 5:42–50. The ’945 patent further states that once the valve is formed and placed in a sequence of solutions (one of isopropyl alcohol of about 70–100%, one of ethanol of about 70–100%, one of glycerol and one of glutaraldehyde, preferably at a concentration of about 0.07–25%) for approximately 36 hours, it is “dried in order to make it easier to handle and fold. Preferably this drying is done by exposing the biocompatible membrane material to light and then mechanically compressing the material to cause protein denaturation.” *Id.* at 5:52–60. The ’945 patent describes

the use of alternative materials that are also cleaned, pressed, and dried to make the folding more practicable. *Id.* at 5:64–6:5.

On the record before us, we agree with Patent Owner that in the context of the claimed invention a “dry” valve is one made of tissue from which water and other liquids are removed. This understanding is consistent with Petitioner’s initial position that a person of ordinary skill in the art “would have understood that the plain and ordinary meaning of ‘dry’ is ‘free or relatively free from water or liquid.’” Pet. 37 (citing Ex. 1003 ¶ 86 (citing Ex. 1033, 696)). We do not agree with Petitioner’s second position that a person of ordinary skill in the art “would have understood that the term ‘dry’ as that term is used in the ’945 Patent claims to describe a heart valve is where the tissue is substantially free from water” because neither the Petition nor Petitioner’s expert, Mr. Scott, cite any authority in support of this position or provide a reasoned explanation as to why this would be so. Pet. 37; Ex. 1003 ¶ 87.

For purposes of this decision, we adopt Patent Owner’s definition of “dry” as “free or relatively free from water or liquid.” Prelim. Resp. 12 (citing Pet. 37).

Patent Owner also proposes claim construction for “to decrease the molecular distance of collagen fibers” and “dry valve has been subjected to light and mechanical compression to decrease the molecular distance of collagen fibers.” Prelim. Resp. 12–16. Construction of these terms, however, is not required in order to resolve the controversy before us. Accordingly, we do not construe this claim language at this time.

C. Ground One: Obviousness of Claims 1–10 Based on the Combined Teachings of Scott and Chen

1. Overview of Scott

Scott “relates generally to medical devices and particularly to compressed bioprosthetic tissue leaflets for heart valve prostheses.”

Ex. 1010 ¶ 1. Scott explains that “most common tissue valves are constructed with whole porcine (pig) valves, or with separate leaflets cut from bovine (cow) pericardium” and that most minimally invasive surgery valves “utilize one or more radially expanding stents coupled to a biological valve, and the assembly must be compressed radially and then passed through the lumen of a large bore catheter.” *Id.* ¶¶ 3, 8. Scott discloses a method of making a heart valve using a sheet material that is bioprosthetic tissue and “crosslinking the sheet material during or just after the step of compressing.” *Id.* ¶ 13.

Scott’s Figures 1 and 2 are reproduced below.

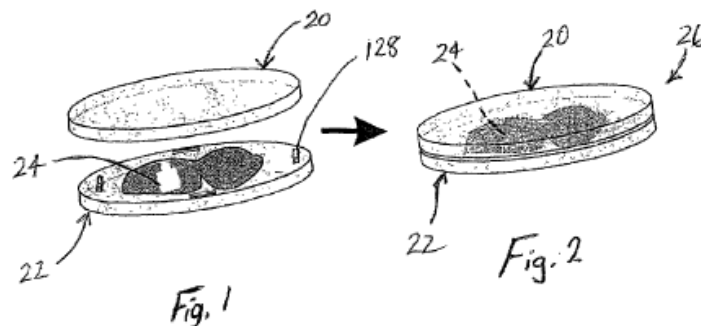


Figure 1 “is a perspective view of a separated pair of compression substrates and a tissue sheet placed on an inner surface of one of the substrates”; Figure 2 is “a perspective view of the compression substrates” of Figure 1 “brought together to sandwich the tissue sheet therebetween.” *Id.* ¶¶ 20, 21.

“[T]issue sheet 24 is the basic component” of Scott’s tissue compression process in which compressive weight adds to the existing weight of upper

tissue of the present invention will substantially retain its reduced thickness.” *Id.*

2. *Overview of Chen*

Chen “relates to an implantable tissue component that can be stored dry.” Ex. 1009, 2:32–33. According to Chen, “[a] number of implantable bioprosthetic devices are currently being used for treating patients with cardiovascular diseases and defects” and “patches made from bovine pericardium may be used for various types of tissue repair.” *Id.* at 1:11–13, 1:21–23. Chen discloses that its tissue component and the interstices thereof comprises “a dimensional stabilizer selected from the group consisting of a polyhydric alcohol and derivatives thereof, a water soluble carbohydrate, and a water soluble gum.” *Id.* at 2:33–37.

Chen explains that “the tissue component is fixed by cross-linking the amine groups of the proteins of the tissue component with an aldehyde” and “[t]he aldehydes conventionally used for this purpose include glutaraldehyde or formaldehyde.” *Id.* at 3:19–23. “[T]he tissue component is treated with an aqueous solution comprising at least one non-volatile, biocompatible, dimensional stabilizer at a concentration and temperature and for a time sufficient to allow an equilibrium to be reached between the fluids in the interstices of the tissue component and the aqueous solution” and “preferably, the aqueous solution comprises glycerol or a derivative thereof, most preferably glycerol.” *Id.* at 3:33–39, 3:55–57.

Further, the tissue component can be “exposed to ambient air at standard room temperature and humidity (at a temperature from about 15° C. to about 25° C., and relative humidity from about 10% to about 30%) following treatment with the aqueous treatment solution” and is then “air dried for a time sufficient to increase the viscosity of the dimensional

stabilizer in the solution entrapped within the interstices of the tissue component such that the treated tissue component is essentially free from excess aqueous treatment solution.” *Id.* at 4:25–34. Chen discloses that increasing the viscosity “permits the dimensional stabilizer to remain within the interstices during subsequent processing of the tissue component or the bioprosthetic device comprising the tissue component, i.e., during sterilization and storage” and “[r]emoval of excess aqueous treatment solution enhances packaging and handling of the tissue component.” *Id.* at 4:37–43.

3. *Analysis*

Petitioner asserts that claims 1–10 are unpatentable over the combined teachings of Scott and Chen. Pet. 25, 38–56. In particular, Petitioner asserts that Scott discloses a dry valve as required by independent claims 1 and 6, and by dependent claims 2–5 and 7–10 based on their dependence from either claim 1 or claim 6. *Id.* at 39 (citing Ex. 1010 ¶ 37); *see also id.* at 56. Petitioner asserts that Scott describes compression of bioprosthetic tissue by squeezing water from the tissue. *Id.* According to Petitioner, a person of ordinary skill in the art “would have understood that squeezing the water from the tissue which reduces the thickness of the pericardium in the preferred range of 50%-60% and higher results in a dry tissue, i.e., tissue that is substantially free from water.” *Id.* at 40 (citing *id.* at 35–37; Ex. 1003 ¶ 91).

Patent Owner contends that “[w]hat Petitioners conveniently omit from their discussion of Scott 454 is its repeated disclosure that the leaflets that are sutured to the stent to form the heart valve are formed from tissue that has been compressed—and either *simultaneously with or after* this compression step—fixed in a cross-linking *solution* comprising

glutaraldehyde.” Prelim. Resp. 20. Thus, according to Patent Owner, “the tissue Scott 454 discloses suturing to the stent is anything but dry.” *Id.*

Scott discloses a heart valve made from bioprosthetic tissue that is compressed by squeezing water from the tissue. Ex. 1010 ¶ 37. Scott states that “if the tissue is fixed during or immediately after the compression, it will retain its reduced thickness even if re-introduced into an aqueous solution.” *Id.* Scott then states that “the tissue will not significantly rehydrate because it has been crosslinked and is no longer as porous as the fresh tissue.” *Id.* Petitioner does not convince us that tissue that is “not significantly rehydrated” and less porous than fresh tissue is necessarily the same as “dry” tissue in accordance with the definition of “dry” adopted in Section II B above. For this reason, we agree with Patent Owner that Scott does not disclose or suggest “a dry valve directly sutured to the stent member” as required by claims 1 and 6. Ex. 1001, 14:11, 14:37. The Petition does not rely on Chen to cure this deficiency in Scott.

Claims 1 and 6 further require subjecting “the treated mammalian pericardium tissue forming the dry valve” “to light and mechanical compression to decrease the molecular distance of collagen fibers.” Ex. 1001, 14:15–18, 14:42–45. Petitioner asserts that Scott “discloses subjecting the tissue to mechanical compression to reduce the thickness of the tissue and reduce any nonuniformity of thickness.” Pet. 47. Petitioner asserts further that it “would have been obvious to a PHOSITA to subject the tissue to light to accelerate the drying of tissue.” Pet. 48 (citing Ex. 1003 ¶ 102). According to Petitioner, “a PHOSITA would have known that an incandescent light bulb produces sufficient heat to dry tissue.” *Id.* at 48–49 (citing Ex. 1011 ¶ 50; Ex. 1032, 490; Ex. 1021, 2:45–47; Ex. 1022, 1:65–71; Ex. 1023, 3:32–38; Ex. 1024, 3:25–31). Petitioner asserts that “A PHOSITA

would have been motivated to use light to accelerate the drying of tissue because there is always a desire to minimize the time required to manufacture a product as a means to reduce cost and reduce the likelihood that a product exposed to the manufacturing environment becomes contaminated.” *Id.* at 49 (citing Ex. 1003 ¶ 102).

Patent Owner contends that Scott does not disclose a dry valve subjected to light to decrease the molecular distance of the collagen fibers. Prelim. Resp. 32. Patent Owner contends further that Petitioner does not even allege that Scott or any other reference teaches subjecting tissue to light to decrease the molecular distance of collagen fibers. *See id.* at 35.

On the record before us, we agree with Patent Owner that Petitioner does not adequately explain why a person of ordinary skill in the art would subject Scott’s dry valve to light to decrease the molecular distance of the collagen fibers. Scott describes the use of compression to decrease the molecular distance of the collagen fibers. Petitioner does not explain how subjecting the compressed tissue to light would further decrease the molecular distance of the collagen fibers as required by claims 1 and 6. Indeed, Petitioner merely asserts that such treatment was known and that is would decrease manufacturing time. Pet. 48–49. For this reason, we agree with Patent Owner that Scott does not disclose or suggest a dry valve “wherein the treated mammalian pericardium tissue forming the dry valve has been subjected to light and mechanical compression to decrease the molecular distance of collagen fibers.” as required by claims 1 and 6. Ex. 1001, 14:15–18, 14:42–45. The Petition does not rely on Chen to cure this deficiency in Scott.

For these reasons, on the record before us, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that the combined teachings of Scott and Chen render claims 1–10 unpatentable.

D. Obviousness of Claims 2, 5, 7, and 10 Based on the Combined Teachings of Scott, Chen, and Andersen

1. Overview of Andersen

Andersen “relates to a valve prosthesis, preferably a cardiac valve prosthesis, for implantation in the body and comprising a collapsible elastical valve which is mounted on an elastical stent wherein the commissural points of the elastical collapsible valve are mounted on the cylinder surface of the elastical stent.” Ex. 1006, 1:13–18. Andersen discloses that when its valve prosthesis “is introduced and placed correctly, the stent is expanded by self-expansion or by means of the expansion arrangement until the stent is given an outer dimension which is slightly larger than the channel in which it is placed.” *Id.* at 2:56–60.

2. Analysis

Petitioner asserts that claims 2, 5, 7, and 10 are unpatentable over the combined teachings of Scott, Chen, and Andersen. Pet. 25, 51–53, 56. Claims 2 and 5 depend from claim 1 and claims 7 and 10 depend from claim 6. Andersen does not cure the deficiencies in Scott discussed in the prior section. Thus, the proposed combination does not meet the limitations inherited by each of claims 2, 5, 7, and 10 based on their dependence from either claim 1 or claim 6.

Accordingly, on the record before us, Petitioner does not demonstrate a reasonable likelihood of prevailing in showing that the combined teachings of Scott, Chen, and Andersen render claims 2, 5, 7, and 10 unpatentable.

E. Obviousness of Claims 1–10 Based on the Combined Teachings of Paniagua, Chen, and Scott

1. Overview of Paniagua

Paniagua “is directed to a percutaneously implantable replacement heart valve and method of making same.” Ex. 1011 ¶ 2. One type of replacement heart valve is a tissue valve that is “constructed by sewing the leaflets of pig aortic valves to a stent to hold the leaflets in proper position, or by constructing valve leaflets from the pericardial sac of cows or pigs and sewing them to a stent.” *Id.* ¶ 17. However, “[t]he pericardium is a thin and very slippery [membrane], which makes it difficult for suturing in a millimetrically precise way.” *Id.* Paniagua purports to solve this problem in the making of a replacement heart valve that includes tissue by using “a process to dry the pericardium in such a way that makes it possible to handle and fold more easily.” *Id.*

Figure 5 of Paniagua depicts an exemplary replacement heart valve device and is reproduced below.

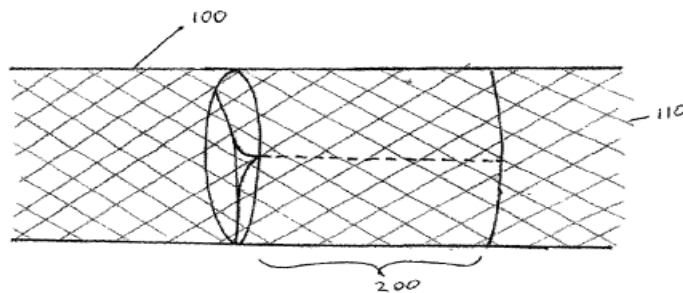


Figure 5 shows a side view of a replacement heart valve device that includes a self-expanding stent in the expanded position. *Id.* ¶ 33. The replacement heart valve device comprises stent member 100 and flexible valve means 200. *Id.* ¶ 37. Stent member 100 includes wire 110 “formed in a closed zigzag configuration” and “is preferably self-expanding although balloon-expandable stents can be used as well, and has a first cylindrical shape in its compressed or collapsed configuration and a second, larger cylindrical shape in its expanded configuration.” *Id.* ¶¶ 37, 40. Valve means 200 comprises generally tubular portion 210 and is preferably “a peripheral upstanding cusp or leaflet portion 220” (shown in Figure 1). *Id.* ¶ 37. Valve means 200 is disposed within cylindrical stent member 100 with tubular portion 210 “transverse of and at some acute angle relative to the stent walls.” *Id.* The preferred material for valve means 200 “is bovine pericardium tissue.” *Id.* ¶ 46.

Paniagua discloses that in order to make the valve, “the bovine pericardium material is isolated and all the fat tissue and extra fibers are removed.” *Id.* ¶ 49. “Once the pericardium is completely clean, it is placed in a solution of gluteraldehyde, preferably at a concentration of about 0.07% during 36 hours, then the pericardium is transferred to a solution of ethanol, preferably at a concentration of about 60% before making the valve.” *Id.*

Paniagua discloses in order to make the pericardium material less slippery and easier to fold, “the pericardium is dried, preferably with artificial light using a 60-watt lamp with the pericardium material placed in a flat aluminum surface to dry it homogeneously.” *Id.* ¶ 50. “A photo drying machine can also be used” and “[t]he final result is a homogeneous tissue that looks like plastic paper and makes it easy to manipulate to fold and suture the valve.” *Id.*

2. *Analysis*

Petitioner asserts that claims 1–10 are unpatentable over the combined teachings of Paniagua, Chen, and Scott. Pet. 25, 56–67. For independent claims 1 and 6, and based on their dependence from one of these claims, dependent claims 2–5 and 7–10, Petitioner asserts that Paniagua discloses most of the limitations of these claims. *Id.* at 56–67. For the limitations requiring the treatment of mammalian pericardium tissue with glutaraldehyde, glycerol, and gas sterilization, Petitioner asserts that “Chen discloses treating the tissue with glycerol following fixation with glutaraldehyde to prevent the tissue from shrinking during the drying process.” Pet. 60. Petitioner asserts further that a person of ordinary skill in the art would have been “motivated to combine Paniagua’s bioprosthetic heart valve tissue treatment with Chen’s method of using glycerol following fixation in view of Chen’s disclosure that treatment with glycerol is useful for preparing biological materials for gas sterilization and for dry storage, particularly for bioprosthetic heart valves.” *Id.* at 60–61 (citing Ex. 1009, 7:3–11) (internal citations and footnote omitted).

Patent Owner argues that Petitioner fails to demonstrate a reasonable expectation of success in combining the teachings of Paniagua, Chen, and Scott. Prelim. Resp. 47. In other words, Patent Owner contends that the result of the application of Chen’s method to Paniagua’s valve would not result in a dry valve as required by the claims. *See id.* at 48–49.

Specifically, Patent Owner argues that

Chen teaches that the tissue is treated with an aqueous solution containing a dimensional stabilizer such as glycerol, and then “*air dried* for a time *sufficient to increase the viscosity of the dimensional stabilizer* in the solution *entrapped within the interstices of the tissue* component such that the treated tissue

component is essentially free from *excess* aqueous treatment solution.

Id. at 48 (citing Ex. 1009, 4:29–34; *id.* at 3:33–45, 4:10–12 (internal quotations omitted)). According to Patent Owner, “Chen goes on to explain that ‘[i]ncreasing the viscosity as described above ***permits the dimensional stabilizer to remain within the interstices*** during subsequent processing of the tissue component or the bioprosthetic device comprising the tissue component, i.e., during sterilization and storage.’” *Id.* at 48–49. Thus, Patent Owner asserts, “Chen aims to achieve a balance between ‘[r]emoval of *excess* aqueous treatment solution,’ while not actually *drying* the tissue, in order to ‘permit[] the dimensional stabilizer to remain within the interstices’ of the tissue.” *Id.* at 49 (citing Ex. 1009, 4:37–43).

Considering these teachings in Chen, we agree that Petitioner has not convincingly demonstrated that application of Chen’s tissue treatment method to Paniagua’s valve would result in a dry valve as claimed. We agree with Patent Owner, that the resulting valve would have excess aqueous treatment solution removed, but not all solution removed. Thus, the resulting valve would not be “dry” in accordance with the definition of this term we adopted in Section II.B above. For this reason, Petitioner has not demonstrated a reasonable likelihood of prevailing in showing that claims 1–10 are unpatentable over the combined teachings of Paniagua, Chen, and Scott.

F. Discretionary Denial Under 35 U.S.C. § 325(d)

As we have determined that Petitioner does not demonstrate a reasonable likelihood of prevailing for any claim on any ground, we need not consider whether application of the Director’s discretionary authority to

deny institution in accordance with 35 U.S.C. § 325(d) is appropriate in this proceeding.

III. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petition is denied as to all challenged claims, and no trial is instituted.

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