

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**EDWARDS LIFESCIENCES CORPORATION AND
EDWARDS LIFESCIENCES LLC**

Petitioners,

v.

Aortic Innovations, LLC

Patent Owner.

IPR2021-****

Patent No. 10,966,846

**DECLARATION OF NIGEL BULLER, M.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 10,966,846**

<i>Edwards v. Aortic Innovations</i> U.S. Patent 10,966,846 Edwards Ex. 1003

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I, Dr. Nigel Buller, M.D., do hereby declare:

I. INTRODUCTION

A. Engagement

1. I have been retained on behalf of Edwards Lifesciences Corporation and Edwards Lifesciences LLC (collectively, “Edwards” or “Petitioner”) to provide my opinion regarding the patentability of claims 1-12 of U.S. Patent No. 10,966,846 (“the ’846 patent”). For the reasons discussed herein, I have concluded that claims 1-12 of the ’846 patent are unpatentable because the prior art references anticipate the claims or render them obvious.

2. I understand that this Declaration supports Edwards’ Petition for the above-captioned *inter partes* review (“IPR”) of the ’846 patent. I have reviewed the Petition and agree with the unpatentability arguments contained therein.

3. I reserve the right to supplement, change, clarify, or modify my opinions should additional information and/or documentation become available to me. I also reserve the right to submit a rebuttal declaration in response to any expert declaration(s) submitted on behalf of the owner of the ’846 patent, Aortic Innovations, LLC (“Aortic Innovations” or “Patent Owner”).

4. I am being compensated at my customary hourly rate for my work in this matter and I am being reimbursed at cost for my expenses. My compensation

in no way depends upon the substance of my opinions or the outcome of this proceeding. I have no financial interest in any of the parties to this proceeding.

B. Experience and Qualifications

5. My experience and qualifications are summarized in my *curriculum vitae*, a copy of which is included as Exhibit 1004.

6. I am a retired Consultant Cardiologist. Until January of 2008, I was Head of Interventional Cardiology at the Queen Elizabeth Hospital, Birmingham and the Lead Clinician for the Cardiac Catheterization Laboratories. The Cardiology Department at the Queen Elizabeth is one of the leading cardiology departments in the UK and one of only five centers in the UK that provides fully comprehensive adult cardiological services including interventional cardiology, electrophysiology, grown-up congenital heart disease and heart transplantation.

7. I have conducted or directly supervised more than 8000 diagnostic and therapeutic non-surgical catheterization procedures since I was first appointed to a National Health Service consultant post in 1990.

8. During my medical training, I was awarded The John Mellanby Scholarship to fund an Intercalated Bachelor of Science degree. In 1977, I received a BSc (First Class Honours) in Physiology from the University of London. Modules included muscle physiology and biophysics at University College London (UCL), for which my tutor was the late Professor Andrew Huxley

FRS, and neurophysiology at the Sherrington School of Physiology, for which my tutor was Professor John Stephens.

9. Following my degree, I was awarded an MRC Training Fellowship to continue my research at UCL and submit a PhD thesis. However, I declined the offer and continued my clinical medical training. Nevertheless, during the three years of undergraduate clinical training I continued my research work in my spare time and, before qualifying in medicine, I had published some of the results of my research in both Nature and The Journal of Physiology. In 1980, I was awarded MB BS by St. Thomas's Hospital Medical School, University of London. In 1983, I became a member and, in 1996, I was elected a Fellow of the Royal College of Physicians in London.

10. I have held a number of positions within highly regarded cardiology departments in the UK.

11. From 1995 to 2010, I was Honoree Senior Lecturer in cardiovascular medicine at the University of Birmingham (UK).

12. From 1995 to 2008, I was employed full time at Queen Elizabeth Hospital, Birmingham.

13. From 1991 to 1995, I was Senior Lecturer in the Department of Interventional Cardiology and Cardiac Medicine at the National Heart and Lung

Institute in London, and Honorary Consultant Cardiologist at the Royal Brompton National Heart and Lung Hospital.

14. Before that, I was a Senior Registrar in Cardiology at Harefield Hospital, Middlesex, and the Royal Free Hospital, London and prior to that a Registrar at the National Heart Hospital, London.

15. From 1984 to 1986, I worked for Smith Kline & French Research Ltd, Philadelphia, USA, as a Research Physician and then as a project Chairman in Cardiovascular Drug Development.

16. My first formal postgraduate training in cardiology was at St. Thomas's Hospital and The Middlesex Hospital in 1981 and 1982, respectively.

17. During my years as a junior doctor I trained in all aspects of cardiology but my interest developed in cardiac catheterization and non-surgical interventional cardiology. My mentor was the late Dr. Anthony Rickards who had performed the first successful coronary artery angioplasty in the UK in 1980. By 1990, I was considered fully trained in catheterization techniques and interventional cardiology including angioplasty and valvuloplasty.

18. In 1990, I was appointed to and, in March 1991, I took up the position of Senior Lecturer in Interventional Cardiology at the National Heart and Lung Institute in London and was the third consultant interventional cardiologist to join

Dr. Anthony Rickards and Dr. Ulrich Sigwart at the Royal Brompton National Heart and Lung Hospital, London.

19. I have routinely assessed and investigated patients suffering from valvular heart disease. Such investigations typically include electrocardiogram (ECG), chest X-ray (CXR) and echocardiography (a sonar examination to obtain detailed anatomical images and functional assessment of the heart and heart valves). These three tests are non-invasive and typically provide confirmation of the clinical diagnosis and allow selection of those patients that require further invasive investigation by means of diagnostic catheterization of the heart (passing flexible tubes through the veins and/or arteries and into the chambers of the heart) for hemodynamic (pressure and flow) measurements and angiography (injection of a radiopaque contrast media into the chambers and blood vessels of the heart so as further to document detailed anatomical and functional information on X-ray imaging). With this information it is then usually possible to determine the cause, the severity and the options for treatment of a patients' heart valve disease.

20. My research interests have included the prevention, diagnosis and treatment of heart disease and the development and clinical application of stents and especially coronary artery stents. I have been an investigator for many national and international scientific clinical trials.

21. My earliest “hands on” clinical involvement with stent implantation was in 1987 when working with the late Dr. Anthony Rickards when I assisted him with the first insertions of stents into human coronary arteries in the UK. Stents were difficult to obtain at the time and initially were only for use in situations of acute or threatened closure after balloon angioplasty. This early work was experimental in nature. I have since conducted large numbers of stenting implantation procedures with stents made by many different manufacturers.

22. During 1991 to 1993, I was an investigator for the Benestent Trial (the major international multicenter “proof of concept” trial designed to demonstrate the benefit of elective stent placement over simple balloon angioplasty in the treatment of coronary artery disease), the results of which were subsequently published in the New England Journal of Medicine in 1994.

23. In 1993, Ulrich Sigwart and I were the co-investigators for the “First-in-Man” study of Guidant Corporation’s “Multilink Stent” that subsequently became the long standing market leader for bare metal stents.

24. In 1994, I implanted the first drug coated stent in a patient in the UK. In the same year I was approved by the U.S. Food and Drug Administration (FDA) to act as a proctor to supervise and oversee the first elective implantations of coronary artery stents in the U.S. (an FDA requirement) following the FDA

approval of the Johnson & Johnson Palmaz-Schatz coronary artery stent. In this latter role I worked at more than fifty of the leading U.S. cardiology departments.

25. In 2013, I received hands-on training on the use and implantation of transcatheter heart valve (“THV”) technology at the New York Presbyterian Hospital.

26. Throughout my career I have had a close working relationship with the research and development departments in the medical device and pharmaceutical industries. I have served on the advisory boards for many of the major medical device manufacturers, including SCIMED, Boston Scientific, Medtronic, Cordis and Guidant/Abbott.

C. Topics of Opinions

27. I offer opinions in this Declaration on the following general topics:

- The subject matter described and claimed in the ’846 patent;
- The level of ordinary skill in the art pertaining to the ’846 patent;
- The teachings of the prior art; and
- Whether claims 1-12 of the ’846 patent are anticipated and/or would have been obvious to a person of ordinary skill in the art at the time of the alleged invention, in view of the prior art.

28. I also provide background information on medical products and devices, including devices for replacing and repairing heart valves.

D. Materials Considered

29. In preparing this Declaration, I have considered the materials referenced in this Declaration and identified in the attached list of exhibits.

30. I also have relied on my education, training, and experience, and my knowledge of pertinent literature in the field of the '846 patent.

II. APPLICABLE LEGAL STANDARDS

31. I am a medical doctor by training and profession. The opinions I am expressing in this Declaration involve the application of my education, training and technical knowledge and experience to the evaluation of certain prior art with respect to the '011 patent.

32. Although I have been previously involved as a technical expert in patent matters, I am not an expert in patent law. Therefore, I have been advised of certain principles of patent law applicable in this matter, which I have used in arriving at my determinations and opinions. The paragraphs below express my understanding of how I must apply these principles in forming my opinions.

A. Claim Construction

33. I have been instructed that in determining whether a patent claim is unpatentable in view of the prior art, the Patent Office construes the claim by giving the claim its ordinary and customary (i.e., plain and ordinary) meaning ascribed to it by a person of ordinary skill in the art at the time of the invention,

consistent with the specification and prosecution history. For the purposes of my analysis and opinions, and to the extent necessary, I have construed each claim term in accordance with its ordinary and customary meaning under the required standard. While I have construed each claim term in light of the specification, I have not imported limitations from the specification into the claim terms; in other words, I have not narrowed the scope of the claim terms by implicitly adding disclosed limitations that have no express basis in the claims.

B. Anticipation

34. I have been instructed that a claim is “anticipated” if a prior art reference describes, either expressly or inherently, each limitation of the claim. I understand that this description must be recognizable to a person of ordinary skill in the art at the time of the alleged invention.

35. I understand that an element is “inherent in,” and therefore taught by, the prior art, if it necessarily flows from the explicit disclosure of the prior art. The fact that a certain result or characteristic may be present in the prior art is not sufficient to establish inherency. However, if the result or characteristic is necessarily present based upon the explicit disclosure in the prior art, it is inherent in the prior art and is therefore disclosed.

C. Obviousness

36. I have been instructed that a claim is “obvious” if the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. An obviousness analysis takes into account the scope and content of the prior art, the differences between the claimed subject matter and the prior art, and the level of ordinary skill in the art at the time of the invention.

37. In determining the scope and content of the prior art, I understand that a reference is considered analogous (i.e., appropriate) prior art if it falls within the field of the inventor’s endeavor. In addition, a reference is prior art if it is reasonably pertinent to the particular problem with which the inventor was involved. A reference is reasonably pertinent if it logically would have commended itself to an inventor’s attention in considering the problem. If a reference relates to the same problem as the claimed invention, that supports use of the reference as prior art in an obviousness analysis.

38. The prior art references applied in this Declaration are analogous art that is usable in an obviousness combination. The references are from the same field as the ’846 patent, e.g., minimally invasive devices for treating heart valves. The references are also pertinent to the problem the inventor was focused on, e.g., treating aortic regurgitation or stenosis through a minimally invasive procedure.

39. To assess the differences between prior art and the claimed subject matter, I have been instructed that the law requires the claimed invention to be considered as a whole. This “as a whole” assessment requires showing that one of ordinary skill in the art at the time of invention, confronted by the same problems as the inventor and with no knowledge of the claimed invention, would have selected the elements from the prior art and combined them in the claimed manner.

40. I am also informed that the law recognizes several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include:

- combining prior art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;
- a predictable use of prior art elements according to their established functions;
- applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
- choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and

- some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

41. A prior art reference may also suggest a limitation of the claims. In that case, even if the prior art reference does not explicitly or inherently disclose the limitation, the motivation to modify the prior art reference to include the limitation may exist within the prior art reference itself. Thus, the limitation would have been obvious over that prior art reference alone. This is the case if a person of ordinary skill in the art would have had a simple design choice or a finite number of identified, predictable solutions, for example, and if the modification furthers the goals of the prior art reference.

42. I have also been informed that the obviousness analysis must be performed from the perspective of a person of ordinary skill in the art at the time of the alleged invention. This is to avoid using impermissible hindsight in the analysis. The claims of the patent must not be used to provide a road map for obviousness; instead, the claims would have been obvious if a person of ordinary skill in the art would have been motivated to combine the teachings of the prior art to arrive at the claimed invention and had a reasonable expectation of success in doing so.

43. An obviousness analysis also must consider whether there are additional factors that would indicate that the invention would not have been obvious. These factors include whether there was: (i) a long-felt need in the industry; (ii) any unexpected results; (iii) skepticism of the invention; (iv) a teaching away from the invention; (v) commercial success; (vi) praise by others for the invention; and (vii) copying by others. I am not aware of any evidence that would suggest that claims 1-12 of the '846 patent would have been non-obvious, as further explained in Section X below.

D. Person of Ordinary Skill in the Art

44. It is my understanding that when interpreting the claims of the '846 patent, I must do so based on the perspective of a person of ordinary skill in the art at the relevant priority date. I have been instructed to assume for the purposes of my opinions that the relevant priority date of the '846 patent is November 7, 2012. However, my opinions would not change if the relevant priority date were December 6, 2011 (the earliest filing date identified on the face of the '846 patent). I have been informed that all of the references relied upon in this Declaration qualify as prior art under either priority date.

45. I am informed that the person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. This is a person of ordinary creativity, not an automaton.

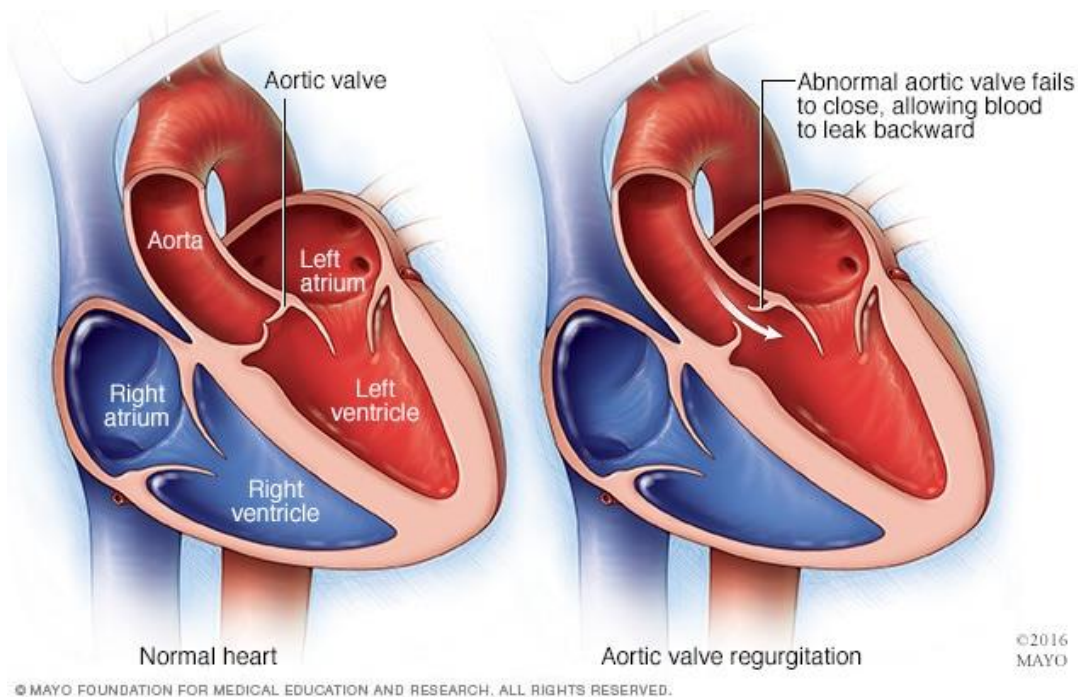
46. I am informed that in determining the level of ordinary skill in the art, several factors are considered. Those factors may include: (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) the rapidity with which innovations are made; (iv) the sophistication of the technology; and (v) the educational level of active workers in the field. A person of ordinary skill in the art must have the capability of understanding the scientific and engineering principles applicable to the pertinent art.

47. Based on my review of the specification and claims of the '846 patent, it is my opinion that a person of ordinary skill in the art would have been an interventional cardiologist with a working knowledge of heart valve designs and endovascular prostheses. This person of ordinary skill in the art would, where necessary, work as a team in combination with a medical device engineer to experiment with or manufacture a prosthetic heart valve.

III. BACKGROUND OF HEART VALVE TECHNOLOGY

A. Anatomy of the Aortic Valve

48. The aortic valve lies between the left ventricle and the aorta. As shown below, the aortic valve leaflets extend distally (to use the terminology in the '846 patent) towards the aorta.



Available at: <https://www.mayoclinic.org/diseases-conditions/aortic-valve-disease/symptoms-causes/syc-20355117#dialogId16413996>.

49. The claims of the '846 patent state that “expansion of the valve assembly is configured to press some of the fibers against the native leaflets of the aorta of the patient.” See *e.g.*, Ex. 1001 ('846 patent) at claim 1. As described below, persons of ordinary skill in the art would have understood that if the fibers press against the annulus of the aortic valve, they must also press against the leaflets.

50. The '846 patent identifies the annulus (identified by item #210) as the point where the aortic valve leaflets attach to the left ventricle:

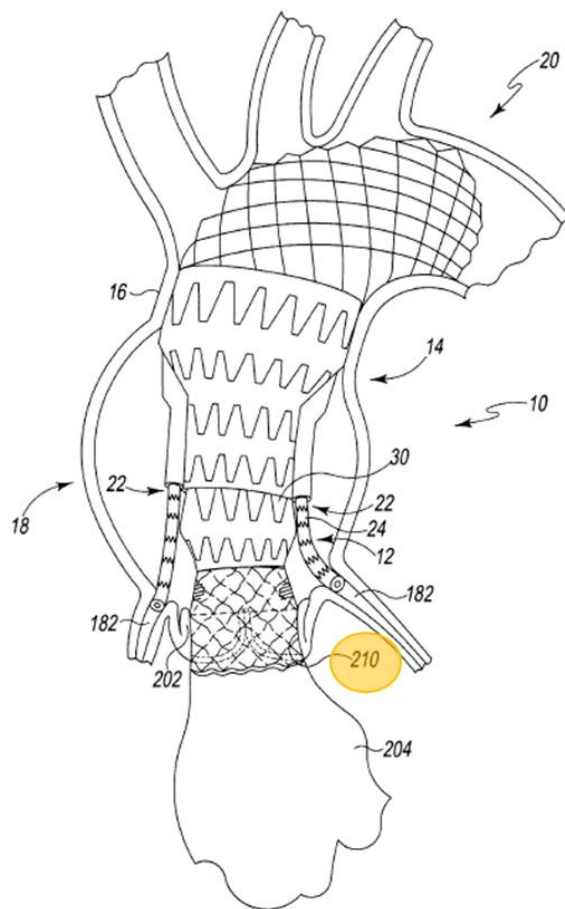
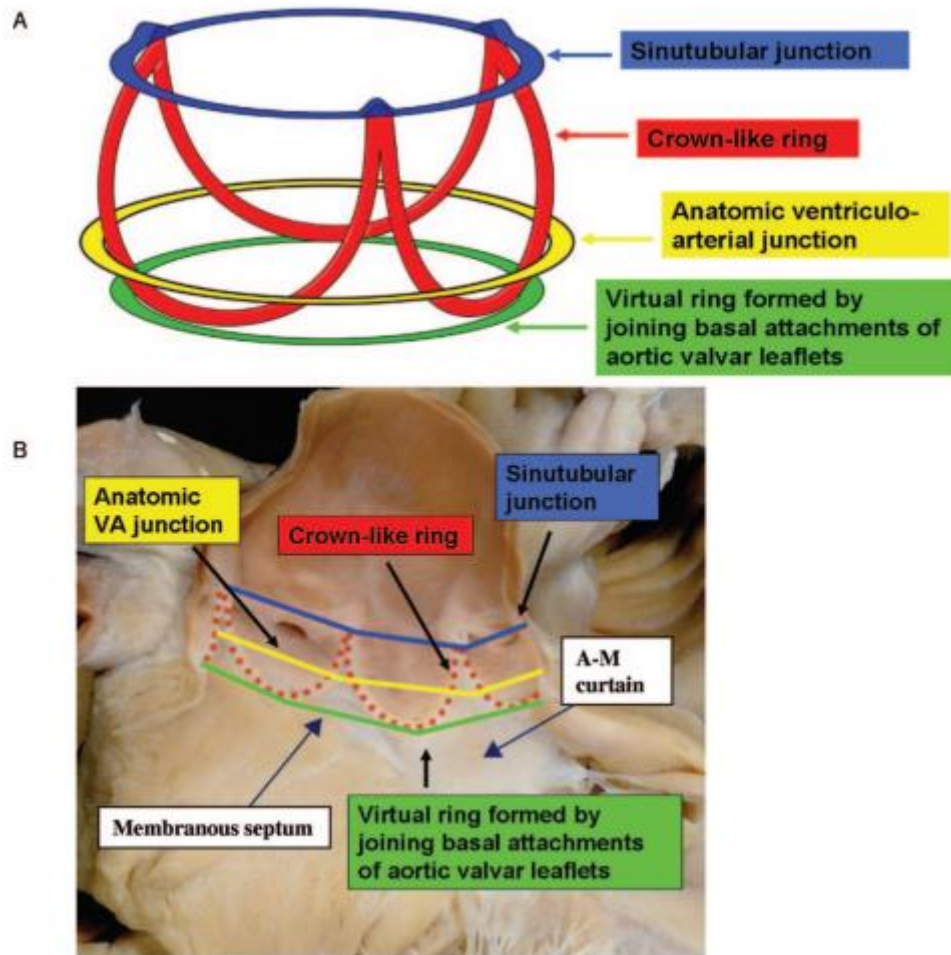


Fig. 2

See *e.g.*, *id.* at Fig. 2.¹ This is further confirmed by the '846 patent's description that the "normal aortic root and the ascending aorta are composed of the aortic annulus, the sinuses of the Valvsalve, the sinutubular junction, and the tubular portion." *Id.* at 1:58-60. The below image from a prior art journal article reflects the structure of the aortic valve. The '846 patent identifies the green line as the annulus.

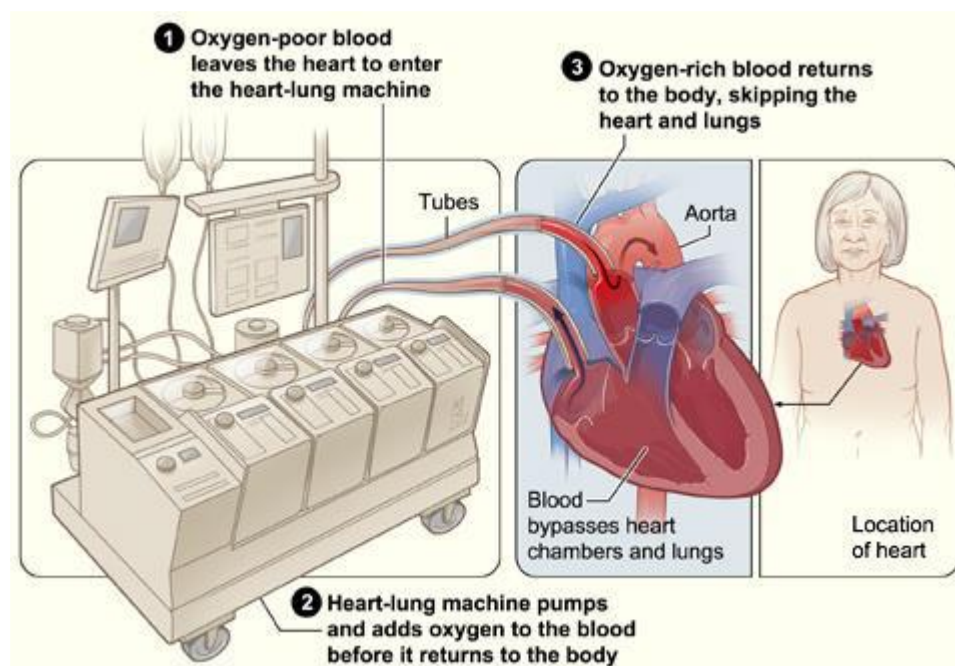
¹ Highlighting and color has been added to all figures unless otherwise noted.



Ex. 1047 (Piazza) at Fig. 4. Because the “annulus” referred to in the ’846 patent is the point where the leaflets begin, a person of ordinary skill in the art would have recognized that fibers pressing against the annulus must also press against the valve leaflets. *Id.* at 76. The journal article confirms this to be the case. SAPIEN, the valve disclosed in the Cribier and Walther references relied upon herein, was positioned within the annulus (i.e., intra-annular) and “once deployed, crushes the leaflets of the native valve against the wall.” *Id.* at 74.

B. Surgical Prosthetic Heart Valves

51. Petitioner Edwards was founded by Miles “Lowell” Edwards in 1958. Edwards’ earliest work related to prosthetic heart valves that could be implanted surgically. Implantation of these devices involves an open surgical procedure that requires use of a heart-lung machine. In order to surgically implant a prosthetic heart valve, a surgeon opens a patient’s chest and the patient is connected to a heart-lung bypass machine, after which the heart can be arrested. The surgeon then surgically removes the diseased native valve and sutures the prosthetic valve in place. A diagram detailing the operation of a heart-lung machine is pictured below:

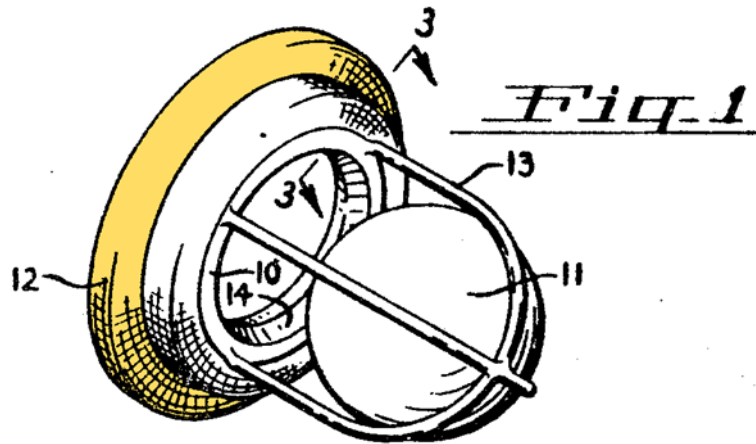


Available at http://www.daviddarling.info/encyclopedia/H/heart_surgery.html.

This procedure is used today for patients receiving a surgically implantable prosthetic heart valve.

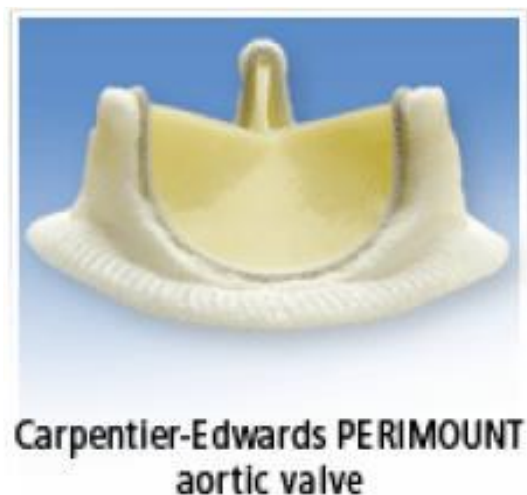
52. One of Edwards' first commercially available surgical valves was a ball and cage valve called the Starr-Edwards valve. U.S. Patent No. 3,365,728 (the "'728 patent"), which issued on January 30, 1968, details the features of this valve. **Ex. 1013** ('728 patent). Notably, even this early valve prosthesis included a circumferentially oriented sewing ring that was adapted to extend into spaces in the tissue surrounding the implanted prosthesis to prevent leakage between the prosthetic valve and the surrounding tissue (*i.e.*, "paravalvular leak"). The '728 patent states:

Connected to the periphery of the valve ring is a suturable sewing ring [12] by which the valve may be connected by sutures with living tissue around the natural orifice in which the valve is implanted. The sewing ring is upholstered with a ring of compressible cushion material which will conform to irregularities in the bed in which the valve is placed whereby a good seal is established and leakage between the valve and the tissue is prevented.



Id. at 1:38-46, 3:12-20, Figs. 1, 3. Thus, paravalvular leak was a well-recognized complication of surgical valve replacement as early as the 1960s.

53. In addition to ball and cage valves, Edwards also developed surgically implantable valves with biological valve leaflets. The biological valve structure could be made with a whole excised valve or formed with pericardial tissue, primarily of bovine or porcine origin. Edwards' PERIMOUNT valve, for example, was first introduced in 1980 and included a tri-leaflet bovine pericardial valve and a frame having a fabric sewing ring akin to the Starr-Edwards valve:



See e.g., <https://www.edwards.com/gb/devices/heart-valves/aortic-pericardial> (describing Carpentier-Edwards PERIMOUNT valve).

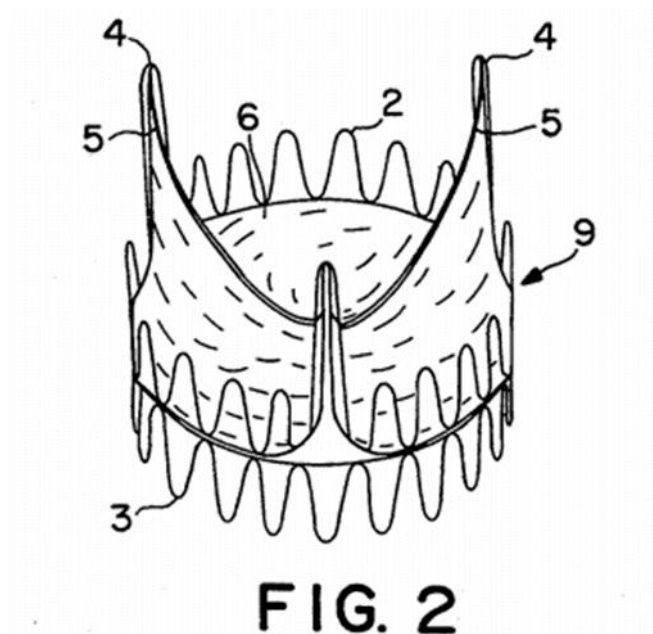
C. Transcatheter Heart Valve (“THV”) Technology

54. THV technology is aimed at providing a patient with a permanently implanted prosthetic heart valve that can be delivered via a catheter.

55. In 1989, Danish doctor Henning Rud Andersen conceived of the seminal invention of a permanently implanted transcatheter bioprosthetic heart valve. That year, Dr. Andersen and his colleagues, Drs. Michael Hasenkam and Lars Knudsen, built the first prototype by hand. The Danish team successfully implanted its prototype in pigs using a catheterization procedure.

56. The Danish team published their results in 1992. **Ex. 1034** (Andersen, Henning, et al., *Transluminal implantation of artificial heart valves. Description of a new expandable aortic valve and initial results with implantation by catheter technique in closed chest pigs*, European Heart Journal, 13:704-08 (1992)). There, Drs. Andersen, Hasenkam, and Knudsen described their hand-made THV, which included “a foldable biological cardiac valve inside a balloon expandable metallic stent.” *Id.*

57. The Danish team’s work also led to several patents, including U.S. Patent No. 5,411,552 (“Andersen patent”). (**Ex. 1014**).



Id. at Fig. 2. The Andersen patent describes multiple THV embodiments that expand upon the inventors' early prototypes, including embodiments having additional tubular graft material that can be used along the surface of the THV. *Id.* at 2:21-27, 2:56-60, 4:3-17, 5:9-28, 7:17-29, Figs. 11-12 (“[T]he stent may be made with a relatively great height and with a cylinder surface which is closed by a suitable material. Thus, a vascular prosthesis known per se is formed wherein the valve is mounted.”).

58. The graft materials used on the external surface of early THVs were designed to conform to the surface of the surrounding tissue. These materials could be made with low-porosity woven fabrics. An early THV detailed in U.S. Patent No. 5,957,949 to Leonhardt et al. (**Ex. 1035**), which issued on September 28, 1999, details graft material to be used as an external cover on a THV:

Graft material 24 is a thin-walled biocompatible, flexible and expandable, low-porosity woven fabric, such as polyester or PTFE. It is capable of substantially conforming to the surface of the living tissue to which stent 26 coerces it.

Ex. 1035 at 5:53-59.

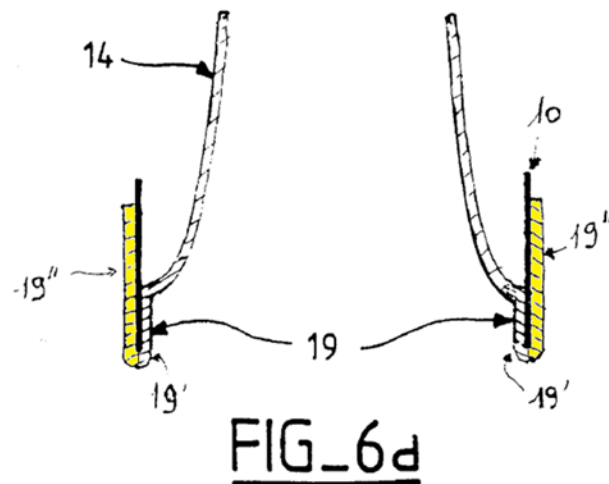
59. In France, Drs. Alain Cribier and Brice Letac conceived of several further THV designs in the mid-1990s. These designs provided the basis for a December 1996 patent application. A family of patents and patent applications stems from this 1996 application, including WO 98/29057 to Letac et al. (“Cribier patent publication”, **Ex. 1018**).

60. This patent publication aims to improve upon the THV technology described in the Andersen patent discussed above. The Cribier patent publication notes that an “aim of the present invention is to provide an efficient prosthesis valve which can be implanted by a catheterization technique, in particular in a stenosed aortic orifice, taking advantage of the strong structure made of the distorted stenosed valve and the large opening area produced by preliminary balloon inflation, performed as an initial step of the procedure.” *Id.* at 5:11-16.

61. Further aims of the Cribier patent publication include providing a THV frame structure capable of withstanding the recoil forces of the native aortic valve in treating aortic stenosis and providing a THV with a frame covering that

“prevent[s] any passage of the body fluid through said frame.” *Id.* at 5:6-10, 8:28-9:6; *see also id.* at 5:17-18, 20:26-21:3, 22:11-20.

62. The embodiment in Figure 6d (below) illustrates an internal cover [19'] that extends from the base of the valve (*i.e.*, the distal end of the valve) to the lower end of the stent [10], which is then “rolled up to be applied to the external wall of the stent” to form an external cover [19'']:

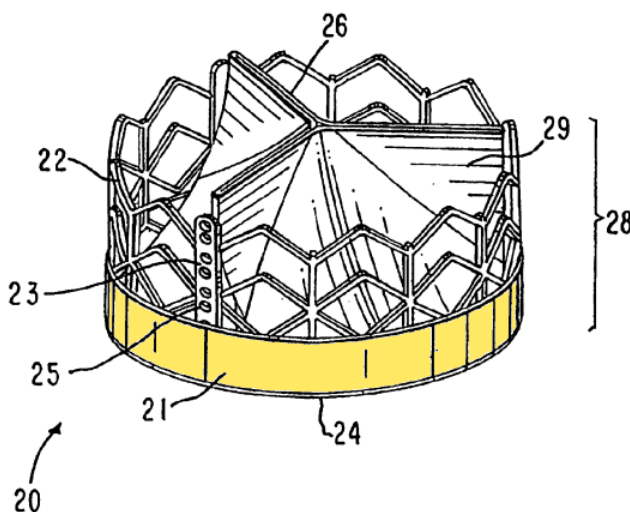


Id. at 22:23-26, Fig. 6d. The single-piece cover is a tubular structure that can be made with any of the materials disclosed for making the valve structure, which include fabric (*e.g.*, Dacron), biological material (*e.g.*, pericardium), or other synthetic materials (*e.g.*, polyethylene). *Id.* at 8:16-23, 22:11-20. The Cribier patent publication discloses multiple ways of securing the cover to the frame. Specifically, the cover can be secured to the frame “at various points of attachment on various parts of the internal [and external] surface” by suturing, molding, gluing, or soldering the cover to the bars of the frame and, in its

expanded state, would prevent blood from flowing between the cover and heart tissue. *Id.* at 22:23-26, 23:15-16, 24:24-27, Fig. 6d; *see also id.* at 23:12-24:23, Figs. 7, 8a-b.

63. Edwards’s U.S. Patent No. 7,585,321 (referred to herein as “Cribier ’321” **Ex. 1045**), claims priority to the Cribier patent publication and includes the THV embodiment having an internal cover that extends beyond and over the proximal end of the stent frame. *Id.* at 13:28-30, Fig. 6d.

64. In 2001, a company named Percutaneous Valve Technologies (“PVT”), which was co-founded by Dr. Cribier and three others (Stan Rowe, Stan Rabinovich, and Dr. Martin Leon), filed a patent application on another THV design that included an external cover:



Ex. 1019 (U.S. Patent No. 6,893,460 B2 to Spenser *et al.* (“’460 patent”)) at Fig.

1. The ’460 patent discloses a THV having a tricuspid valve, a support stent including support beams for securing the commissures of the valve, and a cuff

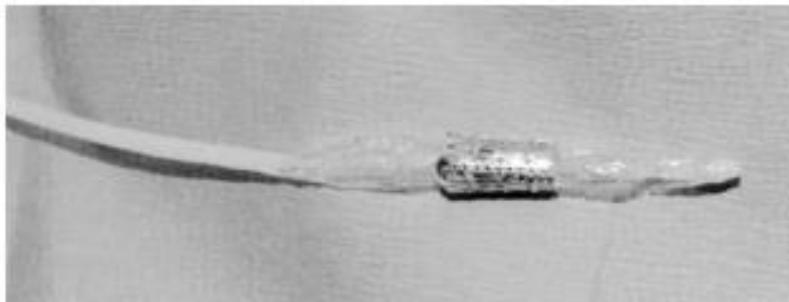
portion wrapped around the support stent at its inlet. *Id.* at 9:1-22, Fig. 1. The '460 patent further discloses that the cuff portion can be rolled up over the edge of the frame to provide a “sleeve-like” portion at the inlet. *Id.* at 8:47-50. This helps prevent leakage. *See id.* (“To prevent leakage from the inlet it is optionally possible to roll up some slack wall of the inlet over the edge of the frame so as to present rolled-up sleeve-like portion at the inlet.”). The cuff portion can be formed with PET (Dacron) fabric. *See id.* at 7:7-10, 10:57-11:10 (“Figs. 8a and 8b demonstrate a method of manufacturing a composite valve, which is based on flexible PU 92 as the main body of the valve, rigid PU support beams 94 serving for the attachment area, and PET sleeve 96 portions for the valve inlet.”).

65. Edwards’s U.S. Patent No. 7,510,575 (referred to herein as “**Spenser**,” **Ex. 1010**), claims priority to the '460 patent and includes the THV embodiment having an outer cuff. **Ex. 1010** at 13:4-25, claim 31, Fig. 1.

66. In April 2002, using a THV developed by PVT, Dr. Cribier performed the first-in-human implantation of a THV in the aortic valve position. **Ex. 1025** (Cribier, Alain, et al., *Percutaneous Transcatheter Implantation of an Aortic Valve Prosthesis for Calcific Aortic Stenosis*, 1006 *Circulation* 3006-3008 (December 10, 2002)).² The THV consisted of three bovine pericardial leaflets

² Dr. Cribier uses the phrase “percutaneous heart valve” or “PHV” to refer to his device. A PHV is the same as a transcatheter heart valve or THV.

mounted within a tubular, slotted stainless steel balloon-expandable stent that was crimped onto a delivery balloon:

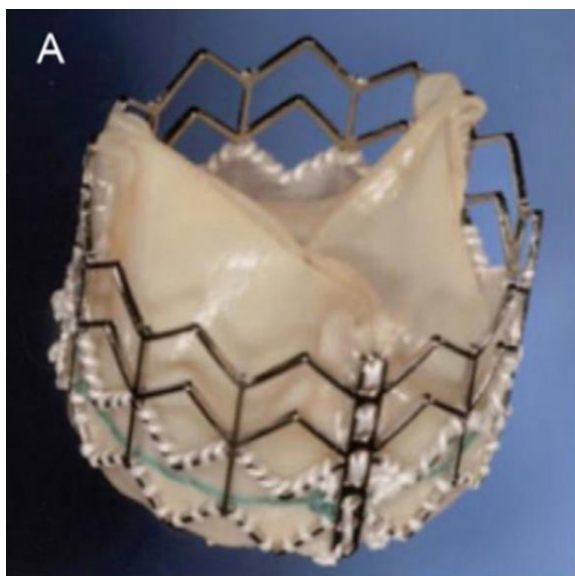


Id. at 3006, Fig. 1. Dr. Cribier implanted the THV using an antegrade approach from the right femoral vein. *Id.* at 3007. Dr. Cribier inserted a 24F sheath into the right femoral vein. The THV was “easily advanced through the sheath, across the interatrial septum, and within the diseased stenotic aortic valve.” *Id.* The balloon was then inflated to place the THV. *Id.* Dr. Cribier concluded that the implantation was successful and demonstrated “the feasibility of implanting a prosthetic heart valve percutaneously, with the use of standard interventional techniques, within the native diseased valve of a patient with calcific aortic stenosis.” *Id.* at 3008.

67. Dr. Cribier continued to successfully use this implantation procedure in later patients. **Ex. 1030** (Cribier Early Experiences). From April 2002 to August 2003, Dr. Cribier attempted THV implantation in six patients. *Id.* at 699. The THV “was successfully and accurately delivered in the subcoronary position in all but one patient.” *Id.* at 700. Dr. Cribier used the “anterograde trans-septal

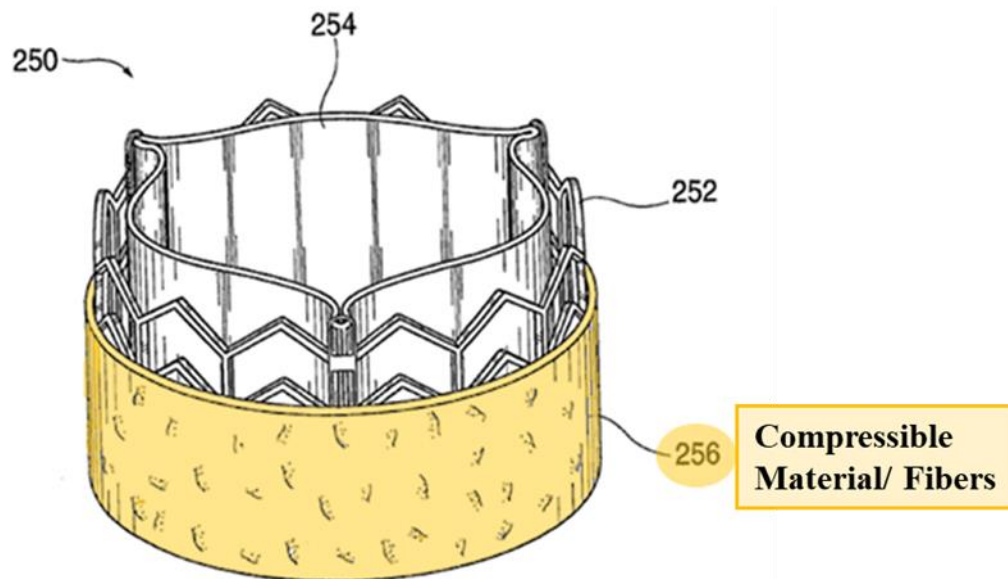
approach” for all cases. *Id.* at 701. Dr. Cribier’s work confirmed “that a bioprosthetic valve can be implanted percutaneously within the native diseased stenotic aortic valve of patients with end-stage life-threatening calcific aortic stenosis, using standard interventional techniques under local anesthesia.” *Id.*

68. In 2004, Edwards acquired PVT and began developing and testing the Cribier-Edwards THV. **Ex. 1023** (Webb, John G. and Binder, Ronald K., *Transcatheter aortic valve implantation: The evolution of prostheses, delivery systems and approaches*, Archives of Cardiovascular Disease 105, 153-159 (March 16, 2012)). The Cribier-Edwards THV “was constructed from a laser-cut stainless steel tubular frame within which was sewn valve leaflets constructed from equine pericardium, with the inflow covered with a fabric sealing cuff (Fig. 3A).” *Id.* at 154.



Id. at Fig. 3A.

69. In 2004, Edwards filed a patent application that formed the basis for PCT Patent Publication WO 2006/005015 A2, referred to herein as **Spenser II (Ex. 1011)**. Spenser II “provides new concepts of percutaneous paravalvular repair, including means for identifying the leak location, repair techniques, and means for leak prevention that can be engineered into the prosthesis itself.” *Id.* at [0014]. Figure 22 (below) “illustrates a valve device, in accordance with another preferred embodiment of the present invention, wherein a layer of compressible material, such as a cloth material, is provided along an exterior surface of a stented valve.” *Id.* at [0085].



Id. at Fig. 22. As shown, “a layer of compressible material 256 is disposed along an outer surface of the stent structure 252.” *Id.* at [00145]. The material “may extend entirely around the stent structure, such as in the form of a sleeve.” *Id.* “In

one preferred embodiment, the compressible material is formed from polyethylene terephthalate (PET) and has a thickness ranging from about 1 to 5 mm.” *Id.* “In certain configurations, the compressible material 256 may resemble a cloth or fabric having small fibers extending from the surface of the material. In various embodiments, the fibers may be straight, curved or hook-shaped.” *Id.*

70. Spenser II explains that the purpose of the compressible material is “to reduce or prevent paravalvular leakage.” *Id.* Spenser II states:

The compressible material expands after deployment at the treatment site. As the compressible material expands, it fills the gaps between the stented valve and the surrounding tissue. Accordingly, the compressible material creates a mechanical seal that prevents paravalvular leakage. In addition, the compressible material, and especially the fibers, may be adapted to encourage coagulation of blood to further fill the gaps and prevent leakage. In an alternative configuration, a tissue growth factor may be applied to the compressible material for promoting the growth of tissue into the material, thereby further sealing the gaps.”

Id.

71. Edwards did not merely patent THVs having outer sealing materials. Edwards also worked with clinical groups on both sides of the Atlantic to add an

outer cloth to the external surface of a THV frame. In 2008, Edwards collaborated with Dr. Anson Cheung and other physicians to develop and test “a cuffed, 26-mm Cribier Edwards transcatheter valve.” **Ex. 1017** (Cheung, Anson, et al., *Transapical Transcatheter Mitral Valve-in-Valve Implantation in a Human*, *Annals of Thoracic Surgery*, 87:e 18-20 (2009)) at e18.

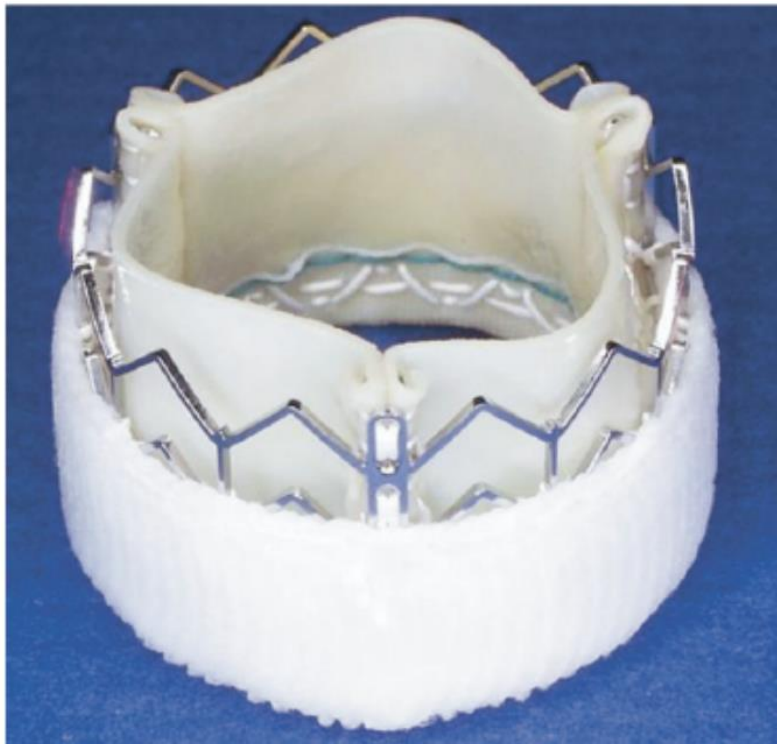


Fig 2. The fabric cuff surrounding the Cribier-Edwards transcatheter valve may provide a better seal for valve-in-valve applications (photograph courtesy of Edwards Lifesciences LLC, Irvine, CA).

Id. at Fig.2. Dr. Cheung implanted the cuffed Cribier-Edwards valve within a patient’s existing mitral bioprosthesis (Carpentier-Edwards PERIMOUNT Plus 6900P valve) using a transapical approach. *Id.* at e18. In the transapical approach, the valve is inserted through the patient’s heart wall. Dr. Cheung and his team

“used a cuffed device for the valve-in-valve implant to provide a better seal within the rigid support ring, minimizing paraprosthetic leak.”³ *Id.* at e19.

72. By 2007, Edwards had modified the Cribier-Edwards valve to create SAPIEN, which included more durable bovine leaflets and a higher internal sealing cuff. **Ex. 1023** (Webb) at 154. SAPIEN was the subject of a large clinical trial, referred to as the PARTNER Trial. **Ex. 1022** (Smith, Craig R., et al., *Transcatheter versus Surgical Aortic-Valve Replacement in High-Risk Patients*, 364 N. Engl. J. Med. 23, 2187-2198 (June 9, 2011)). The results of the PARTNER Trial were published in The New England Journal of Medicine in 2010. *Id.* SAPIEN addressed a long-felt need in the industry for an aortic valve replacement device that did not require open-heart surgery. In view of its pioneering status, SAPIEN’s development and progress were avidly followed in the industry and SAPIEN was discussed in numerous publications and textbooks. *See e.g.*, **Ex. 1009** (Conradi), **Ex. 1016** (Alkashkari, MD, et al., *Percutaneous Pulmonary Valve Implantation for RVOT Defects*, Cardiac Interventions Today, 21-29 (September/October 2010)), **Ex. 1031** (Akin, Jodi and Sharma, Pooja, “Chapter 8: The Edwards SAPIEN Transcatheter Aortic Heart Valve System,” *Transcatheter Aortic Valve Implantation*, edited by Patrick W. Serruys, et al., CRC Press, 2010, 102-114). For

³ “Paraprosthetic,” “perivalvular,” and “paravalvular” leakage are used interchangeably in the prior art to mean leaks around the prosthetic valve.

example, the **Cribier** publication extensively discusses the transfemoral delivery of SAPIEN to a patient's heart valve. **Ex. 1012** (Cribier, Alain, et al., *Technique of Transcatheter Aortic Valve Implantation with the Edwards-Sapien Heart Valve Using the Transfemoral Approach*, Herz, 34:347-56 (2009)). Edwards received regulatory approval to commercially sell SAPIEN in Europe in 2007. **Ex. 1038** (Press Release: Edwards Lifesciences Receives CE Mark for Edwards SAPIEN Transcatheter Heart Valve (Sept. 5, 2007)). In 2011, the FDA approved the transfemoral delivery of SAPIEN for the treatment of inoperable patients with severe symptomatic aortic stenosis. **Ex 1032** (2011 FDA Approval). In 2012, the FDA approved the use of SAPIEN to treat high-risk aortic stenosis patients using the transfemoral and transapical delivery approaches. **Ex. 1033** (2012 FDA Approval).

73. In 2010, Dr. Thomas Walther and several Edwards engineers conducted a valve-in-valve study “focused on the use of an Edwards SAPIEN trans-catheter heart valve (THV) cloth valve (see Fig. 1), which is identical to the SAPIEN, but has an added outer cloth for implantation into a degenerative bovine pericardium, Carpentier-Edwards Perimount (CEP) bioprosthetic valve.” **Ex. 1007** (Walther, Thomas, et al., *Trans-catheter valve-in-valve implantation: in vitro hydrodynamic performance of SAPIEN + cloth trans-catheter heart valve in the*

Carpentier-Edwards Perimount valves, 40 Euro. J. of Cardio-thoracic Surgery 1120-1126 (April 2011)) at 1120.

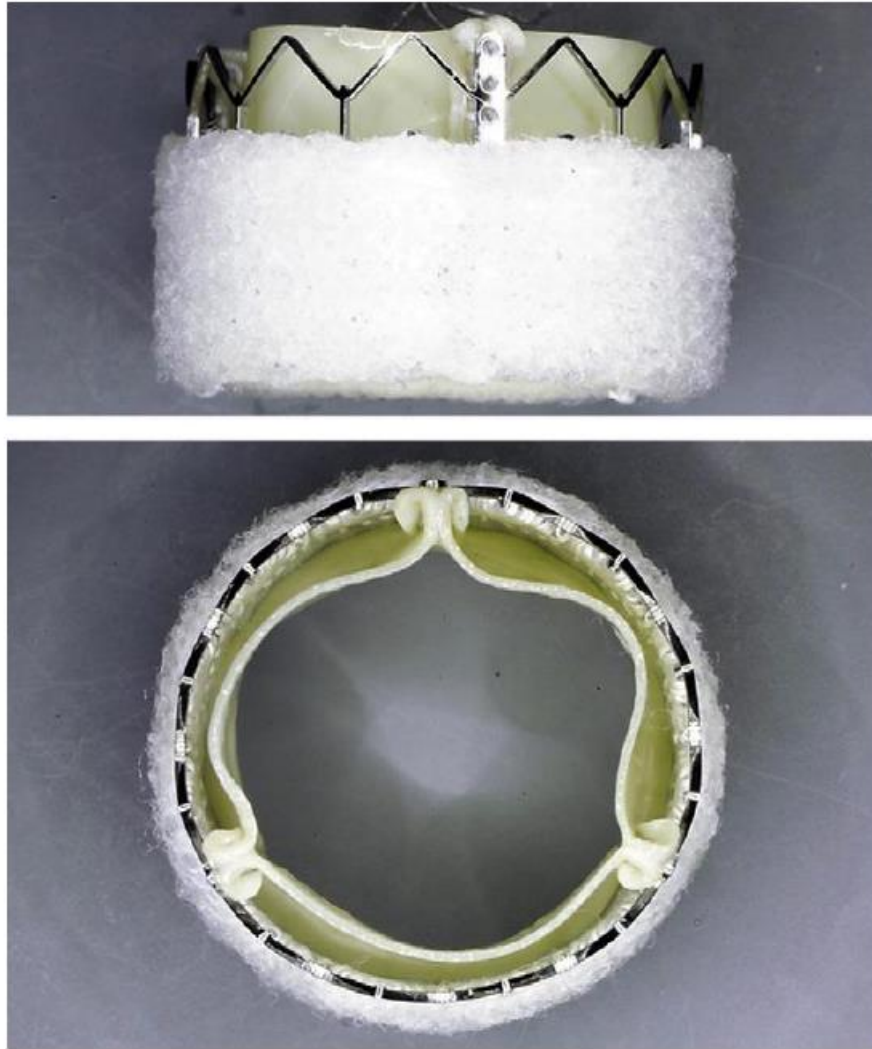
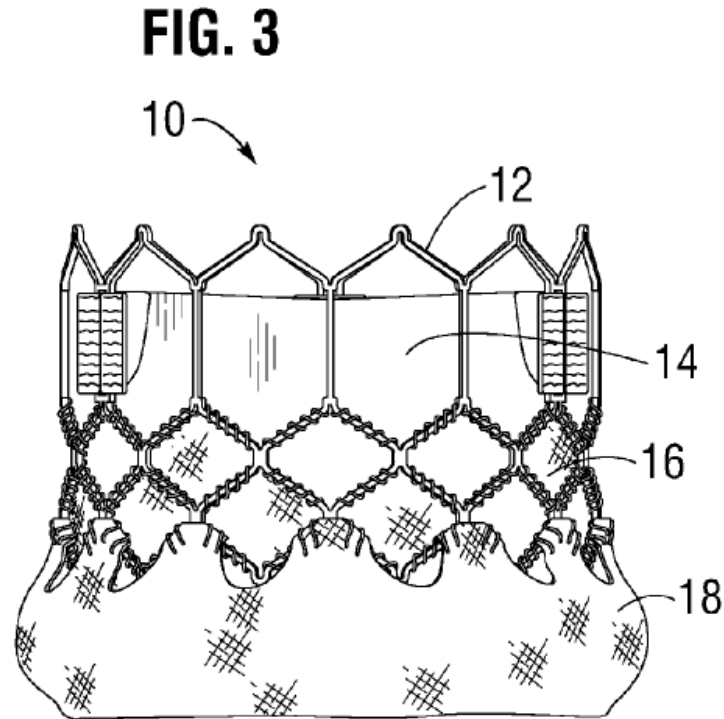


Fig. 1. Cloth valve.

Id. at Fig. 1. The team explained that the “addition of an outer cloth to the SAPIEN cloth valve is designed to reduce paravalvular leak by creating a seal between the two valves and improve resistance to migration with better ‘fit’ within surgical Perimount valves.” *Id.* at 1120. The team concluded that the “SAPIEN +

cloth THV implanted valve-in-valve within the CEP valve demonstrated excellent hydrodynamic performance.” *Id.* at 1125. The team also concluded that an *in vivo* procedure “is feasible.” *Id.*

74. In October 2010, Edwards filed a provisional patent application that matured into U.S. Patent No. 9,393,110 B2, referred to herein as “**Levi**” (**Ex. 1008**). Levi discloses a THV with “four main components: a stent, or frame, 12, a valvular structure 14, an inner skirt 16, and an outer skirt 18”:



Id. at 5:52-58, 6:12-24, 9:7-35, 13:49-14:14, Figs. 1-3, 41-43. “The outer skirt 18 can be laser cut or otherwise formed from a strong, durable piece of material such as woven PET, although other synthetic or natural materials can be used.” *Id.* at 13:49-53. “[W]hen the valve 10 is deployed within the body, the excess material

of the outer skirt 18 can fill in gaps between the frame 12 and the surrounding native annulus to assist in forming a good fluid-tight seal between the valve and the native annulus.” *Id.* at 14:3-7. “The outer skirt 18 therefore cooperates with the inner skirt 16 to avoid perivalvular leakage after implantation of the valve 10.” *Id.* at 14:7-9.

75. The prior-art references identified above demonstrate that Petitioner (and its collaborators) invented and disclosed prosthetic heart valves, and specifically THVs, having an outer sealing material to reduce paravalvular leakage before November 2012. Moreover, by 2012, Petitioner had advanced THV technology to the point that persons of ordinary skill in the art had a number of options they could balance when adding an outer sealing material to a THV device. For example, the prior art demonstrates that persons of ordinary skill in the art had access to a wide range of suitable cloths and fabrics for use as a sealing material. *See e.g.*, Ex. 1007 (Walther) at 1120-21; Ex. 1008 (Levi) at 13:49-53; Ex. 1010 (Spenser) at 13:4-25; Ex. 1011 (Spenser II) at [0085], [00145]; Ex. 1017 (Cheung) at e18-e19; Ex. 1018 (Cribier patent publication) at 8:16-23, 22:11-20. The cloths and fabrics had varying densities, thicknesses, and finishes. *Id.* A person of ordinary skill in the art would have had the option of selecting a cloth or fabric that best suited the specific heart valve assembly and met the necessary size requirements.

76. Additionally, by 2012, Petitioner had developed innovations for the heart valve frame and leaflets to further reduce the size of the heart valve assembly, thereby creating additional space for an outer sealing material. For example, well before November 2012, Edwards had developed SAPIEN XT, which replaced SAPIEN's stainless steel frame with a cobalt chromium alloy. Ex. 1023 (Webb) at 154; Ex. 1036 (Nietlispach, Fabian, et al., *Current Balloon-Expandable Transcatheter Heart Valve and Delivery Systems*, Catheterization and Cardiovascular Interventions, 75:295-300 (2010)) at 296. The cobalt chromium frame allowed "for a thinner, stronger, more open and compressible frame." *Id.*; see also Ex. 1008 (Levi) at 6:31-6:49 (explaining that less material is needed with a cobalt chromium alloy frame). Edwards had also developed methods to reduce the diameter of the inlet portion of the heart valve frame to accommodate a sealing material. Ex. 1008 (Levi) at 16:51-17:18. Likewise, Edwards had disclosed innovative leaflet designs to reduce the crimp profile of the valve and offset or minimize any increase in diameter caused by adding additional components, like a sealing material, to the outside of the valve. *Id.* at 16:24-16:50.

77. Additionally, by 2012, Petitioner had developed delivery systems having smaller diameters than those initially used with SAPIEN. Ex. 1036 (Nietlispach) at 295-297; Ex. 1037 (Le patent publication) at [0005]-[0006]. For example, the Retroflex 3 allowed the transfemoral introduction of SAPIEN 23 or

26 mm valves through 22 or 24 French sheaths. Ex. 1036 (Nietlispach) at 296-297. In contrast, the Novaflex delivery system, the successor to the Retroflex 3, allowed for a reduction in sheath size to 18 French for the 23 mm valve and 19 French for the 26mm valve. *Id.* The Novaflex incorporated an innovative feature where the heart valve was crimped on the inner catheter proximal to the inflatable balloon and then moved onto the balloon once the delivery system had been advanced into the aortic arch. *Id.*; *see also* Ex. 1037 (Le Patent Publication) at [0005]-[0006] (describing off balloon delivery). This unique feature enabled a reduction in sheath size.

78. In 2012, persons of ordinary skill in the art would have been familiar with the above innovations and understood that they could use one or more of the above options to optimize a THV having an outer seal. Thus, the challenged claims are not novel or nonobvious, but merely describe the predictable use of prior art elements according to their established functions.

IV. THE '846 PATENT

A. Summary of the '846 Patent

79. The '846 patent describes endograft devices for repairing ascending aortic aneurysms and replacing defective aortic heart valves. The majority of the embodiments combine multiple components to form a structure that extends into the patient's ascending aorta and aortic arch.

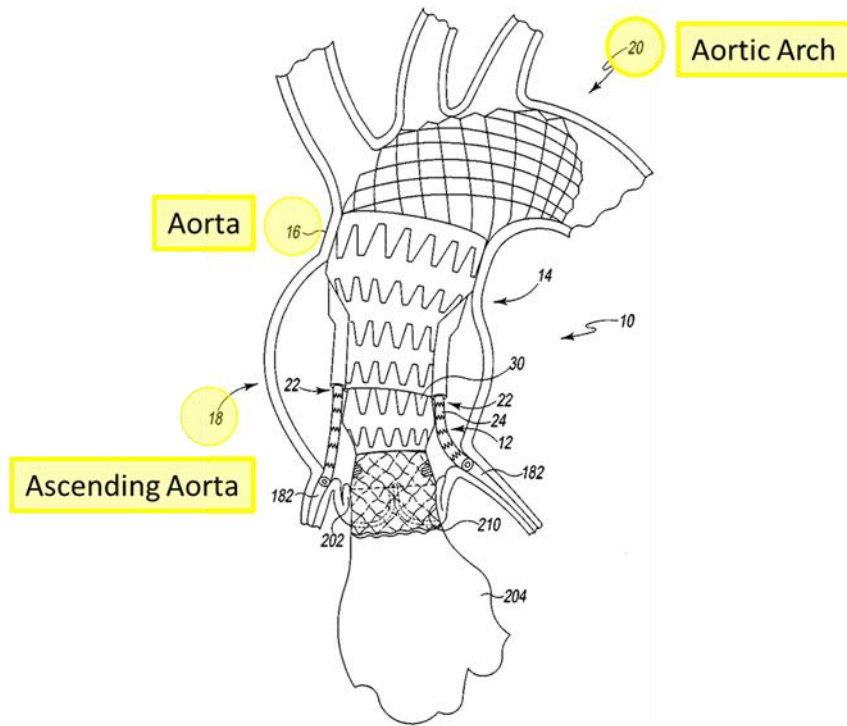


Fig. 2

80. However, the challenged claims of the '846 patent focus on a “valve assembly” for replacing an aortic heart valve. The assembly includes a “dual-frame” extending from a proximal end (i.e., nearest the left ventricle) to a distal end (i.e., furthest from the left ventricle). **Ex. 1001** ('846 patent) 11:61-63; 17:45-47. The “dual-frame” includes a “self-expanding outer frame 216” [red] and a “balloon-expandable inner frame 218 [blue] that is secured to the self-expanding outer frame 216 and houses the valve 32”:

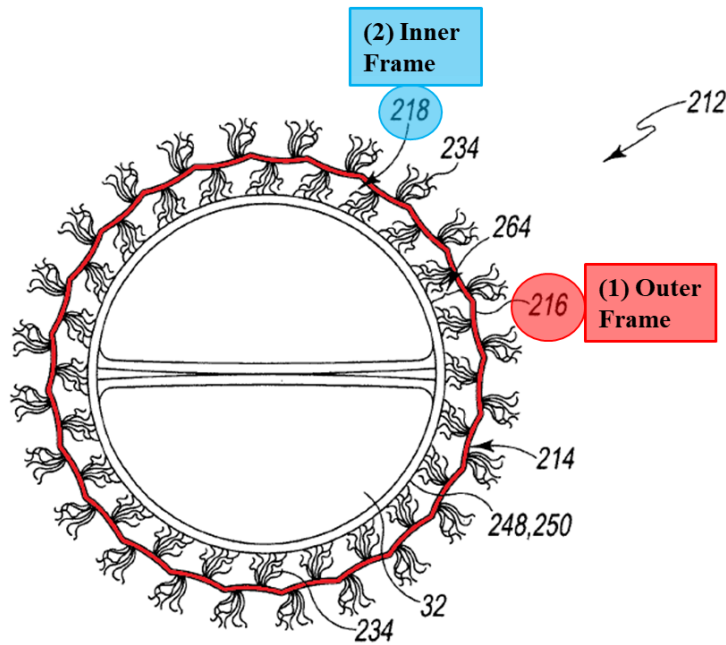
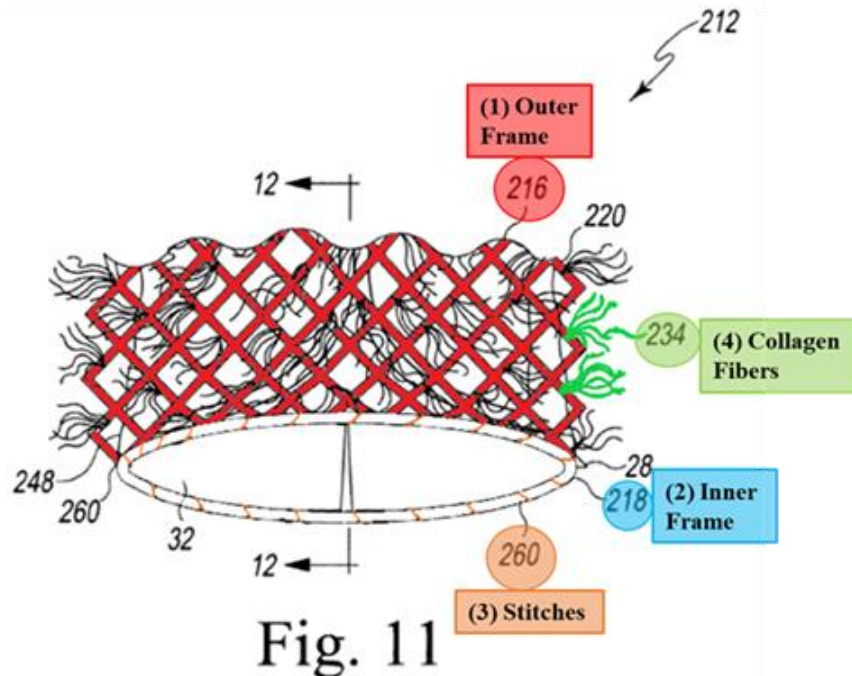


Fig. 13

Id. at 12:9-12, 17:56-59, Fig. 13.

81. The '846 patent states that the outer frame [red] is composed of a metallic or polymeric material that defines a gridded or “open-cell stent configuration.” *Id.* at 12:12-18, 13:17-20, 17:59-64, Fig. 9. The outer frame is self-expanding and may include a plurality of radially extending “collagen fibers” [green] attached to the exterior of the frame “to aid in preventing paravalvular leaks and migration of the [heart valve assembly] within the aortic walls.” *Id.* at 12:43-46, 18:22-25. The inner frame [blue] is a “balloon-expandable tubular stent” constructed of metallic or polymeric material. *Id.* at 13:41-44. The inner frame is secured to the outer frame by a plurality of stitches [orange]. *Id.* at 14:6-8.



82. The outer surfaces of the outer and inner frames may include a covering material, such as polyester, which prevents fluid from passing through the surface of the frame. *Id.* at 13:25-28, 13:51-57, 19:5-8.

83. Claim 10 additionally recites that the graft covering “extends beyond a proximal end of the outer frame and over the proximal end thereof to cover the proximal end of the outer frame.” *See id.* at claim 1. Based on my review of the specification of the ’846 patent, the specification does not describe such an embodiment, as the only description of a “covering material” is limited to a covering on the **outer surfaces** of the self-expanding outer frame or the balloon-expandable inner frame. *See e.g., id.* at 13:25-29, 13:51-57.

84. During prosecution of a predecessor to the ’846 patent, the ’011 patent, Patent Owner identified Figure 11 (above) as allegedly providing support

for this limitation. I disagree that Figure 11 provides supporting disclosure for this limitation. Patent Owner pointed to the “inner frame 218” in Figure 11 as “covering” an end of the outer frame 216. However, as I explained above, the specification teaches that “inner frame 218” is a balloon expandable metal or polymeric stent. *Id.* at 13:38-45. The “inner frame 218” is never described in the specification as a “graft covering,” and thus “inner frame 218” in Figure 11 does not, and cannot, provide supporting disclosure for a graft covering that “extends beyond the proximal end of the outer frame and over the proximal end thereof to cover the proximal end of the outer frame.” Figure 11 also does not depict any inner frame extending beyond and over the proximal end of the outer frame.

B. The Challenged Claims

85. The challenged claims include claims 1-12 of the '846 patent. Claim 1 is the sole independent claim.

86. Claim 1 is illustrative (but not representative) of some of the limitations in the challenged claims. Claim 1 states:

1. A valve assembly comprising:

an outer frame, wherein the outer frame is formed from a metallic material and defines an open cell configuration;

an inner frame that engages a prosthetic heart valve having prosthetic leaflets, wherein the inner frame includes a cylindrically extending inner graft covering extending at least partially radially outwardly of the prosthetic heart valve and radially inwardly of the outer frame for providing sealing to the prosthetic heart valve,

wherein the outer frame is secured to the inner graft covering by stitching at a proximal end of the outer frame;

an outer seal for preventing paravalvular leaks that begins at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame,
wherein the outer seal is attached to the outer frame,
wherein the outer seal is formed of outwardly extending fibers positioned externally to the outer frame,
wherein the outer seal is free of an outer graft covering between the fibers and the outer frame,
wherein the valve assembly has a radially compressed orientation and a radially expanded orientation,
wherein the valve assembly is balloon expandable and expansion of the valve assembly is configured to press some of the fibers against native leaflets of the aorta of the patient.

C. Prosecution History

87. I have reviewed the '846 patent's prosecution history. I see that the Patent Examiner did not make any rejections during prosecution. **Ex. 1002** ('846 patent prosecution history). I also understand that Walther, Spenser, and Cribier were not cited during prosecution.

88. While the Patent Examiner did not discuss any prior art references, I see that Patent Owner made a number of arguments about the prior art and statements concerning the scope of the claims in a Preliminary Amendment.

89. For example, Patent Owner argued that a valve having a frame and inner graft covering is sufficient to meet the limitations “an outer frame” and “an inner frame...wherein the inner frame **includes** a cylindrically extending inner graft covering” during prosecution of the '846 patent. Patent Owner argued the claimed inventions improved upon the art “by having an inner frame that is a graft

covering around the heart valve[.]” Ex. 1002 at 133; *see also id.* at 134 (“Thus, it should be evident that a balloon expandable outer frame...having an outer graft covering of sufficient height, along with an inner graft covering, presented significant engineering design challenges.”). Patent Owner also attempted to distinguish prior art (referred to herein as Spenser II) on the ground that it allegedly did not include a “graft forming the inner frame.” *Id.* at 138; *see also id.* at 145 (“On devices that had an outer seal of more sufficient thickness, the device often did not have an inner seal (see, for example, Spenser)[.]”). Patent Owner also argued that Petitioner’s SAPIEN 3 Ultra product is “covered by the claimed invention” because it “includes an inner frame that is a graft.” *Id.* at 145-146.

90. Patent Owner also made representations about Spenser II in the Preliminary Amendment. Patent Owner admitted that Spenser II teaches “a thick band of fibers emanating therefrom in FIG. 22.” Ex. 1002 (‘846 patent prosecution history) at 138-139. However, in its effort to characterize Spenser II as “thick,” Patent Owner mentioned only the disclosure that Spenser II’s compressible material could be “up to 5 mm” thick. *Id.* at 147. However, Spenser II discloses the material can be only 1 mm thick, five times smaller than the size emphasized by Patent Owner. Thus, Patent Owner’s arguments that Spenser II’s seal would increase diameter size by “up to 10 mm” is incomplete. *Id.* at 147.

91. Patent Owner also tried to distinguish Spenser II by arguing that “there is no graft forming the inner frame, thus the inner sealing is missing.” *Id.*; *see also id.* at 145 (“On devices that had an outer seal of more sufficient thickness, the device often did not have an inner seal (see, for example, Spenser);⁴ this was likely due to increased valve profile, and increased hoop forces that made expansion of the compressed valve more difficult and susceptible to under expansion, or undesirable valve crimp profile.”). However, Patent Owner does not accurately characterize Spenser II. Spenser II does not say that there is no inner graft covering on the valve in Figure 22. The outer compressible material obscures the inner portions of the valve and, thus, it is unclear whether the valve would have an inner graft covering. Moreover, Spenser II never states that including outer and inner seals would disadvantageously increase valve profile or increase hoop forces as alleged by Patent Owner. Such arguments are directly contrary to real-world references like Walther and Levi, which disclose balloon-expandable valves that have outer seals and inner graft coverings. Finally, Patent Owner argues that a person of ordinary skill would not have modified Spenser II to include an inner seal because Spenser II already has an outer seal. However, this argument misunderstands the purpose of the seals. The outer seal reduces

⁴ During prosecution of the ’846 patent, Patent Owner used “Spenser” to refer to the reference called “Spenser II” in this Declaration.

paravalvular leakage between the heart valve and patient's anatomy. In contrast, the inner graft covering prevents leakage between the frame and prosthetic leaflets. As explained more below, to the extent the valve in Figure 22 does not have an inner graft covering, a person of ordinary skill in the art would have found it obvious to combine Spenser II's compressible material with a valve having an inner graft covering, such as Spenser's Figure 44a.

92. Patent Owner also argues that Spenser II "appears to include an outer graft covering between the fibers and the outer frame, which is a claimed negative limitation." Ex. 1002 at 147. This argument is not supported by Spenser II. Spenser II discloses that the compressible material, which "may resemble a cloth or fabric having small fibers extending from the surface of the material," is "disposed along the outer surface" of the stent. Ex. 1011 at [00145]. Spenser II does not disclose any additional "outer graft covering" between the fibrous fabric of the compressible material and the stent frame. Moreover, Spenser II does not contain any disclosure that the compressible material is made of a cloth base or outer graft and a fiber portion.

93. Patent Owner also made representations about Levi in the Preliminary Amendment. Patent Owner admits that Levi "appears to teach an inner and outer seal in FIG. 42." Ex. 1002 at 137-138. However, Patent Owner attempts to dismiss Levi by arguing that "much of the prior art where an inner and outer seal

is disclosed teaches a relatively thin graft material.” *Id.* at 145. However, none of the challenged claims have any “thickness” requirements so it is not clear why this point, even if true, were relevant. Patent Owner also alleges that “[w]hen there was an outer seal, the seal also often had a relatively short height so that the sealing aspects would be below the native leaflets or extending into crevices created by the native leaflets, but not radially overlapping with the leaflets at a most narrow spot of the ascending aorta (see again Cribier, and Levi with the billowing outer graft).” *Id.* However, Levi’s outer skirt satisfies the only height limitation in the claims (outer seal begins at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame) so again it is unclear how this statement, even if true, is relevant. Additionally, the claims do not require the outer seal to radially overlap with the leaflets at a most narrow spot of the ascending aorta.

94. Patent Owner also argues “placing outer seals bands as disclosed by Spencer, [sic] Cribier and Levi, creates significant technical limitations in the functionality of the TAVR device during loading of the device into a sheath and deployment of the devices *in vivo*.” Ex. 1002 at 145. Patent Owner further argues that “the density of this outer seal band (Spencer, [sic] Cribier, and Levi) restricts the necessary foreshortening of the stent frame during deployment *in vivo* and can cause PVL, migration, under-deployment and malfunction of the valve leaflets.”

These statements are incorrect and directly contradicted by Petitioner’s SAPIEN 3 valve, which shares many similarities with the Levi embodiments and became the industry standard for TAVR devices. Likewise, the Walther device was successfully loaded into a sheath for deployment without exhibiting any of the issues described by Patent Owner.

V. SUMMARY OF IPR GROUNDS

95. I have identified the following grounds of unpatentability in this Declaration:

Ground	Claims Challenged	Unpatentability Basis	References
1	1, 3-8, 11-12	103	Cribier + Walther
2	1-12	103	Spenser + Walther
3	1-12	103	Spenser + Spenser II
4	1-12	102(e)	Levi
5	1-12	103	Levi
6	1-12	103	Levi + Walther
7	1-12	103	Levi + Spenser II
8	10	103	Levi + Cribier ’321
9	10	103	Levi + Cribier ’321 + Walther
10	10	103	Levi + Cribier ’321 + Spenser II

VI. GROUND 1: CLAIMS 1, 3-8, 11-12 OBVIOUS OVER

CRIBIER AND WALTHER

96. Cribier is one of the many prior art publications describing SAPIEN. **Ex. 1012** (Cribier). Cribier explains that SAPIEN “consists of a balloon-expandable stent with an integrated bovine pericardial valve.” *Id.* at 347. Cribier states that SAPIEN “can be implanted within the diseased aortic valve using either the retrograde transfemoral or antegrade transapical routes.” *Id.*

97. Walther, as discussed above in my section covering “Transcatheter Heart Valve (“THV”) Technology,” discloses a modified SAPIEN having an added outer cloth:

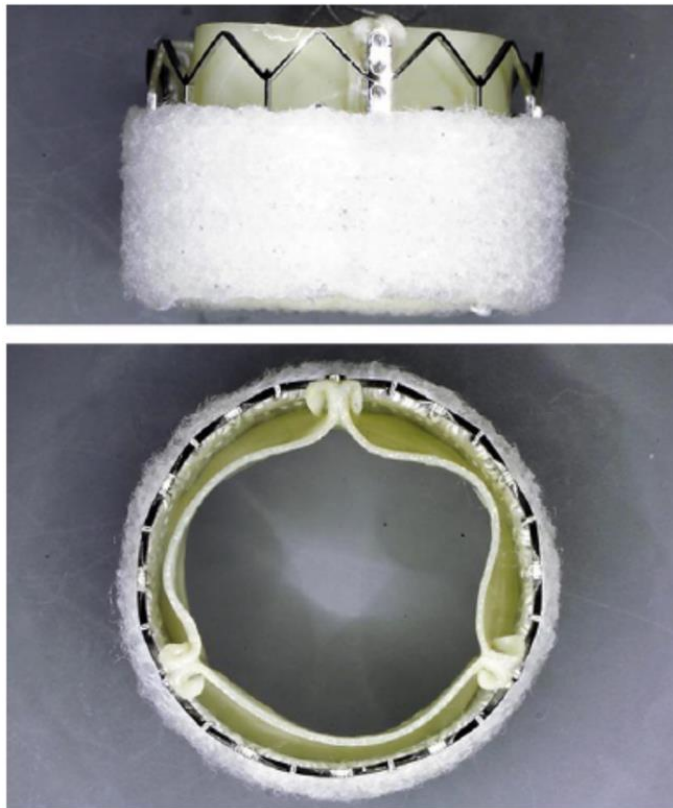


Fig. 1. Cloth valve.

Ex. 1007 (Walther) at 1120-21, Figs. 1-3. Walther explicitly discloses that the modified SAPIENs were “identical” to SAPIEN except for the outer cloth. *Id.* at 1120. SAPIEN would have been well known to a person of ordinary skill in the art by November 2012. Walther generally describes SAPIEN but does not include some of the details about SAPIEN that are discussed in Cribier. Thus, I have combined the teachings of Cribier and Walther to provide a more comprehensive review of the features of the cloth-covered SAPIEN disclosed in Walther. Based on my review of these references, I believe that the combination of Cribier and Walther renders claims 1, 3-8, and 11-12 of the ’846 patent obvious.

A. Claim 1

98. Based on my review of the prior art, it is my opinion that Cribier in combination with Walther renders claim 1 obvious.

1. Preamble

99. The preamble of claim 1 recites: “A valve assembly comprising.”

100. Cribier discloses SAPIEN, which is a valve assembly. Cribier states that SAPIEN “consists of a tubular slotted stainless-steel balloon-expandable stent with an integrated unidirectional trileaflet bovine tissue valve with a polyethylene terephthalate (PET) fabric cuff.” Ex. 1012 (Cribier) at 348. Cribier Figure 1 (below) provides a picture of SAPIEN:



Edwards SAPIEN® THV
23 mm, 26 mm

Id. at Fig. 1.

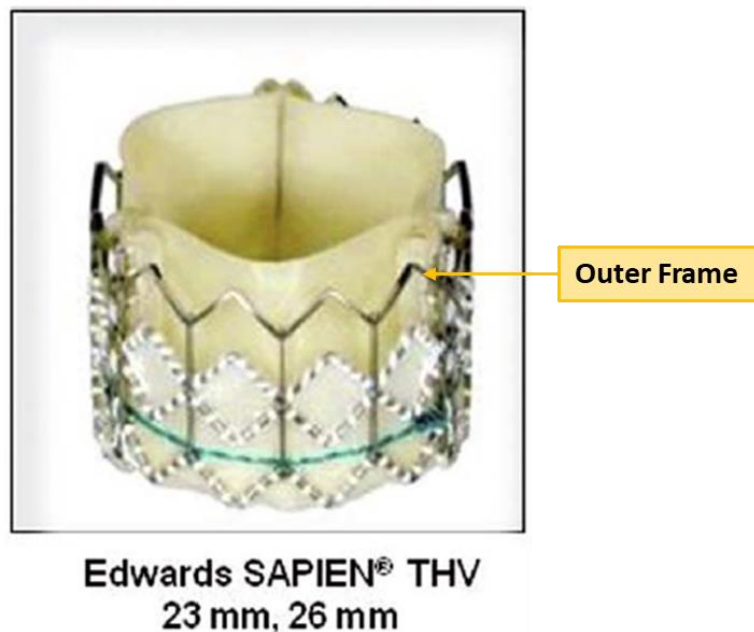
101. As shown in the figure above, SAPIEN's fabric cuff is stitched to the inside of the balloon-expandable stent and also attached to the heart valve leaflets. The green suture line in Figure 1 above is one point of attachment between the fabric cuff and the heart valve leaflets.

2. Outer Frame

102. Claim 1 next recites: "an outer frame, wherein the outer frame is formed from a metallic material and defines an open cell configuration." Cribier also discloses this limitation.

103. Cribier discloses that SAPIEN includes "a tubular slotted stainless-steel balloon-expandable stent." Ex. 1012 (Cribier) at 348. As shown in Figure 1

below, the stent defines an open cell configuration and surrounds the other valve features, such as the heart valve leaflets, making it an “outer frame”:



Id. at Fig. 1.

3. Inner Frame

104. Claim 1 next recites: “an inner frame that engages a prosthetic heart valve having prosthetic leaflets, wherein the inner frame includes a cylindrically extending inner graft covering extending at least partially radially outwardly of the prosthetic heart valve and radially inwardly of the outer frame for providing sealing to the prosthetic heart valve.” Cribier also discloses this limitation.

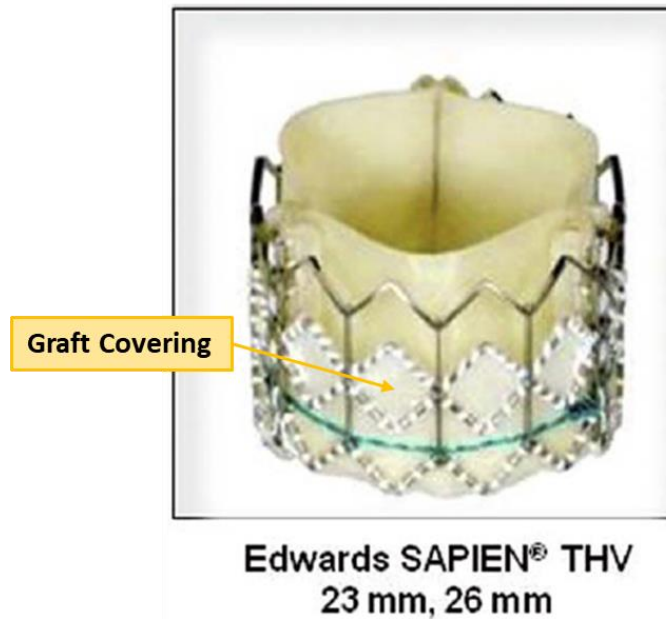
105. As explained the Prosecution History section above (§IV.C), I am aware that Patent Owner argued that an inner graft covering alone is sufficient to meet the limitation “an inner frame...wherein the inner frame ***includes*** a

cylindrically extending inner graft covering” during prosecution of the ’846 patent. For example, Patent Owner argued that Petitioner’s SAPIEN 3 Ultra product is “covered by the claimed invention” because it “includes an inner frame that is a graft.” Ex. 1002 at 145-146.

106. I am aware that the SAPIEN 3 Ultra THV (pictured below) has only one frame:



107. Cribier discloses that SAPIEN includes “a polyethylene terephthalate (PET) fabric cuff.” Ex. 1012 (Cribier) at 348, Fig. 1. The PET fabric cuff is a “graft covering.” Figure 1 below shows the fabric cuff, which is the whiter material that extends around the prosthetic heart valve at the lower end of the outer frame. As shown in the figure, the fabric cuff is “cylindrically extending” and extends radially outwardly of the prosthetic heart valve and radially inwardly of the outer frame:



108. SAPIEN’s PET fabric cuff covers the inside surface of SAPIEN’s outer frame. Based on Patent Owner’s statements during prosecution of the ’846 patent, and to the extent an “inner frame” can be a graft covering, SAPIEN’s PET fabric cuff satisfies this limitation.

109. Cribier also discloses that SAPIEN includes a “unidirectional trileaflet bovine tissue valve.” Ex. 1012 (Cribier) at 348. A person of ordinary skill in the art would therefore have understood that SAPIEN includes three “prosthetic leaflets” constructed from bovine tissue. SAPIEN’s fabric cuff is stitched to the prosthetic leaflets along the blue suture line in the figure above, and thus the fabric cuff “engages” the prosthetic heart valve.

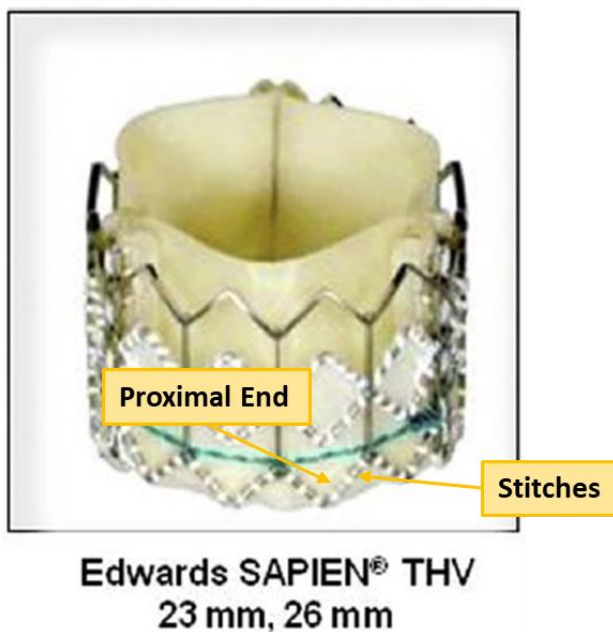
110. A person of ordinary skill in the art would have understood that the SAPIEN’s PET fabric cuff provides sealing to the heart valve. Importantly, if the

PET fabric cuff did not provide sealing to the heart valve, blood could leak around the valve and undermine the efficacy of the assembly. Further, many prior art publications recognized the sealing capabilities of SAPIEN's PET fabric cuff. *See e.g., Ex. 1009 (Conradi, Lenard, et al., Transcatheter aortic and mitral valve interventions: update 2010, 2(4) Interventional Cardiology 513-523 (2010)) at 514 (describing "polyester fabric sealing cuff"); Ex. 1023 (Smith) at 154 (SAPIEN included a "higher sealing cuff...to reduce paravalvular leaks."); Ex. 1025 (Zajarias, Alan and Cribier, Alain G., Outcomes and Safety of Percutaneous Aortic Valve Replacement, 53 J. Am. College of Cardiology 20, 1829-1836 (May 19, 2009)) at 1830 ("The stent has a polyethylene terephthalate fabric skirt that decreases perivalvular leaks."); Ex. 1028 (Roselli, E.E., Engineering transcatheter aortic valve devices: a surgeon's perspective, 225 J. Engineering in Medicine, 207-219 (Mar. 1, 2011)) at 213 (SAPIEN "includes both the valve leaflets and a fabric cuff at the base of the device to optimize the seal and minimize the paravalvular leak")*.

4. Stitching

111. Claim 1 next recites: "wherein the outer frame is secured to the inner graft covering by stitching at a proximal end of the outer frame." Cribier also discloses this limitation.

112. As shown in Cribier’s Figure 1 (below), a plurality of white stitches secure SAPIEN’s fabric cuff to the outer frame along the three lower rows of the frame. The stitches along the lowermost (i.e., proximal) row secure the fabric cuff to the proximal end of the frame:



Ex. 1012 (Cribier) at 348, Fig. 1; *see also* Ex. 1028 (Roselli) at 213 (“The pericardial tissue is sewn to the frame using polytetrafluorethylene (PTFE) suture and includes both the valve leaflets and a fabric cuff at the base of the device to optimize the seal and minimize paravalvular leak.”).

5. Outer Seal

113. Claim 1 next recites: “an outer seal for preventing paravalvular leaks” that: (1) “begins at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame”; (2) “is attached to the outer frame”;

(3) “is formed of outwardly extending fibers positioned externally to the outer frame”; and (4) “is free of an outer graft covering between the fibers and the outer frame.” Cribier in combination with Walther renders the limitations of the outer seal obvious.

114. Walther’s outer cloth, pictured in Figure 1 below, is positioned externally to the outer frame:

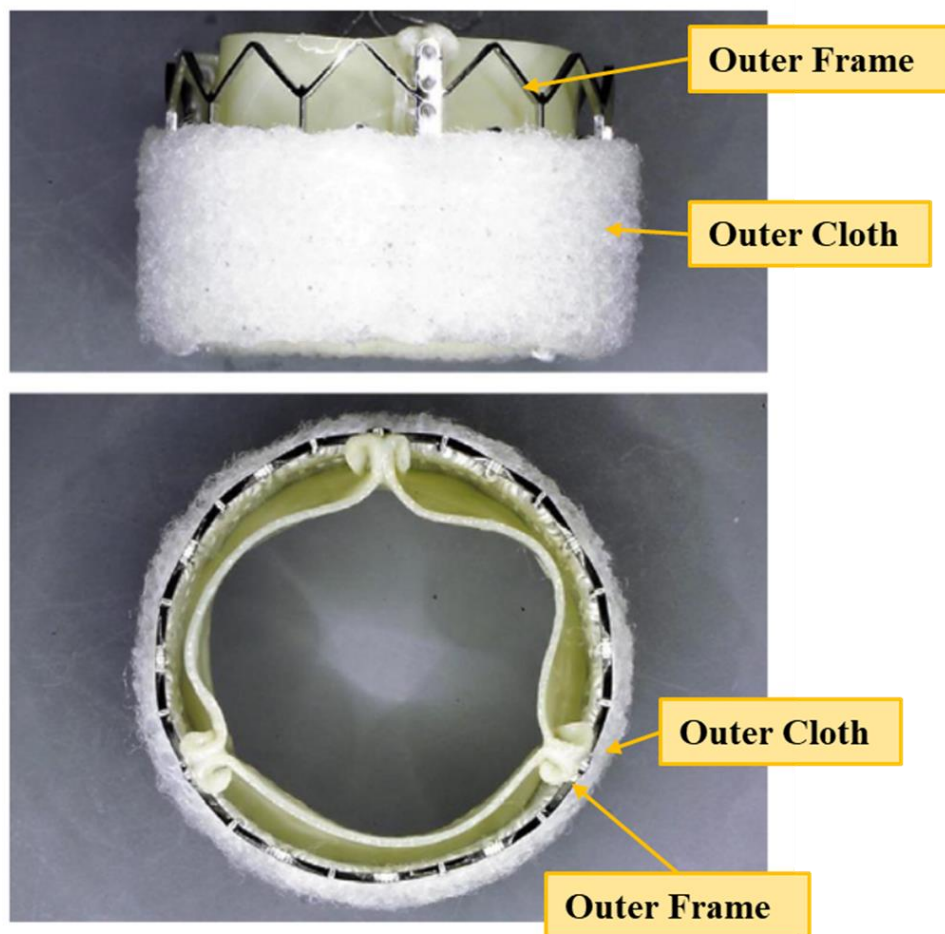
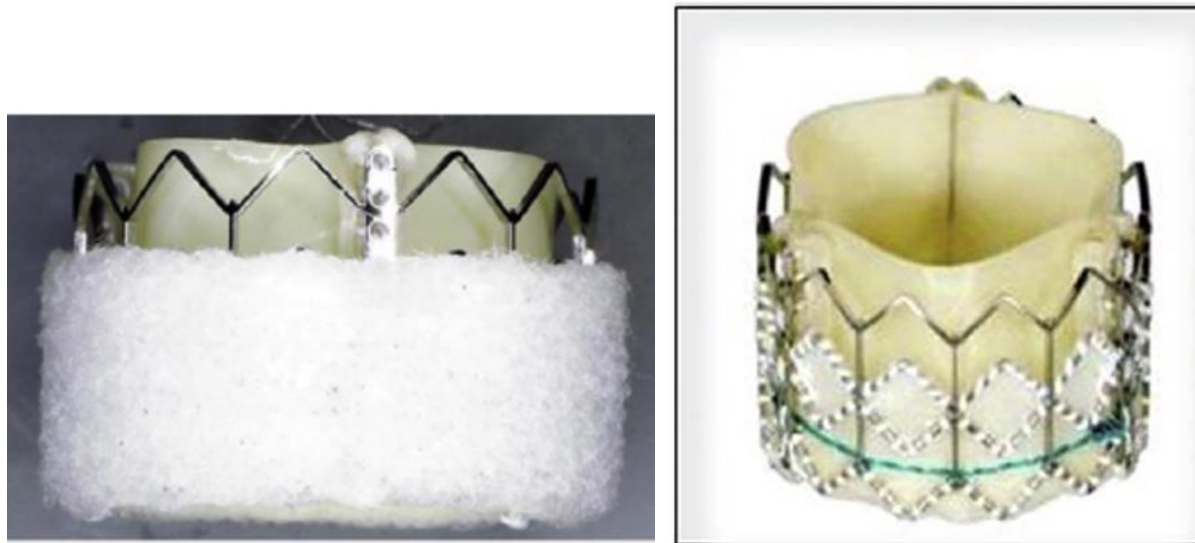


Fig. 1. Cloth valve.

Ex. 1007 (Walther) at Fig. 1. The outer cloth is an outer seal for preventing paravalvular leaks. Walther states that the outer cloth “is designed to reduce

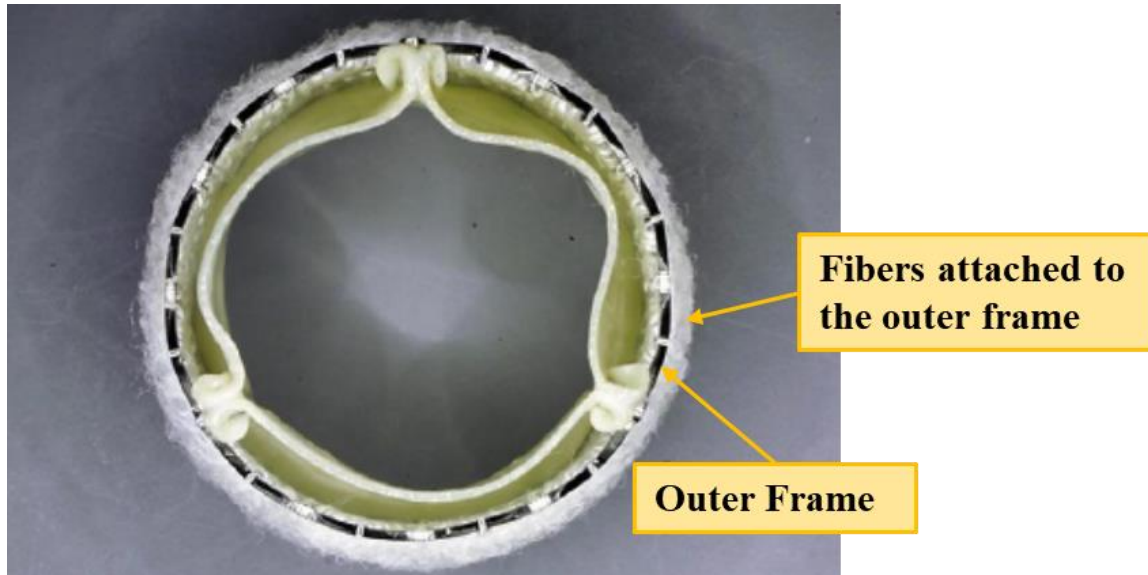
paravalvular leak by creating a seal between the two valves and improve resistance to migration with better ‘fit’ within surgical Perimount valves.” *Id.* at 1120. Based upon the tests, Walther concluded that “the Edwards SAPIEN + cloth THV implanted valve-in-valve within the CEP valve demonstrated excellent hydrodynamic performance,” indicating that the valve performed its sealing function well. *Id.* at 1125.

115. As shown below, the outer cloth begins at the proximal end of SAPIEN’s outer frame and covers the bottom two rows of cells of the frame. A comparison of Walther’s Figure 1 (left) and Cribier’s Figure 1 (right) illustrates that Walther’s outer cloth extends over the proximal two rows of cells:



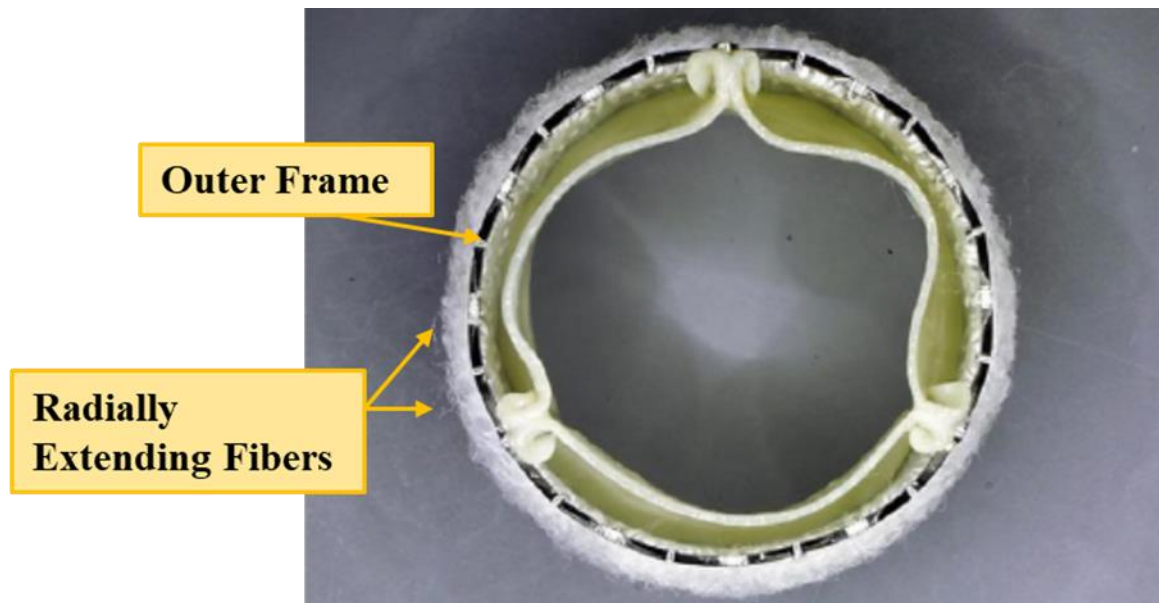
Ex. 1007 (Walther), Fig. 1; Ex. 1012 (Cribier), Fig. 1.

116. Walther discloses that the outer cloth is “stitched onto the perimeter of each SAPIEN valve.” Ex. 1007 (Walther) at 1121, Fig. 1. The perimeter of the SAPIEN valve is the outer frame, as shown below:



Id. at Fig. 1 (excerpt). A person of ordinary skill in the art would therefore understand that Walther’s outer cloth is “attached” to SAPIEN’s outer frame.

117. Walther’s outer cloth is formed from a plurality of outwardly extending fibers that are positioned externally to the outer frame. In the figure below, one can see the fibers extending outwardly from the outer frame all around the external circumference of the valve. Moreover, many of the fibers are shown terminating outwardly of the valve:

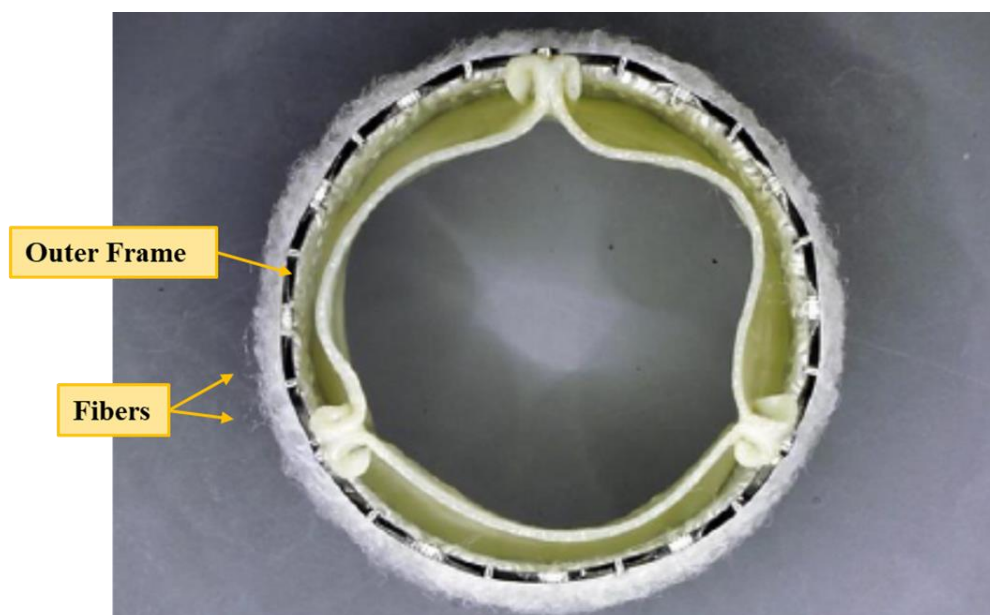


Id. at 1121, Fig. 1.

118. The above figure depicting fibers extending outwardly from the outer cloth is consistent with what a person of ordinary skill in the art would have expected from a cloth. A person of ordinary skill in the art would have expected radially extending fibers (like those shown above) because cloths are known to be made of woven fibers and have some amount of “hairiness.” See *e.g.*, Ex. 1029 (Tyagi, G.K., *Chapter 5: Yarn structure and properties from different spinning techniques*, *Advances in Yarn Spinning Technology* (2010)); Ex. 1029 (Kothari, V K, *Hairiness properties of polyester-cotton blended yarns*, 29 *Indian J. of Fibre & Textile Research* 30-34 (Mar. 2004)). Additionally, Merriam-Webster defines “cloth” as “a pliable material made usually by weaving, felting, or knitting natural or synthetic fibers and filaments.” Available at: <https://www.merriam-webster.com/dictionary/cloth>.

119. Moreover, the fibrous exterior of Walther's outer cloth is not surprising. As demonstrated by Walther's PET outer cloth and SAPIEN's PET fabric cuff, PET can have a range of finishes. Here, Walther discloses that the PET outer cloth is required to "reduce paravalvular leaks" and "increase 'fit' within [Edwards's] surgical Perimount valves." Ex. 1007 (Walther) at 1120. A person of ordinary skill in the art would have been motivated to select an outer cloth having fibrous finish, like the outer cloth shown in Figure 1 above, so that the radially extending fibers that extend outwardly of the outer frame fill the gaps between the SAPIEN and surgical valve. *See also id.* at 1126 (explaining that the outer cloth fills little gaps).

120. Walther's outer cloth ("outer seal") is also "free of an outer graft covering between the fibers and the outer frame." As shown below, the fibers of the outer cloth are directly attached to the metal bars of the outer frame:



Id. at Fig. 1. Walther discloses that the outer cloth was stitched to the perimeter of SAPIEN valves that were “identical” to the existing SAPIEN except for the outer cloth. *Id.* at 1120. Walther never states that any graft covering was positioned between the outer cloth and outer frame. As shown in Cribier’s Figure 1 below, SAPIEN does not include any “graft covering” on the exterior surface of the outer frame:



Edwards SAPIEN® THV
23 mm, 26 mm

Ex. 1012 (Cribier) at Fig. 1. Therefore, a person of ordinary skill in the art would have understood that when Walther’s outer cloth was stitched to the exterior of SAPIEN’s outer frame, there was be no “outer graft covering” between the fibers of the outer cloth and the outer frame.

121. I am aware that Patent Owner has made representations about Walther during the prosecution of a related application (U.S. Patent Application

17/213,251). During that prosecution, Patent Owner admitted that Walther describes a SAPIEN “where a graft may form part of the inner frame.” Ex. 1039 (Patent Owner Amendment with RCE) at 6. However, Patent Owner also argued that Walther describes a valve with “an outer seal made of a cloth base or outer graft and a fiber portion extending from the cloth base/outer graft.” *Id.* at 9. There is no support in Walther for this statement. Walther merely states that an “added poly(ethylene terephthalate) (PET) cloth was stitched onto the perimeter of each SAPIEN valve.” Ex. 1007 (Walther) at 1121. Walther does not describe a “cloth base or outer graft” and a “fiber portion.” Likewise, the figures do not show a “cloth base or outer graft” and a “fiber portion”:

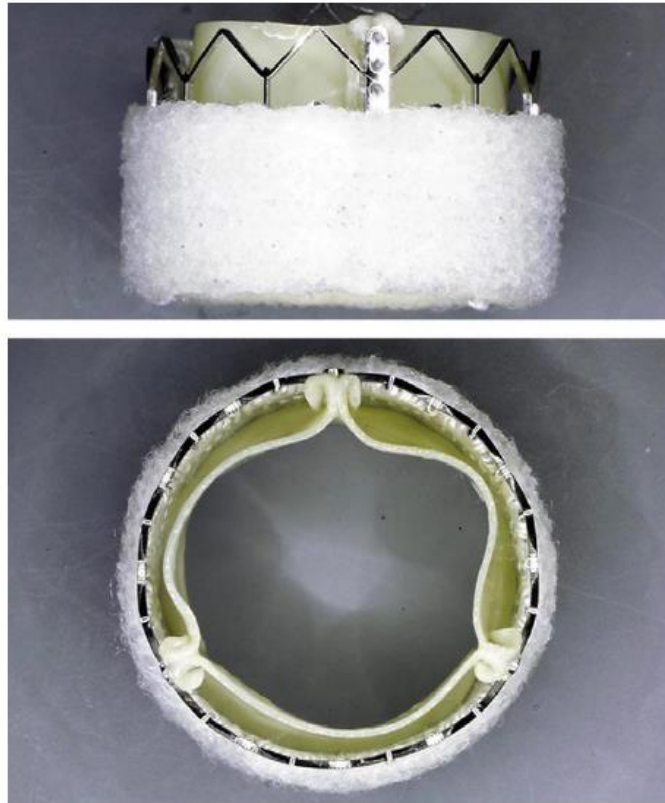


Fig. 1. Cloth valve.

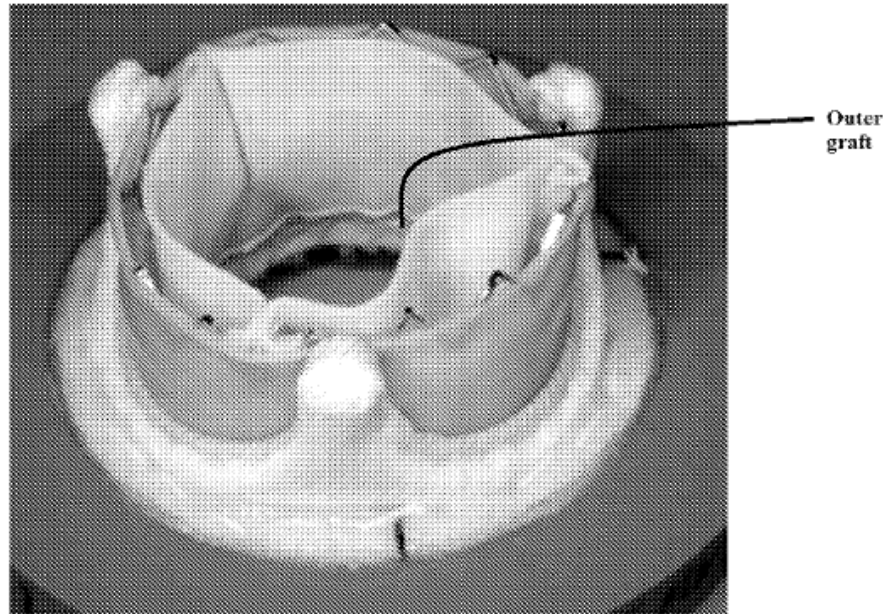
The figures depict a single piece of PET. For this reason, a person of ordinary skill in the art would not have understood Walther to disclose “an outer seal made of a cloth base or outer graft and a fiber portion extending from the cloth base/outer graft,” as argued by Patent Owner.

122. Patent Owner also argued that Walther’s outer cloth is “wrapped around the inflow end of the valve and flipped towards the prosthetic leaflets” and thereby constricts the orifice area and impacts hemodynamics. Ex. 1039 (Patent Owner Amendment with RCE) at 9-10. Again, there is no support in Walther for this statement. Walther never states that its outer cloth is wrapped around the inflow end. To the contrary, Walther’s figures illustrate that the outer cloth is not wrapped around the inflow end. In the below figure, the bottom of the valve is visible below the outer cloth.



It would be impossible to see the bottom of the valve if the outer cloth wrapped around the inflow end.

123. Patent Owner argues that the below figure shows the outer cloth (labeled “Outer graft”) “flipped towards the prosthetic leaflets where the base/outer graft is then stitched to the metallic frame.” *Id.* at 9.



Patent Owner misunderstands the figure. In the above figure, Patent Owner’s line labelled “Outer graft” points to a polytetrafluoroethylene (PTFE) suture that attaches the valve leaflets and inner fabric cuff to the frame. Ex. 1028 (Roselli) at 213. This same suture (green) is also visible on the outside of SAPIEN (with no outer cloth) as shown in the below figure from Cribier:



Edwards SAPIEN® THV
23 mm, 26 mm

Ex. 1012 (Cribier) at Fig. 1.

124. The below enlarged and color photograph from Walther shows that the outer cloth is not wrapped around the inflow end of the valve and sutured to the inside of the valve as Patent Owner argues. If the outer cloth was wrapped around and sutured, as Patent Owner argued, it would be visible in the below figure, but it is not.

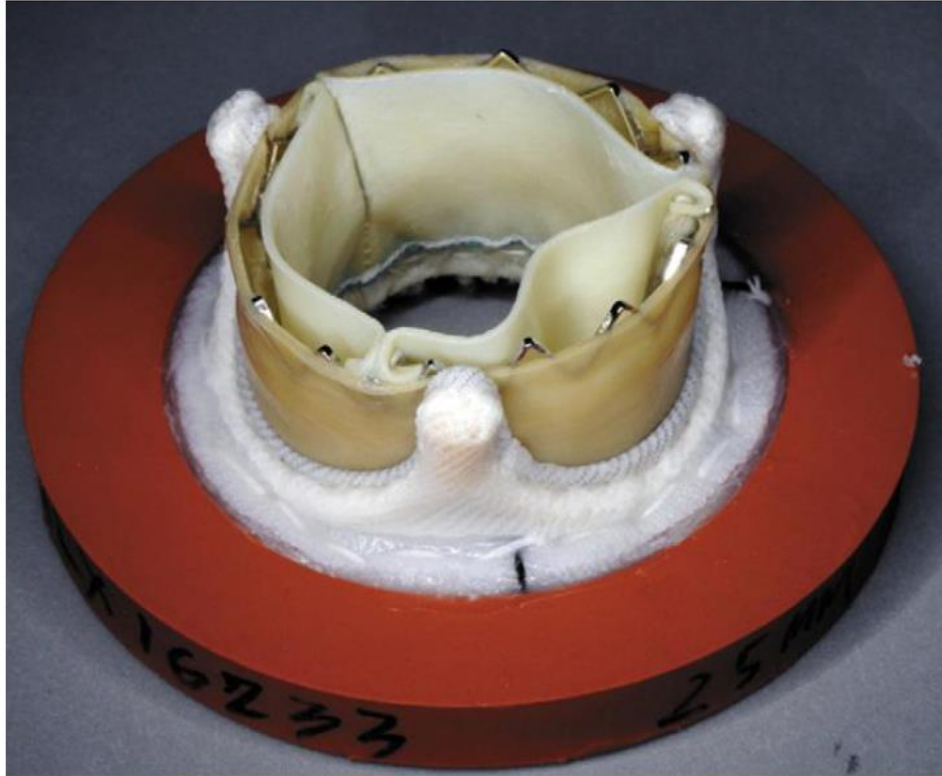


Fig. 2. Cloth THV valve deployed in surgical valve.

Ex. 1007 (Walther) at Fig. 2.

125. Further, because the outer cloth is not “wrapped around the inflow end of the valve and flipped towards the prosthetic leaflets,” a person of ordinary skill in the art would not have been concerned that the outer cloth would constrict the orifice area or impact hemodynamics. Dr. Walther was asked about this potential issue during a Conference Discussion occurring in conjunction with his paper and did not express any concern about this issue, stating: “I am not sure whether it changes the effective orifice area that much and I am pretty sure you just squeeze it in. You have four atmospheres and really it is just filling little gaps there.” Ex. 1007 (Walther) at 1126. Further, Walther concludes that the valve “demonstrated

excellent hydrodynamic performance,” further eliminating any concerns that the outer cloth somehow disadvantageously impacts the orifice area or hemodynamics. *Id.* at 1125-1126. For these reasons, a person of ordinary skill in the art would not have understood Walther’s outer cloth to wrap around the inflow end of the valve or negatively impact hemodynamics.

126. A person of ordinary skill in the art would have been motivated to combine SAPIEN, as described in Cribier, with Walther’s outer cloth because Walther expressly discloses this combination. Ex. 1007 (Walther) at 1020-1021. A person of ordinary skill in the art would have had a reasonable expectation of success in adding an outer cloth (as described in Walther) with SAPIEN (as described in Cribier) because Walther describes how to make the combination, provides images of the combination, and concludes that the cloth-covered SAPIEN “demonstrated excellent hydrodynamic performance.” *Id.* at 1125. Additionally, Walther also discloses that the cloth-covered SAPIEN “has demonstrated acceptable *in vitro* central regurgitation performance in previous verification studies, meeting minimum performance requirement standard per ISO 5840:2005 section 7.2.3.” *Id.* at 1124.

6. **Radially Compressed Orientation and Radially Expanded Orientation**

127. Claim 1 next recites: “wherein the valve assembly has a radially compressed orientation and a radially expanded orientation.” Cribier and Walther both disclose this limitation.

128. Cribier discloses that the SAPIEN is “***compressed*** using a crimping tool over the delivery balloon catheter to symmetrically reduce its overall diameter from its ***expanded size*** to its ‘mounted’ size.” Ex. 1012 (Cribier) at 348 (emphasis added). A person of ordinary skill in the art would have understood that SAPIEN’s “mounted size” is a radially compressed orientation. Similarly, Walther discloses that the cloth-covered SAPIEN valves were crimped and then expanded within various surgical valves by a balloon catheter. Ex. 1007 (Walther) at 1122, Fig. 4. A person of ordinary skill in the art would have understood that SAPIEN is in a radially expanded position when, for example, it is expanded in the surgical valves (as in Walther) or a patient’s native aortic valve (as in Cribier).

7. **Balloon Expandable...To Press Some Fibers Against the Native Leaflets**

129. Claim 1 concludes by reciting: “wherein the valve assembly is balloon expandable and expansion of the valve assembly is configured to press some of

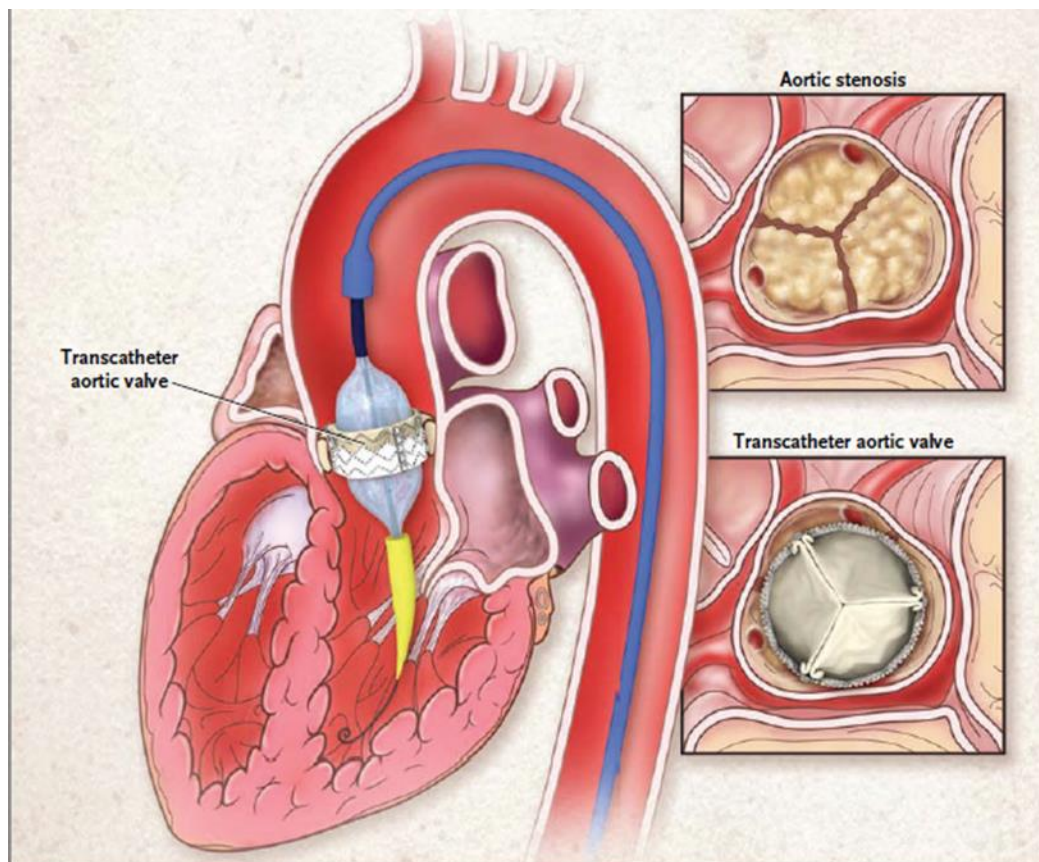
the fibers against native leaflets of the aorta of the patient.” Cribier and Walther render this limitation obvious.

130. Cribier discloses that SAPIEN consists of a “balloon-expandable stent.” Ex. 1012 (Cribier) at 348. Walther also discloses that SAPIEN includes a balloon-expandable stent. Ex. 1007 (Walther) at 1122.

131. Cribier describes the “retrograde transfemoral” approach for implanting SAPIEN. Ex. 1012 (Cribier) at 347-355; *see also* Ex. 1009 (Conradi) at 515-516 (disclosing transfemoral and transapical approaches); Ex. 1024 (Webb) at 156-158 (same). In the transfemoral approach, SAPIEN is “introduced within the femoral artery, advanced to the native aortic valve under X-ray control, positioned across the aortic annulus, and delivered by balloon inflation under rapid heart pacing.” Ex. 1012 (Cribier) at 347; *see also* Ex. 1009 (Conradi) at 514-517, Fig. 4A; Ex. 1028 (Roselli) at 209, 213.

132. A person of ordinary skill in the art would have understood that balloon expansion of SAPIEN presses SAPIEN’s frame against the native leaflets of the aortic valve. Cribier discloses that “one third to half of the stented prosthesis needs to rest above the annulus and the remainder in the LVOT in order to minimize perivalvular leaks and avoid coronary occlusion.” Ex. 1012 (Cribier) at 353-354. When expanded in this position, SAPIEN presses against and

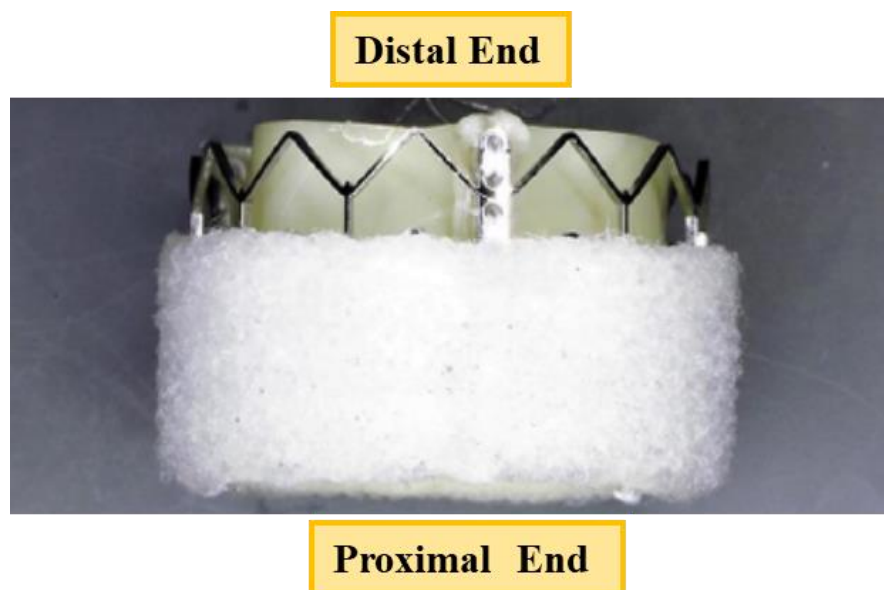
replaces the patient's native aortic leaflets, as illustrated in Figure 1 of the New England Journal of Medicine publication below:



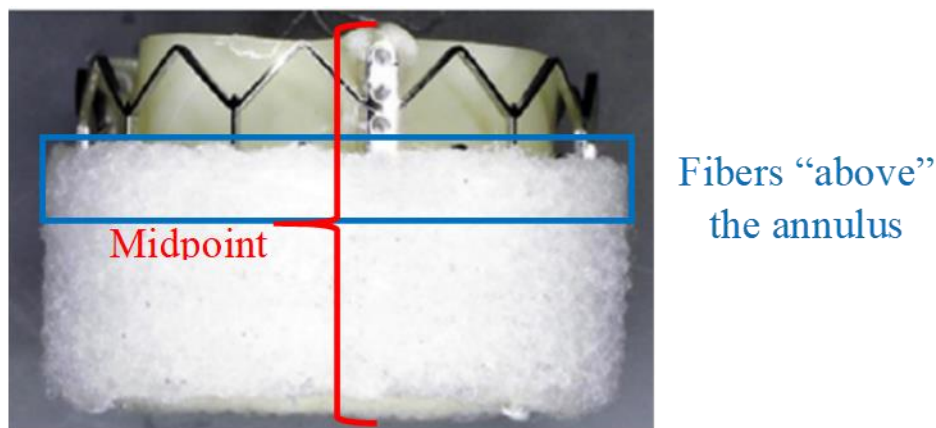
Ex. 1023 (Smith) at Fig. 1; *see also* Ex. 1047 (Piazza) at 74 (disclosing that SAPIEN “is positioned within the aortic root and, once deployed, crushes the leaflets of the native valve against the wall”).

133. Walther discloses the expansion of a cloth-covered SAPIEN within a surgical valve made by Petitioner. Ex. 1007 (Walther) at 1121, Fig. 2. Expansion of the valve presses the outer cloth (i.e., outer seal) against the surgical valve’s prosthetic leaflets. *Id.* at Fig. 2; *see also id.*, 1120-1121. A person of ordinary skill in the art would have understood that expanding the cloth-covered SAPIEN

in a native aortic valve, as described in Cribier, would press the outer cloth (i.e., outer seal) against the patient's native leaflets. As I explained previously, Walther's outer cloth covers the two proximal rows of SAPIEN's outer frame:



Id. at Fig. 1. If one third to half the cloth-covered SAPIEN rested above the annulus and the remainder in the LVOT, the fibers “above the annulus” would press against the leaflets, as illustrated below:



See also infra ¶¶48-50 (discussing the anatomy of the aortic valve and the location of the annulus and leaflets). In fact, Patent Owner admitted this was the case during prosecution of the '846 patent. Patent Owner stated that the “limitation of the fibers covering at least two rows of open cells provides an improvement over the prior art of record because this provides a heightened seal that allows for sealing below the native leaflets and at the native leaflets.” Ex. 1002 at 149.

134. A person of ordinary skill in the art would have found it obvious to deploy Walther’s cloth-covered SAPIEN within a patient’s native valve. A person of ordinary skill in the art would have been motivated to do so to reduce paravalvular leaks. (*Id.*) As explained previously, Walther describes deploying the cloth-covered SAPIEN within an Edwards surgical valve “to reduce paravalvular leak by creating a seal between the two valves.” *Id.* at 1120. Walther’s outer cloth creates a seal by pressing against the surgical valve. *See e.g., id.*, Fig. 2.

135. Cribier discloses that SAPIEN “can be implanted within the diseased native aortic valve using either the retrograde transfemoral or antegrade transapical routes.” Ex. 1012 (Cribier) at 347; *see also id.* (SAPIEN is “positioned across the aortic annulus”). The implanted SAPIEN provides sealing between the outer frame and the patient’s anatomical wall to “minimize perivalvular leaks.” *Id.* at 353; *see also id.* at 354 (describing issues that may cause “perivalvular insufficiency”); *see also* Ex. 1009 (Conradi) at 516-517, Fig.

4A; Ex. 1024 (Webb) at 156-158; Ex. 1012 (Cribier) at Abstract, 350-355; Ex. 1028 (Roselli) at 208-210, 214.

136. However, despite the success of SAPIEN, persons of ordinary skill in the art in November 2012 understood that paravalvular leaks could still occur between SAPIEN's outer frame and the patient's native valve. *See e.g.*, Ex. 1012 (Cribier) at 354 (disclosing that the "vast majority of aortic insufficiency seen on post implantation angiography" with the SAPIEN valve "is perivalvular"; Ex. 1023 (Smith) at 2194 (reporting that 12.2% of patients who received transcatheter implantation of the SAPIEN valve experienced moderate or severe paravalvular leakage at 30 days). This well-known problem would have motivated a person of ordinary skill in the art to apply Walther's known technique for reducing paravalvular leakage (adding an outer cloth to SAPIEN) to a known device (SAPIEN), which was ready for improvement. The performance of the cloth-covered SAPIEN would have been predictable because, for example, Walther explains that the cloth-covered valve performed well in testing. Ex. 1007 (Walther) at 1124-25.

137. A person of ordinary skill in the art would have had a reasonable expectation of success in deploying the cloth-covered SAPIEN in a patient's native aortic valve. Walther discloses that the cloth-covered SAPIEN "demonstrated excellent hydrodynamic performance" and concluded that an *in*

vivo implantation procedure “is feasible.” Ex. 1007 at 1125. Walther also discloses that the cloth-covered SAPIEN “demonstrated acceptable *in vitro* central regurgitation performance in previous verification studies. *Id.* at 1124. Moreover, persons of ordinary skill in the art had studied implantation of SAPIEN within a patient’s native aortic valve using both the transfemoral and transapical approaches and deemed the procedures safe by November 2012. *See e.g.*, Ex. 1012 (Cribier) at 355 (“Transcatheter valve implantation with the Edwards-Sapien Heart Valve can be done safely and efficiently using the transfemoral retrograde approach.”); *id.*, 347 (recognizing that SAPIEN can be implanted using “antegrade transapical routes”); Ex. 1009 (Conradi) at 515-517 (transfemoral and transapical delivery of SAPIEN resulted in 30-day mortality rates of 6.4-7.4% and 11.6-18.6% respectively). A person of ordinary skill in the art would therefore have reasonably expected success in implanting the cloth-covered SAPIEN valve within a patient’s native aortic valve.

138. Additionally, I note that claim 1 does not require endovascular delivery of the heart valve. Thus, any small increases in valve diameter due to the addition of the outer cloth would not have discouraged a person of ordinary skill in the art from implanting the valve in a patient’s native aortic valve. *See e.g.*, Ex. 1022 (Walther, Thomas, et al., *Transapical Minimally Invasive Aortic Valve Implantation*, 116 [suppl I] *Circulation* I-240—I-245 (September 11, 2007)) at I-

244 (“With the transapical technique no limitation in sheath diameter exists, allowing for the implantation of large and eventually cuffed prostheses to achieve a functionally optimal result for patients”). In fact, Dr. Walther recognized size would not be an issue during the Conference Discussion accompanying his publication stating that he hoped the valve would be available soon, “at least for the trans-apical approach, where tight crimping is not an issue.” Ex. 1007 (Walther) at 1126.

B. Claim 3

139. Claim 3 recites: “The valve assembly of claim 1, wherein the outer frame is a singular, integral component.” Cribier discloses the limitation in claim 3. Thus, Cribier combined with Walther renders claim 3 obvious.

140. Cribier discloses that SAPIEN’s frame is a “tubular slotted stainless-steel balloon-expandable stent.” Ex. 1012 (Cribier) at 348. SAPIEN’s frame was laser cut from a single stainless-steel tube. As shown below, SAPIEN’s stent (i.e., outer frame) comprises a “singular, integral component”:



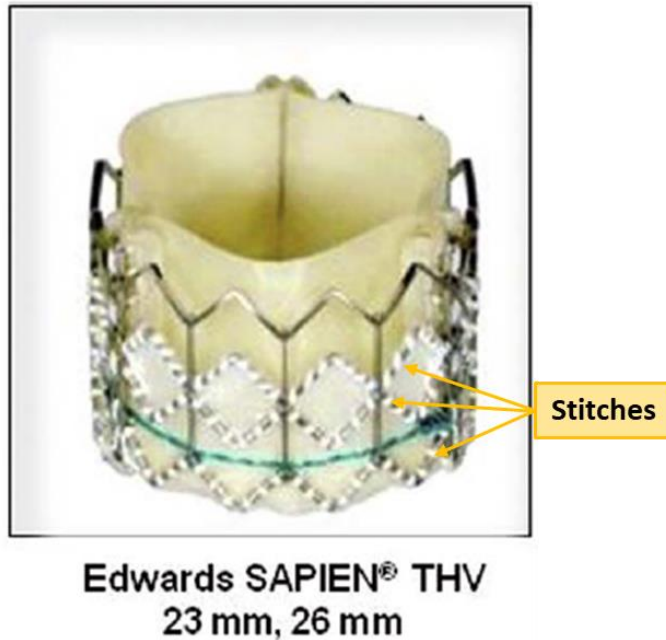
**Edwards SAPIEN® THV
23 mm, 26 mm**

Ex. 1012 at 348, Fig. 1.

C. Claim 4

141. Claim 4 recites: “The valve assembly of claim 1, wherein the outer frame and the inner graft covering are attached by stitches at a distal and proximal portion of the inner graft covering.” Cribier discloses the limitation in claim 4. Thus, Cribier combined with Walther renders claim 4 obvious.

142. Cribier’s Figure 1 (below) shows white stitches securing SAPIEN’s PET fabric cuff (i.e., graft covering) to the metallic stent frame at the top (i.e., distal) and bottom (i.e., proximal) portions of the inner graft covering:

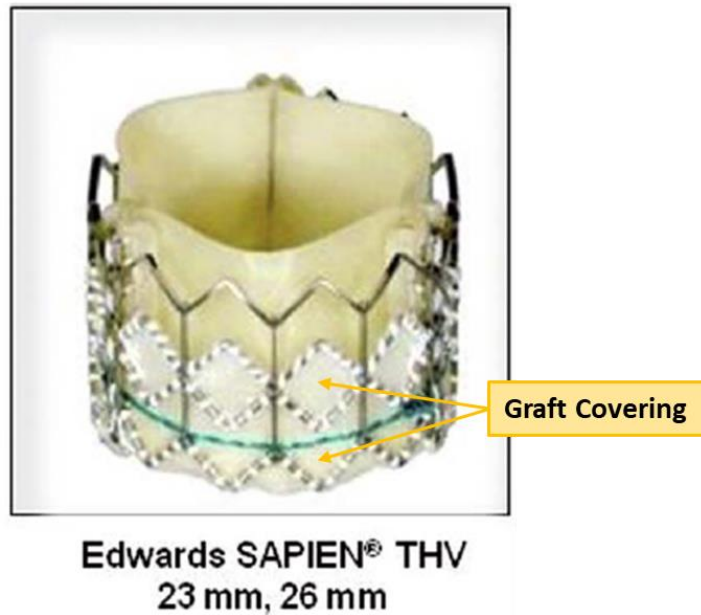


Ex. 1012 (Cribier) at Fig. 1. Several other prior art references also depict SAPIEN's sutures at the proximal and distal portions of the PET graft covering. *See also* Ex. 1009 (Conradi) at Fig. 1; Ex. 1024 (Zajarias) at Fig. 3B; Ex. 1027 (Roselli) at 213, Fig. 4(a).

D. Claim 5

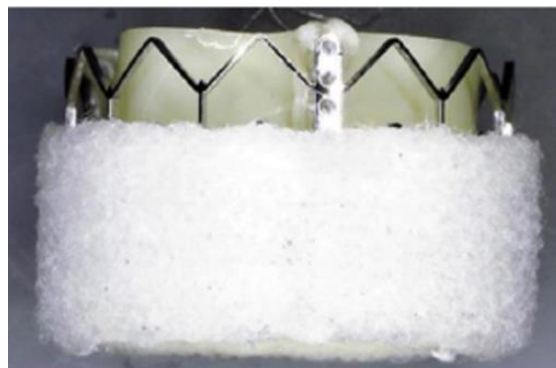
143. Claim 5 recites: “The valve assembly of claim 1, wherein the inner graft covering and the fibers are distinct elements.” Cribier combined with Walther discloses the limitation in claim 5 and renders claim 5 obvious.

144. Cribier discloses that SAPIEN includes an internal PET fabric cuff at the base of the device (i.e., inner graft covering) that is stitched to the inner surface of the stent frame. Ex. 1012 (Cribier) at 348. The whiter material in the below figure is the fabric cuff:



Id. at Fig. 1.

145. Walther discloses that the outer PET cloth (i.e., fibers) “was stitched to the perimeter of each SAPIEN valve”:



Ex. 1007 at 1121, Fig. 1 (excerpt). A person of ordinary skill in the art would have understood that the fibers comprising Walther’s outer cloth are a “distinct element” from SAPIEN’s internal fabric cuff because the outer cloth and internal cuff reside on opposite sides of the frame and are separately stitched to the frame.

The above figures illustrate that the outer cloth and fabric cuff are “distinct elements.”

E. Claim 6

146. Claim 6 recites: “The valve assembly of claim 1, wherein the valve assembly is delivered endovascularly.” Cribier in combination with Walther renders this claim obvious.

147. I note that despite claiming endovascular delivery, the ’846 patent does not contain any disclosure regarding how to size the disclosed valves for endovascular delivery. For example, the ’846 patent never discloses the length, thickness, or width of the sealing material and fibers, the density of the fibers, or the crimp profile of the valve. In my opinion, the dual-frame concept must rely on the prior art for all of the dimensional teachings.

148. By November 2012, persons of ordinary skill in the art would have been aware that SAPIEN could be endovascularly delivered through different blood vessels. For example, persons of ordinary skill had successfully delivered SAPIEN through the common iliac artery, which is a larger artery than the femoral artery and can, therefore, accommodate bigger devices. Ex. 1043 (Kainuma, Satoshi, et al., *Transcatheter aortic valve implantation: first trans-iliac experience in Japan*, General Thoracic Cardiovascular Surgery 59:273-276 (2011); see also Ex. 1044 (Craido, Frank, *Iliac Arterial Conduits for*

Endovascular Access: Technical Considerations, J. Endovasc. Ther. 14:347-351 (2007) (describing endovascular access through the common iliac artery). The common iliac artery also provide an alternative route for endovascular delivery when the femoral artery was too diseased or tortuous . *Id.* Delivery through the common iliac artery is endovascular delivery.

149. Additionally, Cribier describes the successful delivery of SAPIEN using the “retrograde transfemoral” approach. Ex. 1012 (Cribier) at 347-356; *see also* Ex. 1009 (Conradi) at 515-517 (disclosing transfemoral and transapical approaches); Ex. 1023 (Webb) at 156-158 (same). In the transfemoral approach, SAPIEN is “introduced within the femoral artery, advanced to the native aortic valve under X-ray control, positioned across the aortic annulus, and delivered by balloon inflation under rapid heart pacing.” Ex. 1012 (Cribier) at 347; *see also* Ex. 1009 (Conradi) at 514-517, Fig. 4A; Ex. 1027 (Roselli) at 209, 213. Delivery of SAPIEN using the transfemoral approach is “endovascular” delivery. Cribier also mentions the antegrade transseptal approach in which a SAPIEN was delivered through the femoral vein. Ex. 1012 (Cribier) at 348; *see also* Ex. 1030 (describing antegrade transsepatal approach). The antegrade transseptal approach is yet another type of endovascular delivery.

150. Walther discloses implanting the cloth-covered SAPIEN *in vitro* using Edwards’ transapical delivery system (the Ascendra). Ex. 1007 (Walther) at 1121.

Transapical delivery is a method for implanting prosthetic heart valves that includes inserting the valve between the ribs and through the heart wall.

151. In my opinion, a person of ordinary skill in the art would have found it obvious, and been motivated, to endovascularly deliver a cloth-covered SAPIEN, like the one disclosed in Walther, in 2012. Persons of ordinary skill in the art would have been motivated to endovascularly deliver the Walther valve through the common iliac artery because the artery is large and would not have required any modifications to Walther's valve

152. Persons of ordinary skill in the art also would have been motivated to endovascularly deliver the Walther valve through the femoral artery. Many persons of ordinary skill in the art considered the transfemoral approach "as the technique of first choice" and safer than the transapical approach, which was associated with "more adverse events and higher mortality rates." Ex. 1009 (Conradi) at 515-516; Ex. 1020 (Yuksel, Uygur, *Balloon-Expandable Transcatheter Aortic Valve Implantation*, Cardiac Interventions Today (Aug./Sept. 2009) at 52; Ex. 1043 (Kainuma) at 275.

153. A person of ordinary skill in the art would have possessed the skills necessary to adapt a cloth-covered SAPIEN, like the one in Walther, for transfemoral delivery. *Supra* §§III.C, VI.A.5. First, persons of ordinary skill in the art would have had access to a range of suitable cloths having varying

thicknesses and densities and could have selected an appropriately dimensioned cloth for endovascular delivery through, for example, the femoral artery. *Id.*; see also e.g., Ex. 1011 (Spenser II) at [0055], [00145]; Ex. 1008 (Levi) 13:49-53. Second, by 2012, Petitioner had developed delivery systems having smaller diameters than those initially used with SAPIEN. *Supra* §§III.C, VI.A.5; Ex. 1036 (Nietlispach) at 295-297; Ex. 1037 (Le patent publication) at [0005]-[0006]. These delivery systems would have permitted a person of ordinary skill in the art to endovascularly deliver a valve having a greater diameter than SAPIEN alone. Third, by 2012, Petitioner had adopted new frame metals that reduced profile and developed ways to adapt the frame and leaflets to create additional space for an outer seal. *Supra* §§III.C, VI.A.5; see e.g., Ex. 1008 (Levi) at 6:31-49, 16:24-17:18; *infra* §VIII.F.1. Persons of ordinary skill in the art would have found it obvious to utilize one or more of these known strategies to make the cloth-covered SAPIEN suitable for endovascular delivery, and particularly for transfemoral delivery.

154. A person of ordinary skill in the art would have had a reasonable expectation of success in endovascularly delivering the cloth-covered SAPIEN for several reasons. First, Walther concludes that *in vivo* (i.e., in a patient) implantation of the cloth-covered valve “is feasible.” Ex. 1007 at 1125. Second, by 2012 many prior art references reported the successful transfemoral delivery of

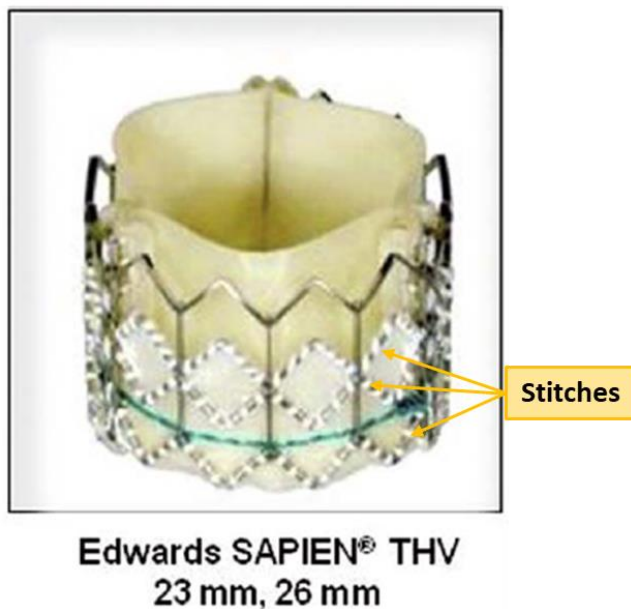
SAPIEN and SAPIEN had been approved by the FDA. *See e.g.*, Ex. 1009 (Conradi) at 517; Ex. 1012 (Cribier) at 355; Ex. 1032 (2011 FDA Approval). Third, persons of ordinary skill in the art had successfully implanted SAPIEN through the common iliac artery, which could accommodate the delivery of larger devices. Ex. 1043 (Kainuma). In view of these factors, a person of ordinary skill in the art would have reasonably expected success in endovascularly delivering a cloth-covered SAPIEN.

F. Claim 7

155. Claim 7 recites: “valve assembly of claim 1, wherein a seal is created between the inner frame and the outer frame.” Cribier discloses this limitation. Thus, Cribier in combination with Walther renders claim 7 obvious.

156. Cribier discloses that SAPIEN includes a “fabric cuff.” Ex. 1012 (Cribier) at 348, Fig. 1. As explained in claim 1, if an “inner frame” can be a “graft covering,” SAPIEN’s fabric cuff is an inner frame. A seal is created between the inner frame and the outer metallic frame to prevent blood from leaking through or around the device (i.e., paravalvular leakage). *See e.g.*, Ex. 1016 (Alkashkari) at 23 (SAPIEN includes a “fabric-sealing cuff covering the lower portion of the stent [that] facilitates a seal with the calcified conduit and prevents paravalvular leaks”). A person of ordinary skill in the art would have understood that a seal is created between the sealing cuff and SAPIEN’s stainless

steel stent because a plurality of sutures securely attach the cuff to the stent, as shown below:



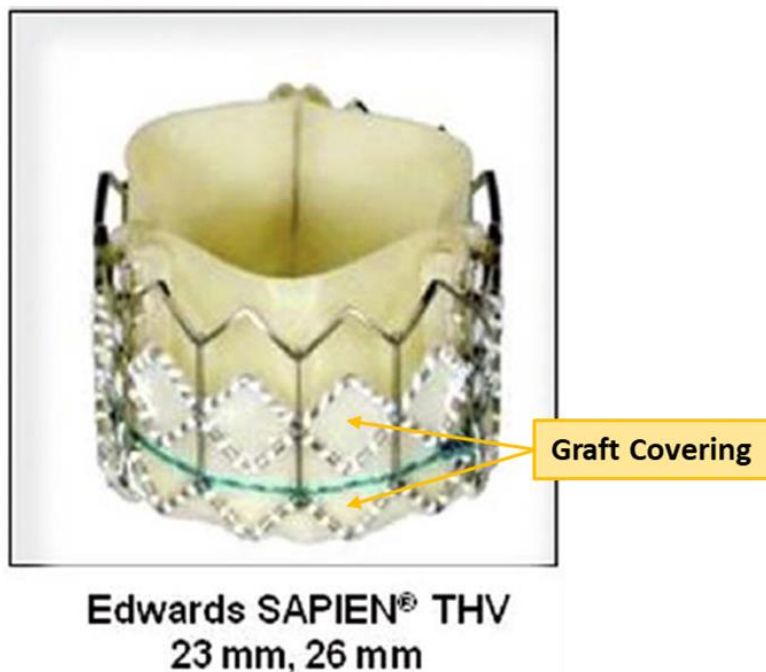
Ex. 1012 at Fig. 1. Additionally, a person of ordinary skill in the art would have understood that SAPIEN would not work if a seal did not exist between the cuff and stent because blood could disadvantageously leak between the cuff and stent.

G. Claim 8

157. Claim 8 recites: “The valve assembly of claim 1, wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.” Cribier discloses this limitation. Thus, Cribier combined with Walther renders claim 8 obvious.

158. As I explained in claim 1, Cribier discloses that SAPIEN includes an internal fabric cuff at the proximal end (lower end in the picture below) of the device (i.e., inner graft covering) that is stitched to the inner surface of the stent

frame. *Supra* §VI.A.3-4; Ex. 1012 (Cribier) at 348. SAPIEN's inner graft covering, which is the whiter material in the figure below, covers the bottom two rows of cells of SAPIEN's outer frame but **does not** cover the uppermost row of cells, as shown in Cribier's Figure 1 below:



Id. at Fig. 1.

159. As further explained in claim 1, Walther's outer cloth (i.e., outer seal) covers the bottom two rows of cells of SAPIEN's outer frame. *Supra* §VI.A.5. Walther's outer cloth does not cover the uppermost row of cells of SAPIEN's frame, as illustrated in the side-by-side comparison of Walther's Figure 1 (left) and Cribier's Figure 1 (right):



Compare Ex. 1007 (Walther) at Fig. 1 with Ex. 1012 (Cribier) at Fig. 1.

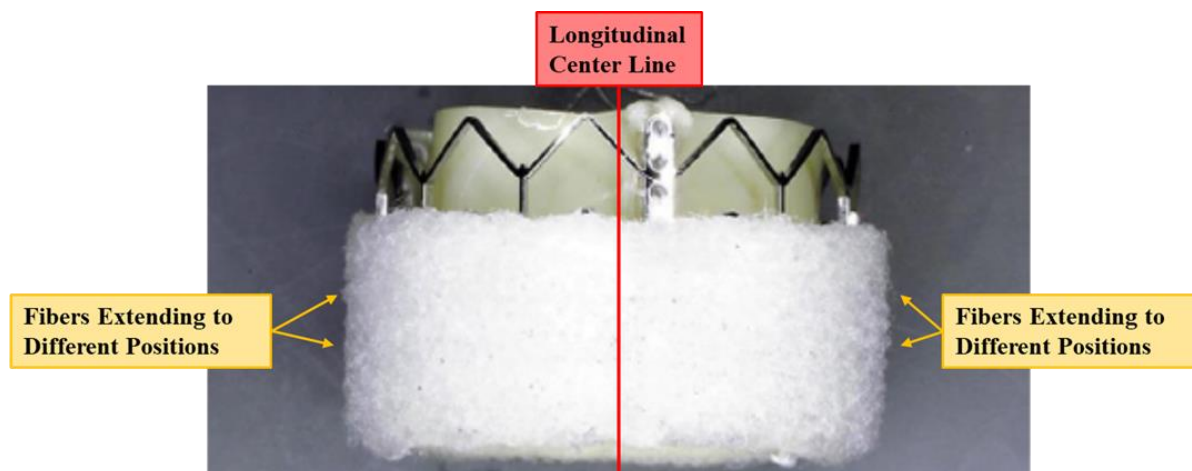
160. Therefore, the uppermost row of cells in Walther’s cloth-covered SAPIEN valve, which is a “portion of the outer frame,” is uncovered by both the inner fabric cuff (inner graft covering) and the outer cloth (outer seal).

H. Claim 11

161. Claim 11 recites: “The valve assembly of claim 1, wherein the outwardly extending fibers extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly.” Cribier in combination with Walther renders this claim obvious.

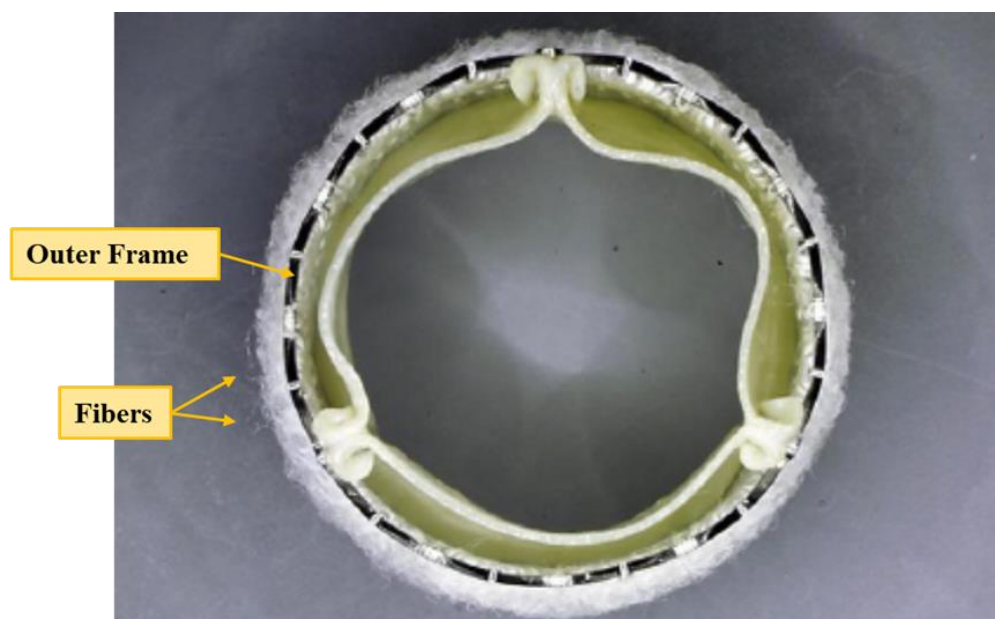
162. As I explained in claim 1, Walther discloses a modified SAPIEN valve with PET cloth sutured to the exterior of the outer frame, and Walther’s outer cloth is formed from a plurality of outwardly extending fibers. *Supra* §VI.A.5. Walther’s outer cloths surrounds the valve and, therefore, the fibers

extend to the left and right of a longitudinal centerline. Thus, Walther's outer cloth includes outwardly extending fibers that "extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly":



Ex. 1007 (Walther) at Fig. 1 (excerpt).

163. Additionally, Walther's outer cloth is not uniform. As shown in the figure below, some fibers extend further out from the frame than others.

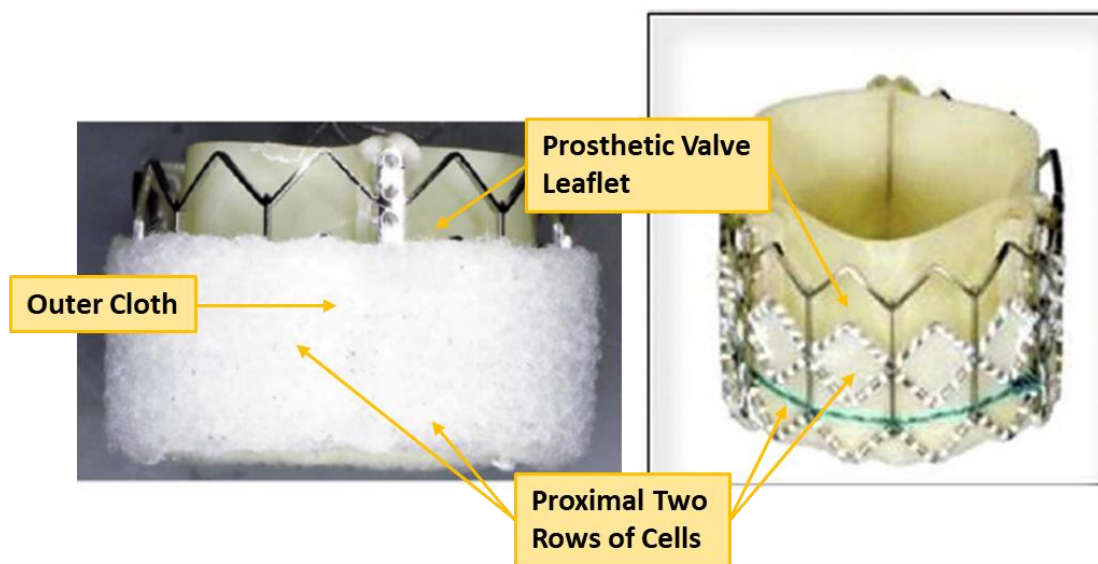


Thus, even the fibers on the same side of the valve (relative to the centerline) “extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly.”

I. Claim 12

164. Claim 12 recites: “The valve assembly of claim 1, wherein the graft covering, outer seal, and prosthetic leaflets are radially overlapping.” Cribier in combination with Walther discloses this limitation and renders claim 12 obvious.

165. As I explained in claims 1 and 8, Walther’s outer cloth (i.e., outer seal) and SAPIEN’s inner fabric cuff cover the two most proximal rows of cells in SAPIEN’s outer frame:



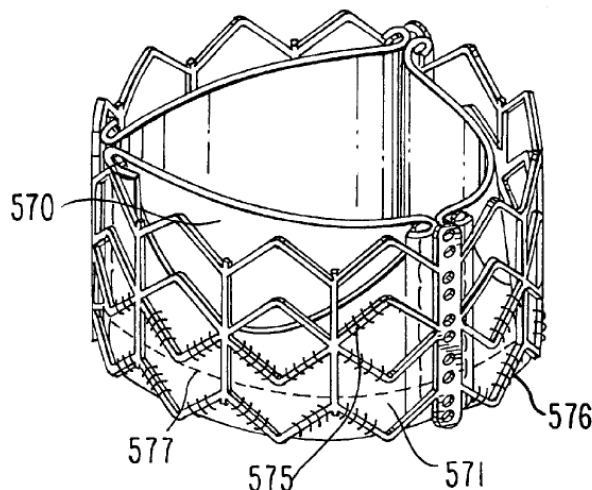
Supra §§VI.A.5, VI.G; *compare* Ex. 1007 (Walther) at Fig. 1 with Ex. 1012 (Cribier) at Fig. 1. Sapien’s leaflets extend toward the proximal end of the valve and are sutured to the inner fabric cuff along the green suture line visible in the

figure above right. Therefore, the outer cloth (outer seal), inner fabric cuff (graft covering), and prosthetic leaflets are radially overlapping at least along the two proximal rows of the device.

**VII. GROUNDS 2-3: CLAIMS 1-12 OBVIOUS OVER SPENSER
AND WALTHER OR SPENSER II**

166. Spenser describes heart valve assemblies similar to SAPIEN including the below embodiment (Figure 44a of Spenser):

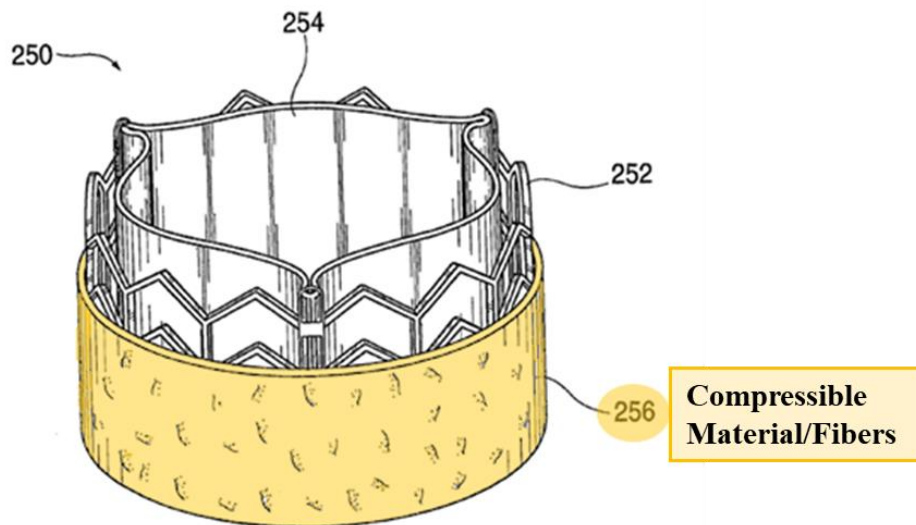
FIG. 44a



Ex. 1010, Fig. 44a. Figure 44a is very similar (if not identical) to SAPIEN. The SAPIEN Instructions for Use (“IFU”) identify Spenser as potentially covering SAPIEN. Ex. 1040, 8.

167. As I explained in Ground 1, Walther discloses a modified SAPIEN that includes an added outer cloth. *Supra* §VI.A.5. Similarly, Spenser II discloses a prosthetic stented valve that includes a layer of “compressible material”

disposed along the outer surface of the stent structure” to reduce paravalvular leaks:



Ex. 1011 (Spenser II) at [00144]-[00145], Fig. 22. Spenser II explains that the compressible material “may resemble a cloth or fabric having ***small fibers*** extending from the surface of the material.” *Id.* at [00145] (emphasis added). During prosecution of the ’846 patent, Patent Owner admitted that Spenser II teaches “a thick band of fibers emanating therefrom in FIG. 22.” Ex. 1002 (’846 patent prosecution history) at 138-139. Patent Owner tried to distinguish Spenser II by arguing that “there is no graft forming the inner frame, thus the inner sealing is missing.” *Id.* However, to the extent the valve in Figure 22 does not have an inner graft covering, a person of ordinary skill in the art would have found it

obvious to combine Spenser II's compressible material with a valve having an inner graft covering, such as Spenser Figure 44a.

168. For the reasons I provide in detail below, it is my opinion that a person of ordinary skill would have been motivated to combine Walther's outer cloth or Spenser II's outer compressible material with the heart valve assemblies in Spenser, including the assembly shown in Figure 44a. Based on my review of these references, I believe that the combination of Spenser and Walther or Spenser II renders claims 1-12 obvious.

A. Claim 1

169. Based on my review of the prior art, it is my opinion that the combination of Spenser and Walther or Spenser II renders claim 1 obvious.

1. Preamble

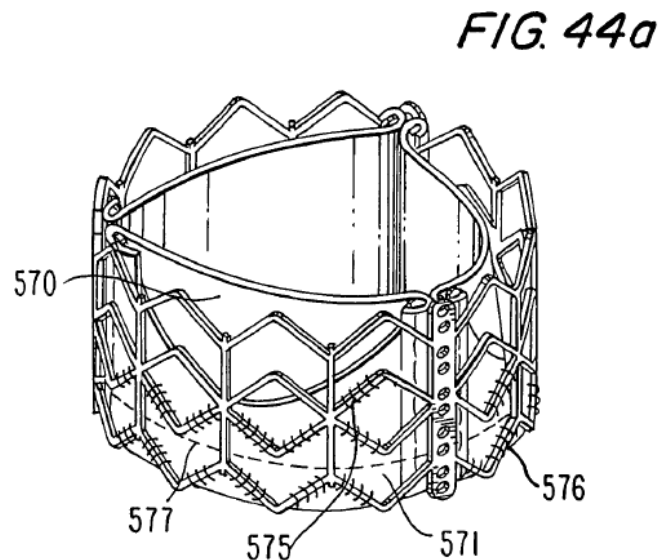
170. The preamble of claim 1 recites: "A valve assembly comprising." Spenser discloses a valve assembly.

171. Spenser discloses a heart valve prosthesis that may be implanted "at the natural aortic valve position at the entrance to the left ventricle of a myocardium of a patient." Ex. 1010 (Spenser) at 1:13-15, 5:17-25, 5:65-6:3, 17:19-18:43.

2. Outer Frame

172. Claim 1 next recites: “an outer frame, wherein the outer frame is formed from a metallic material and defines an open cell configuration.” Spenser also discloses this limitation.

173. Figure 44a of Spenser illustrates “an implantable prosthetic valve in accordance with [a] preferred embodiment of the present invention” that includes “frame 575”:



Ex. 1010 (Spenser) at 26:30-34; *see also id.* at 19:5-13 (describing frame).

174. As shown in Figure 44a above, frame 575 defines an open cell configuration and surrounds the other valve features, including the leaflets and inner graft covering, making it an “outer frame.” *Id.* at Fig. 44a-44b. Spenser further discloses that the frame may be made from metallic materials such as “nickel titanium.” *Id.* at 12:28-31.

3. Inner Frame

175. Claim 1 next recites: “an inner frame that engages a prosthetic heart valve having prosthetic leaflets, wherein the inner frame includes a cylindrically extending inner graft covering extending at least partially radially outwardly of the prosthetic heart valve and radially inwardly of the outer frame for providing sealing to the prosthetic heart valve.” Spenser also discloses this limitation.

176. The embodiment in Figure 44a of Spenser includes an “additional piece of PET” 571 for “sealing and protecting the pericardium.” Ex. 1010 (Spenser) at 26:30-34, Figs. 44a-44c; *see also id.* claims 10, 30 (“including a fabric layer interposed between the valve assembly and support stent”). The “pericardium” is the prosthetic pericardial leaflets 570 (*see e.g.*, Figures 44a-b below). *Id.* at 26:30-54. The PET 571 is a “graft covering.”

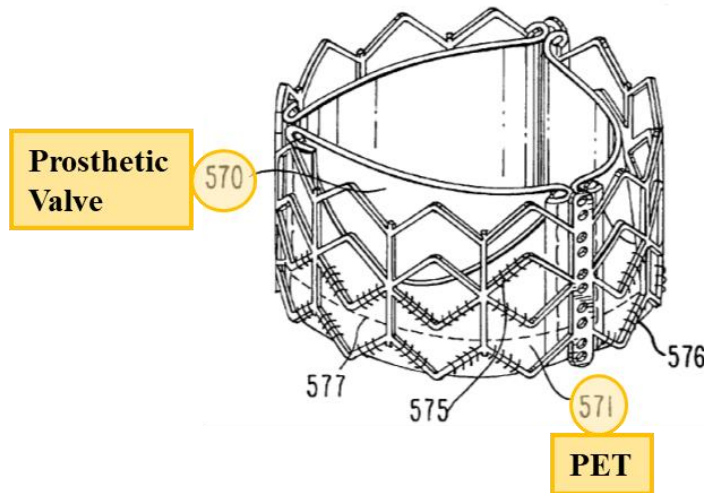
177. As shown in Spenser’s Figure 44b, the PET 571 [blue] is positioned “between the leaflets [570 yellow] and the frame [575 red]”⁵:

⁵ In Fig. 44b, the lead lines for 571 and 575 both point to the outer frame [red]. Ex. 1010 (Spenser) at Fig. 44b. I believe this is a drafter’s error. As explained in Spenser’s written disclosure, the lead line for the outer PET layer 571 should point to the middle layer [blue] because PET 571 is described as being positioned “between the leaflets [570] and the frame [575].” *Id.* at 26:40-42.

Diagram illustrating a catheter assembly 570. The assembly includes a frame 575, a PET layer 571, and a leaflet 572. The assembly is shown in a curved state, with labels 576 and 577 indicating specific components or regions.

178. As shown in Figure 44b above and Figure 44a below, the PET 571 is “cylindrically extending” and extends radially outwardly of the prosthetic heart valve 570 and radially inwardly of the outer frame 575 for providing sealing to the heart valve:

FIG. 44a



Id. at 26:30-34, Fig. 44a. Thus, based on Patent Owner’s statements during prosecution, and if an inner frame can be a graft covering, PET 571 is an inner frame that includes a graft covering.

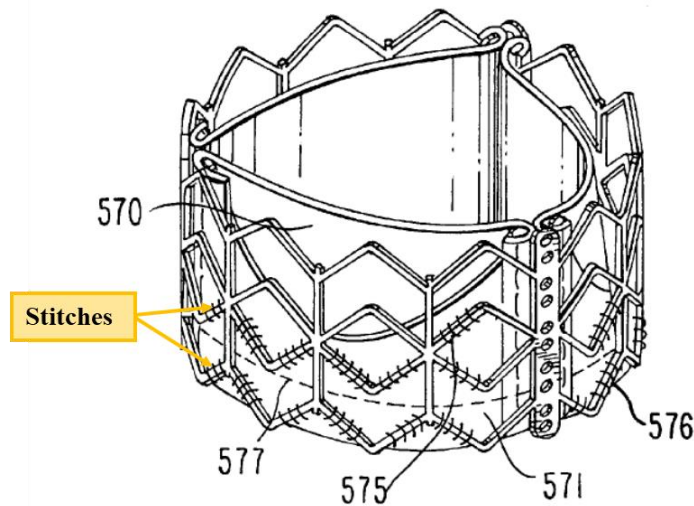
4. Stitching

179. Claim 1 next recites: “wherein the outer frame is secured to the inner graft covering by stitching at a proximal end of the outer frame.” Spenser also discloses this limitation.

180. Spenser discloses that a “[b]ottom attachment suture 576, connects the three layers, the leaflet and both PET layers [571, 572] to the frame and forms a strong sealing line.” Ex. 1010 (Spenser) at 26:45-47, Figs. 44a-44c; *see also id.* claims 10, 30.

181. Figure 44a illustrates that the bottom suture 576 secures the inner PET layer (inner graft covering) by stitching at the proximal end of the outer frame:

FIG. 44a



Id., Fig. 44a; *see also id.*, Fig. 44b (showing sutures).

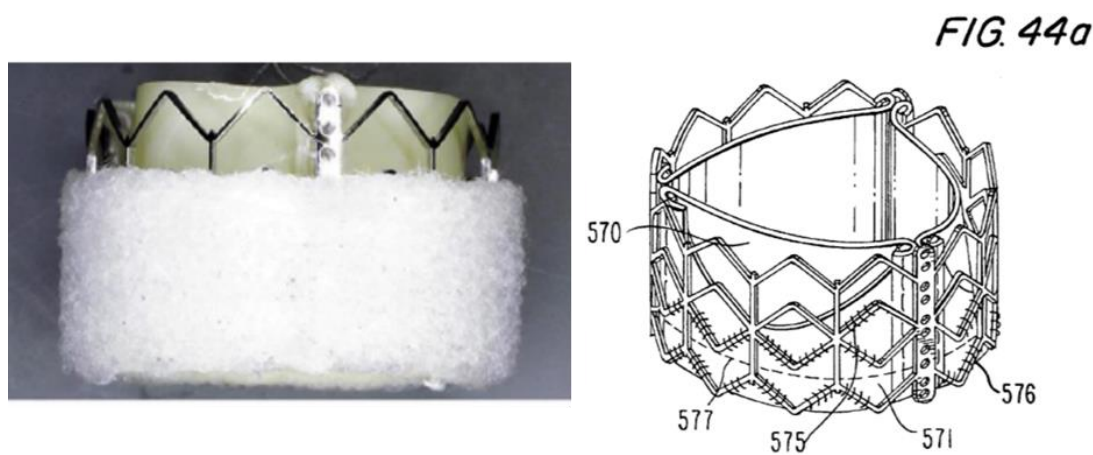
5. Outer Seal

182. Claim 1 next recites: “an outer seal for preventing paravalvular leaks” that: (1) “begins at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame”; (2) “is attached to the outer frame”; (3) “is formed of outwardly extending fibers positioned externally to the outer frame”; and (4) “is free of an outer graft covering between the fibers and the outer frame.” Spenser in combination with Walther or Spenser II renders the outer seal limitations obvious.

a. Walther

183. Walther discloses an outer cloth formed of outwardly extending fibers that is attached to the exterior of SAPIEN’s outer frame for preventing paravalvular leaks as discussed in Ground 1. *Supra* §VI.A.5. The outer cloth

covers begins at a proximal portion of the outer frame (see left figure below) and extends over at least two rows of cells formed in the outer frame. *Id.* If Walther's outer cloth were added to Spenser's Figure 44a, the cloth would also begin at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame. A side-by-side comparison of Walther's Figure 1 (left) and Spenser's Figure 44a (right) illustrates that Walther's outer cloth would be at the proximal end and cover the two bottom rows of cells. As stated previously, Figure 44a is very similar (if not identical) to SAPIEN:

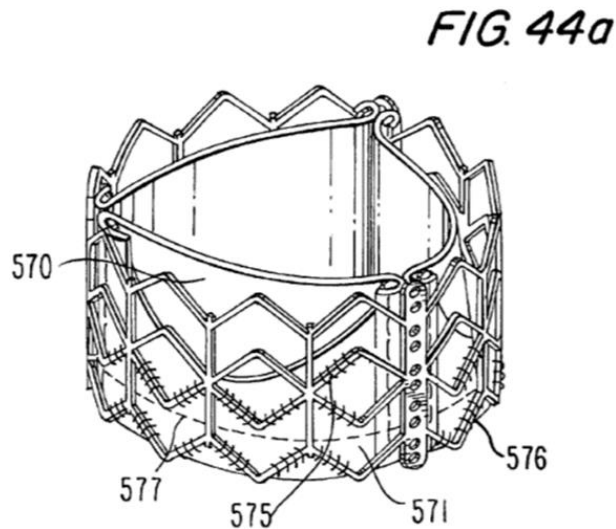


Compare Ex. 1007 (Walther) at Fig. 1 *with* Ex. 1010 (Spenser) at Fig. 44a.

184. As I explained in Ground 1, Walther's outer cloth is stitched (attached) to SAPIEN's outer frame. *Supra* §VI.A.5. A person of ordinary skill in the art would have been motivated to stitch Walther's outer cloth to Figure 44a's frame because Walther describes this method of attachment and stitching is simple and would have been known to persons of ordinary skill in the art. A

person of ordinary skill in the art would have expected success in attaching Walther's outer cloth to Figure 44a as explained below.

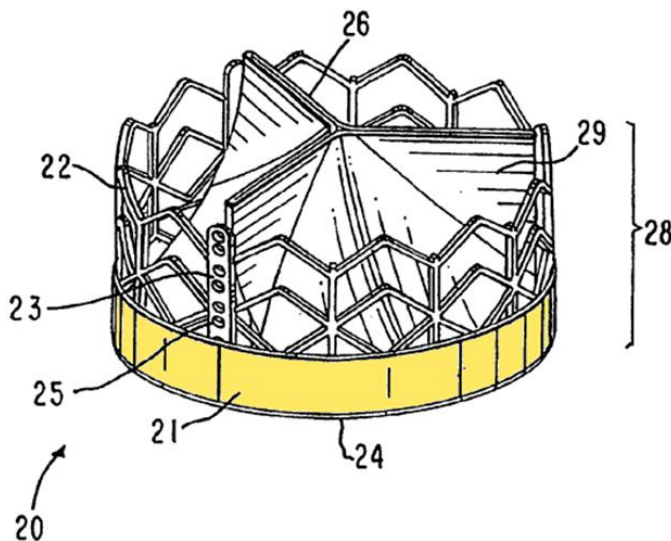
185. As I explained in Ground 1, Walther's outer cloth is "free of an outer graft covering between the fibers" of the outer cloth and the outer frame of the SAPIEN valve. *Supra* §VI.A.5. Spenser's Figure 44a also does not depict any "outer graft covering" on the exterior of the outer frame 575 and Spenser's specification does not describe frame 575 as having an outer graft covering:



Ex. 1010 (Spenser) at Fig. 44a. Therefore, a person of ordinary skill in the art would have understood that when Walther's outer cloth is added to the exterior of Figure 44a's outer frame, there would be no "outer graft covering" between the fibers of the outer cloth and the outer frame.

186. A person of ordinary skill in the art would have been motivated to combine Walther's outer cloth with Spenser's Figure 44a because Walther

expressly discloses combining an outer cloth with a similar (if not identical) heart valve (SAPIEN). Ex. 1007 (Walther) at 1020-1021. Additionally, Spenser suggests adding an outer cloth to Figure 44a by disclosing a similar valve with an outer cuff portion 21 for sealing around the valve:



Ex. 1010 (Spenser) at 13:22-25, Fig. 1. Adding Walther’s outer cloth to Figure 44a would have merely entailed applying a known technique (attaching an outer cloth) to a known device (Figure 44a) ready for improvement (enhanced sealing).

187. A person of ordinary skill would have had a reasonable expectation of success in combining an outer cloth with Figure 44a because Walther discloses how to combine a cloth with a similar (if not identical) heart valve, provides images of the combination, and concludes that the cloth-covered valve “demonstrated excellent hydrodynamic performance.” See Ex. 1007 (Walther) at 1125.

188. I note that during prosecution of a related patent application (U.S. Patent Application No. 17/213,251), Patent Owner suggests, although does not explain, that foreshortening could be an issue in combining an outer cloth, like the one in Walther, with a stent frame. Here, a person of ordinary skill in the art would not have been concerned by the combination of an outer cloth, like Walther's, with the frame in Spenser's Figure 44a because the frame in Figure 44a is almost identical to SAPIEN. Walther already establishes that the outer cloth could be successfully added to SAPIEN's frame, crimped onto a delivery balloon, and expanded within a valve. Additionally, to the extent foreshortening were a problem, which is not mentioned in Walther, persons of ordinary skill in the art would have understood by November 2012 how to adjust and attach the outer cloth to respond to any foreshortening by the stent. For example, Levi (discussed herein) describes methods of building some slack into the outer cloth or skirt to allow for foreshortening. Ex. 1008 (Levi) at 13:32-14:14. For these reasons, any foreshortening of the stent would not have discouraged a person of ordinary skill in the art from adding an outer seal to a heart valve frame or led such a person to believe that the combination would not be successful.

b. Spenser II

189. Spenser II also discloses the outer seal limitation. Spenser II discloses that “[t]o reduce or prevent paravalvular leakage, a layer of compressible material 256 is disposed along an outer surface of the stent structure 252”:

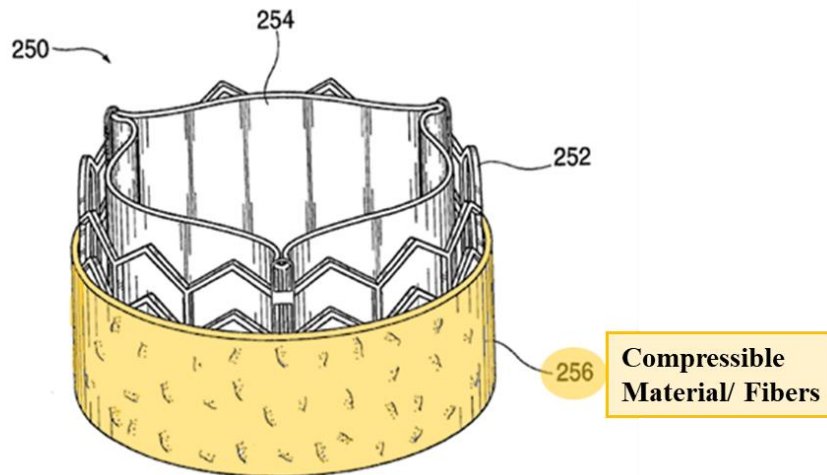


FIG. 22

Ex. 1011 (Spenser II) at [00145], Fig. 22. As shown, the compressible material is positioned externally to the outer frame. Spenser II explains that the compressible material “*may resemble a cloth or fabric having small fibers extending from the surface of the material.*” *Id.* (emphasis added). Spenser II further discloses that the compressible material expands upon implantation in the patient’s heart valve and “fills the gaps between the stented valve and the surrounding tissue,” which “creates a mechanical seal that prevents paravalvular leakage.” *Id.* The compressible material is therefore an “outer seal for preventing paravalvular

leaks.” In fact, during prosecution of the ’846 patent, Patent Owner admitted that Spenser II includes an “outer seal.” Ex. 1002 at 145.

190. Spenser II’s compressible material begins at the proximal portion of the valve and covers the bottom two rows of cells formed by stent structure 252, as shown in Spenser II’s Figure 22 below:

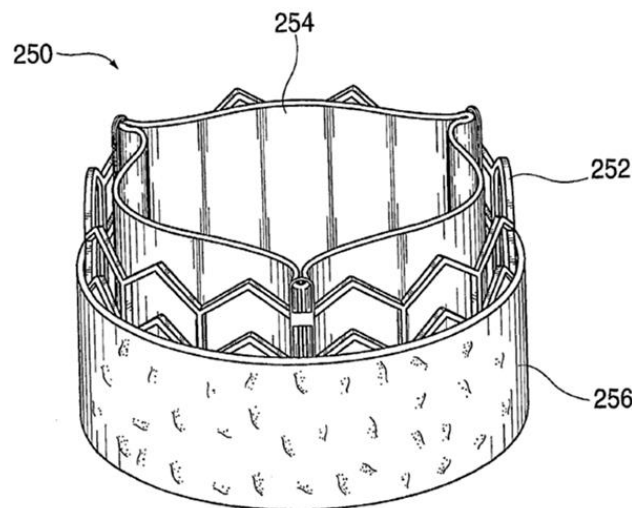


FIG. 22

Ex. 1011, Fig. 22.

191. A person of ordinary skill in the art would have understood that when added to the exterior of the frame in Spenser’s Figure 44a, the compressible material would cover the bottom two rows of cells formed by the outer frame. The side-by-side comparison of Spenser II’s Figure 22 (left) and Spenser’s Figure 44a (right) below confirms the compressible material would cover the bottom two rows of cells of Figure 44a’s frame:

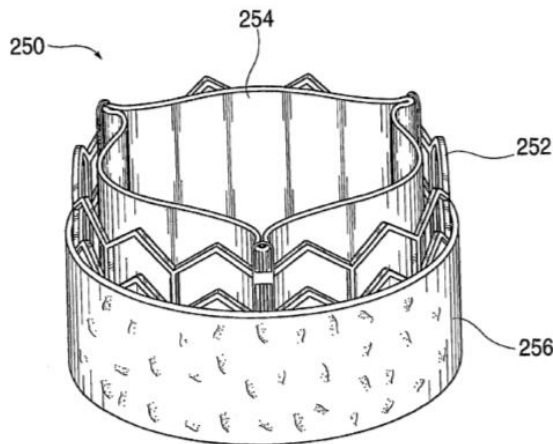


FIG. 22

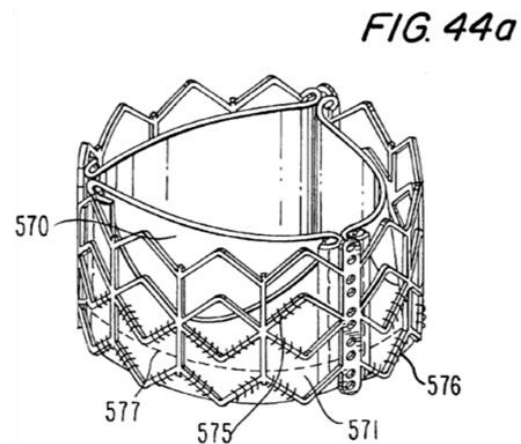


FIG. 44a

Compare Ex. 1011 (Spenser II) at Fig. 22 with Ex. 1010 (Spenser) at Fig. 44a. If claim 1 requires the fibers to *entirely* cover two rows of cells, a person of ordinary skill in the art would have found it obvious to slightly increase the height of Spenser II's compressible material. Spenser II does not disclose that the compressible material cannot cover more of the frame. Further, Walther demonstrates that an outer covering that completely covers two rows of cells was known in the art. Moreover, as explained in Ground 1, a person of ordinary skill in the art would have had access to many different cloths having different dimensions and sizes. *Supra* §§III.C, VI.A.5, VI.E. Furthermore, a person of ordinary skill in the art would not have expected the minimal increase in height that would be necessary to entirely cover the second row of grids to impact the performance or deliverability of the valve.

192. Spenser II discloses that the compressible material 256 “is disposed along an outer surface of the stent structure 252”:

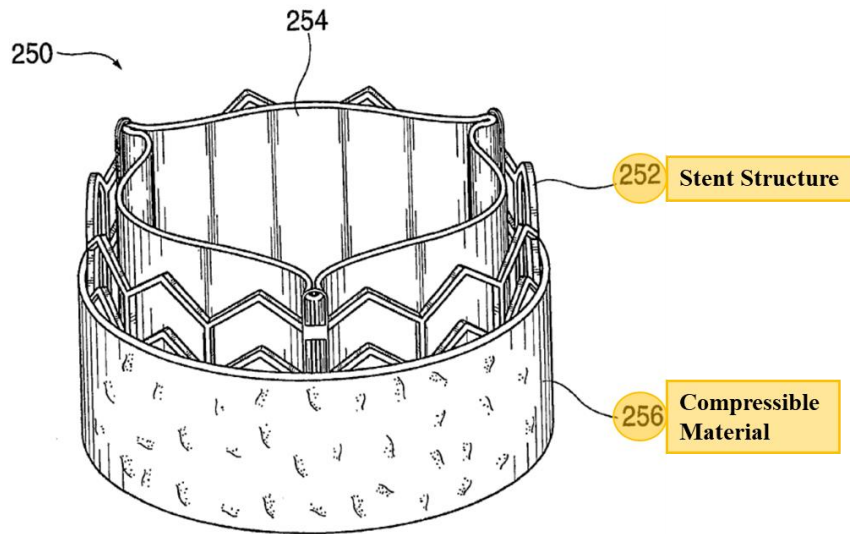


FIG. 22

Ex. 1011 (Spenser II) at [00145], Fig.22. Thus, if Spenser II’s compressible material were added to the outer frame in Spenser’s Figure 44a as shown in Figure 22 (above), the compressible material (outer seal) would be “disposed along the outer surface” of Spenser’s outer frame and would thus be “attached” to the outer frame.

193. Spenser II’s compressible material is “free of an outer graft covering between the fibers and the outer frame.” Spenser II discloses that the compressible material, which “may resemble a cloth or fabric having small fibers extending from the surface of the material,” is “disposed along the outer surface” of the stent. *Id.* at [00145]. Spenser II does not disclose any additional “outer graft covering” between the fibrous fabric of the compressible material and the stent frame. Therefore, a person of ordinary skill in the art would have understood that there is no such “outer graft covering” between the fibers of the compressible material and

the outer frame. Moreover, Spenser II does not contain any disclosure that the compressible material is made of a cloth base or outer graft and a fiber portion. Rather, Spenser II consistently describes the compressible material as a “layer” or single piece of cloth or fabric.

194. As I explained in the previous section, Spenser’s Figure 44a does not include any “outer graft covering” on the exterior of the outer frame 575. *Supra* §VII.A.5.a. Therefore, a person of ordinary skill in the art would understand that when Spenser II’s compressible material is added to the exterior of Figure 44a’s outer frame, there would be no “outer graft covering” between the fibers of the compressible material and the outer frame.

195. A person of ordinary skill in the art would have been motivated to combine Spenser II’s compressible material with Spenser’s Figure 44a for a number of reasons. First, Spenser and Spenser II describe similar valves, share three common inventors, and Spenser II explicitly references Spenser’s parent application: U.S. Publication No. 2003/0153974 (Ex. 1015). *See, e.g.*, Ex. 1010 (Spenser) at Abstract, 2:5-15; Ex. 1011 (Spenser II) at [0001], [0009]-[0014].

196. Also, as I explained in Ground 1, paravalvular leaks were known to occur with SAPIEN, which is similar (if not identical) to Figure 44a. *Supra* §VI.A.E. A person of ordinary skill in the art would have been motivated to combine Spenser II’s compressible material with Figure 44a to “address leaks that

can occur around the implanted valve” and “to encourage coagulation of blood to further fill the gaps and prevent leakage.” Ex. 1011 (Spenser II) at [0010], [0145]. Moreover, adding the compressible material to Figure 44a would have merely entailed the combination of known elements (Figure 44a and compressible material) according to known methods (stitching or otherwise attaching) to yield the predictable result of reducing paravalvular leakage.

197. A person of ordinary skill would have had a reasonable expectation of success in combining Spenser II’s compressible material with Figure 44a because the valve assemblies share many common features, including a balloon-expandable metallic stent having a gridded configuration that supports prosthetic leaflets, and inner graft covering, and being radially compressible for endovascular delivery. *See, e.g.*, Ex. 1010 (Spenser) at 2:5-15; 12:28-36, 13:26-54, 19:5-13; *see also, e.g.*, Ex. 1011 (Spenser II) at [0011]-[0015], [00144]. Moreover, Spenser already discloses valves having a sealing material positioned around the inlet, for example in Figure 1. Ex. 1010 (Spenser) at 13, 22-25, claim 31, Fig. 1. Finally, Claim 1 is not limited to endovascular delivery, so a person of ordinary skill in the art would not have been discouraged from making the combination by any small increases in diameter that might occur from the addition of the compressible material. Also, a person of ordinary skill in the art would not have had any concerns about stent foreshortening because the valve in Spenser II,

which is very similar to Spenser's Figure 44a, is a balloon expandable valve and Spenser II does not describe any problems with foreshortening. *Supra* §VII.A.5.a.

6. Radially Compressed Orientation and Radially Expanded Orientation

198. Claim 1 next recites: "wherein the valve assembly has a radially compressed orientation and a radially expanded orientation." Spenser, Walther, and Spenser II all disclose this limitation.

199. Walther discloses this limitation for the reasons I provided in Ground 1. *Supra* §VI.A.6. Spenser discloses that its prosthetic valve "has the ability to change its diameter from about 4 mm [radially compressed orientation] to about 25 mm [radially expanded orientation]." Ex. 1010 (Spenser) at 27:67-28:2. Likewise, Spenser II discloses a stented valve that comprises "an expandable stent structure" that may be "adapted for radial expansion using a balloon catheter." Ex. 1011 (Spenser II) at [00144]. A person of ordinary skill in the art would have understood that a balloon expandable stent structure, as disclosed in Spenser II, would include a radially compressed and a radially expanded configuration.

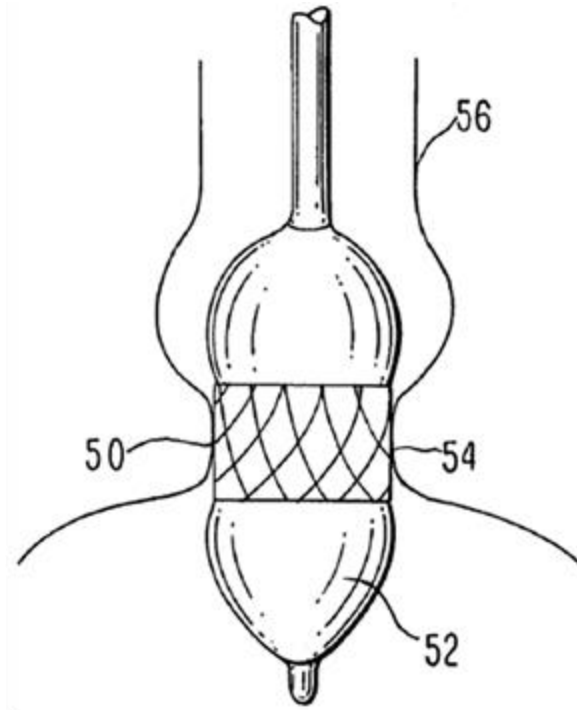
7. Balloon Expandable...To Press Some Fibers Against the Native Leaflets

200. Claim 1 concludes by reciting: "wherein the valve assembly is balloon expandable and expansion of the valve assembly is configured to press some of

the fibers against native leaflets of the aorta of the patient.” Spenser and Walther or Spenser II render this limitation obvious.

201. Spenser discloses that the valve assembly depicted in Figure 44a “resembles the valve shown in Fig. 43.” Ex. 1010 (Spenser) at 26:34-35. The valve shown in Figure 43 may be “inflated by a balloon . . . [such that] the frame is expanded to the full diameter.” *Id.* at 26:19-22; *see also id.* at 12:4-8, 14:10-14, 17:19-18:43 (balloon-expandable assemblies). A person of ordinary skill in the art would therefore have understood that Figure 44a is also balloon expandable. A person of ordinary skill in the art would have further understood that Figure 44a would remain balloon expandable after adding either Walther’s outer cloth or Spenser II’s outer compressible material, as both references explicitly disclose that the use of the outer cloth/compressible material with a balloon-expandable valve. *See* Ex. 1007 (Walther) at 1122 (cloth-covered SAPIEN was balloon-expandable); Ex. 1011 (Spenser II) at [00144] (valve “adapted for radial expansion using a balloon catheter”).

202. Spenser’s Figure 4 (below) “depicts deployable valve deployment in a natural aortic valve position in accordance with the present invention”:



Ex. 1010 (Spenser) at 8:66-67, 14:15-20, Fig. 4; *see also id.*, 5:17-6:36, 17:19-18:43, Figs. 17a-17b. As shown above, the valve presses against the patient’s aortic annulus. *Id.* at Fig. 4. Although not pictured in Fig. 4, a person of ordinary skill in the art would have understood that the valve also presses against the patient’s native aortic leaflets, which are attached to the annulus and extend distally therefrom. *Supra* §III.A. A person of ordinary skill in the art would have understood Figure 4 to illustrate the placement of Spenser’s Figure 44a because Figure 4 describes “the present invention” and Figure 44a is described as a “preferred embodiment of the present invention.” Ex. 1010 (Spenser) at 8:66-67, 26:30-34.

203. As I explained previously, Walther's outer cloth and Spenser II's compressible material would cover at least the two proximal rows of Figure 44a's outer frame. *Supra* §VII.A.5. As illustrated by Figure 4 and understood by a person of ordinary skill in the art, expanding Figure 44a would cause at least a portion of the proximal two rows to press against the patient's native aortic leaflets for the reasons SAPIEN would press against the leaflets. *Supra* §VI.A.7. Thus, expansion of Figure 44a would press some of the fibers of Walther's outer cloth and Spenser II's compressible material against the patient's native aortic leaflets. In fact, Patent Owner admitted this was the case during prosecution of the '846 patent. Patent Owner stated that the "limitation of the fibers covering at least two rows of open cells provides an improvement over the prior art of record because this provides a heightened seal that allows for sealing below the native leaflets and at the native leaflets." Ex. 1002 at 149.

204. A person of ordinary skill in the art would have found it obvious to deploy Spenser's Figure 44a combined with Walther's outer cloth or Spenser II's compressible material within a patient's native valve. Spenser discloses methods of implanting the described valves, such as Figure 44a, at the natural aortic valve. *See e.g.*, Ex. 1010 (Spenser) at 5:17-6:36 (listing delivery steps). A person of ordinary skill would have been motivated to apply Walther's and Spenser II's known techniques for reducing paravalvular leakage (adding an outer cloth to a

valve frame) to Spenser's known prosthetic heart valves (*e.g.*, Figure 44a) for the same reasons I provided for Walther and SAPIEN. *Supra* §VI.A.7. My discussion of SAPIEN is relevant here because Figure 44a is very similar, if not identical, to SAPIEN.

205. A person of ordinary skill in the art would have had a reasonable expectation of success in deploying Figure 44a with an outer cloth or compressible material, like Walther's or Spenser II's, in a patient's native aortic valve. Walther discloses that the cloth-covered valve "demonstrated excellent hydrodynamic performance" and concluded that an *in vivo* implantation procedure "is feasible." Ex. 1007 (Walther) at 1125. Likewise, Spenser II describes the implantation of a valve with a compressible material in a native valve and, given the similarities between the stents in Spenser's Figure 44a and Spenser II's Figure 22, POSITAs would have expected implantation in a native valve to work equally well if the compressible material were added to Spenser's Figure 44a. Ex. 1011 at [0144]-[0145].

206. Moreover, Spenser describes endovascular implantation of its described valves, including Figure 44a, within the aortic valve and persons of ordinary skill in the art had successfully implanted SAPIEN, which is similar (if not identical) to Figure 44a, within a patient's native aortic valve countless times by November 2012. Ex. 1010, 2:6-12, 12:8-36, 13:26-54, 14:12-14; *see also e.g.*,

Ex. 1012 at 355 (“Transcatheter valve implantation with the Edwards-Sapien Heart Valve can be done safely and efficiently using the transfemoral retrograde approach.”); Ex. 1009 at 515-517 (transfemoral and transapical delivery of SAPIEN resulted in 30-day mortality rates of 6.4-7.4% and 11.6-18.6% respectively). Thus, a person of ordinary skill in the art would have been confident in implanting Figure 44a with Walther’s outer cloth or Spenser II’s compressible material within a patient’s native aortic valve.

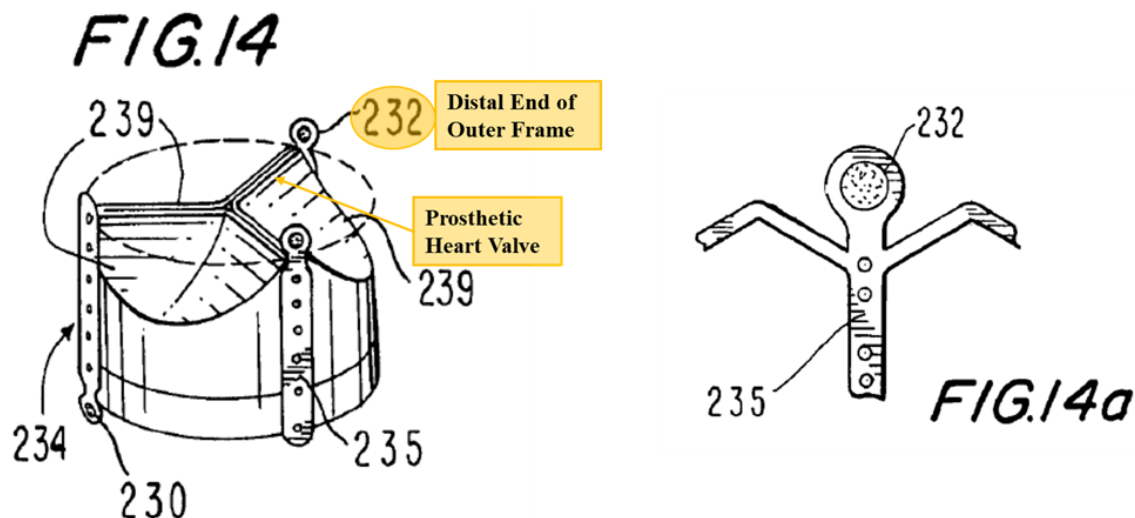
207. Additionally, I note that claim 1 does not require endovascular delivery of the heart valve. Thus, any small increases in valve diameter due to the addition of the outer cloth or compressible material would not have discouraged a person of ordinary skill in the art from implanting the valve in a patient’s native aortic valve. *Supra* §VI.A.7.

B. Claim 2

208. Claim 2 recites: “The valve assembly of claim 1, wherein the outer frame extends distally further than the prosthetic heart valve.” Spenser discloses the limitations in claim 2. Thus, Spenser combined with Walther or Spenser II renders claim 2 obvious.

209. Spenser discloses the limitations in claim 2 in at least two ways. First, Spenser discloses heart valves having “heavy metal markers [232] on the

stent, which markers allow observation and thereby adjustment of orientation while placing the device in the required location.”

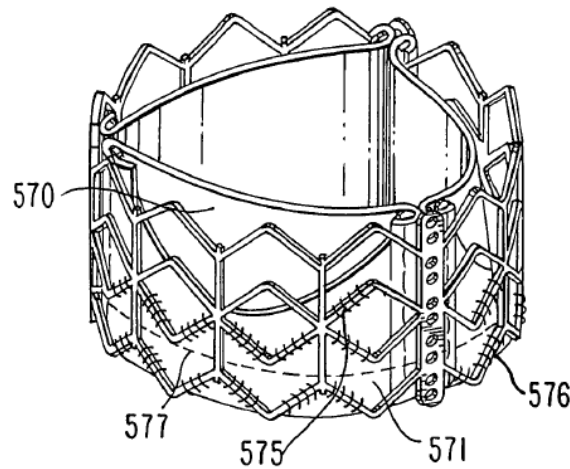


Ex. 1010 (Spenser) at 16:27-51, Figs. 14-14a. As shown in Figure 14 (above left), the portion of the outer frame having the marker extends distally further than the prosthetic heart valve. A person of ordinary skill in the art would have been motivated to add the markers to the stent in Spenser’s Figure 44a to better visualize the stent during deployment. A person of ordinary skill in the art would have reasonably expected success in adding the marker because Spenser describes using the marker with a stent similar to Figure 44a and metal markers were commonly used in the field by 2012.

210. Second, Spenser illustrates a method of attaching the leaflets 430 to a metallic frame 420:

212. Figure 44a includes “frame 575”:

FIG. 44a



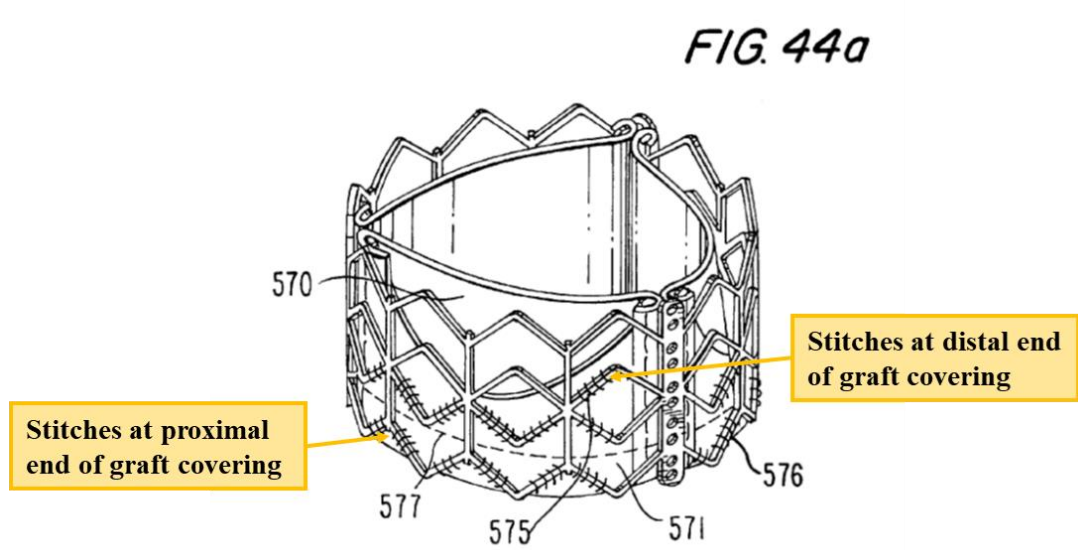
Ex. 1010 (Spenser) at 26:30-34; *see also id.* at 19:5-13 (describing frame). As shown in figure 44a above, the vertically straight bars of the frame are each connected by four rows of interconnected, angular struts that form the gridded configuration of the frame. *See id.* Thus, frame 575 is a singular, integral component. *Id.* at Fig. 44a-44b.

D. Claim 4

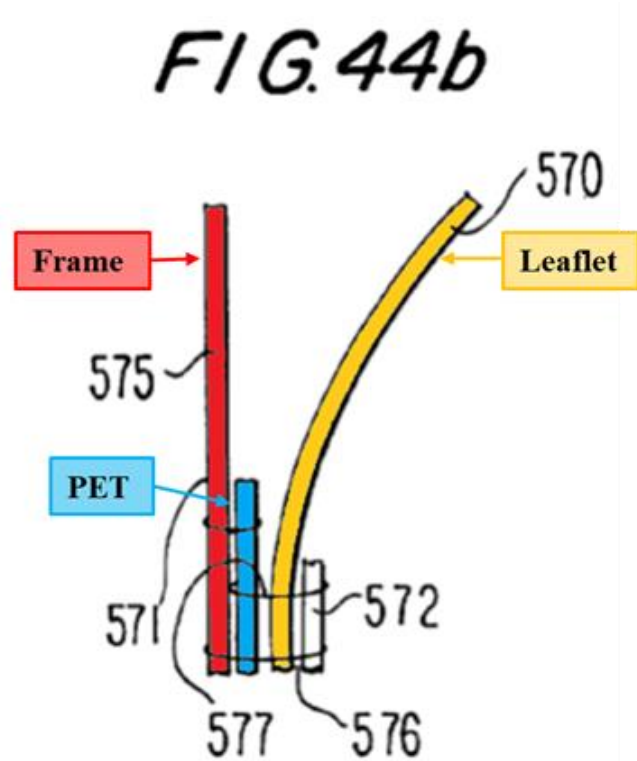
213. Claim 4 recites: “The valve assembly of claim 1, wherein the outer frame and the inner graft covering are attached by stitches at a distal and proximal portion of the inner graft covering.” Spenser discloses the limitations in claim 4. Thus, Spenser combined with Walther or Spenser II renders claim 4 obvious.

214. Spenser’s PET layer 571, which is a graft covering, is attached to the frame 575 with bottom suture 576 and upper suture 578. Ex. 1010 (Spenser) at

26:42-48, Figs. 44a-44c. Figure 44a below shows that the sutures secure the PET layer 571 to the outer frame with a plurality of stitches at the top and bottom of the graft covering:



Id. at Fig. 44a. The sutures are further shown in Figure 44b, below.



E. Claim 5

215. Claim 5 recites: “The valve assembly of claim 1, wherein the inner graft covering and the fibers are distinct elements.” Spenser in combination with Walther or Spenser II renders claim 5 obvious.

216. As I explained in claim 1, Figure 44a of Spenser discloses a layer of PET fabric stitched to the interior surface of the outer frame. *Supra* §§VII.A.3-4. A person of ordinary skill in the art would have understood that Walther’s outer cloth and Spenser II’s outer compressible are separate materials from the inner layer of PET fabric and, therefore, “distinct elements.”

F. Claim 6

217. Claim 6 recites: “The valve assembly of claim 1, wherein the valve assembly is delivered endovascularly.” Spenser in combination with Walther or Spenser II renders claim 6 obvious.

218. Spenser discloses endovascular delivering heart valve assemblies. Spenser discloses that “[a]n aspect of the present invention deals with the possibility of *implanting the valve percutaneously*, i.e., inserting the valve assembly on a delivery device similar to a catheter, then implanting the valve at the desired location *via a large blood vessel such as the femoral artery*, in a procedure similar to other known interventional cardiovascular procedures.” Ex. 1010 (Spenser) at 2:6-12 (emphasis added). Spenser explains that the prosthetic

valve may be crimped to a narrow configuration that is “suitable for percutaneous catheterization and deployment.” *Id.* at 14:12-14; *see also id.* at 12:8-17, 12:28-36, 13:26-54. Spenser also discloses a method of endovascularly implanting the prosthetic valve in a patient’s native aortic valve using a balloon catheter that is guided through the patient’s vasculature to the patient’s native aortic valve. *Id.* at 5:17-6:36, 17:19-18:43.

219. According to Spenser, Figure 44a illustrates a “preferred embodiment of the **present invention**.” *Id.* at 26:30-34. Thus, a person of ordinary skill in the art would have understood that Spenser’s disclosure of endovascular delivery would apply to the embodiment in Figure 44a. *See id.* at 2:6-12, 26:30-34.

220. Spenser II also discloses endovascular delivery. Spenser II states that “[t]he present invention provides a series of new **percutaneous** concepts of paravalvular repairs including . . . built-in means for leak prevention.” Ex. 1011 (Spenser II) at Abstract (emphasis added); *see also id.* at [0014]. Spenser II teaches that “[p]ercutaneous introduction of medical devices is a preferred surgical procedure for it involves making only a very small perforation in the patient's skin (usually in the groin or armpit area) under local anesthetic sedation.” *Id.* at [0012]. Percutaneous delivery as described in Spenser II is endovascular delivery.

221. A person of ordinary skill in the art would have been motivated to endovascularly deliver Figure 44a with Walther's outer cloth or Spenser II's compressible for the same reasons a person would have been motivated to deliver the Walther valve endovascularly. *Supra* §VI.E. By 2012, persons of ordinary skill in the art had demonstrated that devices not suitable for delivery through smaller blood vessels could still be endovascularly delivered through the common iliac artery. (Ex. 1043, 273-276; Ex. 1044.) Thus, a person of ordinary skill in the art would have reasonably expected that Spenser's Figure 44a combined with Walther's outer cloth or Spenser II's compressible material would have been deliverable through this route.

222. Moreover, if persons of ordinary skill in the art wanted to deliver the combined valve through smaller blood vessels, they would have possessed the skills and equipment necessary to adapt the outer seal or valve for the particular vessel, including the femoral artery, as discussed in Ground 1. (*Supra* §VI.E.) A person of ordinary skill in the art would have found it obvious to utilize one or more of the known techniques discussed in Ground 1 to combine Walther's outer cloth or Spenser II's compressible material with Spenser's Figure 44a for endovascular delivery.

223. Moreover, Spenser discloses that the "maximal size of a catheter inserted into the femoral artery should be no more than 8 mm in diameter." Ex.

1010 (Spenser) at 27:65-67. Spenser’s prosthetic valve “has the ability to change its diameter from about 4 mm to about 25 mm.” *Id.* at 27:67-28:2. Spenser II’s compressible material can have “a thickness ranging from about 1 to 5 mm.” Ex. 1011 at [00145]. POSITAs would have reasonably expected that adding a compressible material 1 mm thick to Spenser’s 4-mm valve would have resulted in a device suitable for endovascular delivery through the femoral artery because the device’s diameter would have been no more than 8 mm. Additionally, a person of ordinary skill in the art would have recognized the availability of even thinner compressible materials that could be used to further reduce the profile. Thus, a person of ordinary skill in the art would have reasonably expected the combination of Spenser II’s compressible material, or a similar but thinner material, and Figure 44a to be suitable for transfemoral delivery.

G. Claim 7

224. Claim 7 recites: “The valve assembly of claim 1, wherein a seal is created between the inner frame and the outer frame.” Spenser discloses this limitation. Thus, Spenser combined with Walther or Spenser II renders claim 7 obvious.

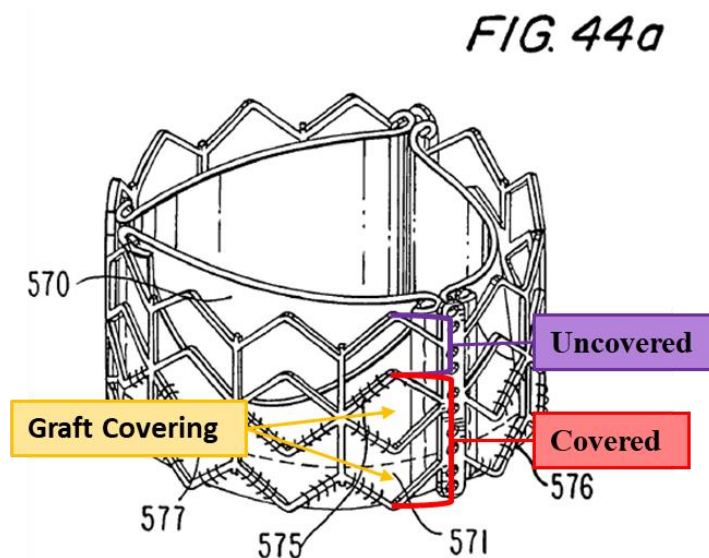
225. Spenser’s Figure 44a includes a layer of PET positioned between the valve leaflets and the support frame “*for sealing* and protecting the pericardium.” Ex. 1010 (Spenser) at 26:30-54 (emphasis added). Spenser further discloses that

the “[b]ottom attachment suture 576, connects . . . the leaflet and both PET layers to the frame and **forms a strong sealing line.**” *Id.* at 26:45-47 (emphasis added). From these disclosures, a person of ordinary skill would have understood that a seal is created between Spenser’s inner PET layer and outer frame.

H. Claim 8

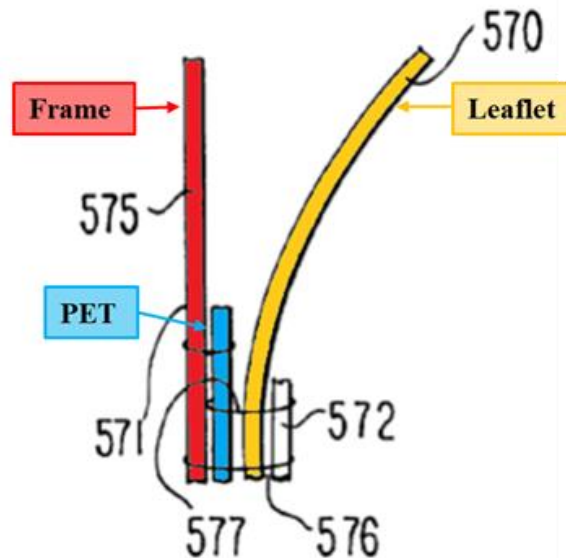
226. Claim 8 recites: “The valve assembly of claim 1, wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.” Spenser in combination with Walther or Spenser II renders claim 8 obvious.

227. As shown in Spenser’s Figure 44a below, the inner PET fabric covers the bottom two rows of cells of Figure 44a’s outer frame but **does not** cover the uppermost row of cells:



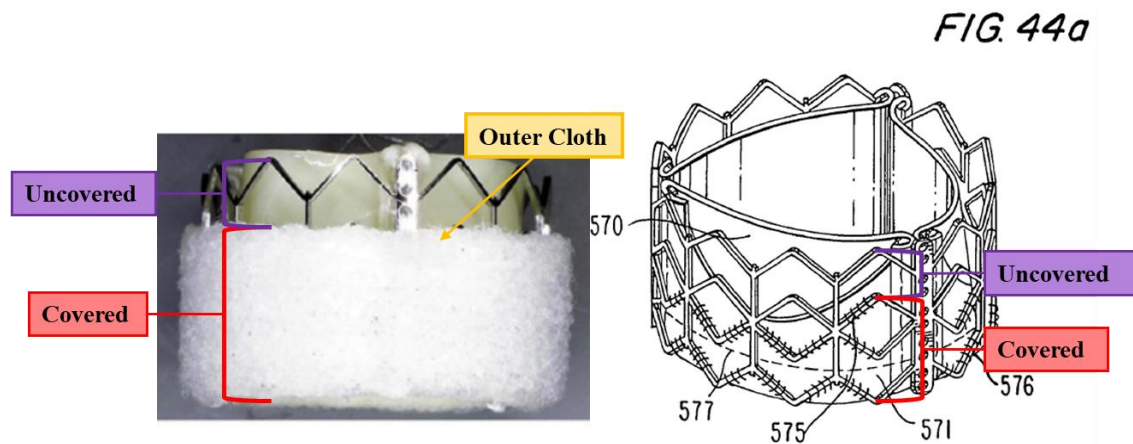
Ex. 1010 (Spenser) at Fig. 44a. Figure 44b (below) confirms that the inner PET layer 571 [blue] does not cover the entire frame 575 [red].

FIG. 44b



1. Walther

228. As I explained previously, Walther's outer cloth covers the two most proximal circumferentially extending rows of cells formed in SAPIEN's open cell configuration. *Supra* §VI.A.5. If Walther's outer cloth were added to Spenser's Figure 44a, the cloth would cover the bottom two rows of cells of the support stent but **would not** cover the uppermost row of cells, as illustrated in the side-by-side comparison of Walther's Figure 1 (left) and Spenser's Figure 44a (right):



Compare Ex. 1007 (Walther) at Fig. 1 with Ex. 1010 (Spenser) at Fig. 44a.

229. Therefore, when Walther’s outer cloth is added to Spenser’s Figure 44a, the uppermost row of cells, which are a “portion of the outer frame,” would be uncovered by the both the inner PET fabric (graft covering) and the outer cloth (outer seal).

2. Spenser II

230. Figure 22 of Spenser II (below) shows the compressible material covering the bottom two rows of cells formed by stent structure 252, leaving the uppermost (i.e., distal) third row of cells uncovered:.

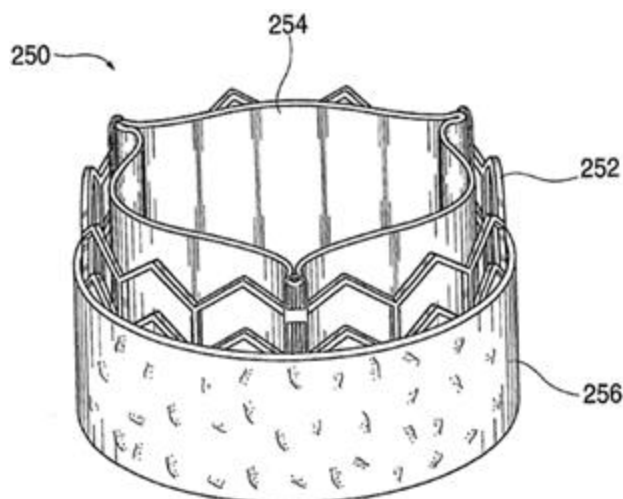
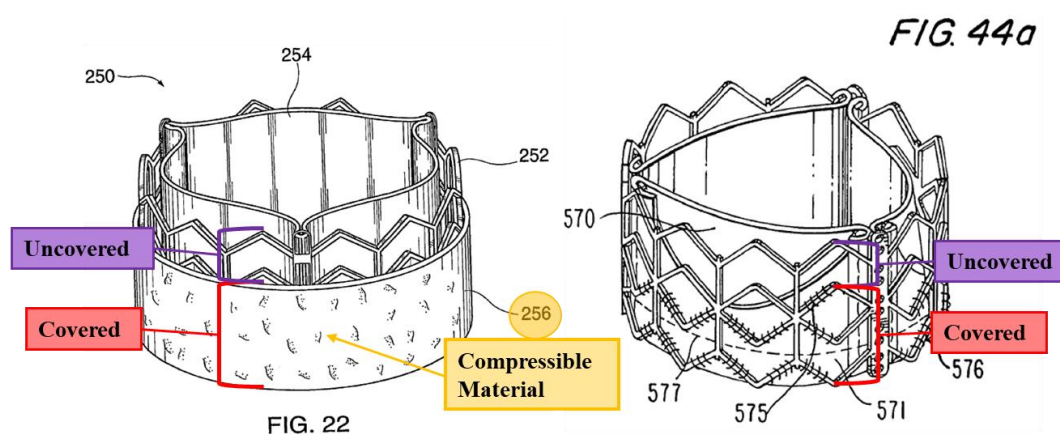


FIG. 22

Ex. 1011 (Spenser II) at Fig. 22.

231. When added to the exterior of the stent in Spenser's Figure 44a, the compressible material would cover the bottom two rows of cells formed by the stent frame but **would not** cover the uppermost row of cells, as illustrated in the side-by-side comparison of Spenser II's Figure 22 (left) and Spenser's Figure 44a (right):



Compare *id.* at Fig. 22 with Ex. 1010 (Spenser) at Fig. 44a. As discussed above, if the claims require the fibers to *entirely* cover two rows of cells, a person of

ordinary skill in the art would have found it obvious to slightly increase the height of Spenser II's compressible material. *Supra* §VII.A.5.b. Therefore, when Spenser II's compressible material is added to Spenser's Figure 44a, the uppermost row of cells, which are a "portion of the outer frame," would be uncovered by both the inner PET fabric (graft covering) and the compressible material (outer seal).

I. Claim 9

232. Claim 9 recites: "The valve assembly of claim 1, wherein a distal end of the outer frame extends distally beyond the prosthetic leaflets."

233. This claim is substantially similar to claim 2, which recites: "The valve assembly of claim 1, wherein the outer frame extends distally further than the prosthetic heart valve." In both claims, the outer frame extends distally further than, or beyond, the prosthetic heart valve (or prosthetic leaflets).

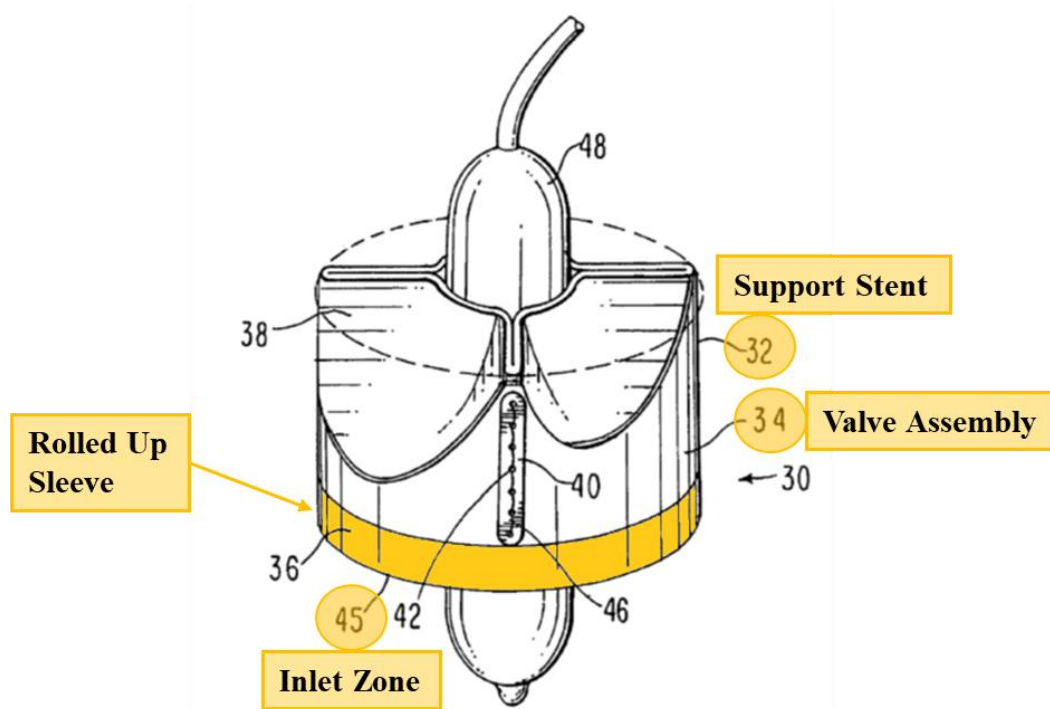
234. Thus, Spenser discloses this limitation and Spenser combined with Walther or Spenser II renders claim 9 obvious for the same reasons the references render claim 2 obvious.

J. Claim 10

235. Claim 10 recites: "The valve assembly of claim 1, wherein the graft covering extends beyond a proximal end of the outer frame and over the proximal end thereof to cover the proximal end of the outer frame." Spenser discloses this

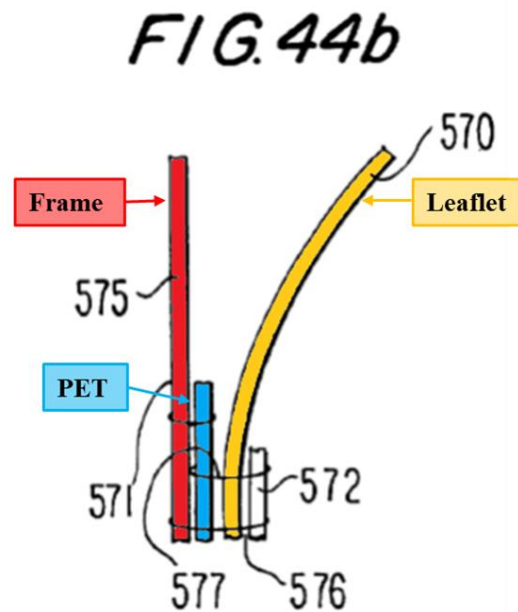
limitation. Thus, Spenser combined with Walther or Spenser II renders claim 10 obvious.

236. Spenser discloses an embodiment of its valve, shown in Figure 2, in which a “portion of the valve assembly 34 at an inlet Zone 45 is optionally rolled over support stent 32 at the inlet, making up a rolled sleeve [yellow], which enhances the sealing of the device at the valve inlet.” Ex. 1010 (Spenser) at 14:6-9. I note that in Figure 2 below, the dashed lines indicates the support stent, which is not shown in full in the figure. *Id.* at 13:63-66.



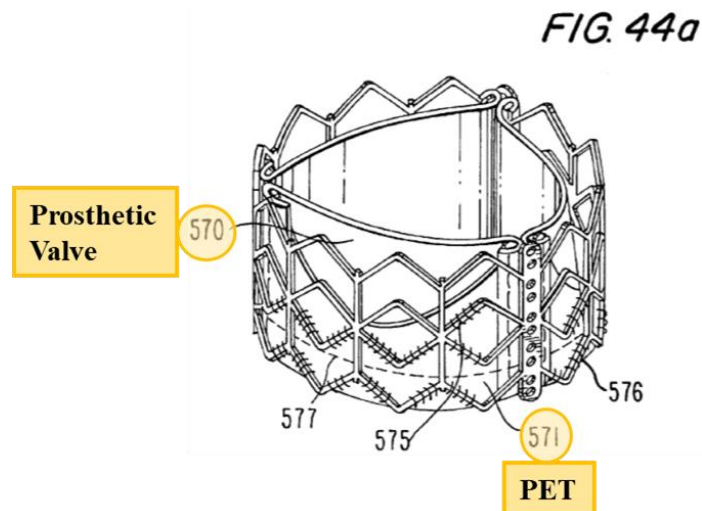
Id. at Fig. 2.

237. As I explained in claim 1, Spenser's Figure 44a includes a piece of PET fabric (inner graft covering) positioned between the outer frame and the valve leaflets. *Supra* §VII.A.3.



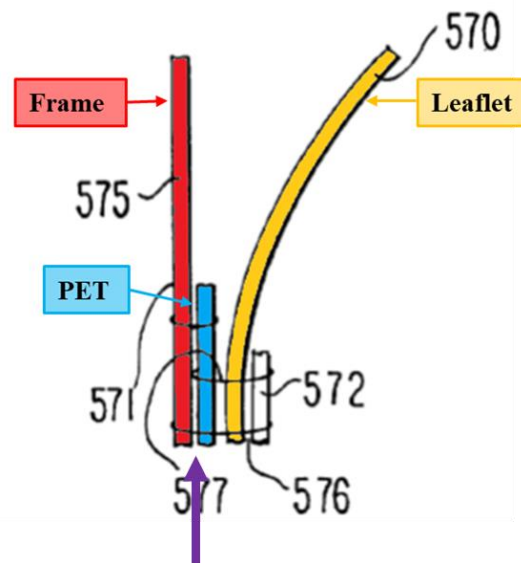
Ex. 1010 (Spenser) at Fig. 44b.

238. A person of ordinary skill in the art would have found it obvious to apply Spenser's teachings regarding the embodiment in Figure 2 to the inner PET fabric in Figure 44a and extend the inner PET fabric over the proximal end of the outer frame 575.



A person of ordinary skill in the art would have been motivated to extend PET 571 to “enhance[] the sealing of the device [in Figure 44a] at the valve inlet.” *Id.* at 14:6-9. A person of ordinary skill would have understood that extending the inner PET fabric over the proximal end of the outer frame would provide an additional seal between the inner PET and the outer frame at the valve inlet. This additional seal would ensure that blood does not leak through gaps between the PET fabric and the outer frame (and ultimately the outer seal), indicated by the purple arrow in Figure 44b below:

FIG. 44b

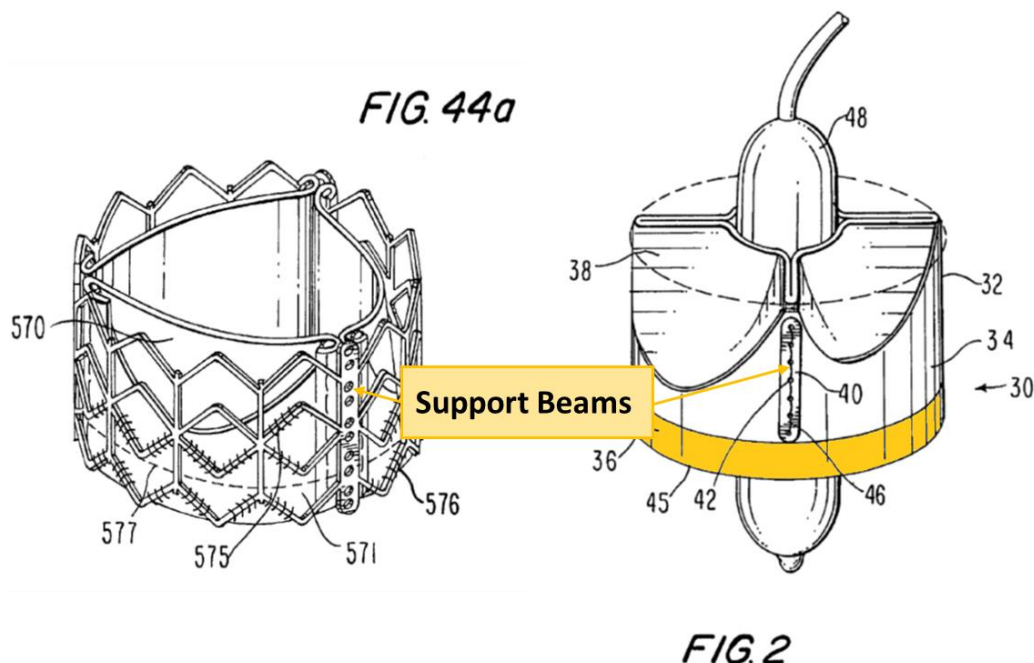


Id. at Fig. 44b. If the inner PET is not wrapped around the inlet end of the outer frame, a person of ordinary skill would understand that there is a greater possibility of blood seeping through the gaps at the interface between the inner PET fabric and the outer frame.

239. Additionally, a person of ordinary skill in the art would have been motivated to extend the cuff over the proximal end to reduce the risk that the edges of the frame would damage the surrounding tissue. Ex. 1048 (Essinger) at [0098]. This modification would have merely entailed applying a known technique (extending the cuff) to a known device (SAPIEN) ready for improvement (enhanced sealing and reduce frame exposure).

240. A person of ordinary skill in the art would have reasonably expected success in extending the inner PET fabric over the proximal end of Figure 44a's

outer frame because Figures 2 and 44a describe similar heart valves. See Ex. 1010 at 14:41-44, 26:30-54. Both valves include an inner PET layer that is stitched to a gridded, metallic, balloon-expandable support stent that has three parallel support beams for attaching leaflets:



Id. at 13:62-14:3; 26:30-54, Figs. 2, 44a. A person of ordinary skill in the art would have reasonably expected that the teachings of Figure 2 would also apply to Figure 44a due to these similarities (and the fact that the Figures are described in the same patent).

241. A person of ordinary skill in the art would have been motivated to add Walther's outer cloth or Spenser II's compressible material to Spenser's Figure 44a even if Figure 44a had an inner graft covering extending over the proximal end of the frame because the outer cloth/compressible material serves a different purpose

than the extended graft covering. As explained above, the extended graft covering prevents blood from leaking between the inner and outer frames. See Ex. 1010 (Spenser) at 26:30-34. In contrast, the outer cloth/compressible material prevents blood from leaking between the valve and surrounding tissue. See Ex. 1007 (Walther) 1120; Ex. 1011 (Spenser II) at [00145]. Moreover, a person of ordinary skill in the art would have understood that Spenser's inner PET layer would be a thin fabric, and thus wrapping the PET around the proximal end of the frame would not have a substantial effect on the valve's profile. Therefore, a person of ordinary skill in the art would not have been discouraged from adding the outer cloth/compressible material to Spenser 44a's frame having the extended inner PET layer.

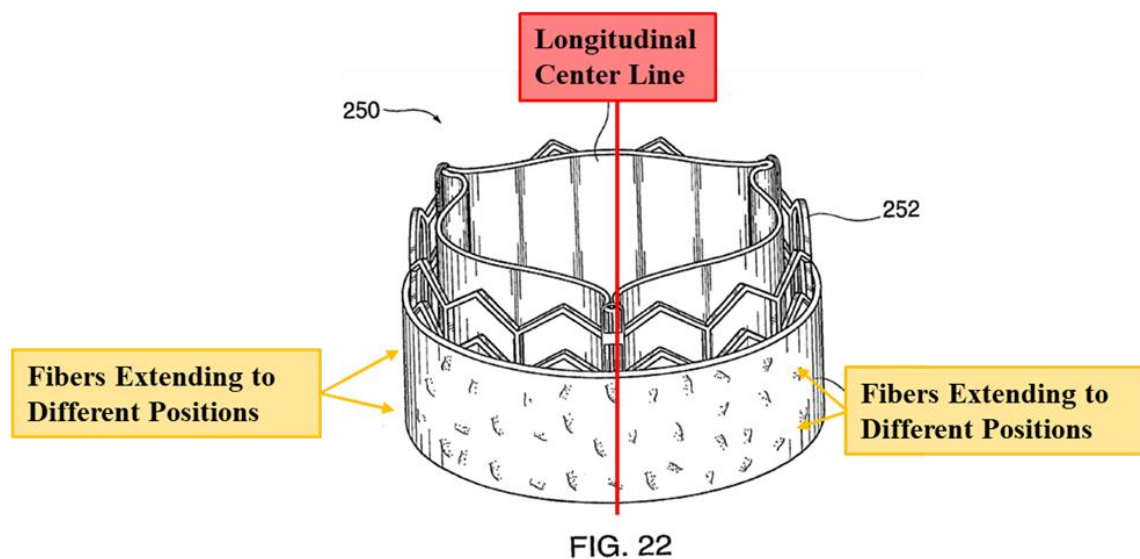
K. Claim 11

242. Claim 11 recites: "The valve assembly of claim 1, wherein the outwardly extending fibers extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly." Spenser in combination with Walther or Spenser II renders this claim obvious.

243. Walther's outer cloth discloses this limitation for the reasons I provided in Ground 1. *Supra* §VI.H.

244. Spenser II's compressible material also discloses this limitation. Spenser II's compressible material extends around the outer frame so fibers

extend to the left and right of the “centerline.” Thus, the compressible material includes fibers that “extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly”:



Ex. 1011 (Spenser II) at Fig. 22.

245. Additionally, Spenser II’s compressible material does not have a uniform surface. Spenser II discloses that the fibers of the compressible material “may be straight, curved, or hook shaped.” Ex. 1011 (Spenser II) at [00145]. A person of ordinary skill in the art would have understood the speckled markings on the compressible material 256 in Figure 22 below to indicate that some of the fibers extend further out from the frame than others:

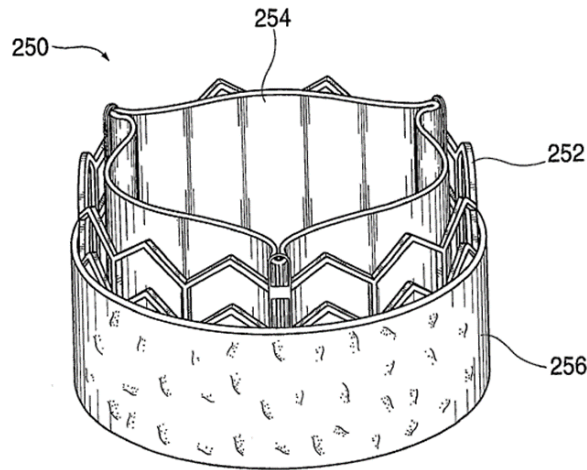


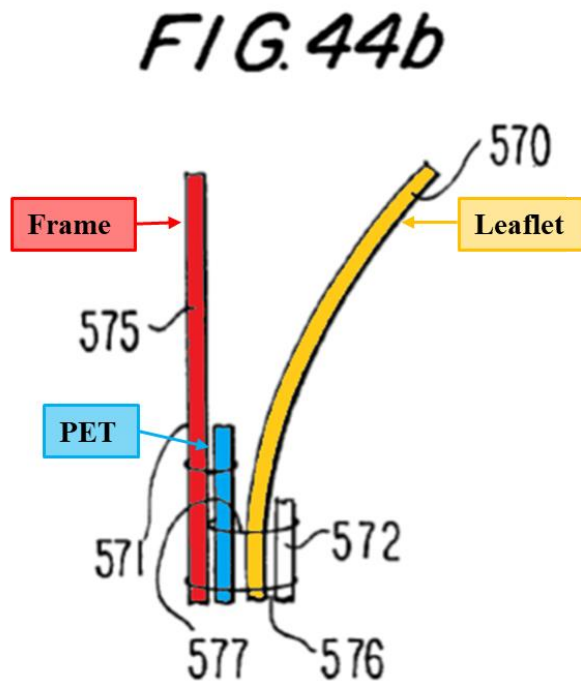
FIG. 22

Thus, even the fibers on one side of the valve “extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly.”

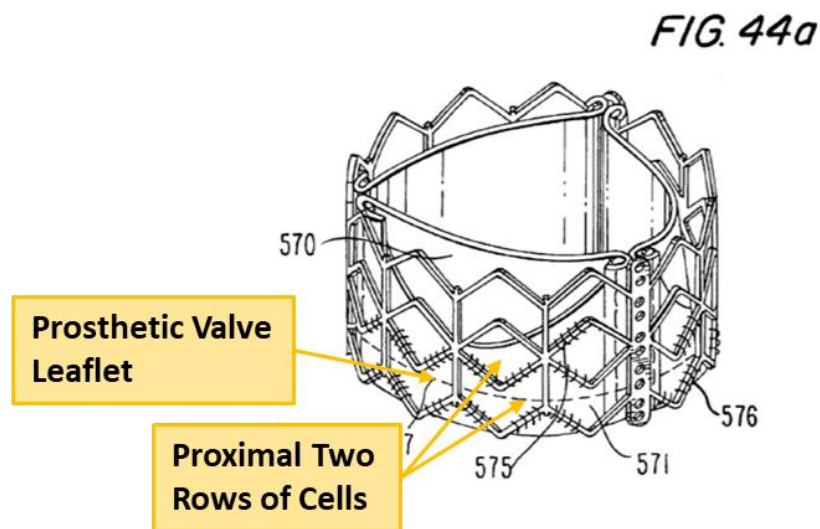
L. Claim 12

246. Claim 12 recites: “The valve assembly of claim 1, wherein the graft covering, outer seal, and prosthetic leaflets are radially overlapping.” Spenser in combination with Walther or Spenser II renders claim 12 obvious.

247. As I explained in claim 1, Spenser’s Figure 44a includes an inner PET fabric 571 (inner graft covering) that is secured to the interior surface of the outer frame and extends around the prosthetic heart valve at the lower end of the outer frame. *Supra* §VII.A.3. Spenser discloses that PET 571 is positioned “between the leaflets and the frame.” Ex. 1010 (Spenser) at 26:40-42. A person of ordinary skill in the art would have understood that PET 571 radially overlaps with the leaflets 570, as illustrated below:



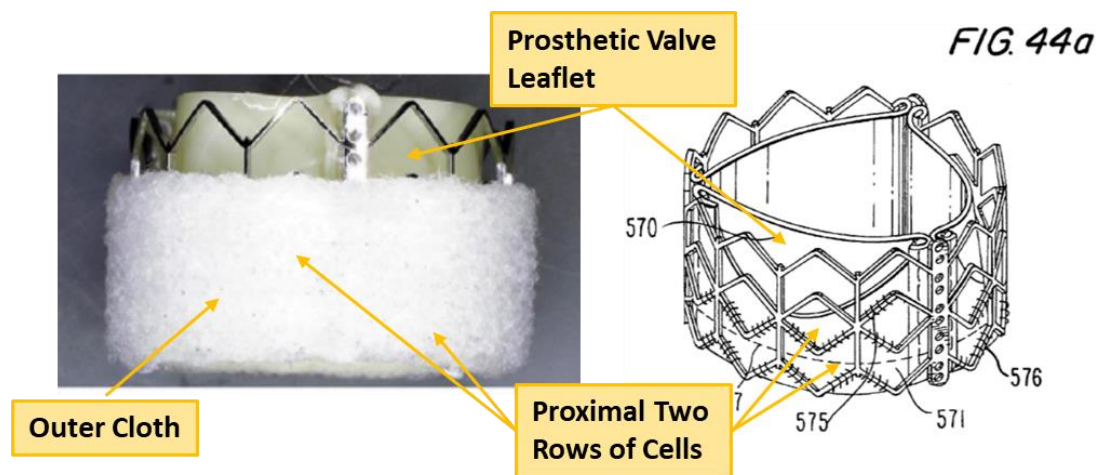
Id. at Fig. 44b. Figure 44a (below) depicts the sealing line where the prosthetic leaflets are sutured to the inner PET layer.



1. Walther

248. As I explained in claim 1, if Walther's outer cloth were added to Spenser's Figure 44a, the cloth would cover the proximal two rows of cells of the

support stent. *Supra* §VII.A.5.a. A side-by-side comparison of Walther's Figure 1 (left) and Spenser's Figure 44a (right) illustrates that the two proximal rows of cells covered by the outer cloth would "radially overlap" with the prosthetic leaflets 570 of Spenser's Figure 44a:



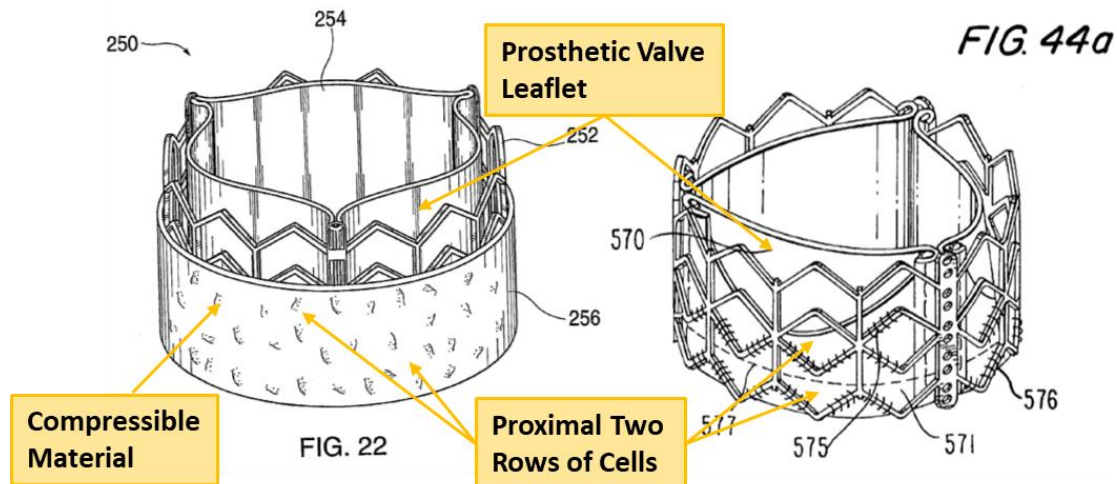
Compare Ex. 1007 (Walther) at Fig. 1 *with* Ex. 1010 (Spenser) at Fig. 44a.

249. Therefore, the combination of Spenser and Walther would include an inner graft covering, an outer cloth (outer seal), and prosthetic leaflets that are radially overlapping.

2. Spenser II

250. As I explained in claim 1, when added to the exterior of the stent in Spenser's Figure 44a, Spenser II's compressible material would cover the proximal two rows of cells formed by the stent frame. *Supra* §VII.A.5.b. A side-by-side comparison of Spenser II's Figure 22 (left) and Spenser's Figure 44a (right)

illustrates that the compressible material would radially overlap with the prosthetic leaflets of Figure 44a:

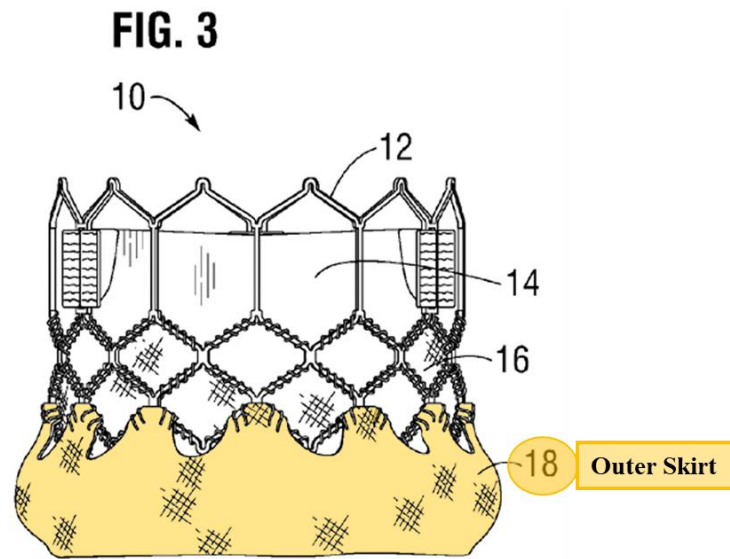


Compare Ex. 1011 (Spenser II) at Fig. 22 with Ex. 1010 (Spenser) at Fig. 44a.

251. Therefore, the combination of Spenser and Spenser II would include an inner graft covering, an outer compressible material (outer seal), and prosthetic leaflets that are radially overlapping.

VIII. GROUNDS 4-7: CLAIMS 1-12 ANTICIPATED BY LEVI
OR OBVIOUS OVER LEVI ALONE OR WITH
WALTHER OR SPENSER II

252. Levi discloses a prosthetic heart valve assembly having an outer skirt of woven PET fabric secured to the exterior surface of a stent frame, as shown in Figure 3 below:



Ex. 1008 (Levi) at 13:50-53, 13:62-66, Fig. 3. As I explain in detail below, Levi’s outer skirt of woven PET fabric is an outer seal that includes outwardly extending fibers, as required by the claims of the ’846 patent. Therefore, based on my review of the prior art, I believe Levi discloses or suggests every limitation of claims 1-12 and either anticipates or renders the claims obvious.

253. However, if Levi does not disclose or suggest the claimed “outer seal,” Walther and Spenser II do. *Supra* §§VI.A.5, VII.A.5. It is my opinion that a person of ordinary skill in the art would have found it obvious to combine the outer seals from Walther or Spenser II with Levi for the reasons I provide below. Therefore, it is my opinion that Levi in combination with Walther **or** Spenser II also discloses every limitation of claims 1-12 and renders the claims obvious.

A. Claim 1

254. Based on my review of the prior art, it is my opinion that Levi anticipates claim 1 or renders it obvious alone or in combination with Walther or Spenser II.

1. Preamble

255. The preamble of claim 1 recites: “A valve assembly comprising.”

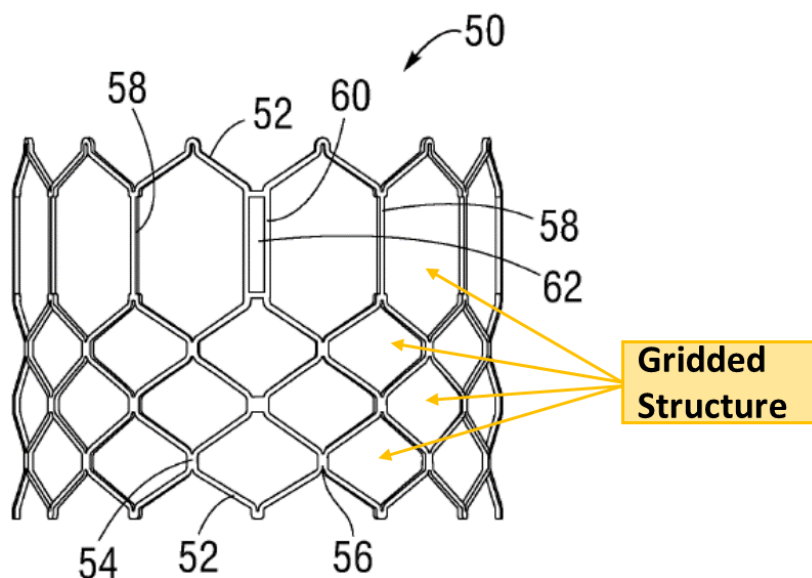
256. Levi discloses a valve assembly. Levi discloses “embodiments of a prosthetic heart valve, and delivery systems for implanting heart valves.” *See e.g.*, Ex. 1008 (Levi) at 1:16-17, Figs. 1-3.

2. Outer Frame

257. Claim 1 next recites: “an outer frame, wherein the outer frame is formed from a metallic material and defines an open cell configuration.” Levi also discloses this limitation.

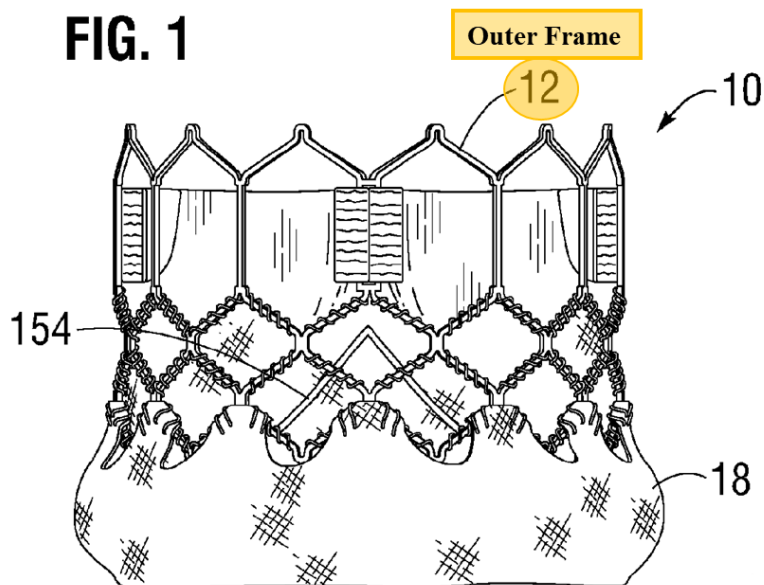
258. Levi discloses an expandable frame formed from metal (e.g., stainless steel, cobalt-chromium, etc.) that defines an open cell structure, as shown in Figure 11 below:

FIG. 11



Ex. 1008 (Levi) at 6:17-24, Fig. 11. As shown in Figure 1 below, the frame 12 surrounds the other components of the valve and is thus an “outer frame”:

FIG. 1

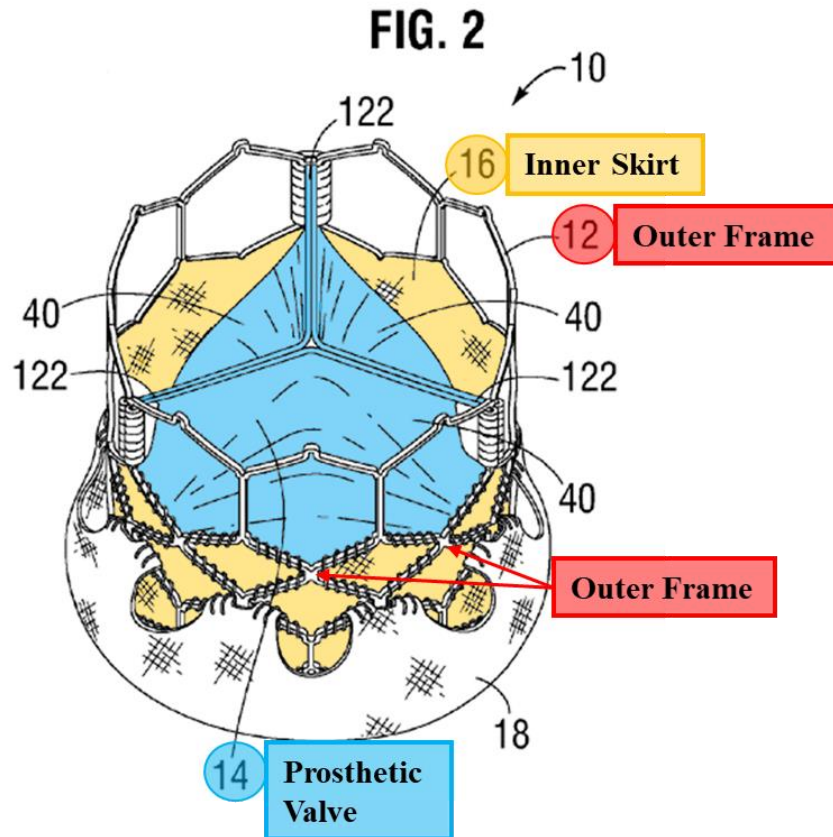


Id. at Fig. 1.

3. **Inner Frame**

259. Claim 1 next recites: “an inner frame that engages a prosthetic heart valve having prosthetic leaflets, wherein the inner frame includes a cylindrically extending inner graft covering extending at least partially radially outwardly of the prosthetic heart valve and radially inwardly of the outer frame for providing sealing to the prosthetic heart valve.” Levi also discloses this limitation.

260. Levi discloses an “inner skirt 16 ... to assist in forming a good seal between the valve and the native annulus by blocking the flow of blood through the open cells of frame 12 below the lower edge of the leaflets.” Ex. 1008 (Levi) at 9:7-11. The inner PET skirt therefore provides sealing to the prosthetic heart valve. The inner skirt is constructed of “a tough, tear resistant material such as polyethylene terephthalate (PET).” *Id.* at 9:11-16. PET, for example, is a “graft covering.” The inner skirt is engaged to the valvular structure “via one or more thin PET reinforcing strips. *Id.* At 9:25-29. The “valvular structure 14 can comprise three leaflets 40, collectively forming a leaflet structure.” *Id.* at 5:59-62, Fig. 2. The three leaflets of the valvular structure are “prosthetic leaflets.” Levi’s inner skirt 16 [yellow] is cylindrically extending and extends at least partially radially outwardly of prosthetic valvular structure 14 [blue] and radially inwardly of the outer frame 12 [red] as illustrated in Figure 2 below:



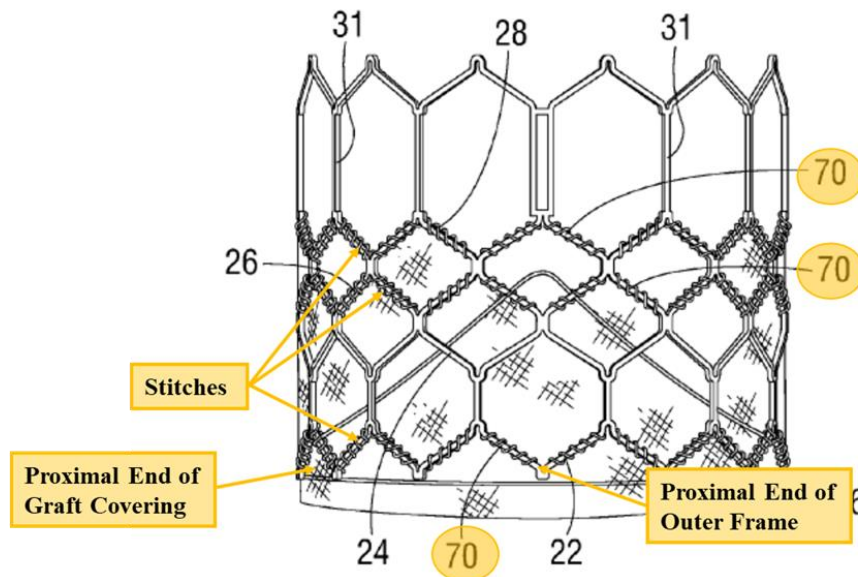
Id. at Fig. 2. Therefore, based on Patent Owner’s statements during prosecution, and if a graft covering can be an inner frame, Levi’s inner skirt satisfies this limitation. In fact, during prosecution of the ’846 patent, Patent Owner admitted that Levi includes an inner seal. Ex. 1002 at 137-138, 145.

4. Stitching

261. Claim 1 next recites: “wherein the outer frame is secured to the inner graft covering by stitching at a proximal end of the outer frame.” Levi also discloses this limitation.

262. Levi’s inner skirt is secured to the frame by stitching (sutures 70) at the proximal end of the outer frame, as shown in Figure 20 below:

FIG. 20



Ex. 1008 (Levi) at 9:24-25, 10:11-30, Figs. 20, 39.

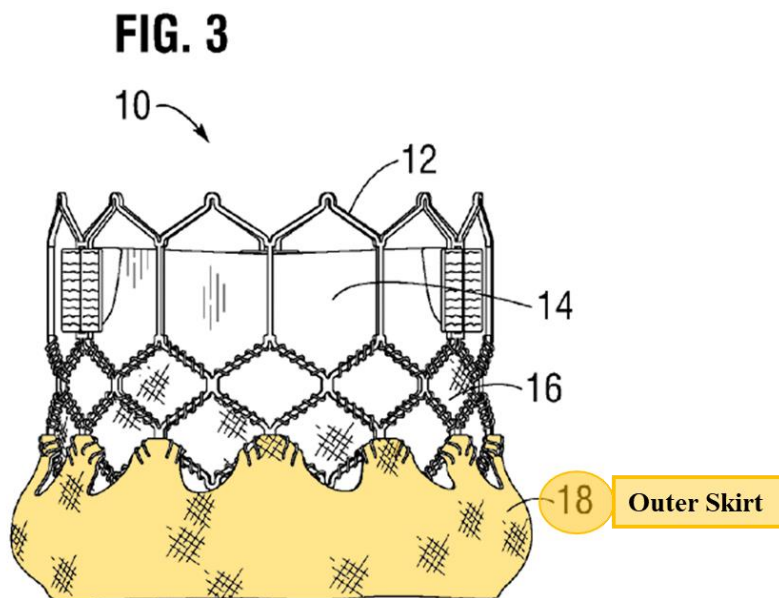
5. Outer Seal

263. Claim 1 next recites: “an outer seal for preventing paravalvular leaks” that: (1) “begins at a proximal portion of the outer frame and extends over at least two rows of cells formed in the outer frame”; (2) “is attached to the outer frame”; (3) “is formed of outwardly extending fibers positioned externally to the outer frame”; and (4) “is free of an outer graft covering between the fibers and the outer frame.”

a. Levi

264. Levi discloses the limitations of the outer seal or renders them obvious.

265. Levi discloses an outer skirt of woven PET fabric secured to the exterior surface of the frame. Ex. 1008 (Levi) at 13:50-53, 13:62-66. The outer skirt is thus “positioned externally to the outer frame.”

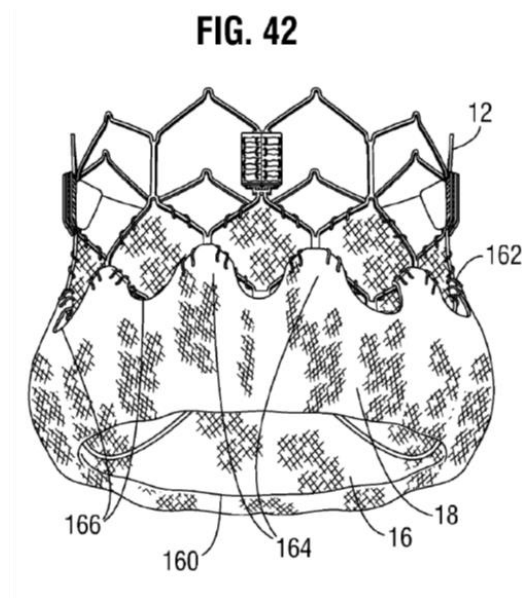


Id. at Fig. 3.

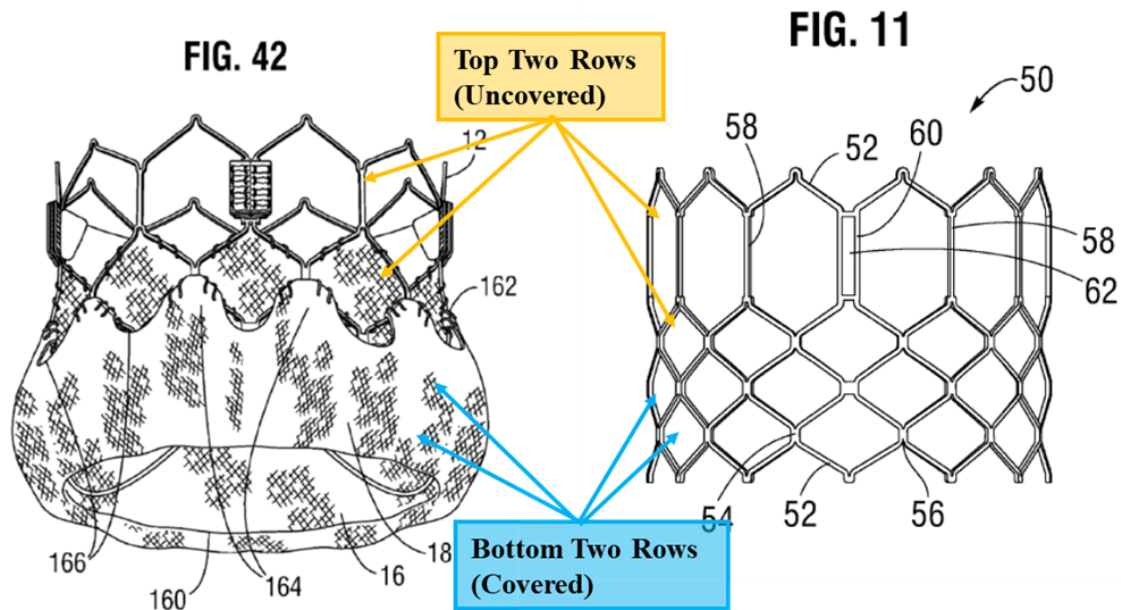
Levi discloses that the outer skirt is constructed with excess material that “does not lie flat against the outer surface of the frame 12,” but bulges radially outwardly as the frame expands and foreshortens. *Id.* at 13:62-14:2. The excess material allows the outer skirt to “fill gaps between the frame 12 and the surrounding native annulus to assist in forming a good fluid-tight seal between the valve and the native annulus.” *Id.* at 14:3-7. By forming a fluid-tight seal with the native annulus, the outer skirt helps prevent blood from leaking around the outside of the valve (i.e., paravalvular leakage). The outer skirt is therefore an

outer seal “for preventing paravalvular leaks.” In fact, Patent Owner admitted during prosecution that Levi includes an “outer seal.” Ex. 1002 at 137-138, 145.

266. Levi’s outer skirt begins at the proximal end of the outer frame and extends over at least the bottom two rows of open cells formed by the outer frame, as shown in Figure 42 below:

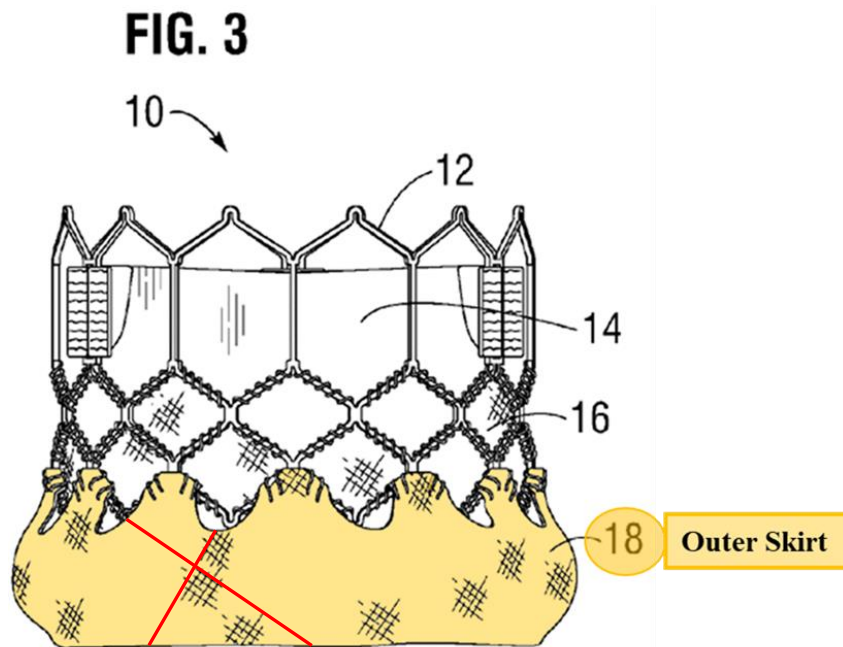


Id. at Fig. 42. The side-by-side comparison of Levi’s Figures 11 and 42 below confirms that Figure 42’s outer skirt covers at least the bottom two rows of cells:



Compare *id.* at Fig. 42 with *id.* at Fig. 11.

267. The outer skirts depicted in Levi's figures (see *e.g.*, Figs. 3, 42) include checkered markings to illustrate that the outer skirts are made of woven PET threads or fibers (see red lines illustrating two fibers):



See *id.* 9:52-56, 13:62-14:2, Fig. 3.

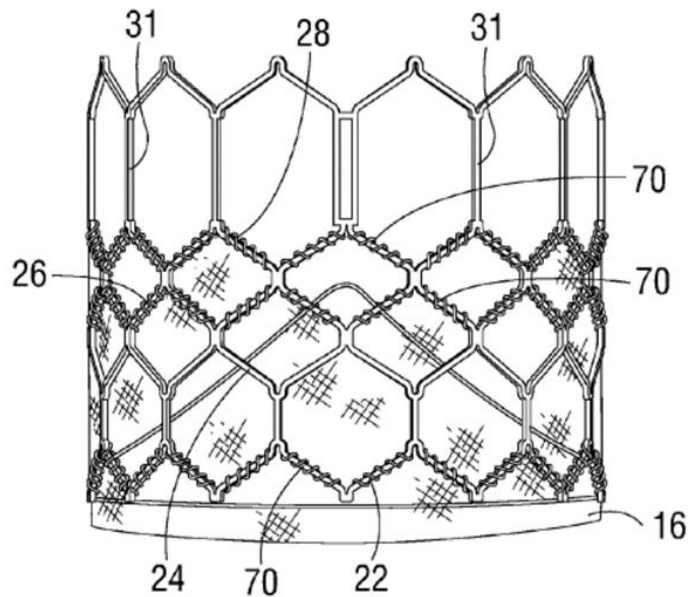
268. A person of ordinary skill in the art would have understood that each woven fiber that makes up the skirt is an “outwardly extending fiber” because the outer skirt “bulge[s] outwardly” from the frame. See *id.* at 9:52-56, 13:62-14:2. As shown in Figure 3 above, the outer skirt “does not lie flat against” the outer frame. Rather, each fiber extends outwardly from the frame. Additionally, the skirt “fill gaps” caused by the surrounding tissue and becomes folded or pinched by the tissue in those locations causing the fibers to extend outwardly of the outer frame. *Id.* at 14:3-7. Levi therefore discloses an outer seal “formed of outwardly extending fibers positioned externally to the outer frame.” *Id.*

269. Additionally, a person of ordinary skill in the art would have understood that the outer surface of the woven PET fabric of Levi’s outer skirt

would not be entirely smooth, but would necessarily have fibers, or strands, that extend radially outwardly from the surface of the fabric. A person of ordinary skill in the art would have known that textile polyester yarn, such as PET yarn, exhibits a property known as “hairiness,” which describes the “amount and length of fibre ends and loops protruding from the body of the yarn.” Ex. 1028 (Tyagi) at 124. The hairiness of yarn can be influenced by a number of factors, and a person of ordinary skill in the art would have understood that polyester fabrics, such as PET, would exhibit at least some level of hairiness. *See id.*; *see also* Ex. 1029 (Kothari) at 32 (disclosing that 100% polyester yarn included between 50 and 150 hairs per meter). Therefore, even if the woven PET fabric of the outer skirt does not itself constitute “outwardly extending fibers,” a person of ordinary skill would have nonetheless understood that Levi’s outer skirt includes a “outwardly extending fibers” positioned externally to the outer frame.

270. Levi’s valve is free of an “outer graft covering” between the fibers of the outer skirt and the outer frame. Levi teaches that the outer skirt is sutured directly to the exterior of the outer frame. *Id.* at 13:58-61; *see also id.* at Fig. 42. Levi does not include any “outer graft covering” on the exterior of the outer frame between the skirt and the frame, as shown in Figure 20, which depicts the valve without the outer skirt attached:

FIG. 20



Id. at Fig. 20. Therefore, a person of ordinary skill in the art would understand that when the outer skirt is stitched to the exterior of the outer frame, there would be no “outer graft covering” between the fibers of the outer skirt and the outer frame.

271. Levi therefore discloses or renders obvious an “outer seal” as claimed in claim 1.

b. Levi and Walther

272. Walther’s outer cloth satisfies the “outer seal” limitations for the reasons presented in Ground 1. *Supra* §VI.A.5. Moreover, a person of ordinary skill in the art would have been motivated to attach Walther’s outer cloth to Levi’s frame in the same way that the cloth is attached to SAPIEN. Specifically, person of ordinary skill in the art would have been motivated to suture the outer cloth to

the valve frame beginning at the proximal end of the frame such that the outer cloth covers at least two rows of cells in the frame. A person of ordinary skill in the art would have been motivated to attach the outer cloth in this way because Walther discloses that the orientation provided good results and Levi suggests a similar orientation for its outer skirt. Moreover, suturing is a simple procedure that would have been well known to person of ordinary skill in the art.

273. As further explained in Ground 1, Walther's outer cloth is free of an outer graft covering between the fibers and the outer frame. *Supra* §VI.A.5. Likewise, Levi's outer skirt is also free of an outer graft covering between the fibers and the outer frame. *Supra* §VIII.A.5.a. Thus, a person of ordinary skill in the art would have understood that if Walther's outer cloth were added to Levi's frame, the outer seal (i.e., cloth) would be free of an outer graft covering between the fibers and the outer frame.

274. It is my opinion that a person of ordinary skill in the art would have found it obvious to replace Levi's bulging outer PET skirt with Walther's outer cloth. A person of ordinary skill would have been motivated by Walther's disclosure that its outer cloth prevents paravalvular leakage, increases the fit between the implanted prosthetic valve and the existing valve, and promotes tissue ingrowth. *See* Ex. 1007 (Walther) at 1120. The substitution of Walther's outer cloth for Levi's outer skirt would have merely entailed substitution of one known

element (Walther's outer cloth) for another (Levi's bulging PET) to yield the predictable results of reducing paravalvular leakage.

275. Moreover, the field of heart valves had a finite number of options to address paravalvular leakage in November 2012. Walther and Levi disclose two such methods. A person of ordinary skill would have found it obvious to select one of these finite, predictable options and, as I explain below, would have had a reasonable expectation of success in doing so.

276. A person of ordinary skill would have had a reasonable expectation of success in substituting Walther's outer cloth for Levi's outer skirt. The valve frames in Walther and Levi share many common features, including being balloon-expandable and formed of interconnected metal struts. Thus, a person of ordinary skill in the art would have reasonably expected the teachings of one patent to apply to another. Additionally, Walther discloses that the cloth-covered SAPIEN valves displayed "excellent hydrodynamic performance" and that *in vivo* implantation of the valve "is feasible," suggesting to persons of ordinary skill in the art that other cloth-covered valves would enjoy similar success. Ex. 1007 (Walther) at 1125.

277. Moreover, Levi suggests adding other components, like Walther's outer cloth, to the inflow portion of the outer frame. Ex. 1008 (Levi) at 16:41-45. Levi discloses that the inflow portion of the frame has a narrower crimped

diameter so that “if **additional components** are mounted to that portion of the valve, such as an outer skirt 18, the reduced profile of that portion of the valve can help offset or minimize the increase in diameter caused by the additional component.” Ex. 1008 (Levi) at 16:41-45 (emphasis added). A person of ordinary skill would have understood that Walther’s outer cloth would be a potential “additional component.”

278. Levi also discloses alternative frame materials and methods for modifying the leaflets to reduce the valve size to create more room for an outer seal. *Id.* at 6:31-49, 16:24-17:18. Persons of ordinary skill in the art would have understood they could utilize one or more of these strategies to add Walther’s outer cloth to Levi’s frame if the access vessel required a smaller valve. For all of these reasons, a person of ordinary skill would have reasonably expected success in using Walther’s outer cloth on Levi’s valve.

279. Finally, claim 1 does not limited to endovascular delivery so small increases in diameter due to the substitution of Walther’s outer seal for Levi’s outer skirt would not have discouraged people of ordinary skill in the art from making or using the combined valve. *See e.g.*, Ex. 1021 (Walther, Thomas, et al., *Transapical Minimally Invasive Aortic Valve Implantation*, 116 [suppl I] *Circulation* I-240—I-245 (September 11, 2007)) at I-244 (“With the transapical technique no limitation in sheath diameter exists, allowing for the implantation of

large and eventually cuffed prostheses to achieve a functionally optimal result for patients”).

c. Levi and Spenser II

280. Spenser II’s outer compressible material satisfies the “outer seal” limitations for the reasons presented in Ground 3. *Supra* §VII.A.5.b. Moreover, a person of ordinary skill in the art would have been motivated to attach Spenser II’s compressible material to Levi’s frame in the same way that the material is attached in Spenser II. Specifically, person of ordinary skill in the art would have been motivated to attach the compressible material to Levi’s valve frame beginning at the proximal end of the frame such that the compressible material covers at least two rows of cell in the frame. A person of ordinary skill in the art would have been motivated to attach the compressible material in this way because Spenser II discloses that the compressible material “creates a mechanical seal that prevents paravalvular leakage” and Levi discloses a similar orientation for the outer skirt. Ex. 1011 (Spenser II) at [00145].

281. As further explained in Ground 1, Spenser II’s compressible material is free of an outer graft covering between the fibers and the outer frame. *Supra* §VII.A.5.b. Likewise, Levi’s outer skirt is also free of an outer graft covering between the fibers and the outer frame. *Supra* §VIII.A.5.a. Thus, a person of ordinary skill in the art would have understood that if Spenser II’s compressible

material were added to Levi's frame, the outer seal (i.e., compressible material) would be free of an outer graft covering between the fibers and the outer frame.

282. In my opinion, a person of ordinary skill in the art would have found it obvious to replace Levi's bulging outer PET skirt with Spenser II's compressible material. A person of ordinary skill would have been motivated by Spenser II's teachings that its radially extending fibers reduce or prevent paravalvular leakage and "may be adapted to encourage coagulation of blood to further fill the gaps and prevent leakage." Ex. 1011 (Spenser II) at [00145]. The substitution of Spenser II's compressible material for Levi's outer skirt would have merely entailed substitution of one known element (Spenser II's compressible material) for another (Levi's bulging PET) to yield the predictable results of reducing paravalvular leakage.

283. Moreover, as I discussed in the prior section, the field of heart valves had a finite number of options to address paravalvular leakage in November 2012. *Supra* §IX.A.5.b. Spenser II and Levi disclose two such ways. A person of ordinary skill would have found it obvious to select either of these finite, predictable options and, as discussed below, would have had a reasonable expectation of success in doing so.

284. A person of ordinary skill would have had a reasonable expectation of success in substituting Spenser II's compressible material for Levi's outer skirt.

The valve frames in Spenser II and Levi share many common features, including being balloon-expandable and formed of interconnected metal struts. Additionally, the references specifically relate to prosthetic heart valves developed by Edwards and share a common inventor (Benichou). *See* Ex. 1008 (Levi) at 1; Ex. 1011 (Spenser II) at 1. Thus, a person of ordinary skill in the art would have reasonably expected the teachings of one patent to apply to another. Additionally, Walther discloses that the cloth-covered SAPIEN valves displayed “excellent hydrodynamic performance” and that *in vivo* implantation of the valve “is feasible,” suggesting to persons of ordinary skill in the art that other cloth-covered valves would enjoy similar success. Ex. 1007 (Walther) at 1125.

285. Moreover, as discussed in the previous section, Levi discloses a number of ways to accommodate an outer seal on its outer frame, which would have encouraged a person of ordinary skill in the art to add Spenser II’s compressible material to Levi’s frame. *Supra* §VIII.A.5.b. Also discussed in the previous section, claim 1 does not limited to endovascular delivery so small increases in diameter due to the substitution of Spenser II’s compressible material for Levi’s outer skirt would not have discouraged people of ordinary skill in the art from making or using the combined valve. *Id.*

6. **Radially Compressed Orientation and Radially Expanded Orientation**

286. Claim 1 next recites: “wherein the valve assembly has a radially compressed orientation and a radially expanded orientation.” Levi, Walther, and Spenser II all disclose this limitation.

287. Walther discloses this limitation for the reasons I provided in Ground 1. *Supra* §VI.A.6. Spenser II discloses this limitation for the reasons I provided in Grounds 2-3. *Supra* §VII.A.6.

288. Levi also discloses this limitation. Levi teaches that “[w]hen constructed of a plastically-expandable material, the frame 12 (and thus the valve 10) ***can be crimped to a radially compressed*** state on a delivery catheter and then ***expanded*** inside a patient by an inflatable balloon or equivalent expansion mechanism.” Ex. 1008 (Levi) at 6:20-24 (emphasis added). Thus, Levi discloses a valve assembly having a radially compressed orientation and a radially expanded orientation.

7. **Balloon Expandable...To Press Some Fibers Against the Native Leaflets**

289. Claim 1 concludes by reciting: “wherein the valve assembly is balloon expandable and expansion of the valve assembly is configured to press some of the fibers against native leaflets of the aorta of the patient.” Levi discloses this

limitation or renders it obvious alone or in combination with Walther or Spenser II.

290. Levi discloses that “the frame 12 (and thus the valve 10) can be crimped to a radially compressed state on a delivery catheter and then expanded inside a patient by an inflatable balloon.” Ex. 1008 (Levi) at 6:17-28. Thus, a person of ordinary skill in the art would have understood that Levi’s valve is balloon expandable. In fact, Patent Owner admitted this was the case during prosecution of the ’846 patent. Patent Owner stated that the “limitation of the fibers covering at least two rows of open cells provides an improvement over the prior art of record because this provides a heightened seal that allows for sealing below the native leaflets and at the native leaflets.” Ex. 1002 at 149.

291. Alternatively, if Levi’s outer skirt was replaced with Walther’s outer cloth or Spenser II’s outer compressible material, a person of ordinary skill in the art would have understood that the resulting valve would remain balloon expandable because both Walther and Spenser II disclose that the outer cloth/compressible material may be added to a balloon-expandable valve. See Ex. 1007 (Walther) at 1122; Ex. 1011 (Spenser II) at [00144].

292. Levi discloses that the valve illustrated in Figures 1-3 “is adapted to be implanted in the native aortic annulus” and that when the frame is expanded, the skirt will “fill gaps between the frame 12 and the surrounding native annulus

to assist in forming a good fluid-tight seal between the valve and the native annulus.” Ex. 1008 (Levi) 5:52-54, 14:3-7. A person of ordinary skill in the art would have understood when the outer skirt “fills gaps between the frame 12 and the surrounding native annulus,” the outer skirt would also press against the patient’s native aortic leaflets, which are attached to the native annulus and extend distally therefrom. *Supra* §III.A.

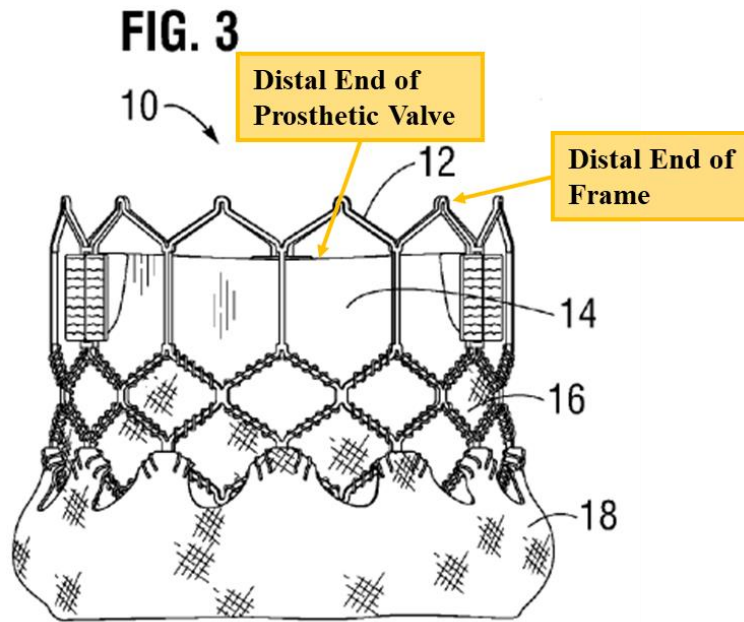
293. Alternatively, if Levi’s outer skirt was replaced with Walther’s outer cloth or Spenser II’s outer compressible material, a person of ordinary skill in the art would understand that the fibers of the outer cloth/compressible material, rather than the outer skirt, would press against the native leaflets. As explained previously, a person of ordinary skill in the art would have been motivated to simply attach the outer cloth/compressible material to Levi’s outer frame in the same way and orientation that the components were attached to their prior valves. *Supra* §VIII.A.5.b-c. Thus, the outer cloth/compressible material would press against the annulus and leaflets just like Levi’s outer skirt. *Supra* §§VI.A.7, VII.A.7.

B. Claim 2

294. Claim 2 recites: “The heart valve assembly of claim 1, wherein the outer frame extends distally further than the prosthetic heart valve.” Levi

discloses this limitation. Thus, Levi anticipates claim 2 or renders claim 2 obvious alone or in combination with Walther or Spenser II.

295. Levi discloses a prosthetic heart valve having a radially compressible and expandable stent frame. Ex. 1008 (Levi) at 6:17-20, 6:31-40. Levi discloses that “the inflow and outflow ends of a frame generally tend to over-expand more so than the middle portion of the frame due to the ‘dog boning’ effect of the balloon used to expand the valve.” *Id.* at 8:8-11. “To protect against over-expansion of the leaflet structure 14,” Levi teaches that the “**leaflet structure desirably is secured to the frame 12 below the upper row of struts 32.**” *Id.* at 8:11-13 (emphasis added). Levi teaches that this configuration helps ensure that the leaflets do not “protrude outwardly beyond the outflow end of the frame when the valve is crimped,” protecting the leaflets from damage that may be caused by a “pushing mechanism or stop member [of the balloon catheter] that pushes against or abuts the outflow end of the valve.” *Id.* at 8:21-39. When the leaflet structure is secured to the frame below the upper row of struts, as in Figure 3 below, the frame 12 extends distally further than the prosthetic valve 14:



Id. at Fig. 3.

C. Claim 3

296. Claim 3 recites: “The valve assembly of claim 1, wherein the outer frame is a singular, integral component.” Levi discloses this limitation. Thus, Levi anticipates claim 3 renders claim 3 obvious alone or in combination with Walther or Spenser II.

297. Levi discloses that its outer frame “comprises multiple rows of circumferentially extending, angled struts 52 [yellow] that are connected to each other at nodes, or connecting portions, 54 and 56 [blue].” Ex. 1008 (Levi) at 8:61-64. Levi further discloses that “[t]he uppermost row of struts 52 are connected to an adjacent row of struts by a plurality of axially extending struts 58 [red] and

commissure window frame portions 60 [red].” *Id.* at 8:64-67. Levi’s Figures 11-12 illustrate the outer frame:

FIG. 11

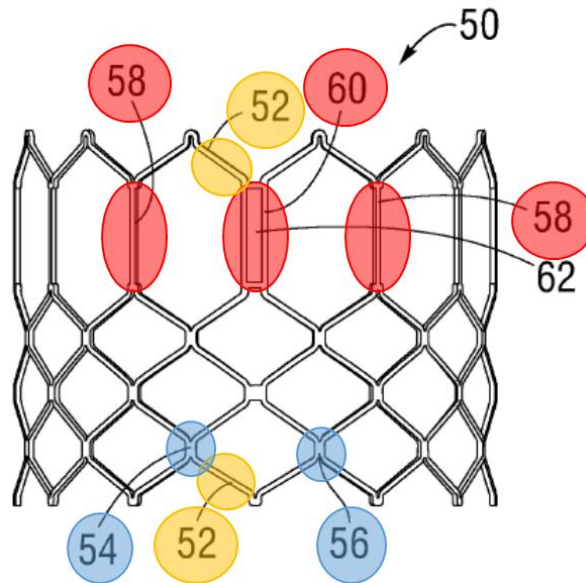
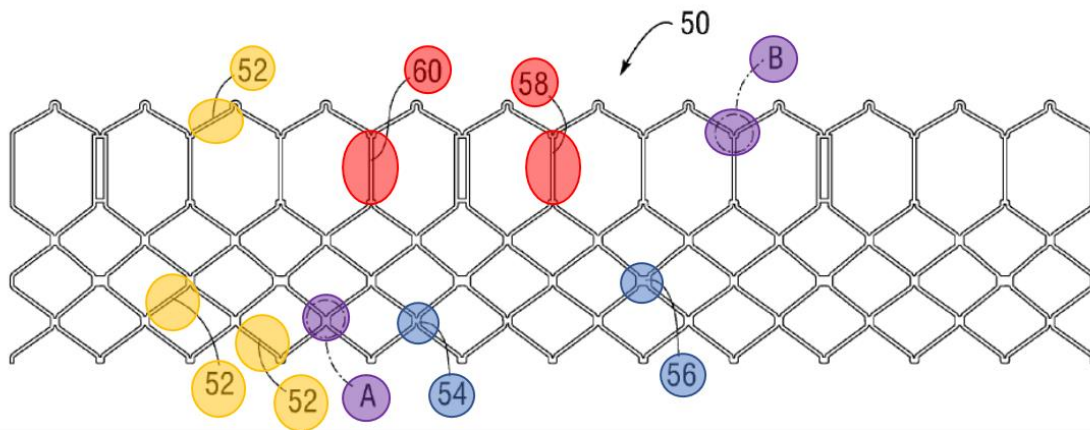


FIG. 12



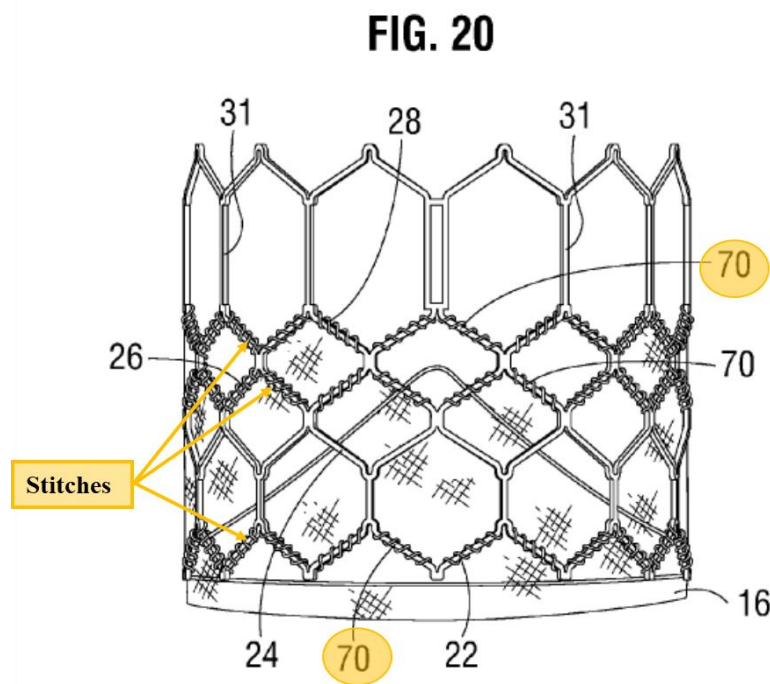
Id. at Figs. 11, 12.

298. Because all of the metallic bars of the outer frame are interconnected, as shown in the figures above, the outer frame is a singular, integral component. *See id.* at 6:50-7:17, 9:4-6, Figs. 4-10, 13-14.

D. Claim 4

299. Claim 4 recites: “The valve assembly of claim 1, wherein the outer frame and the inner graft covering are attached by stitches at a distal and proximal portion of the inner graft covering.” Levi discloses the limitations in claim 4. Thus, Levi anticipates claim 4 or renders claim 4 obvious alone or in combination with Walther or Spenser II.

300. As shown in Figure 20 below, Levi teaches that sutures 70 secure the inner skirt to the frame 12 using a plurality of stitches at the top (i.e., distal) and bottom (i.e., proximal) portion of the inner graft covering:

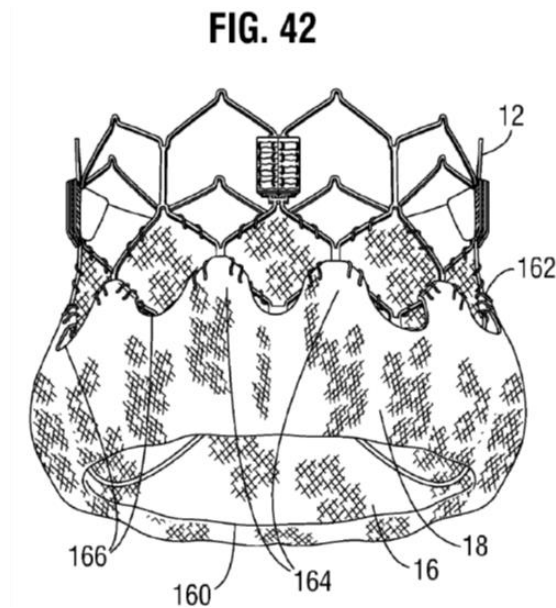


Ex. 1008 (Levi) at 9:24-25, 10:11-30, Figs. 20, 39.

E. Claim 5

301. Claim 5 recites: “The valve assembly of claim 1, wherein the inner graft covering and the fibers are distinct elements.” Levi discloses the limitations in claim 5. Thus, Levi anticipates claim 5 or renders claim 5 obvious alone or in combination with Walther or Spenser II.

302. Levi discloses an inner PET skirt that is secured to the inner surface of the outer frame, and an outer PET skirt that is separately secured to the outer surface of the outer frame. Ex. 1008 (Levi) at 9:24-25, 10:11-30, 13:49-61, 16:51-54, Figs. 3, 20, 39. Levi discloses that the inner and outer skirts can be separate pieces of PET, stating “the lower edge 160 of the skirt 18 can be sutured to the lower edge of the inner skirt 16 at the inflow end of the valve,” as shown in Figure 42 below:



Id. at 13:55-58, Fig. 42. There would be no reason to suture the skirts together if they were not “distinct components.” Therefore, a person of ordinary skill in the art would have understood that Levi’s outer skirt is a “distinct element” from the inner skirt (i.e., the graft covering).

303. Alternatively, if Levi’s outer skirt were replaced with Walther’s outer PET cloth or Spenser II’s outer compressible material, a person of ordinary skill in the art would have understood that the outer cloth/compressible material and Levi’s inner skirt would be “distinct elements” for at least the reasons that the elements would be positioned on opposite sides of the outer frame and separately attached thereto. The inner skirt would be positioned on the interior surface of the outer frame and secured thereto by a plurality of stitches. *Supra* §VIII.A.3-4. The outer cloth/compressible material would be positioned around the exterior surface of the outer frame and separately secured thereto. *Supra* §VIII.A.4-5.

F. Claim 6

304. Claim 6 recites: “The valve assembly of claim 1, wherein the valve assembly is delivered endovascularly.” Levi discloses the limitations in claim 6. Thus, Levi anticipates claim 6 or renders claim 6 obvious alone or in combination with Walther or Spenser II.

1. Levi

305. Levi discloses that due to known “drawbacks associated with conventional open-heart surgery, percutaneous and minimally-invasive surgical approaches” were developed in which “collapsible transcatheter heart valves . . . can be percutaneously introduced in a compressed state on a catheter and expanded in the desired position by balloon inflation or by utilization of a self-expanding frame or stent.” Ex. 1008 (Levi) at 1:57-67. Percutaneous delivery as described in Levi is endovascular delivery. Levi discloses several features to enable such endovascular delivery. *See id.* at 6:46-49.

306. For example, Levi discloses that its frame is preferably constructed of nickel-cobalt-chromium-molybdenum alloy, which allows for less material to be used so that “the crimped profile of the frame can be reduced, thereby providing a lower profile valve assembly **for percutaneous delivery to the treatment location in the body.**” Ex. 1008 (Levi) at 6:31-49 (emphasis added); *see also id.* at 7:10-12. Levi discloses that “[b]y minimizing the diameter of the valve when mounted on the delivery shaft, the assembly can **[be] contained within a smaller diameter catheter and thus can be passed through smaller vessels in the body** and can be less invasive in general.” *Id.* at 14:60-64 (emphasis added). A person of ordinary skill in the art would have understood that Levi’s valve is delivered endovascularly.

307. Additionally, Levi discloses a number of features to accommodate additional graft or sealing material at the proximal end of the device. *Infra* §VII.A.5. For example, Levi discloses methods to reduce the diameter of the valve frame at the inlet, or to modify the leaflets to reduce the frame size, to create room for additional components. Ex. 1008 (Levi) at 16:24-17:18. Thus, a person of ordinary skill in the art would have expected success in delivering Levi's valve endovascularly.

2. Levi and Walther or Spenser II

308. Alternatively, Levi in combination with Walther or Spenser II render this claim obvious. A person of ordinary skill in the art would have understood that after replacing Levi's outer skirt with Walther's outer cloth or Spenser II's compressible material, the resulting device would remain suitable for endovascular deployment. For example, even if the addition of Walther's outer cloth or Spenser II's compressible material resulted in some small increase in the valve diameter, a person of ordinary skill in the art would have recognized that the valve could still be endovascularly delivered through the patient's common iliac artery. Ex. 1043 (Kainuma).

309. Additionally, Levi teaches that "[w]hen crimped, the frame 12 has a reduced diameter region extending along a portion of the frame . . . that generally corresponds to the region of the frame covered by the outer skirt 18" so that the

outer skirt “does not increase the overall crimp profile of the valve.” Ex. 1008 (Levi) at 8:46-54; *see also id.* at 2:22-35, 14:22-35, 16:38-45, 17:14-18. Walther’s outer cloth or Spenser II’s compressible material would also cover the reduced diameter region, which would reduce any risk that the outer cloth/compressible material would disadvantageously increase the crimp profile. *Id.* at 8:46-54.

310. Levi additionally discloses several other features that minimize the crimped profile of the valve and would enable endovascular delivery of a valve equipped with Walther’s outer cloth or Spenser II’s compressible material. Levi teaches that the configuration of its outer frame enables a “reduction in the frame wall thickness to achieve a smaller crimped diameter of the valve.” *Id.* at 7:10-12. Levi’s outer frame is also formed with relatively larger open cells in the uppermost row, which allow portions of the prosthetic leaflets to protrude from the frame when the valve is crimped, again reducing the minimum crimped profile of the valve. *Id.* at 7:36-42, 15:17-24. The frame may also be formed with a “thickness that varies along its length to optimize strength where needed, yet minimize material (and therefore crimp profile) at selected regions of the frame,” such as the inflow end that is covered by the outer skirt. *Id.* at 16:54-17:18. The frame may also include window frame portions which are depressed radially inwardly relative to the other portions of the frame, which also minimizes the

crimp profile of the valve. *Id.* at 14:40-45. The shape of Levi's prosthetic leaflets also minimize the valve's profile. Levi teaches that the leaflets may be tapered or "V-shaped" instead of the traditional "U-shaped leaflets." *Id.* at 14:26-30, 16:24-40. The tapered shape of the leaflets results in less leaflet material at the inflow end of the valve, which further minimizes the crimped profile of the inflow end that is covered by the outer skirt or some other "additional component." *Id.* Even Levi's inner skirt is designed to help minimize the crimp profile. Levi teaches that its skirt is woven with fibers that are non-perpendicular to the upper and lower edges of the skirt, which enables the skirt to undergo greater axial elongation when the valve is crimped, resulting in a more uniform crimping profile and a smaller crimped diameter. *Id.* at 9:36-11:2. A person of ordinary skill in the art would have found it obvious to use any or all of Levi's methods to minimize the crimped profile of the valve, which would enable endovascular delivery of a valve with a fibrous outer seal.

311. Levi discloses that "[i]n one example, the frame of a 26-mm valve, when crimped, had a diameter D_1 of 14 French at the outflow end of the valve and a diameter D_2 of 12 French at the inflow end of the valve." *Id.* at 8:56-59. A person of ordinary skill in the art would have understood that adding Walther's outer cloth or Spenser II's compressible material (which is described as being 1 mm thick in some embodiments) to Levi's valve would result in a device suitable

for endovascular delivery through, for example, the common iliac artery or a smaller artery such as the femoral artery. In addition, as discussed in Ground 1, a person of ordinary skill in the art would have had access to a range of suitable cloths and materials having varying thicknesses and densities and could have selected an appropriately dimensioned cloth/material for endovascular delivery. *Supra* §VI.E.

312. Levi also expressly suggests adding other components, like Walther's outer cloth or Spenser II's compressible material, to the inflow portion of the outer frame, stating "if additional components are mounted to that portion of the valve, such as an outer skirt 18, the reduced profile of that portion of the valve can help offset or minimize the increase in diameter caused by the additional component." Ex. 1008 (Levi) at 16:41-45. A person of ordinary skill in the art would have understood that Walther's outer cloth or Spenser II's compressible material would be a potential "additional component." For these reasons, a person of ordinary skill in the art would have reasonably expected success in adding materials like Walther's outer cloth or Levi's compressible material to Levi's valve.

G. Claim 7

313. Claim 7 recites: "The valve assembly of claim 1, wherein a seal is created between the inner frame and the outer frame." Levi discloses the

limitation in claim 7. Thus, Levi anticipates claim 7 or renders claim 7 obvious alone or in combination with Walther or Spenser II.

314. Levi discloses that its inner skirt assists “in ***forming a good seal*** between the valve and the native annulus by blocking the flow of blood through the open cells of frame 12 below the lower edge of the leaflets.” Ex. 1008 (Levi) at 9:7-11 (emphasis added). A person of ordinary skill in the art would have understood that “blocking the flow of blood through the open cells” means that a seal is created between Levi’s inner skirt and frame. If a seal was not created, the inner skirt would not be able to block the flow of blood.

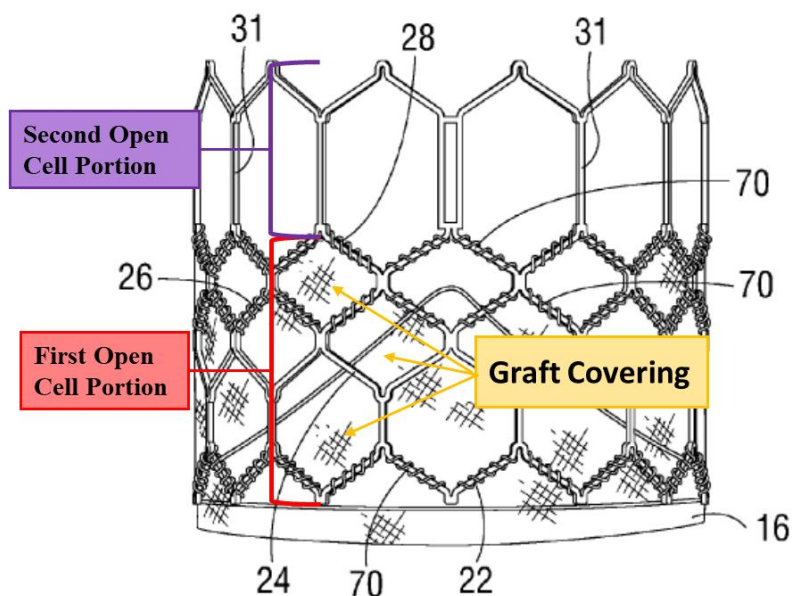
H. Claim 8

315. Claim 8 recites: “The valve assembly of claim 1, wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.” Levi discloses the limitations in claim 8 and anticipates claim 8 or renders claim 8 obvious alone or in combination with Walther or Spenser II.

1. Levi

316. As I explained in claim 1, Levi discloses an inner PET skirt (inner graft covering) stitched to the interior surface of the outer frame. *Supra* §VIII.A.3. As shown in Figure 20 below, Levi’s inner skirt 16 covers the bottom (i.e., proximal) three rows of cells in the outer frame but does not cover the uppermost row of cells:

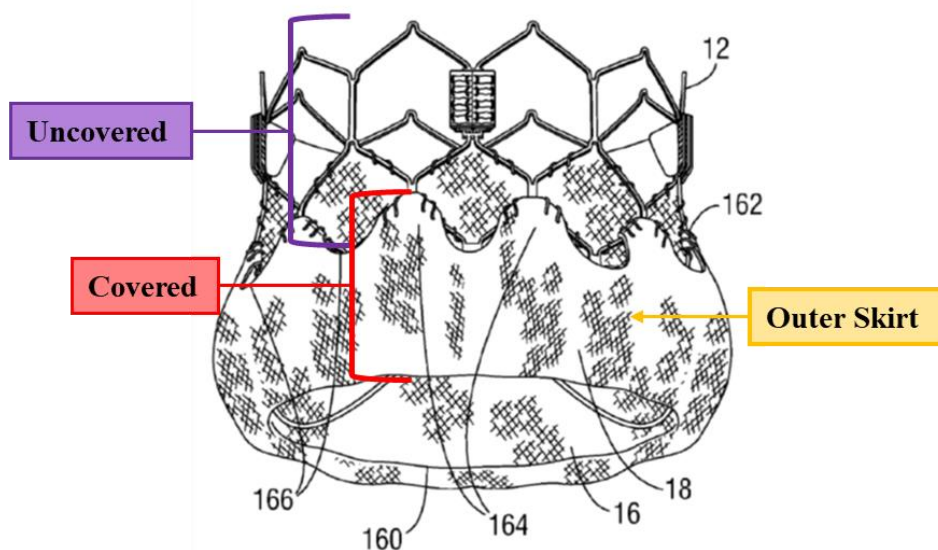
FIG. 20



Ex. 1008 (Levi) at Fig. 20.

317. As I explained in claim 1, Levi's Figure 42 shows that the outer skirt (outer seal) covers the bottom two rows of cells of the outer frame but does not cover the uppermost two rows of cells:

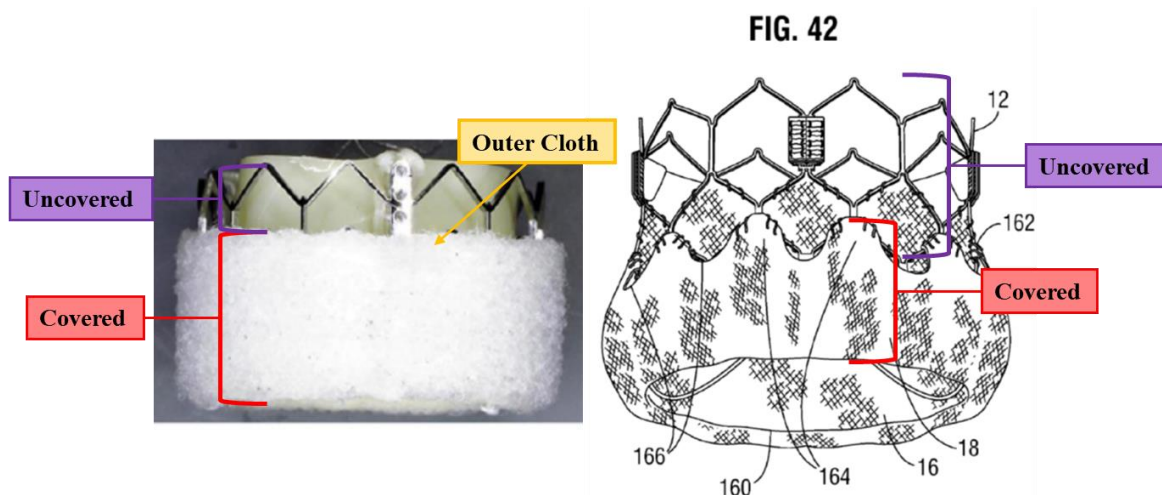
FIG. 42



Id. at Fig. 42. Therefore, Levi discloses a valve wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.

2. Walther

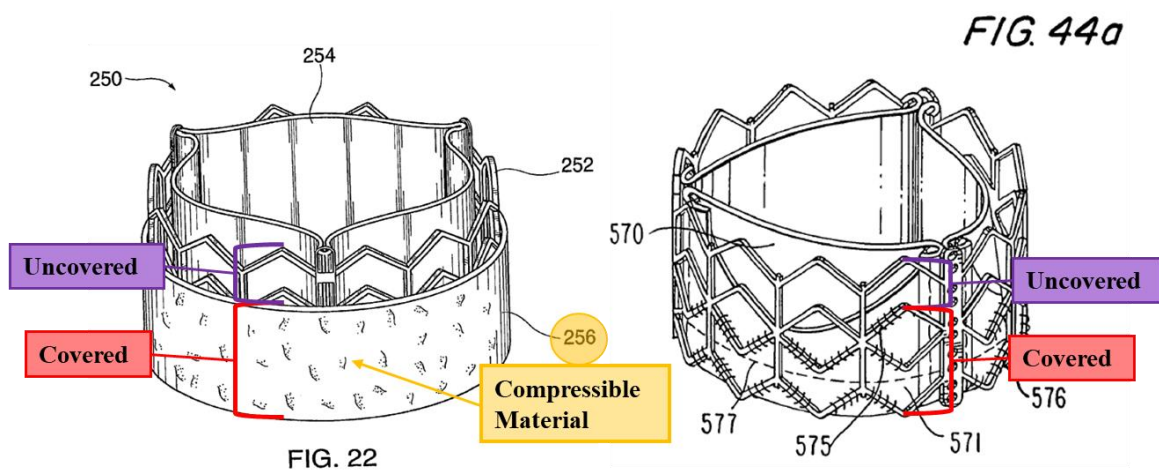
318. As I explained in Ground 1, Walther's outer cloth covers two circumferentially extending rows of cells formed from SAPIEN's open cell configuration but does not cover the distal portion of the frame. *Supra* §VI.G. If Walther's outer cloth were substituted for Levi's outer skirt, the outer cloth would cover the bottom two rows of cells of the support stent but **would not** cover the uppermost row of cells, as illustrated in the side-by-side comparison of Walther's Figure 1 (left) and Levi's Figure 42 (right) below:



Compare Ex. 1007 (Walther) at Fig. 1 *with* Ex. 1008 (Levi) at Fig. 42. Therefore, the combination of Levi and Walther would result in a valve wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.

3. Spenser II

319. As I explained in Grounds 2-3, Spenser II's compressible material covers the bottom two rows of cells formed by stent structure 252, but does not cover the upper portion of the stent structure. *Supra* §VII.H. When added to the exterior of the stent in Levi's valve, the compressible material would cover the bottom two rows of cells formed by the stent frame but **would not** cover the uppermost two rows, as illustrated in the side-by-side comparison of Spenser II's Figure 22 (left) and Levi's Figure 42 (right) below:



Compare Ex. 1011 (Spenser II) at Fig. 22 with Ex. 1008 (Levi) at Fig. 42. As discussed above, if the claims require the fibers to *entirely* cover two rows of cells, a person of ordinary skill in the art would have found it obvious to slightly increase the height of Spenser II's compressible material. *Supra* §VII.A.5.b.

320. Therefore, the combination of Levi and Spenser II would result in a valve wherein a portion of the outer frame is uncovered by the graft covering and the outer seal.

I. Claim 9

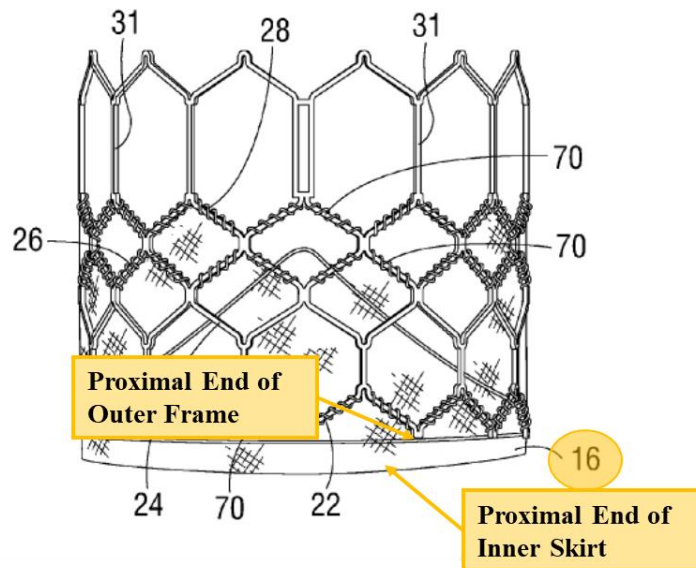
321. As explained in Grounds 2-3, claim 9 is substantially similar to claim 2. Therefore, Levi discloses the limitations in claim 9 for the same reasons presented in claim 2. Thus, Levi anticipates claim 9 or renders claim 9 obvious alone or in combination with Walther or Spenser II.

J. Claim 10

322. Claim 10 recites: “The valve assembly of claim 1, wherein the graft covering extends beyond a proximal end of the outer frame and over the proximal end thereof to cover the proximal end of the outer frame.” Levi discloses this limitation or renders the limitation obvious. Thus, Levi anticipates claim 10 or renders claim 10 obvious alone or in combination with Walther or Spenser II.

323. Levi discloses an inner PET skirt sutured to the interior surface of the stent frame. *Supra* §VIII.A.3. As shown in Figure 20 below, the lower edge of Levi’s inner skirt extends beyond the proximal end of the outer frame:

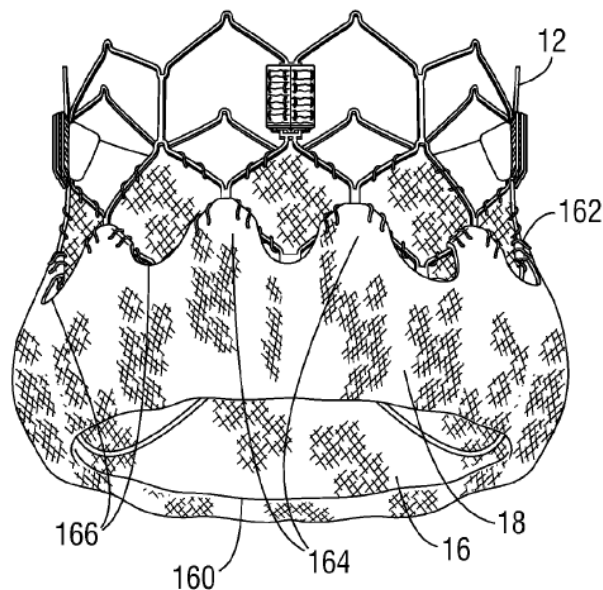
FIG. 20



Ex. 1008 (Levi) at Fig. 20.

324. Additionally, Levi discloses “the lower edge 160 of the skirt 18 can be sutured to the lower edge of the inner skirt 16 at the inflow end of the valve.” *Id.* at 13:55-58. This embodiment is illustrated in Figure 42 below:

FIG. 42



Id. at Fig. 42. Because the inner skirt extends beyond the proximal end of the outer frame, a person of ordinary skill in the art would have understood that the attachment of the skirts necessarily causes the lower edge of the inner skirt 16 to extend over the proximal end of the outer frame to cover the proximal end of the outer frame. This is particularly true when the outer skirt bulges outwardly from blood flow and pulls the proximal portion of the inner skirt over the distal end of the frame. Thus, Levi discloses this limitation.

325. Alternatively, persons of ordinary skill in the art would have found it obvious to extend Levi's inner skirt over the proximal end of the frame to cover the proximal end. Levi discloses that the "upper edge portion [distal] of the [inner] skirt is wrapped around the upper surfaces of struts 28 and secured in place with sutures 70." *Id.* at 10:12-26, Fig. 20. Levi teaches that this wrapping "provides for a stronger and more durable attachment of the skirt to the frame." *Id.*, 10:26-28. A person of ordinary skill in the art would have been motivated to apply this same technique to the lower (proximal) edge of the inner skirt to create a stronger attachment between the inner skirt and frame. Indeed, because the inner skirt extends beyond the proximal end of the frame, persons of ordinary skill in the art would have found it obvious to wrap Levi's inner skirt over the proximal end and secure the inner skirt to the outside of the frame using this wrapping technique. Persons of ordinary skill in the art would have expected success in

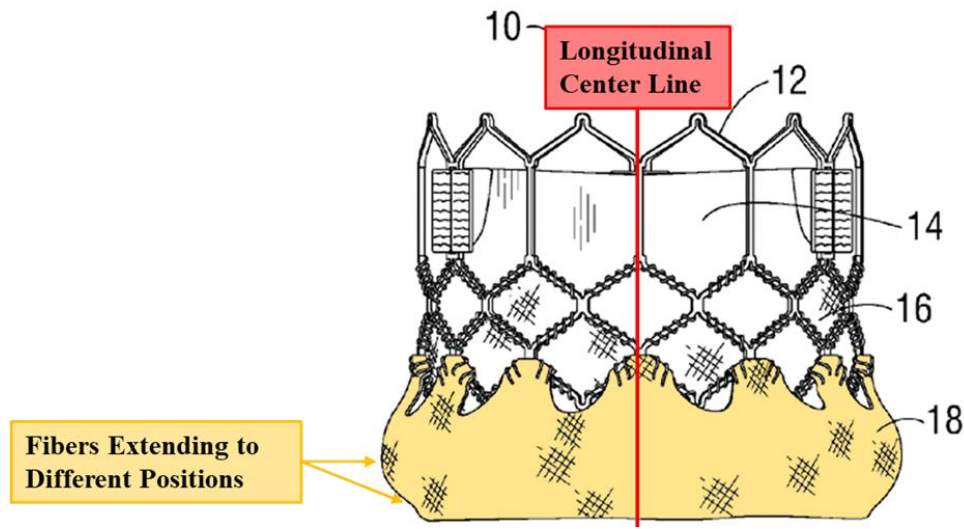
attaching the inner skirt in this way because Levi already discloses that it was successful for the distal end of the skirt. In this configuration, persons of ordinary skill in the art would have recognized that the outer skirt could still be stitched to the inner skirt. Thus wrapping the proximal end of Levi's inner skirt around the outer frame would not compromise Levi's outer skirt and, because the inner skirt is made of a thin material, would not have significantly affected the valve's crimped profile.

K. Claim 11

326. Claim 11 recites: "The valve assembly of claim 1, wherein the outwardly extending fibers extend outwardly to different positions relative to a centerline run through a longitudinal of the valve assembly." Levi discloses the limitations in claim 11. Thus, Levi anticipates claim 11 or renders claim 11 obvious alone or in combination with Walther or Spenser II.

327. As I explained in claim 1, Levi discloses an outer skirt (outer seal) of woven PET fabric formed of outwardly extending fibers. *Supra* §VIII.A.3. A person of ordinary skill in the art would have understood that the outwardly extending fibers of the outer skirt "extend outwardly to different positions relative to a centerline run through a longitudinal of the valve" as a result of the bulging:

FIG. 3



Ex. 1008 (Levi) at Fig. 3. Additionally, as I explained in claim 1, Levi’s outer skirt is design to “fill gaps” caused by the surrounding tissue and becomes folded or pinched by the tissue in those locations causing the fibers to extend outwardly of the outer frame. *Id.* at 14:3-7. A person of ordinary skill in the art would understand that the gaps in the surrounding tissue that cause the outer skirt to fold or pinch would be located at numerous different positions relative to a longitudinal center line running through the valve, and thus the extending fibers created by these gaps extend outwardly to different positions relative to the longitudinal center line.

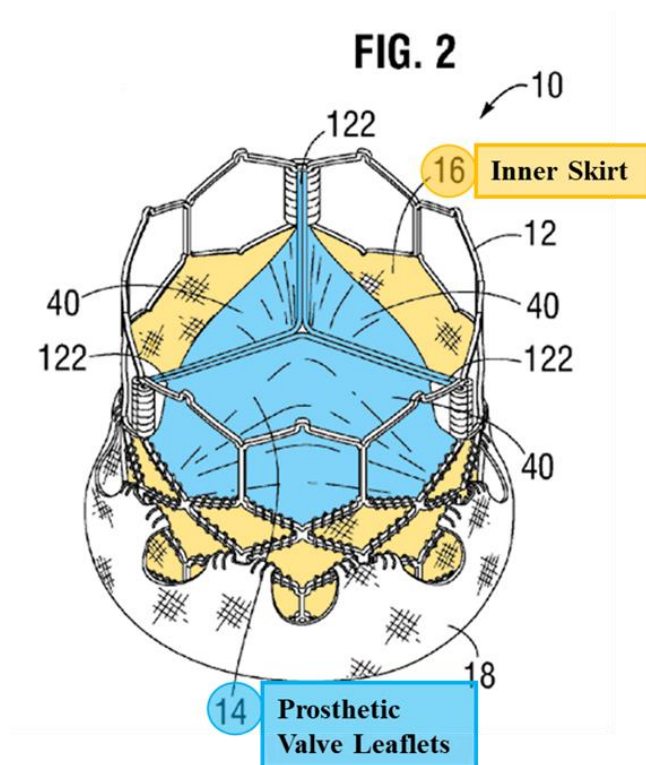
328. Alternatively, if Walther’s outer cloth or Spenser II’s compressible material were substituted for Levi’s outer skirt, the resulting valve would include fibers that “extend outwardly to different positions relative to a centerline run

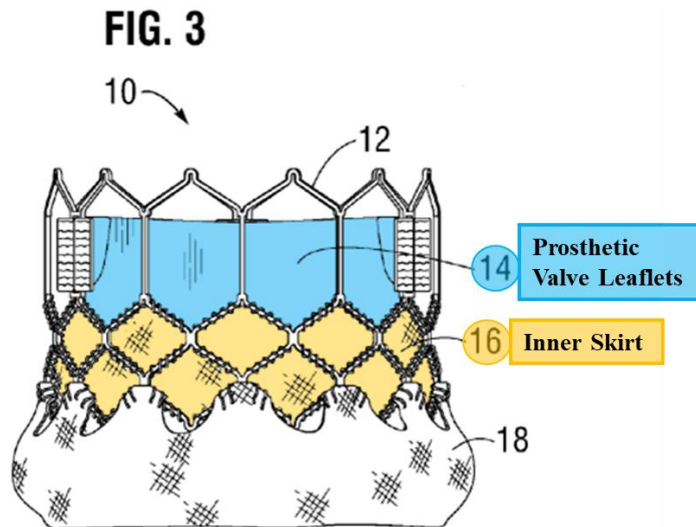
through a longitudinal of the valve” for the reasons previously stated. *Supra* §§VI.H, VII.K.

L. Claim 12

329. Claim 12 recites: “The valve assembly of claim 1, wherein the graft covering, outer seal, and prosthetic leaflets are radially overlapping.” Levi discloses the limitations in claim 11. Thus, Levi anticipates claim 11 or renders claim 11 obvious alone or in combination with Walther or Spenser II.

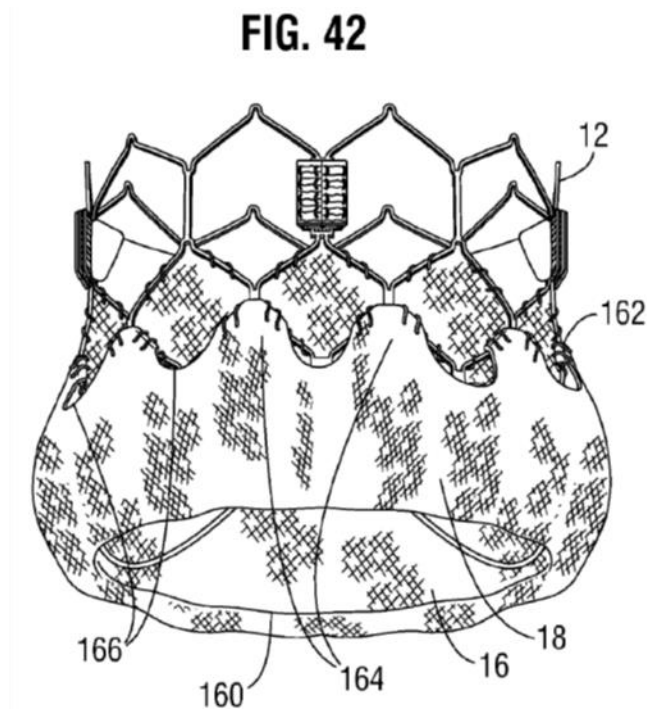
330. As I explained in claim 1, Levi discloses an inner skirt comprised of a PET fabric graft covering that extends around the prosthetic valve leaflets. *Supra* §VIII.A.3. As shown in Figures 2 and 3 below, Levi’s inner skirt 16 [yellow] radially overlaps with the leaflets of the prosthetic heart valve 14 [blue]:



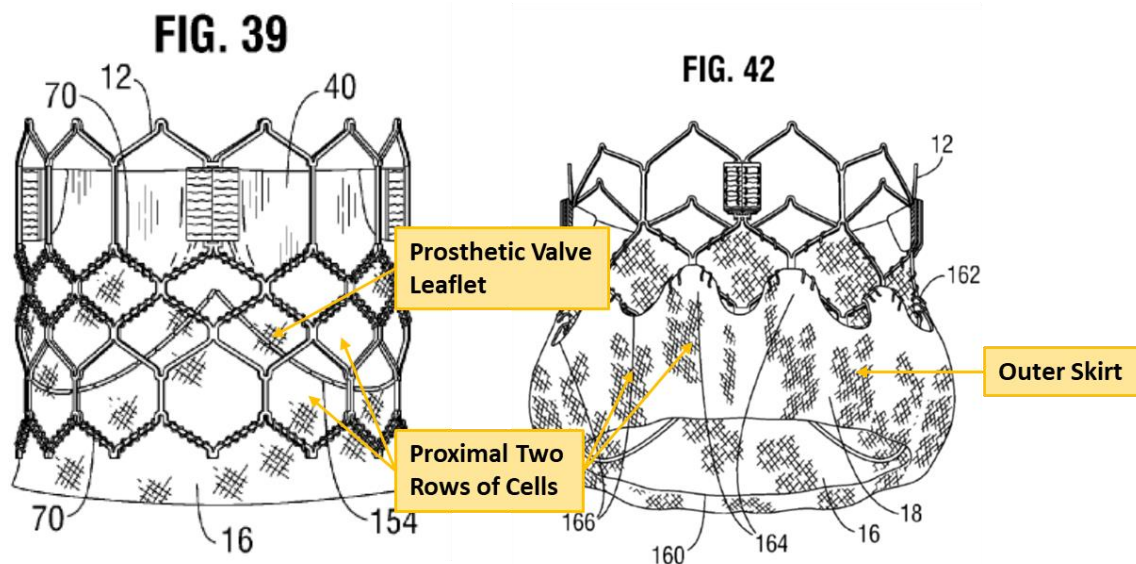


Ex. 1008 (Levi) at Figs. 2, 3.

331. As I also explained in claim 1, Levi's Figure 42 (below) shows that the outer skirt may cover the bottom (i.e., proximal) two rows of open cells formed by the outer frame:



Id. at Fig. 42. The two proximal rows of Levi's outer frame covered by the outer skirt radially overlap with the prosthetic leaflets, as illustrated in the side-by-side comparison of Figures 39 and 42 below:



Compare id. at Fig. 39 *with id.* at Fig. 42. Therefore, Levi discloses a valve wherein the inner PET skirt (inner graft covering), outer skirt (outer seal), and prosthetic leaflets radially overlap.

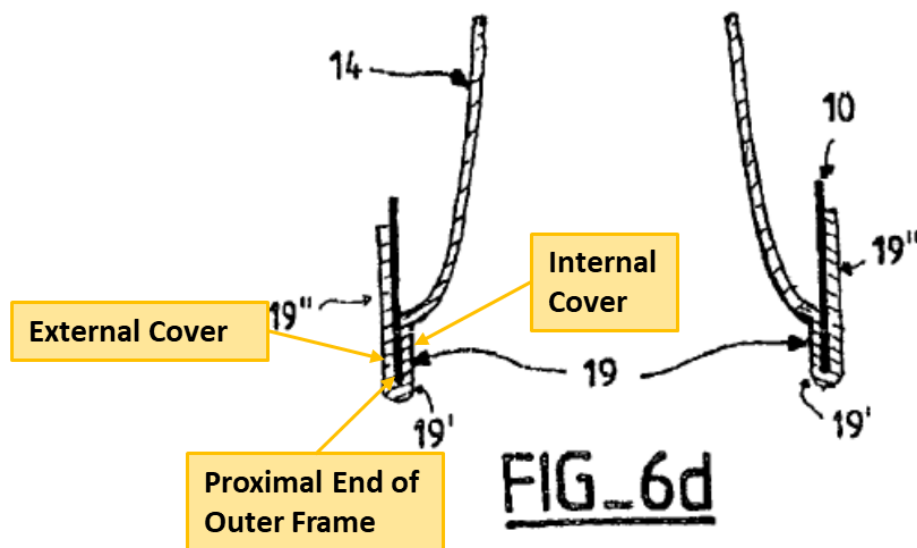
332. Alternatively, Levi in combination with Walther and Spenser II renders this claim obvious. Walther and Spenser II disclose an outer seal that covers the bottom two rows of cells formed by the stent frame, which radially overlap with the prosthetic leaflets. Ex. 1007 (Walther) at 1121, Fig. 1; Ex. 1011 (Spenser II) at [00145], Fig.22; *supra* §§VI.I, VII.L. A person of ordinary skill in the art would have been motivated to attach Walther's outer cloth or Spenser II's compressible material to Levi's outer frame in the same way, and would have

expected success in doing so, because the references demonstrate that covering the bottom two rows is effective at creating a seal. The combined device would thus include an outer seal covering the bottom two rows of cells formed by Levi's outer frame, which radially overlap with the prosthetic leaflets and the inner skirt (graft covering) for the reasons I provided above.

IX. GROUNDS 8-10: CLAIM 10 OBVIOUS OVER LEVI AND CRIBIER '321 AND OPTIONALLY WALTHER OR SPENSER II

333. Claim 10 recites: "wherein the graft covering extends beyond the proximal end of the outer frame and over the proximal end thereof to cover the proximal end of the outer frame." Levi renders this limitation obvious for the reasons I provided in Grounds 4-7. *Supra* §VIII.J. However, if Levi does not disclose this limitation, Cribier '321 does. Therefore, it is my opinion that claim 10 would have been obvious over Levi in combination with Cribier '321 and optionally Walther or Spenser II.

334. Cribier '321 discloses a valve having an internal cover 19 that "is extended at its lower [proximal] end 19' to an external cover 19" which is rolled up to be applied on the external wall of the stent 10." Ex. 1045 (Cribier '321) at 13:28-30. As shown below, the internal cover 19 (i.e., graft covering) extends beyond and over the proximal end of the frame 10 to cover the proximal end:



Id. at Fig. 6d. The internal cover is “preferably” “made of synthetic biocompatible material such as TEFLON® or DACRON®, polyethylene, polyamide” and, therefore, is a graft covering. *Id.* at 5:15-18, 13:15-16.

335. A person of ordinary skill in the art would have found it obvious to apply Cribier ’321’s teaching to Levi’s inner skirt. Such a person would have been motivated to use Levi’s inner skirt to cover the proximal end of the frame to further “enhance[] the sealing of [Levi’s] device at the valve inlet.” Ex. 1010 (Spenser), 14:6-9. A person of ordinary skill in the art would have understood that extending Levi’s inner skirt over the proximal end of the outer frame would prevent leaks between the inner skirt and frame. *Supra* §§VII.J, VIII.J.

336. Additionally, a person of ordinary skill would have been motivated to do so to strengthen the attachment of Levi’s inner skirt to the stent frame and to provide a softer surface to reduce the risk of sharp metallic edges at the proximal

end of the outer frame damaging the surrounding biological tissues during delivery and implantation. *See e.g.*, Ex. 1045 (Cribier '321) at 13:25-14:10; Ex. 1048 (Essinger) at [0098] (“[T]he skirt reduces risk of sharp edges in the framework of the stent that may jeopardize the integrity of the surrounding biological structures The protruding ‘petals’ of the skirt 103 act as soft, dampening elements when bent over the tip of the [outer frame].”).

337. Additionally, Levi suggests the extension of the inner skirt by disclosing that the upper edge of the inner skirt is wrapped around the metal struts of the outer frame and disclosing that the inner skirt extends beyond the end of the frame at the proximal end. Ex. 1008 (Levi) at 10:12-26. Thus, the extension of Levi’s inner skirt would have merely entailed applying a known technique (extending the skirt) to a known device (Levi’s frame) ready for improvement (enhanced sealing). Moreover, such a combination would merely entail the combination of known elements to yield the predictable results.

338. A person of ordinary skill in the art would have had a reasonable expectation of success in combining Cribier '321’s extended internal cover with Levi’s inner skirt because the valve assemblies in Levi and Cribier '321 share many common features, including a prosthetic valve member housed within a balloon-expandable metallic stent, and a PET graft covering positioned between the prosthetic valve and the stent secured with a plurality of stitches. *See, e.g.*, Ex.

1008 (Levi) at 6:17-24, 9:7-29; Ex. 1013, 5:15-18, 8:46-64, 9:27-30, 12:28-32, 13:15-16, 13:54-59, 14:31-35, 14:45-47.

339. A person of ordinary skill in the art would not have expected the outer skirt's performance to be impacted by extending Levi's inner skirt beyond and over the proximal end of the outer frame. Levi teaches that the "lower edge of the [outer] skirt 18 can be sutured to the lower edge of the inner skirt 16 at the inflow end of the valve." Ex. 1008 (Levi) at 13:55-58. As explained above, in this configuration, Levi's inner skirt extends beyond and over the proximal end of the valve. *Supra* §VII.J. Further, if the inner skirt were extended over the proximal end of the frame and secured to the exterior of the frame, the outer skirt could still be sutured to the inner skirt, or another part of the valve, so that it continued to operate in the same way. Therefore, a person of ordinary skill in the art would reasonably expect success in applying Cribier '321's teachings to the similarly constructed valve disclosed in Levi.

340. Likewise, a person of ordinary skill in the art would not have been discouraged from extending Levi's inner skirt if Walther's outer cloth or Spenser II's compressible material were substituted for Levi's outer skirt for the reasons explained previously. *Supra* §VII.J.

X. SECONDARY CONSIDERATIONS

341. I am not aware of any secondary considerations of nonobviousness. I understand that Patent Owner does not practice the '846 patent. For example, I am not aware of any products sold by Patent Owner that would be covered by the '846 patent and, therefore, I am not aware of any commercial success.

342. Further, given that the devices claimed in the '846 patent are not new, and were invented long before November 2012, I am not aware of any long-felt need in the industry, unexpected results, skepticism of the invention, or teaching away from the invention. I am also not aware of any praise for the alleged inventions or copying of the alleged inventions by other companies. If Patent Owner identifies any alleged evidence of secondary considerations in the future, I reserve the right to respond to that information.

XI. CONCLUSION

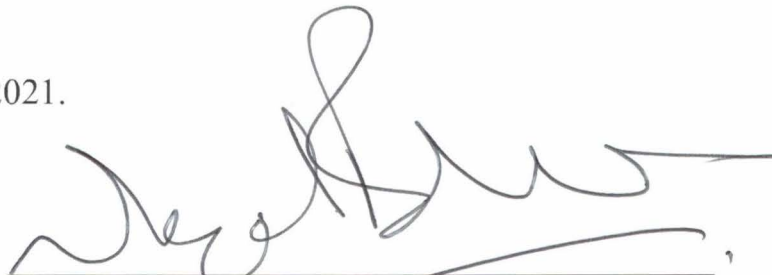
343. For the foregoing reasons, it is my opinion that claims 1-12 of the '846 patent are anticipated and/or rendered obvious by the prior art discussed above in view of the knowledge of one of ordinary skill in the art at the time of the alleged invention.

344. I reserve the right to supplement my opinions in the future to address or respond to any arguments that Patent Owner may raise, as well as new information, including, but not limited to, any claim constructions advanced by

Patent Owner or adopted by the Board in the Institution Decision, and respond to any alleged secondary considerations as they become available to me.

345. I declare that the foregoing is true and correct, and further that the foregoing statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on October 10, 2021.



Dr. Nigel Buller, M.D.