

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SKECHERS U.S.A., INC.
Petitioner,

v.

NIKE, INC.,
Patent Owner.

U.S. Patent No. 9,730,484

DECLARATION OF DR. SABIT ADANUR

I declare under penalty of perjury under the laws of the United States of America that all statements made here are true and correct, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code.

Date: 4 November 2024



Dr. Sabit Adanur

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DECLARATION OF SABIT ADANUR, PH. D

I, Sabit Adanur, do hereby declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Skechers U.S.A., Inc. (“Skechers” or “Petitioner”) as an expert to provide my opinions about the state of the art of the technology described in U.S. Patent No. 9,730,484 (“the ’484 patent”) (EX1001) and on the patentability of claims 1, 5-9, and 11-17 of the ’484 patent.

2. I understand that Skechers will submit this declaration (“Declaration”) in connection with an *inter partes* review (IPR) proceeding before the Patent Trial and Appeal Board.

3. I receive compensation at my normal consulting rate of \$300.00 per hour for my time working on this matter, plus expenses. My compensation is not contingent on the outcome of this matter or the specifics of my testimony.

4. All “EX10XX” cites here are to exhibits I understand will be submitted by the Petitioner in this Proceeding. All “Appendix _” cites followed by a letter are to appendices to this Declaration. All citations to “Section XX” are internal citations to the sections of this Declaration. All citations to “Paragraph XX” are internal citations to the paragraphs of this Declaration.

II. BACKGROUND AND QUALIFICATIONS

5. I received a Bachelor of Science (BS) degree in Mechanical Engineering from Istanbul Technical University, Istanbul, Turkey, in 1982, and a Master of Science (MS) degree in Textile Engineering and Science and a Doctor of Philosophy (PhD) degree in Fiber and Polymer Science, both from North Carolina State University in 1985 and 1989, respectively.

6. In 1992, I joined the faculty of Auburn University in Auburn, Alabama, and have since been a Professor in the Departments of Textile Engineering, Polymer and Fiber Engineering and Mechanical Engineering.

7. Over the past 35 years, my work has focused on research in fibers, yarns, polymers, fabrics, and fabric design. This includes research relating to manufacturing, testing and analysis of polymers, fibers, fabrics and fabric structures, including knitted socks and shoes. This also includes research relating to textile machinery and equipment.

8. During my tenure at Auburn University, I have taught undergraduate and graduate courses relating to knitting technology and textile materials and machinery, including Kinematics and Dynamics (MECH 2140), Engineered Flexible Structures (MECH 5320/6320/6970D01), and Manufacturing of Polymeric Structures (MECH5520/6520/PFEN 6200).

9. To date, 9 individuals have received their Ph.D. degree in Mechanical Engineering, Polymer & Fiber Engineering (PFEN), and Textile Engineering, under my supervision.

10. I have authored or co-authored more than 80 refereed scientific publications. I have also authored several books, including:

- Wellington Sears Handbook of Industrial Textiles (Technomic Publishing Co., Inc., 1995)
- Handbook of Weaving (Technomic Publishing Co., Inc., 2001)
- Paper Machine Clothing (2d ed.) (AstenJohnson, Inc., December 2017, 1st edition 1997)

11. Throughout my career, I have been involved with numerous professional organizations, including American Society of Mechanical Engineers (ASME), Technical Association for the Pulp and Paper Industry (TAPPI), Fiber Society, Manufacture Alabama, and Phi Psi Textile Fraternity (Honorary member).

12. I have also been a member of the Editorial Board for various journals in the textile industry, including Journal of Industrial Textiles, Electronic Journal of Textiles, POLITEKNIK, Journal of Coated Fabrics, and Textile and Technique.

13. A current curriculum vitae is attached as Appendix A and includes the above listed credentials, additional background and information.

III. MATERIALS CONSIDERED

14. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials. In forming my opinions, I have considered the materials I identify in this report.

15. I may rely upon these materials and/or additional materials to respond to arguments raised by the Patent Owner. I may also consider additional documents and information in forming any necessary opinions — including documents that may not yet have been provided to me.

16. My analysis of the materials produced in this matter is ongoing and I will continue to review any new material as it is provided.

IV. LEGAL STANDARDS

17. I am not an attorney. In expressing my opinions and considering the subject matter of the claims of the '484 Patent, I am relying upon certain basic legal principles that have been explained to me.

18. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art” and generally includes patents and printed publications (e.g., books, journal publications, articles on websites, product manuals, etc.).

19. I understand that in this proceeding the Petitioner has the burden of proving that the claims of the '749 patent are anticipated by or obvious from the

prior art by a preponderance of the evidence. I understand that “a preponderance of the evidence” is evidence sufficient to show that a fact is more likely true than it is not.

20. I understand that there are two ways in which prior art may render a patent claim unpatentable. First, the prior art can be shown to “anticipate” the claim. Second, the prior art can be shown to have made the claim “obvious” to a person of ordinary skill in the art. My understanding of the two legal standards is set forth below.

A. Anticipation

21. I understand that the following standards govern the determination of whether a patent claim is “anticipated” by the prior art.

22. I understand that the “prior art” includes patents and printed publications that existed before the earliest filing date (the “effective filing date”) of the claim in the patent. I also understand that a patent will be considered prior art if it was filed before the effective filing date of the claimed invention, while a printed publication will be considered prior art if it was publicly available before that date.

23. I understand that, for a patent claim to be “anticipated” by the prior art, each and every requirement of the claim must be found, expressly or inherently, in a single prior art reference as recited in the claim. I understand that claim limitations that are not expressly described in a prior art reference may still be there if they are

“inherent” to the thing or process being described in the prior art. For example, an indication in a prior art reference that a particular process complies with a published standard would indicate that the process must inherently perform certain steps or use certain data structures that are necessary to comply with the published standard.

24. I understand that if a reference incorporates other documents by reference, the incorporating reference and the incorporated reference(s) should be treated as a single prior art reference for purposes of analyzing anticipation.

25. I understand that it is acceptable to consider evidence other than the information in a particular prior art document to determine if a feature is necessarily present in or inherently described by that reference.

B. Obviousness

26. I understand that a patent claim is unpatentable if the subject matter of the claim as a whole would have been obvious to a person of ordinary skill in the art of the claimed subject matter, as of the time of the invention at issue.

27. I understand that the following factors must be evaluated to determine whether the claimed subject matter is obvious: (1) the scope and content of the prior art; (2) the difference or differences, if any, between each claim of the patent and the prior art; (3) the level of ordinary skill in the art at the time the patent was filed, and (4) whatever objective factors indicating obviousness or non-obviousness may be present in any particular case.

28. I understand the objective factors indicating obviousness or non-obviousness may include: commercial success of products covered by the patent claims; satisfying a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention; praise of the invention by those in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; and the patentee proceeded contrary to the accepted wisdom of the prior art. I also understand that any of this evidence must be specifically connected to the invention rather than being associated with the prior art or with marketing or other efforts to promote an invention. I am not presently aware of any evidence of “objective factors” suggesting the claimed inventions are not obvious, and reserve my right to address any such evidence if it is identified in the future.

29. In addition, I understand that the obviousness inquiry should not be done in hindsight, but must be done using the perspective of a person of ordinary skill in the relevant art as of the effective filing date of the patent claim.

30. I have been informed and understand that a patent claim can be considered to have been obvious even if all the requirements of a claim are not found in a single prior art reference. Specifically, I have been informed and understand that the teachings of two or more references may be combined if such a combination

would have been obvious to one having ordinary skill in the art. In determining whether a combination based on multiple references would have been obvious, it is appropriate to consider, among other factors: (1) whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results; (2) whether a person of ordinary skill in the art could implement such a combination, and would see the benefit of doing so; (3) whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art; (4) whether a person of ordinary skill would have recognized a reason to combine known elements in the manner described in the claim; (5) whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and (6) whether the claimed invention applies a known technique that had been used to improve a similar device or method in a similar way.

31. I understand the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand that an example of a solution in one field of endeavor may make that solution obvious in another related field. I also understand that market demands or design considerations may prompt variations of a prior art system or process,

either in the same field or a different one, and that these variations will ordinarily be considered obvious variations of what has been described in the prior art.

32. I also understand that if a person of ordinary skill can implement a predictable variation, that variation would have been considered obvious. I understand that for similar reasons, if a technique has been used to improve one product, and a person of ordinary skill in the art would recognize that it would improve similar products in the same way, using that technique to improve the other products would have been obvious unless its actual application yields unexpected results or challenges in implementation.

33. I understand that the obviousness analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, but instead can take account of the “ordinary innovation” and experimentation that does no more than yield predictable results, which are inferences and creative steps that a person of ordinary skill in the art would employ.

34. I understand that sometimes it will be necessary to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art. I understand that all these issues may be considered to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

35. I understand that a person of ordinary skill attempting to solve a problem will not be led only to those elements of prior art designed to solve the same problem. I understand that steps suggested by common sense are important and should be considered. Common sense teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a person of ordinary skill will be able to fit the teachings of multiple patents together like pieces of a puzzle. As such, the prior art considered can be directed to any need or problem known in the field of endeavor as of the priority date of the patent and can provide a reason for combining the elements of the prior art in the manner claimed. In other words, the prior art does not need to be directed towards solving the same problem that is addressed in the patent. Further, the individual prior art references themselves need not all be directed towards solving the same problem.

36. I understand that an invention that might be considered an obvious variation or modification of the prior art may be considered non-obvious if one or more prior art references discourage or lead away from the line of inquiry disclosed in the reference(s). A reference does not “teach away” from an invention simply because the reference suggests that another embodiment of the invention is better or preferred. My understanding of the doctrine of teaching away requires a clear indication that the combination should not be attempted (e.g., because it would not work or explicit statements saying the combination should not be made).

37. I understand that a person of ordinary skill is also a person of ordinary creativity.

38. I further understand that in many fields, it may be that there is little discussion of obvious techniques or combination, and it often may be the case that market demand, rather than scientific literature or knowledge, will drive design trends. When there is such a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within their technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance, the fact that a combination was obvious to try might show that it was obvious. The fact that a particular combination of prior art elements was “obvious to try” may indicate that the combination was obvious even if no one attempted the combination. If the combination was obvious to try (regardless of whether it was actually tried) or leads to anticipated success, then it is likely the result of ordinary skill and common sense rather than innovation.

39. I have been informed and understand that in considering obviousness, it is important not to determine obviousness using the benefit of hindsight derived from the patent being considered.

40. I have been informed and understand that where there is a reason to modify or combine the prior art to achieve the claimed invention, the claims may be

rejected as prima facie obvious provided there is also a reasonable expectation of success.

C. Claim Construction

41. I have been instructed and advised by Counsel on the law and general principles relevant to claim construction. I have applied these principles to the facts set forth in this declaration in rendering my opinions.

42. I understand that claims are interpreted from the perspective of a person of ordinary skill in the art (“POSA” or “POSITA”) at the time of the invention. I understand that claim construction is a matter of law, but that in the process of determining the meaning of a claim term, the Board has to inquire into how a POSITA would have understood the claim term at the time of the invention.

43. I understand that the words of a claim are generally given their ordinary and customary meaning to a POSITA at the time of the invention, to the extent such a meaning exists.

44. I understand that a POSITA is deemed to read a claim term not only in the context of the particular claim in which the term appears, but in the context of the entire patent, including the other claims, the specification, and the prosecution history, which is called the “intrinsic evidence.” I understand that claim terms must be construed in a manner consistent with the intrinsic evidence. I further understand that the specification is highly relevant to claim construction and claims are to be

read in light of the specification, except that limitations should not be imported or read into the claims from the specification.

45. I understand that a patentee may choose to be his or her own lexicographer and define a term differently from plain and ordinary meaning in the art of the term, to the extent such a meaning exists, and that, under such circumstances, the patentee's own definition should control. Additionally, a claim term with a plain and ordinary meaning may not be entitled to that meaning when the patentee expressly disavowed the scope under such plain and ordinary meaning through descriptions in the specification or statements made during prosecution.

46. I understand that certain types of "extrinsic evidence," such as general purpose and scientific dictionaries, relevant scientific principles, references illustrating the meaning of technical terms, and the state of the art, may also be relevant to claim construction. Extrinsic evidence should not be considered, however, divorced from the context of the intrinsic evidence or used to contradict intrinsic evidence.

V. TECHNICAL BACKGROUND

A. Knitting Techniques

47. Knitting is an old technology that has been used in manufacturing apparel for centuries before the priority date of each of the asserted patents. *See* EX1050 (Spencer), 7 ("The term 'knitting' dates from the mid-sixteenth century

....”). In fact, knitting has been used, by hand or machine, specifically to make footwear no later than the 1930s. *See, e.g.*, U.S. Patent Nos. 1,803,554 (“Knilans”) (EX1051), 2,047,724 (“Zuckerman”) (EX1052), and 2,675,631 (“Doughty”) (EX1053); EX1054 (Knitwear in Fashion), 8 (hand-knitted “Hard Rope” shoe made in 1994/95 by Simone Memel); Chinese Patent Publication No. CN 2187379Y (“Li”) (EX1055; EX1056).

48. Knitting involves interlooping yarn to create a textile. *See* EX1050, 55-2 (“Knitting is the most common method of interlooping and is second only to weaving as a method of manufacturing textile products.”); EX1057 (Man-Made Fiber and Textile Dictionary), 4 (defining “KNITTING” to mean “[a] method of constructing fabric by interlocking series of loops of one or more yarns.”); EX1062, 127 (“[K]nitting involves the interlooping of one yarn system into continuously connecting vertical columns (wales) and horizontal rows (courses) of loops to form a knitted fabric structure.”). As David J. Spencer explained in his book “Knitting Technology: A Comprehensive Handbook and Practical Guide” published in 2001 (EX1050), “[i]nterlooping (Fig. 1.3) consists of forming yarn(s) into loops, each of which is typically only released after a succeeding loop has been formed and intermeshed with it so that a secure ground loop structure is achieved. The loops are also held together by the yarn passing from one to the next.” *Id.*, 2.

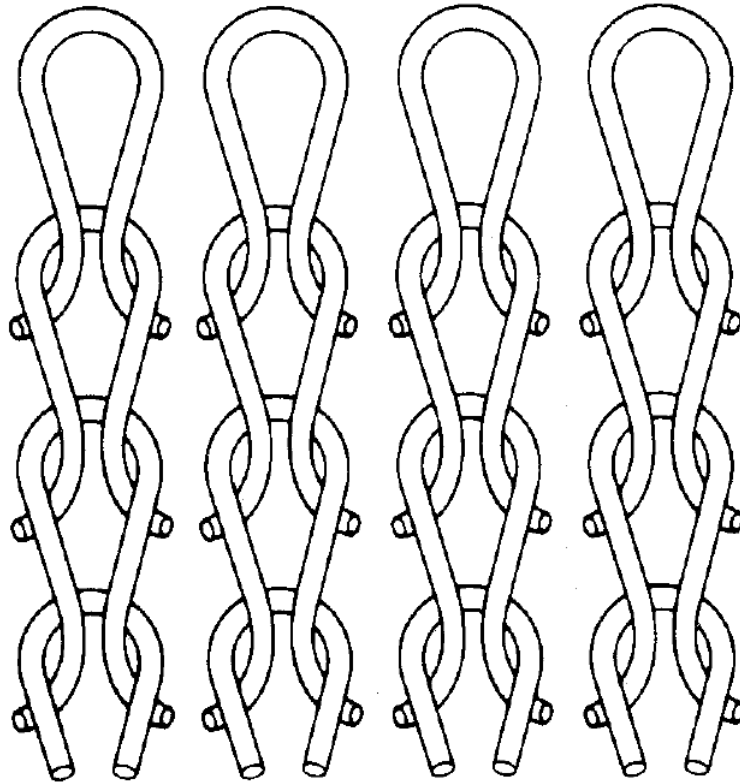


Fig. 1.3 Interlooping.

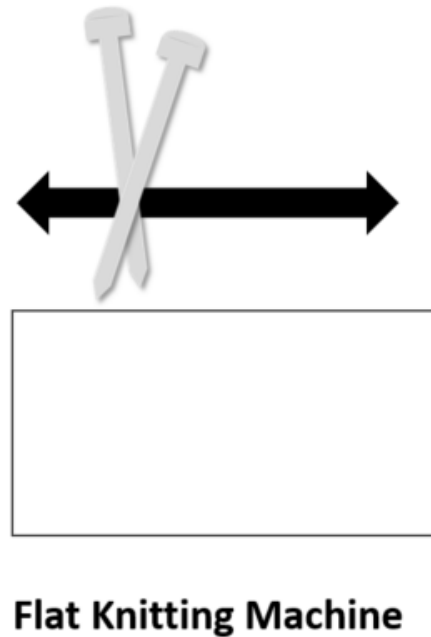
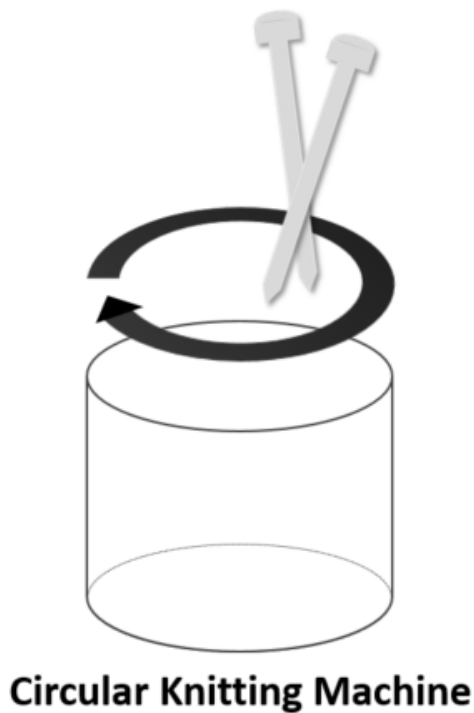
Id., 3.

49. Knitting techniques can be generally divided into two sectors: weft knitting and warp knitting. EX1057 (Man-Made Fiber and Textile Dictionary), 4 (“The two major classes of knitting are warp knitting and weft knitting[.]”); EX1062, 127. Warp knitting is a “type of knitting in which the yarns generally run lengthwise in the fabric,” whereas in weft knitting “one continuous thread runs crosswise in the fabric making all of the loops in one course.” EX1054, 4. “Weft knitting is the more diverse, widely spread and larger of the two sectors, and accounts for approximately

one quarter of the total yardage of apparel fabric compared with about one sixth for warp knitting.” EX1050 (Spencer), 49.

50. Different knitting processes can be used to make textiles with a variety of different patterns, textures, and other characteristics, such as flexibility, elasticity, strength, and thickness.

51. Two common weft knitting techniques are circular knitting and flat knitting. Circular knitting produces textiles in a continuous tube, while flat knitting produces textiles in sheets. EX1062, 128-29.



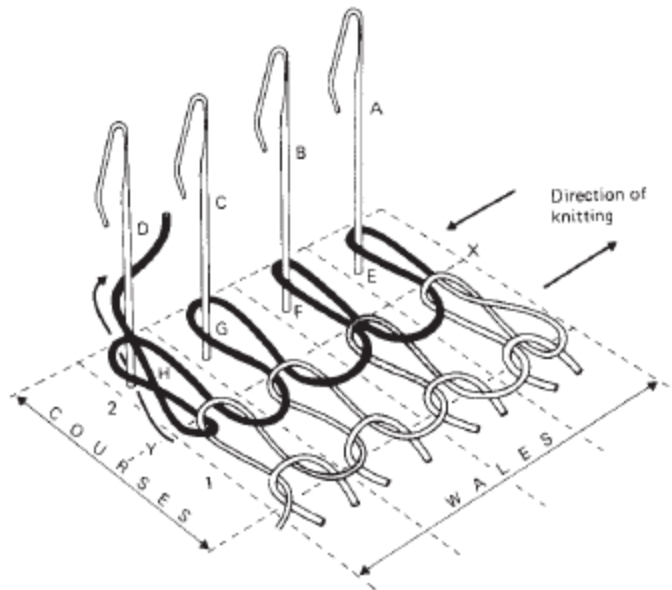


Fig. 6.1 Weft knitting.

EX1050 (Spencer), 48.

52. The use of different textures in the same item, whether that item is an article of footwear or a garment worn on the body, is a long-standing and integral part of fashion design. This includes the use of contrasting or complementary textures, the shapes of the textured elements, and the locations of such textured elements, among other examples. This is also the case for using different colors or patterns in the same knit element.

53. Both techniques have been in use for more than a century for knitting garments. *See, e.g.*, EX1050 (Spencer), 207 (“The first flat bar machine (Section 8.4.2) was demonstrated in 1862 and patented in 1865 by the Rev. Isaac Wixom Lamb, an American clergyman. He later changed the arrangement to the inverted V-bed shape patented by Eisenstuck.”), 258 (“Circular machinery entered hosiery

production inauspiciously during the nineteenth century[.]”). Nowadays both techniques are being used to produce a single textile with multiple characteristics, such as different yarns, textures, colors, or patterns, in order to avoid having to stitch together multiple textiles. *See, e.g., id.*, 57, 102-104, 111-14, 137-38, 154-55.

54. Flat knitting can be more efficient than circular knitting in this regard. Specifically, flat knitting offers many advantages and benefits, including the flexibility of the manufacturing process, the ability to change fabric structures and forms “very fast,” the possibility of changing yarn types in the same structure, and the ability to knit to shape “without cutting waste or making-up time” and to produce complex shapes. EX1050, 379.

55. Flat knitting is particularly suitable for “integral garment knitting” or “knitting to shape,” with which garments “are knitted in one piece,” requiring “little or no seaming when they leave the knitting machine.” EX1059, 3; EX1050, 193 (explaining the “reason is that knitting to shape generally involves wale fashioning achieved by selective loop transfer to and from needles in the same bed – a technique not readily available on circular machines”).

56. Integral garment knitting techniques are particularly advantageous at least for the following reasons:

- Time saving:

Even if - depending on the actual design- the summarized knitting time for the individual components of a sweater might be less than the manufacturing of a complete sweater, the overall production time, needed to sew and finish the product, generally takes much longer. Compared to the manufacturing period required to produce, for example, a complete woman's fully fashion sweater, time savings of about 35% can be reached.

EX1058, (Melliand International (September 2003)) at 5.

- Fewer production steps:

Depending on the production organization further stages like a build up of garment components, handling and shipping of the individual parts to the making-up locations and all relevant organizational and control efforts around these stages are not required either.

Id.

- Reduction in yarn waste:

The production of complete garments is the optimal process regarding yarn consumption, since there virtually is no waste generated due to the missing cutting and sewing operations. All yarn is supposed to run into the sweater. The particular knitting

process also allows the continuous use of yarn cones and facilitates and optimizes the actual yarn processing. The volume of the yarn orders can be adapted and does not need to foresee a comprehensive excess charge.

Id.

- Positive economic advantages:

An economic evaluation of the aforementioned points indicates that due to shortened lead time the cash flow is positively activated due to an overall reduction in idle times. The streamlined process resulting in the knitting being the major production part reduces the number of personnel being involved in the manufacturing and the production control.

Further positive cost reductions are achieved by the optimized yarn consumption, minimized storage and logistic costs as well as by less expenditure for waste disposal.

Id.

- Better quality:

The decreased number of production and handling steps reduces the risk of defects and damages. As a consequence of the single piece production method, the product quality can be seen as more

constant and homogenous. This helps avoiding the damage and loss caused by defective parts.

Id.; see also EX1061 (International Textile Bulletin (May 2003)), 6 (“The latest [whole garment knitting] technology offers to the customer the promise of comfort, particularly in close fitting garments, children’s wear and underwear tops”; “The excess material which occurs in traditional knitwear can be avoided, resulting in lighter garments,” as well as “significantly lower” “material consumption and make-up costs”; “High quality stitch construction combined with the use of high quality yarns will be available to customers at more affordable prices.”).

57. Flat knitting also allows for intarsia designs to integrate “coloured areas into a cohesively-knitted structure.” EX1050, 102-104.

58. There are four primary or “base structures from which all weft knitted fabrics and garments are derived.” EX1050, 60. These include “plain, rib, interlock and purl,” each of which “is composed of a different combination of face and reverse meshed stitches, knitted on a particular arrangement of needle beds.” *Id.* Each of these base structures may be used “in combination with another primary structure in a garment-length sequence,” though not all knitting machines can produce all types of base structures. *Id.* “Other types of stitch may be produced on each of the four-needle arrangement base structures by varying the timing of the intermeshing sequence of the old and new loops.” *Id.*, 90. In addition, “[i]ndividual element

movement (particularly of latch needles) enables weft knitting machines to produce designs and structures based upon needle selection for loop intermeshing and transfer. This also facilitates the production of garment parts shaped on the knitting machine.” *Id.*, 52; *see also id.*, 105.

59. Because different knit stitches and combinations of stitches have different properties, a wide variety of characteristics can be imparted to different parts of a textile element by changing the type(s) of knit structures used throughout the fabric. For example, rib stitches are “particularly suitable for the extremities of articles such as tops of socks, cuffs of sleeves, rib borders of garments, and stolling and strapping for cardigans. Rib structures are elastic, form-fitting, and retain warmth better than plain structures.” *Id.*, 68. Various properties can also be imparted to areas of a textile element by changing the type of yarns (which are made up of fibers) used in the knitting process. Different types of fibers have varying levels of tensile strength, stiffness, toughness, elasticity, recovery, friction, abrasion resistance, moisture absorption, and thermoplasticity, among many other properties. EX1062, 565-68, 575, 581-82, 586-97. These characteristics in turn affect the properties of the textile elements in which the yarns are used. As just one example, natural fibers (such as cotton and wool) are hygroscopic, meaning they are able to absorb water, whereas many man-made or synthetic fibers (such as acrylic and vinyon) are much less absorptive. *Id.*, 593.

60. Moreover, the consideration and possible use of (1) rib or stripe patterns; (2) contrasting patterns; (3) differently shaped elements in the pattern; (4) different orientations of the elements in the pattern; and (5) different locations of the elements in the patterns, among other things, is a long-standing and integral part of fashion design and would have been obvious or obvious to try from the perspective of a POSITA familiar with either footwear or textiles. Indeed, rib or stripe patterns are among the simplest and most ubiquitous of a finite number of aesthetic design elements in footwear and in knit fabrics, and their use and success is predictable.

61. Moreover, flat knitting machines by the time of the alleged inventions were capable of producing multiple gauges in the same garment, which “involves a combination of techniques, including half-gauging, using different numbers of yarn ends, intarsia zoning, and blocks of different gauges of needles each working with its corresponding count of yarn and yarn carrier.” *Id.*, 234. Gauge “defines the spacing of the needles in the needle bed (usually as *needles per inch*),” such that a finer gauge results in a higher density of stitches. *Id.*, 4. Multiple gauge machines, such as those discussed below, can be used to produce a single garment with numerous patterns, each having different properties (*e.g.*, elasticity, breathability, recovery, etc.):



Fig. 19.6 Multi-gauge technique garment.

Id., 235.

62. A variety of weft knitting techniques may also be used to shape a textile element as it is knit, including “varying the number of needles in action in the knitting width,” “changing the knitting construction,” and “altering the stitch length.” *Id.*, 184; *see also id.*, 185-192. For example, “[i]n *needle selection shaping*, the selvedge needle(s) is introduced or withdrawn from the knitting width by means

of needle selection,” thus changing the width of a textile element by adding to or removing from the number of needles in operation and the number of loops (or “stitches”) formed in each row (or “course”). *Id.*, 188.

B. Knitting Machines

63. Long before the priority date of the patents, knitting machines had been used to commercially manufacture knitted textiles. Such machines can be hand or power controlled to “convert yarn into knitted loop structures,” and can be easily customized. EX1050 (Spencer), 18-19. Users of knitting machines can therefore manufacture textiles with a wide variety of characteristics, including patterns and textures. *See, e.g., id.*, 134-135 (Electronic control “provides greater versatility as regards design parameters, simplifies the modification of repeat sequences and size, style and pattern-changing operations, and, in some cases, enables changes to occur whilst the machine is knitting[.]”).

64. Common knitting machines used no later than the early 2000s included weft knitting machines, which included flat-bed machines and circular machines, and warp knitting machines, which included tricot and raschel machines. EX1054, 26-27 (printed pages 174-175).



Fig. 12.2 Knitting patterns and programmes are quickly generated using automatic routines. These are checked and can be transmitted on-line to the CMS knitting machine. Simultaneous monitoring of production can also be achieved [Stoll SIRIX].

EX1050, 137.

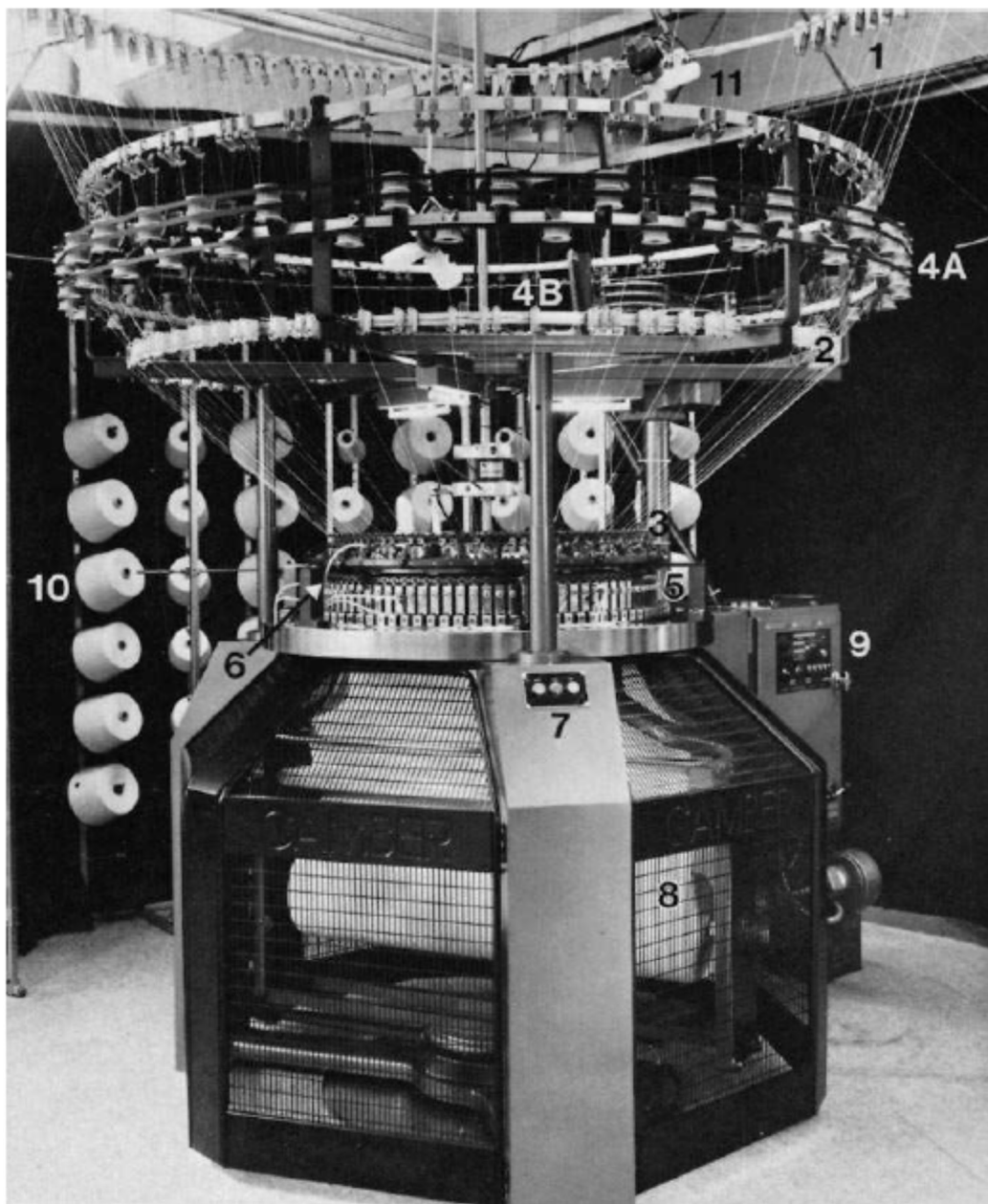


Fig. 13.12 The modern circular single jersey fabric machine.

Id., 156.

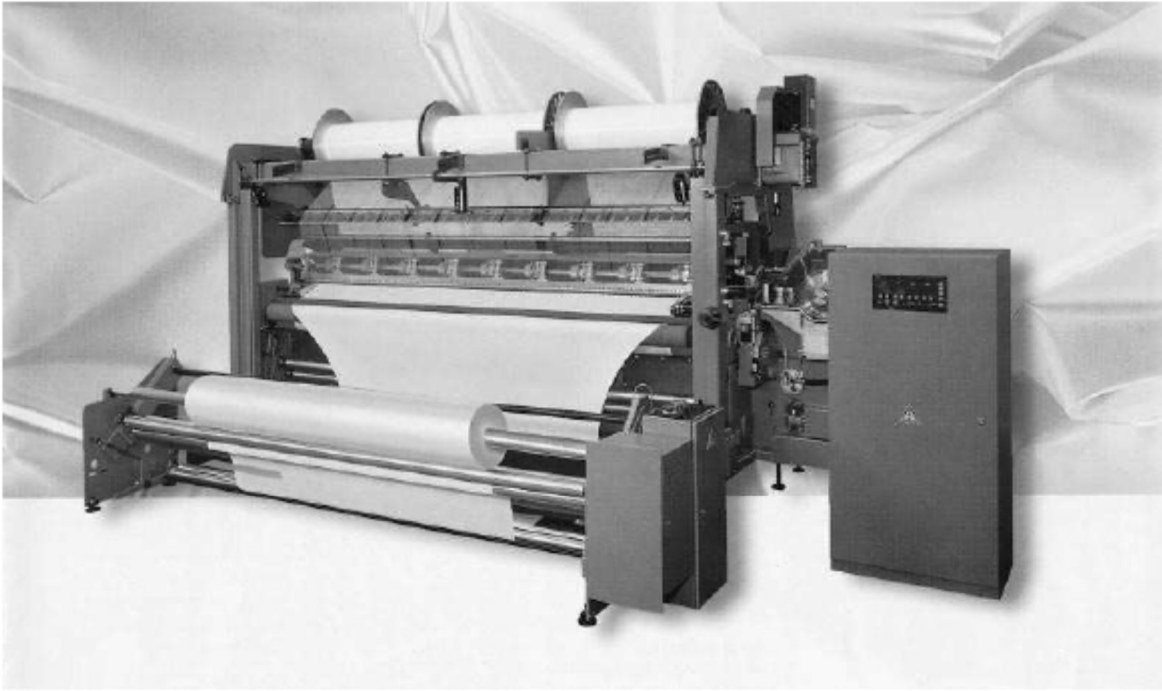


Fig. 23.2 Tricot machine HKS 2-3 [Karl Mayer].

Id., 287.

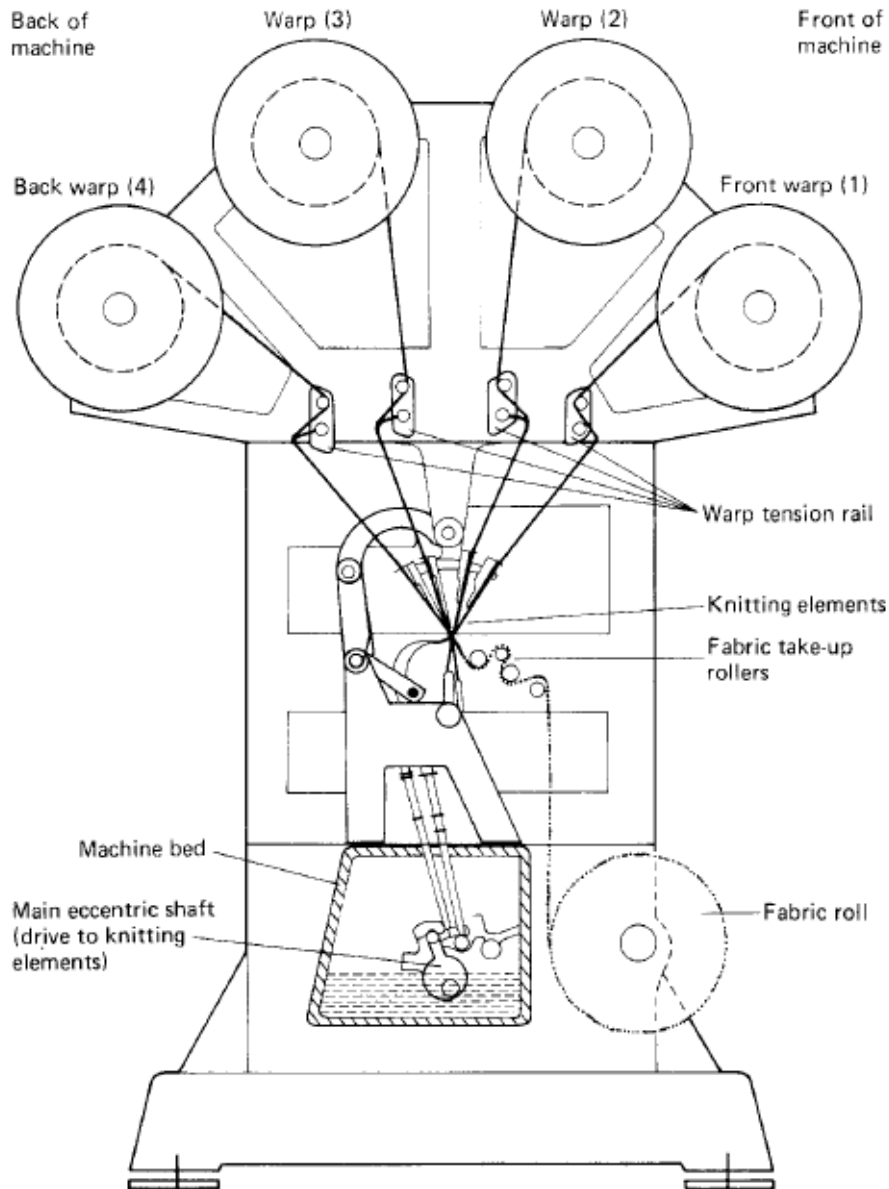


Fig. 24.5 Cross-section of a latch needle raschel machine [Reprinted by permission of *Knitting Times*, official publication of the NKSA in the USA].

Id., 303.

65. As discussed above, flat knitting is particularly suitable for integral and complete garment knitting. At least two flat knitting machine manufacturers, H. Stoll GmbH & Co. and Shima Seiki Manufacturing, Ltd., had “developed machinery for integral garment knitting” by 2003. *See* EX1054, 30 (printed page 178); *see also*

EX1050, 234 (“Stoll ready-to-wear integrates many of the laborious and time-consuming making-up processes into the knitting process; for example, pockets, button-hole panels, facings, overlapping collars, bows, and loops.”), 237-38 (“Shima Seiki launched their patented WholeGarment technique at ITMA’95 with two different V-bed models, each having unique features. These involve integrally and seamlessly knitting a complete tubular garment on a V-bed rib machine.”); EX1059, 3-5 (“If ITMA 1995 in Paris witnessed the dawn of commercial complete garment knitting, then IKME 2003, held during October in Milan was the venue where this exciting technology really did come of age.... Shima Seiki ... exhibited its trademark WholeGarment machines in four different needlebed configurations New from Stoll at IKME was the CMS 330 TC Knit & Wear machine.”); EX1060, 4 (“Completed knitted (‘Whole-Garment’ knit and wear) or fully fashioned products were running on most machines” from “the leading flat knitting machinery manufacturers at IKME – Shima Seiki (J), Stoll (D), Steiger (CH), Universal (D) Protti (I).”).

66. These innovative integral knitting machines offered great potential for both fashion designers and knitwear manufacturers. The machines not only resulted in “yarn material saving” and reduction in “making-up operations,” but “allow[ed] the completely knitted garment to appear visually as a whole – a new creation dimension for the designer.” *Id.*

VI. THE '484 PATENT

A. Effective Filing Date

67. The application that resulted in the '484 patent (EX1001) is U.S. Patent Application Serial No. 14/087,169, filed on November 22, 2013. The '484 patent claims ultimate priority back to U.S. Patent No. 7,774,956, filed on November 10, 2006. All of the prior art that I rely upon below predates November 2006, and thus, for now, I assume that the claims of the '484 patent have an effective filing date of November 10, 2006, regardless of whether there is actually support in the provisional application for all of the claim limitations.

B. Person of Ordinary Skill in the Art

68. Based upon my experience in the field and the information discussed below, I believe a person of ordinary skill in the art in the field of the '484 patent in November 2006 would have been someone with at least a few years of experience in knit materials and knitting methods and machines that can be used in making footwear, or a bachelor's degree in textile-related sciences, engineering, or industrial product design, or equivalent academic or work experience, including in the footwear industry. Such a person of ordinary skill would have at least a general understanding of general construction processes and materials used in the manufacturing process of fabric-based articles. For individuals with a lower educational level, a person could still be of ordinary skill in the art provided that

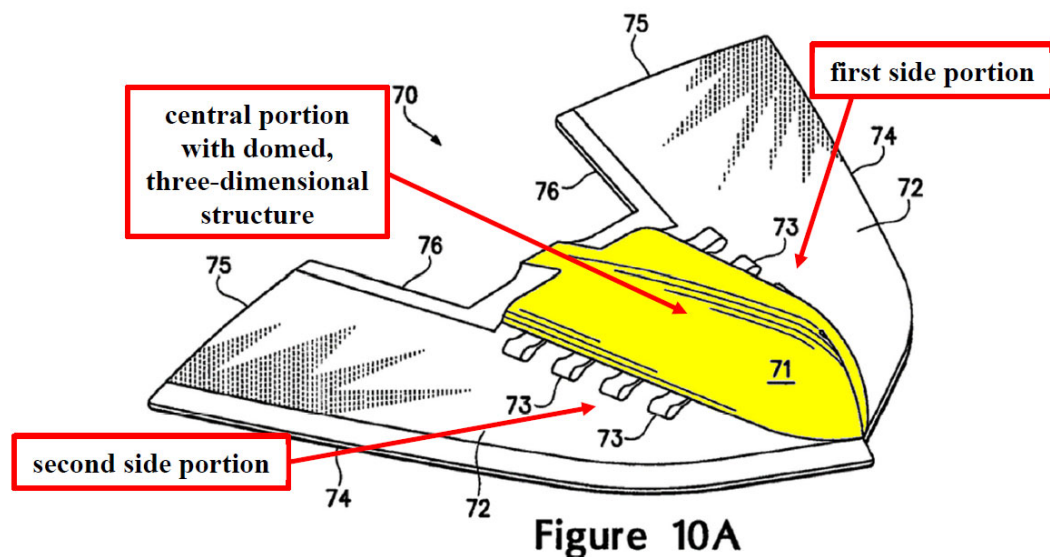
person's working experience compensates for any such lower educational level, or vice versa. My opinions regarding the level of ordinary skill in the art are based on, among other things, my years of experience in the above field of art, my understanding of the fundamental qualifications that would be relevant to a person tasked with constructing fabric-based articles, including manufacturing footwear that incorporates knitted components, and my familiarity with the backgrounds of colleagues and coworkers, both past and present. Although my qualifications and experience exceed those of the hypothetical person having ordinary skill in the art defined above, my analysis and opinions regarding the '484 patent have been based on the perspective of a POSITA, as described above, as of the relevant time for the '484 patent (November 2006).

C. Overview of the '484 Patent

69. The '484 patent discloses articles of footwear with uppers that include flat-knitted elements. EX1001, 4:28-48. The specification explains that, in flat knitting, knitted material is produced by knitting from alternating sides, for example by turning the material periodically. *Id.*, 7:27-30. Flat knitting contrasts with circular knitting in which the material is knitted from the same side. *Id.*, 7:34-36.

70. The '484 patent states that "flat knitting can be used to provide textile structures for use in footwear uppers of a final desired shape such that textile cutting steps can be avoided (which eliminates waste, avoids the need for finish cut edges,

saves time, saves money, etc.).” *Id.*, 4:51-55. In one embodiment of a flat-knit structure, an upper 70 includes a “central portion 71, a pair of side portions 72, and eight lace loops 73.” *Id.*, 10:18-23.



Id., Fig. 10A (annotated).

71. As shown above, the central portion 71 has a domed, three-dimensional structure shaped to extend over a foot. EX1001, 10:34-38.

72. The '484 patent illustrates the “domed, three-dimensional structure” feature in only three figures (Figures 10A-10C) and provides only two paragraphs of description. *Id.*, Figs. 10A-10C, 10:18-46. There is no substantive disclosure about how to knit three-dimensional structures.

D. The Prosecution History

73. I have reviewed the U.S. file history and note that the Examiner rejected the originally-filed claims as being anticipated by Dua-592 (EX1014) or obvious

over Dua-592 in view of a secondary reference. EX1013 ('484 File History), 1218-1226. In response, Nike amended the claims to add that the domed, three-dimensional structure is “shaped to extend above the plane of the first side portion and the second side portion when the flat-knitted element is in a flattened configuration.” *Id.*, 1254. Following thereafter, a Notice of Allowance was issued. *Id.*, 2018.

74. I also reviewed portions of the file history for European Patent Application No. 21166675 (“the EP '675 application”), a European counterpart application to the '484 patent. I note that claim 1 of the EP '675 application included similar limitations to the '484 patent's claim 1. EX1019, 11.

75. During examination, the Examiner objected to the EP '675 application's claim 1 for multiple reasons, including because the application included insufficient disclosure for a skilled person to carry out the claimed invention. EX1019, 15. The Examiner explained that “nothing is described nor disclosed nor explained on how a domed three-dimensional knitted element could be manufactured through a flat-knitting process.” *Id.* According to the Examiner, “[i]t is clear to any skilled person that the present subject-matter lacks essential information on how such an effect (domed portion) could be achieved.” *Id.*

76. In response, Nike pointed to the Hong reference (EX1016) as an example that “[t]here are numerous prior art documents which disclose that

achieving three-dimensional knitted textiles may generally be obtained through flat knitting, such as e.g. ‘The development of 3D shaped knitted fabrics for technical purposes on a flat knitting machine’, Hong et al.” *Id.*, 8.

77. As described in more detail below in Section VII.B, Hong describes what was, in 1994, a new commercial electronic flat-knitting machine by Shima Seiki and provides specifics of how it can produce three-dimensional shaped fabrics for a variety of technical purposes. EX1016 (Hong), 189-191. Hong also describes a variety of exemplary three-dimensional shaped knitted fabrics developed on the machine, including tubular forms, spherical forms, and others. Hong, 191-194. Hong explains that “[o]ne of the main advantages [of such flat-knitting machines] is the facility of these machines to knit fabric pieces to a particular shape or form.” *Id.*, 189.

E. The Claims of the ’484 Patent

78. This declaration addresses the patentability of claims 1, 5-9, and 11-17 of the ’484 patent.

F. Construction of Terms Used in the Claims of the ’484 Patent

79. I understand that in a parallel litigation, Nike and Skechers agreed that the term “central portion having a domed, three dimensional structure” means “central portion having a domed, three-dimensional structure formed during the flat-

knitting process, and not afterward.” EX1005, 2. I have considered and applied this construction in my analysis below.

80. I understand that, when not otherwise construed, claim terms should be given their ordinary and customary meaning as understood by one of ordinary skill in the art in view of the patent and its file history. Therefore, except for the agreed meaning of the term “central portion having a domed, three dimensional structure” noted above, I have used what I believe to be the ordinary and customary meaning of the claim terms as understood by one of ordinary skill in the art in view of the ’484 patent and its file history.

VII. OVERVIEW OF THE PRIOR ART

A. U.S. Publication No. 2005/0193592 (“Dua-592”) (EX1014)

81. U.S. Publication No. 2005/0193592 by Nike, Inc. is entitled “Article of Footwear Having a Textile Upper,” and was published on September 8, 2005 (“Dua-592”). EX1014, 1.

82. Dua-592 discloses articles of footwear, including uppers produced using a flat-knitting process. EX1014, Abstract, [0061]. Dua-592 discloses that flat knitting is a type of weft knitting, which is one of the two main mechanical processes developed for knitting a textile (i.e., warp and weft knitting). Flat knitting is same type of knitting process used in the ’484 patent. EX1014, [0044]; EX1001, Abstract.

83. Dua-592 states that manufacturing efficiency is increased by forming its upper to be “a single, unitary element of material” rather than numerous jointed elements. EX1014, [0060]. As Dua-592 acknowledges, flat-knitting can “impart various textures, different properties, or different yarn types to the textile element.” *Id.*, [0061]. For example, Dua-592 explains yarns can be selected to provide a variety of physical properties to a textile element, such as strength, stretch, support, stiffness, recovery, fit, and form. *Id.*, [0052], [0056].

84. Dua-592 discloses various embodiments of knitted textile elements for forming uppers. For example, one embodiment comprises a “[t]extile element 40 [that] exhibits the general shape depicted in FIG. 8 prior to the formation of seams 51-54. Following formation of seams 51-54, however, textile element 40 exhibits the shape of upper 30 depicted in FIGS. 2-7.” *Id.*, [0038].

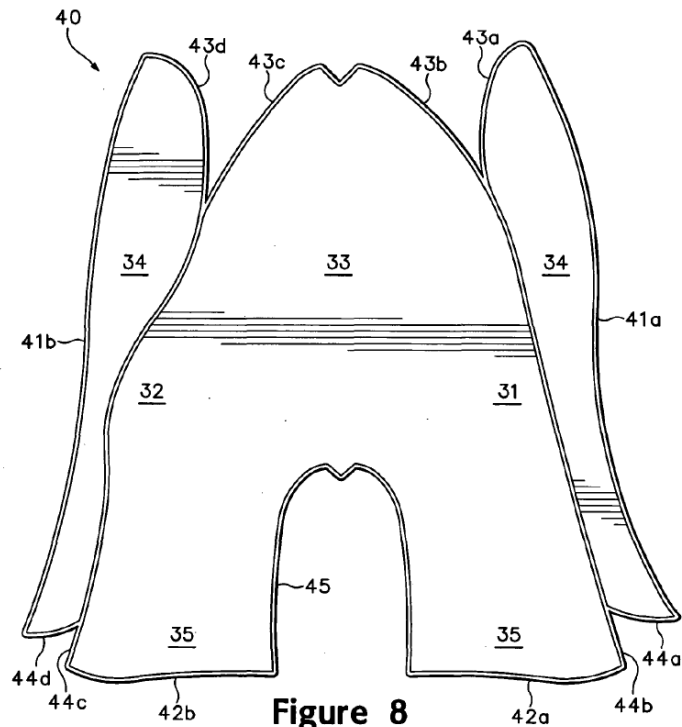


Figure 8

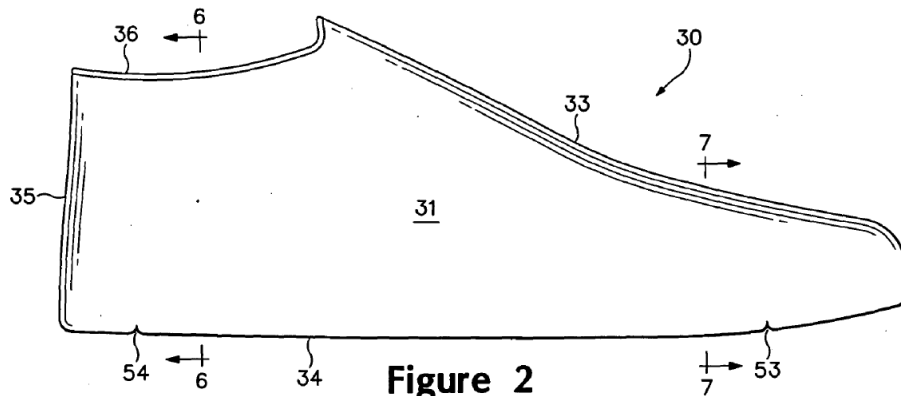


Figure 2

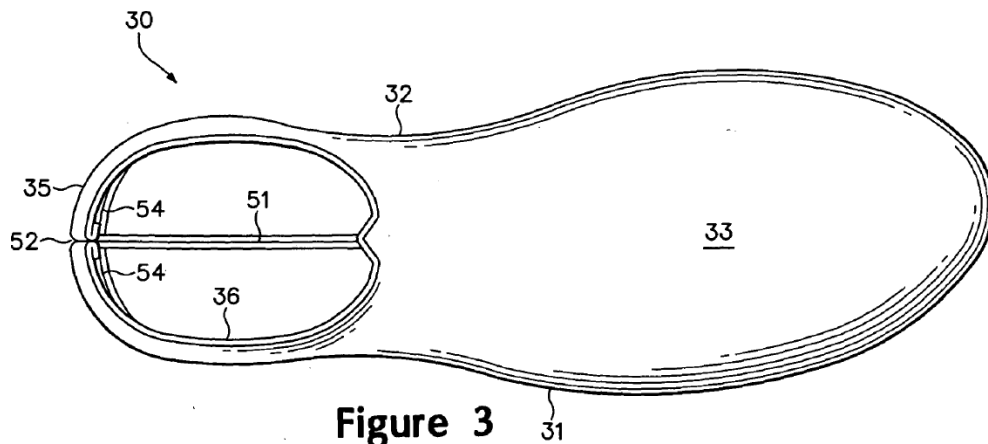
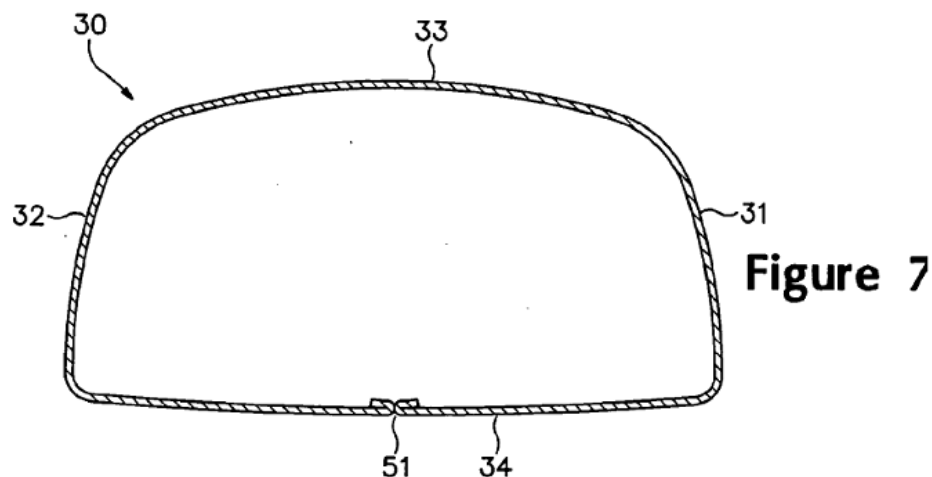


Figure 3

85. Dua-592 also discloses that the instep region 33 of FIG. 8 above would form a domed, three-dimensional structure when the textile element 40 is assembled into an article of footwear, as shown below.



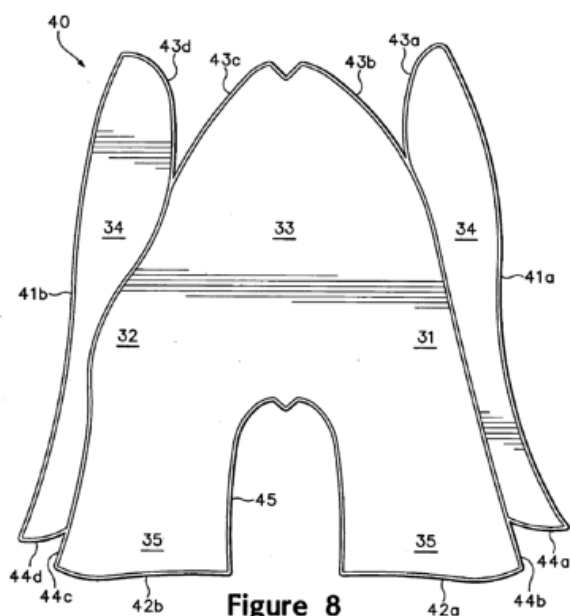
86. Dua-592's textile element embodiments can be summarized as follows:

- Embodiment #1 – textile element 40 of FIGs. 1-9;
- Embodiment #2 – textile element 40' of FIG. 10;
- Embodiment #3 – textile element 40" of FIG. 11;
- Embodiment #4 – textile element 140 of FIG. 12; and
- Embodiment #5 – textile element 240 of FIGs. 13-14.

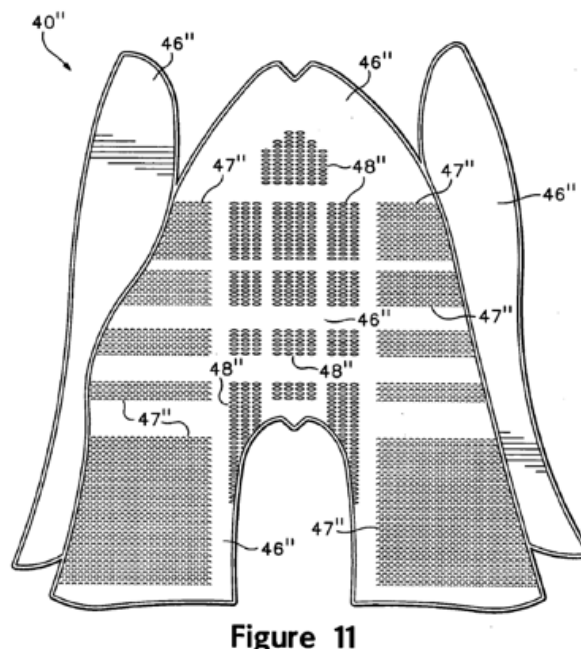
87. I note that Dua-592's embodiments share many common features, including having the same "general shape" and the fact that each comprises a flat-knitted element which is formed into a three-dimensional shoe upper. EX1014, [0053]-[0055]. For example, it appears that Embodiment #3 differs from Embodiment #1 only with respect to the fact that Embodiment #3 has differing

textured areas whereas Embodiment #1 has the same texture throughout, as shown below.

Embodiment #1



Embodiment #3

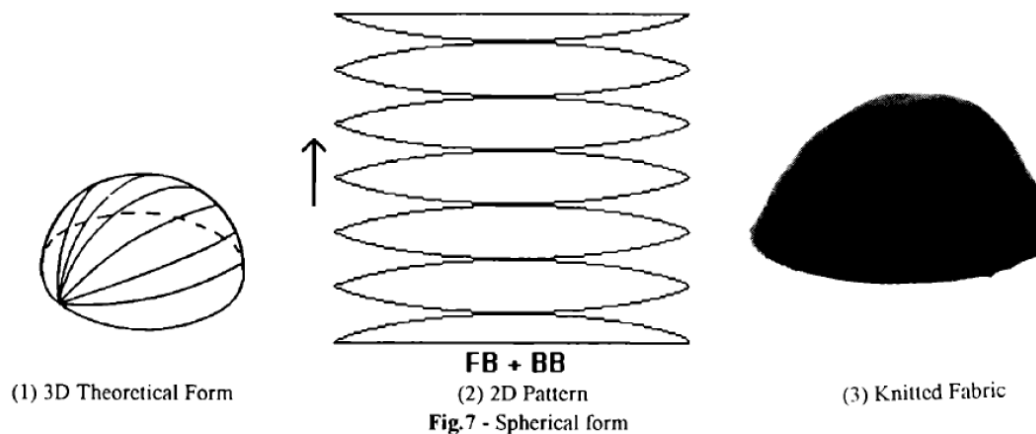


88. In describing Embodiment #3, Dua-592 also explains how its various textured areas extend over the lateral region 31, medial region 32, and instep region 33 which are regions of the upper depicted in FIGs. 1-8 for Embodiment #1. EX1014, [0055]. This means Dua-592’s disclosure with respect to Embodiment #1 equally applies to at least Embodiment #3.

B. Hong – “The development of 3D shaped knitted fabrics for technical purposes on a flat knitting machine (EX1016)”

89. Hong, which is dated in 1994, describes how flat knitting can be used to form a variety of shapes across a wide range of applications, including “protection clothing, transportation related textiles (cars, planes and space crafts), geotextiles,

building construction related textiles, packaging materials, military related textiles, medical textiles, sports related textiles, etc.” EX1016, 189. An example of one flat knit shape from Hong is shown below.



EX1016, Fig. 7.

90. Hong explains how a three-dimensional concept (e.g., above left) may be transferred to a two-dimensional pattern (e.g., above middle), which is then used by known flat knitting machines to produce a knitted three-dimensional shaped fabric (e.g., above right). *Id.*, 1, 192-193. Hong discusses three different methods for flat knitting three-dimensional shapes, including “using different structural combinations, using different loop lengths, and altering the number of knitting needles and knitted courses.” *Id.*, 189. Hong discloses that “[o]ne of the main advantages is the facility of these machines to knit fabric pieces to a particular shape or form.” *Id.* “By using the new flat knitting machines, it is possible not only to knit the new loop structures which are not possible on the conventional flat knitting

machines, but also knit *fully fashioned garments*.” *Id.* Knit to shape is another way of saying fully fashioned, which I understand Nike’s expert from another IPR proceeding involving the ’484 patent acknowledged. EX1020, 55:18-19, 57:6-13.

91. As Hong explains, flat knitting fully fashioned garments “is very important to reduce the waste of expensive materials during cutting as well as in eliminating the additional making up operation.” EX1016, 189; 193 (“[K]nitting directly the 3D shapes can overcome fabric waste and diminish the labour cost inherent to the use of two-dimensional fabrics which have to fit the variable geometry of a three-dimensional seat bum.”).

92. Hong concludes by stating that its disclosure presents various examples of three-dimensional shaped knitted fabrics and encouraging a skilled artisan to exploit the capacity of a flat knitting machine to “knit more types of three-dimensional knitted fabrics.” *Id.*, 194.

C. Choi – “Three dimensional seamless garment knitting on V-bed flat knitting machines” (EX1015)

93. Choi discloses details for seamless garment knitting techniques on V-bed flat knit machines as early as 1995, including describing and comparing machines from two major flat-knitting machine suppliers, Shima Seiki and Stoll. EX1015, Abstract. Choi explains that “[s]eamless knitting, or complete knitting, which produces one entire complete garment without a sewing or linking process, provides a variety of advantages in knitting production such as savings in cost and

time, higher productivity, quick response production and other advantages.” *Id.*, 5. Choi further explains that “seamless garment knitting makes it possible not only to create several types of tubular formed knitting but also to build diverse design structures on the tubular knitted garments simultaneously.” *Id.*, 6. Examples in which three-dimensional flat knitting has been used include “fashion, upholstery, industrial, automotive, and medical textiles.” *Id.*, 7. One of the oldest applications for flat knitting, dating back to the 1800’s, was to make articles of footwear in the form of socks. *Id.*, 5.

94. Choi also describes the difference between fully-fashioned knitting and seamless knitting. With fully-fashioned knitting, “all parts of the garment are knitted separately, [thus] the fully-fashioned knitting still requires a post sewing or linking process,” where “[l]inking is defined as a process of joining side seams or edges of fabric pieces together with a row of knitting on a linking machine.” *Id.*, 9. In contrast, “seamless flat V-bed knitting actually creates complete garments, which do not require any kind of cutting or sewing process.” *Id.*, 12.

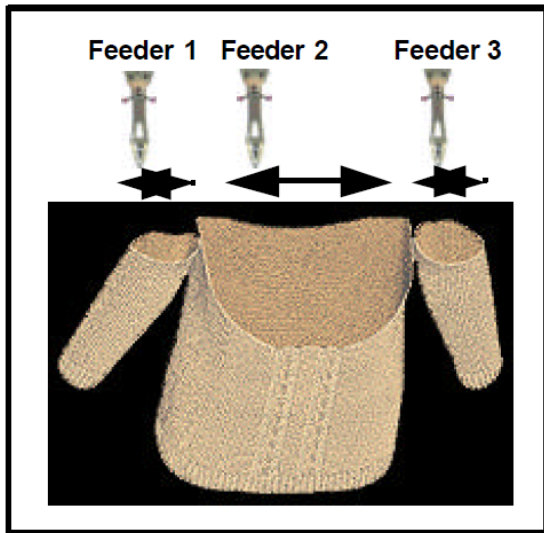


Figure 6.1. Three-dimensional complete garment knitting until underarm point (Shima Seiki)

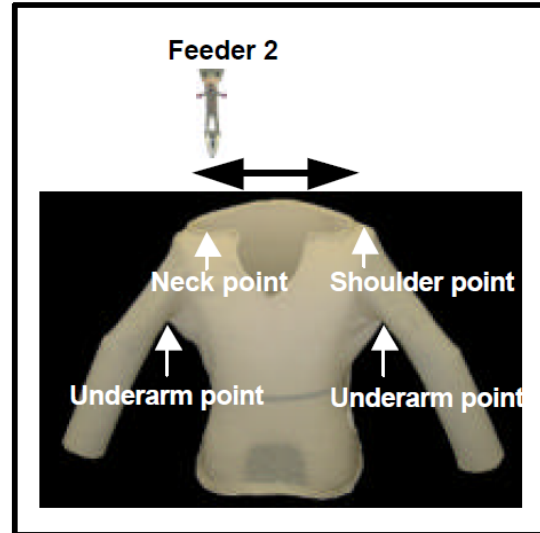


Figure 6.2. Three-dimensional complete garment knitting after underarm point

Id., 13.

95. One manufacturer of seamless flat V-bed knitting machines is Shima Seiki, which manufacturers “the innovative WHOLEGARMENT® machine that can produce a one-piece three-dimensional complete garment with no stitching, linking or sewing processes.” *Id.*, 14.

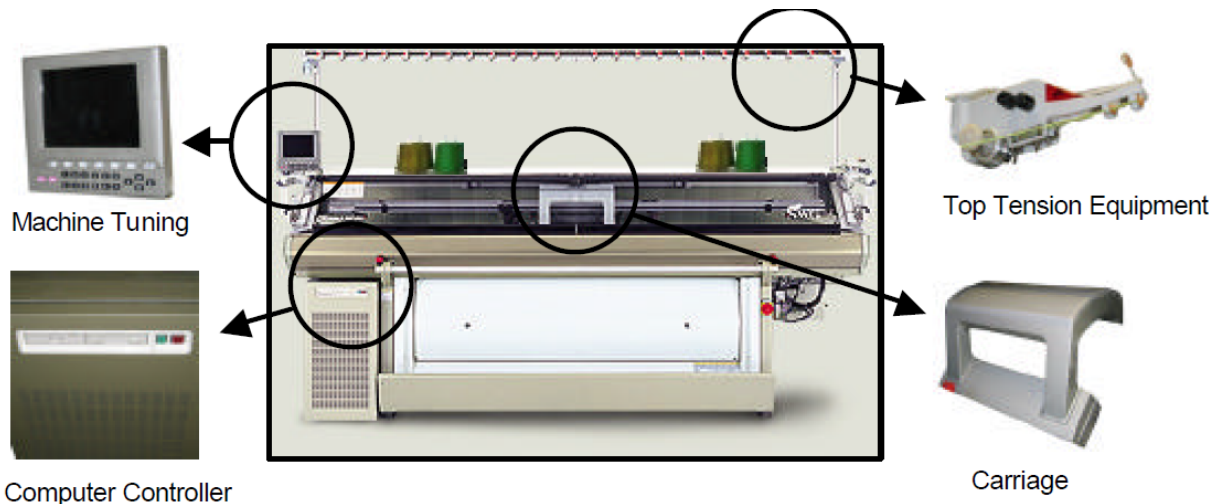


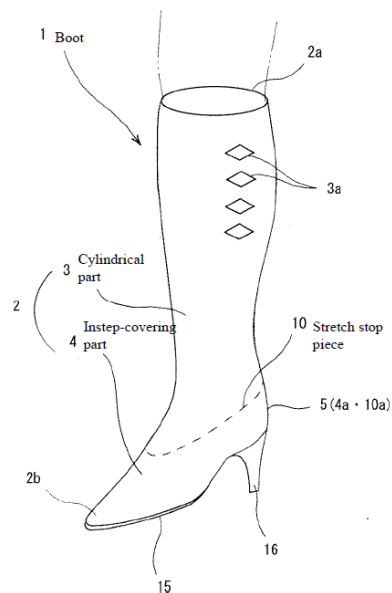
Figure 7.1. SWG-V® machine

Id., 15.

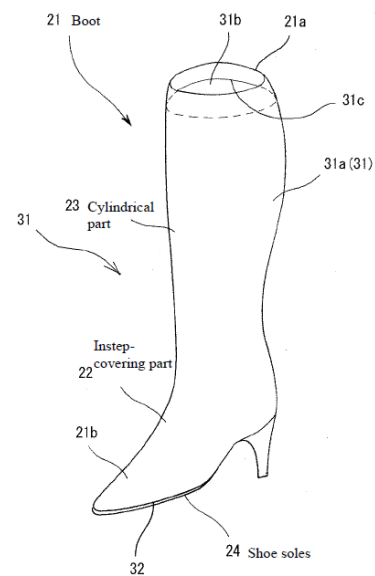
D. JP3118186 (“Yamamoto”) (EX1017)

96. Yamamoto discloses an article of footwear in which “entire outer surface of boot 1 (excluding the sole) is formed by a single piece of fabric 2 continuously knitted with yarn” EX1017, Abstract.

[FIG. 1]



[FIG. 3]

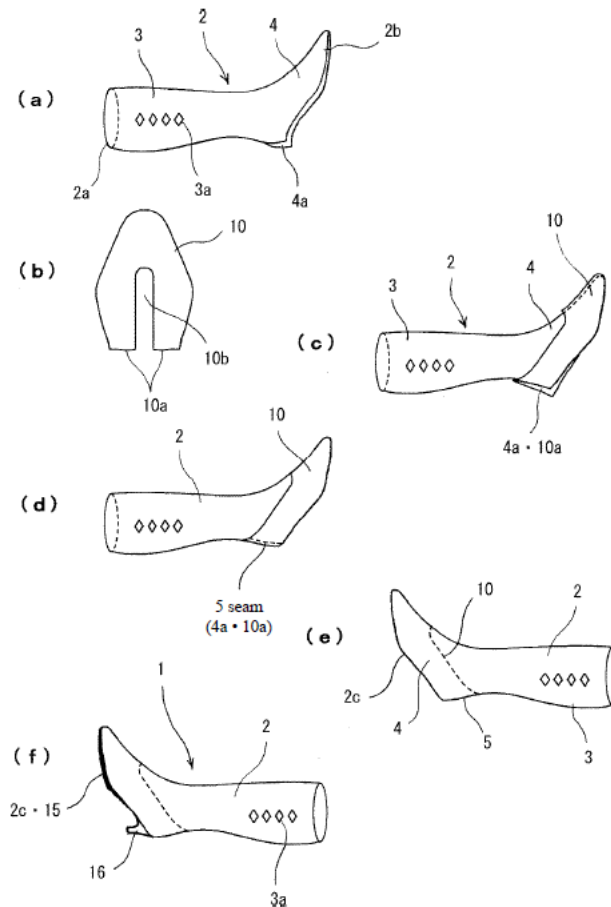


Id., FIGs. 1 & 3.

97. Yamamoto explains how it is “possible to knit the cylindrical fabric that forms the outer surface of the boot continuously with yarn ... using a flat knitting machine with a three-dimensional seamless knitting function called WHOLEGARMENT (registered trademark).” *Id.*, [0011].

98. Yamamoto uses “[a] stretch stop piece 10 for determining the shape of the shoe is bonded to the inside of the instep-covering part 4 of the fabric 2.” *Id.*, [0022].

[FIG. 2]



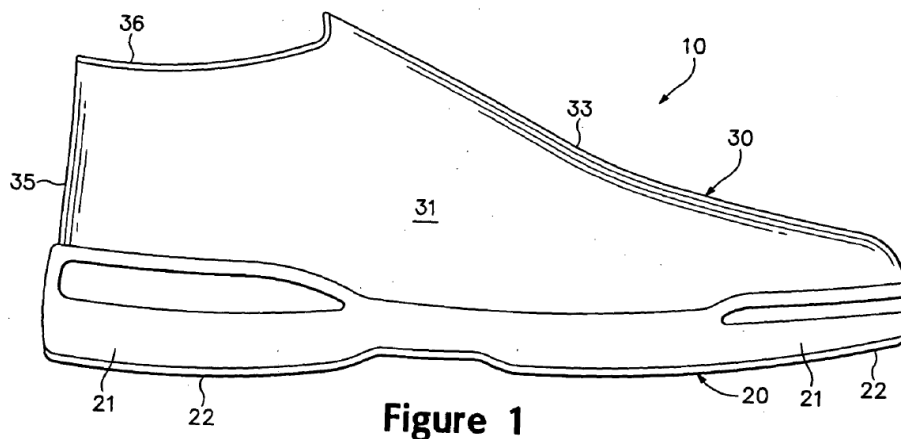
99. As shown above in, the “stretch stop piece 10 is prepared as a member that covers and defines the shape [of the foot] from the instep of the foot to the back of the heel (FIG. 2(b))” (*Id.*, [0025]), where the stretch stop piece 10 is affixed by thermal pressing or adhesive to the instep-covering part 4 of the fabric. *Id.*, [0026].

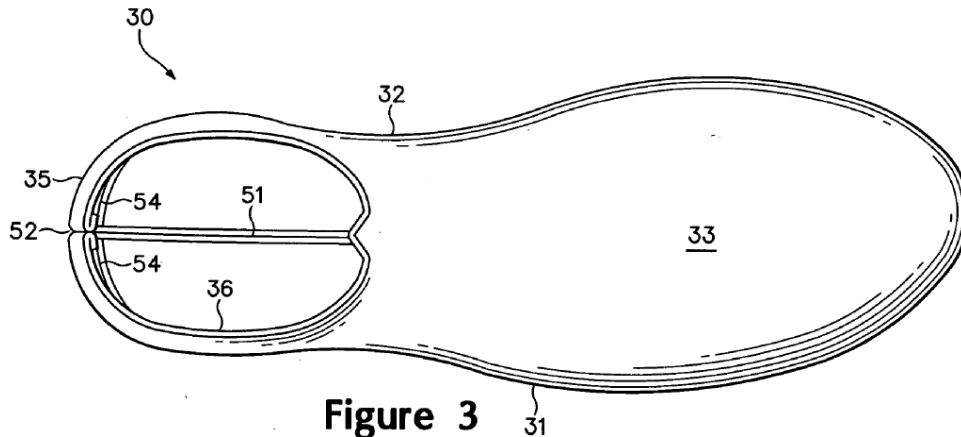
VIII. CLAIMS 1, 5-9, AND 11-17 ARE OBVIOUS OVER DUA-592 IN VIEW OF HONG AND/OR CHOI (GROUND 1)

A. Claim 1

1. Element 1[pre]: “An article of footwear comprising”

100. Each of Dua-592’s textile elements are knitted components formed into an article of footwear. For example, the footwear 10 of Embodiment #1 includes sole structure 20 and an upper 30, where “[s]ole structure 20 is secured to a lower portion of upper 30.” EX1014 (Dua-592), [0033]; *see also* [0034]-[0035] (describing sole structure). Moreover, “[u]pper 30 is at least partially formed from a textile element 40 that defines an interior void for comfortably receiving a foot,” where the “textile element 40 may form substantially all of upper 30” *Id.*, [0033]; Abstract (“An article of footwear and a method of manufacturing the article of footwear are disclosed.”).

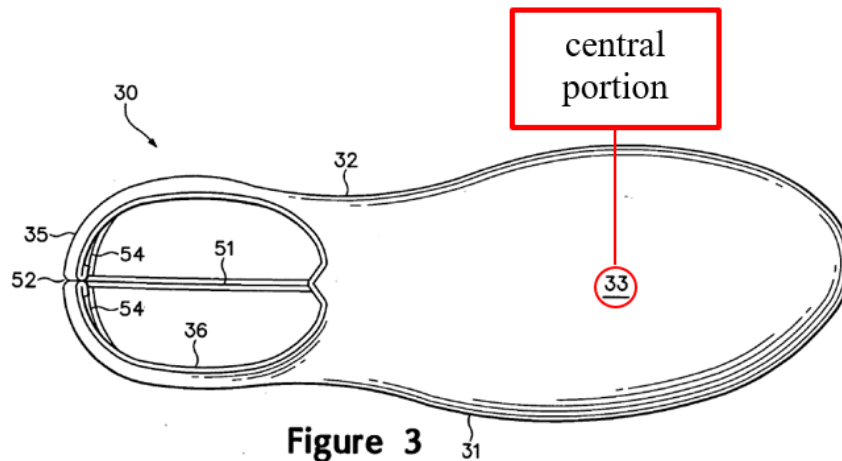




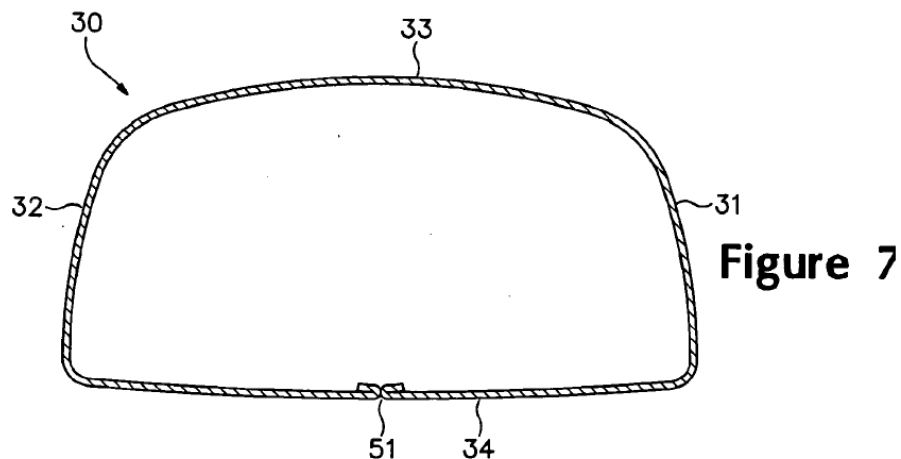
2. **Element 1[a]: “an upper including a flat-knitted element formed from at least one yarn mechanically manipulated in a flat-knitting process, the flat-knitted element including a first layer having:”**

101. Dua-592 describes that its flat-knitted elements, including the textile element 40 of Embodiment #1 and element 40" of Embodiment #3, can be formed through a “variety of mechanical processes,” including “flat knitting.” EX1014 (Dua-592), [0044]-[0045], [0045] (“[T]extile element 40 may be formed on either a warp knitting machine or a weft knitting machine.”); [0055]-[0056] (describing Embodiment #3 as a “single, unitary element of material” formed using one of a variety of knitting processes, including “flat knitting”); Claim 65 (“An article of footwear comprising: an upper incorporating a textile element formed through a flat knitting process”).

102. Dua-592 also discloses “[t]he upper of an article of athletic footwear, for example, may be formed from multiple material layers that include an exterior layer, an intermediate layer, and an interior layer.” *Id.*, [0006]. I note that



106. When describing Embodiment #3, Dua-592 also discloses that “the area of textile element 40” corresponding with instep region 33 includes a third texture 48.” EX1014 (Dua-592), [0055]. The central portion corresponding to instep region would have “a domed, three-dimensional structure,” as shown below.



Id., FIG. 7.

107. I note that Element 1[e] below requires the flat-knitted element to have the “domed, three-dimensional structure” when “in a flattened configuration,” but Element 1[b] contains no such limitation and is therefore satisfied by Dua-592’s

assembled upper 30. Moreover, claim 1 is to an “article of footwear,” not an upper, and therefore the “central portion” should correspond to a state in which the upper is assembled into an article of footwear.

108. In any event, to the extent that the “domed, three-dimensional structure” of Element 1[b] does not correspond to an assembled state of the upper, it would have been obvious to form Dua-592’s flat-knit textile elements with a domed, three-dimensional central portion extending over the top of the foot in view of the express teachings of Hong and/or Choi.

109. First, Hong explains that flat knitting a three-dimensional structure was well-known and common. For example, Hong discloses “[t]echnical textiles have been applied in different fields such as protection clothing, transportation related textiles (cars, planes and space crafts), geotextiles, building construction related textiles, packaging materials, military related textiles, medical textiles, sports related textiles, etc.” EX1016 (Hong), 189. Hong further explains that “[f]lat knitting machines are traditionally used for producing pullovers and other outerwear garments. One of the main advantages is the facility of these machines to knit fabric pieces to a particular shape or form.” *Id.*; Abstract (“The use of a new electronic flat knitting machine (Shima Seiki SES 122FF) for producing three-dimensional shaped fabrics for technical purposes is described.”); 189 (“This work describes the use of the new flat knitting machines to knit 3D structures.”); 194 (“By exploiting the

capacity of this [flat-knitting] machine, it is possible to knit more types of three-dimensional knitted fabrics.”).

110. I also note that Hong discloses complicated structures that may include sections knitted separately before or after they were knitted together , such as the multi-tubed structure below.

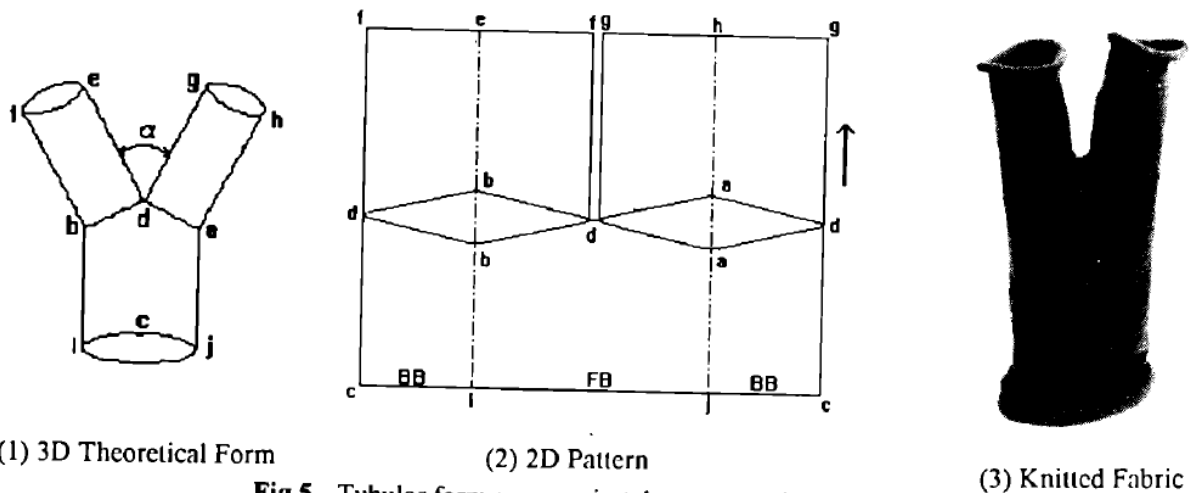


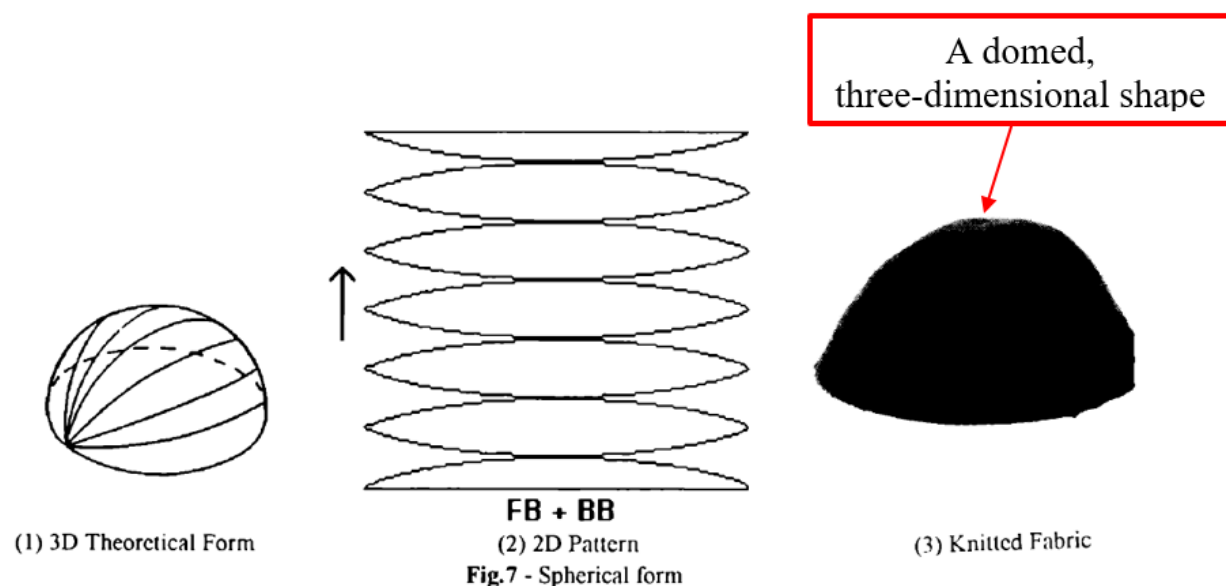
Fig.5 - Tubular form : one main tube connected to two smaller tubes

Hong, 192 (“During knitting, the two smaller tubes are separately knitted with two cam systems.”).

111. Even if the sections were knitted first and then joined “together with a row of knitting on a linking machine,” that would all still be part of the same knitting process. EX1015 (Choi), 32, 9 (“[B]ecause all parts of the garment are knitted separately, the fully-fashioned knitting still requires a post sewing or linking process,” where “[l]inking is defined as a process of joining side seams or edges of fabric pieces together with a row of knitting on a linking machine.”). Linking process

can be considered a type of knitting process in the sense that the links that are used to join separate pieces are similar to or same of the stitches used in knitting.

112. While fully-fashioned knitting may require linking for more complex shapes, such shapes are not at issue in the '484 patent which instead involves a simple dome-shaped structure. Instead, Hong teaches that “[i]t is not difficult to knit a spherical form in the SES 122FF flat knitting machine.” EX1016 (Hong), 192. It should be noted that the spherical form in Hong is made as one piece without any sewing or linking.



EX1016 (Hong), 193.

113. Thus, there would be no “post sewing or linking process” needed to form the basic dome-shaped structure which are at issue in the '484 patent. As an example, sewing or linking would be required to produce the 3D shape completed

sweater from the separately knitted front body, back body and sleeves that are shown in Figure 5.2 in Choi.

114. Hong also discloses that Shima Seiki flat knitting machines can be used to beneficially knit fully fashioned garments. EX1016 (Hong), 189. “This is very important to reduce the waste of expensive materials during cutting as well as in eliminating the additional making up operation.” *Id.* In addition, “knitting directly the 3D shapes can overcome fabric waste and diminish the labour cost inherent to the use of two-dimensional fabrics which have to fit the variable geometry of a three-dimensional seat bum.” *Id.*, 193.

115. Thus, Hong expressly confirms that flat knitting three-dimensional shapes in knitted elements was well-known and had known benefits, such as reducing fabric waste and labor costs. Computer controlled flat knitting also offers more versatility. EX1050 (Spencer), 244; EX1015 (Choi), 2 (“[F]lat knitting machines have greater versatility in loop structure combinations and patterning because their machine cams can be changed after every course (even after every stitch), and they are able to knit one or both beds easily.”). Knit-to-shape procedure that is possible with flat knitting makes it flexible and cost effective since it reduces processing steps, optimizes material consumption and reduces/eliminates waste. Flat knitting also improves production planning and pattern generation. Computer controlled flatbed knitting machines are capable of producing complex shapes

including 3D surfaces with double curvatures like saddle shape. EX1023. Moreover, as I noted above, Nike admitted during prosecution of the European counterpart to the '484 patent that flat knitting a three-dimensional structure was well-known and common, and specifically relied on Hong to overcome a rejection that the disclosure lacked essential information on how to create such a domed, three-dimensional structure. *See* Section VI.D.

116. Second, Choi also discloses that three-dimensional shapes could be formed on flat knitting machines at the time without any post sewing or linking process. Specifically, Choi teaches that “[s]eamless knitting, or complete knitting, which produces one entire complete garment without a sewing or linking process” EX1015 (Choi), 5; 12 (“seamless flat V-bed knitting actually creates complete garments, which do not require any kind of cutting or sewing process.”); 14 (“the innovative WHOLEGARMENT® machine that can produce a one-piece three-dimensional complete garment with no stitching, linking or sewing processes.”).

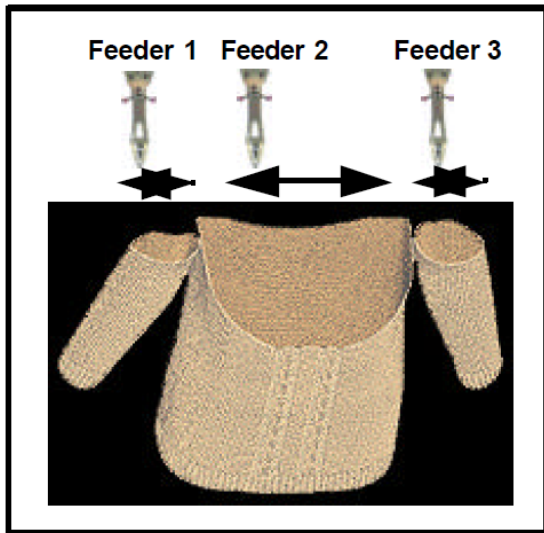


Figure 6.1. Three-dimensional complete garment knitting until underarm point (Shima Seiki)

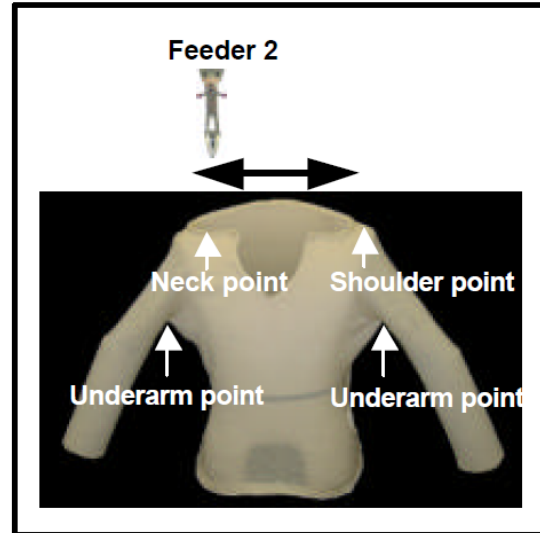


Figure 6.2. Three-dimensional complete garment knitting after underarm point

Id., 13.

117. Choi explains that “seamless garment knitting makes it possible not only to create several types of tubular formed knitting but also to build diverse design structures on the tubular knitted garments simultaneously.” *Id.*, 6. Moreover, a POSITA would understand that Choi’s three-dimensional flat knitting can be used in a wide variety of applications, including footwear such as socks. *Id.*, 2 (“The end use of knitted fabrics, created either in tubular or flat form, can be apparel and other products including sweaters, underwear, hosiery, socks and stockings.”); 7 (“Seamless garment knitting on the V-bed machine has primarily been used for apparel. However, in recent years, this new three-dimensional knitting technique has been extended in other areas such as fashion, upholstery, industrial, automotive, and medical textiles.”); *Id.*, (“A diverse range of seam-free products can be created such

as hand gloves, hats, *socks*, and sweaters according to the machine gauge and types of machine.”). Choi teaches that it is possible to seamlessly knit various three-dimensional structures, including not only “hand gloves, hats, socks, and sweaters,” but also three-dimensional upholstery (e.g., office chairs), car seats, and medical textiles (e.g., orthopedic supports, compression stockings, etc.); *see id.*, 7-8.

118. It would have been obvious to apply Choi’s flat knitting teachings to produce the flat-knitted elements of the ’484 patent because Choi explains that doing so results in “savings in cost and time, higher productivity, quick response production and other advantages.” *Id.*, 5. Choi specifically touts seamless knitting technology as “eliminate[ing] post labor work, which saves production time and cost.” *Id.*, 1. It would have also been obvious to use seamless knitting technology in the context of a knit upper because “the technology offers knitwear consumers more comfort and better fit by eliminating seams.” *Id.*

119. Flatbed knitting machines can produce 3D seamless structures that the shaping does not have to be restricted to the selvedge areas, allowing to produce a wide range of technical knitted structures. *See generally*, EX1024. It is generally desirable in apparel to minimize seams which contact the wearer, particularly where there could be rubbing between the fabric and body, which would apply in the context of shoe uppers as well. Mr. Delgatty, an expert in footwear design and

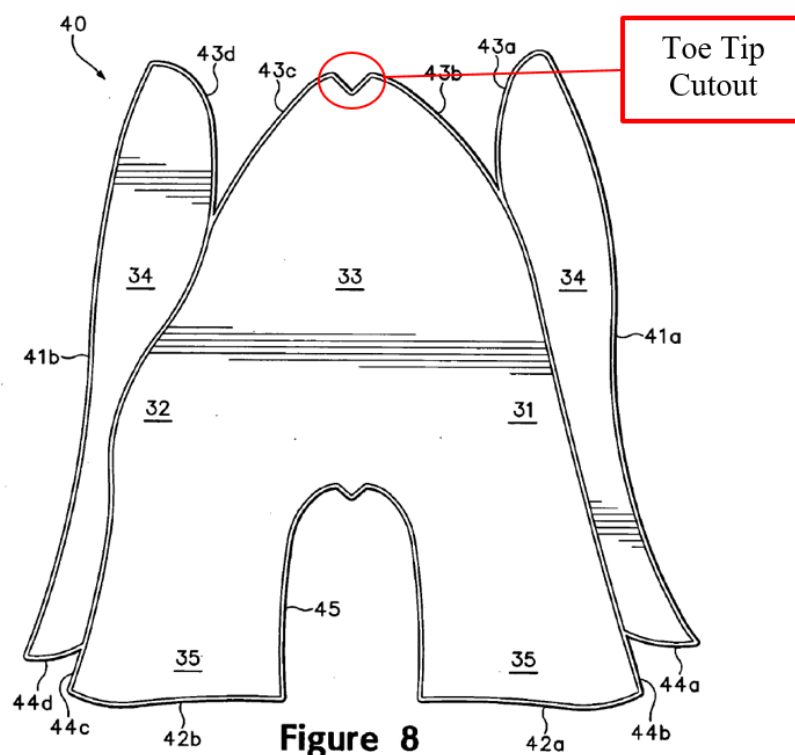
manufacturing, also identifies specific manufacturing benefits from minimizing seams in footwear. EX1003 (Delgatty), ¶11 (*see also* Exhibit A of EX1003).

120. Moreover, Choi describes additional benefits of seamless knitting technology, including minimizing the “risk of defects and damages,” ability to “create design structures and patterns across the entire garment.” EX1015 (Choi), 1. The application of Choi’s seamless knitting technology teachings to shoes was obvious, particularly in light of the recognized broad applicability of three-dimensional seamless knitting, including to socks and stockings, as noted above. *Id.*, 29 (“Three-dimensional seamless knitting with its diverse capabilities can be applied to numerous products such as fashion, upholstery, automobiles, aerospace, medical textiles, et cetera. Seamless knitting is forecasted to continue growing and could be one of the largest next generation knitting technologies.”).

121. I understand that the socks and stockings that Choi mentions are types of footwear, as Mr. Delgatty confirmed. EX1022 (The Complete Footwear Dictionary), at 4 (defining footwear as: “Any foot covering in the form of shoes, boots, slippers, or hose used for utility and/or dress wear. Not necessarily synonymous with shoes, which are simply one category of footwear.”); 5 (defining “hose” to include things like socks and stockings.); EX1003 (Delgatty), ¶12.

122. In view of the above teachings of Choi and general knowledge regarding seamless knitting, it would have been desirable and obvious to flat knit a

domed, three-dimensional structure in the central portion of Dua-592's first layer (of either Embodiment #1 or #3) to simplify the assembly process, reduce the waste of expensive materials, eliminate additional making up operation, and diminish labor cost. For example, forming the central portion of Dua-592 as a domed, three-dimensional structure would eliminate the need for a toe tip cutout used in Dua-592 since the toe portion would be sufficiently rounded before assembly.



123. A POSITA also have had a reasonable expectation of success modifying Dua-592 with Hong and/or Choi to achieve the claimed invention in view of the fact that both Hong and Choi detail the capabilities of known flat knitting machines as including the creation of three-dimensional knit structures, including more complex three-dimensional structures than a simple dome-shaped structure as

claimed in the '484 patent. Both Hong and Choi describe the three-dimensional knitting capabilities of such Shima Seiki machines, and a POSITA would have been familiar with such machines. For example, as I noted previously, Nike overcame a rejection of insufficient disclosure during prosecution of the European counterpart application by pointing to Hong's disclosure as evidence that it was generally known how to achieve three-dimensional knitted textiles through flat knitting. EX1019, 8.

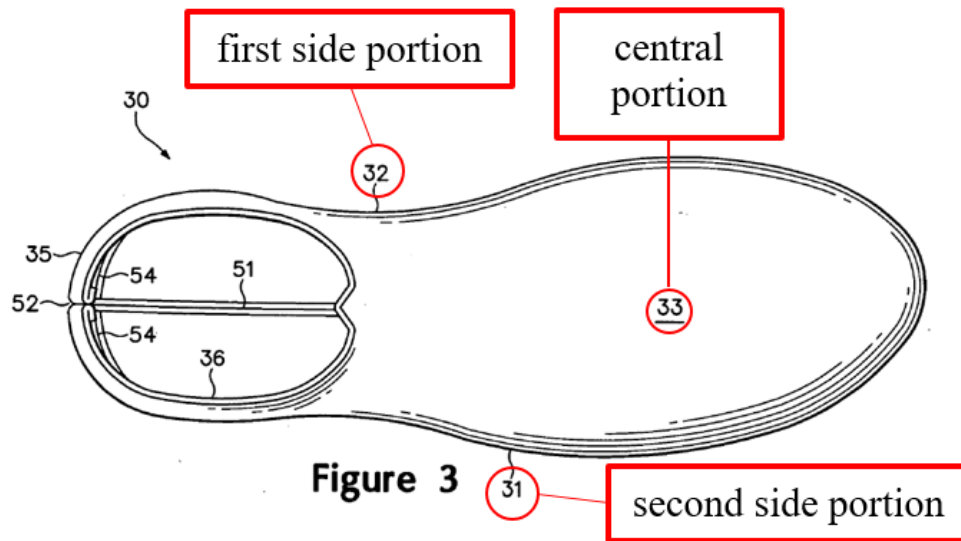
124. Therefore, Dua-592 in view of Hong and/or Choi satisfies Element 1[b].

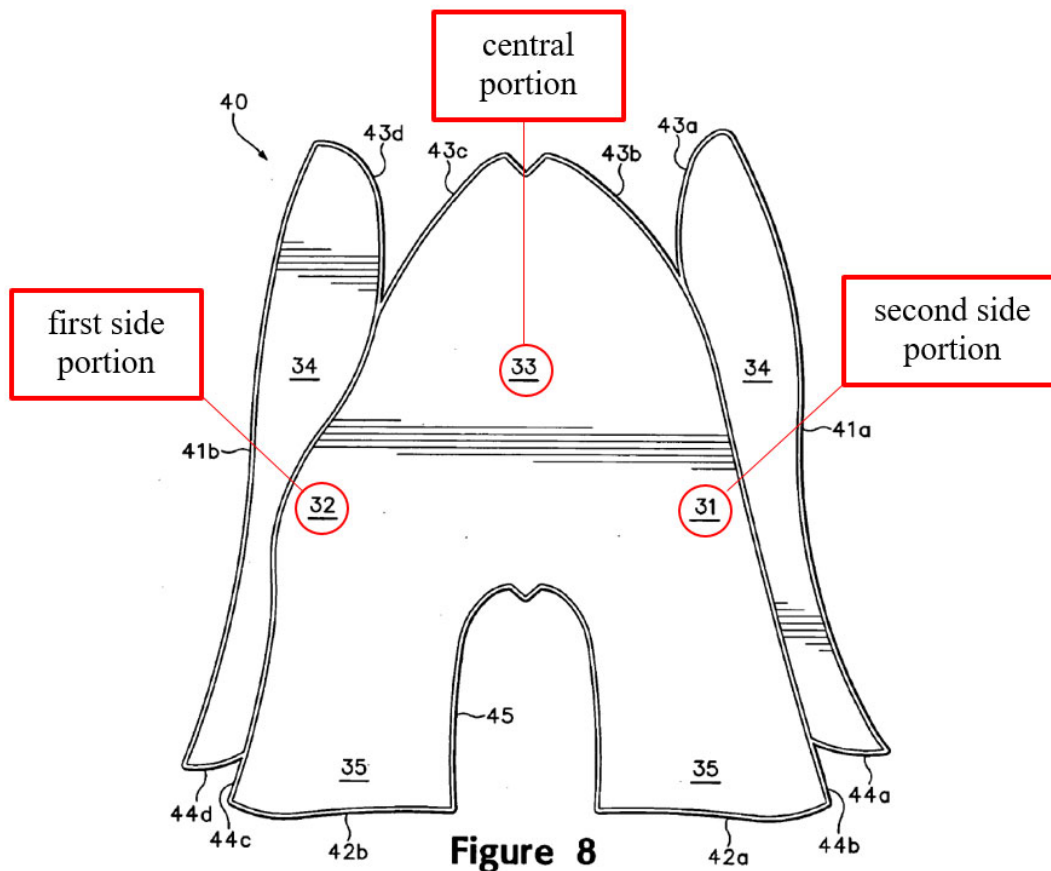
4. **Element 1[c]: “a first side portion being formed of unitary construction with the central portion and extending from a first side of the central portion; and”**
5. **Element 1[d]: “a second side portion being formed of unitary construction with the central portion and extending from a second side opposite the first side of the central portion,”**

125. The flat-knitted element of Dua-592 comprises first and second side portions formed of a unitary construction with the central portion and extending therefrom, as I describe below.

126. Dua-592 discloses that the upper 30 into which textile element 40 is formed has “a lateral region 31, an opposite medial region 32, an instep region 33, a lower region 34, and a heel region 35. Lateral region 31 extends through a longitudinal length of footwear 10 and is generally configured to contact and cover a lateral *side* of the foot. Medial region 32 has a similar configuration that generally

corresponds with a medial *side* of the foot.” EX1014 (Dua-592), [0036]. Thus, at least the medial region 32 and lateral region 31 are first and second side portions that extend from respective sides of the instep portion 33 (central portion).

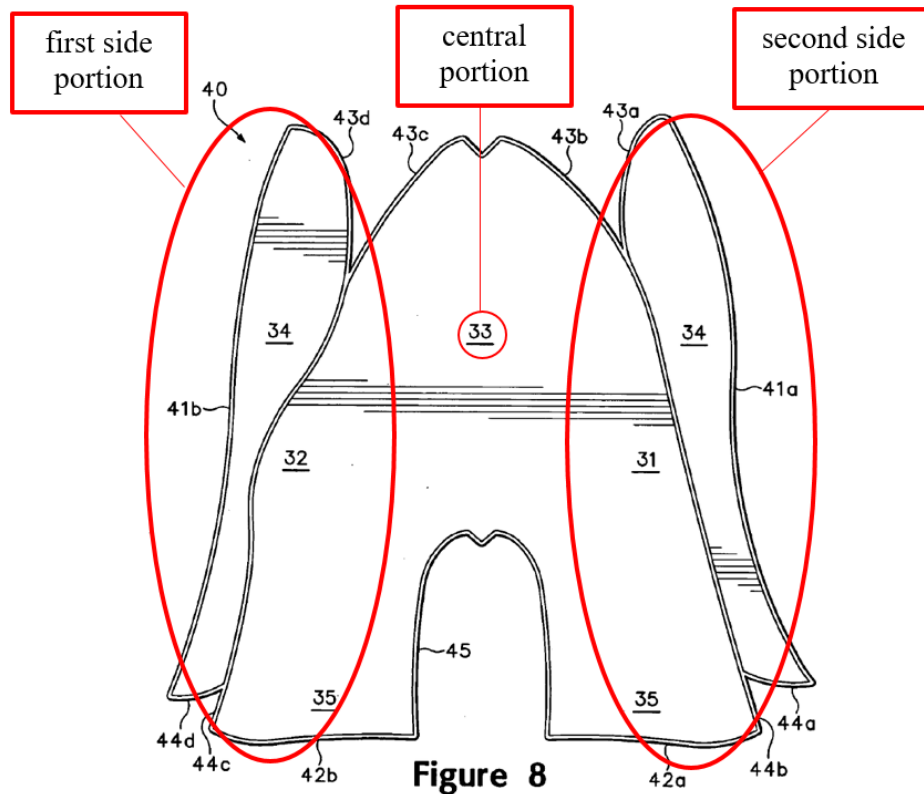




Id., FIG. 8 (annotated).

127. With respect to Embodiment #3, which is shown in FIG. 11, I note that Dua-592 describes the embodiment as having the same “general shape” of Embodiment #1. *Id.*, [0055].

128. As an alternative, the medial region 32 and lateral region 31, together with their respective lower regions 34, would comprise the claimed first and second side portions extending from respective sides of the instep portion 33 (central portion). See below.



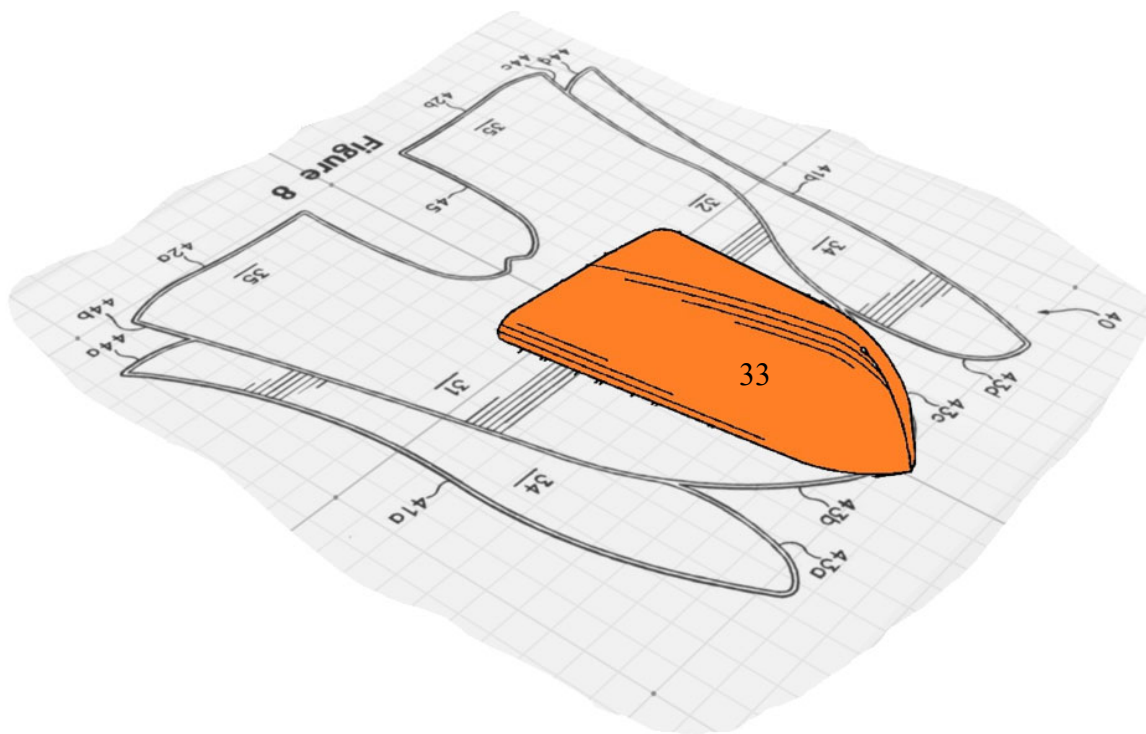
129. In either of the above alternatives, Dua-592 discloses that the side portions are formed of unitary construction with the central portion. *Id.*, [0037] (“Textile element 40 is a single material element that is formed to exhibit a unitary (i.e., one-piece) construction, and textile element 40 is formed or otherwise shaped to extend around the foot.”); [0042] (“the various portions of textile element 40 are formed as an unitary element without seams”); [0043]-[0045]; [0045] (“[T]extile element 40 may be formed on either a warp knitting machine or a weft knitting machine.”); [0055]-[0056] (describing Embodiment #3 as a “single, unitary element of material” formed using one of a variety of knitting processes).

130. Therefore, Dua-592 satisfies Element 1[c] and 1[d].

6. Element 1[e]: “the domed, three-dimensional structure shaped to extend above the plane of the first side portion and the second side portion when the flat-knitted element is in a flattened configuration.”

131. When Embodiment #1 or #3 of Dua-592’s flat-knitted elements is formed in accordance with the teachings of Hong and/or Choi, which it would be have been obvious to do as I explained under Element 1[b], the central portion 33 of the textile element would comprise a domed, three-dimensional structure shape that extends above the plane of the first side portion (e.g., medial region side 32) and a second side portion (e.g., lateral region 31) when the textile element is laid in a flattened configuration. *Supra*, Element 1[b]. For example, below is a rendition of FIG. 8 from Dua-592 shown in a three-dimensional orientation after being modified with teachings of Hong and/or Choi to have a domed, three-dimensional central portion 33 (orange).

132. Domed, three-dimensional knitted shapes have been produced for decades using flat knitting machines. EX1050 (Spencer), 189 (“Three-dimensional shaping of pouches can be achieved on small-diameter hosiery machines by using held loop shaping in a similar manner to flat knitting, so that the number of courses knitted by adjacent needles is varied in order to knit a pouch for a heel and, if necessary, for a toe.”).



133. Therefore, Dua-592 also satisfies Element 1[e], and Dua-592 in view of Hong and/or Choi renders claim 1 obvious.

B. Claim 5

“The article of footwear of claim 1, wherein the knitted element defines a void for receiving a foot of a wearer.”

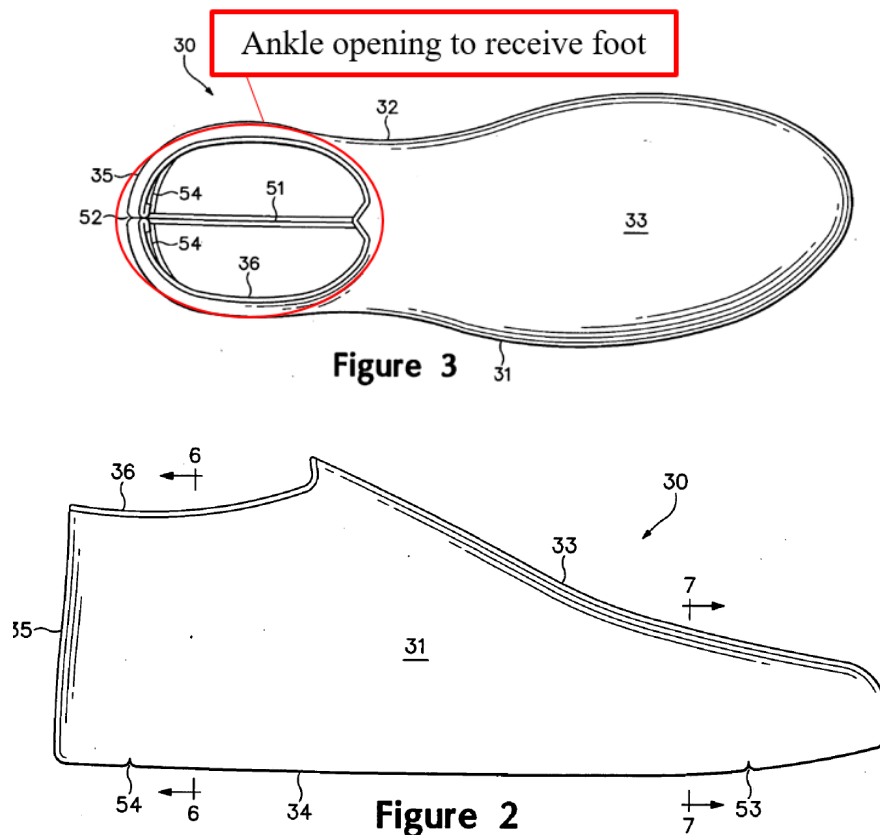
134. Dua-592 discloses “[t]he upper forms a void on the interior of the footwear for receiving the foot,” where “[t]he void has the general shape of the foot, and access to the void is provided by an ankle opening.” EX1014 (Dua-592), [0005], Abstract, [0033] (“Upper 30 is at least partially formed from a textile element 40 that defines an interior void for comfortably receiving a foot and securing a position of the foot relative to sole structure 20.”), [0036], [0039]-[0041].

135. As such, claim 5 is obvious over Dua-592 in view of Hong and/or Choi.

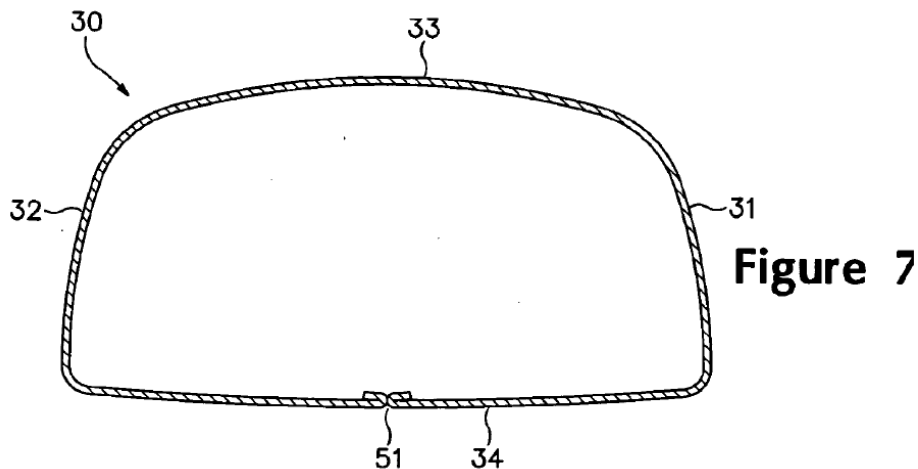
C. Claim 6

“The article of footwear of claim 1, wherein the knitted element defines at least a portion of an exterior surface of the upper, and the knitted element defines at least a portion of a void for receiving a foot of a wearer.”

136. In describing FIGs. 2-7 (Embodiment #1), Dua-592 discloses that “textile element 40 forms both an exterior surface and an interior surface of upper 30.” EX1014 (Dua-592), [0037]. For example, textile element 40 of FIG. 8 is formed into upper 30, as shown in FIG. 2 below. *Id.*, [0038]-[0039].



137. FIG. 7 is a cross-sectional view of upper 30, as defined by section line 7-7 in FIG. 2 above.



138. Dua-592 includes similar disclosure for Embodiment #3. For example, the first texture 46" if Embodiment #3 is describes as extending laterally across areas corresponding with lateral region 31, medial region 32, and instep region 33. *Id.*, [0055]-[0056] ("Third texture 48" includes apertures that "facilitate the transfer of air between the void within upper 20 and the area outside of upper 20.).

139. Thus, Claim 6 is also obvious over Dua-592 in view of Hong and/or Choi because Dua-592's textile elements defines at least a portion of an exterior surface of the upper. And, as described above, Dua-592's textile elements define at least a portion of a void for receiving a foot of a wearer. *Supra*, Claim 2

D. Claim 7

"The article of footwear of claim 1, wherein the knitted element includes a first area and a second area, the first area including a first type of knit structure, and the second area including a second type of knit structure, the first type being different than the second type."

140. While the '484 patent does not use the term “knit structure” outside of claim 7, I note that when describing the only embodiment having a domed structure, the '484 patent describes areas of the upper as having “different knit types,” such as side portions 72 of FIGs. 10A-10C having a “non-ribbed type of knit” and the central portion 71 being ribbed. EX1001, 10:18-46.

141. The '484 patent further discloses that, with respect to the forward portion 61 of the central element 60, “a ribbed configuration stretches to a different degree than the non-ribbed configurations.” *Id.*, 7:66-8:3. Thus, at least in the context of the '484 patent, the types of “knit structures” that fall within claim 7 would include at least different types of knit textures, including types of knit textures which stretch to different degrees. Even outside the context of the '484 patent, the term “knit structure” is broad and would be understood to encompass different types of knit textures.

142. As described above in the Technology Background section, knit structures are generally classified as weft knit or warp knit structures. Weft knit structures can be circular or flat structures. There are different stitch (loop) types that are used in weft knit structures: plain stitch, purl (reverse) stitch, miss stitch and tuck stitch, etc. Each stitch type provides different characteristics to the knit structure such as different modulus, different elongation in either direction, different surface roughness, different texture, different air permeability, different abrasion resistance,

different moisture handling, different thickness, different hand, etc. Weft knit structures can be single knit structure (have one layer of loops formed with one yarn system, such as jersey, rib and purl) or double knit structures (have two inseparable layers of loops). Jersey knits have different structures such as plated, pile, cross-tuck, Jacquard, openwork, etc. Rib knits can be 1x1 rib, 2x2 ribs and cardigan (half cardigan or full cardigan). Double knits can be rib double knit and interlock double knit. Warp knitted structures can be tricot or raschel structure. Tricot structures can be single, two, three and four (or more) bar tricot structures. Raschel machines can have more than 60 guide bars and therefore the structures can be highly patterned, lacy, crotched, etc. In short, there are many different knitted structures and each structure has unique geometrical, mechanical and hand properties. As a result, each structure may have different extensibility, recovery, strength, stiffness, modulus, flexural resistance, abrasion and wear resistance, moisture handling, surface smoothness, texture, air permeability, weight per unit area, thickness, density, hand, etc. For example, a particular “structure has been used for ladder-resist shadow welts in stockings and for textured designs” EX1050 (Spencer), 94; 99 (“The tuck stitch may also be employed to produce open-work effects, improve the surface texture, ...”); 100 (“Colour is one of the five ingredients of fashion, the other four being style, silhouette, texture and pattern”); 141 (“Using the yarn programme, yarn types, shades, and textures can be generated and stored to closely simulate knitted panels,

in advance of the knitting process”). Each knit structure can be made with a variety of fibers and yarns which change the properties of the knit structure even more. EX1025 (Choi and Ashdown), 1034 (“...the mechanical properties of knitted fabrics vary according to knit structures, fibers, yarns, and densities” For example, nylon provides excellent wear and abrasion resistance; it also absorbs more moisture compared to other synthetic fibers. Different knit structures have effects on the deformation of weft-knit preforms. EX1026 (Savci).

143. Consistent with that interpretation, Embodiment #3 of Dua-592 teaches the textile element 40" is comprised of “areas with three different textures,” including a first texture 46", a second texture 47", and a third texture 48", as reflected in FIG. 11 below. EX1014 (Dua-592), [0055]. As shown below, textures 46"-48" are in different areas, including at least a first area and a second area. For example, the areas comprising a first one of texture 46", 47", or 48" would be a first area, while the areas which comprise a second one of texture 46", 47", or 48" would be a second area, per claim 7.

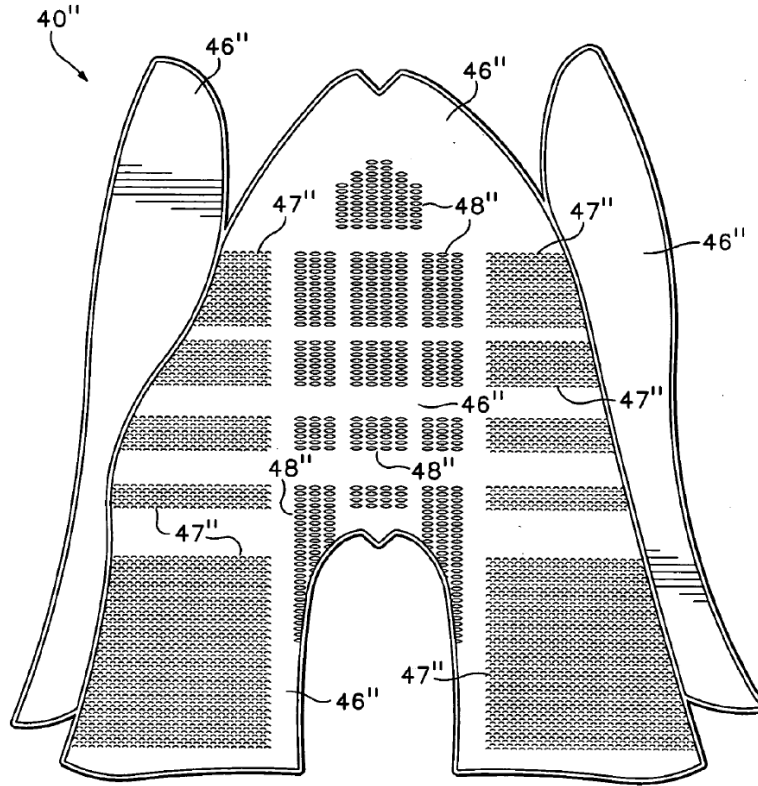


Figure 11

144. Dua-592 teaches that “[t]extures 46"-48" may exhibit aesthetic differences, or the differences may be structural. For example, the degree of stretch in areas with textures 46"-48" may be different, or the wear resistance of the areas may vary depending upon the stitch utilized.” *Id.*, [0055], [0060] (“Similarly, other types of knitting, such as a flat knitting, may be utilized within the scope of the present invention to impart various textures, different properties, or different yarn types to the textile element.”).

145. Therefore, Dua-592 in view of Hong and/or Choi renders obvious claim 7 because the combination would similarly include a knitted element with a first area

and a second area, where the first area including a first type of knit structure and the second area including a second, different type of knit structure.

E. Claim 8

“The article of footwear of claim 1, wherein the at least one mechanically manipulated yarn includes a first yarn and a different second yarn, the first yarn being located in a first area of the upper, and the second yarn being located in a second area of the upper.”

146. In describing Embodiment #3, Dua-592 explains that “the type of yarn utilized in various areas of textile elements 40' and 40" may be changed to impart different properties.” EX1014 (Dua-592), [0056]. For example, Dua-592 provides various examples of yarns, and explains that each type “may impart differing properties to the areas corresponding with textures 46'-47' and 46"-48",” as using elastane to impart stretch, wool for insulation, and nylon for durability. *Id.*

147. At least because Dua-592 discloses that the degree of stretch in areas with textures 46"-48" may be different, it would have been a matter of common sense to use yarns with more stretch, such as elastane, for areas which would benefit from more stretch. The instep area, which is where texture 48" is located, is one such area that would benefit from having more stretch to facilitate putting on and taking off the footwear, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶¶19-21. Similarly, it would also have been a matter of common sense to use yarns with less

stretch but more durability, such as nylon, for area which would do not require as much stretch but would benefit from more durability.

148. Moreover, the lateral and media sides, which is where texture 47" is located, are areas that would benefit from having more durability as compared to the instep region, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶¶13-14.

149. Thus, Claim 8 is also obvious over Dua-592 in view of Hong and/or Choi.

F. Claim 9

“The article of footwear of claim 1, wherein the knitted element forms a defined shape having finished edges during the flat knitting process.”

150. I note that the '484 patent discloses that flat knitting provides edges of textile elements that “do not need to be finished to prevent unraveling,” unlike textile elements cut from a larger textile element. EX1001, 8:16-26.

151. Dua-592 similarly discloses flat knitting as a known process for making its textile elements, which would have a defined shape and finished edges. Flat knitting machines have been used for centuries. EX1050 (Spencer), 207 (“The first flat bar machine (Section 8.4.2) was demonstrated in 1862 and patented in 1865 by the Rev. Isaac Wixom Lamb, and American clergyman.”). The first motor-driven jacquard flat machine was commercialized in 1926. *Id.*, 224; *Id.* (“In the 1960s, the Japanese company Shima Seiki...pioneered the development of the automatic V-bed

seamless glove-knitting machine”); 225 (“V-bed flat knitting machines was able to knit rib or plain garment panels”). A panel structure would necessarily have defined shape and finished edge to prevent raveling. To produce 3D fabrics, the advantages of flat knitting includes “possibility of knitting to shape without cutting waste or making-up time”, which involves defined shapes and finished.” *Id.*, 379; 39 (“In weft knitting, the yarn continues to be supplied in one direction (except at the selvages of straight [i.e., flat] knitting machines”). A straight (flat) knitting machine produces a piece of fabric with 2 finished edges that the yarn does not ravel in an integrated structure. *Id.*, 185 (“The firm, fashioned selvedge edges can be point- or cup-seamed together, without the need for cutting and seaming to shape involving loss of expensive fabric.”).

152. FIGS 3, 4, 5, 6, 7, 8 and 9 in Hong show well defined shapes and finished edges on fabrics knitted on a flat knitting machine. *See also* EX1015, 7 (Choi) (“A welt in knitting means ‘a secure edge of a fabric. The welts are usually at the starting end of the fabric’”). Seamless garment knitting offers the benefit of “better trimmability for finished edge lines.” *Id.*, 29 (Table 5). For example, Dua-592 explains that “the textile element may be removed from the textile structure and incorporated into footwear 10 ... Similarly, other types of knitting, such as a flat knitting, may be utilized within the scope of the present invention to impart various textures, different properties, or different yarn types to the textile element.” EX1014

(Dua-592), [0061]. It was known, when flat knitted, that a knitted element like Dua-592's would form a defined shape with finished edges during the flat knitting process, as is reflected in the textile elements 40 and 40" of Embodiments #1 and #3.

153. Moreover, when Dua-592's textile element is knitted in accordance with the flat knit teachings of Hong and/or Choi, as I described above under to Element 1[b], the textile element would have a defined shape and finished edges. For example, Hong describes using flat knit machines to "knit fully fashioned garments" (Hong, 1), and "knitting to shape." Hong, 2. Similarly, Choi teaches that "[s]eamless knitting, or complete knitting, which produces one entire complete garment without a sewing or linking process" EX1015 (Choi), 5; 12 ("seamless flat V-bed knitting actually creates complete garments, which do not require any kind of cutting or sewing process."); 14 ("the innovative WHOLEGARMENT® machine that can produce a one-piece three-dimensional complete garment with no stitching, linking or sewing processes."). Moreover, Choi explains that "'Seamless' garment knitting creates a complete garment by several different carriers (feeders) with minimal or no cutting and sewing processes (Figure 5.3). Thus, seamless knitting has the capability for production time and cost saving by removing post-knit processes such as the linking or sewing and cutting operation." *Id.*, 11.



*Figure 5.3. Complete garment production
by a seamless flat knitting machine*

Id.

154. Such complete garments would have defined shapes and finished edges because otherwise yarn raveling would occur. Flat knitting machines produce such shapes and edges. This would continue to be the case when Hong and/or Choi's knitting techniques are applied to Dua-592's textile elements to form the central portion as a domed, three-dimensional structure. *See supra*, Element 1[b]. Moreover, flat knitting three dimensional knitted elements was well-known at the time, and the '484 patent does not disclose any particular features for how to achieve its flat knitting process. EX1050 (Spencer), 91 ("Held stitches of this type are used for producing three-dimensional shaping such as heel and toe pouches for footwear, held-loop shaping on flat machines, and designs in solid colour intarsia"); 188 ("Shaping by three-dimensional wale fashioning occurs...to shape stocking heels or bosom pouches").

155. Thus, Claim 9 is also obvious over Dua-592 in view of Hong and/or Choi.

G. Claim 11

1. Element 11[pre]: “A method of manufacturing an article of footwear, the method comprising:”

156. Element 11[pre] is satisfied for the same reasons as Element 1[pre]. *See supra*, Element 1[pre].

157. In addition, Dua-592 explains that “[a]n article of footwear and a method of manufacturing the article of footwear are disclosed.” EX1014 (Dua-592), Abstract. Dua-592 indicates that the “discussion and accompanying figures disclose an article of footwear 10 and a method of manufacturing footwear 10, or components thereof, in accordance with the present invention.” *Id.*, [0032]. As described above, Dua-592 discloses that a mechanical flat knitting process can be used to manufacture its textile elements, including the textile elements of Embodiments #1 and #3. *See supra*, Element 1[pre].

158. Because the mechanical flat knitting process of Dua-592, in combination with the teachings of Hong and/or Choi, is used to produce textile elements having the “central portion,” “first side portion,” and “second side portion” as Claim 1, Claim 11 is obvious in light of Dua-592 in view of Hong and/or Choi for the same reasons. *See supra*, Claim 1.

2. **Element 11[a]: “forming during a flat-knitting process an upper including a flat-knitted element including a first layer having:”**

159. Element 11[a] is satisfied for the same reasons as Element 1[a]. *See supra*, Element 1[a].

3. **Element 11[b]: “a central portion having a domed, three-dimensional structure configured for extending over the top of a foot”**

160. Element 11[b] is satisfied for the same reasons as Element 1[b]. *See supra*, Element 1[b].

4. **Element 11[c]: “a first side portion being formed of unitary construction with the central portion and extending from a first side of the central portion; and”**

5. **Element 11[d]: “a second side portion being formed of unitary construction with the central portion and extending from a second side opposite the first side of the central portion,”**

161. Elements 11[c] and 11[d] are satisfied for the same reasons as Elements 1[c] and 1[d]. *See supra*, Elements 1[c]-1[d].

6. **Element 11[e]: “wherein the domed, three-dimensional structure is shaped to extend above the plane of the first side portion and the second side portion when the flat-knitted element is in a flattened configuration.”**

162. Element 11[e] is satisfied for the same reasons as Element 1[e]. *See supra*, Element 1[e].

H. Claim 12

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a stitch type of the first area being different that a stitch type of the second area.”

163. I note that Dua-592 discloses “an upper incorporating a textile element formed through a weft knitting process” where “the weft knitting process is flat knitting” and “the textile element has a first area and a second area with a unitary construction, the first area being formed of a first stitch type, and the second area being formed of a second stitch type that is different from the first stitch type.” EX1014 (Dua-592), Claim 7, 19; *see also id.*, Claims 20, 30, 66.

164. Dua-592 explains that different textures, aesthetics, degrees of stretch, and degrees of wear resistance are formed by varying the type of stitch. *Id.*, [0055]. And, in describing Embodiment #3, Dua-592 discloses “varying the stitch types to form textures 46'-47' and 46"-48",” which are correspond to different areas, including a first area and a second area, as shown in FIG. 11 below.

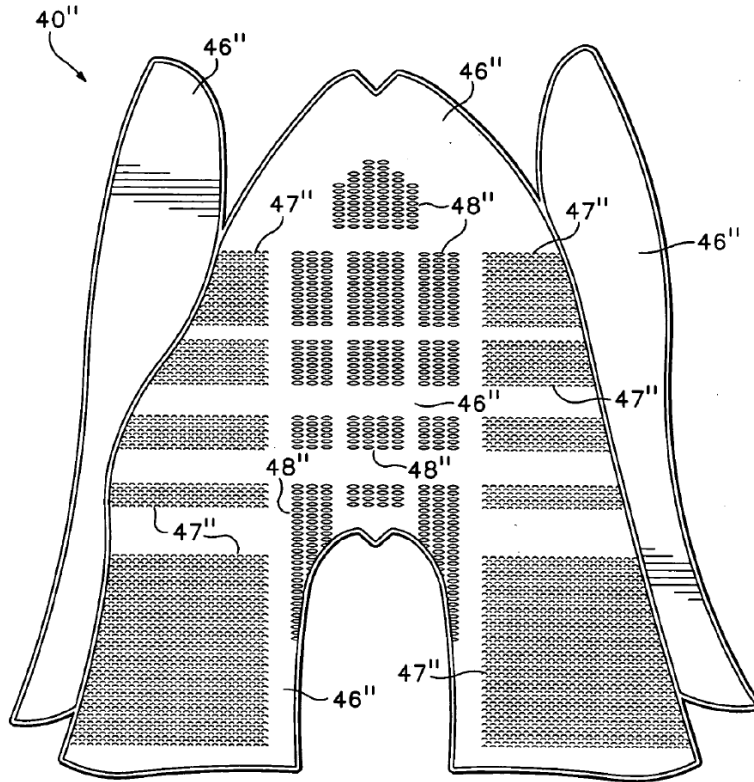


Figure 11

Id., FIG. 11; *see also id.*, [0060].

165. Therefore, Claim 12 is rendered obvious by Dua-592 which discloses the features of claim 12.

I. Claim 13

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a yarn type of the first area being different than a yarn type of the second area.”

166. Claim 13 is substantially similar to claim 8, and is obvious for the same reasons. *See supra*, Claim 8.

J. Claim 14

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a stitch type and a yarn type of the first area being different than a stitch type and a yarn type of the second area.”

167. Dua-592 discloses this limitation for the reasons I described above with respect to claims 8 and 12.

168. In addition, I note that Dua-592 specifically discloses “an upper incorporating a textile element formed through a flat knitting process, the textile element having a first area and a second area with a unitary construction, the first area having a first set of properties, and the second area having a second set of properties that are different from the first set of properties” and “the first set of properties and the second set of properties are at least one of a stitch configuration and a yarn type.” EX1014 (Dua-592), Claims 65-66.

169. Also, in describing Embodiment #3, Dua-592 explains that the various textures shown in the different areas in FIG. 11 can be formed by varying **both** stitch type and yarn type: “In addition to varying the stitch types to form textures 46'-47' and 46"-48", the type of yarn utilized in various areas of textile elements 40' and 40" may be changed to impart different properties.” EX1014 (Dua-592), [0056].

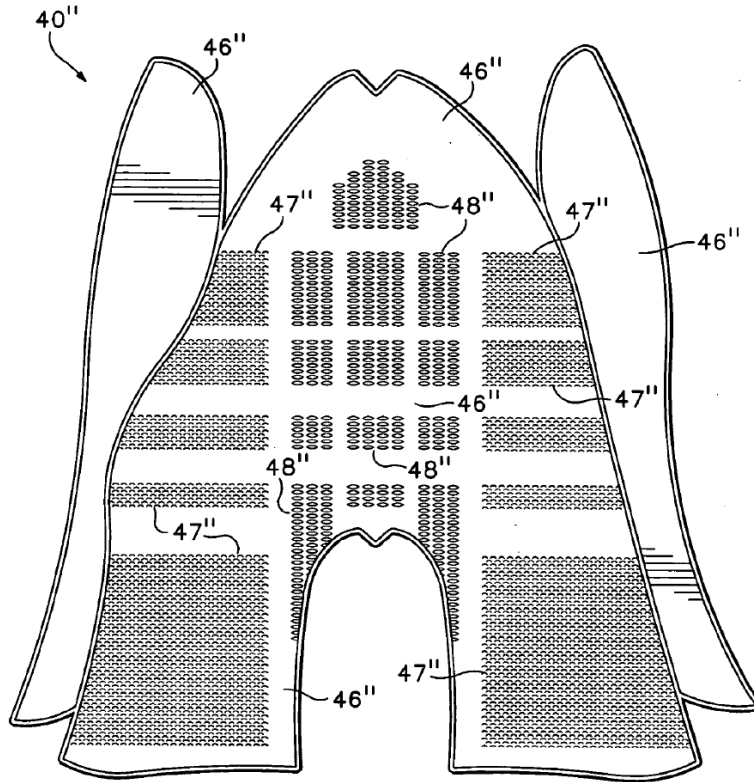


Figure 11

Id., FIG. 11; *see also id.*, [0060].

170. It was also generally known in the art that varying stitch and/or yarn type in a knitted component would impart different physical and aesthetic properties. EX1050 (Spencer), 3 (“Yarns are the raw materials manipulated during knitting...Textile fibers are the raw materials of the yarns into which they are spun.”). Each fiber type has different properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or smoothness, permeability, moisture absorbency, aesthetics, etc. *See* EX1062, 555-606. As a result, yarns which are made of fibers also have different properties based on the fibers used as well as based on yarn manufacturing methods and yarn

structure. Yarns can be staple yarn (made of short fibers) or continuous filament yarns (made of very long fibers). Staple yarns can be made with ring spinning, open-end (rotor spinning), air-jet spinning or friction spinning methods. Each method results in different yarn properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or smoothness, permeability, aesthetics, etc. Yarns also have different direction and amount of twist, which affect their stiffness, strength and surface roughness. Besides, yarns can be single yarns or plied yarns which affects strength, surface and friction characteristics. See EX1062, 611-620. All these yarn properties affect the knitted fabric properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or smoothness, permeability, moisture handling, aesthetics, etc. See EX1062, 127-132, 625-645. “The properties of more than one type of fibre may be incorporated into a fabric as the result of blending the fibres during spinning, or by knitting two or more types of yarn” EX1050 (Spencer), 4.

171. As described above in the Technology Background section, knit structures are generally classified as weft knit or warp knit structures. Weft knit structures can be circular or flat structures. There are different stitch (loop) types that are used in weft knit structures: plain stitch, purl (reverse) stitch, miss stitch and tuck stitch, etc. Each stitch type provides different characteristics to the knit structure

such as different modulus, different elongation in either direction, different surface roughness, different texture, different air permeability, different abrasion resistance, different moisture handling, different thickness, different hand, etc. Weft knit structures can be single knit structure (have one layer of loops formed with one yarn system, such as jersey, rib and purl) or double knit structures (have two inseparable layers of loops). Jersey knits have different structures such as plated, pile, cross-tuck, Jacquard, openwork, etc. Rib knits can be 1x1 rib, 2x2 ribs and cardigan (half cardigan or full cardigan). Double knits can be rib double knit and interlock double knit. Warp knitted structures can be tricot or raschel structure. Tricot structures can be single, two, three and four (or more) bar tricot structures. Raschel machines can have more than 60 guide bars and therefore the structures can be highly patterned, lacy, crotched, etc. In short, there are many different knitted structures and each structure has unique geometrical, mechanical and hand properties. As a result, each structure may have different extensibility, recovery, strength, stiffness, modulus, flexural resistance, abrasion and wear resistance, moisture handling, surface smoothness, texture, air permeability, weight per unit area, thickness, density, hand, etc. For example, a particular “structure has been used for ladder-resist shadow welts in stockings and for textured designs” EX1054 (Spencer), 94; 99 (“The tuck stitch may also be employed to produce open-work effects, improve the surface texture, ...”); 100 (“Colour is one of the five ingredients of fashion, the other four being

style, silhouette, texture and pattern”); 141 (“Using the yarn programme, yarn types, shades, and textures can be generated and stored to closely simulate knitted panels, in advance of the knitting process”). Each knit structure can be made with a variety of fibers and yarns which change the properties of the knit structure even more. EX1025 (Choi and Ashdown), 1034 (“...the mechanical properties of knitted fabrics vary according to knit structures, fibers, yarns, and densities...” For example, nylon provides excellent wear and abrasion resistance; it also absorbs more moisture compared to other synthetic fibers. “Different knit structures have effects on the deformation of weft-knit preforms” *See generally*, EX1026 (Savci).

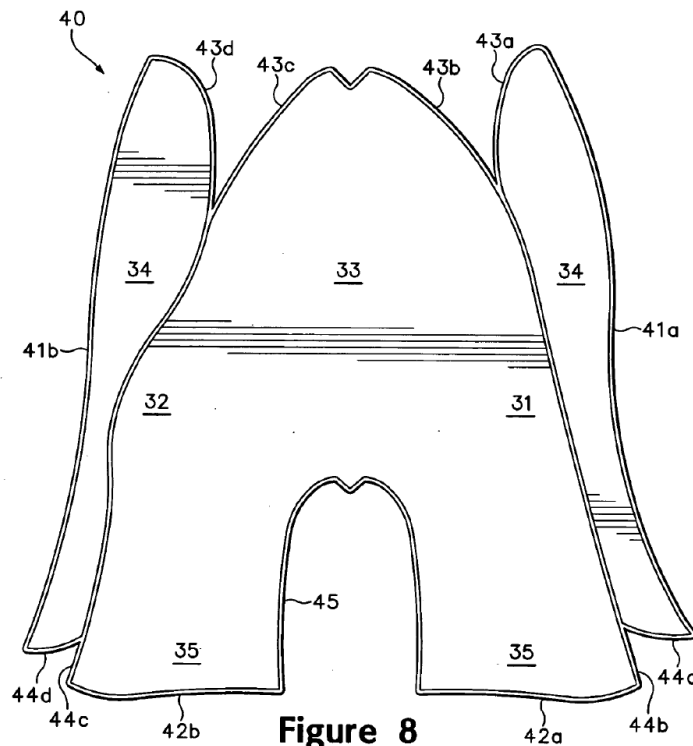
172. In light of the express disclosure in Dua-592, and the general knowledge in the art of the effect of varying stitch and yarn type in a knitted component, it would have also been obvious to vary the type of stitch and yarn used at different areas of the upper produced by the combination in order to give the different areas different characteristics, such as different textures, aesthetics, structures, or wear resistance. Shoe uppers generally have some areas which are more wear resistant than other areas, for example, and that design choices would also vary stitch and yarn type to produce desired aesthetic effects, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶¶13-14, 26-28.

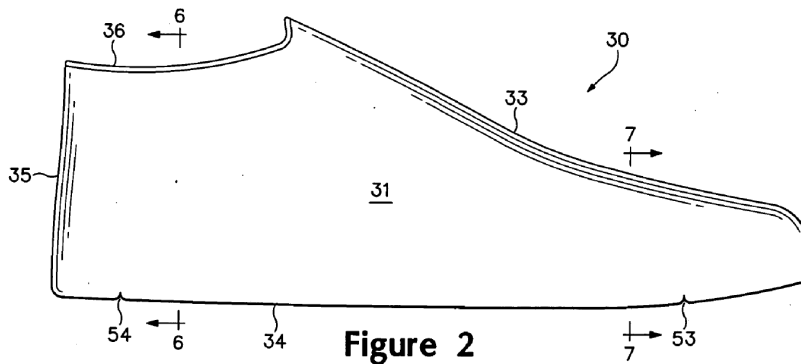
173. Therefore, Claim 14 is rendered obvious by Dua-592 which discloses the features of claim 14.

K. Claim 15

“The method recited in claim 11, further comprising assembling the flat-knitted element into an article of footwear.”

174. I note that Dua-592 discloses different assembly techniques that may be used to prepare upper material for incorporation into footwear. EX1014 (Dua-592), [0012]. Moreover, Dua-592 discloses that “[t]extile element 40 exhibits the general shape depicted in FIG. 8 prior to the formation of seams 51-54” and that “[f]ollowing formation of seams 51-54, however, textile element 40 exhibits the shape of upper 30 depicted in FIGS. 2-7.” *Id.*, [0038]; *see also id.*, [0039]-[0040]; [0041] (“Following the formation of each of seams 51-54, the manufacturing of upper 30 is essentially complete.”).



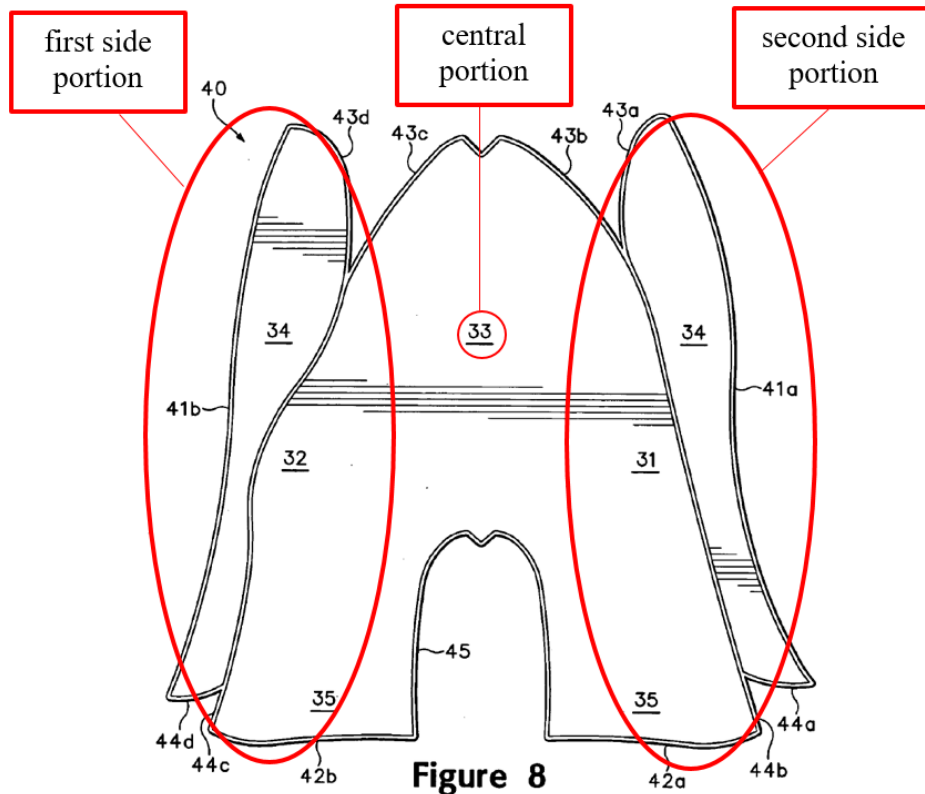


175. Therefore, Claim 15 is also rendered obvious by Dua-592 which discloses the features of claim 15.

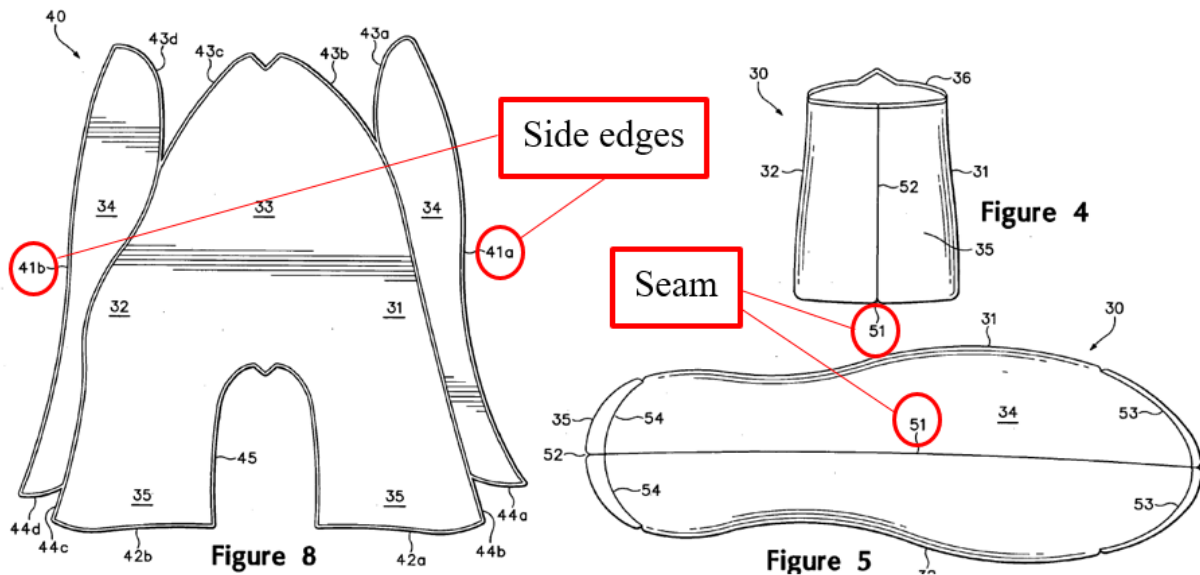
L. Claim 16

“The method recited in claim 15, wherein the assembling includes joining side edges of the first side portion and the second side portion to form a seam extending under a foot and along a longitudinal length of the foot.”

176. Dua-592's medial region 32 and lateral region 31, together with their respective lower regions 34, would be first and second side portions, respectively, extending from respective sides of the instep portion 33 (central portion). *See Supra*, Element 1[c]-1[d].



177. I note that in describing the assembly of upper 30, Dua-592 explains that “[s]eams 51-54 are formed by securing various edges of textile element 40 together. More specifically, (1) seam 51 is formed by securing an edge 41a with an edge 41b” EX1014 (Dua-592), [0038].



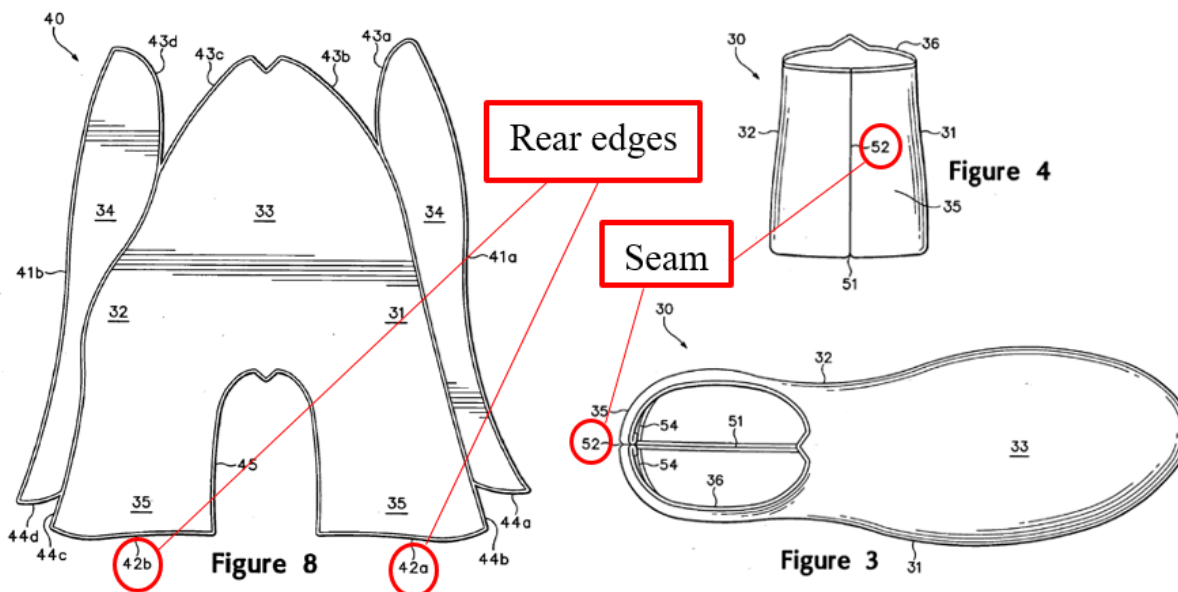
178. Thus, edges 41a-41b would comprise side edges of the first and second side portions, where edges 41a-41b are joined to form seam 51 which extends longitudinally under the foot, as shown below, thereby satisfying claim 16. Therefore, Claim 16 is also obvious.

M. Claim 17

“The method recited in claim 15, wherein the assembling includes joining rear edges of the first side portion and the second side portion to form a seam that extends upward along a heel.”

179. Dua-592 discloses that “folding or overlapping of textile element 40 to form seam 51 places edge 42a adjacent to edge 42b, which facilitates the formation of seam 52.... Upon the joining of edges 42a and 42b to form seam 52, the u-shaped

area becomes an aperture in textile element 40 and effectively forms ankle opening 36.” EX104 (Dua-592), [0040].



180. Thus, edges 42a-42b are rear edges that form seam 52 which extends upward along a heel, thereby satisfying claim 17. Therefore, Claim 17 is also obvious.

IX. CLAIMS 1, 5-9, AND 11-15 ARE OBVIOUS OVER YAMAMOTO IN VIEW OF CHOI (GROUND 2A)

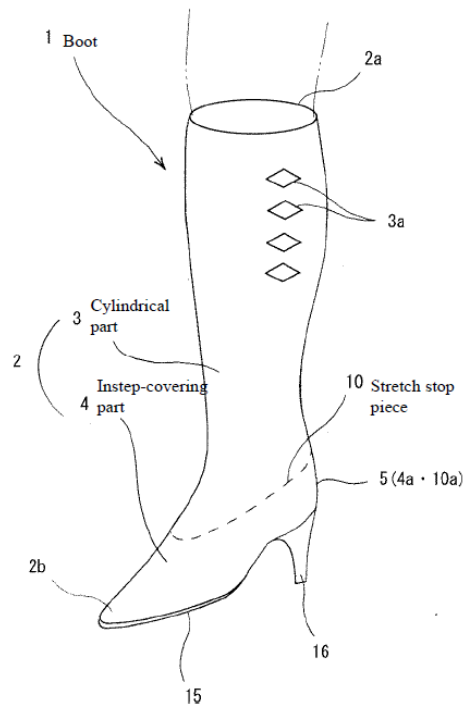
A. Claim 1

1. Element 1[pre]: “An article of footwear comprising”

181. Yamamoto is directed to a boot in which “[t]he entire outer surface of boot 1 (excluding the sole) is formed by a single piece of fabric 2 continuously knitted with yarn” EX1017, Abstract.

182. As shown in FIG. 1 below, “boot 1 has a cylindrical part 3 above the ankle and an instep-covering part 4 that covers from the instep of the foot to the back of the heel formed with one piece of stretchable continuous fabric 2, where a sole 15 and heel 16 are attached under the instep-covering part 4.” *Id.*, [0021].

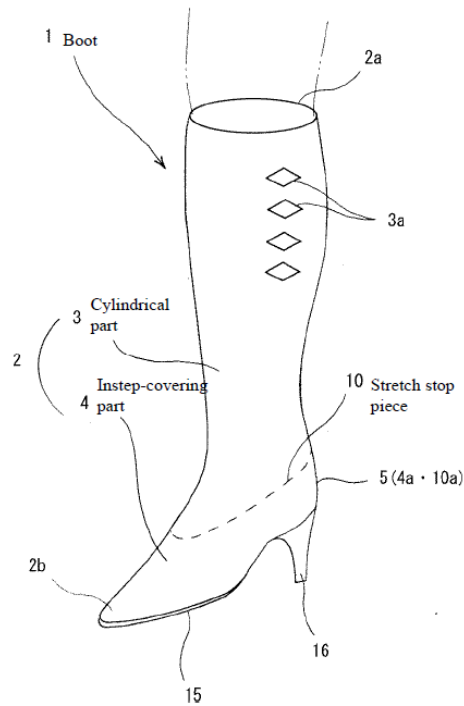
[FIG. 1]



2. **Element 1[a]: “an upper including a flat-knitted element formed from at least one yarn mechanically manipulated in a flat-knitting process, the flat-knitted element including a first layer having:”**

183. I note that Yamamoto discloses that “[t]he entire outer surface of boot 1 (excluding the sole) is formed by a single piece of fabric 2 continuously knitted with yarn” EX1017, Abstract; FIGs. 1-2.

[FIG. 1]



184. Yamamoto also discloses that “boot 1 has a cylindrical part 3 above the ankle and an instep-covering part 4 that covers from the instep of the foot to the back of the heel formed with one piece of stretchable continuous fabric 2, where a sole 15 and heel 16 are attached under the instep-covering part 4. The fabric 2 is provided so as to cover the entire outer surface of the boot 1 (other than the sole 15) by itself.” *Id.*, [0021].

185. Moreover, in Yamamoto the flat-knit upper is a “single layer of fabric.” EX1017, [0012]; [0022] (“the fabric is made of only one layer without overlapping.”), [0028].

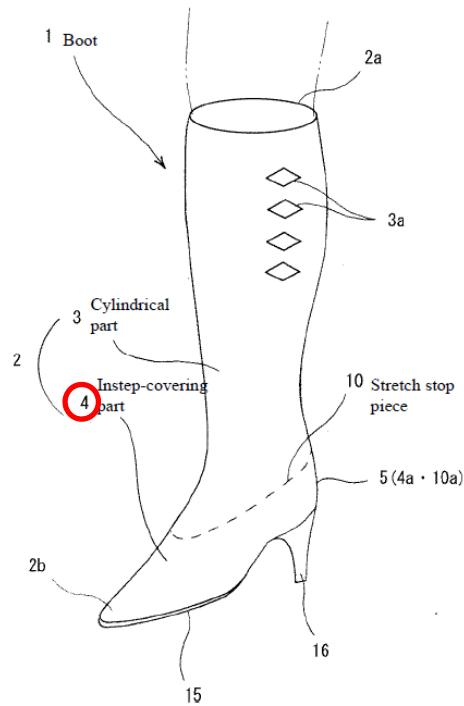
186. I also note that Yamamoto discloses that it is “possible to knit the cylindrical fabric that forms the outer surface of the boot continuously with yarn ... using a flat knitting machine with a three-dimensional seamless knitting function called WHOLEGARMENT (registered trademark).” *Id.*, [0011]. Yamamoto explains that “a flat knitting machine having a three-dimensional seamless knitting function called WHOLEGARMENT (registered trademark) or the like may be used.... By doing so, the fabric 2 is formed three-dimensionally without sewing, and there is no need to cut the fabric, so no waste material is generated.” *Id.*, [0024].

187. Therefore, Yamamoto’s single piece of fabric 2 satisfies the flat-knitted element of Element 1[a].

3. Element 1[b]: “a central portion having a domed, three-dimensional structure configured for extending over the top of a foot;”

188. Yamamoto’s boot includes a central portion having a domed, three-dimensional structure extending over the foot in the form of the central portion of instep-covering part 4. EX1017 (Yamamoto), Abstract (“boot 1 (excluding the sole) is formed by a single piece of fabric 2 continuously knitted with yarn, and of this fabric 2, the instep-covering part 4 covers at least the tip of the foot and the instep of the foot”).

[FIG. 1]



189. While Element 1[e] below requires the flat-knitted element to have the “domed, three-dimensional structure” when “in a flattened configuration,” Element 1[b] contains no such limitation and is therefore satisfied by Yamamoto’s assembled shoe, as shown above.

190. In any event, to the extent that the “domed, three-dimensional structure” of Element 1[b] does not correspond to an assembled state of the upper, it would have been obvious to form Yamamoto’s “single piece of fabric 2” with a domed, three-dimensional central portion extending over the top of the foot in view of the express teachings of Choi.

191. Choi discloses that three-dimensional shapes could be formed on flat knitting machines at the time without any post sewing or linking process. Specifically, Choi teaches that “[s]eamless knitting, or complete knitting, which produces one entire complete garment without a sewing or linking process” EX1015 (Choi), 5; 12 (“seamless flat V-bed knitting actually creates complete garments, which do not require any kind of cutting or sewing process.”); 14 (“the innovative WHOLEGARMENT® machine that can produce a one-piece three-dimensional complete garment with no stitching, linking or sewing processes.”).

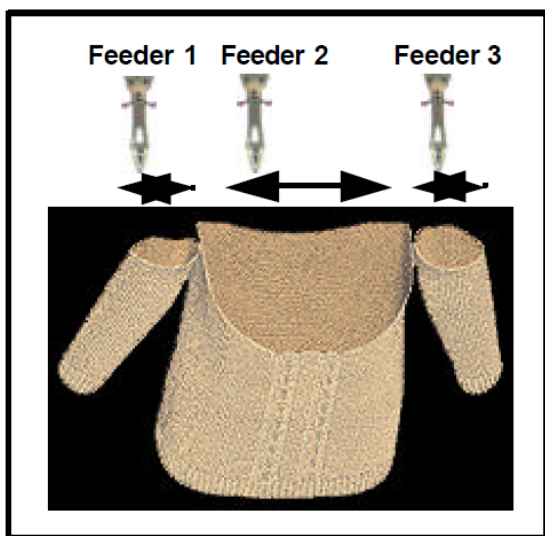


Figure 6.1. Three-dimensional complete garment knitting until underarm point (Shima Seiki)

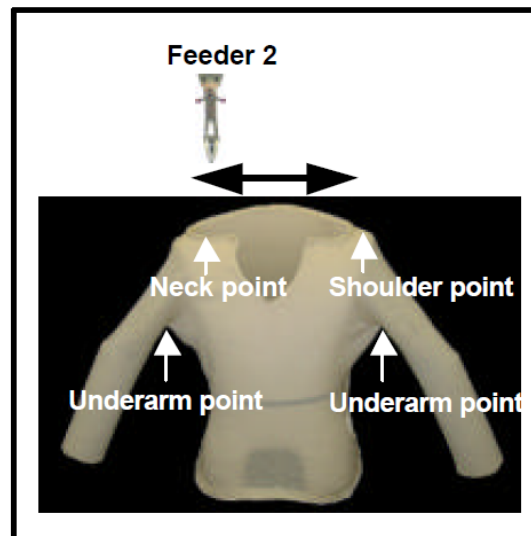


Figure 6.2. Three-dimensional complete garment knitting after underarm point

Id., 13.

192. Choi explains that “seamless garment knitting makes it possible not only to create several types of tubular formed knitting but also to build diverse design structures on the tubular knitted garments simultaneously.” *Id.*, 6. Moreover, a

POSITA would understand that Choi's three-dimensional flat knitting teachings can be used in a wide variety of applications, including footwear. *Id.*, 7 ("Seamless garment knitting on the V-bed machine has primarily been used for apparel. However, in recent years, this new three-dimensional knitting technique has been extended in other areas such as fashion, upholstery, industrial, automotive, and medical textiles."); *Id.*, ("A diverse range of seam-free products can be created such as hand gloves, hats, *socks*, and sweaters according to the machine gauge and types of machine."). Choi teaches that it is possible to seamlessly knit various three-dimensional structures, including not only "hand gloves, hats, socks, and sweaters," but also three-dimensional upholstery (e.g., office chairs), car seats, and medical textiles (e.g., orthopedic supports, compression stockings, etc.). *Id.*, 7-8.

193. It would have been obvious to apply Choi's flat knitting teachings to produce the "single piece of fabric 2" of Yamamoto because Choi explains that doing so results in "savings in cost and time, higher productivity, quick response production and other advantages." *Id.*, 5. Choi specifically touts seamless knitting technology as "eliminate[ing] post labor work, which saves production time and cost." *Id.*, 1. It would have also been obvious to use seamless knitting technology in the context of a knit upper because "the technology offers knitwear consumers more comfort and better fit by eliminating seams." *Id.* Seamless knitting offers several advantages. EX1050 (Spencer), 238 ("A new feature of this technique [integrally

and seamlessly knitting] is the ability to knit tubular rib with a high wale density and therefore improved extensibility and appearance. *WholeGarment knitting* [i.e., seamless knitting technology introduced by Shima Seiki at ITMA '95] removes or reduces the need for subsequent making-up (and in some cases cutting) operations, consequently reducing the garment throughput time and work in progress. It also provides the potential for introduction novel styling features into knitwear garments"); 255 ("The *seamless bodywear garment machine* knits body-width underwear garments (Fig. 20.7) requiring little or no making-up and with no uncomfortable side-seams"); EX1027 (Sayer, Wilson & Challis), 39-41 ("3D seamless knitwear machinery allows the creation of virtually finished garments, which require little to no make-up. The introduction of this technology forces a conceptual shift in the way knitted garments are both designed and created. The garments are designed so that they fall off the machine complete, with integrally knitted sleeves, side seams, details and edgings... The introduction of this technology presents significant advantages for the manufacturer and unique challenges for the designer...Seamless technology could therefore be advantageous to the UK manufacturing market as it is more machine rather than labour intensive and enables quality to be manufactured with reduced production times and thus labour costs... retailer who needs to appreciate the marketable qualities of seamless garments, and the consumer who needs to recognize the ergonomic advantages of

wearing garments without bulky seams”). It is generally desirable in apparel to minimize seams which contact the wearer, particularly where there could be rubbing between the fabric and body, which would apply in the context of shoe uppers as well. Mr. Delgatty also identifies additional specific manufacturing benefits from minimizing seams in footwear. EX1003 (Delgatty), ¶11.

194. Moreover, Choi describes additional benefits of seamless knitting technology, including minimizing the “risk of defects and damages,” ability to “create design structures and patterns across the entire garment.” EX1015 (Choi), 1. The application of Choi’s seamless knitting technology teachings to shoes was obvious, particularly in light of the recognized broad applicability of three-dimensional seamless knitting, including to socks and compression stockings, as noted above. *Id.*, 29 (“Three-dimensional seamless knitting with its diverse capabilities can be applied to numerous products such as fashion, upholstery, automobiles, aerospace, medical textiles, et cetera. Seamless knitting is forecasted to continue growing and could be one of the largest next generation knitting technologies.”).

195. In view of the above teachings of Choi and general knowledge regarding seamless knitting, it would have been obvious to form Yamamoto’s “single piece of fabric 2” with a domed, three-dimensional central portion extending over the top of the foot in view of the express teachings of Choi. It would have been

particularly obvious to apply Choi's teachings with respect to Shima Seiki's WholeGarment® machine to produce the single piece fabric 2 of Yamamoto because Yamamoto specifically discloses that its knit boot fabric can be formed "using a flat knitting machine with a three-dimensional seamless knitting function called WHOLEGARMENT (registered trademark)." EX1017 (Yamamoto), [0011], [0024]. It would have been obvious to apply Choi's teachings because Choi's seamless knitting teachings results in "savings in cost and time, higher productivity, quick response production and other advantages." EX1015 (Choi), 5. Choi specifically touts seamless knitting technology as "eliminat[ing] post labor work, which saves production time and cost." *Id.*, 1.

196. In the context of Yamamoto's footwear, it would have been obvious to use the seamless WholeGarment® knitting machines mentioned by Choi because "the technology offers knitwear consumers more comfort and better fit by eliminating seams." *Id.* A POSITA would have recognized additional benefits, including minimizing the "risk of defects and damages" and the ability to "create design structures and patterns across the entire garment." *Id.*, 1, 5-6. The application of Choi's seamless knitting technology teachings to shoes was obvious, particularly in light of the recognized broad applicability of three-dimensional seamless knitting, including to socks and compression stockings, as noted above. *Id.*, 29 ("Three-dimensional seamless knitting with its diverse capabilities can be applied to

numerous products such as fashion, upholstery, automotives, aerospace, medical textiles, et cetera. Seamless knitting is forecasted to continue growing and could be one of the largest next generation knitting technologies.”).

197. Accordingly, it would be desirable and obvious to form the central portion of Yamamoto’s instep-covering part 4 as a domed, three-dimensional structure to simplify the assembly process, reduce the waste of expensive materials, eliminate additional making up operation, and diminish labor cost.

198. As a specific example, forming the central portion of Yamamoto’s boot as a domed, three-dimensional structure would eliminate the need for Yamamoto’s stretch stop piece 10, which Yamamoto bonds to the instep-covering part 4 to help define the shape of the upper. EX1017 (Yamamoto), [0022], [0026]. The fact that Choi discloses that seamless three-dimensional knitting machines are capable of producing three-dimensional upholstery (e.g., office chairs), car seats, and medical textiles (e.g., orthopedic supports, compression stockings, etc.) without mention of needing additional shape-retentive structures (EX1015 (Choi), 7-8) means such knitting machines are similarly capable of producing a simple dome-shaped shoe upper without the need for additional supporting structures. For example, Choi details the capabilities of known flat knitting machines as including the creation of three-dimensional knit structures, including more complex three-dimensional structures than a simple dome-shaped structure as claimed in the ’484 patent.

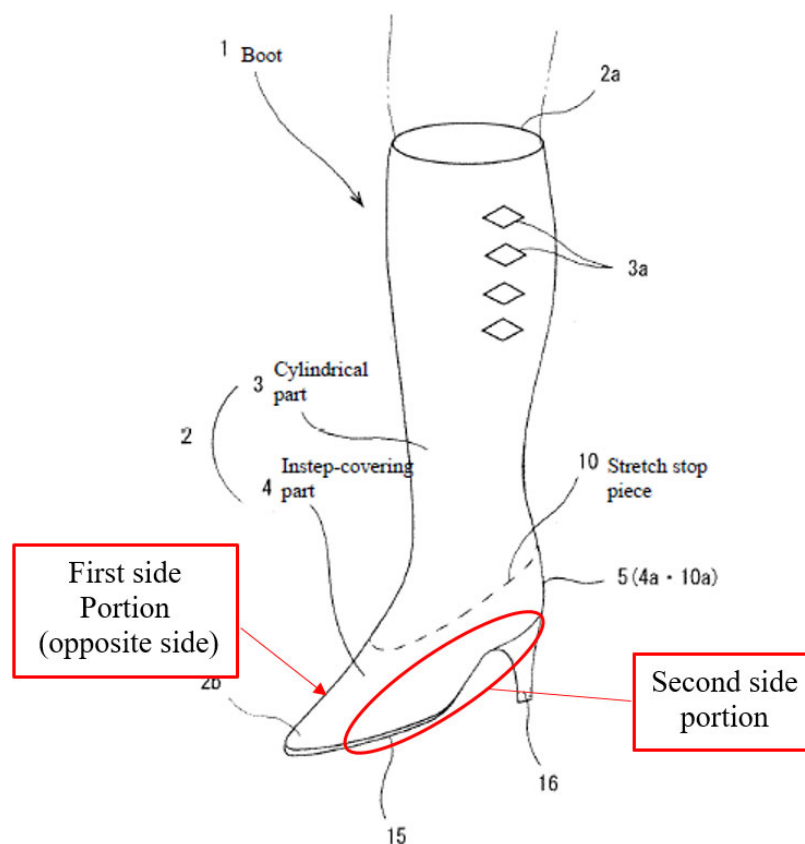
199. Thus, the combination would have beneficially eliminated the need for the additional stretch stop piece 10 by forming the central portion of Yamamoto's instep-covering part 4 to have a domed, three-dimensional structure.

200. A POSITA would have had a reasonable expectation of success of creating a dome-shaped version of at least the central portion of Yamamoto's instep-covering Part 4 in view of the fact that Choi details the capabilities of known flat knitting machines as including the creation of three-dimensional knit structures, including more complex three-dimensional structures than a simple dome-shaped structure as claimed in the '484 patent. Choi describes the three-dimensional knitting capabilities of such Shima Seiki machines, and a POSITA would have been familiar with such machines. For example, as noted above, Nike overcame a rejection of insufficient disclosure during prosecution of the European counterpart application by pointing to Hong's disclosure as evidence that it was generally known how to achieve three-dimensional knitted textiles through flat knitting. EX1019, 8.

201. Therefore, Yamamoto in view of Choi satisfies Element 1[b].

4. **Element 1[c]: “a first side portion being formed of unitary construction with the central portion and extending from a first side of the central portion; and”**
5. **Element 1[d]: “a second side portion being formed of unitary construction with the central portion and extending from a second side opposite the first side of the central portion,”**

202. The flat-knitted fabric 2 of Yamamoto (textile element) includes a first side portion and a second side portion formed of a unitary construction with the central portion (central portion of instep-covering portion 4) and extending therefrom, as illustrated below.



[G. 2]

(a)

Diagram (a) shows a side view of a device. It features a central portion (2) and two side portions (3). The central portion (2) is a curved, elongated structure. The side portions (3) are located on either side of the central portion. A dashed line (2a) indicates a boundary or fold. A series of four diamond shapes (3a) are shown along the length of the side portions. A circular feature (4) is located at the top of the central portion. A label 'Central Portion' points to the central portion (2). A label 'First and Second Side Portions' points to the side portions (3). A label '2b' points to the top edge of the central portion. A label '4a' points to the bottom edge of the central portion.

Central Portion

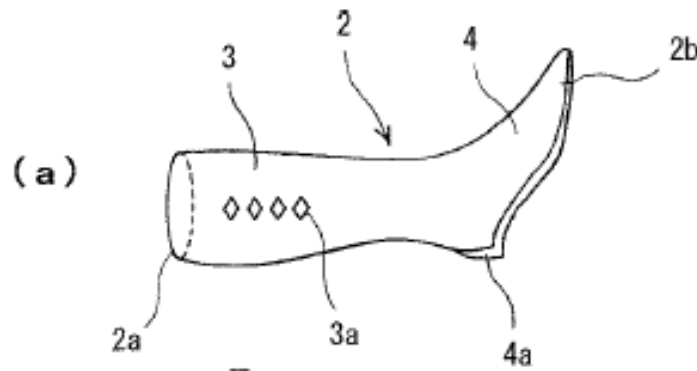
First and Second Side Portions

6. **Element 1[e]: “the domed, three-dimensional structure shaped to extend above the plane of the first side portion and the second side portion when the flat-knitted element is in a flattened configuration.”**

205. For example, with reference to FIG. 2(a) below, Yamamoto discloses [t]he instep-covering part 4 is an area below the ankle, but by creating a cut

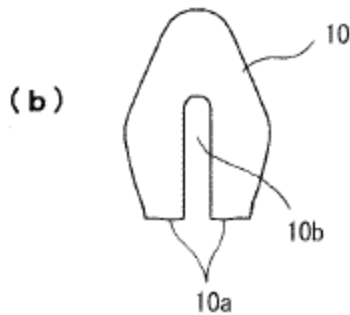
line 4a at the back of the heel and discontinuing between the left and right sides, it is knitted into a planar shape (one piece is folded back at the toe) rather than a cylindrical shape.” EX1017 (Yamamoto), [0024].

[FIG. 2]



206. With there being a cut 4a along the bottom and heel regions, when the instep-covering portion 4 is placed in a similar orientation to that of the now-eliminated stretch stop piece 10 shown in FIG. 2(b) below, i.e., in a flattened configuration with the medial and lateral sides extending outward from the central portion of the instep-covering portion 4, the medial and lateral sides of the instep-covering portion 4 would lie in the “planar shape” described in Yamamoto. *Id.*, [0024].¹

¹ The proposed combination does not change the fact that Yamamoto’s upper is knitted with an open bottom and heel area, as shown in FIG. 2(a). *See infra*, Ground 2B.



207. Because the central portion is formed with a domed, three-dimensional structure per Choi as I described under Element 1[b], that central portion would extend above the plane of the medial and lateral sides which remain in the “planar shape.”

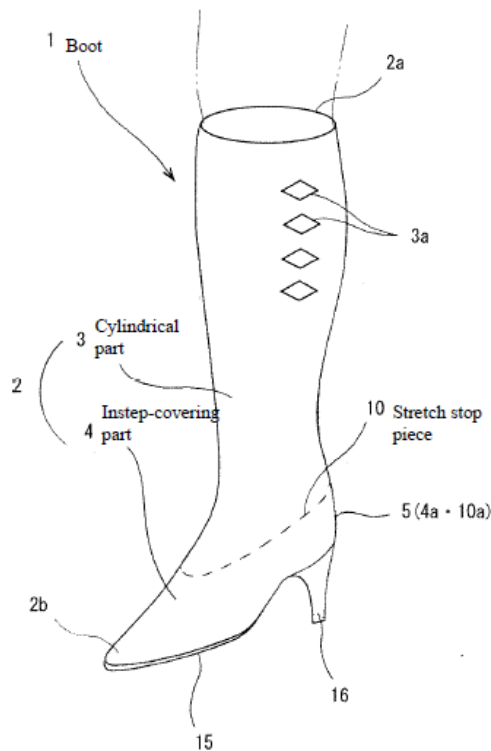
208. Therefore, Yamamoto in view of Choi satisfies Element 1[e] as well, and therefore renders claim 1 obvious.

B. Claim 5

“The article of footwear of claim 1, wherein the knitted element defines a void for receiving a foot of a wearer.”

209. Yamamoto’s fabric 2 (flat-knitted element) is “formed to cover the foot by a single layer of fabric” EX1017 (Yamamoto), [0012]; [0013] (describing the “fabric that covers the foot is made of a single piece of fabric continuously knitted with yarn). Yamamoto’s fabric 2 is comprised of the cylindrical part 3 which defines a void for receiving and accommodating at least a portion of the leg, and the instep-covering portion 4 which defines a void for receiving and accommodating a foot, as shown for example in FIG. 1.

[FIG. 1]



210. Therefore, Claim 5 is obvious in view of Yamamoto and Choi.

C. Claim 6

“The article of footwear of claim 1, wherein the knitted element defines at least a portion of an exterior surface of the upper, and the knitted element defines at least a portion of a void for receiving a foot of a wearer.”

211. Yamamoto’s boot 1 is made of a “single layer of fabric” in the form of fabric 2. EX1017 (Yamamoto), [0012], [0022] (“the fabric is made of only one layer without overlapping.”), [0028]. Thus, as a single layer of knitting, fabric 2 (a flat-knitted element) would define both the exterior surface of the boot 1 and at least a portion of a void for receiving a foot of a wearer. *Supra*, Claim 5.

212. Therefore, Claim 6 is obvious in view of Yamamoto and Choi

D. Claim 7

“The article of footwear of claim 1, wherein the knitted element includes a first area and a second area, the first area including a first type of knit structure, and the second area including a second type of knit structure, the first type being different than the second type.”

213. While the '484 patent does not use the term “knit structure” outside of claim 7, I note that when describing the only embodiment having a domed structure, the '484 patent describes areas of the upper as having “different knit types,” such as side portions 72 of FIGs. 10A-10C having a “non-ribbed type of knit” and the central portion 71 being ribbed. EX1001, 10:18-46.

214. The '484 patent further discloses that “a ribbed configuration stretches to a different degree than the non-ribbed configurations.” *Id.*, 7:66-8:3. Thus, at least in the context of the '484 patent, the types of “knit structures” that fall within claim 7 would include at least different types of knit textures, including types of knit textures which stretch to different degrees. Even outside the context of the '484 patent, the term “knit structure” is broad and would be understood to encompass different types of knit textures.

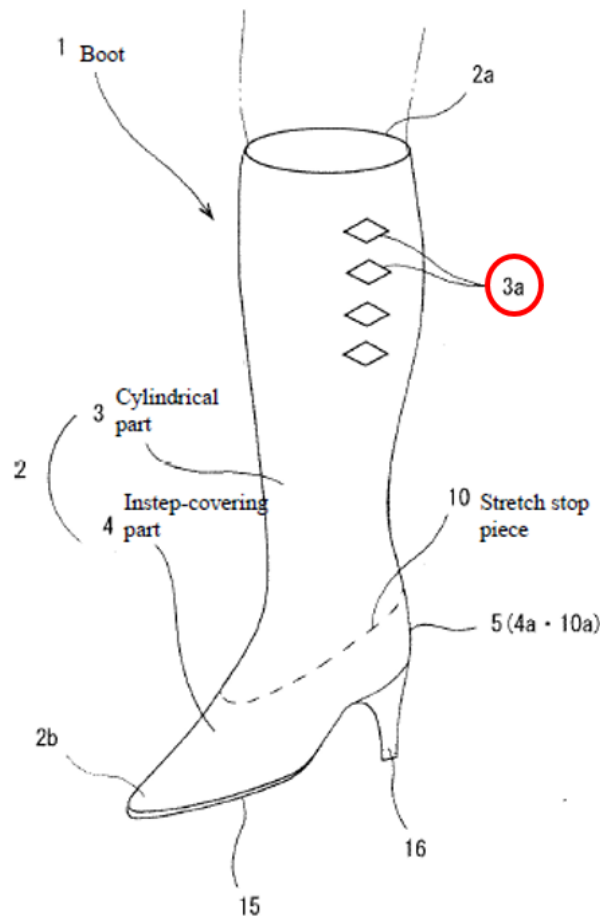
215. As described above, knit structures are generally classified as weft knit or warp knit structures. Weft knit structures can be circular or flat structures. There are different stitch (loop) types that are used in weft knit structures: plain stitch, purl

(reverse) stitch, miss stitch and tuck stitch, etc. Each stitch type provides different characteristics to the knit structure such as different modulus, different elongation in either direction, different surface roughness, different texture, different air permeability, different abrasion resistance, different moisture handling, different thickness, different hand, etc. Weft knit structures can be single knit structure (have one layer of loops formed with one yarn system, such as jersey, rib and purl) or double knit structures (have two inseparable layers of loops). Jersey knits have different structures such as plated, pile, cross-tuck, Jacquard, openwork, etc. Rib knits can be 1x1 rib, 2x2 ribs and cardigan (half cardigan or full cardigan). Double knits can be rib double knit and interlock double knit. Warp knitted structures can be tricot or raschel structure. Tricot structures can be single, two, three and four (or more) bar tricot structures. Raschel machines can have more than 60 guide bars and therefore the structures can be highly patterned, lacy, crotched, etc. In short, there are many different knitted structures and each structure has unique geometrical, mechanical and hand properties. As a result, each structure may have different extensibility, recovery, strength, stiffness, modulus, flexural resistance, abrasion and wear resistance, moisture handling, surface smoothness, texture, air permeability, weight per unit area, thickness, density, hand, etc. For example, a particular “structure has been used for ladder-resist shadow welts in stockings and for textured designs” EX1054 (Spencer), 94; 99 (“The tuck stich may also be employed to

produce open-work effects, improve the surface texture, ..."); 100 ("Colour is one of the five ingredients of fashion, the other four being style, silhouette, texture and pattern"); 141 ("Using the yarn programme, yarn types, shades, and textures can be generated and stored to closely simulate knitted panels, in advance of the knitting process"). Each knit structure can be made with a variety of fibers and yarns which change the properties of the knit structure even more. EX1025 (Choi and Ashdown), 1034 ("...the mechanical properties of knitted fabrics vary according to knit structures, fibers, yarns, and densities..." For example, nylon provides excellent wear and abrasion resistance; it also absorbs more moisture compared to other synthetic fibers. "Different knit structures have effects on the deformation of weft-knit preforms" *See generally*, EX1026 (Savci).

216. Consistent with that interpretation, Yamamoto discloses that a "lace-like mesh can also be added to any desired area to create a cool feeling." EX1017 (Yamamoto), [0019]. Such a "lace-like mesh," an example of which is lace-like mesh 3a highlighted below, would be a different type of knit structure than non-laced portions of Yamamoto's upper.

[FIG. 1]



217. Yamamoto further explains that “it is easy to create a cool feeling by adding a lace-like mesh to any location, etc., and it is possible to further enhance fashionability and improve breathability.” *Id.*, [0013]. In adding such a lace-like mesh, a “first area” of the fabric 2 (flat-knitted element) corresponding to the lace-like mesh, a “first area” of the fabric 2 (flat-knitted element) corresponding to the lace-like mesh would have a different knit structure from a “second area” of the fabric 2 (flat-knitted element) which does not correspond to the lace-like mesh.

218. Moreover, Yamamoto discloses that “is also possible to create knitting patterns on the fabric.” *Id.*, [0011]. Specifically, “the shape and dimensions of the

boot 1, the material and thickness of the fabric 2 (including the pantyhose type), the form of the mesh 3a (including the pattern and roughness), etc. are not limited to the examples shown.” *Id.*, [0022]. To that end, Choi discloses that “[t]hrough computerized flat bed knitting, more variety of knit patterns and structures can be created and designs can be instantly and efficiently changed through a computer-aided design.” EX1015 (Choi), 6. In particular, “Shima Seiki created a large pattern structure database of knitted parts” such that “[k]nit and garment designs can be easily changed at will.” *Id.*, 18. See below.

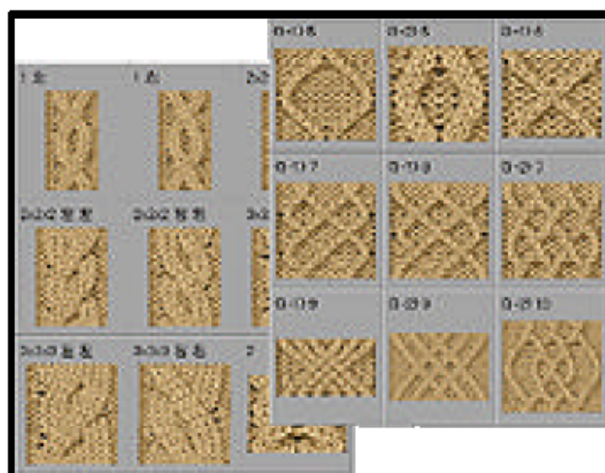


Figure 7.1.2e.
Structure
pattern
database

Id.; 12 (“various structures such as plain, rib, and purl can be created within the seamless garment at the same time.”).

219. Therefore, when constructing Yamamoto’s boot using Shima Seki’s WholeGarment® machine, per Element 1[b], it would have been obvious to incorporate different knit structures on different areas of Yamamoto’s boot,

including the different knit structures which are stored in Shima Seiki's database. One reason to do this would be to improve the aesthetics of the boot, which is something Yamamoto expressly describes as desirable. EX1017 (Yamamoto), [0013] (discussing "adding a lace-like mesh to any location ... to further *enhance fashionability* and improve breathability."); [0019] ("is possible to make boot that is both economical and *fashionable*."); [0015] ("[the boots] can provide a smooth silhouette and are *fashionable*"). Enhancing fashionability is generally desired in the apparel industry, including the footwear industry, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶26.

220. Therefore, Yamamoto in view of Choi renders obvious claim 7 because the combination would similarly include a knitted element with a first area and a second area, where the first area including a first type of knit structure and the second area including a second, different type of knit structure.

E. Claim 8

"The article of footwear of claim 1, wherein the at least one mechanically manipulated yarn includes a first yarn and a different second yarn, the first yarn being located in a first area of the upper, and the second yarn being located in a second area of the upper."

221. Yamamoto discloses that "it is also possible to knit a single piece of fabric continuously while *forming part of the fabric with different yarn*, such as by joining the yarn in the middle." EX1017 (Yamamoto), [0011]. Similarly, Yamamoto

discloses that “by doubling the part that covers the foot to increase heat retention and strength, and *knitting different yarns on the inside and outside*, it is possible to make boot that is both economical and fashionable.” *Id.*, [0019].

222. I note that one aspect of Yamamoto is to use a yarn containing fibers embedded “ with deodorizing particles. *See e.g., id.*, [0008], [0010], [0019] (A POSITA would understand the term “woven” in the context of Yamamoto refers to “embedded”). However, not all areas of the upper have such a yarn type. *See e.g., id.*, [0022] (“[I]t is also a good idea to use fibers with deodorizing functions such as bincho charcoal, sulfur, germanium ore, etc. “woven” (embedded) into them. Furthermore, it is also possible to use yarn made of such fibers not for the entire fabric 2 but for a portion thereof (for example, only the portion covering from the tip of the foot to the instep of the foot).”); [0015] (“This is because it is possible to reduce the amount of the special yarn having the minute particles used, and the outer portion can also be formed by knitting another yarn with a nice appearance (for example, one with lamé [fabrication]).”). In other words, Yamamoto discloses that some areas are to have a special yarn containing fibers “woven with” (containing) deodorizing particles, and some areas are not.

223. Thus, Yamamoto in view of Choi renders obvious claim 8 because Yamamoto discloses using a “first yarn” having particles with fibers having a deodorizing function in some areas of the upper, e.g., from the tip of the foot to the

instead of the foot (a first area), but that a “second yarn” without such fibers should be used in other areas of the upper (a second area).

F. Claim 9

“The article of footwear of claim 1, wherein the knitted element forms a defined shape having finished edges during the flat knitting process.”

224. I note that the ’484 patent discloses that flat knitting provides edges of textile elements that “do not need to be finished to prevent unraveling,” unlike textile elements cut from a larger textile element. EX1001, 8:16-26.

225. Yamamoto similarly discloses flat knitting as a known process for making its textile elements, which would have a defined shape and finished edges. For example, Yamamoto similarly discloses flat knitting as a known process for making its boot, which would have a defined shape and finished edges, particularly when knitted in accordance with the flat knit teachings of Choi, as described above with respect to Element 1[b]. Flat knitting machines have been used for centuries. EX1050 (Spencer), 207 (“The first flat bar machine was demonstrated in 1862 and patented in 1865 by the Rev. Isaac Wixom Lamb, and American clergyman”). The first motor-driven jacquard flat machine was commercialized in 1926. *Id.*, 224; *Id.* (“In the 1960s, the Japanese company Shima Seiki...pioneered the development of the automatic V-bed seamless glove-knitting machine”); 225 (“V-bed flat knitting machines was able to knit rib or plain garment panels”). A panel structure would

necessarily have defined shape and finished edge to prevent raveling. To produce 3D fabrics, the advantages of flat knitting includes “possibility of knitting to shape without cutting waste or making-up time”, which involves defined shapes and finished.” *Id.*, 379; 39 (“In weft knitting, the yarn continues to be supplied in one direction (except at the selvages of straight [i.e., flat] knitting machines)”). A straight (flat) knitting machine produces a piece of fabric with 2 finished edges to that the yarn does not ravel in an integrated structure. *Id.*, 185 (“The firm, fashioned selvedge edges can be point-or cup-seamed together, without the need for cutting and seaming to shape involving loss of expensive fabric.” FIGS 3, 4, 5, 6, 7, 8 and 9 in Hong show well defined shapes and finished edges on fabrics knitted on a flat knitting machine. *See also* EX1015, 7 (Choi) (“A welt in knitting means ‘a secure edge of a fabric. The welts are usually at the starting end of the fabric’”). Seamless garment knitting offers the benefit of “better trimmability for finished edge lines.” *Id.*, 29 (Table 5).

226. In particular, Choi teaches that “[s]eamless knitting, or complete knitting, which produces one entire complete garment without a sewing or linking process” EX1015 (Choi), 5; 12 (“seamless flat V-bed knitting actually creates complete garments, which do not require any kind of cutting or sewing process.”); 14 (“the innovative WHOLEGARMENT® machine that can produce a one-piece three-dimensional complete garment with no stitching, linking or sewing

processes.”). Moreover, Choi explains that “‘Seamless’ garment knitting creates a complete garment by several different carriers (feeders) with minimal or no cutting and sewing processes (Figure 5.3). Thus, seamless knitting has the capability for production time and cost saving by removing post-knit processes such as the linking or sewing and cutting operation.” *Id.*, 11.



Figure 5.3. Complete garment production by a seamless flat knitting machine

Id.

227. Such complete garments would have defined shapes and finished edges, which would also be the case when Choi’s knitting techniques are applied to Yamamoto’s knitted upper (fabric 2). *See supra*, Element 1[b]. Moreover, flat knitting such knitted elements was well-known at the time, and the ’484 patent does not disclose any particular features for how to achieve its flat knitting process. In fact, I believe that the ’484 patent does NOT make any mechanical or physical changes to known flat and/or other knitting machines, and anybody could manufacture the claimed products using the teachings of the prior art cited here along with machines which were commercially available at that time.

228. Therefore, Claim 9 is obvious in view of Yamamoto and Choi.

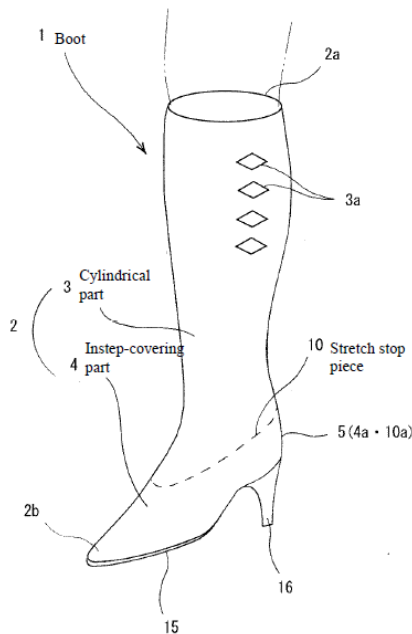
G. Claim 11

1. Element 11[pre]: “A method of manufacturing an article of footwear, the method comprising:”

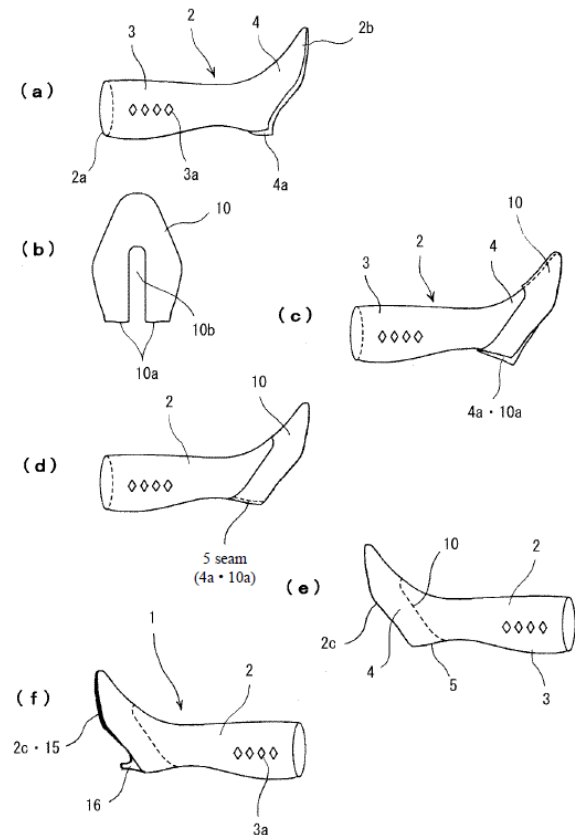
229. Element 11[pre] is satisfied for the same reasons as Element 1[pre]. *See supra*, Element 1[pre].

230. In addition, Yamamoto explains that “boot 1 shown in FIG. 1 can be manufactured according to the following steps 1) to 6) shown in FIG. 2.” EX1017 (Yamamoto), [0023]; [0020] (“FIG. 1 is a perspective view of a boot 1 (stretch boot), and FIGS. 2(a) to 2(f) are explanatory diagrams regarding a method of manufacturing the boot 1.”).

[FIG. 1]



[FIG. 2]



231. Yamamoto discloses that a “flat knitting machine having a three-dimensional seamless knitting function called WHOLEGARMENT” can be used to manufacture the fabric 2 forming the upper of boot 1. *See supra*, Element 1[pre]. Because that mechanical flat knitting process, in combination with the teachings of Choi, can be used to produce knitted textile elements having the “central portion,” “first side portion,” and “second side portion” as recited in Claim 1, Claim 11 is obvious in light of Yamamoto and Choi for the same reasons. *See supra*, Claim 1.

2. Element 11[a]: “forming during a flat-knitting process an upper including a flat-knitted element including a first layer having:”

232. Element 11[a] is satisfied for the same reasons as Element 1[a]. *See supra*, Element 1[a].

3. Element 11[b]: “a central portion having a domed, three-dimensional structure configured for extending over the top of a foot”

233. Element 11[b] is satisfied for the same reasons as Element 1[b]. *See supra*, Element 1[b].

4. Element 11[c]: “a first side portion being formed of unitary construction with the central portion and extending from a first side of the central portion; and”

5. Element 11[d]: “a second side portion being formed of unitary construction with the central portion and extending

from a second side opposite the first side of the central portion,”

234. Elements 11[c] and 11[d] are satisfied for the same reasons as Elements 1[c] and 1[d]. *See supra*, Elements 1[c]-1[d].

6. Element 11[e]: “wherein the domed, three-dimensional structure is shaped to extend above the plane of the first side portion and the second side portion when the flat-knitted element is in a flattened configuration.”

235. Element 11[e] is satisfied for the same reasons as Element 1[e]. *See supra*, Element 1[e].

236. Therefore, Claim 11 is obvious in view of Yamamoto and Choi.

H. Claim 12

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a stitch type of the first area being different that a stitch type of the second area.”

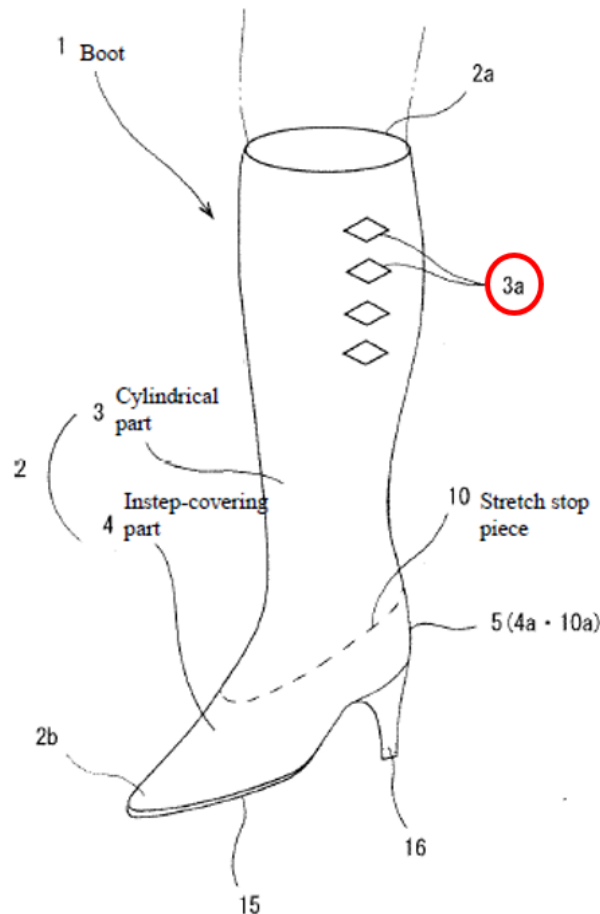
237. I note that the '484 patent does not clearly indicate what a “stitch type” means but, in general, it would be understood to include stitch patterns. This is consistent with the disclosure of the '484 patent, which explains that “[b]y selectively placing multiple different yarns and/or stitch patterns at multiple different locations in the overall structure during the knitting process, flat knitted products may have multiple different physical properties (e.g., different stretchability, different moisture management capabilities, etc.) at multiple different locations or

zones within a single, unitary construction (e.g., different properties at different zones or locations within a single footwear structure).” EX1001, 4:60-5:1.

238. I note that Yamamoto discloses that a “lace-like mesh can also be added to any desired area to create a cool feeling.” EX1017 (Yamamoto), [0019]. An example of such a “lace-like mesh” is lace-like mesh 3a highlighted below in FIG.

1. The “lace-like mesh” would be a different stitch type than non-laced portions of Yamamoto’s upper.

[FIG. 1]



239. Yamamoto further explains that “it is easy to create a cool feeling by adding a lace-like mesh to any location, etc., and it is possible to further enhance fashionability and improve breathability.” *Id.*, [0013]. Therefore, a “first area” of the fabric 2 (flat-knitted element) which corresponds to the lace-like mesh would have a different stitch type from a “second area” of the fabric 2 (flat-knitted element) which does not correspond to the lace-like mesh.

240. Yamamoto also discloses that “it is also possible to create knitting patterns on the fabric.” *Id.*, [0011]. Specifically, “the shape and dimensions of the boot 1, the material and thickness of the fabric 2 (including the pantyhose type), the form of the mesh 3a (including the pattern and roughness), etc. are not limited to the examples shown.” *Id.*, [0022]. Along similar lines, Choi discloses that “[t]hrough computerized flat bed knitting, more variety of knit patterns and structures can be created and designs can be instantly and efficiently changed through a computer-aided design.” EX1015 (Choi), 6. In particular, “Shima Seiki created a large pattern structure database of knitted parts” such that “[k]nit and garment designs can be easily changed at will.” *Id.*, 18. See below.

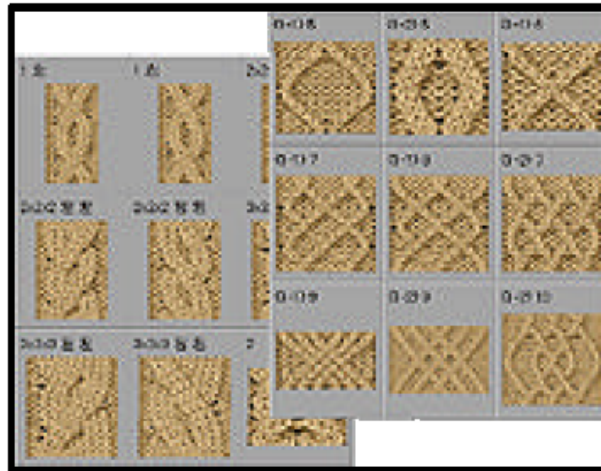


*Figure 7.1.2e.
Structure
pattern
database*

Id.; 12 (“various structures such as plain, rib, and purl can be created within the seamless garment at the same time.”).

241. Forming such different knit structures would require the use of different stitch types, for example different stitch patterns as shown above from Choi. There are different stitch (loop) types or patterns that are used in weft knit structures: plain stitch, purl (reverse) stitch, miss stitch and tuck stitch, etc. Each stitch type provides different characteristics to the knit structure. Weft knit structures can be single knit structure (have one layer of stitches formed with one yarn system, such as jersey, rib and purl) or double knit structures (have two inseparable layers of stitches). Jersey knits have different structures such as plated, pile, cross-tuck, Jacquard, openwork, etc. Rib knits can be 1x1 rib, 2x2 ribs and cardigan (half cardigan or full cardigan). Double knits can be rib double knit and interlock double knit. Warp knitted structures can be tricot or raschel structure. Tricot structures can be single, two, three

and four (or more) bar tricot structures. Raschel machines can have more than 60 guide bars and therefore the structures can be highly patterned, lacy, crotched, etc. Different stitch types can be used in the same knitted fabric which opens up endless possibilities for the knitted fabric design. In short, there is theoretically endless number of knitted structures, and each structure has unique geometrical, mechanical and hand properties. EX1062, 127-132. Therefore, when constructing Yamamoto's boot using Shima Seki's WholeGarment® machine, per Element 1[b], it would have been obvious to incorporate different knit structures on different areas of Yamamoto's boot, such as the different knit structures stored in Shima Seiki's database. This would result in different stitch types being used in different areas. Moreover, this would have been simple to do, as Choi explains, and would have added to the aesthetics of the boot, which is something Yamamoto expressly describes as desirable. EX1017 (Yamamoto), [0013] (discussing "adding a lace-like mesh to any location ... to further *enhance fashionability* and improve breathability."); [0019] ("is possible to make boot that is both economical and *fashionable*."); [0015] ("[the boots] can provide a smooth silhouette and are *fashionable*"). Enhancing fashionability is generally desired in the apparel industry, including the footwear industry, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶26.

242. Therefore, Claim 12 is obvious in view of Yamamoto and Choi.

I. Claim 13

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a yarn type of the first area being different than a yarn type of the second area.”

243. Claim 13 is substantially similar to claim 8, and is obvious for the same reasons. *See supra*, Claim 8.

J. Claim 14

“The method recited in claim 11, wherein the flat knitting process includes forming a first area and a second area, a stitch type and a yarn type of the first area being different than a stitch type and a yarn type of the second area.”

244. Yamamoto discloses this limitation for the reasons provided with respect to claims 8 and 12 in this ground.

245. In addition, it would have been an obvious design choice to use one type of yarn and stitch in a first area, while using a different type of yarn and stitch in a second area in order to give the different areas different characteristics, such as different textures, aesthetics, structures, or wear resistance. It is common practice to use different yarn types and different stitch types in different portions of knitted structures to impart different properties to different parts of the knitted structure. EX1050 (Spencer), 3 (“Yarns are the raw materials manipulated during knitting...Textile fibers are the raw materials of the yarns into which they are spun.”). Each fiber type has different properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or

smoothness, permeability, moisture absorbency, aesthetics, etc. See EX1062, 555-606. Micro or nanosize particles can also be embedded into the fiber structure to give the fiber different properties such as flame resistance. EX1028 (Adanur and Selver).

246. As a result, yarns which are made of fibers also have different properties based on the fibers used as well as based on yarn manufacturing methods and yarn structure. Yarns can be staple yarn (made of short fibers) or continuous filament yarns (made of very long fibers). Staple yarns can be made with ring spinning, open-end (rotor spinning), air-jet spinning or friction spinning methods. Each method results in different yarn properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or smoothness, permeability, aesthetics, etc. Yarns also have different direction and amount of twist, which affect their stiffness, strength and surface roughness. Besides, yarns can be single yarns or plied yarns which affects strength, surface and friction characteristics. See EX1062, 611-620. All these yarn properties affect the knitted fabric properties such as strength, modulus, elongation, abrasion and wear resistance, flexibility, density, surface roughness or smoothness, permeability, moisture handling, aesthetics, etc. See EX1062, 127-132, 625-645. “The properties of more than one type of fibre may be incorporated into a fabric as the result of

blending the fibres during spinning, or by knitting two or more types of yarn”
EX1050 (Spencer), 4.

247. As described above in the Technology Background section, knit structures are generally classified as weft knit or warp knit structures. Weft knit structures can be circular or flat structures. There are different stitch (loop) types that are used in weft knit structures: plain stitch, purl (reverse) stitch, miss stitch and tuck stitch, etc. Each stitch type provides different characteristics to the knit structure such as different modulus, different elongation in either direction, different surface roughness, different texture, different air permeability, different abrasion resistance, different moisture handling, different thickness, different hand, etc. Weft knit structures can be single knit structure (have one layer of loops formed with one yarn system, such as jersey, rib and purl) or double knit structures (have two inseparable layers of loops). Jersey knits have different structures such as plated, pile, cross-tuck, Jacquard, openwork, etc. Rib knits can be 1x1 rib, 2x2 ribs and cardigan (half cardigan or full cardigan). Double knits can be rib double knit and interlock double knit. Warp knitted structures can be tricot or raschel structure. Tricot structures can be single, two, three and four (or more) bar tricot structures. Raschel machines can have more than 60 guide bars and therefore the structures can be highly patterned, lacy, crotched, etc. In short, there are many different knitted structures and each structure has unique geometrical, mechanical and hand properties. As a result, each

structure may have different extensibility, recovery, strength, stiffness, modulus, flexural resistance, abrasion and wear resistance, moisture handling, surface smoothness, texture, air permeability, weight per unit area, thickness, density, hand, etc. For example, a particular “structure has been used for ladder-resist shadow welts in stockings and for textured designs” EX1050 (Spencer), 94; 99 (“The tuck stitch may also be employed to produce open-work effects, improve the surface texture, ...”); 100 (“Colour is one of the five ingredients of fashion, the other four being style, silhouette, texture and pattern”); 141 (“Using the yarn programme, yarn types, shades, and textures can be generated and stored to closely simulate knitted panels, in advance of the knitting process”). Each knit structure can be made with a variety of fibers and yarns which change the properties of the knit structure even more. EX1025 (Choi and Ashdown), 1034 (“...the mechanical properties of knitted fabrics vary according to knit structures, fibers, yarns, and densities...”). For example, nylon provides excellent wear and abrasion resistance; it also absorbs more moisture compared to other synthetic fibers. “Different knit structures have effects on the deformation of weft-knit preforms” *See generally*, EX1026 (Savci).

248. For example, Yamamoto discloses using a “first yarn” having particles with fibers having a deodorizing function from the tip of the foot to the instep of the foot (a first area), but that a “second yarn” without such fibers should be used in other areas of the upper (a second area). *See supra*, Claim 8; EX1017 (Yamamoto),

[0022] (disclosing that the “material and thickness of the fabric 2 ... are not limited to the examples shown.”). Shoe uppers are generally designed to have certain areas which are more wear resistant than other areas, for example, and that design choices would also vary stitch and yarn type to produce desired aesthetic effects, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶¶13-14, 26-28.

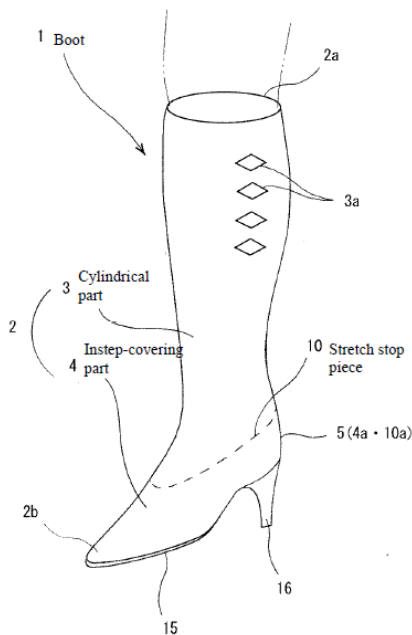
249. Therefore, Claim 14 is obvious in view of Yamamoto and Choi.

K. Claim 15

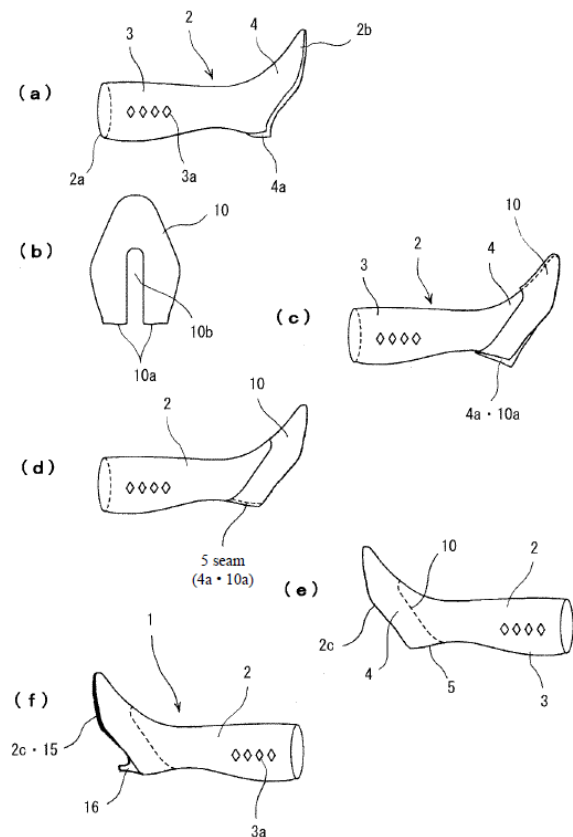
“The method recited in claim 11, further comprising assembling the flat-knitted element into an article of footwear.”

250. I note that Yamamoto explains that “[t]he entire outer surface of boot 1 (excluding the sole) is formed by a single piece of fabric 2 continuously knitted with yarn” EX1017 (Yamamoto), Abstract. Fabric 2 is a flat-knitted element within the meaning of the ’484 patent. *See supra*, Element 1[a]. Yamamoto further discloses that “boot 1 shown in FIG. 1 can be manufactured according to the following steps 1) to 6) shown in FIG. 2.” EX1017 (Yamamoto), [0023]; [0020] (“FIG. 1 is a perspective view of a boot 1 (stretch boot), and FIGS. 2(a) to 2(f) are explanatory diagrams regarding a method of manufacturing the boot 1.”). Moreover, Yamamoto’s fabric 2 (a flat-knitted element) “is provided so as to cover the entire outer surface of the boot 1 (other than the sole 15) by itself. *Id.*, [0021].

[FIG. 1]



[FIG. 2]



251. Therefore, Yamamoto clearly discloses assembling its flat-knitted element into an article of footwear, and therefore Claim 15 is also obvious in view of Yamamoto and Choi.

X. CLAIMS 16-17 ARE OBVIOUS OVER GROUND 2A IN FURTHER VIEW OF DUA-592 (GROUND 2B)

252. It would have been obvious, when constructing Yamamoto's footwear, to look to other references to understand known approaches for enclosing the bottom and heel portions because Yamamoto does not provide details on how the upper (fabric 2) is secured to the sole 15 and heel 16. Specifically, it would have been

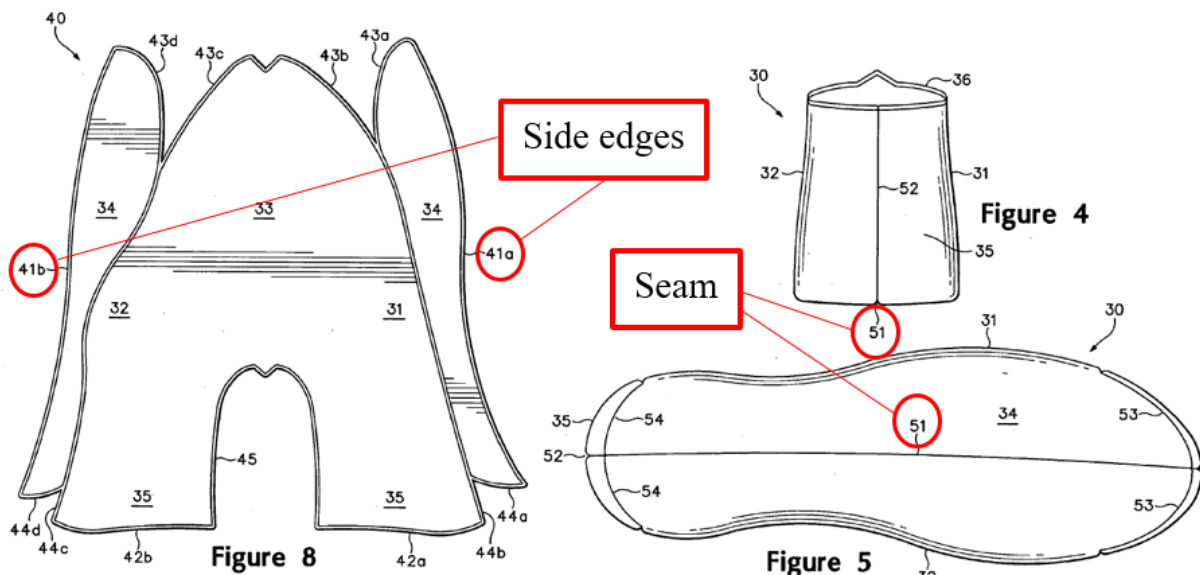
obvious to look to Dua-592 because it, like Yamamoto, is directed to an article of footwear having an upper produced using a flat-knitting process. A POSITA would have been particularly motivated to look to the techniques disclosed in Dua-592 because the uppers of Dua-592 and Yamamoto are both knitted and made using substantially the same process (flat knitting). It would have been obvious to use the same or similar techniques as Dua-592 for securing Yamamoto's knitted upper to its sole structures, and there would have been a reasonable expectation of success in achieving the features of claims 16-17 given that Dua-592 discloses to do so. There are a finite number of ways of assembling an upper, and joining the edges of the upper underneath the foot is one such known approach, as Mr. Delgatty confirmed. EX1003 (Delgatty), ¶¶15-18. In sum, it would have been obvious to try to use Dua-592's approach for enclosing the bottom and heel portions since the upper of Yamamoto, even as modified by Choi, has an open bottom and heel area and there are only a finite number of ways of securing such an upper to Yamamoto's sole 15 and heel 16.

A. Claim 16

“The method recited in claim 15, wherein the assembling includes joining side edges of the first side portion and the second side portion to form a seam extending under a foot and along a longitudinal length of the foot.”

253. As Dua-592 describes, it was known in the field of unitary knit uppers that side and rear edges of first and second side portions of a flat-knitted element

could be joined under the foot along longitudinal length of the foot and upwards along a heel, respectively. In particular, Dua-592 discloses that “[s]eams 51-54 are formed by securing various edges of textile element 40 together. More specifically, (1) seam 51 is formed by securing an edge 41a with an edge 41b” EX1014 (Dua-592), [0038]. Thus, edges 41a-41b would comprise side edges of the first and second side portions, where edges 41a-41b are joined to form seam 51 which extends longitudinally under the foot, as shown below.

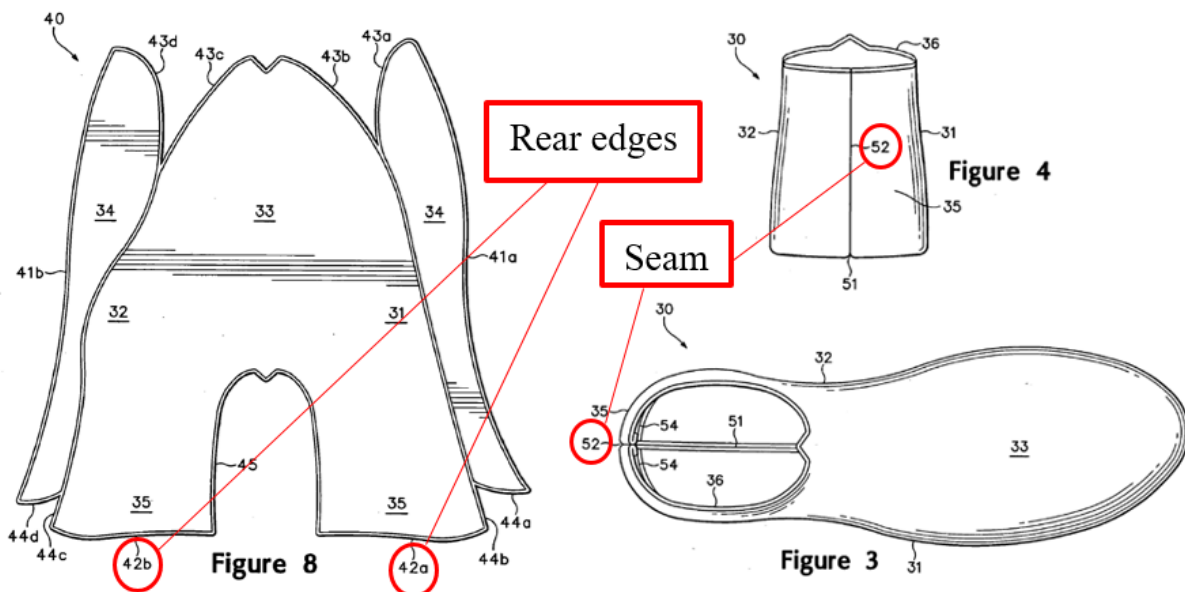


254. Therefore, Claim 16 is obvious in view of the Yamamoto-Choi combination, in further view of Dua-592.

B. Claim 17

“The method recited in claim 15, wherein the assembling includes joining rear edges of the first side portion and the second side portion to form a seam that extends upward along a heel.”

255. Dua-592 also discloses that “folding or overlapping of textile element 40 to form seam 51 places edge 42a adjacent to edge 42b, which facilitates the formation of seam 52.... Upon the joining of edges 42a and 42b to form seam 52, the u-shaped area becomes an aperture in textile element 40 and effectively forms ankle opening 36.” EX1014 (Dua-592), [0040]. Thus, edges 42a-42b are rear edges that form seam 52 which extends upward along a heel, thereby satisfying claim 17.



256. Therefore, Claim 17 is also obvious in view of the Yamamoto-Choi combination, in further view of Dua-592.

APPENDIX A

SABIT ADANUR

Professor

Auburn University, Department of Mechanical Engineering, Auburn, AL 36849

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e-mail: adanusa@eng.auburn.edu, <http://www.eng.auburn.edu/~adanusa>

1. EDUCATION

June 1989	Ph.D. in Fiber and Polymer Science North Carolina State University, Raleigh, North Carolina.
Dec. 1985	M.S. in Textile Engineering and Science North Carolina State University, Raleigh, North Carolina.
July 1982	B.S. in Mechanical Engineering Istanbul Technical University, Istanbul, Turkey.

PROFESSIONAL EXPERIENCE

Aug. '15 – Present	<u>Professor</u> Auburn University, Mechanical Engineering Department, Auburn, Alabama.
Oct. '00 – Aug. '15	<u>Professor</u> Auburn University, Polymer and Fiber Engineering Department, Auburn, Alabama.
Oct. '96 – Sept. '00	<u>Associate Professor</u> Auburn University, Textile Engineering Department, Auburn, Alabama.
Sep. '92 - Sep. '96	<u>Assistant Professor</u> Auburn University, Textile Engineering Department, Auburn, Alabama.
Nov. '89-Aug '92	<u>Product and Process Development Manager</u> Asten Forming Fabrics, Inc., Appleton, Wisconsin.
July '89-Oct. '89	<u>Process Development Engineer</u> Asten Forming Fabrics, Inc., Appleton, Wisconsin.
Aug. '83-Jun. '89	<u>Research/Teaching Assistant</u> North Carolina State University, Raleigh, North Carolina.

Professional Development Activities

- Attended the “WileyPLUS for Your Dynamics Course”, on 17 March 2022 for continuous improvement.

- Personal Protective Equipment (PPE) by IFAI (Industrial Fabrics Association International, Roseville, MN) for Covid 19, attended 7 webinars, May - June 2020.
- Summer Meta-Assessment Institute, July 10-14, 2017, Auburn University.
- Attended the webinar by Southern Alliance for Advanced Vehicle Manufacturing (SAAV), June 11, 2014.
- Attended the Biggio Seminar “Engaging Students in Active Learning”, 14 February 2013, Biggio Center, Auburn University.
- Attended the tutorial “Canvas Orientation”, Sept. 20, 2011, Auburn University.
- Attended the workshop “Introduction to Performance Tasks”, by [Cla]ssroom Academy, 15-16 August 2011, Auburn, AL.
- Completed the Alabama Ethics Law Training, March 31, 2011.

2. ASSIGNED DUTIES FOR THE PAST THREE YEARS (average)

<u>Quarter</u>	<u>Teaching (%)</u>	<u>Research (%)</u>	<u>Extension/Service (%)</u>
Summers	10	90	0
Academic	60	30	10

3. HONORS AND AWARDS

- Ranked among the world’s top 2% of all independently cited researchers by Stanford University, 2023.
- Auburn Author Award, 2018.
- Outstanding Faculty Award, Department of Polymer and Fiber Engineering, 2008-2009
- Outstanding Faculty Award, Department of Polymer and Fiber Engineering, 2007-2008
- Outstanding Teacher Award, Department of Textile Engineering, 2002-2003.
- Outstanding Teacher Award, Department of Textile Engineering, 2001-2002.
- Auburn Alumni Professor Award (1999 – 2004).
- Outstanding Teacher Award, Department of Textile Engineering, 2000-2001.
- AU College of Engineering Birdsong Merit Teaching Award 2000
- Outstanding Teacher Award, Department of Textile Engineering, 1999-2000.
- Auburn Alumni Engineering Council Senior Faculty Research Award, 1999.
- 1995 NSF Faculty Early Career Development (CAREER) Award, National Science Foundation, \$ 210,000.00, duration: 4 years (Sept. 1, 96-Aug. 31, 2000).
- 1991 George Goldfinger Award. "This award is presented to the graduate of the North Carolina State University, College of Textiles, Fiber and Polymer Science Program who was judged to have submitted the most outstanding Ph.D. thesis over the past two years".

4. SCHOLARLY CONTRIBUTIONS

4. A. TEACHING

4.A.1 Courses Taught for the Past Three Years

<u>Course</u>	<u>Title</u>	<u>Credit</u>	<u>Enrollment</u>
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Spring 2024

MECH 2140	Kinematics and Dynamics	3	65
MECH 5520/65200-PFEN 6200	Manufacturing of Polymeric Structures	4 (3+1)	50

Fall 2023

MECH 2140	Kinematics and Dynamics	3	32
MECH 5320/63200/6970D01	Engineered Flexible Structures	3	76

Summer 2023

MECH 2140	Kinematics and Dynamics	3	13
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Spring 2023

MECH 2140	Kinematics and Dynamics	3	65
MECH 5520/65200-PFEN 6200	Manufacturing of Polymeric Structures	4 (3+1)	80

Fall 2022

MECH 2140	Kinematics and Dynamics	3	45
MECH 5320/63200/6970D01	Engineered Flexible Structures	3	81

Spring 2022

MECH 2140	Kinematics and Dynamics	3	50
MECH 5970/6970-PFEN 6200	Manufacturing of Polymeric Structures	4 (3+1)	72

Fall 2021

MECH 2140	Kinematics and Dynamics	3	27
MECH 5970/6970	Engineered Flexible Structures	3	72

4.A.2 Graduate Students Whose Work Has Been Completed

Students for Whom The Candidate Served as Major Professor

Student	Degree	Chair	Department	Graduation Date	Current Employer
Jayswal, Ajay	PhD	Dr. Adanur	ME	Aug. 2023	Oak Ridge National Lab
Jayswal, Ajay	MS	Dr. Adanur	ME	Aug 2021	Oak Ridge National Lab
Alby, Laine	MS	Dr. Adanur	ME	May 2022	Enercon Services, Atlanta
Cermik, Ozdes	PhD	Dr. Marghitu/Adanur	ME	May 2017	K. Maras University
Shen, Yang	PhD	Dr. Adanur	PFEN	Dec. 2015	Highland Ind.
Shen, Yang	MS	Dr. Adanur	PFEN	Dec. 2013	Ph.D. student in PFEN
Meeks, Steve	MS	Dr. Adanur	PFEN	May 2012	WNA
Zheng, Hai	MS	Dr. Adanur	PFEN	Dec. 2010	Graduate Student
Gocek, Ikilem	PhD	Dr. Adanur	PFEN	May 2010	Istanbul Technical Univ.

Keskin, Reyhan	PhD	Dr. Adanur	PFEN	May 2010	Pamukkale University
Liu, Wei	PhD	Dr. Adanur	PFEN	May 2010	Intertek, IL
Selver, Erdem	MS	Dr. Adanur	PFEN	May 2010	PhD Student/England
Liu, Wei	MPFEN	Dr. Adanur	PFEN	May 2009	AU PhD student
Isikel, Lale	MS	Dr. Adanur	PFEN	May 2007	A company in Turkey
Irsale, Swagat J.	PhD	Dr. Adanur	PFEN	Dec. 2005	Nexus Software Sol, Inc., MN
Ascioglu, Birgul	PhD	Dr. Adanur	PFEN	Aug. 2005	Valeo, Inc., Bursa, Turkey
Irsale, Swagat J.	MS	Dr. Adanur	Textile Eng.	Dec. 2003	Nexus Software Sol, Inc., PA.
Hughes, Kevin	MTE	Adanur/Tippur	Textile Eng.	May 2005	GKN Aerospace
Vakalapudi, Sathendra	MS	Dr. Adanur	Textile Eng.	Aug. 2003	Detroit (software co.)
Onal, Levent	PhD	Dr. Adanur	Textile Eng.	May 2002	Erciyes University
Turel, Tacibaht	MS	Dr. Adanur	Textile Eng.	Aug. 2002	PhD, Consumer Aff.
Tascan, Mevlut	MS	Dr. Adanur	Textile Eng.	May 01	PhD, Clemson Univ.
Orak, Hakan	MS	Adanur/Tippur	Textile Eng.	May 01	PhD, Clemson Univ.
Kayathi, K. K.	MS	Dr. Adanur	Textile Eng.	January 01	India
Xu, BaoHua	MS	Dr. Adanur	Textile Eng.	Aug. 99	PhD Student, TE
Arumugam, Yuvaraj	MS	Dr. Adanur	Textile Eng.	July 98	Goodyear Tire Co.
Qi, Jing	MS	Dr. Adanur	Textile Eng.	May 98	Grad Student in EE
Tewari. Ashutosh	MS	Dr. Adanur	Textile Eng.	Dec. 97	California Co.
Hou, Zhenwei	MS	Dr. Adanur	Textile Eng.	Dec. 97	PhD Candidate
Gongalareddy, Sreekanth	MS	Dr. Adanur	Textile Eng.	Dec. 96	Telecom., Atlanta
Mallick, Sumita B.	MS	Dr. Adanur	Textile Eng.	Aug. 96	PhD (Boston Univ.)
Zhai, Honglian	MS	Dr. Adanur	Textile Eng.	Aug. 96	TCOM, Maryland
Yuksekkaya, M. Emin	MS	Dr. Adanur	Textile Eng.	June 96	Prof., Usak U., Turkey
Tsao, Yen P.	MS	Dr. Adanur	Textile Eng.	Dec. 95	Taiwan
Tam, Chi-Wen	MS	Dr. Adanur	Textile Eng.	March. 95	Taiwan
Sartain, Stephen L.	MS	Dr. Adanur	Textile Eng.	Dec. 94	Own automotive business

Others:

Inan, Gunes	PhD	Dr. Adanur	Textile Eng.	Aug. 04-Dec. 04
Kilinc, F. Selcen	PhD	Dr. Adanur	Textile Eng.	Aug. 00 – Dec. 01
Unsal, Evren	PhD	Dr. Adanur	Textile Eng.	Aug. 00-Feb. 01
Xu, BaoHua	PhD	Dr. Adanur	Textile Eng.	June 99 – Dec. 99
Zhenwei Hou	PhD	Dr. Adanur	Textile Eng.	Jan. 99 – Sept. 99
Mallick, Sumita B.	PhD	Dr. Adanur	Civil Eng.	Aug. 96 – Aug. 98
Nalamati, R. Kumar	MS	Dr. Adanur	Mech. Eng.	Sept. 95- April 96

Students for Whom The Candidate Served as Committee Member

Student	Degree	Chair	Department	Graduation Date	Current Employer
1. Alizadeh, Nima	PhD	Dr. Auad	CHEN	Spring 2021	Posdoc
2. Akhan, Ahmet F.	MS	Dr. Marghitu	ME	Spring 2019	Turkey
3. Sangars, Uday B.	MS	Dr. Beale	ME	Dec. 2015	Company
4. Furlong, Shane	MS	Dr. Broughton	PFEN	Dec. 2015	Company

5. Snead, Ed	MS	Dr. Thomas	PFEN	May 2015	PhD
6. Shirgaonkar, S.	MS	Dr. Beale	MECH	Dec. 2014	Hanwha, Opelika
7. White, Charles J.	PhD	Dr. Byrne	CHEN	Aug. 2014	FDA
8. Poyraz, Selcuk	PhD	Dr. Zhang	PFEN	June 2014	Assist. Prof., Turkey
9. Smith, James	MS	Dr. Zhang	PFEN	May 2014	Private Industry
10. Wang, Xialong	MS	Dr. Zhang	PFEN	Spring 2013	PhD at another univ.
11. Blackwell, C.	MS	Dr. Thomas	PFEN	Dec. 2012	CSP
12. Liu, Zhen	PhD	Dr. Zhang	PFEN	Spring 2012	UMaryland
13. Liu, Yang	MS	Dr. Zhang	PFEN	Dec. 2011	PhD student at AU
14. Quinones, Vladimir	PhD	Dr. Thomas	PFEN	Spring 2011	Post-doc at AU
15. Luna, Eric	PhD	Dr. Tatarchuk	Chemical Eng.	Summer 2009	Syngenta Crop, NC
16. Anthony, Rebecca	MS	Dr. Thomas	PFEN	Spring 2009	Industry, MS
17. Hasan Kocer	M.S.	Dr. Broughton	PFEN	Fall 2007	PhD student ITAS
18. Ray, Rebecca	M.S.	Dr. Thomas	PFEN	Fall 2006	Company
19. Ma, Erjian	PhD	Dr. Jang	Materials Eng.	Spring 01	Company
20. McCarthy, P. J.	MCE	Dr. Elton	Civil Eng.	Spring 96	Denver, CO
21. Xiao, Liming	PhD	Dr. Yang	Materials Eng.	Spring 98	Postdoc, AU EE
22. Hunt, Rich	MS	Dr. Nelms	Electrical Eng.	June 97	Company
23. Kirkpatrick, C. T.	MS	Dr. Jang	Materials Eng.	Spring 97	California Company
24. Kotha, S.	MS	Dr. Gowayed	Textile Eng.	Spring 97	India
25. Xi, Xiaomei	PhD	Dr. Yang	Materials Eng.	Aug. 96	California Company
26. Zhang, Qiang	PhD	Dr. Beale	Mechanical Eng.	Jan. 96	Maryland
27. Vickers, Daniel	MS	Dr. Beale	Mechanical Eng.	March 95	FMP/Rauma

Students for Whom the Candidate Served as Outside Reader

Student	Degree	Chair	Department	Defense Date
Shah, Syed H. R.	PhD	Dr. Ahmed	Aerospace Eng.	TBD
Khan, Omar	PhD	Dr. Ahmed	Aerospace Eng.	Apr. 23, 2021
Ozcan Ozturk	PhD	Dr. Nadolnyak	College of Agr.	Aug. 5, 2017
Donath, Gregory W.	PhD	Dr. Duke	Chemical Eng.	Nov. 10, 2008
Ajitsaria, Jyoti K.	PhD	Dr. Choe	Mech. Eng.	Aug. 29, 2008
Butts, Daniel Alan	PhD	Dr. Gale	Materials Eng.	May 9, 2005
ElBashir, Nimir	PhD	Dr. C. Roberts	Chemical Eng.	Nov 15, 2004
Gopalakrishnan, M.	PhD	Dr. ElHalwagi	Chemical Eng.	May 21, 2002
Noureldin, M.	PhD	Dr. ElHalwagi	Chemical Eng.	Oct.12, 00
Patil, A. R.	PhD	Dr. Crocker	Mechanical Eng.	Sept. 11, 00
Park, Y.	PhD	Dr. Roberts	Chemical Eng.	July 20, 00
Shelley, M. D.	PhD	Dr. El-Halwagi	Chemical Eng.	Apr. 20, 00
Abdo, Z. A. M.	PhD	Dr. Gale	Materials Eng.	Dec. 3, 99
Garrison, W.	PhD	Dr. El-Halwagi	Chemical Eng.	May 8, 97
Yim, J. H.	PhD	Dr. Jang	Materials Eng.	Apr. 25, 97
Hamad, A. A.	PhD	Dr. El-Halwagi	Chemical Eng.	Apr. 21, 97
Mallick, R. B.	PhD	Dr. Brown	Civil Eng.	Apr. 8, 97
Zhao, Li-Ren	PhD	Dr. Jang	Materials Eng.	Feb. 26, 96
Haque, Anwarul	PhD	Dr. Raju	Mechanical Eng.	Oct. 10, 95
Yim, Jong H.	PhD	Dr. Jang	Materials Eng.	April 25, 95

4.A.3 Graduate Students on Whose Committee the Candidate is Presently Serving

<u>Student</u>	<u>Degree</u>	<u>Chair</u>	<u>Department</u>
Akhan, A. F.	MS	Dr. Marghitu	MECH

Visiting Scholars/Students Supported

<u>Name</u>	<u>Origin</u>	<u>Duration</u>
Ms. Roxanne Guarin	Undergraduate student from Univ. of Mass-Amherst	May 21, 2008- July 31, 2008
Ms. Stacy Yee	Undergraduate student from Univ. of Michigan	May 21, 2007- July 27, 2007
Ms. Christina Yacoob	Undergraduate student from SUNY Buffalo	May 29, 2006-Aug. 4, 2006
Dr. Levent Gumusel	Turkey	Jan. – Feb. 2005, Jan. 2006
Dr. Hasan Bas	Turkey	Jan. – Feb. 2005, Jan. 2006
Ms. Abibe Maimaiti	China	Sept. 2001-Sept. 2002
Dr. Gulay Ozcan	Turkey	January 01 – February 01
Dr. Tianyi Liao	China	Aug. 96 - March 99.
Dr. Sule Altun	Turkey	July 99-Sept. 99

4.A.4 Courses and Curricula Developed

New Undergraduate Courses Developed:

Dr. Adanur has developed the following courses which did not exist before.

1. MECH 5520/6520 – PFEN 6200 Manufacturing of Polymeric Structures
2. MECH 5320/6320 Engineered Flexible Structures
3. PFEN 3200 Polymer Processing
4. ENGR 1110 Introduction to Polymer and Fiber Engineering
5. PFEN 3300 Fibrous Product Testing and Instrumentation
6. PFEN 4300 Engineered Fibrous Structures
7. PFEN 5100/6100 Fabrics for Papermaking
8. TXTN 3450 Technical Textiles
9. TE 225 Fabric Design and Manufacturing
10. TE 460 Mechanics of Textile Manufacturing Processes and Systems

New Graduate Courses Developed:

1. PFEN 6100 Fabrics for Papermaking
2. PFEN 6200 Polymer Processing
3. PFEN 6250 Advanced Engineering Fibrous Structures
4. PFEN 7210 Fabric Formation and Properties
5. PFEN 8200 Advanced Textile Structure Design and Development

4.A.5 Grants Received Related to Teaching (Total \$ 241,864.00; see also 4.B.8)

1. Adanur, S., Graduate Outreach Program (GOP) Grant, \$135.00, Spring 2009.
2. Two injection molding machines were donated to polymer processing lab by ThermoFisher Scientific of Auburn, May 2007, \$9,000.00.
3. Travel fund for the ITMA 2003, Birmingham, England.
Funding Agent: Highland Takata Industries
Amount: \$ 3,428.92
Duration: Oct. 21-30, 2003.
4. Developing a Course Based on Equipment Design for Introduction to Engineering
Funding Agent: AU College of Engineering
Amount: \$ 24,050
PI: P. Jones (leader), C. A. Flood, S. Adanur
Duration: June 1, 1999-May 31, 2000
5. Title: Travel fund for IFAI Expo 1999, San Diego, CA.
Funding Agent: Highland Takata Industries
Amount: \$ 4,000.00
PI: W. Walsh, S. Adanur, R. Broughton, Y. ElMogahzy
Duration: Oct. 28-30, 1999.
6. Title: Travel fund for Messe Frankfurt Industrial Textiles Fair, Frankfurt, Germany
Funding Agent: Highland Takata Industries
Amount: \$ 4,000.00
PI: S. Adanur (50%), W. Walsh (50%)
Duration: May 11-18, 1998
7. Title: Textile Structural Composites Laboratory
Funding Agent: National Science Foundation, Instrumentation and Laboratory Improvement (ILI)
Amount: \$ 87,185.00
PI: S. Adanur (95 %), Co-PIs: W. Walsh, R. Walker, B. Jang
Duration: Sept. 1, 94- Aug. 31, 96
This NSF grant is specifically for undergraduate curriculum development purposes.
8. Title: Wellington Sears Handbook of Industrial Textiles
Funding Agent: Wellington Sears Company, Valley, Alabama.
Amount: \$ 60,000.00
PI: Sabit Adanur
Duration: Oct. 1, 93 - March 15, 95.
9. Title: Discretionary Teaching Grant-in-Aid
Funding Agent: Auburn University

Amount: \$ 200.00

PI: Sabit Adanur

Duration: Nov. 1, 92 - Apr. 30, 93.

4.A.6 Publications Pertaining to Teaching

Textbooks/Book Chapters

1. Adanur, S., Paper Machine Clothing, 2nd Edition, December 2017. Library of Congress Catalog Card No. 2017-949013, ISBN No. 978-0-692-92120-3, 279 pages (331 figures, 47 tables).
2. Updating the Wellington Sears Handbook of Industrial Textiles, which has been an industry standard since 1995. The new expanded edition has new chapters and state of the art technology related to polymers, fibers, yarns, fabrics and their manufacturing processes and applications.
3. Chapter 8 – “Structure and Mechanics of Coated Fabrics”, book chapter in “Structure and Mechanics of Fibre Assemblies”, edited by Peter Schwartz - Woodhead Publishing Limited and CRC Press LLC, 2008.
4. Adanur, S., Wellington Sears Handbook of Industrial Textiles, Technomic Publishing Co., Inc., Lancaster, PA, 1995. Library of Congress Catalog Card No. 95-61229, ISBN No. 1-56676-340-1, 850 pages (519 figures and 140 tables).
5. Adanur, S., Paper Machine Clothing, Technomic Publishing Co., Inc., Lancaster, PA, 1997. Library of Congress Catalog Card No. 97-60981, ISBN No. 1-56676-544-7, 405 pages (338 figures, 55 tables).
6. Adanur, S., Handbook of Weaving, Technomic Publishing Co., Inc., 2001. Library of Congress Catalog Card No. 00-107625, ISBN No. 1-58716-013-7. 446 pages (539 Figures, 52 Tables).

Lecture Notes (Bound)

1. TE 425 Technical Textiles, Lecture Notes, Auburn University, 191 pages.
2. TE 460 Mechanics of Textile Manufacturing Processes and Systems, Lecture Notes, Auburn University, 154 pages.

4.A.7 Other Contributions to Teaching

1. ABET (Accreditation Board for Engineering and Technology) coordinator. Accreditation of Textile Engineering program in 1998 (first time ever), Fiber Engineering program in 2004 and Polymer and Fiber Engineering program in 2010 was achieved.
2. Semester Transition (was responsible for the quarter to semester transition for the curriculums in the Department of Textile Engineering).
3. Expansion of Master's Program (actively participated in expanding the Master's program in the Department. There were not adequate graduate level courses that covered certain aspects of the Master of Science program in Textile Engineering. Developed four new graduate level courses for this purpose).
4. Establishment of Ph.D. Program (was a member of the Textile Engineering Department Committee to establish a joint Ph.D. program with the Consumer Affairs Department).

Establishment of High Performance Materials Laboratory

Dr. Adanur has established an industrial textiles/composites laboratory in the Department. The lab is equipped with state-of-the-art equipment and is being used for teaching. Besides teaching, the laboratory provides an excellent opportunity for undergraduate and graduate students in their projects and independent studies. The lab will strengthen the University's interaction with industry. A new Instron was purchased and installed in the lab. Dr. Adanur received funding

from National Science Foundation for a computerized braiding machine which has been installed in the lab. He has purchased and installed a new compression molding machine and Dynatup impact testing machines with the NSF EPSCoR funding. The value of these machines is around \$ 600,000.00.

Establishment of Polymer Processing Laboratory

With the funding from Department of Commerce, Dr. Adanur went to University of Akron, Ohio to tour their polymer science and polymer engineering labs and analyze their equipment in 2006. Based on that analysis, Dr. Adanur specified and ordered the single screw extruder and injection molding machine for the PFEN department. These two machines are the heart of the current polymer processing lab in the department which is being used for teaching, research and extension.

4.A.7 Teaching Philosophy

My primary goal in teaching is to help produce high quality graduates to meet the needs of the industry and contribute to the advancement of engineering, science and technology in the field. I try to give the students the best education possible while preparing them for other aspects of life as well. Constant improvement of graduate and undergraduate education is essential for this purpose.

Good education of its people is the best investment that a country can make for the future. In the heart of this investment is the teachers and educational environment. Teaching is a combination of art and science and I believe that a good teacher is a gifted person. A teacher not only educates and teaches but also nurtures and prepares students for life. There is no substitute for one-to-one interaction between the student and faculty. Faculty should develop a suitable learning environment for students of different backgrounds. Although I emphasize, encourage and require teamwork in my classes, I also try to nurture the development of individual entrepreneurship and attributes in my students by giving them individually challenging tasks. I give the most importance to understanding the fundamental concepts and issues (not memorization) which should be the key to an engineering education. This gives students self-confidence and allows them to use their potential to the maximum. I try to train them to master the details without losing the "big picture" from their sight.

I believe that there are two aspects of higher education in engineering: technical and non-technical aspect. In the technical side, I provide students with education involving the application of the latest engineering and science principles to design, development, manufacturing and testing of engineered polymeric and fibrous products and processes. Polymer and fiber engineering is truly multi-disciplinary, and I am fortunate to have a multi-disciplinary background to give the students an education that has "breadth and depth". The application of technical textiles has spread into aerospace, civil engineering, architecture and construction, filtration, medicine, military and defense, paper making, safety and protection, transportation, agriculture, sports and recreation. I try to keep myself up to date with the latest engineering and science principles in these disciplines that are relevant to our profession to educate the students in a timely fashion. I incorporate the design aspect of polymer and fiber engineering in the courses that I teach throughout the curriculum. My courses present real-world applications without sacrificing conceptual and theoretical bases.

Both theory and applications should be taught in a complementary fashion. For this purpose, I closely integrate laboratory experience with classroom teaching. Students are exposed to industry problems during college years through field trips, special projects and case studies. Interdepartmental cooperation is encouraged through team projects. Understanding of the concepts and creative thinking are the keys for a successful engineering education. Student involvement is a key factor in successful learning.

The non-technical aspect of college education is as important as the technical aspect. A university is a bridge where young teenaged minds evolve into mature, knowledgeable and responsible citizens. They learn various life skills and attributes, some of which are learned outside the classroom. Therefore, I believe in developing a mentor-mentee relationship with students so that I can help during their transition in college years. For this reason, I try to make myself always available for students and I feel very rewarded when I see that I made a difference in a student's preparation for

life. I try to offer opportunities for extracurricular activities to prepare my students to meet the demands of a career in the present and future engineering workplace and be able to assume a responsible place of leadership in a complex technological society. If the students' evaluations and comments are an indicator, I feel that I am making a difference for them.

I follow the most recent developments in teaching technology closely and adapt them as soon as possible if they are feasible and useful. I have attended many seminars by the Biggio Center for the Enhancement of Teaching and Learning and will continue to do so whenever I can.

4.B RESEARCH / CREATIVE WORK

4.B.1 Books/Book Chapters (See 4.A.6)

1. Adanur, S., Paper Machine Clothing, 2nd Edition, December 2017. Library of Congress Catalog Card No. 2017-949013, ISBN No. 978-0-692-92120-3, 279 pages (331 figures, 47 tables).
2. Updating the Wellington Sears Handbook of Industrial Textiles, which has been an industry standard since 1995. The new expanded edition has new chapters and state of the art technology related to polymers, fibers, yarns, fabrics and their manufacturing processes and applications.
3. Chapter 8 – “Structure and Mechanics of Coated Fabrics”, book chapter in “Structure and Mechanics of Fibre Assemblies”, edited by Peter Schwartz - Woodhead Publishing Limited and CRC Press LLC, 2008.
4. Adanur, S., Wellington Sears Handbook of Industrial Textiles, Technomic Publishing Co., Inc., Lancaster, PA, 1995. Library of Congress Catalog Card No. 95-61229, ISBN No. 1-56676-340-1, 850 pages (519 figures and 140 tables).
5. Adanur, S., Paper Machine Clothing, Technomic Publishing Co., Inc., Lancaster, PA, 1997. Library of Congress Catalog Card No. 97-60981, ISBN No. 1-56676-544-7, 405 pages (338 figures, 55 tables).
6. Adanur, S., Handbook of Weaving, Technomic Publishing Co., Inc., 2001. Library of Congress Catalog Card No. 00-107625, ISBN No. 1-58716-013-7. 446 pages (539 Figures, 52 Tables).

4.B.2 Article-length Publications

Refereed Journal Articles Published (*: student)

1. A. Sapkota*, S. Ghimire* and S. Adanur, “A Review on Fused Deposition Modeling (FDM)-Based Additive Manufacturing (AM) Methods, Materials and Applications for Flexible Fabric Structure, Journal of Industrial Textiles, September 3, 2024, Vol. 54, 1-51, <https://doi.org/10.1177/15280837241282110>.
2. A. Jayswal*, J. Liu, G. Harris, R. Mailen and S. Adanur, Creep behavior of 3D printed polymer composites, Journal of Polymer Engineering and Science, 2023; 63: 3809-3818, doi:10.1002/pen.26486.
3. S. Adanur, A. Jayswal*, K. O. Griffin* and J. L. Hancock*, Additive Manufacturing of Weft Knitted and Braided Fabric Structures with Fused Deposition Modeling, Journal of the Textile Institute, <https://doi.org/10.1080/00405000.2023.2201910>, Published 25 April 2023.
4. A. Jayswal*, R. W. Mailen, J. Liu, G. Harris, M. Siwakoti, and S. Adanur, Thermo-mechanical behavior of 3D printed fabric structures, submitted to Journal of Polymer Engineering and Science, Published 7 April 2023, <http://doi.org/10.1002/pen.26319>.
5. A. Jayswal*, J. Liu, G. Harris and S. Adanur, Thermo-mechanical properties of composite filaments for 3D printing of fabrics, Journal of Thermoplastic Composite Materials, <https://doi.org/10.1177/08927057231163489>, 14 March 2023.
6. L. Alby*, A. Jayswal*, S. Morris, W. McAtee*, V. Gowda and S. Adanur, A Novel Face Mask Design with Improved Properties for COVID-19 Prevention, Textile Research Journal, 5 January 2023, <https://doi.org/10.1177/00405175221146295>.

7. Jayswal, A*, and Adanur, S., "An overview of additive manufacturing methods, materials, and applications for flexible structures", *Journal of Industrial Textiles*, Vol. 52, pp. 1-42, 2022, <https://doi.org/10.1177/15280837221114638>.
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Invited Feature Articles

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37. Adanur, S. (50%), and Liao, T. (50%), "3D Modeling of Textile Composite Preforms", Proceedings of the ICCE/5 Fifth International Conference on Composites Engineering, July 5-11, 1998, Las Vegas, NV.
38. Adanur, S. (50%), and Xu, B.* (50%), "Impact Resistance of Microwave Cured Glass/Epoxy Composites", Proceedings of the Second International Conference on Composite Science and Technology, ICCST/2, June 9-11, 1998, Durban, South Africa.
39. Mallick, S. B.* (50%), Elton, D. J. (25%), and Adanur, S. (25%), "A New Approach in Modeling of Soil-Geotextile Interface Behavior in Pullout Tests", Proceedings of the Sixth International Conference on Geosynthetics, March 25-29, 1998, Atlanta, GA.
40. Adanur, S.(50%), and Xu, B.* (50%), "Fast, Net Shape Manufacturing of Textile Composites", Proceedings of the Design and Manufacturing Grantees Conference, National Science Foundation, Monterrey, Mexico, January 1998.
41. Adanur, S. (50%), Hou, Z. * (50%), "Recycling and Reuse of PVC Coated Polyester Fabric", TCL7, Proceedings of the 7th International Conference on Textile Coating and Laminating, Charlotte, NC, November 1997.
42. Adanur, S. (50%), and Xu, B.* (50%), "Characteristics of Microwave-Cured Braided Glass/Epoxy Composites", Proceedings of the Composites at Lake Louise, CALL '97, Lake Louise, Canada, October 1997.
43. Adanur, S. (50%), Arumugam, Y. S.* (5%), and Xu, B.* (45%), "Fast Net Shape Manufacturing of Braided Textile Composite Structures", Proceedings of the Fourth International Conference on Composites Engineering (ICCE/4), Hawaii, July 1997.
44. Adanur, S. (50%), and Sreekanthreddy, G.* (50%), "Compression Behavior of 3D Reinforced Glass/Epoxy Laminar Composite Profiles", ICAPC-97, Proceedings of the International Conference on Advanced Polymer Composites, Materials, Processing and Applications, Beijing University of Aeronautics and Astronautics, Beijing, China, June 1997.
45. Basu Mallick, S.* (40%), Elton, D. J. (30%), and Adanur, S. (30%), "An Experimental Characterization of Soil-Woven Geotextile Interface in Large Box Pullout Tests", Proceedings of the Geosynthetics '97, Long Beach, CA, March 1997, pp. 927-940.
46. Adanur, S., "Manufacturing of Industrial Textiles", 10 pages, Proceedings of the NSF sponsored Symposium, December 1996, Alexandria, Egypt.
47. Adanur, S. (40%), Mallick, S.*(30%) , and Zhai, H.*(30%), "Analysis of Geotextile-Soil Interaction in Pull-Out Tests", Proceedings of the IS Kyushu '96, International Symposium on Earth Reinforcement, Fukuoka, Japan, November 1996.
48. Warren, A.* (50%), El-Halwagi, M. (25%) and Adanur, S. (25%), "Design of a New Process for Converting Textile Solid Waste into Transportation Fuel", Proceedings of the First Trabzon International Energy and Environment Symposium, Karadeniz Technical University, Trabzon, Turkey, July 1996.
49. Adanur, S. (50%), and Gongalareddy, S.*(50%), "Compressive Properties of Stitched Woven Fiberglass Fabric Reinforced Composite Sections for Civil Engineering Applications", ICCE/3, Proceedings of the Third International Conference on Composites Engineering, New Orleans, LA, July 1996.
50. Adanur, S., (80%) and Tam, C. A*. (20%), "On-machine Stitching of 3-D Laminate Structures for Composites", Proceedings of the 2nd International Conference on Composites Engineering (ICCE/2), New Orleans, LA, August 1995.

51. Wang, S.* (40%), Adanur, S. (40%) and Jang, B. Z. (20%), "Thermo-Mechanical Behavior of Fiber/Filler Reinforced Phenolic Matrix Composites", Proceedings of the 2nd International Conference on Composites Engineering (ICCE/2), New Orleans, LA, August 1995.
52. Wang, S.* (40%), Adanur, S. (40%) and Jang, B. Z. (20%), "Mechanical Behavior of Fiber/Filler Reinforced Phenolic Matrix Composites", Proceedings of the 2nd International Conference on Composites Engineering (ICCE/2), New Orleans, LA, August 1995.
53. Adanur, S. (50%), Mallick, S. B.* (25%), and Zhai, H.* (25%), "Design and Characterization of Geotextiles for High Performance Applications", Proceedings of the Hi-Tech Textiles Exhibition and Conference, Textile World and INDA, Greenville, SC, July 1995.
54. Mallick, S. B.* (40%), and Zhai, H.* (40%), "A Laboratory Study on Pull-out Performance of Woven Geotextiles", Geosynthetics '95 Conference Proceedings, Nashville, TN, February 1995. This student paper, directed by Dr. Adanur (10%) and Dr. Elton (10%), was one of the 6 papers accepted for the conference.
55. Adanur, S. (60%), and Tsao, Y. P.* (40%), "Stitch Bonded Textile Structural Composites", SAMPE, Proceedings of the 26th International Technical Conference, Atlanta, GA, October 94.
56. Kozey, K.* (40%), Kumar, S. (20%), (Ga Tech), Adanur, S. (20%), and Mohamed, M. H. (20%), (NC State), "Compressive Failure Mechanisms in Woven and Laminate Glass/Epoxy Composites", SAMPE, Proceedings of the 26th International Technical Conference, Atlanta, GA, October 94.
57. Adanur, S. (60%), Tsao, Y. P.* (20%), and Tam, C. W.* (20%), "Improving Fracture Resistance in Laminar Textile Composites", Proceedings of International Conference on Composite Engineering, ICCE/1, New Orleans, LA, August 1994.
58. Adanur, S., "Design and Structure of Fabrics for Papermaking", 3rd Annual International Hi-Tech Textiles Conference, Textile World and INDA, Greenville, SC, June 1994.
59. Adanur, S., (50%) and Walker, R. P. (50%), "Yarn Preparation for Weaving in the Future", Proceedings of the 33rd Annual Textile Slashing Short Course, Auburn University, AL, September 1993.
60. Adanur, S., "Effects of Forming Fabric Design on Paper Properties", Second International Hi-Tech Textiles Exhibition and Conference Proceedings, Greenville, SC, July 1993.

Non-refereed Journal Articles

1. Griffin, K., Jayswal, A., and Adanur, S., Additive Manufacturing of Braided Structures for Composite Reinforcement, Auburn University, Journal of Undergraduate Scholarship, 19 August 2022.
2. LaBombard, K., and Adanur, S., "Manufacturing of Nanoparticle Reinforced Materials through Electrospinning", Auburn University, Journal of Undergraduate Scholarship, http://our.auburn.edu/wp-content/uploads/2019/01/AUJUS-2018-Workspace_0000-dragged.pdf, January 25, 2019.
3. O'Dell, H., "Narrow Fabrics in Broad Use", Industrial Fabrics Products Review, Nov. 2007, pp. 48-51 (Adanur was interviewed and quoted in this article).
4. "Your Firm Has ISO Certification: What Comes Next?", This editorial paper was published based on our article: Allen, B.*. (50%), and Adanur, S. (50%), "ISO 9000: First Results After Implementation", Textile World, August 1994.
5. Adanur, S., "Forming Fabrics in Papermaking", Textile and Technique, Turkish/English, August 1994, pp. 115-118.
6. Adanur, S., "Latest Developments in Weaving Machinery at ATME-I 93 Show", Textiles and Technique, Turkish/English, September 1993 (in Turkish).

Tech Briefs

1. Bakhtiyarov, S., Overfelt, R. A., and Adanur, S., "Improvements in Fabrication of Sand/Binder Cores for Casting", NASA Tech Briefs, July 2005.
2. "US-Turkey Cooperative Research", AL EPSCoR, 2004 Annual Report to the AL Commission on Higher Education, 10 Dec. 2004, pp. 18-19.
3. A summary report was submitted to Ms. Jennifer Braxton, Economic Development Analyst with the Economic Development Partnership of Alabama, Birmingham, entitled "Fiberglass Composite Research", Sept. 3, 2004; 4 pages.
4. Bakhtiyarov, S., Overfelt, R. A., and Adanur, S., "Improvements in Fabrication of Sand/Binder Cores for Casting", NASA Tech Brief, April 9, 2002.

4.B.3 Technical Presentations Made (presenter's name is in *Italic*)

1. *S. Adanur*, Additive Manufacturing of Polymeric Structures, Keynote Speech-9, 13th International Fiber and Polymer Research Symposium (13th ULPAS), Bolu Abant Izzet Baysal University, Turkey, November 3-4, 2023 (via Zoom).
2. *S. Adanur*, Latest Developments in Paper Machine Clothing as it Relates to Papermaking, TAPPIcon 2023, Technical Association of the Pulp and Paper Industry, April 22-26, 2023, Atlanta, GA.
3. Alby, L., Jayswal, A., and *Adanur, S.*, Novel Medical Facemasks for Covid-19, The Fiber Society 2022 Fall Meeting and Technical Conference, NC State University, Raleigh, NC, 19-21 October 2022.
4. *Jayswal, A.*, and *Adanur, S.*, Computational Analysis of 3D Printed Woven Fabrics, The Fiber Society 2022 Fall Meeting and Technical Conference, NC State University, Raleigh, NC, 19-21 October 2022.
5. *Jayswal, A.*, and *Adanur, S.*, Design, fabrication, and testing of novel 3D printed facemasks, CPAC Summer seminar series, Auburn University, 20 July 2021.
6. *Jayswal, A.*, and *Adanur, S.*, Effect of Heat Treatment on the Crystallinity and Mechanical Properties of FDM 3D Printed Twill Fabric Structures, AU Research 2021 Student Symposium, Auburn University, 30 March 2021.
7. *Adanur, S.*, and Jayswal, A., 3D Printing of Fabric-like Structures, TechTextil North America, 19 November 2020 (Webex presentation).
8. *LaBombard, K.*, and *Adanur, S.*, "Manufacturing of Nanoparticle Reinforced Materials Through Electrospinning", The Fiber Society 2017 Fall Conference, Athens, GA, Nov. 8-10, 2017.
9. Shen, Y., Broughton, R., Beale, D., Foster, W., Branscomb, D., and *Adanur, S.*, "Failure Analysis of Open-Architecture Composite Structures Under Compression", The Fiber Society 2015 Fall Meeting and Technical Conference, October 28-30, 2015, College of Textiles, North Carolina State University, Raleigh, NC.
10. Shen, Y., Sangars, U., *Adanur, S.*, Broughton, R., *Beale, D.*, and Foster, B., "Failure Analysis of Micro-joints in Open-architecture Composite Structures (O-ACS)", TEXCOMP-12, 12th International Conference on Textile Composites, NC State University, College of Textiles, Raleigh, NC, USA, May 26-29, 2015.
11. *Shen, Y.*, *Adanur, S.*, Broughton, R., Beale, D., and Foster, B., "Buckling Analysis of Open-Architecture Composite Structures (O-ACS)", This is Research: Student Symposium 2015, Auburn University, 13 April 2015.
12. *Adanur, S.*, "Application of Fluid Dynamics in PFEN", presentation given to AU Fluid Dynamics Working Group, 5 March 2015, Auburn, AL (Fluid Dynamics Working Group was established as a result of the SGCOE Interdisciplinary Faculty Research Colloquium).
13. *Shen, Y.*, and *Adanur, S.*, "Modeling of tensile properties of multi-layer fabrics by multi-scale finite element method", Auburn University Graduate Scholar Forum, 5 March 2014.
14. *Shen, Y.*, and *Adanur, S.*, "A Biaxial Braiding Tubular Structure Based on Helical Auxetic Yarns", The Fiber Society International Symposium on Fibers Interfacing the World, Oct. 23-25, 2013, Clemson, SC.

15. *Adanur, S.*, and Liu, W., “Desulfurization Properties of Activated Carbon Fibers in Dry Conditions”, International Istanbul Textile Congress 2013, New Materials, May 30-31, 2013, Istanbul, Turkey.
16. *Shen, Y.*, *Adanur, S.*, *Meir, A.* and *Cao, Y.*, “Finite Element Analysis of Uniaxial Tension of Polyester Monofilament Woven Fabric”, Auburn Research Week, 3 April 2013.
17. *Adanur, S.*, and Broughton, R., “Recovery and Reuse of Waste PVC Coated PET Fabrics”, The 4th International R&D Project Brokerage Event, Bursa, Turkey, Feb. 2-3, 2012 (presented as poster as well).
18. *Adanur, S.*, “PVA Nanofiber Based Membrane for Proton Exchange Membrane Fuel Cells”, The 4th International R&D Project Brokerage Event, Bursa, Turkey, Feb. 2-3, 2012 (presented as poster as well).
19. Selver, E., and *Adanur, S.*, Properties of Nanoclay Added Composite Polypropylene Monofilaments Using Twin and Single Screw Extruders, Fiber Society International Symposium on New Frontiers in Fiber Materials Science, Oct. 11-13, 2011, Charleston, SC.
20. *Adanur, S.*, A Novel Filling Insertion System for Weaving, The 3rd International R&D Project Brokerage Event, Bursa, Turkey, Feb. 10-11, 2011.
21. *Adanur, S.*, Conceptual Design and Characterization of 3D Interlaced Fibrous Structures, The 3rd International R&D Project Brokerage Event, Bursa, Turkey, Feb. 10-11, 2011.
22. Zheng, H., and *Adanur, S.*, “Synthesis and Characterization of Sulfonated Polyimide Based Membrane for Proton Exchange Membrane Fuel Cell Applications”, Alabama Composites Conference, Aug. 24-26, 2010, Birmingham, AL (presented as poster as well).
23. Liu, W., and *Adanur, S.*, “Activated Carbon Fiber Filter Media in Proton Exchange Membrane Fuel Cells for Automotives”, Techtextil North America Symposium, May 18-20, 2010, Georgia World Congress Center, Atlanta, GA.
24. *Adanur, S.*, and Selver, E., “Processing and Properties of nanoclay reinforced polypropylene monofilaments”, The 4th International Technical Textiles Congress, 16-18 May 2010, Istanbul, Turkey.
25. *Adanur, S.*, and Gocek, I., “Nanoclay and Compatibilizer Effects on Polypropylene Cast Film Processing and Properties”, Fiber Society Spring 2010 International Conference, May 12-14, 2010, Bursa, Turkey.
26. Keskin, R., and *Adanur, S.*, “Improving Toughness of Polypropylene Injection Molded Parts with Thermoplastic Elastomer Materials”, The Fiber Society 2009 Fall Meeting and Technical Conference, The University of Georgia, Athens, GA, Oct. 28-30, 2009.
27. *Gocek, I.*, and *Adanur, S.*, “Effect of Processing Parameters on Polypropylene Film Properties”, The Fiber Society 2009 Fall Meeting and Technical Conference, The University of Georgia, Athens, GA, Oct. 28-30, 2009.
28. *Selver, E.*, and *Adanur, S.*, “Processing and Property Relationship of Nanoclay Reinforced Polypropylene Monofilaments”, The Fiber Society 2009 Fall Meeting and Technical Conference, The University of Georgia, Athens, GA, Oct. 28-30, 2009.
29. *Liu, W.*, and *Adanur, S.*, “Application of Activated Carbon Fibers in Fuel Cell Cathode Filter Media”, The Fiber Society 2009 Spring Conference: International Conference on Fibrous Materials 2009, Shanghai, China, May 27-29, 2009.
30. *Adanur, S.*, Nanotechnology Applications in Textiles, The 6th Textile Congress, Suleyman Demirel University, Isparta, Turkey, May 1-3, 2009.
31. *Liu, W.*, and *Adanur, S.*, “Activated carbon fiber filter media for PEM fuel cell cathode”, AU Annual Research Forum, 10 March 2009.
32. *Adanur, S.*, “Nanotechnologies are Coming Your Way”, Industrial Fabrics Association International (IFAI) Expo '08, October 21-23, 2008, Charlotte, NC (invited presentation).
33. *Adanur, S.*, and Isikel, L., “Manufacturing of Carbon Nonwoven Gas Diffusion Layers with Wet-Laying Process”, Techtextil North America Symposium, April 1-3, 2008, Atlanta, GA.

34. *Adanur, S., Gumusel, L. and Bas, H., "A Novel 3D Woven-Knit Hybrid Fabric for Composites", Techtextil North America Symposium, April 1-3, 2008, Atlanta, GA.*
35. *Adanur, S., and Isikel, L., "Nonwoven Fabrics for Gas Diffusion Layers in Polymer Electrolyte Membrane Fuel Cells", Conference on Structural Composites Applications in Defense, Infrastructure, Transportation, Corrosion-Prevention and Power Industry, March 4-6, 2008, Birmingham, AL.*
36. *Auad, M. L. , Mosiewicki, M. A., Richarson, T., Adanur, S., Aranguren, M. I. , Marcovich, N. E., Medeiros, E. S., and Mattoso, L. H. C., "Shape Memory Polyurethanes Reinforced with Electrically Conductive Cellulose Crystals" , COMAT 2007, December, 2007, Brazil.*
37. *Ascioglu, B., and Adanur, S., "Nanofiber Coating and Nanofiber Based Continuous Yarn Manufacturing" (including proceedings), 2nd Textile Technology and Textile Machinery Congress, 19-20 October 2007, Gaziantep, Turkey.*
38. *Adanur, S., "Innovation in Textiles, Nanotechnology Practices and Technical Textiles", 1st International Textile and Apparel Summit, June 2-3, 2007, Denizli, Turkey.*
39. *Adanur, S., and Isikel, L., "Design and Characterization of Nonwoven Fabrics for Gas Diffusion Layer in Polymer Electrolyte Membrane Fuel Cells", May 23, 20007, Karadeniz Technical University, Trabzon, Turkey.*
40. *Ascioglu, B., and Adanur, S., "Hexagonal Unit Cell Model for Thermal Conductivity of Nano-Micro Fiber Composites", ULIBTK '07, The 16th Heat Transfer Congress, May 30- June 2, 2007, Erciyes University, Kayseri, Turkey.*
41. *Isikel, L., and Adanur, S., "Manufacturing of Gas Diffusion Layers for Polymer Electrolyte Membrane Fuel Cell", Auburn University 17th Annual GSC Research Forum, 7 March 2007, Foy Union, AU.*
42. *Adanur, S., and Irsale, S., "Textile Stent Prototyping and Modeling", IFAI Expo 2006 Medical Textiles Symposium, Atlanta, Oct. 31, 2006.*
43. *Adanur, S., "Wide World of Industrial Textiles", presentation given to the teachers at the Istanbul Textile Vocational School, June 22, 2006, Istanbul, Turkey.*
44. *Adanur, S., "Dynamics of Air-Jet Weaving", The First Istanbul International Textile and Textile Machinery Congress, June 1-2, 2006, Istanbul, Turkey.*
45. *Adanur, S., Aglan, H., Gumusel, L., and Bas, H., "Textile Machinery and Processes for Composite Preform Manufacturing", The First Istanbul International Textile and Textile Machinery Congress, June 1-2, 2006, Istanbul, Turkey.*
46. *Adanur, S., Isikel, L., and Abdelhady, F., "Coated and Laminated Fabrics for Fuel Cells", TechTextil Symposium North America, March 28-30, 2006, Atlanta, GA.*
47. *Isikel, L., and Adanur, S., "Comparative Evaluation of GDL Media for PEMFCs", Auburn University Annual Graduate Student Research Paper Competition, 9 March 2006, Foy Union, AU.*
48. *Adanur, S., Schwartz, P., Broughton, R., S., Thomas, H., Byrne, M., and Hong, J. W., "Novel Polymeric Materials and Structures for Biomedical/Health Applications", presentation given to the AU internal committee for NSF Major Research Instrumentation (MRI) Program, 9 Dec. 2005.*
49. *Adanur, S., "Application of Industrial Textiles", Seminar given to ITAS 8960 Class, 8 Sept. 2005.*
50. *Adanur, S., "High Tech Textiles", Bossa, Adana, Turkey, 18 July 2005.*
51. *Adanur, S., "Coated and Laminated Fabrics for Fuel Cells", 2nd International Technical Textiles Congress, Istanbul, Turkey, 13-15 July 2005.*
52. *Adanur, S., and Ascioglu, B., "Challenges and Opportunities in Nano Fiber Manufacturing and Applications", 2nd International Technical Textiles Congress, Istanbul, Turkey, 13-15 July 2005.*
53. *Adanur, S., "Higher Education in the U.S", Suleyman Demirel University, Isparta, Turkey, 8 July 2005.*
54. *Adanur, S., "High Tech Textiles", Suleyman Demirel University, Isparta, Turkey, 8 July 2005.*
55. *Adanur, S., "High Tech Textiles", Denizli Chamber of Commerce, Turkey, 7 July 2005.*

56. *Adanur, S.*, “High Tech Textiles”, Pamukkale University, Denizli, Turkey, 6 July 2005.
57. *Adanur, S.*, “Higher Education in the U.S”, Karadeniz Technical University, Trabzon, Turkey, 30 June 2005.
58. *Irsale, S.*, and *Adanur, S.*, “Exporing Textile Stents: Prototyping and Modeling”, Fiber Society Spring 2005 Conference, May 25-27, 2005, St. Gallen, Switzerland.
59. *Ascioglu, B.*, and *Adanur, S.*, “Heat Transfer Modeling in Nanofiber Reinforced Composite”, Auburn University Annual Graduate Student Research Paper Competition, 10 March 2005, Foy Union, AU.
60. *Irsale, S.*, and *Adanur, S.*, “Textile Prosthesis for Vascular Applications”, NTC Paper presentation, 10 January 2005, Spidle Hall, Auburn University.
61. *Ascioglu, B.* and *Adanur, S.*, “Heat Transfer Modeling in Nanofiber Reinforced Composite”, NTC Paper presentation, 10 January 2005, Spidle Hall, AU.
62. *Adanur, S.*, “High Performance and Nano Fibers”, Twichell Corporation, Dothan, AL, Sept. 2, 2004.
63. *Adanur, S.*, “Dynamic Analysis of Air-Jet Filling Insertion: Effect of Timing on Air and Yarn Velocity”, SECTAM XXII, 22nd Southeastern Conference on Theoretical and Applied Mechanics, August 15-17, 2004, Tuskegee, AL.
64. *Ascioglu, B.*, and *Adanur, S.*, “Heat Transfer Behavior of Particle Reinforced Nanofibers”, SECTAM XXII, 22nd Southeastern Conference on Theoretical and Applied Mechanics, August 15-17, 2004, Tuskegee, AL.
65. *Irsale, S.*, and *Adanur, S.*, “Compression Force Modeling of Braided Textile Stents”, SECTAM XXII, 22nd Southeastern Conference on Theoretical and Applied Mechanics, August 15-17, 2004, Tuskegee, AL.
66. *Ascioglu, B.*, and *Adanur, S.*, “Modeling of Thermal Conductivity in Nanofiber Composites”, ICCE-11, 11th Annual International Conference on Composites/Nano Engineering, Hilton Head, SC, August 8-14, 2004.
67. *Adanur, S.*, and *Ascioglu, B.*, “Processing Characterization of PVA Nanofibers in Electrospinning”, ICCE-11, 11th Annual International Conference on Composites/Nano Engineering, Hilton Head, SC, August 8-14, 2004.
68. *Adanur, S.*, “Geotextiles”, Unsa, Inc., Istanbul, Turkey, July 19, 2004.
69. *Adanur, S.*, and *Vakalapudi, J. S.*, “Fabric Design and Analysis System in 3D Virtual Reality”, The 2nd International Istanbul Textile Congress, April 22-24, 2004, Istanbul, Turkey.
70. *Irsale, S.*, and *Adanur, S.*, “Monofilament Yarns in Braided Vascular Prostheses”, TechTextil Symposium North America, Atlanta, GA, March 30-April 1, 2004.
71. *Ascioglu, B.*, *Adanur, S.*, *Patra, P. K.*, *Inan, G.*, *Kim, Y.*, and *Warner, S.*, “Heat Transfer Modeling in Nanofiber Reinforced Composites”, ICCE-10, New Orleans, July 20-26, 2003.
72. *Inan, G.*, *Patra, P. K.*, *Warner, S. B.*, *Kim, Y. K.*, *Ascioglu, B.*, and *Adanur, S.*, “In-Situ Polymerized Flame Retardant Nanocomposites”, ICCE-10, New Orleans, July 20-26, 2003.
73. *Onal, L.*, and *Adanur, S.*, “A Novel 3D Structure, 3D Hybrid Woven/Knitted Fabric”, Proceedings of the The Fiber Society 2003 Spring Symposium, “Advanced Flexible Materials and Structures: Engineering with Fibers”, June 30-July 2, 2003, Loughborough, England.
74. *Adanur, S.*, “Wide World of Industrial Textiles”, June 19, 2003, Marmara University, Istanbul, Turkey,
75. *Sathendra, V.*, and *Adanur, S.*, “Fabric Design and Analysis System in 3D Virtual Reality”, Auburn University Annual Research Forum, Auburn, AL, 20 March 2003.
76. *Adanur, S.*, “Wide World of Industrial Textiles”, Dong Hua University, Shanghai, China, 26 Sept. 2002.
77. *Adanur, S.*, and *Onal, L.*, “Experimental Analysis of Textile Composites”, TechTextil North America Symposium, Atlanta, GA. April 9-11, 2002, April 9-11, 2002.
78. *Elton, D. J.*, *Howie, D. L.*, and *Adanur, S.*, “Bubblepoint Testing of Nonwoven Geotextiles”, 37th Symposium on Engineering Geology and Geotechnical Engineering, Boise, Idaho, March 27-29, 2002.
79. *Adanur, S.*, and *Turel, T.*, “Mechanics of Air-Jet Filling Insertion”, 2001 ASME International Mechanical Engineering Congress & Exposition, New York, NY, Nov. 14, 2001.

80. *Adanur, S.*, "Role of Technical Fabrics in Papermaking: An Overview", Techtextil Symposium North America, March 13-15, 2001, Atlanta, Georgia.
81. *Adanur, S.*, and Onal, L., "Effects of Production Variables on Stress-Strain Behavior of Glass/Epoxy Textile Composites in Compression Molding", The 2000 American Society of Mechanical Engineers (ASME) Congress & Exposition, Orlando, FL, Nov. 5-10, 2000.
82. *Adanur, S.*, and Onal, L., "Impact Failure Analysis of Glass/Epoxy Textile Composites", The 2000 American Society of Mechanical Engineers (ASME) Congress & Exposition, Orlando, FL, Nov. 5-10, 2000.
83. *Adanur, S.*, and Orak, H., "Textile Composites", DOE/TACOM Army 21st Century Truck Program, Auburn University, Auburn, AL. 3 August 2000.
84. *Adanur, S.*, Xu, B., and Orak, H., "Braided Composite Automotive Chassis Frame", ICCE/7 Seventh International Conference on Composites Engineering, July 2-8, 2000, Denver, CO.
85. *Elton, D. J.*, and *Adanur, S.*, "Varying Pore Sizes in Hydroentangled Geotextiles", Techtextil North America International Trade Fair for Technical Textiles and Nonwovens", March 22-24, 2000, Atlanta, GA.
86. *Adanur, S.*, Bakhtiyarov, S., and Beale, D., "Characterization of Air-Yarn Interface in Air-Jet Weaving", National Textile Center Annual Forum, January 27-29, 2000, Myrtle Beach, SC.
87. Hou, Z., and *Adanur, S.*, "Direct Use of Waste PVC Coated Fabrics to Reinforce Composites", 1999 International Mechanical Engineering Congress & Exposition, November 17, 1999, Nashville, Tennessee.
88. *Bakhtiyarov, S.* (50%), and *Adanur, S.* (50%), "Airflow over Wavy Yarn in Air-jet Filling Insertion", Second International Symposium on Mathematical & Computational Applications, Baku, Azerbaijan, September 1-3, 1999.
89. *Adanur, S.* (50%), and *Bakhtiyarov, S.* (50%), "Numerical Study of Collision Efficiency of Dust Particles", Second International Symposium on Mathematical & Computational Applications, Baku, Azerbaijan, September 1-3, 1999.
90. *Yuksekkaya, M. E.*, Thomas, H., and *Adanur, S.*, "Analysis of Elastic Deformation of Braided Tubular Structures for Medical Applications, The Fiber Society 58th Annual General Conference, Symposium on Textile and Polymer Based Biomaterials, Philadelphia, PA, May 3-4, 1999.
91. *Adanur, S.*, Gawayed, Y., and Thomas, H., "On-Line Measurement of Fabric Properties ", National Textile Center Annual Forum, January 28-30, 1999, Myrtle Beach, SC.
92. *Adanur, S.*, and Xu, B., "Influence of Microwave Fast Preheating on Epoxy Resin Chemorheology Properties", The 1998 International Mechanical Engineering Congress and Exposition, November 15-20, 1998, Anaheim, CA.
93. *Adanur, S.*, and Liao, T., "3D Modeling of Textile Composite Preforms", ICCE/5 Fifth International Conference on Composites Engineering, July 5-11, 1998, Las Vegas, NV.
94. *Adanur, S.*, and Xu, B., "Impact Resistance of Microwave Cured Glass/Epoxy Composites", ICCST/2, Second International Conference on Composite Science and Technology, Durban, South Africa, June 9-11, 1998.
95. Mallick, S. B., Elton, D. J., and *Adanur, S.*, "A New Approach in Modeling of Soil-Geotextile Interface Behavior in Pullout Tests", Sixth International Conference on Geosynthetics, March 25-29, 1998, Atlanta, GA.
96. *Adanur, S.*, and Hou, Z., "Recycling and Reuse of PVC Coated Polyester Fabric", TCL7, The 7th International Conference on Textile Coating and Laminating, Nov. 17-18, 1997, Charlotte, NC.
97. *Adanur, S.*, and Xu, B., "Characteristics of Microwave-Cured Braided Glass/Epoxy Composites", Composites at Lake Louise, CALL '97, October 12-17, 1997, Canada.
98. *Adanur, S.*, Arumugam, Y. S., and Xu, B., "Fast Net Shape Manufacturing of Braided Textile Structures", ICCE/4, Fourth International Conference on Composites Engineering, July 6-12, 1997, Big Island of Hawaii.

99. *Adanur, S.*, and Sreekanthreddy, G., "Compression Behavior of 3D Reinforced Glass/Epoxy Laminar Composite Profiles", ICAPC-97, International Conference on Advanced Polymer Composites, Materials, Processing and Applications, Beijing University of Aeronautics and Astronautics, Beijing, China, June 3-5, 1997.
100. *Adanur, S.*, "Geotextiles: Design and Applications in Alabama", Presentation to Alabama Congressional Delegation, May 9, 1997.
101. Basu Mallick, S., Elton, D. J., and *Adanur, S.*, "An Experimental Characterization of Soil-Woven Geotextile Interface in Large Box Pullout Tests", Geosynthetics '97, March 10-13, 1997, Long Beach, CA.
102. Yuksekkaya, M., *Thomas, H.*, *Adanur, S.*, Chaikof, E., "Polymeric Braided Stents for Medical Applications", 1996 ASME International Mechanical Engineering Congress and Exposition, Nov. 17-22, 1996, Atlanta, GA.
103. *Ghosh, T.*, and *Adanur, S.*, Design and Characterization of Geotextiles for High Performance Applications, Nonwovens Cooperative Research Center, Semi-Annual Meeting, Year 5, Nov. 20, 1996, Raleigh, NC.
104. *Adanur, S.*, Mallick, S., and Zhai, H., "Analysis of Geotextile-Soil Interaction in Pull-Out Tests", IS Kyushu '96, International Symposium on Earth Reinforcement, November 12-14, 1996, Fukuoka, Japan.
105. Warren, A., El-Halwagi, M. and *Adanur, S.*, "Design of a New Process for Converting Textile Solid Waste into Transportation Fuel", *TIEES-96*, The First Trabzon International Energy and Environment Symposium, July 29-31, 1996, Karadeniz Technical University, Trabzon, Turkey.
106. *Adanur, S.*, and Gongalareddy, S., "Compressive Properties of Stitched Woven Fiberglass Fabric Reinforced Composite Sections for Civil Engineering Applications", ICCE/3, Third International Conference on Composites Engineering, July 21-26, 1996, New Orleans, LA.
107. *Adanur, S.*, Design and Characterization of Geotextiles for High Performance Applications, Nonwovens Cooperative Research Center, 5th Annual Meeting, May 29, 1996, Raleigh, NC.
108. *Adanur, S.*, "Manufacturing of Industrial Textiles: Requirements and Opportunities", Sulzer-Ruti Technical Fabric Symposium, February 21-23, 1996, Spartanburg, SC.
109. *Adanur, S.*, "State of the Art in Technical Textiles", Discover EXPO '95, Industrial Fabric and Equipment Exposition, Industrial Fabrics Association International, Charlotte, NC, Oct. 12-14, 1995.
110. Wang, S., *Adanur, S.* and Jang, B. Z., "Thermo-Mechanical Behavior of Fiber/Filler Reinforced Phenolic Matrix Composites", 2nd International Conference on Composites Engineering (ICCE/2), August 21-24, 1995, New Orleans, LA.
111. *Adanur, S.*, and Tam, C. A., "On-machine Stitching of 3-D Laminate Structures for Composites", 2nd International Conference on Composites Engineering (ICCE/2), August 21-24, 1995, New Orleans, LA.
112. Wang, S., *Adanur, S.* and Jang, B. Z., "Mechanical Behavior of Fiber/Filler Reinforced Phenolic Matrix Composites", Proceedings of the 2nd International Conference on Composites Engineering (ICCE/2), August 21-24, 1995, New Orleans, LA.
113. *Adanur, S.*, Mallick, S. B., and Zhai, H., "Design and Characterization of Geotextiles for High Performance Applications", Hi-Tech Textiles Exhibition and Conference, July 24-26, 1995, Greenville, SC.
114. *Broughton, R. M.*, Bakhtiyarov, S. I., Brady, P., and *Adanur, S.*, "Initial Design of Nonwoven Fabrics for Air Filtration", Hi-Tech Textiles Exhibition and Conference, July 24-26, 1995, Greenville, SC.
115. *Adanur, S.*, and Tsao, Y. P., "Stitch Bonded Textile Structural Composites", The 26th International Technical Conference, SAMPE, October 24-27, 94, Atlanta, GA.
116. *Adanur, S.*, Tsao, Y. P., and Tam, C. W., "Improving Fracture Resistance in Laminar Textile Composites", First International Conference on Composites Engineering, August 28-31, 1994, New Orleans, LA.
117. *Adanur, S.*, "Design and Structure of Fabrics for Papermaking", Third International Hi-Tech Textiles Exhibition & Conference, June 21-22, 1994, Greenville, SC.
118. *Adanur, S.*, and Walker, B., "Yarn Preparation for Weaving in the Future (Yarn Preparation for the Second Loom)", 33rd Annual Textile Slashing Short Course, September 22, 1993, Auburn University, AL.

119. *Adanur, S.*, "Paper Machine Clothing", Istanbul Technical University, Textile Engineering Department, August 4, 1993.
120. *Adanur, S.*, "Effects of Forming Fabric Design on Paper Properties", 2nd International Hi-Tech Textiles Conference, July 21, 1993, Greenville, SC.
121. ElMogahzy, Y., Gawayed, Y. and Adanur, S., "Mechanical Characterization of Geotextiles/Soil Interaction", The Fiber Society Spring Meeting, May 1993, Raleigh, NC.
122. *Adanur, S.*, "Design and Applications of Forming Fabrics in Papermaking", North Carolina State University, College of Textiles, Fiber, Polymer and Textile Seminar Program, March 17, 1993, Raleigh, NC.

4.B.4 Poster Sessions Presented (presenter in *Italic*)

1. *S. Adanur*, A. Sapkota and S. Ghimire, Manufacturing of Polymeric Structures, AU Undergraduate Research Showcase poster presentation 17 October 2023.
2. *A. Sapkota*, A. Jayswal and S. Adanur, Manufacturing and Mechanical Properties Evaluation of 3D Printed Fabric-like Structures, Graduate Engineering Research Showcase (GERS) poster presentation, 12 October 2023, Auburn University.
3. *S. Ghimire*, A. Jayswal and S. Adanur, Study of PLA/TPU Mixture Composites for Additive Manufacturing of Flexible Materials, Graduate Engineering Research Showcase (GERS) poster presentation, 12 October 2023, Auburn University.
4. *S. Ghimire* and S. Adanur, Studying the potential of PLA/TPU Blended Composite for 3D Printing of Fabric-like Structures, MECH-MATL Graduate Student Research Poster Competition, 1 October 2023.
5. *A. Sapkota* and S. Adanur, Additive manufacturing of polymeric flexible structures, MECH-MATL Graduate Student Research Poster Competition, 1 October 2023.
6. A. Jayswal and S. Adanur, Additive manufacturing of polymeric flexible structures, AU Student Research Symposium, March 28, 2023, Auburn University.
7. *A. Jayswal* and S. Adanur, Additive manufacturing of polymeric flexible structures, Graduate Engineering Research Showcase (GERS), March 23, 2023, Huntsville, AL.
8. *Jayswal, A.*, and Adanur, S., Manufacturing and Characterization of Composite Filaments for 3D Printing of Fabrics, The Fiber Society 2022 Fall Meeting and Technical Conference, NC State University, Raleigh, NC, 19-21 October 2022.
9. *Alby L.*, and Adanur, S., Novel Reusable Textile Facemask to Prevent Spread of COVID-19, AU SGCoE, Graduate Engineering Research Showcase, Huntsville, AL, March 29, 2022.
10. *Jayswal, A.*, and Adanur, S., Characterization of Composite Filaments for 3D Printing of Fabrics, AU SGCoE, Graduate Engineering Research Showcase, Huntsville, AL, March 29, 2022.
11. *Alby, L.*, and Adanur, S., Design, Fabrication, and Testing of Novel Medical Facemasks to Prevent Covid-19, 2021 Graduate Engineering Research Showcase, 28 October 2021.
12. *Jayswal, A.* and Adanur, S., Characterization of PLA/TPU Composite Filaments Manufactured for 3D Printing with FDM, Poster presentation, 2021 Graduate Engineering Research Showcase, 28 October 2021.
13. *Jayswal, A.*, and Adanur, S., Additive Manufacturing of Fabric-like Structures, 2020 Virtual Student Research Symposium, April 2020.
14. *Adanur, S.*, "Air-Jet Filling Insertion System", Mechanical Engineering Undergraduate Research Information Poster Session, 10 October 2017, Wiggins Hall, Auburn University.
15. *Adanur, S.*, "Air-Jet Filling Insertion System", Mechanical Engineering Undergraduate Research Information Poster Session, 1 September 2016, Wiggins Hall, Auburn University.

16. *Adanur, S.*, Shen, Y., “Braided Structures Based on Helical Auxetic Yarns”, Uludag Textile Exporters Association UTIB International R&D Brokerage Event, Bursa, Turkey, May 27-29, 2015.
17. Shen, Y., *Adanur, S.*, Broughton, R., Beale, D. and Foster, B., “Failure Analysis of Micro-joints in Open-architecture Composites Structures (O-ACS)”, Fall 2014 Graduate Engineering Research Showcase, Auburn University, Oct. 23, 2014.
18. Shen, Y., and *Adanur, S.*, “Finite Element Analysis of Monofilament Woven Fabrics under Uniaxial Tension”, 2nd Annual Graduate Engineering Research Show Case, Auburn University, Oct. 24, 2013.
19. *Adanur, S.*, “A Novel Braided Structure to Increase Compression and Torsion Resistance of Composites”, The 5th International R&D Project Brokerage Event, Bursa, Turkey, 4-5 April 2013.
20. *Adanur, S.*, “Prevention of PEM Fuel Cell Poisoning via Adsorption using Activated Carbon Fiber Based Cathode Filters”, The 5th International R&D Project Brokerage Event, Bursa, Turkey, 4-5 April 2013.
21. *Adanur, S.*, “Health and Safety Effects of Nanoparticles Embedded in Textile Materials”, The 5th International R&D Project Brokerage Event, Bursa, Turkey, 4-5 April 2013.
22. *Adanur, S.*, and Broughton, R., “Recovery and Reuse of Waste PVC Coated PET Fabrics”, The 4th International R&D Project Brokerage Event, Bursa, Turkey, Feb. 2-3, 2012.
23. *Adanur, S.*, “PVA Nanofiber Based Membrane for Proton Exchange Membrane Fuel Cells”, The 4th International R&D Project Brokerage Event, Bursa, Turkey, Feb. 2-3, 2012.
24. *Adanur, S.*, A Novel Filling Insertion System for Weaving, The 3rd International R&D Project Brokerage Event, Bursa, Turkey, Feb. 10-11, 2011.
25. *Adanur, S.*, Conceptual Design and Characterization of 3D Interlaced Fibrous Structures, The 3rd International R&D Project Brokerage Event, Bursa, Turkey, Feb. 10-11, 2011.
26. Liu, W., and *Adanur, S.*, “Activated carbon fiber filter media for proton exchange membrane fuel cell cathode”, The Fiber Society 2009 Spring Conference: International Conference on Fibrous Materials 2009, Shanghai, China, May 27-29, 2009 (chosen as one of the 4 best posters).
27. Liu, W., and *Adanur, S.*, “Activated carbon fiber filter media for proton exchange membrane fuel cell cathode Fiber Society Meeting, Shanghai, China, June 2009. Won the best poster award.
28. *Adanur, S.*, and Irsale, “Development of Drug Eluting Textile Stents”, NTC Forum, June 3, 2008, Greenville, S.C.
29. Lee, S., Liu, W., and *Adanur, S.*, “Nonwoven Fibrous Structures from Electrospun Nanofibers”, NSF Research Experience for Undergraduates REU Program in Micro/Nano-Structured Materials, Therapeutics and Devices Poster Session, AU Saugahatchee Club, July 26, 2007.
30. Liu, W., and *Adanur, S.*, “Characterization of PVA and PAN Electrospun Nonwoven Fibers”, Auburn University 17th Annual GSC Research Forum, 7 March 2007, Foy Union, AU.
31. Isikel, L., *Adanur, S.*, Tatarchuk, B., Isikel, L., (Auburn University), Warner, S., Fan, Q., and Narvekar, V., “Coated and Laminated Fabrics for Fuel Cells”, NTC Forum, Feb. 25-27, 2007, Hilton Head, S.C.
32. Thomas, H., Riggs, L., Elton, D., and *Adanur, S.*, “Reinforcement Fabrics with Electronic Antenna Capabilities”, NTC Forum, Feb. 25-27, 2007, Hilton Head, S.C.
33. Yacoob, S., Isikel, L., and *Adanur, S.*, “Nonwoven Fabric Manufacturing and Testing Using Electrospinning”, NSF Research Experience for Undergraduates (REU) Program, Moores Mill Club, Auburn, 4 August 2006.
34. *Adanur, S.*, Isikel, L., and Abdelhady, F., “Coated and Laminated Fabrics for Fuel Cells”, TechTextil Symposium North America, March 28-30, 2006, Atlanta, GA.
35. *Adanur, S.*, Choe, B., Fan, Q., and Warner, S., “Coated and Laminated Fabrics for Fuel Cells”, National Textile Center 14th Annual Forum, February 19-21, 2006, Hilton Head, SC.
36. *Adanur, S.*, Swagat, I., Warner, S., and Chaikof, E., “Textile Prostheses for Vascular Applications”, National Textile Center 14th Annual Forum, February 19-21, 2006, Hilton Head, SC.

37. Adanur, S., Choe, B., Fan, Q., and Warner, S., "Coated and Laminated Fabrics for Fuel Cells", National Textile Center 13th Annual Forum, March 20-22, 2005, Raleigh, NC.
38. Adanur, S., Swagat, I., Warner, S., and Chaikof, E., "Textile Prostheses for Vascular Applications", National Textile Center 13th Annual Forum, March 20-22, 2005, Raleigh, NC.
39. Adanur, S., Ascioglu, B., Prabir, K. P., Warner, S. B. et al, "Nano Engineered Fire Resistant Composite Fibers", National Textile Center 13th Annual Forum, March 20-22, 2005, Raleigh, NC.
40. Irsale, S., and Adanur, S., "Exploring Textile Stents: Prototyping and Modeling", AU Annual Graduate Student Research Forum, March 10, 2005, Auburn, AL.
41. Adanur, S., and Irsale, S., "Textile Prosthesis for Vascular Applications", Presentation and Poster Session, TechTextil Symposium North America, Atlanta, GA, March 30-April 1, 2004.
42. Adanur, S., Ascioglu, B., Prabir, K. P., Warner, S. B. et al, "Nano Engineered Fire Resistant Composite Fibers", National Textile Center Annual Forum, February 15-17, 2004, Hilton Head, SC.
43. Adanur, S., Swagat, I., Warner, S., and Chaikof, E., "Textile Prostheses for Vascular Applications", National Textile Center Annual Forum, February 15-17, 2004, Hilton Head, SC.
44. Ascioglu, B., and Adanur, S., "Nano Engineered Fire Resistant Composite Fibers", Auburn University Annual Research Forum, Auburn, AL, 20 March 2003. This poster won the 2nd place in Engineering.
45. Adanur, S., Ascioglu, B., Prabir, K. P., Warner, S. B. et al, "Nano Engineered Fire Resistant Composite Fibers", National Textile Center Annual Forum, February 16-18, 2003, Hilton Head, SC.
46. Adanur, S., and Sathendra, V., "Fabric Design and Analysis System in 3D Virtual Reality", National Textile Center Annual Forum, February 16-18, 2003, Hilton Head, SC.
47. Adanur S., and Onal, L., "Design and Characterization of a Novel 3D Hybrid Knitted/Woven Fibrous Structure for Composites", 2003 NSF Design, Service and Manufacturing Grantees and Research Conference, January 6-9, 2003, Birmingham, AL.
48. Turel, T., Adanur, S., Bakhtiyarov, S., Ahmed, A., and Beale, D., "Filling Yarn Insertion in Air-Jet Weaving", National Textile Center Annual Forum, February 10-12, 2002, Charlotte, NC.
49. Sathendra, V., and Adanur, S., "Fabric Design and Analysis System in 3D Virtual Reality", National Textile Center Annual Forum, February 10-12, 2002, Charlotte, NC.
50. Adanur, S., and Onal, L., "Factors Affecting the Mechanical Properties of Laminated Glass/Graphite-Epoxy Hybrid Composites", 2002 NSF Design, Service and Manufacturing Grantees and Research Conference, January 7-10, 2002, San Juan, Puerto Rico.
51. Tascan, M., and Adanur, S., "Filling Yarn Insertion in Air-Jet Weaving", 11th Research Forum, Auburn University, March 19, 2001.
52. Onal, L., and Adanur, S., "Impact Properties of Textile Composites", 11th Research Forum, Auburn University, March 19, 2001.
53. Kilinc, F. S., and Adanur, S., "3D Fabric Design and Analysis", 11th Research Forum, Auburn University, March 19, 2001.
54. Tascan, M., Adanur, S., Bakhtiyarov, S., Ahmed, A., and Beale, D., "Filling Yarn Insertion in Air-Jet Weaving", National Textile Center Annual Forum, February 11-13, 2001, Myrtle Beach, SC.
55. Kilinc, F. S. and Adanur, S., "Fabric Design and Analysis System in 3D Virtual Reality", National Textile Center Annual Forum, February 11-13, 2001, Myrtle Beach, SC.
56. Adanur, S., and Orak, H., "Design and Manufacturing Automotive Chassis Frame with Net Shape Braided Composite Structures", 2001 NSF Design and Manufacturing Research Conference, January 7-10, 2001, Tampa, FL.
57. Adanur, S., Bakhtiyarov, S., and Beale, D., "Filling Yarn Insertion in AirJet Weaving", National Textile Center Annual Forum, January 27-29, 2000, Myrtle Beach, SC.

58. Adanur, S., and Xu, B., "Design and Manufacturing Automotive Chassis Frame with Net Shape Braided Composite Structures", 2000 NSF Design and Manufacturing Research Conference, January 3-6, 2000, Vancouver, British Columbia, Canada.
59. Adanur, S., Gowayed, Y., and Thomas, H., "On-Line Measurement of Fabric Properties ", National Textile Center Annual Forum, January 28-30, 1999, Myrtle Beach, SC.
60. Adanur, S., and Xu, B., "Fast Net Shape Manufacturing of Braided Textile Composites", NSF CAREER Awardees Meeting, January 10-12, 1999, Washington D.C.
61. Adanur, S., and Xu, B., "Process Development of Microwave Preheating and Infrared Post Curing of Braided Polymer/Epoxy Composites", The 1999 National Science Foundation (NSF) Design and Manufacturing Grantees Conference, January 5-8, 1999, Long Beach, CA.
62. Adanur, S., Liao, T., and Ghosh, T., "Design and Characterization of Geotextiles for High Performance Applications", National Textile Center Annual Forum, January 29-31, 1998, Panama City, FL.
63. Adanur, S., Gowayed, Y., and Thomas, H., "On-Line Measurement of Fabric Properties", National Textile Center Annual Forum, January 29-31, 1998, Panama City, FL.
64. Adanur, S., and Xu, B., "Fast, Net Shape Manufacturing of Textile Composites", National Science Foundation, Design and Manufacturing Grantees Conference, January 5-8, 1998, Monterrey, Mexico.
65. Adanur, S., Gowayed, Y., Ghosh, T., Goswami, B., Mallick, S. B., Zhai, H., "Design and Characterization of Geotextiles for High Performance Applications", National Textile Center Annual Forum, January 28-30, 1997, Myrtle Beach, SC.
66. Adanur, S., Thomas, H., Gowayed, Y., "On-Line Monitoring", National Textile Center Annual Forum, January 28-30, 1997, Myrtle Beach, SC.
67. Adanur, S., and Xu, B., "Fast, Net Shape Manufacturing of Textile Composites", National Science Foundation, Design and Manufacturing Grantees Conference, Seattle, Washington, Jan. 7-10, 1997.
68. Adanur, S., Mallick, S., and Zhai, H., "Analysis of Geotextile-Soil Interaction in Pull-Out Tests", IS Kyushu '96, International Symposium on Earth Reinforcement, November 12-14, 1996, Fukuoka, Japan.
69. Adanur, S., Mallick, S., and Zhai, H., "Design and Characterization of Geotextiles for High Performance Applications", National Textile Center Annual Forum, January 24-26, 1996, Raleigh, NC.
70. Adanur, S., et al., "Textile Structural Composites", National Textile Center Annual Forum, January 24-26, 1996, Raleigh, NC.
71. Adanur, S., Mallick, S., and Zhai, H., Design and Characterization of Geotextiles for High Performance Applications, National Textile Center, Annual Forum, Atlanta, GA, January 26-28, 1995.
72. Mohamed, M., Adanur, S., et al., "Textile Structural Composites", National Textile Center, Annual Forum, January 26-28, 1995, Atlanta, GA.
73. Adanur, S., and Tam, C. W., "Fabrication and Testing of On-loom Stitched 3-D Glass/Epoxy Laminar Composites", The 8th Annual Alabama Materials Research Conference, Tuscaloosa, AL, Sept. 26-27, 1994.
74. Walker, B., Beale, D., Broughton, R., and Adanur, S., "Improving the Woven Fabric Production Rate by Braiding Process", National Textile Center, Annual Forum, Greenville, SC, February 1994.
75. Mohamed, M., Adanur, S., et al., "Textile Structural Composites", National Textile Center, Annual Forum, Greenville, SC, February 1994.
76. Walker, B., Beale, D., Broughton, R., and Adanur, S., "Improving the Woven Fabric Production Rate by Braiding Process", National Textile Center, Annual Forum, Auburn, AL, February 1993.
77. Mohamed, M., Adanur, S., et al., "Textile Structural Composites", National Textile Center, Annual Forum, Auburn, AL, February 1993.

4.B.5 Senior Design Projects Supervised

1. Chris Upp and Nicholas Hammond, "GKN Postcured Composite Structures", Spring 2018.
2. Matthew A. Phillips and Alexandria Gunter, PFEN 4820, "GKN Aerospace Vacuum Port Redesign", Spring 2017.
3. John C. Sampson, and Jon C. Walker, PFEN 4820, "Solving the Edge Problem During Manufacturing of Composite Parts for the Bell 525 Helicopter Project", Spring 2016.
4. Webb Broussard and Blake Townsend, "Normalizing Autoclave Heat Rate Regardless of Mass or Mold Material", PFEN 4820, Spring 2015.
5. Chris Lee, Chris Porter and Austin Yuill, "Formula SAE Composite Wheel", Spring 2013.
6. Mason Brummal and James Smith (PFEN 4810-4820), "Weight Reduction of Mandrels Used in Composite Manufacturing", GKN Aerospace Alabama, Tallassee, AL, Spring 2012.
7. Melanie McDonald and Charles Blackwell (PFEN 4820), "Bulkhead Core Crushing", GKN Aerospace Alabama, Tallassee, AL, Spring 2011.
8. Joseph Rossi Schell, Steven Crace and James Clay Graben (PFEN 4820), "Carbon Tow Tension Control in Malimo Stitch Bonding Process for Composite Preform Manufacturing", V2 Composites, Auburn, AL, Spring 2011.
9. Sam A. Missioum and Betsy Claunch (PFEN 4820), "Engineering Solutions for Increased Efficiency in Hollow-fiber Production of Hemodialysis", Gambro Renal Products, Opelika, AL, Spring 2011.
10. Ozbasli, Halil, "Stadium Covers", TXMT 4900, Fall 2006.
11. Anthony, Rebecca, and Hudson, Katie, "Hail Storm Protective Fabrics, FBEN 4910-4920, Fall-Spring 2006.
12. George, Mellany, "Performance of Coated and Laminated Fabrics for Fuel Cells", FBEN 4920, Fall 2005.
13. Bates, Tiffany, and Williams, Jennie, "Medical Stents: Textile Materials versus Metals", FBEN 4920, Spring 2005.
14. Willams, Gerald, "Endovascular Stent Grafts", TXMT 4910, Spring 2005.
15. Cooper, Jared, "Biocompatible Polyester Stents for Vascular Applications", FBEN 4920, Fall 2004.
16. McCollum, Brian, "Composite Drumsticks", FBEN 4920, Fall 2004.
17. Stroud, Megan, "The Price of Turf", FBEN 4920, Fall 2004.
18. Nicole Sizemore, "Bubble Point Test Method", TXEN 4920, Summer 2004.
19. Andrea Rogers, "Operating Room Material Requirements", TXMT 4910, Spring 2004.
20. Joseph Godfrey, "Fiber Optics Woven into Fabrics", TXEN 4920, Fall 2003.
21. Melissa Mitchell "UV Resistance of Coated Fabrics for Stadium Covers", Summer 2003.
22. Andrea Janel Smith, "Turfgrass Reinforcement", Spring 2003.
23. Thomas Hogan, "Composite Tree Climber", Spring 2003.
24. Carlos Eduardo Handal, "Recycling of T-shirt Waste, Spring 2003.
25. Jason Mattox, "Geocomposite Design", Spring 2003.
26. Kalitha Mitchell, "Carpet Tile Manufacturing Problems", Fall 2002.
27. Eric Chambers, "Composite Baseball Bat", Fall 2002.
28. Jeremy Legg, "Heat Stress Analysis: Making Aubie Cooler", Fall 2002.
29. Paula Bates, "An Examination of Acoustic Textile Structures", Spring 2002.
30. Margaret Harris, "Design of a Polymeric Y Shaped Braided Stent for Aortic Implantation", Spring 2002.
31. Colin Dawson, "The Design, Construction and Testing of Composite Canoes", Spring 2002.

32. Sarah Robinson, "Western Saddle Design", Spring 2002.
33. Dan C. Siggers, "Canine Body Armor", Spring 2002.
34. Leslie Alexander, "Development of Golf Driver Shaft Using Industrial Textiles", Fall 2001.
35. Rebecca A. Bevis, "Interfacial Shear Strength Evaluation of Thermoplastic and Thermoset Resins by the Single Fiber Pullout Test", Fall 2001.
36. Kevin Hughes, "Carbon Composite Billiard Cue", Spring 2001.
37. Meredith Kaye Fetner, "Evaluation of Quality Problems Associated with the Manufacture of Inflatable Evacuation Systems", Spring 2001.
38. Fatma Erdonmez, "Fiber Reinforced Bricks", Spring 2000.
39. Heather M. Anders and Daniel A. Butts, "Fiber Reinforced Concrete", Spring 2000.
40. Mary M. Jacobs, Leia A. Cutcliffe and Ron Levitzke, Jody Aaron, "Composite Golf Club", Spring 2000.
41. Julee E. Diplacido, "Design and Fabrication of a Three-Dimensional Woven Fabric Structure Using a Jacquard Loom", Winter 2000
42. Dina R. Tareea, "Composite Bone", Winter 2000.
43. Elizabeth A. Bray, "Braided Tennis Racquet", Winter 2000.
44. Tareek Mohamed, "Permeability of Geotextiles", Winter 99.
45. Leigh N. Haugseth, "Application of Sampling Plan for Codon Airbag Fabric", Winter 99.
46. Robert Gallardo and Dustin Jowers, "Design of a Polymer Stent", Winter 99.
47. Jason Eisele, "Puncture Resistant Military Textiles", Winter 99.
48. Rebecca Kenney and Charles Moore, "Design and Development of a New Geotextile Structure for Soil Reinforcement", Winter 99.
49. Casey Blythe and Wesley Greer, "Incorporating Polypropylene Filament Yarns and Nonwoven Structures for Geotextile Applications", Fall 98.
50. Jeannie Stephens, Erica Graves and Ryan Radel, "Composite Bicycle Frame", Spring 1998 (co-advisor with Dr. Gowayed).
51. James Collier and Kasey Myers, "Flame Resistant Military Fabrics", Spring 1998.
52. Mary Elizabeth Stahr, "Properties of Airbag Fabric Contributing to Strength and Foldability", Winter 1998.
53. Paul Roberts, "Geotextile Pullout Test: Study of Geotextile-Soil Interaction", Fall 1997.
54. Kenneth Cole and Russell Matoy, "Effects of Forming Fabrics on Paper Formation", Spring 1997.
55. Jonathan Douglas and Samuel Mooney, "Design and Development of a Y-Shaped Braided Polyester Aortic Stent", Winter 1997.
56. Barclay Payne, "Warp-out Process", Winter 1997.
57. Leanna Land, "Design of Polyester Stent for Aortic Implantation", Fall 1996.
58. Tara Schaneville and Rotricia Smith, "Design and Applications of Biomaterials for Coronary Artery Reinforcement", Spring 1996.
59. Michelle Struth, "Tiger Textiles", Winter 1996.
60. Stephanie Carnley, "Computers and Computer Aided Design in the Textile Industry", Winter 1995.
61. Coley Jay Smith, "Effects of Fabric Structure on Bending Stiffness", Winter 95.
62. Karen Countess, "Performance Comparison of Woven Geotextiles in Fabric-Soil Interaction", Winter 95.
63. Keith Rollins, "Adhesion Characteristics of Reinforcement Fabrics to Rubber", Fall 1994.
64. Amy N. Goddard, "Ultrasonic Seaming", Spring 94.

65. Dayna M. Smith, "Medical Textiles: Design of Absorbency Tester for Medical Toweling", Spring 94.
66. Brian Allen, "The Effects of ISO 9000 Quality Systems on Textile Product Quality", Winter 94.
67. Mike McCauley and Eva Shelton, "Design and Fabrication of a New Textile Structural Composite Racket" Winter 1994.
68. Brian Wingfield, "Pack Design for a 3/4" Laboratory Extruder", Winter 94.
69. Thomas L. Pritchard, "The Properties of Non-crimp Fabric Based Composites", Winter 94.
70. Westley Mixon, "The Effects of Forming Fabric Design Parameters on Tissue Paper Properties", Spring 93.
71. Philip Douglas Tierce, Jr., "The Effect of Forming Fabric Design on Final Sheet Qualities", Winter 93.
72. David C. Terrell, "Laminated Textile Structural Composites", Winter 93.

4.B.6 Patents / Inventions / Disclosures

1. Adanur, S., Alby, L., and Jayswal, A., "A Novel Multiuse Facemask with Hybrid Materials", filed on 2/26, 2021 (patent disclosure).
2. Adanur, S., "Improving Sheet Dryness in Papermaking with the Inclusion of High Surface Area Polymeric Fibers", filed on 1/24/2017 (patent disclosure).
3. Adanur, S. and Zheng, H., "A novel way of measuring proton conductivity of fuel cell membranes", AU Technology Disclosure, filed on 7/9/2010.
4. Adanur, S., Vakalapudi, J. S., and Liao, T., "VirtualFabric Design and Analysis System", Auburn University Software Disclosure, 20 July 2006.
5. Adanur, S., and Ascioglu, B., "Modification of Smooth Polymeric Surfaces with Nanofibers using Electrospinning", Auburn University Technology Disclosure, 12 October 2005.
6. Adanur, S., and Irsale, S., "Polymeric Textile Prostheses for Vascular Surgery Applications", Auburn University Technology Disclosure, 25 July 2005.
7. Adanur, S., "Air-Jet Filling Insertion Simulator", Auburn University Patent Technology Disclosure, Dec. 16, 2003.
8. Adanur, S., "Rotational Curing Device for Fast Net-shape Manufacturing of Braided Composites", Auburn University Patent Technology Disclosure, July 20, 2000.
9. Bakhtiyarov, S. I., Overfelt, R. A., and Adanur, S., "Reinforced Sand-Binder System for Coremaking Process", Patent Disclosure, November 1998.
10. Adanur, S., Hou, Z., and Broughton, R. M., "A New Method to Separate the Components of Coated Fabrics", Patent Disclosure, July 22, 1997.
11. McCumsey, K., and Adanur, S., "Two Layer Fabric with Two Extra Strands", Patent Disclosure, April 15, 1992.

4.B.7 Other Research Contributions

1. Irsale, S., "Exploring Textile Stents: Prototyping and Modeling", submitted to the Fiber Society Graduate Student Research Competition, March 3, 2006.

Technical Reports Submitted

1. Adanur, S., Design, Fabrication and Testing of Novel Medical Facemasks to Prevent COVID-19, 6 Quarterly Reports and Final Report, submitted to Alabama Department of Economic and Community Affairs (ADECA), 18 May 2022.
2. National Science Foundation annual reports

3. Adanur, S., Gowayed, Y., Elton, D., and Ghosh, T. K., Design and Characterization of Geotextiles for High Performance Applications, Nonwovens Cooperative Research Center, Annual Report, Year 5, May 29, 1996, Raleigh, NC.
4. National Textile Center (NTC) quarterly and annual reports
5. Semi-annual and annual reports to US Army Natick
6. NSF EPSCoR annual reports
7. Final report to NSF for Instrumentation and Laboratory Improvement Program
8. Monthly progress reports to Wellington Sears Company, Valley, AL.

Thesis and Dissertation

1. Adanur, S., "Dynamic Analysis of Single Nozzle Air-Jet Filling Insertion", Ph.D. Thesis, North Carolina State University, May 1989, 219 pages.
2. Adanur, S., "Air-Jet Filling Insertion: Velocity Measurement and Influence of Yarn Structure", Master's Thesis, North Carolina State University, 1985, 133 pages.

4.B.8 Grants and Contracts

1. Jayswal, A. (PI) and Adanur, S., "Manufacturing, characterization, and computational analysis of composite filaments for additive manufacturing of fabrics", submitted to ICAMS (Interdisciplinary Center for Advanced Manufacturing Systems, 15 May 2022-15May 2023, \$2,610.00.
2. Griffin, K., and Adanur, S., Additive Manufacturing of Braided Structures for Composite Reinforcement, AU Undergraduate Research Fellowship, \$2,250.00 for student, \$750.00 for mentor, May 15 – August 15, 2022.
3. Design, Fabrication and Testing of Novel Medical Facemasks to Prevent COVID-19, \$75,000.00, State of Alabama, Department of Economic and Community Affairs (ADECA), Feb. 1, 2021 – May 15, 2022.
4. OVPR Undergraduate Research Program Project, Electrospinning of Polymeric Fibers, Adanur budget: \$1,500.00 (Student, Kiana LaBombard, assistantship: \$5,000.00). May 15, 2017-May 15, 2018.
5. Adanur, S., "Polymeric and Textile Materials for Spherical Air Ships". Sponsor: Skyborne International, Duration: 2 years (2/1/2015-1/31/2017), Budgeted: \$75,000.00.
6. Broughton, R. (PI), Beale, D., Adanur, S., and "Design and Analysis of Stiffeners and Tension Compression Struts Using Braided, Open-Architecture Composite Structures (O-ACS)", \$150,000.00, 21 November 2013-December 2015.
7. Adanur, S. (PI), Meir, A. J., and Cao, Y., "Virtual 3D Interlaced Fabric Design and Characterization", \$50,890.44, AU-IGP, 1 February 2012 - 31 December 2015.
8. National Science Foundation, REU Site for Micro/Nano-Structured Materials, Therapeutics, and Devices, PI: M.E. Byrne, Co-PI: S. Duke, Period: 03/1/11 - 02/28/14; \$357,191. Faculty Mentors: S. Adanur, M. Auad, M. Byrne, S. Duke, A. Gorden, E. Davis, V. Davis, O. Fasina, R. Gupta, J.W. Hong, E. Lipke, B. Prorok, W. Ravis, C. Roberts.
9. Adanur, S., "Development of Composite and Sandwich Structured Fuel Cell Membranes", Department of Commerce, Sept. 2009-Aug. 2010, \$100,000.00, 9/1/2009-8/31/2010.
10. Secured donation of 10, 862 kg of polymers and color additives to the Polymer and Fiber Engineering by Thermo Fisher, whose value is around \$21,600 (April 2010).
11. Adanur, S., Graduate Outreach Program (GOP) Grant, \$135.00, Spring 2009 (teaching).
12. Adanur, S., "Nanoparticle Reinforced Hybrid Fibers and Films", Department of Commerce, \$119,999.00, 6/1/08-5/31/09.

13. Davis, Ed (PI/Mentee), and Adanur, S. (Mentor), "Imogolite/PEO Nanocomposite Fibers and Membranes", \$4,000.00, AU 2008 Faculty Mentoring Program.
14. Adanur, S., and 4 other researchers from Clemson University, "Development of Drug Eluting Textile Stents", \$4,000, NTC, 2008-2009.
15. Tatarchuk, B. (PI), Adanur, S., and Broughton, R., Tank and Automotive Command Center (TACOM) Project, Prevention of Fuel Cell Poisoning, PFEN share \$72,000, Fall 2005-Spring 2010.
16. Ikiz, Y., "Development of Nanofibers for Filtration Using Electrospinning", Pamukkale University, sponsored by TUBITAK of Turkey, 80,500 YTL (~\$ 61,923), Jan. 2006-Dec. 2008, (Dr. Adanur is a "consultant" with no compensation).
17. Duke, S. (PI), Byrne, M. E. (Co-PI), Adanur, S., and 10 other researchers, "REU Site for Micro/Nano-Structured Materials, Therapeutics, and Devices", NSF Research Experiences for Undergraduates (REU), \$297,846, Summer 2006-Summer 2008.
18. Adanur, S. (PI), and Aglan, H. (Co-PI, Tuskegee University), "U.S.-Turkey Cooperative Research: Design and Processing Characteristics of Novel Three Dimensional Fibrous Preforms for Composite Reinforcement", \$34,201.00, Sept. 1, 2004-Aug. 31, 2007, National Science Foundation.
19. Adanur, S. (PI), Choe, B., Fan, Q., and Warner, S., "Coated and Laminated Fabrics for Fuel Cells", \$318,074.00, May 1, 2004-April 30, 2008, National Textile Center.
20. Thomas, H., (PI), Adanur, S., Elton, D., and Riggs, L., "Reinforcement Fabrics with Electronic Transmission Capabilities", \$278,390.00, May 1, 2005-April 30, 2008, National Textile Center.
21. Adanur secured donation of two injection molding machines to Auburn University on May 3, 2007 by Thermofisher Scientific of Auburn:
 - FU CHIN SHIN 75 TON, MODEL: KT-75G, SERIAL # H03185, YEAR: 1988, Value: \$4,500.00
 - FU CHIN SHIN 75 TON, MODEL: KT-75, SERIAL # H03172, YEAR: 1988, Value: \$4,500.00.
22. Adanur, S., (PI), and Warner, S., "Textile Prostheses for Vascular Applications", \$389,753.00, Auburn's share: \$241,510.00, May 1, 2003-April 30, 2006, National Textile Center.
23. Patra, P. (PI), Adanur, S., and 4 other researchers, "Nano Engineered Fire Resistant Composite Fibers", Auburn's share: \$90,920.00, May 1, 2002-April 30, 2005, National Textile Center.
24. Parker, F., Dyer, D. (leaders), Adanur, S., and several other Engineering Faculty, "AU Priority Areas; Transportation Pinnacle: Commercial Highway Systems", October 1, 99-September 30, 2004 (total budget amount is unknown at this time). Budget for Adanur: \$24,000.
25. Adanur, S., (leader) ElMogahzy, Y., and Abdelhady, F., "Yarn and Fabric Design and Analysis in 3D Virtual Reality", National Textile Center, \$ 177,938, May 1, 2000 - April 30, 2003.
26. Adanur, S. (PI), Bakhtiyarov, S., and Beale, D., "Characterization of Air-Yarn Interface in Air-Jet Weaving", National Textile Center, \$ 262,742.00, May 1, 1999-April 30, 2002.
27. Equipment Secured for Air-Jet Research

L5200 S 210 N2 IK TE Air-Jet Weaving Machine (L5200 series, filament execution, 210 cm max. reed width, low built (without superstructure), two color picks at will, crank shedding motion, electronic filling feeders)

Manufacturing # 031166
 Serial # JA 2663
 Machine # 0003
 Manufacturing date: 1997.08
 Market Value: \$15,000.00.
 Donor: Sulzer Textile, Inc.
 Date Received: Nov. 22, 2002

28. Adanur, S., Fast Net-Shape Manufacturing of Polymer Composite Structures, 1995 NSF Faculty Early Career Development (CAREER) Program, National Science Foundation, \$ 210,000.00; duration: 5 years, Sept. 1, 96-Aug. 31, 2001.
29. ElHalwagi, M. (leader), Adanur, S., and 15 other faculty, "Bicomplexity Incubation Project Proposal FY 2000-2002", \$ 220,000.00, National Science Foundation, Duration: 1 year, Sept. 2000- August 2001.
30. Adanur, S., and Shalaby, S. E. (Egypt), "Design and Manufacture of Stitch Bonded, Thermoplastic Textile Composites", US-Egypt Science and Technology Joint Fund, \$ 39,978, September 1, 1998 - August 31, 2001.
31. P. Jones (leader), C. A. Flood, S. Adanur, "Developing a Course Based on Equipment Design for Introduction to Engineering"; AU College of Engineering; \$ 24,050; June 1, 1999-May 31, 2000.
32. Adanur, S. (team leader), Thomas, H., Gawayed, Y. and Ghosh, T., On-line Measurement of Fabric Mechanical Properties for Process Control, National Textile Center, \$ 446,912.00; duration: 3 years, March 1, 96 – April 31, 2000.
33. Jang, B. Z., Yang, X. F., and Adanur, S. (30%), "Solid Free Form Fabrication of Advanced Alloys and Metal Matrix Composites", College of Engineering Graduate Research Assistantship, \$ 20,000.00; duration: October 1, 1997-September 30, 1999.
34. Elton, D., and Adanur, S. (50%), "Waterjet Manufacturing of Custom Geotextiles", College of Engineering Infrastructural Awards, \$ 62,524.00; duration: October 1, 1997-September 30, 1999.
35. Utilization of Solid Waste in Alabama, Y. Gawayed (Project Coordinator), S. Adanur and 15 other researchers, NSF/EPSCoR, \$ 3 million, Dr. Adanur's share: \$ 150,000.00; duration: 4 years, Aug. 95-July 99.
36. Design and Characterization of Geotextiles for High Performance Applications, National Textile Center, Sabit Adanur (PI) and 5 other researchers from 4 universities; amount: \$ 915,000.00; Auburn's share \$ 520,000.00; duration: March 1, 1994 - April 30, 1998.
37. A New Military Fabric with Flame Resistance Properties; US Army Natick R&D and Engineering Center; PI: S. Adanur (100%), \$ 40,000.00; 24 months, Dec. 1995 - Dec. 97.
38. Fingerprinting and Backward Quality Projection in Textile Products, PIs: Y. Elmogahzy (leader), R. Broughton, S. Adanur, Y. Gawayed (Auburn), S. Jayaraman (Ga Tech), M. Suh, W. Oxenham, J. Woo, J. Rust (NC State), E. Backe (ITT), \$ 540,000.00, Dr. Adanur's share: \$ 40,000.00, National Textile Center, Duration: 1 year, March 1, 1995 - February 28, 1996.
39. Textile Structural Composites Laboratory, National Science Foundation, Instrumentation and Laboratory Improvement (ILI) Award, \$ 87,185.00 (42.5% NSF, 42.5 % Auburn cost share, 15% Private Industry Contribution), PI: S. Adanur (95%), Co-PIs: W. Walsh, R. Walker, B. Jang, 30 months, September 1, 94 - August 31, 96 (See 4.A.5).
40. Textile Structures for Composites: Stitch Bonded Laminar Composites, National Textile Center, \$ 2,310,000 for 4 universities; Auburn's share \$ 223,656.00, PI: S. Adanur (50 %), Yasser Gawayed (50%), March 1, 1993 - February 28, 1996.
41. Wellington Sears Handbook of Industrial Textiles, Wellington Sears Company, Valley, AL, PI: Sabit Adanur (100%), \$ 60,000.00, October 1, 1993-March 15, 1995.
42. Design of a Braiding Machine to Produce Wide, Flat Woven Structures at a Significantly Increased Production Rate, PIs: R. Walker (leader), R., Broughton, S. Adanur, D. Beale, M. Nelms, National Textile Center, \$ 570,000.00, Adanur's share: \$ 90,000.00, March 92 - February 94.

4.B.9 Description of the Scholarly Program

The objectives of my research program are to design, fabricate, test and analyze high-performance polymeric materials, fibrous structures and composites in order to improve overall performance; to develop new, innovative products and manufacturing processes and to reduce the total cost of high-performance materials production.

As part of this plan, I have started new research programs in textile structural composites, nanocomposites, extrusion, injection molding, geotextiles, paper machine clothing, medical textiles, safety and protective materials, transportation materials, and nanomaterials in the department. Funding for several research projects has been secured from a variety of sources including National Science Foundation (NSF), US Army, National Textile Center (NTC) and private industry. A lab for high performance fibrous structures has been established in the department. The lab is equipped with state-of-the-art equipment for both research and teaching. The research results are being disseminated in national and international platforms as indicated in this document.

I am implementing an integrated design/fabrication/analysis/testing research program for high performance polymers, fibers, fabrics, composites, nanocomposites and plastics. The outline of my research program includes development of new structures, computer aided design and modeling, analysis, testing and database development. The research plan is aimed at increasing our understanding of the manufacturing, processing and performance of high-performance fibrous structures. This research program requires a multi-disciplinary background in mechanics, materials, physics, fibers, polymers, textile technology, heat transfer, computers and programming which are my expertise areas. I will continue to interact with other faculty and cooperate closely with other laboratories in local and regional universities.

My research group at Auburn University is recognized nationally and internationally in high performance polymeric, fibrous and composite structures. We are frequently invited to give lectures, seminars and papers in national and international organizations. We conduct both fundamental and applied research; in either case, we do original, state of the art research. Fundamental research expands our knowledge and contributes to the literature database. Fundamental research for the sake of doing research is not much use unless it is used in design, development, manufacturing and application of a useful product or process. Therefore, in every chance, I try to apply the knowledge gained from the fundamental work to a practical application. This is used to solve the current and emerging problems of the industry. Fundamental and theoretical research should be confirmed with experimental and real-life data whenever possible.

Graduate students are an important part of my research program. One of my goals is to develop an understanding and appreciation of research in my graduate students. Moreover, I strongly encourage my undergraduate students to take part in graduate research projects and I give them that opportunity whenever possible. I supported several undergraduate students to conduct research at Auburn through NSF REU program. I encourage and require team work strongly among my students while allowing each one to develop his/her own research personality, creativity and analytical thinking method. I have transferred several graduate research procedures into undergraduate courses.

I believe that research is essential to the future of Auburn University along with teaching and extension. Although, they may have been perfected in the industry, almost every major invention started at the universities. I incorporate my research findings into the classroom teaching promptly. A curriculum that is not continuously fed with new research findings may become stagnant. Research should not be done for the sake of doing research; it should be focused with a goal in mind while keeping an open eye for possible surprising developments along the way.

4.C21

Short Courses / Workshops / Seminars (presenter's name is in *Italic*)

1. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 2, 2013, Auburn University.
2. *Adanur, S.*, "Higher Education in Alabama", Panelist and presenter in "Workshop: Restructuring of Higher Education in Turkey, Problems and Solutions", Marmara University, Istanbul, Turkey, 6 July 2012.
3. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 3, 2012, Auburn University.
4. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 5, 2011, Auburn University.

5. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 6, 2010, Auburn University.
6. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 7, 2009, Auburn University.
7. *Adanur, S.*, Composite Materials, Short course given to Boy Scouts at Merit Badge University, March 17, 2007, Auburn University.
8. *Adanur, S., and Isikel, L.*, Fuel cell research at PFE, presentation and demonstration given to Civil Air Patrol students, July 17, 2006, Auburn.
9. *Adanur, S.*, and Demir, A., Manufacturing of Industrial Textiles, Workshop given to Hassan Textile Inc., Istanbul, Turkey, July 20, 1999.
10. *Adanur, S.*, "Manufacturing of Geotextiles", 5th NSF/IFAI Professor Training Course for Geosynthetics, AU Engineering Extension Service, Auburn, AL, August 9-14, 1998 (also, gave an instructional tour of the Geotextiles and Fabric Formation labs to the course participants).
11. *Adanur, S.*, "Wide World of Industrial Textiles", Seminar given to the faculty of the Department of Textile Science, University of Port Elizabeth, Port Elizabeth, South Africa, June 8, 1998.
12. *Adanur, S.*, "Testing of Technical Textiles", Industrial Textiles Short Course, Clemson University, January 28-29, 1998, Clemson, SC.
13. *Adanur, S.*, "Textile Research Update", presented at the Georgia Association of Family and Consumer Sciences District K Meeting, Tuesday, Nov. 11, 1997, Columbus, GA.
14. *Adanur, S.*, and Broughton, R. M., "Manufacturing, Properties and Testing of Geotextiles", AU-IFAI (Industrial Fabrics Association International) Educate the Educators Short Course, July 20-25, 1997, Auburn, AL (also, gave an instructional tour of the Geotextiles and Fabric Formation labs to the course participants).
15. *Adanur, S.*, and Hou, Z., "Recycling of Coated Fabrics", Workshop on Added Value Reclamation of Solid Waste, NSF EPSCoR, July 22-23, 1997, Auburn, AL.
16. *Adanur, S. (90%)*, and *Mohamed, M. H. (10%)*, "Manufacturing of Industrial Textiles", US-Egypt Workshop on Manufacturing Technologies, Dec. 6-9, 1996, Alexandria, Egypt.
17. Prepared the Weaving and Knitting sessions for the short course Introduction to Textiles for Industry Professionals (ITIP-96), May 14-15, 1996 (cancelled).
18. *Adanur, S.*, "Overview of Industrial Textile Applications", Industrial Fabrics Association International (IFAI) Tutorial "Textiles Used in Structural Composites", 41st International SAMPE Symposium and Exhibition, March 24-28, 1996, Anaheim, CA.
19. *Adanur, S.*, "ISO 9000", Total Quality Management in the Textile Industry (SPC & Quality Engineering), Quality Tech, March 20-22, 1996, Pine Mountain, GA.
20. *Adanur, S. (70%)*, and Broughton, R. M. (30%), "Manufacturing, Properties and Testing of Geotextiles", AU-IFAI (Industrial Fabrics Association International) Educate the Educators Short Course, July 7-12, 1996, Auburn, AL (also, gave an instructional tour of the Geotextiles and Fabric Formation labs to the course participants).
21. *Adanur, S. (50%)* and Walker, R. P. (50%), "Yarn Preparation for Weaving in the Future (Yarn Preparation for the Second Loom)", the 33rd Annual Textile Slashing Short Course, September 20-22, 1993, Auburn University, AL.; enrollment: 81.

Technical Sessions Developed/Chaired

1. International Istanbul Textile Congress 2013, Session: New Materials, Room 3, May 30-31, 2013, 13.40-15.40, Istanbul, Turkey.

2. Session 202: Composites, Techtextil North America Symposium, Wednesday, April 2, 2008, 8:30 a.m. - 11:00 a.m., Atlanta, GA.
3. Session 3 (afternoon session) at the First Istanbul International Textile and Textile Machinery Congress, June 2, 2006, Istanbul, Turkey.
4. Session 4, 2nd International Technical Textiles Congress, Istanbul, Turkey, 13-15 July 2005.
5. Session TC-1: Computational Mechanics, 1.45 pm – 3.15 pm, Tuesday, August 17, 2004, SECTAM XXII, Twenty Second Southeastern Conference on Theoretical and Applied Mechanics, August 15-17, 2004, Tuskegee University, Tuskegee, AL.
6. Session 4a, NANO 4, 7.20 pm-10.00 pm, Monday August 9, 2004, ICCE-11, 11th Annual International Conference on Composites/Nano Engineering, Hilton Head, SC, August 8-14, 2004.
7. Session 203 Paper Making Fabrics, Techtextil Symposium North America, March 13-15, 2001, Atlanta, Georgia. Developed and chaired the session with 5 speakers.
8. ICCE/5, Fifth International Conference on Composites Engineering, Session 7a, Textile I, 3.40 pm-6.00 pm, July 5-11, 1998, Las Vegas, NV.
9. ICAPC-97, International Conference on Advanced Polymer Composites, Materials, Processing and Applications, Session 2, Mechanics of Composite Materials (I), Beijing University of Aeronautics and Astronautics, Beijing, China, June 3-5, 1997.
10. ICCE/4, Fourth International Conference on Composites Engineering, Session 16c, Textile V, 8.00 am-11.00 am, July 6-12, 1997, Big Island of Hawaii.
11. The Fiber Society, Fall 1996 General Technical Conference, Session IV: Marine Applications of Textiles, Wednesday, Oct. 16, 1996, Newport, Rhode Island.
12. ICCE/3 Third International Conference on Composites Engineering, July 21-26, 1996, New Orleans, LA. Session 12b, July 25, 96, 3.45 pm-5.45 pm, Textile Composites III, Adanur, S., and Wang, Y.
13. ICCE/2 Second International Conference on Composites Engineering, August 21-24, 1995, New Orleans, LA.
 - Session 4d, Aug. 22, 1995, 10.10 am-12.10 pm, Textiles: 3D structures.
 - Session 5d, Aug. 22, 1995, 1.20 pm - 3.20 pm, Textiles: Applications.
 - Session 9d, Aug. 23, 1995, 3.35 pm-5.35 pm, Textiles: Analysis.
14. Paper Machine Clothing: Materials and Technologies. Third International Hi-Tech Textiles Exhibition & Conference, June 21-22, 1994, Greenville, SC. Planned and organized the presentation topics and found five speakers.

Workshops Attended

1. Attended the ITM Texpo Eurosia 2013, in Istanbul, Turkey, May 29, 2013.
2. Composite Manufacturing Workshop, March 30-31, 2005, Auburn, AL.

Editorships

1. Member of the Editorial Board for Journal of Industrial Textiles, Sage Publications (Jan. 2000 - present).
2. Member of the Editorial Board for the Electronic Journal of Textiles (August 2002 – 2010)
3. Member of the Editorial Board for the POLITEKNIK (Turkish/English), (Dec. 2004-2009).
4. Member of the Editorial Board for the Electronic Journal of Textiles (August 2002 – 2009).
5. Member of the Editorial Board for Journal of Coated Fabrics, Technomic Publishing, Co., Inc., Lancaster, PA, (January 1998 – Jan. 2000).
6. Member of the editorial board for Textile and Technique which is a specialized monthly textile magazine published in Turkey (Turkish/English), 1993-2003.

4.D. SERVICE

Department, College and University Service Work

1. ME Undergraduate Curriculum Committee (Fall 2022-present).
2. Founding faculty advisor for AU Chess Club, August 2020 – present (105 members).
3. Member of the Academic Standards Committee, August 2020 – 2023.
4. Member of the Student Conduct Committee, August 2020 – 2023.
5. Mechanical Engineering Senator for AU Faculty Senate, June 2020 – present.
6. Member of the Academic Honesty Committee, Aug. 2019 – Aug. 2022.
7. Member of the Patent and Invention Disclosure Committee, Aug. 2017 - Aug. 2020.
8. Chair of the Academic Computing Committee, Aug. 2019 - Aug. 2020 (member Aug. 2017 - Aug. 2020).
9. Member of the Faculty Salaries and Welfare Committee, Aug. 2015 – Aug. 2018.
10. Prepared and submitted SACS Assessment Reports for PFEN Masters and Ph.D. programs, June 2017.
11. Prepared and submitted SLO7 report for SACS, 20 November 2014.
12. Member of the Calendar and Schedules Committee, Aug. 2014 – Aug. 2017.
13. Member of the Academic Program Review Committee, Aug. 2013-Aug. 2016.
14. Prepared and submitted SACS Assessment Reports for TE/PFEN B.S., M.S. and Ph.D. programs, 2011-2017.
15. ABET Coordinator for the TE/PFEN department, 1992-2016. Successfully got ABET accreditation in 1998 (first time ever), 2004 and 2010. Prepared the Termination Report in 2016.
16. Participated in the AU Strategic Planning Focus Group sponsored by the Office of the Provost, 19 March 2013.
17. Member of the Academic Standards Committee, Aug. 2012-Aug. 2015.
18. Member of the Post Tenure Review Committee, Aug. 2012-Aug. 2015.
19. Prepared the 2011 SACS assessment reports for PFEN B.S., M.S., and Ph.D. programs, Jan.-Feb. 2012.
20. Member of the PFEN faculty search committee, Aug. 2011- Aug. 2012.
21. Member of the Faculty Handbook Review Committee, Aug. 2011-Aug. 2014.
22. Member of the Faculty Dismissal Committee, Aug. 2010-Aug. 2013.
23. Mentor - AU Early Career Faculty Mentoring Program, Sept. 2009-present.
24. Chair of the AU Faculty Grievance Committee, Aug. 2009-Aug. 2010.
25. Member of the Student Discipline Committee, Aug. 2009-Aug. 2012.
26. Hosted TALON exhibit for incoming engineering freshman with Julia Freeman at the AU Hotel and Conference Center, Feb. 18, 2008.
27. Member of the new PFEN PhD Program Committee, Apr. 2008-present.
28. Member of the AU Faculty Grievance Committee, Nov. 2007-May 2009.
29. Member of the PFEN Faculty Search Committee (Chair: Dr. Buschle-Diller), Aug. 2007-Apr. 2008.
30. Member of the CoE Graduate Student Recruiting Committee (appointed by the Dean), Chair of the Best Practices Subcommittee, March. 2007-present (unofficially started Fall semester 2006).
31. Chair of the PFEN Faculty Search Committee, Fall 2006-Spring 2007.
32. Member of the Alumni Engineering Research Award Committee (meeting held on March 10, 2008).

33. Responsible for the polymer processing equipment purchase (visited University of Akron, Oct. 2006).
34. Chair of the AU Student Academic Grievance Committee, Jan. 2006-Aug. 2008.
35. Member of the AU Student Academic Grievance Committee, Aug. 2005- Dec. 2005.
36. Member of the AU Academic Honesty Committee, 2003-2006.
37. Member of the Alumni Professorship Committee, 2002-2005.
38. Member of the Budget Advisory Committee, Feb. 2003-2005.
39. Graduate Faculty (reappointed November 2002)
40. Member of the Ginn Professorship Selection Committee, 2002.
41. Member of the Engineering Faculty Council (EFC), 2002-2205.
42. Member of the AU Diversity Leadership Council, May 2002-2004.
43. TE Department Futures Committee Member, 2001.
44. Mentoring Committee member for Dr. Alicia McClain, Assistant Professor. February 2001- 2004.
45. Member of the AU Senate Research Grant-in-Aid Committee, Fall 2000- Fall 2003.
46. Member of the Textile Engineering Department Head Search Committee, 1999-2000.
47. Member of the College of Engineering Freshman Computing Initiative (FCI) Committee (1999-2000)
48. National Textile Center (NTC) Site Director for Department of Textile Engineering (June 1998 to October 2001). Responsible for the overall coordination of NTC proposals, projects and budgets for the Textile Engineering Department.
49. Chairman of the Textile Engineering Curriculum Committee (1993-2000).
50. Coordinated the Semester Transition activities for TXEN, TXCH, TXMT, TXTS and ITAS programs. Prepared/edited the departmental semester transition package (162-page document)
51. College of Engineering Priorities Task Force Member (1998). Participated in two task force teams: one in research and one in teaching.
52. Member of the College of Engineering Curriculum Committee (1993 to 2016).
53. Chairman of the Textile Engineering Award Committee. The committee nominated Pat Smith and Paul Brady for the Spirit of Excellence Award which they won (1992-2000).
54. Member of the new PhD program in Integrated Textiles and Apparel (ITAS) preparation committee (1994 - 1998).
55. Member of the three new faculty and two new technician search committees in Textile Engineering (1994-2000).
56. Participated in the 1994-1995 and 1995-96 Faculty/Student Mentor Program
57. Honorary Member of the Phi Psi Textile Fraternity.
58. Freshmen scholarship interviewer (1993-2000)

Professional Society Activities

1. Member of the TASSA (Turkish-American Scientists and Scholars Association) Interim Council, 2004-2006.
2. Member, Industrial Fabrics Association International (IFAI) Safety & Protective Products Division, 2003-2010.
3. Chair of the American Society of Mechanical Engineers-Textile Engineering Division, ASME-TED (2000-2001). Attended the ASME Technical Executives Committee (TEC) meeting in New York, NY, November 2001.

4. Vice-Chair of the American Society of Mechanical Engineers-Textile Engineering Division, ASME-TED (1998-2000). Attended the ASME Technical Executives Committee (TEC) meeting in Houston, TX, March 3-5, 2000.
5. Newsletter Editor of the American Society of Mechanical Engineers-Textile Engineering Division, ASME-TED (1995-present). Prepared and published the ASME Textile Engineering Division Newsletter - Fall 1996 issue.
6. Secretary-Treasurer of the American Society of Mechanical Engineers-Textile Engineering Division, ASME-TED (1995-1997).
7. Program Chairman of the American Society of Mechanical Engineers (ASME), Chattahoochee Section (1995-96)
8. Secretary of the American Society of Mechanical Engineers (ASME), Chattahoochee Section (1994-95).
9. Treasurer of the American Society of Mechanical Engineers (ASME), Chattahoochee Section (1993-94).
10. Member of the American Society of Mechanical Engineers-Textile Engineering Division (ASME-TED) Revitalization Task Force. There has been a lack of enough activity in recent years in TED and the objective of the Task Force is to retain Textile Engineering as an active ASME technical division (1994 - 1995).

Membership

- American Society of Mechanical Engineers (ASME)
- Technical Association for the Pulp and Paper Industry (TAPPI)
- Manufacture Alabama
- Honorary member of the Phi Psi Textile Fraternity

Proposals Reviewed:

1. Reviewed 4 AU internal proposals for the NSF MRI program, 11 August 2023.
2. National Science Foundation, STTR Phase I. Reviewed 3 proposals online, Sept. 2, 2021.
3. National Science Foundation, CMMI-FM Future Manufacturing Program. Reviewed 3 multi-million dollar, 4-year proposals, 25 June 2021. Attended 2-day online panel on June 30-July 1, 2021.
4. National Science Foundation, SBIR/STTR Program (reviewed 5 proposals), Sept. 11, 2020.
5. National Science Foundation FMSG Materials and Construction Virtual Panel, 6 proposals reviewed out of 17 (panelist for others), July 27-28, 2020, Zoom Meeting.
6. National Science Foundation SBIR/STTR Program (reviewed 4 proposals), Oct. 10-11, 2019.
7. National Science Foundation SBIR/STTR Program (reviewed 4 proposals), March 11-12, 2019.
8. NSF Panelist for Nanomanufacturing Proposals (Panel #: P100737), Dec. 14, 2009, Arlington, VA. Reviewer/Lead/Scribe for 8 proposals, Panelist for 26 proposals.
9. Panelist for NSF SBIR-STTR Program, Aug. 23, 2007, National Science Foundation, Arlington, VA.
10. NSF Proposal No. 0242891 entitled "Human Powered Wearable Computers" by Hechmi Hamouda and Warren J. Jasper, November 2002.
11. Proposal No: INT-9811022, National Science Foundation, PI: C. L. Smith, North Carolina State University, June 1998.
12. Reviewer for the National Textile Center Proposals (Fabrication Competency), 1998-2001.
13. Visited National Science Foundation on Nov. 4, 1999 as a panel reviewer of 15 CAREER proposals.

Reviewing for Journals:

Textile Research Journal, Journal of Elastomers and Plastics, International Composites Engineering Journal, Journal of Cotton Science, Journal of the Textile Institute (England). More than a hundred articles have been reviewed to date.

Other:

1. Judge for AU GERS 3M Research Presentations (5 presentations judged), 12 October 2023.
2. Judge for the MECH-MATL Graduate Student Research Poster Competition, 1 October 2023 (8 posters).
3. Judge for AU Student Research Symposium, March 28, 2023 (judged 4 oral presentations).
4. Judge, 2021 Graduate Engineering Research Showcase, 28 October 2021 (6 posters).
5. Judge for the ME Graduate Student Poster Competition, 25 Sept. 2022 (7 posters).
6. Judge, AU Research 2021 Student Symposium, 31 March 2021, (4 online presentations).
7. Judge, College of Engineering FiveInFive Graduate Student Presentations (4 online presentations), 28 October 2020.
8. Judge, 2020 Virtual Auburn Student Research Symposium (6 posters), 1 May 2020.
9. Judge for Three Minute Thesis (3MT), Auburn University, 24 October 2019.
10. Judge for ME Conference Graduate Student Poster Session, 15 Sept. 2019.
11. Judge, Auburn Research Student Symposium, 9 April 2019.
12. Judge for AU SG Graduate Engineering Research Showcase, 24 October 2018.
13. Judge for AU This is Research Student Symposium, Biomedical Health (Oral Presentations), 26 March 2018.
14. Judge for ME Conference Graduate Student Poster Session, 30 Sept. 2018.
15. Gave a presentation about the education opportunities in the U.S.A. to a group of university students in Istanbul, Turkey, July 16, 2018.
16. Judge for AU This is Research Student Symposium, Biomedical Health (Oral Presentations), 26 March 2018.
17. Judge for Graduate Student Poster Contest at ME Conference, 17 September 2017.
18. Prepared and submitted SACS Assessment Reports for PFEN Masters and Ph.D. programs, June 2017.
19. Judge for two proposals submitted to UTIB International R&D Brokerage Event, 27-28 April 2017, Bursa, Turkey (14 April 2017).
20. Judge for AU This is Research Student Symposium, 13 April 2017.
21. Judge, “2017 Finish in 5 Competition”, AU SG College of Engineering Graduate Students (CEGS), 22 March 2017.
22. Judge, AU SG College of Engineering, Graduate Engineering Research Showcase, 20 October 2016.
23. Judge for AU This is Research Student Symposium, 13 April 2016.
24. Judge for several proposals submitted to UTIB International R&D Brokerage Event, 12-13 May 2016, Bursa, Turkey.
25. Judge for AU SG College of Engineering Fall 2015 Graduate Engineering Research Showcase, 22 October 2015.
26. Judge for eight proposals submitted to UTIB International R&D Brokerage Event, 27-29 May 2015, Bursa, Turkey.
27. Judge for oral session; This is Research: Student Symposium 2015, Auburn University, 13 April 2015.
28. Feb. 27, 2015; gave polymer processing lab tours during the E-day.
29. Judge, Fall 2014 Graduate Engineering Research Showcase, Auburn University, Oct. 23, 2014.
30. Judge for the “Turkey Innovation Week”, Dec. 6-8, 2012, Istanbul, Turkey. Judged 10 proposals.
31. Recommendation letter for promotion of a professor at an NTC University, December 2004.
32. Member of the Fiber Society Award Committee, 2011- 2013.
33. Member of the Scientific Committee for the International Congress of Innovative Textiles, ICONTEX2011, 20-22 October 2011, Tekirdag, Turkey. Reviewed manuscripts for acceptance to the conference.

34. Gave the commencement speech at Marmara University, College of Engineering Graduation Ceremony, Istanbul, Turkey, 6 July 2011.
35. Presented the NTC booth, 1.00-5.00 pm, Techtextil North America Symposium, April 2, 2008, Atlanta, GA.
36. Helped with the Engineering Technologies Academy for Civil Air Patrol cadets, July 8-12, 2003, Auburn University.
37. Organized the AU Textile Engineering booth for the Techtextil North America International Trade Fair for Technical Textiles and Nonwovens, March 23-25, 2000, Atlanta, GA.
38. Gave a lecture to Prof. Richard Penaskovic's class RELG 0304 – Western Religions on June 1, 1999.
39. Attended the Milliken Summer Challenge University/Industry Programs (1997 and 1998).
40. Served as judge in the Industrial Fabrics Association International (IFAI)'s annual International Achievement Awards competitions (1995-2000)
41. International Advisory Board Member, International Conference on Composites Engineering (ICCE); ICCE/9 (2002 San Diego, CA), ICCE/8 (2001 Tenerife, Spain), ICCE/7 (2000, Denver, Colorado), ICCE/6 (1999, Florida Resort, FL), ICCE/5 (1998, Las Vegas, NV), ICCE/4 (1997, Big Island of Hawaii).
42. Reviewer of Proposals for National Science Foundation (NSF)
43. Attended the workshop "Integrating Design into the Engineering Curriculum", which was offered by the Southern Methodist University, in Dallas, TX on March 19-21, 1998. This was part of ABET preparation activities.
44. "Two-man, Three Season, Double Walled Tent for the US Marine Corps Systems Command (MARCORSYSCOM)". Proposal prepared on behalf of National Apparel, Inc., of Montgomery, AL for the US Marine Corps. Project Total: \$ 18,750,000.00; 150 pages, July 97.
45. Gave a presentation to Alabama Congressional Delegation on Geotextiles, May 9, 1997.
46. Prepared and presented the AU Textile Engineering booth during the 3rd International High-Tech Textiles Conference, Greenville, SC, June 94.
47. Prepared and presented the AU Textile Engineering booth during the 2nd International High-Tech Textiles Conference, Greenville, SC, July 93.

Companies and Organizations Served

Some of the work was done on a no charge bases. Inquiries varied; some visits, some by analysis and transmittal of samples and/or data, some literature search, technical reports, patent infringement cases, testimonies, expert witness, trials, etc. The following list does not include companies that I served through the phone.

- 3Tex, Raleigh, NC. Analysis of McGinley System.
- A-Carb LLC
- Alexander Shunnarah
- Allied Signal, Medical Textiles, Virginia.
- Amoco Fabrics and Fibers Company, Bainbridge, GA.
- Asten Forming Fabrics, Appleton, WI.
- AU Vet. School, testing of ligaments on Instron, Sept. 29-Oct. 3, 1995.
- Berry Plastics
- Best Fabrics
- Bo-Tex Sales Corporation, Hogansville, GA. Recycling.
- Bruin Plastics Co. Recycling.
- C. M. Offray & Son, Inc. Recycling.
- Clark Schwebel, Inc. 3D weaving.
- Commissariat A L'energie Atomique and Aerospatiale of France. Composite research.
- Continental AG

- Cooley Inc. Recycling.
- Cordis Corp.
- Deerfield Specialty Papers, Inc., Augusta, GA on wear of forming fabrics.
- Development and testing of "Hail no Hail" fabric for Marks & Flinn of Montgomery, AL, 1994.
- DeWayne Layfield
- Doran Textiles, Shelby, NC. Mr. Reuben Bond on 'Team Weaving' concept. (6.5.93)
- Dority-Manning
- Eastern Technologies
- Eaton Corp, Milwaukee, Woven and knit reinforcements for composites
- Emory University, Atlanta, GA. Polymeric stents.
- Environmental Technical Services. Recycling.
- EverCare Co.
- Flexol Packaging
- Gallery Co.
- Hanon Systems
- Hassan Textile Inc., Istanbul, Turkey.
- Hoechst Celanese, Mr. Dan Cain, Spartanburg, SC on developing a warp knitted structure using elastomeric monofilament fiber.
- Howard Rubenstein
- HSN
- Hunting rope testing for Alexander Shunnarah
- Illinois Tool Works
- Industrial Fabrics Association International (IFAI). Recycling.
- Industrial Textile Associates, Greer, SC. Analysis of a rayon fabric carbonized after weaving.
- InterVascular
- John Boyle & Co., Inc. Recycling.
- Johnston Composite Reinforcements, Inc., Phenix City, AL. Process improvement.
- Johnston Industries, Utilization Plant, Valley, AL. Fibrograph.
- KilpatrickStockton
- Kimberly Clark
- Kinedyne Corporation, Prettvile, AL.
- Lindsay Wire, Florence, MS. Mr. Ton Rietzelt on Jacquard Weaving (6.30.93)
- Maples Industries
- Mesa Associates.
- Milliken
- Milliken & Company, Specialty Industrial Business, LaGrange, GA. Geotextiles, composites.
- Mr. Les Letlow
- N. V. Bekaert S. A., Belgium.
- National Apparel, Inc., Montgomery, AL. Combat tent.
- Nollapelli
- North Carolina State University, College of Textiles. Consultant for the Air-Jet Loom Simulator.
- Novus
- NSF Panelist

- PE Technikon and CSIR of South Africa. Textile Engineering education and research.
- Seattle Textile Company, Seattle, WA, on testing of PVC coated polyester sheeting designed for use in flame resistant, coated fabric type hose.
- Shakespeare Monofilament, Columbia, SC. Development of Forming Fabric, 1994.
- Softbelly's
- Southern Mills
- Startex, Spartanburg, SC. Recycling of coated fabrics.
- State of Maine/AAAS
- Sulzer-Ruti, Inc., Spartanburg, SC. Forming fabrics.
- SulzerTextil.
- Textrade.com
- TrustForte Corporation.
- Twitchell Corporation, Dothan, AL. Weaving.
- Tyco Industries, AL.
- U.S. CRDF Science Center
- Unsa, Istanbul, Turkey.
- US Geotextiles, Opelika, AL., Evaluation of ultrasonic seams of geotextiles.
- Weblon, Inc. Recycling.
- Wellington Sears Co., Valley, AL.
- Zyvex Corporation

Community Service

1. Soccer coach, U13G, Auburn Parks and Recreation Department, Fall 2013 season
2. Soccer coach, U13G, Auburn Parks and Recreation Department, Spring 2013 season
3. Soccer coach, U13G, Auburn Parks and Recreation Department, Fall 2012 season
4. Soccer coach, U10G, Auburn Parks and Recreation Department, Spring 2012season
5. Participated at the Spring Fling, Yarbrough Elementary School, Apr. 29, 2011
6. Soccer coach, U10G, Auburn Parks and Recreation Department, Spring 2011season
7. Soccer coach, U16, Auburn Parks and Recreation Department, Fall 2010 season
8. Soccer coach, U16, Auburn Parks and Recreation Department, Fall 2009 season
9. Gave a tour of the Polymer Processing lab to Drake Middle School 6th graders Cosmic Cat team, Spring 2009.
10. Chaperon for AU Explore field trip of Yarbrough Elementary School 5th graders, Apr. 25, 2008, 8.30-13.30.
11. Soccer Coach for U13 Boys, Auburn Parks and Recreation Department, Fall 2007.
12. Soccer Coach for U6 coed team, Auburn Parks and Recreation Department, Spring 2007 and Fall 2007.
13. Attended the 'football throwing' booth at Yarbrough Elementary School's "Spring Fling", 28 April 2006.
14. Gave a seminar about Polymer and Fiber Engineering to Mrs. Fleming's 5th grade class at Yarbrough Elementary School, Thursday, April 27, 2006.
15. Soccer Coach for U10 and U13 Boys, Auburn Parks and Recreation Department, Spring 2006, Fall 2006, Spring 2007.
16. Soccer Coach for U10 and U13 Boys, Auburn Parks and Recreation Department, Spring 2005 and Fall 2005.

17. Participated at the Yarbrough Elementary School WinterFest, Feb. 25, 2005.
18. Soccer Coach for U8 Boys, Auburn Parks and Recreation Department, Fall 2004
19. President of the Auburn Ministerial Association (AMA) 2003-2004, member since 2002.
20. Seminar given at the Leadership Alabama Retreat: "Religion: Does it Unite or Divide?", Tuskegee University Chapel, Jan. 30, 2004.
21. Participated in home building for Habitat for Humanity (2002-present)
22. Participated in Community Market activities (2003-present)
23. Presentation made at the Interfaith Community Service of Thanksgiving, Nov. 21, 2000, Auburn University Chapel.
24. Gave 5 seminars/tours to Auburn City School students between 1994 to 2000.
25. Member of the United Way of Lee County, Campus Division, Campaign pilot program, 1996-present.
26. Certified soccer coach for Under 6, Under 8, Under 10 and Under 13 years old kids, Auburn Parks and Recreation Department, 1993-present.
27. Gave a lab tour to AU Child Study Center Preschool Class, January 19, 2000.

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