Filed on behalf of Bedgear LLC

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FREDMAN BROS. FURNITURE COMPANY, INC.,
Petitioner

v.

BEDGEAR, LLC
Patent Owner

Case IPR2017-00351
U.S. Patent No. 9,015,883

DECLARATION OF DR. RADHAKRISHNAIAH PARACHURU IN SUPPORT OF PATENT OWNER'S RESPONSE PURSUANT TO 37 C.F.R. § 42.120

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EXHIBIT LIST

Exhibit No.	Exhibit Description
2001	Declaration of Dr. Radhakrishnaiah Parachuru in Support of Patent Owner
2002	CV of Dr. R. Parachuru
2003	K. Bilisik et al., "3D Fabrics for Technical Textile Applications", *Non-woven Fabrics*, Chapter 4 ("3-D Fabrics")
2004	Declaration of Dr. Radhakrishnaiah Parachuru in Support of Patent Owner Response
2005	P.G. Tortora and I. Johnson, "The Fairchild Books Dictionary of Textiles", 8th Edition, Bloomsbury Publishing Inc., 2014 ("Dictionary of Textiles")
2006	ASTM D 737 : Standard Test Methods for Air Permeability of Textile Fabrics ("ASTM")
2007	J. Hu, "3-D fibrous assemblies - Properties, applications and modeling of three-dimensional textile structures", Woodhead Publishing Limited, 2008 ("3-D Fibrous Assemblies")
2008	The Reiter Manual of Spinning, Volume 1: The Technology of Short Staple Spinning ("Manual of Spinning")
2009	S.J. Kadolph, "Textiles", 11th Ed., Pearson Education, Inc., 2011 ("Kadolph Textiles")
2010	R. Thompson, "Manufacturing Processes for Textile and Fashion Design Professionals", Thames & Hudson Inc., 2014 ("Manufacturing Processes")
2011	J. Jerde, "Encyclopedia of Textiles", Facts On File, Inc., 1992 ("Encyclopedia of Textiles")
2012	Sleepgram Luxury Pillow

Exhibit No.	Exhibit Description
2013	Textileweb.com., "Meryl Nexten", Nylstar, Inc.
2014	G. Baugh, "The Fashion Designer's Textile Directory", Barron's, 2011 ("Textile Directory")
2015	U.S. Patent Publication No. 2009/0083908 to Fry ("Fry")
2016	Deposition Transcript of Jennifer Frank Rhodes, September 26, 2017
2017	Defendant Fredman Bros. Furniture Company Inc.'s Responsive Claim Construction Brief, Civil Action No. 2:15cv06759
2018	Declaration of Dr. Radhakrishnaiah Parachuru in Support of Claim Construction Reply, Civil Action No. 2:15cv06759

Declaration of Dr. Radhakrishnaiah Parachuru In Support of Patent Owner's Response Pursuant to 37 C.F.R. § 42.120

I, Radhakrishnaiah Parachuru, declare as follows:

I. Overview

1. I am over 21 years of age and otherwise competent to make this declaration. I make this declaration based upon facts and matters within my own knowledge and on information provided to me by others.

2. I have been retained as an expert witness to provide testimony on behalf of Bedgear LLC ("Patent Owner") as part of the following *inter partes* review proceedings ("IPRs"): IPR2017-00350, IPR2017-00351, IPR2017-00352, and IPR2017-00524 regarding the validity of U.S. patent numbers: 8,887,332 ("the '332 Patent"), entitled "Pillow with gusset of open cell construction," 9,015,883 ("the '883 Patent"), entitled "Pillow with gusset of open cell construction," 8,646,134 ("the '134 Patent"), entitled "Pillow with gusset of open cell construction," and 9,155,408, entitled "Pillow protector."[1]

3. I understand that the '134 Patent was filed on June 22, 2012 and issued on February 11, 2014, the '332 Patent was filed on December 16, 2013 and issued on November 18, 2014, the '883 Patent was filed on July 10, 2014 and

[1] The substance of this declaration is limited to opinions related to IPR2017-00350, -00351, - and 00352.

issued on April 28, 2015. I also understand that the ‘134, ‘332, and ‘883 Patents share substantially the same specification and that all claim priority to the same provisional patent application, Application No. 61/499,907, filed on June 22, 2011.

4. I have reviewed and am familiar with the specifications and relevant portions of the prosecution histories of the ‘134, ‘332, and ‘883 Patents. I have also reviewed the provisional application in the priority chain of the ‘134, ‘332, and ‘883 Patents. As I explain in more detail below, I am familiar with the technology at issue at the time of the ‘134, ‘332, and ‘883 Patents, which, for purposes of this declaration, I have assumed to be June 22, 2011.[2]

5. I have also reviewed and am familiar with the prior art references cited by Petitioner in the grounds for *inter partes* review of the ‘134, ‘332, and ‘883 Patents.

6. I understand that the Patent Office has instituted a review of claims 1-6, 8-13, 15-18, and 20-24 of the ‘134 Patent based on the following grounds:

a. Claims 1, 4, 5, 11, 17, and 22 are anticipated by PCT International Publication No. WO 2010/075294 to Rasmussen (“Rasmussen”) (Ex. 1006);

[2] My opinions expressed herein would not be affected should the “time of the invention” be found to be sometime between June 22, 2011 and June 22, 2012.

b. Claims 1, 4–6, 8, 11, 13, 17, 18, 22, and 23 are anticipated by an alternative interpretation of Rasmussen;

c. Claims 2, 3, and 12 are rendered obvious by Rasmussen in view of U.S. Patent No. 3,109,182 to Doak ("Doak") (Ex. 1008);

d. Claims 9, 15 and 20 are rendered obvious by Rasmussen in view of European Patent App. No. EP 1378193 A1 to Vuiton ("Vuiton") (Exs. 1044-1046); and

e. Claims 10, 16, 21, and 24 are rendered obvious by Rasmussen in view of U.S. Patent Application Publication No. US 2007/0246157 to Mason ("Mason") (Ex. 1012).

7. I understand that the Patent Office has instituted a review of claims 1–11, 13, 15–23, and 27–34 of the '332 Patent based on the following grounds:

a. Claims 1–3, 6–9, 13, 16, 18–20, 22, 27, 29–31, 33, and 34 are anticipated by Rasmussen;

b. Claims 1–3, 6–9, 11, 13, 15, 16, 18–20, 22, 23, 27, and 31–34 are anticipated by an alternative interpretation of Rasmussen;

c. Claim 17 is rendered obvious by Rasmussen;

d. Claims 4, 5, and 28 are rendered obvious by Rasmussen in view of Doak;

e. Claims 24 and 25 are rendered obvious by Rasmussen in view of U.S. Patent Application Publication No. 2007/0261173 to Schlussel ("Schlussel") (Ex. 1009);

f. Claim 17 is rendered obvious by Rasmussen in view of U.S. Patent No. 6,988,286 to Schecter et al. ("Schecter") (Ex. 1011);

g. Claims 10 and 21 are rendered obvious by Rasmussen in view of Mason; and

h. Claim 28 is rendered obvious by Rasmussen in view of U.S. Patent No. 6,760,935 to Burton et al. ("Burton") (Ex. 1013).

8. I understand that the Patent Office has instituted a review of claims 1–10, 12–15, and 17–20 of the '883 Patent based on the following grounds:

a. Claims 1–4, 7–10, 14, 15, 18, and 20 are anticipated by Rasmussen;

b. Claims 1–4, 7–10, 13–15, 17, 18, and 20 are anticipated by an alternative interpretation of Rasmussen;

c. Claims 5, 6, and 19 are rendered obvious by Rasmussen in view of Doak;

d. Claim 12 is rendered obvious by Rasmussen in view of Mason; and

e. Claim 19 is rendered obvious by Rasmussen in view of Burton.

9. I have been asked to provide a technical review, analysis, and insight regarding the above-noted references, which I understand form the basis for the grounds of rejection as set forth in the Petition and instituted by the Board.

10. I am being compensated for my time in connection with these IPRs at a rate of $250 per hour. I am also being compensated for any out-of-pocket expenses for my work in this review. My compensation as an expert is in no way dependent upon the results of any investigations I undertake, the substance of any opinion I express, or the ultimate outcome of the review proceedings. I have been advised that Bryan Cave LLP represents the Patent Owner in this matter.

II. My Background and Qualifications

11. I am a Principal Research Scientist and Senior Academic Professional with the Fiber and Polymer Division of the School of Materials Science and Engineering at the Georgia Institute of Technology ("Georgia Tech"), in Atlanta, Georgia. I have been involved in the field of textiles for over 35 years.

12. I earned a Bachelor's in Textile Technology from the University of Madras, India in 1973, a Master's in Textile Technology from the University of Madras, India in 1975, and a Doctorate in Textile Engineering from the Indian Institute of Technology in 1980. I also earned a Master's in Decision Sciences from Georgia State University in 1995.

13. I first joined the School of Textile and Fiber Engineering at Georgia Tech in December 1989. During the mid-1990s, the School of Textile and Fiber Engineering became the School of Polymer and Fiber Engineering, which in 2010 merged with the School of Materials Science and Engineering. Over my 28 years of experience at Georgia Tech, I have held various positions. I began as a Research Scientist – I, was promoted to Research Scientist – II after 5 years, and later became a Senior Research Scientist after 9 years. I served as a Senior Research Scientist for 7.5 years before attaining my current position.

14. My major responsibilities at Georgia Tech include teaching, research and industry/public support. At Georgia Tech, I have taught both theory and laboratory courses in the areas of yarn formation, weaving, knitting, and nonwovens. These classes also touch upon both physical testing and quality control.

15. For almost 35 years, I have performed research in the areas of fiber-product manufacturing and evaluation of the performance of fiber-based products such as yarns, fabrics, garments, carpets and other miscellaneous fiber products. Research in these areas included: application of instrumental techniques for the objective evaluation of the handle and comfort properties of textile fabrics and other structured fiber assemblies. Specifically, this research included studying relationships between the structural parameters of woven, knitted and nonwoven

fabrics and their properties, such as: thermal insulation/conductivity, absorption and retention of moisture, softness and compressibility, surface roughness, surface friction, and mechanical behavior. Specific funded research topics investigated in this area include:

- Understanding the factors governing the functional performance of healing and shape-wear garments;
- Studying the relationship between the construction and end use performance of knitted sweat shirts;
- Research on the frictional properties of woven apparel fabrics;
- Research on the effects of fabric structure and yarn-to-yarn liquid migration on liquid transport in fabrics;
- Studying handle and comfort properties of plain weave fabrics made from high performance fibers;
- Studying both the cutaneous and perceived comfort response of fabrics in humans (including in hot, humid environments); and
- Predicting the compressive pressure exerted on the body by specially engineered post-operative wound healing garments from their stretch and recovery properties.

16. Beyond functional evaluation of fibrous structures, I have also designed state of the art fiber products with engineered functional performance for

both apparel and non-apparel applications. Specific types of research in this area include:

- Development and evaluation of vapor barrier textiles for energy conservation and environmental control purposes;
- Design and optimization of polypropylene-rich wickable towels;
- Development of hydrophilic, comfortable fabrics from hybrid Cellulosic-Nomex® fibers;
- Design and development of functionally tailored textile fabrics using engineered multi-component yarns; and
- Design of a stretch fabric that stretches by 300% and recovers instantly.

17. My research in textiles and fabrics has also included applying new techniques in design of fabrics. Specific grants and research in this area include:

- Application of lasers to develop design patterns on unfinished textile fabrics.

18. I have also defined new approaches for applying Kawabata Evaluation System (KES) techniques to product and process optimization in the textile and allied industries. I have also facilitated improvements at the ground level in manufacturing, including:

- Improving the colorfastness of nylon rug yarn; and
- Determining the cause of differential fading of white linen subjected to weekly industrial laundering.

19. A more detailed listing of my professional background and accomplishments is found in my *curriculum vitae* provided as Exhibit 2002.

III. My Expertise and the Person of Ordinary Skill in the Art

20. As a result of my more than 35 years of experience in the field of materials science and textile research, design, development and evaluation, I am very familiar with the types of materials used in the '134, '332, and '883 Patents. In particular, I am familiar with the moisture-wicking and heat transfer properties of these materials as well as the potential cutaneous effects of these materials on individuals.

21. Accordingly, I am qualified to provide expert opinions on the technology described in the '134, '332, and '883 Patents as well as the teachings of the prior art references at the time of these patents.

22. Counsel has informed me, and I understand, that the "person of ordinary skill in the art" is a hypothetical person who is presumed to be familiar with the relevant scientific field and its literature at the time of the invention. This hypothetical person is also a person of ordinary creativity capable of understanding the scientific principles applicable to the pertinent field.

23. I am informed by counsel and I understand that the level of ordinary skill in the art may be determined by reference to certain factors, including (1) the type of problems encountered in the art, (2) prior art solutions to those problems, (3) the rapidity with which innovations are made, (4) the sophistication of the technology, and (5) the educational level of active workers in the field.

24. Counsel has asked me to assume for the purposes of this declaration that the "time of invention" applicable to the challenged claims of the '134, '332, and '883 Patents is June 22, 2011.[3]

25. Based on the above factors, in my opinion, a person of ordinary skill in the art at the time of the '134, '332, and '883 Patents would have a bachelor's degree in textile science, textile engineering or a similar degree along with several years of industry experience in applying the moisture and heat transfer properties of materials which typically come into close direct or indirect contact with human skin. Additional graduate education in textile or material sciences might substitute for experience.

IV. Applicable Legal Standards

26. I am not an attorney and do not expect to offer any opinions regarding the law. However, counsel at Bryan Cave LLP have informed me of certain legal

[3] My opinions expressed herein would not be affected should the "time of the invention" be found to be sometime between June 22, 2011 and June 22, 2012.

principles relating to patent claim construction and invalidity that aided in developing my opinions set forth in this report.

Anticipation

27. I understand that an issued patent claim is invalid as anticipated if each and every limitation of that claim is disclosed in a single prior art reference that enables a person of ordinary skill in the art to make the allegedly anticipating subject matter. I understand that to be anticipatory, a reference must enable one of ordinary skill in the art to practice an embodiment of the claimed invention without undue experimentation.

28. My understanding is that if a prior art reference does not disclose a given limitation expressly, it may do so inherently. I have been informed by counsel and I further understand that a prior art reference will inherently anticipate a claimed invention if any claim limitations or other information missing from the reference would nonetheless be known by the person of ordinary skill in the art to be necessarily present in the subject matter of the reference.

Obviousness

29. I understand that an issued patent claim is invalid as obvious if it can be shown that the differences between the patented subject matter and the prior art are such that the subject matter as a whole would have been obvious, at the time the invention was allegedly made, to a person having ordinary skill in the art.

Relevant considerations include the level of ordinary skill in the art, the scope and content of the prior art, differences between the prior art and the claims at issue, and any objective secondary considerations of non-obviousness.

30. My understanding is that the obviousness inquiry requires that the prior art be considered in its entirety. I also understand that, in order to evaluate the obviousness of a patent claim over a given prior art combination, one should analyze whether the prior art references, included collectively in the combination, disclose each and every element of the allegedly invalid claim as those references would have been read by the person of ordinary skill in the art at the time of the invention. Then one should determine whether that combination makes the challenged claim obvious to the person of ordinary skill in the art by a preponderance of the evidence. I understand that such preponderance of the evidence is satisfied if the proposition is more likely to be true than not true.

31. I understand that obviousness cannot be proven by mere conclusory statements or by merely showing that a patent claim is a combination of elements that were already previously known in the prior art. Rather, it is my understanding that a party challenging a patent claim in an *inter partes* review proceeding must further establish that there was an apparent reason with some rational underpinnings that would have caused a person of ordinary skill at the time of the alleged invention to have combined and/or altered these known elements to arrive

at the claimed invention. Such reasons might include, for example, teachings, suggestions, or motivations to combine that would have been apparent to a person of ordinary skill in the art or that the proposed modification would have been "obvious to try."

32. My understanding is that one should avoid the use of "hindsight" in assessing whether a patent claim would have been obvious.[4] For example, a claim should not be considered in view of what persons of ordinary skill would know today, nor should it be reconstructed after the fact by starting with the claims themselves and/or by reading into the prior art the teachings of the invention at issue.

[4] Based on my discussions with counsel, I understand that that the term "obvious" has both a legal and a technical meaning. When the term is used throughout this declaration, my opinions and conclusions will be directed to the technical meaning of obvious (i.e., whether subject matter was within the technical grasp of a person of ordinary skill at the time of the '134, '332, and '883 Patents).

33. Counsel has informed me, and I understand, that I should assume for the purposes of this declaration that the "time of invention" applicable to the challenged claims of the '134, '332, and '883 Patents is June 22, 2011.[5]

Claim Language

34. I understand that, in *inter partes* review proceedings, claim terms are to be given the broadest reasonable construction in light of the specification as would be read by a person of ordinary skill in the relevant art.

35. As the result of my education and experience, I believe that I understand how the challenged claims of the '134, '332, and '883 Patents would be understood by a person of ordinary skill in the art applying the above standard.

V. Overview of the Relevant Technology at the Time of the '134, '332, and '883 Patents

A. Overview of Certain Fabric Properties

36. Apparel and other fabrics designed for human contact provide a boundary between the micro-environment immediately surrounding the human body and the larger environment.

37. In many instances, fabrics act as a physical barrier that separates two environments. In the case of fabrics designed to contact the human body, fabrics

[5] My opinions expressed herein would not be affected should the "time of the invention" be found to be sometime between June 22, 2011 and June 22, 2012.

can prevent contamination in both directions – human (e.g., sweat and other bodily fluids) to environment and environment (e.g., dirt, dust) to human. Additionally, fabric systems can be used to regulate temperature and moisture accumulation in these environments.

38. With respect to fabrics designed to be worn or to come into close contact with the human body (e.g., a pillow), significant comfort related factors include the temperature-regulating and moisture absorbing/dispersing characteristics of the fabric. Whether someone is comfortable when in contact with a particular fabric depends, in part, on the quantitatively measurable properties of that fabric that promote or restrict the passage of heat, air, moisture and/or vapor through the fabric. Other subjective components of comfort are difficult to measure and are generally expressed in qualitative terms. When in contact with the human body, fabrics contribute to the human body's temperature regulating system.

39. Heat and moisture transfer through fabrics can be measured and expressed in quantitative terms. For example, measurements can be taken to quantify a fabric's effects with respect to: heat balance, heat loss, air permeability, thermal conductivity, water vapor permeability, etc.

40. Heat balance accounts for the balance between the heat generated by the human body (i.e., metabolic heat) and the heat received from external sources

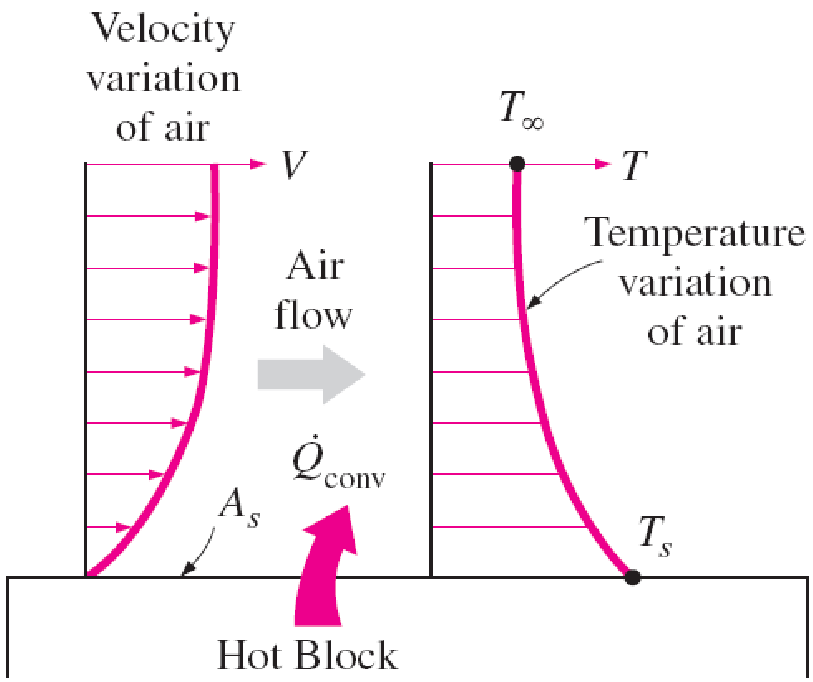
on the one hand and the heat lost from the body on the other. If the heat gain (metabolic heat + external heat) and the heat loss are not in balance, then the body temperature will either rise or fall. Small variations from the body's normal core temperature will go unnoticed, larger variations will cause discomfort, extreme variations can have significant consequences including death.

41. In most situations, human body temperature is above the temperature of the external environment. In these cases, the human body tends to lose heat to the environment. Generally, there are four mechanisms that allow a warm body (e.g., a human body or a pillow core) to lose heat to the environment in order to maintain its thermal balance. These mechanisms include conduction, convection, radiation and evaporation.

42. Conduction is a process in which heat is transferred between two substances via direct contact. The rate of heat exchange is determined by the temperature difference between the two substances and by their thermal conductivities.

43. Convection is a process in which heat is transferred via a moving fluid (liquid/gas). For example, air in contact with a body (e.g., a human body or other warm block or body such as a pillow core) is heated by conduction which causes the heated air to move away from the body and be replaced by cooler air (e.g., a convective current). Because air tends to 'cling' to solid surfaces, materials with a

large exposed surface area, such as a mass of fine fibers, act as a good restrictor of air movement and thus lessen the effect of convection. The figure below illustrates a convective process.



44. Radiation is a process in which heat is transferred via electromagnetic waves. Electromagnetic waves are able to pass through air without transferring much heat to the air. Radiation and absorption of heat are both influenced by an object's color.

45. Evaporation is a process where heat is transferred via a phase change from liquid to gas. Changing liquid water into water vapor requires heat energy. When liquid water (e.g., sweat) is evaporated from the skin's surface the energy required to do so is removed from the skin, thus cooling it. There are two basic

forms of evaporative perspiration: 1) insensible - in this form the perspiration is transported through the skin's pores as a vapor which will then pass through the air gaps between yarns in a fabric, and 2) liquid – this form occurs at higher sweating rates and it wets the fabric which is in contact with the skin. The two forms of perspiration raise separate problems: one is the ability of water vapor to pass through the fabric, particularly the outer layer; and the other is the ability of the fabric in contact with the skin of absorbing or otherwise managing the liquid sweat.

46. The ability of a fabric to allow perspiration in its vapor form to pass through it is measured by its moisture vapor permeability in grams of water vapor per square meter per 24 hours. A fabric of low moisture vapor permeability is unable to pass sufficient perspiration and this leads to sweat accumulation in the fabric and hence discomfort. The overall moisture vapor permeability of a complex fabric product, such as a pillow depends on the resistance of the material(s) used in each layer (e.g., outer cover, inner cover, fill material) along with air gaps which add to the total resistance of the system. If the production of perspiration is greater than the amount the fabric system will allow to escape, moisture will accumulate at some point in the fabric system. Moisture-wicking fabrics, as their name suggests, are intended to carry moisture away from the skin and surface of the fabric, thus maintaining comfort.

47. In the absence of external forces, the transport of liquids into fibrous assemblies is driven by capillary forces that arise from the wetting of the fiber surfaces, this is called “wicking.” If the liquid, however, does not wet the fibers it will not wick into the fibrous assembly. The wetting of fibers is purely dependent on their surface properties, in particular in the case of wetting with water, whether the surface is hydrophobic or hydrophilic. Therefore, the wetting and wicking properties of fibers can be modified by surface coatings. When wicking takes place in a material whose fibers can absorb liquid, the fibers may swell as the liquid is taken up, which may reduce the capillary spaces between fibers, potentially altering the rate of wicking. The fabric’s wicking rate is dependent on the capillary dimensions of the fibrous assembly and the viscosity of the liquid.

48. Since they are thermodynamic processes, conduction, convection, and radiation affect the heat flow in fabrics. The heat flow through a fabric is due to a combination of conduction and radiation, convection within a fabric being negligible. The conduction loss is determined by the thickness of the fabric and its thermal conductivity. Thermal conductivity is itself a combination of the conductivity of air (k_A) and that of the fiber (k_F): Thermal conductivity $k = (1 - f)k_A + f(k_F)$, where ‘f’ is the fiber volume fraction, which is the fraction by volume of the fabric taken up by fiber. Heat flow due to radiation, however, is more complex. Factors affecting radiated heat flow in fabrics include the

temperature difference between the heat emitter and the heat absorber. Because it is either scattered or absorbed by the fibers, infra-red radiation generally only travels a few millimeters into a fabric. These fibers in turn emit radiation which travels a further short distance to the next fibers and so on until it reaches the fabrics' far surface. Therefore, radiated heat flow between the human body and the fibers of a contacting fabric is indirect and depends on the absorption and emission properties of the fibers.

49. The insulation value of a complex fabric product such as a pillow is not just merely dependent on the insulation value of each individual layer (e.g., outer cover, inner cover, fill material) but on the system as a whole since the air gaps between the layers can add considerably to the total insulation value. When the gaps between layers are large, air movement can take place within them, leading to heat loss by convection. The insulation value of a fabric is in fact mainly dependent on its thickness and it can be estimated from the relationship: clo = 1.6 · thickness in cm where clo is a measure of thermal resistance. The insulation value of a material is generally measured by its thermal resistance which is the reciprocal of thermal conductivity and is defined as the ratio of the temperature difference between the two faces of the fabric to the rate of flow of heat per unit area normal to the faces.

50. Practical methods for measuring thermal conductivity measure the total heat transmitted by all mechanisms (e.g., by conduction through the fiber, by conduction through the entrapped air, and by radiation). Thermal conductivity tests include: TOG meter, two plate method and guarded hot plate method.

51. The thermal characteristics of a fabric are dependent on certain characteristics of the fabric with respect to air, including permeability, resistance and porosity. The air permeability of a fabric is a measure of how well it allows the passage of air through it. Dictionary of Textiles (Ex. 2005), p. 450. The ease with which air passes is of importance for a number of fabric end uses such as pillows, industrial filters, tents, sail cloths, parachutes, raincoat materials, shirtings, down-proof fabrics and airbags. The air permeability of a fabric is the volume of air measured in cubic centimeters passed per second through $1cm^2$ of the fabric at a pressure of 1cm of water. The air resistance of a fabric is the time in seconds for $1cm^3$ of air to pass through $1cm^2$ of the fabric under a pressure head of 1cm of water. *See* ASTM D (Ex. 2006).

52. The porosity of a fabric is a ratio of airspace (void) to the total volume of the fabric (void + solid matter) expressed as a percentage. Dictionary of Textiles, p. 476. Because porosity is indicative of the amount of open space in a fabric, permeability can be related to porosity. As such, one would expect that the more open the structure of the fabric, the greater the air permeability.

53. This relationship, however, is not always so simple. Yarn twist is also important in air permeability. Generally, as twist increases, the circularity and density of the yarn increases in a fabric. In turn, this reduces the yarn diameter and the fabric cover which increases the air permeability. Yarn crimp and weave pattern influence the shape and area of the interstices between the yarns and may permit yarns to extend easily. Such yarn extension would open up the fabric, thus increasing the air permeability.

54. Sensorial comfort is a qualitative aspect concerned with how a fabric feels when it is applied next to the skin. It has been found that when subjects' skin contacted various fabrics they could not detect differences in fabric structure, drape or fabric finish but could detect differences in fabric hairiness. Some of the separate factors contributing to sensorial comfort which have been identified are: 1) tickle - caused by fabric hairiness, 2) prickle - caused by coarse and therefore stiff fibers protruding from a fabric surface, 3) wet cling - which is associated with sweating and is caused by damp and sticky sweat residues on skin, and 4) warm/cool touch - which is a transient feeling experienced for a fraction of a second when a fabric that is at a lower temperature than the skin is touched. Here, the greater the amount of momentary loss of heat to the fabric surface, the cooler the contact sensation will be and vice versa.

B. 2-D Textiles

55. Broadly speaking, there are four primary techniques for constructing fabrics. These techniques include: weaving, knitting, braiding, and nonwoven manufacturing. Using variations of these techniques a variety of 2-D fabrics may be constructed. For example:

56. Weaving - standard weaving uses two perpendicular yarn sets: warp (0˚) and weft (90˚). These yarns make a series of interlacements according to a pattern. Triaxial weaving introduces a third filler yarn. 3-D Fabrics, p. 8-9 (Ex. 2003); 3-D Fibrous Assemblies (Ex. 2007), p. 2 ("Weaving is the most widely used textile manufacturing technique and accounts for the majority of two-dimensional 2-D fabric produced"), p. 3-4 (describing triaxial woven fabrics).

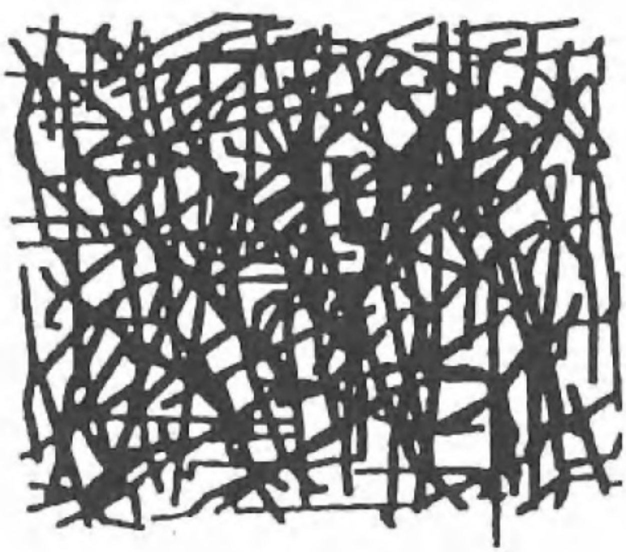
57. Braiding - standard braiding uses a single yarn set, where two oriented braiders are intertwined with each other. Triaxial braiding uses 3 yarn sets, with 6 oriented braiders (two pairs for each yarn set). 3-D Fabrics, p. 9-10; 3-D Fibrous Assemblies, p. 6-7 ("A braid is a textile structure formed by interlacing two or more sets of yarns").

58. Knitting - standard knitting is characterized by rows and columns of interconnected yarn loops. Two basic types of knitting are warp and weft. Inlay yarns may also be used to modify the mechanical properties of the resulting structure. 3-D Fabrics, p. 10-12; 3-D Fibrous Assemblies, p. 4-5 ("Knitted fabrics

are textile structures assembled from basic construction units called loops. There exist two basic technologies for manufacturing knitted structures: weft and warp-knitted technology"); 3-D Fibrous Assemblies, p. 17 ("Knitting is the interlocking of one or more yarns through a series of loops").

59. Nonwovens - Nonwovens are made up of short fibers held together by various techniques including: needling, stitching, chemical or thermal bonding, and electrospinning. 3-D Fabrics, p. 12; 3-D Fibrous Assemblies, p. 5 ("Non-woven fabrics are broadly defined as sheet or web structure bonded together by entangling fibre or filaments either mechanically, thermally or chemically"). A representation of a basic non-woven structure is reproduced below:

6 3-D fibrous assemblies



1.4 Basic non-woven fabric.

3-D Fibrous Assemblies, p. 6.

60. Use of fibers is one of the primary differences between nonwoven manufacturing and the techniques of knitting, weaving, and braiding discussed above. Generally, knitting, weaving, and braiding use yarns or twisted fibrous strands – which are strands of fibers that are aligned, straightened, parallelized and randomly distributed along length dimension before they are twisted and converted into spun yarn of continuous length. Very fine yarns usually have roughly 50-60 fibers in the cross section while coarse yarns may have up to 250 fibers in the cross section. *See e.g.,* Manual of Spinning (Ex. 2008), p. 13 ("About thirty fibers are needed at the minimum in the yarn cross-section, but there are usually over 100. One hundred is approximately the lower limit for almost all new spinning processes"), p. 49 (Section 7.12 and table - Number of fibers in the yarn cross-section). The spinning process (short staple yarn manufacturing process), aligns, straightens and overlaps the individual short fibers before twisting them into continuous length yarn. This process of converting short length fibers into continuous length yarn is termed "spinning." Or "short staple spinning. The figure below illustrates a fibers being spun into a continuous length yarn.

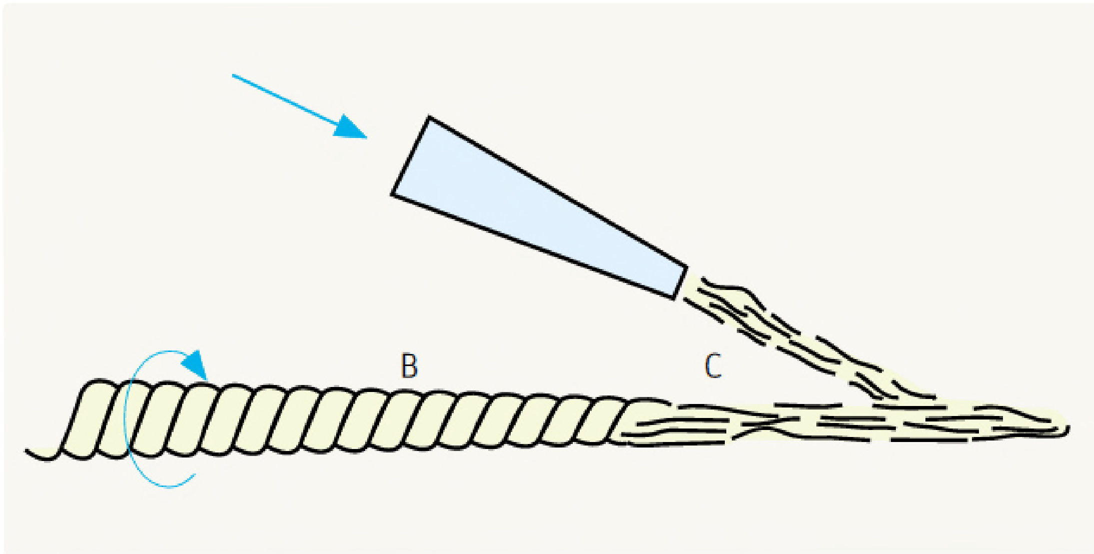


Fig. 51 – Binding-in of the fibers in open-end spinning

Manual of Spinning, p. 51.

61. The figures below illustrate an ideal arrangement of fibers in a yarn.

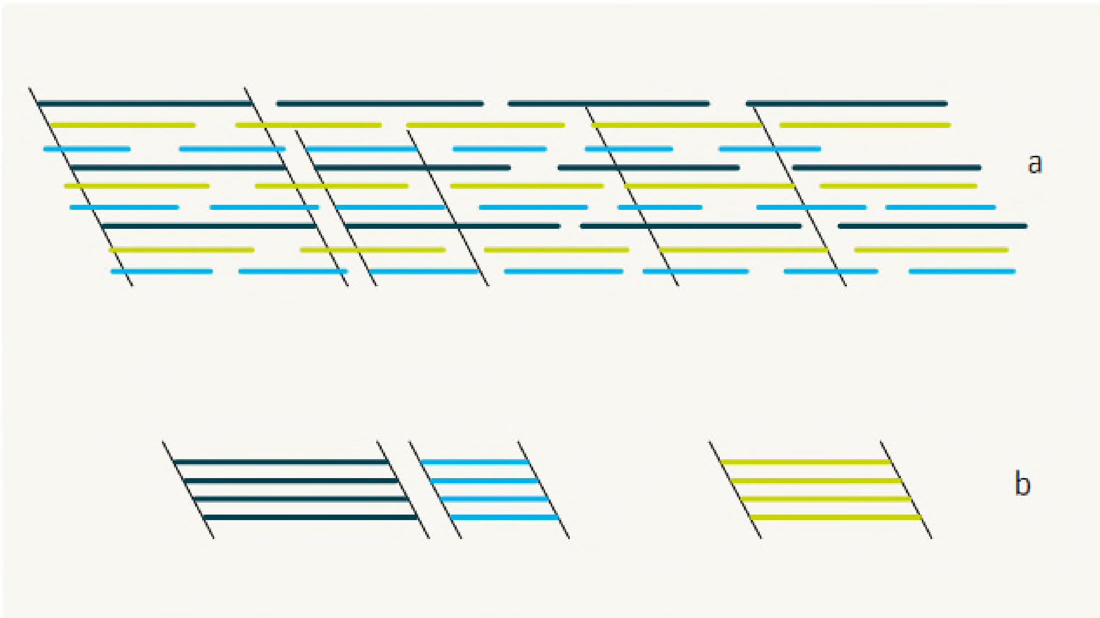


Fig. 49 – The ideal arrangement of fibers of different lengths in the yarn
a, the distribution within the yarn strand;
b, the length groups extracted group-wise from the strand.

Manual of Spinning, p. 49.

62. There are four different manufacturing technologies available to convert short fibers into continuous length yarn and they are: i) ring spinning, ii) open end spinning, iii) air-jet spinning, and iv) friction spinning. Each yarn manufacturing technology imparts its own characteristic set of properties to the yarn on the top of the properties inherited by the yarn through its fiber content and twist density. Manual of Spinning, p. 50-52. The figure below depicts yarns resulting from various spinning techniques.

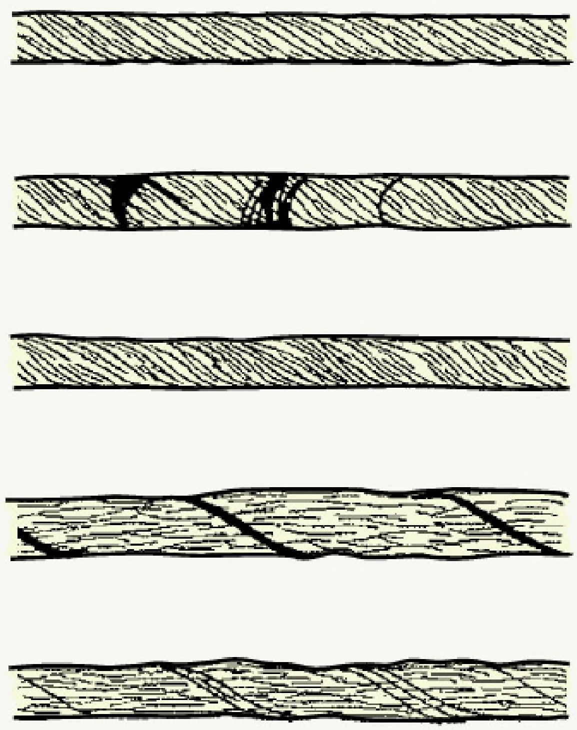


Fig. 54 – Differences in the yarn structure for various spinning processes (drawings without attention to hairiness)

Manual of Spinning, p. 52.

63. As such, yarns can be made of various natural, man-made, and blends of fibers such as cotton (plant-based), wool (animal-based), polyester (synthetic). Kadolph Textiles, p. 32 (Ex. 2009). Fabrics intended for certain end uses prefer single fiber yarns (100% cotton yarns are mostly used to produce knitted underwear garments because they provide the desired functionalities of sweat absorption, breathability and thermal comfort). Fabrics intended for many other end uses (such as men's and women's suits, dress pants, shirts, pillow covers, etc.)

use blended yarns comprising two or more fibers in the blend. Blending offers the opportunity to take advantage of the desirable properties of the individual fibers. A polyester/wool suit, for example, gives the much needed wrinkle resistance, smooth surface appearance, warmth and durability, properties that cannot be obtained by using either pure polyester or pure woolen yarn. The type of fiber(s) used in the yarn dictates many properties of the yarn and hence the property of the resulting fabric and the garment.

64. Typically a medium count (30s count) cotton yarn is 0.006 inches in diameter and it has roughly 110 fibers in its cross section. The diameter (thickness) of each individual cotton fiber that forms medium count yarn is close to 0.00005 inches. Kadolph Textiles, p. 35 ("fine fibers are of better quality. Fineness is measured in micrometers (a micrometer is 1/10000 millimeter or 1/25,400 inch). The diameter range for some natural fibers is 16-20 micrometers for cotton, 12 to 16 for flax, 10 to 50 for wool, and 11 to 12 for silk"). A cotton fiber is thus 20-30 times finer than that of human hair. The diameter and the diameter uniformity of synthetic fibers (and that of their yarns) can be more precisely controlled. Kadolph Textiles, p. 35 ("For manufactured fibers like rayon, nylon, and polyester, dimeter is controlled at several points in the process"). The diameter of polyester, nylon, etc. fibers used in common apparel is similar to that of the cotton fiber, while micro denier fibers can be 10-20 times finer than cotton.

65. Because yarns are twisted bundles of one or more types of individual fibers, yarns themselves can vary in physical shape and size and they may exhibit a wide variation in their properties, including porosity and a range of other properties such as mechanical, thermal, optical, moisture absorption, thermal insulation, bending and flexing, surface friction, tactile sensation, etc. Kadolph Textiles, p. 40-41 (Table of Fiber Properties). These properties are largely reflected in the resulting fabrics and garments. These properties can also be modified through chemical (finishing) treatments applied on fibers in yarn, fabric or garment stages. Chemical treatments can also add a new set of functional properties that are not inherent in the fibers. Kadolph Textiles, p. 376 ("A **finish** is any process that is done to fiber, yarn, or fabric either before or after fabrication to change the *appearance* (what is seen), the *hand* (what is felt), or the *performance* (what the fabric does) (emphasis in original).

66. Additionally, yarn thickness (diameter) can be varied by increasing or decreasing the number of fibers in the yarn cross section or by changing the diameter of the individual synthetic fibers used in the yarn. Two yarns of the same diameter containing the same type of fibers can show major difference in properties, including porosity, based on how exactly the yarn diameter is engineered. The amount of twist inserted to bind the fibers together (twist density) is another critical parameter that influences many properties of the yarn, including

yarn porosity, diameter, strength, compressive softness, moisture absorption and its rate of dissipation between the fibers, surface frictional behavior, thermal insulation, etc. *See e.g.,* Manual of Spinning, p. 52 ("The yarn structure is dependent primarily upon the raw material, spinning process, spinning unit, machine, machine settings, twist, etc. The structure can be open or closed; voluminous or compact; smooth or rough or hairy; soft or hard; round or flat; thin or thick, etc.").

67. While all the properties mentioned above are important for the optimal performance of a performance engineered pillow and pillow cover, of particular importance to the subject matter of the '134, '332, and '883 Patents is the ability to vary a yarn's porosity. As discussed, above, the porosity of a fabric is a ratio of airspace to the total volume of the fabric expressed as a percentage. Three elements contributing to overall porosity are porous fibers, porous yarns and porous fabric structures.

68. Thus, to increase porosity, yarns may be made more porous buy using hollow or porous fibers. For example, yarns can be made from llama and alpaca hairs, which are naturally hollow fibers. Manufacturing Processes (Ex. 2010), p. 490 ("Hollow fibres, such as llama and alpaca hair"), p. 495 ("The fibres from these animals are partially hollow, making them lightweight with good insulation properties.").

69. Yarns can also be made from hollow synthetic fibers that are made with different levels of hollowness and porosity. In some fabrics made of hollow fibers, the insulative effect is due to the air trapped within the core of the fiber. Because porosity is the ratio of void volume to total volume, these hollowed fibers tend to increase porosity. Naturally, to reduce porosity, yarns may be made less porous by using solid rather than hollow structures. The figure below illustrates synthetic (nylon) fiber manufactured with voids that tend to increase porosity.

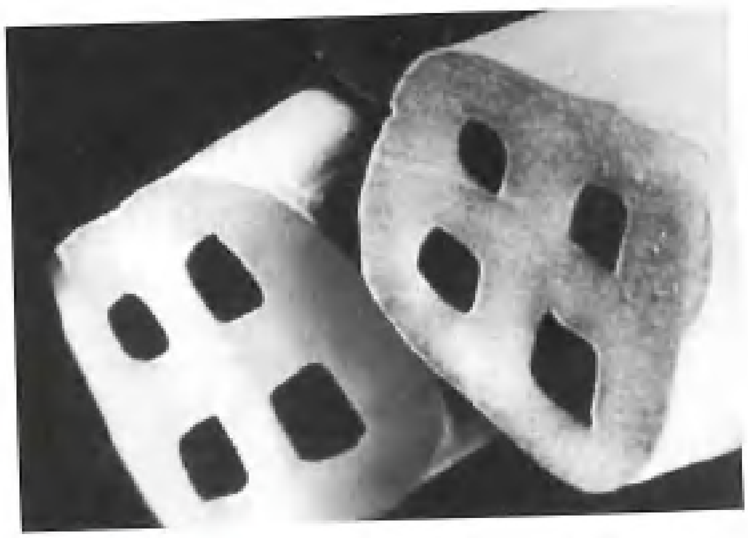


Figure 8.7 Nylon fiber with voids.
SOURCE: Courtesy of E. I. du Pont de Nemours & Company.

Kadolph Textiles, p 160.

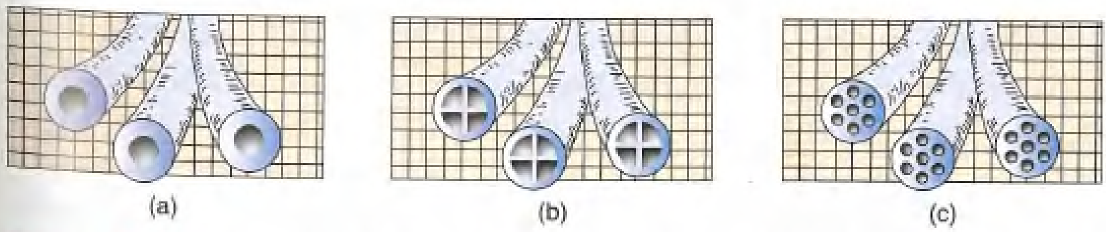


Figure 8.11 Hollow polyester fibers: (a) 1-Hollofil, (b) 4-Quallofil, and (c) 7-Hollofil.
SOURCE: Courtesy of E. I. du Pont de Nemours & Company.

Kadolph Textiles, p 171.

70. Porosity may also be varied by varying the physical structure of the fibers used to make the yarn. For example, using straight fibers tends to reduce porosity in the resultant yarn because the fibers are able to mesh more closely along their axes thereby reducing porosity. Encyclopedia of Textiles (Ex. 2011), p. 241 ("In **contrast to cotton and other cellulosic fibers**, wool is distinguished also by crimps in the fiber, sometimes as many as 30 per inch of length. **These crimps create many tiny air pockets** which impart to wool a resilient, spongy texture.") (emphasis added).

71. Another fiber physical property that affects the porosity of spun yarn is the fiber cross sectional shape. While fibers with circular cross section tend to pack tight with close surface contact, fibers with triangular, tri-lobal or other irregular cross sectional shapes leave considerable gaps between the fibers, thus providing for higher yarn and fabric porosity. Because porosity is the ratio of void volume to total volume, the lack of air pockets tends to reduce porosity. The

figures below illustrate acetate fibers with an irregular cross-section and nylon fibers with a tri-lobal cross section.

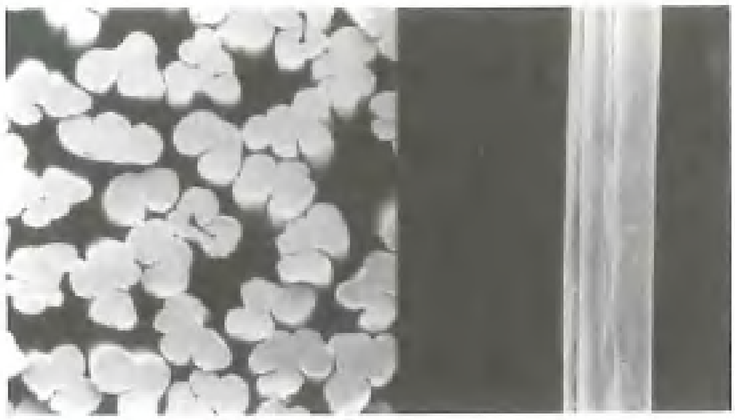


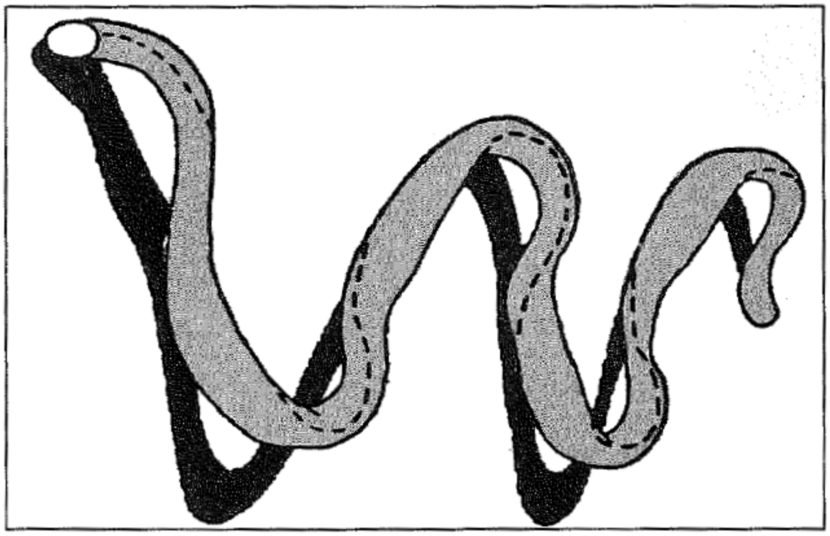
Figure 7.4 Photomicrographs of acetate fiber: cross-sectional view (left), longitudinal view (right).
SOURCE: Courtesy of the British Textile Technology Group.

Kadolph Textiles, p 141.

Figure 8.6 Photomicrographs of trilobal nylon.
SOURCE: Courtesy of E. I. du Pont de Nemours & Company.

Kadolph Textiles, p 160.

72. On the other hand, using crimped fibers, tends to increase porosity because the bends/crimps in the fibers create space between other individual fibers and prevent them from meshing more closely along their axes. For example, wool which has a natural crimp exhibits this property. Encyclopedia of Textiles, p. 241 ("In contrast to cotton and other cellulosic fibers, wool is distinguished also by crimps in the fiber, sometimes as many as 30 per inch of length. **These crimps create many tiny air pockets** which impart to wool a resilient, spongy texture.") (emphasis added) . Because porosity is the ratio of void volume to total volume, these air pockets tends to increase porosity. An illustrative example of crimp in wool is depicted below.



Encyclopedia of Textiles, p. 241.

73. It is also possible to covert a spun yarn with normal fiber packing density and normal porosity into a more porous and bulkier yarn by a special yarn processing step called "texturing' or 'texturization'. The most common technique that creates bulk and increased porosity in yarns made of natural fibers such as cotton is 'air-jet texturing' which subjects the entangled fibers in the cotton yarn to air turbulence, thus separating and re-entangling them in a bulked configuration. Thus fabrics made from air-jet textured 100% cotton yarns are more comfortable compared to fabrics made from regular cotton yarns because of their enhanced softness, porosity and absorption properties. While blended short staple yarns can also be subjected to air-jet texturing to achieve a similar enhancement in yarn and fabric properties, yarns made of 100% synthetic fibers such as polyester are

textured (bulked) by heat setting them in twisted (fold twisted) state and then removing the folding twist. All post-spinning bulking treatments applied on the yarn result in enhanced bulk and porosity. Controlled texturing is a means of engineering different levels of comfort properties into yarn and fabric. Kadolph Textiles, p. 216-218 ("The characteristics of bulk yarns are quite different from those of smooth filament yarns. Bulking gives filaments the aesthetic properties of spun yarns by altering the surface characteristics and **creating space** between the fibers… Fabrics are more absorbent, **more permeable** to moisture**, more breathable**") (emphasis added). The figure below illustrates air-jet texturing (bulking) of filament yarns.

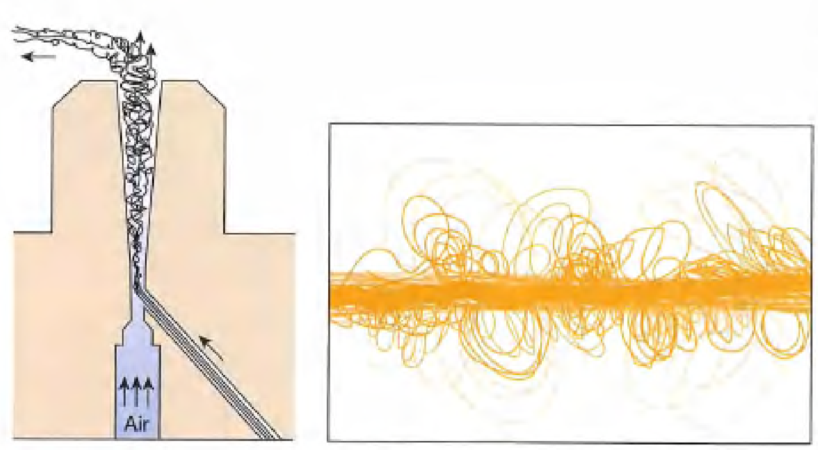


Figure 10.6 Air-jet process (left), bulky yarn (right).
SOURCE (left): Courtesy of Solutia Inc.

Kadolph Textiles, p. 218.

C. 3-D Textiles

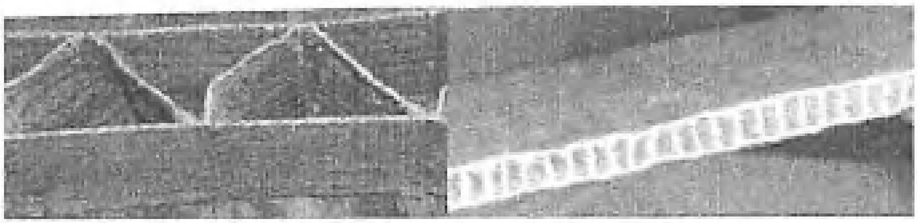
74. By extending the basic 2-D techniques of knitting, weaving, braiding, and non-wovens and adding further complexity a wide range of 3-D textiles can be created. The major defining characteristic of 3-D textiles is substantiality in the thickness or z-direction when compared with 2-D textiles. *See also* 3-D Fibrous Assemblies, p. 1 ("3-D textiles are those materials that have a system or systems in all three axes of plane"), p. 8.

75. By extending into the 3-D dimension 3-D textiles can take on even more varied forms than their 2-D counterparts. As such, 3-D textiles are a broad class of forms with nearly limitless areas for variation. As an introduction, the basic forms of 3-D textiles are discussed below. Each basic form can then be varied to create more specific forms of 3-D textiles.

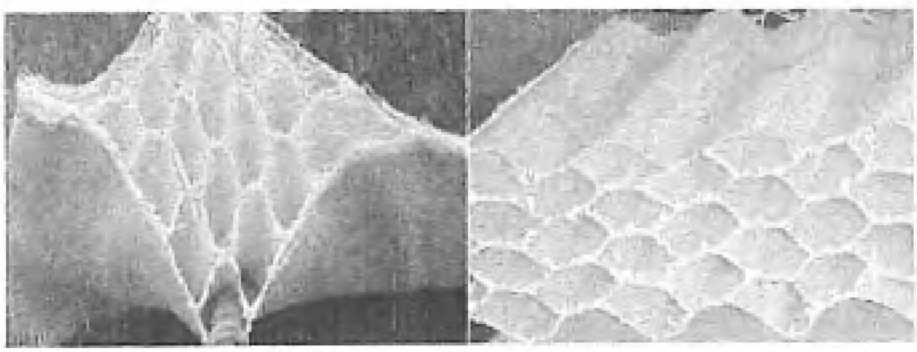
76. 3-D woven fabrics: 3-D woven fabrics can be produced using either multiwarp weaving technology or conventional weaving technology. 3-D Fibrous Assemblies, 10. Sub-variations of 3-D woven fabrics include 3-D solids with further sub variations being constructed using multilayer, orthogonal, or angle interlock techniques. 3-D Fibrous Assemblies, p. 11.

77. Another sub-variation of 3-D woven fabrics are 3-D hollows. These 3-D hollow structures can be of at least two forms: flat surface and uneven surface. These hollow structures can be created using multilayer principle, where several

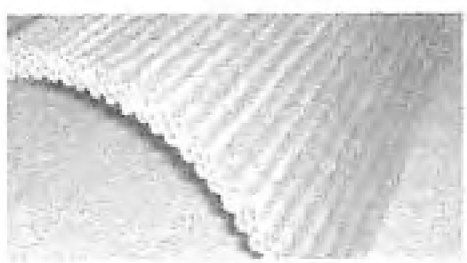
layers of yarns are woven together using different interlacing techniques. 3-D Fibrous Assemblies, p. 11. Some examples of 3-D hollow structures are reproduced below. As can be seen, these structures are highly porous due to the large percentage of void space.



(a) 3-D hollow flat surface



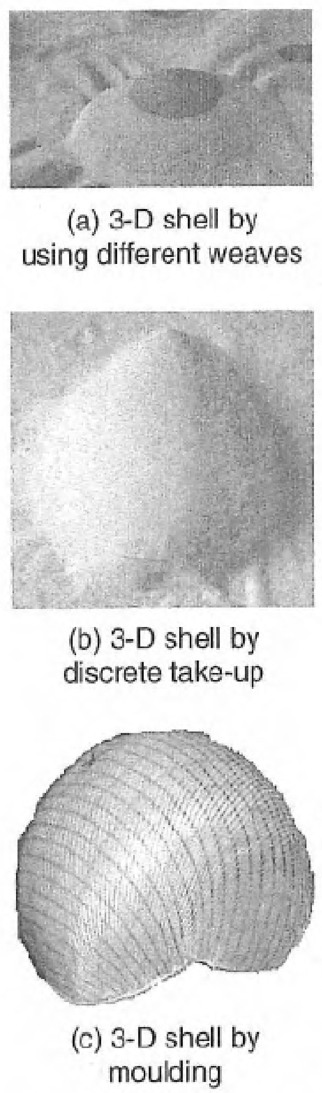
(b) 3-D hollow with hexagonal cells



(c) 3-D hollow uneven surface

3-D Fibrous Assemblies, p. 13.

78. A further sub-variation of 3-D woven fabric are 3-D shell structures. 3-D shell structures can be created using weave patterns, differential take-up (which modifies the basic structure to have a shell form) or molding. 3-D Fibrous Assemblies, p. 11-12. Some examples of 3-D shell structures are reproduced below.



1.9 3-D woven shell structures.

3-D Fibrous Assemblies, p. 14.

79. As a final example of 3-D woven structures are 3-D nodal fabrics. In 3-D nodal fabrics tubes are joined to obtain special types of structures. These structures are typically used for industrial applications. 3-D Fibrous Assemblies, p. 12.

80. Further examples of 3-D woven textiles are provided below:

<u>Fully interlaced weaves</u>

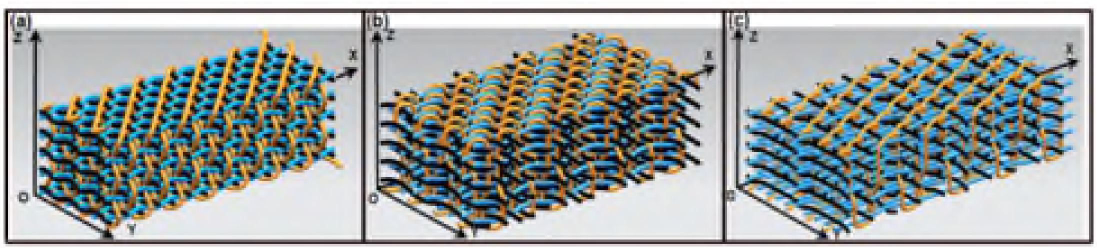


Figure 10. Three-dimensional fully-interlaced woven preform structures. General view of the five-layer computer-aided drawing of (a) 3D plain (b) 3D twill, and (c) 3D satin woven preform structures [60].

3-D Fabrics, p. 14.

<u>Orthogonal weave</u>

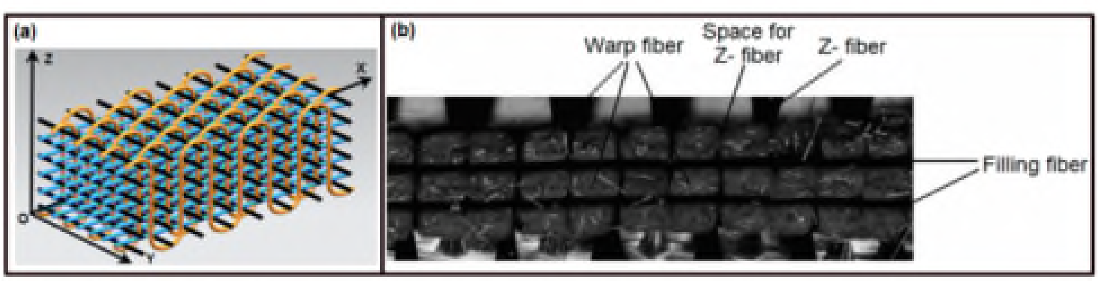


Figure 12. (a) Schematic view of 3D orthogonal woven unit cell (b) 3D woven carbon fabric preform [60, 62].

3-D Fabrics, p. 15.

<u>Multiaxis weave</u>

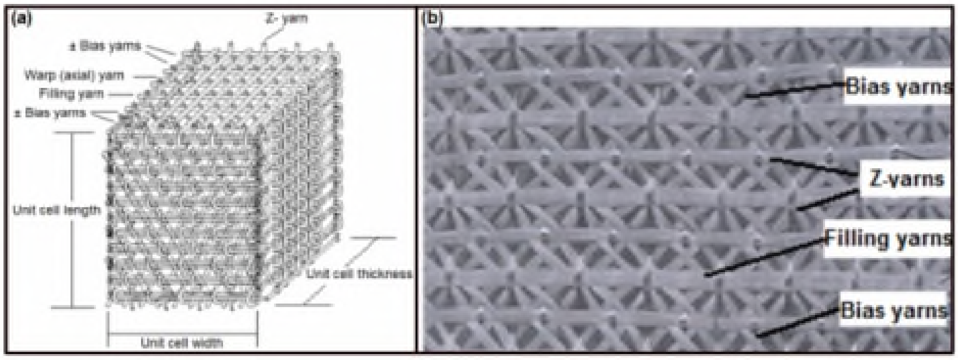
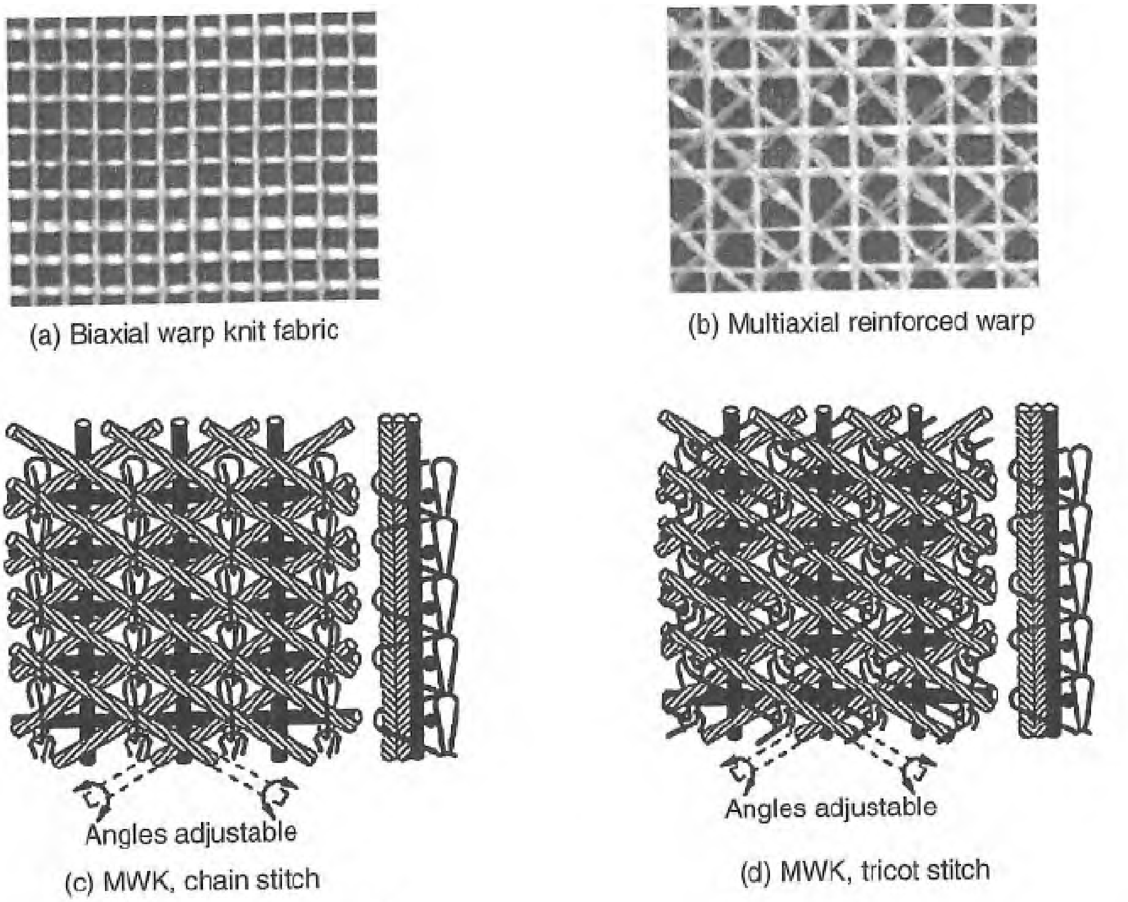


Figure 14. (a) The unit cell of multiaxis fabric (b) Top surface of multiaxis small tow size carbon fabric [30, 67].

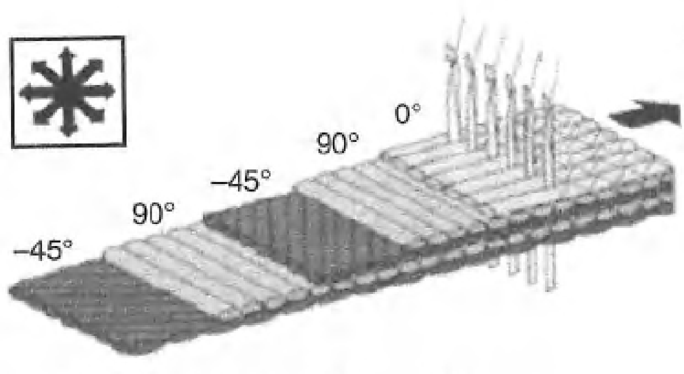
3-D Fabrics, p. 16.

81. A second sub-variation of 3-D textiles are 3-D knit structures. 3-D knit structures can be produced using either warp or weft knitting. 3-D Fibrous Assemblies, p. 17. Multiaxial warp knitting (MWK) typically use four different load bearing yarn systems such that each can take on stress and strain in virtually all directions. 3-D Fibrous Assemblies, p. 17.

82. The yarn layers of MWK systems may have different orientations and yarn densities. 3-D Fibrous Assemblies, p. 17. "Theoretically, the MWK can be made to as many layers of multiaxial yarns as needed." 3-D Fibrous Assemblies, p. 18. 3-D spacer fabrics are generally 3-D knit structures. Some examples of 3-D knit structures are reproduced below.



1.14 Knit structures.



1.15 Multiaxial warp-knit system.

3-D Fibrous Assemblies, p. 18.

83. A sub-category of 3-D knits are 3-D spacer materials. In 3-D spacers two separate fabric layers (top and bottom) are connected by intermediary yarns to form a "sandwich" structure. Examples of 3-D spacer fabrics are illustrated below. It is important to note that as seen in the leftmost two images not all spacer fabrics have top or bottom layers with a webbed formation. *See also*, Schlussel, ¶ [0016] ("spacer fabric… or 3-dimensional fabric, is typically made by knitting two fabric layers. The two fabric layers could be the same or different, i.e. mesh or solid").

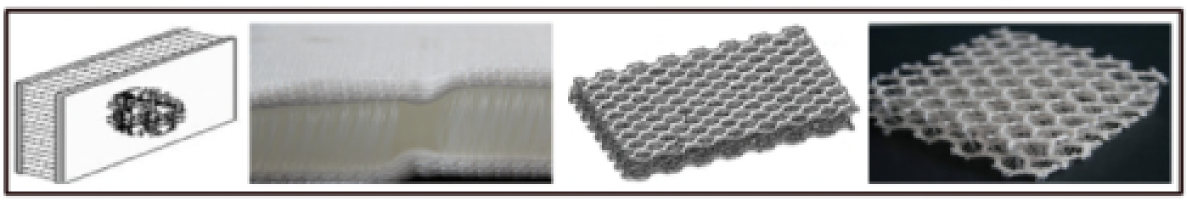
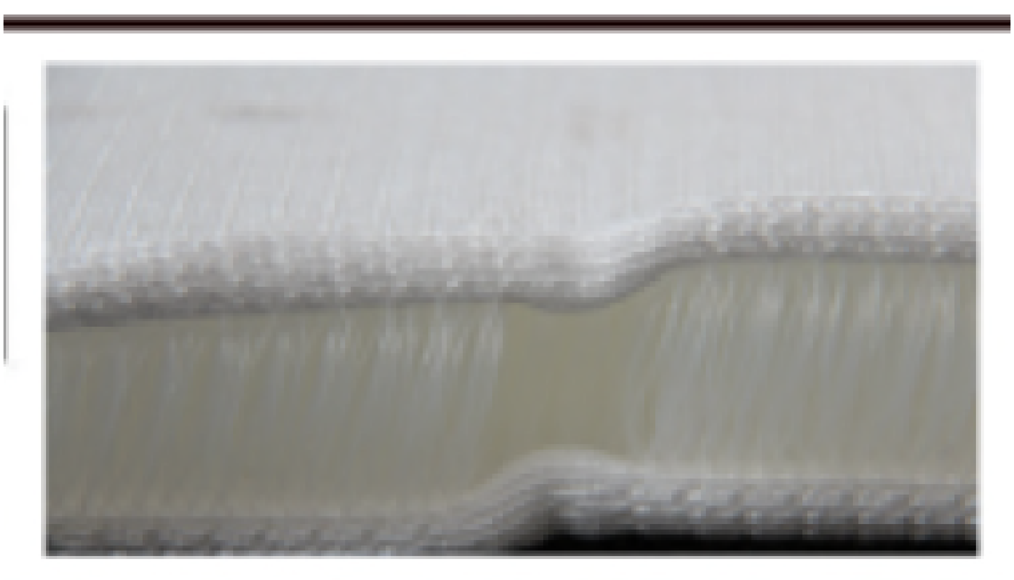


Figure 21. Various developed actual and schematic 3D knitted sandwich or spacer fabrics [79].

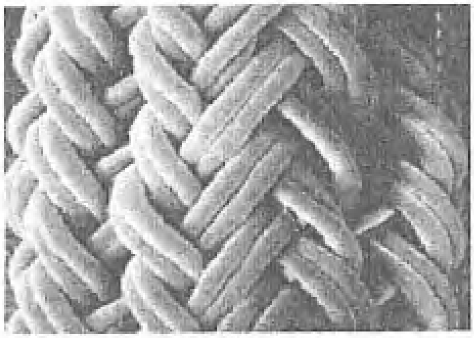
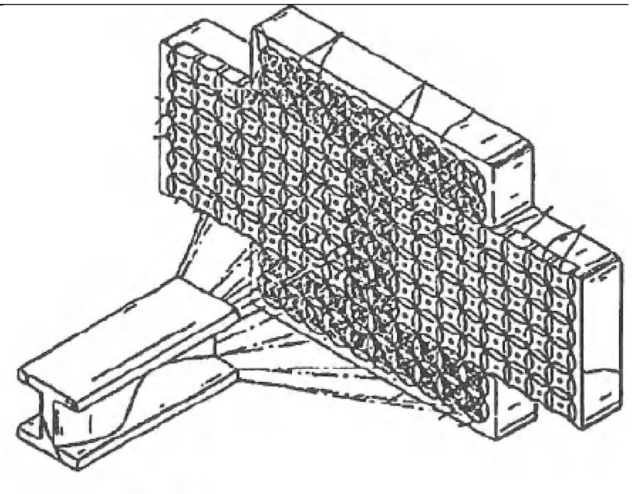
3-D Fabrics, p. 20.



84. Because the spacer fibers loosely bind the top and bottom layers, the spacer fabric is highly porous. The fabric is highly porous essentially because the sides of the fabrics between the top and bottom layers are only partially filled with spacer fibers.

85. A third variation of 3-D textiles are 3-D braided structures. In 3-D braiding, "the fabric is constructed by intertwining or orthogonal interlacing of two or more yarn systems." 3-D Fibrous Assemblies, p. 19. 3D braiding techniques can be used to create structures "with almost any fibre orientation and cross-section geometry." 3-D Fibrous Assemblies, p. 20. In 3-D braids reinforcing yarns are used to connect different layers and increase strength. 3-D Fibrous Assemblies, p. 19. The use of additional axial yarns or braider yarns allow for changes in fabric geometry and the ability to create complex shapes. 3-D Fibrous Assemblies, p. 21.

86. Some examples of 3-D braided structures are reproduced below.

 1.16 Braid structure. 3-D Fibrous Assemblies, p. 20.	 3-D Fibrous Assemblies, p. 23.

87. Further examples of 3-D braided textiles are provided below:

<u>Full braid</u>

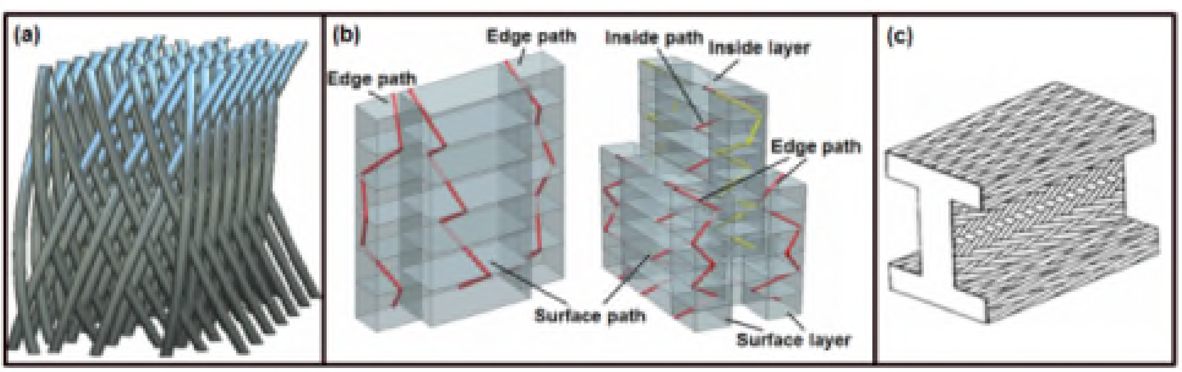


Figure 16. (a) Unit cell of 3D braided preform (b) braider yarn path on the edge and inside of the 3D representative braided preform with 4 layers (left) and 6 layers (right) [70], and (c) schematic views of 3D braided I-beam preform [71].

3-D Fabrics, p. 17.

Axial braid

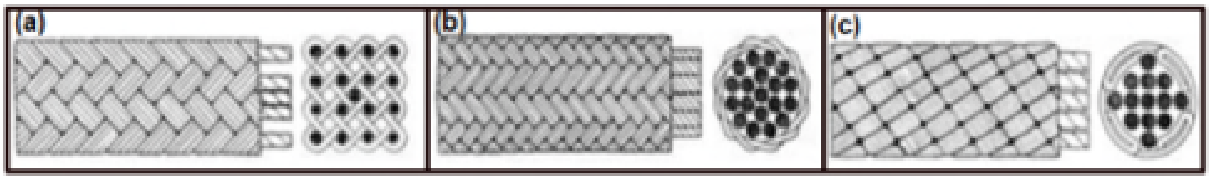


Figure 17. Solid braid fabrics (a) 4×4 axial braided fabric (b) axial round core braided fabric, and (c) axial spiral core braided fabric [72].

3-D Fabrics, p. 18.

Multiaxis braid

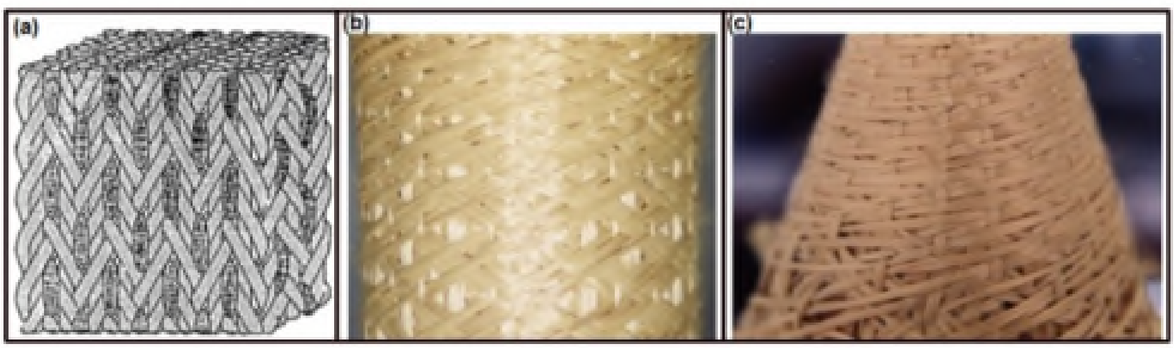
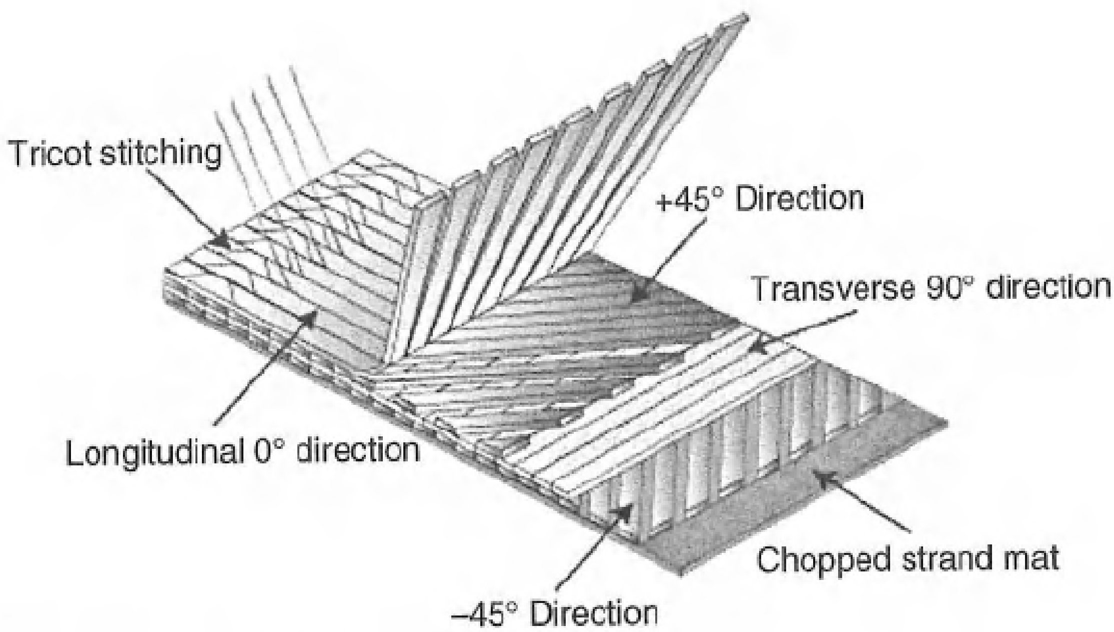


Figure 19. (a) The unit cell of multiaxis 3D braided preform [77]; multiaxis 3D braided para-aramid preforms (b) cylindrical Kevlar® preform and (c) conic Kevlar® preform [78].

3-D Fabrics, p. 19.

88. A fourth variation of 3-D textiles are 3-D stitched fabrics. Here, multiple layers of threads are used to create the 3-D structure. The threads of the layers can have differing orientations. 3-D Fibrous Assemblies, p. 23. Thread orientation can be input at almost any angle and is usually chosen based on the application. 3-D Fibrous Assemblies, p. 24-25. A non-structural stitching thread

holds the various layers together. 3-D Fibrous Assemblies, p. 23-24. Some examples of 3-D stitched structures are reproduced below.

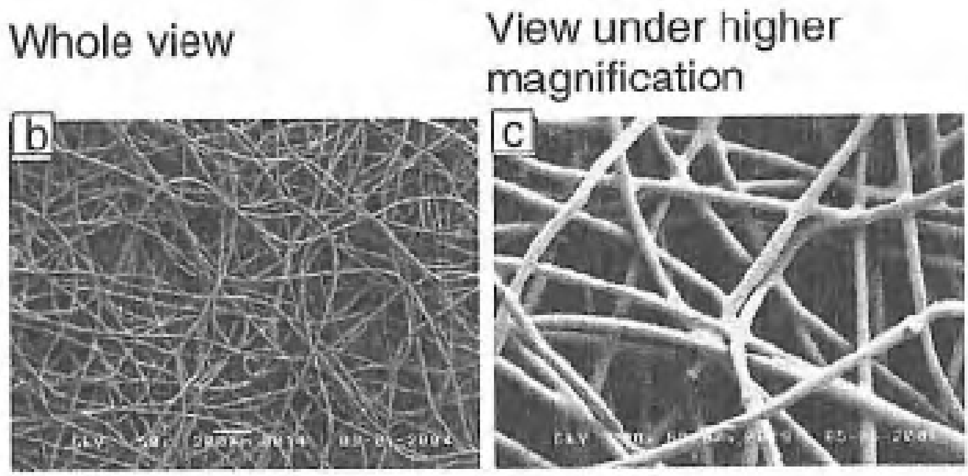


1.21 Stitch-bonded quadraxial fabric.

3-D Fibrous Assemblies, p. 24.

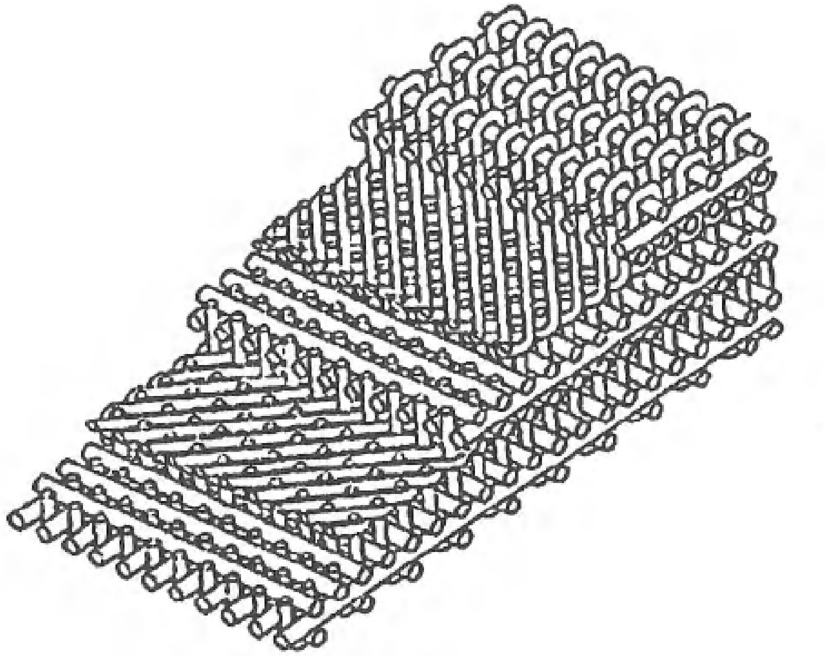
89. A fifth variation of 3-D textiles are 3-D non-woven fabrics. 3-D non-woven may be created using mechanical, chemical, or other processes. For example, 3-D non-wovens may be created by needle punching, spun bonding, melt blowing, air laying, etc. 3-D Fibrous Assemblies, p. 25. In air-laying, air streams are used to blow fibres on screens or molds. 3-D Fibrous Assemblies, p. 25. In some 3-D non-woven systems, yarns are used to bind layer together. Using this

technique a variety of shapes can be created. 3-D Fibrous Assemblies, p. 28. Some examples of 3-D non-woven structures are reproduced below.

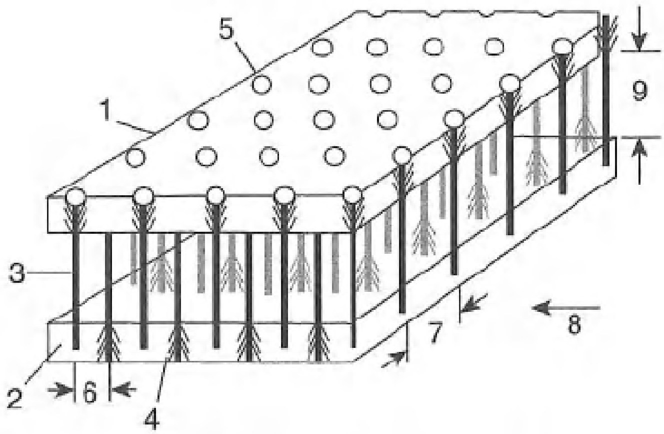


1.22 Examples of 3-D non-woven structures.

3-D Fibrous Assemblies, p. 26.



1.25 Non-woven fibre architecture.



1.26 Structure of Napco® 3-D non-woven fabric: 1 – top layer; 2 – bottom layer; 3 – connecting layer (bridge fibres from 1); 4 – bridge fibres from 2; 5 – needle stitch; 6 – distance between bridge fibres depending on stitch depth; 7 – distance between bridge fibres depending on needle density; 8 – take-out direction; 9 – product thickness depending on the spacer's width.

3-D Fibrous Assemblies, p. 29.

3-D Fibrous Assemblies, p. 26, 29.

90. Further examples of 3-D non-wovens are provided below:

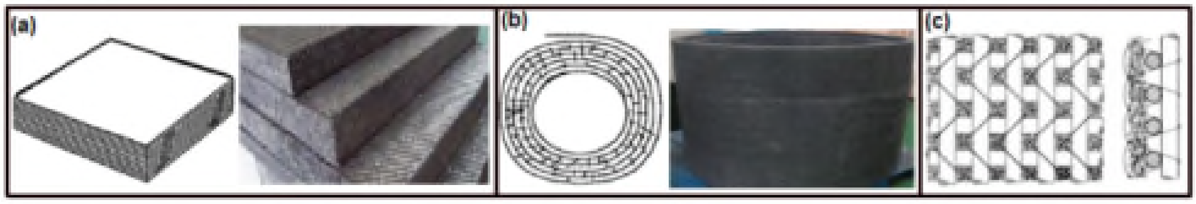


Figure 22. Three-dimensional nonwoven fabric; (a) schematic view of flat 3D nonwoven preform (left) and 3D PAN-based graphite felt composite (right); (b) schematic view of circular 3D nonwoven preform (left) and 3D PAN-based graphite felt composite (right); (c) top and side views of 3D biaxially reinforced nonwoven preform [80, 81, 83].

3-D Fabrics, p. 20.

91. Using the basic techniques above a vast spectrum of nearly limitless 3-D textile forms can be constructed. At the most basic level, various types of yarns (or fibers in the case of non-wovens) may be used. Yarn or fiber types may be varied, for example cotton, polyester, wool, nylon or blends thereof may be used to create 3-D textiles.

92. As a further variation, the physical form of the yarn itself may be varied. Thicker or thinner yarns may be used. Hollow or solid core yarns may also be used. Yarns may also be constructed of crimped or straight fibers. Both hollow or crimped fiber yarns would tend to increase porosity due to the larger percentage of void volume present. As discussed above, yarns can also be made inherently more porous through the texturing techniques.

93. Another factor is the tightness of the structure itself. Tight structures tend to have lower porosity because there is less space between the yarns forming

the structure. Similarly, loose structures tend to have higher porosity due to the increased space between the yarns forming the structure. Varying the number of yarn sets also for the creation of diverse structure. *See e.g.,* 3-D Fibrous Assemblies, p. 18 ("Theoretically, the MWK can be made to as many layers of multiaxial yarns as needed"). Use of fewer yarn sets would tend to create a more open structure, however, this is not always the case.

94. In my opinion, at least to the sheer number of parameters involved (e.g., fiber type, yarn construction, fabric structure, fabric tightness, finishing), a person of ordinary skill in the art would not at once envisage each member of the genus of 3-D textiles. My opinion holds true even if I were to limit the scope of the genus to highly porous 3-D textiles specifically suited to pillows. This is at least due to the large number of porous yarns, configurations and combinations thereof that can be used to create them.

VI. OVERVIEW OF THE '134, '332, and '883 PATENTS ("Gusseted Pillow Patents")

A. The Specification

95. The Gusseted Pillow Patents are generally directed to pillows that have a gusset that, among other things, enable improved airflow and reduced heat buildup inside the pillow, thereby significantly enhancing the cooling effects and comfort to a user. Ex. 1001, Abstract, 1:36-40, 2:10-14, FIG. 1. An example of

these innovative pillow designs is shown in an annotated version of Figure 2, which is provided below.

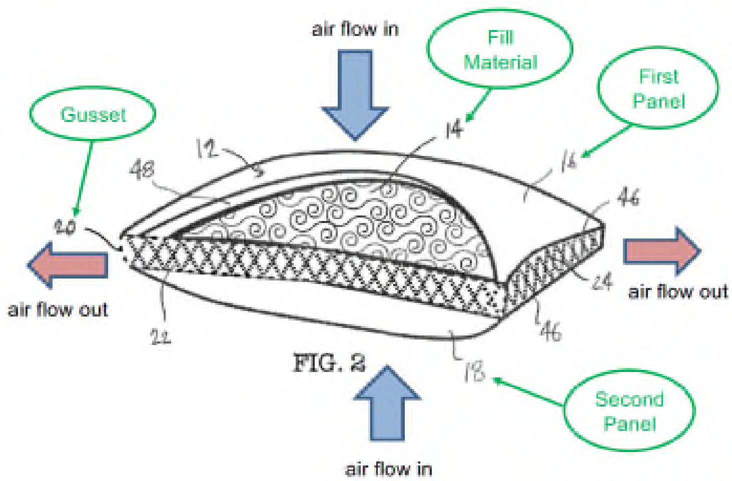


FIG. 2

96. As shown in Figure 2, the pillow has a cover that includes two fabric panels – a first panel (16) and a second panel (18) – and a gusset (20) that joins the two panels together. Ex. 1001, Abstract, 1:64-2:2, 3:1-7, FIG. 2. In some embodiments, the gusset may also "perimetrically bound" the two panels. *Id*. Together, the gusset and the two panels form a pillow cover (12) into which a compliant fill material (14), such as microfiber, cluster/ball fiber, down memory foam, or latex, is disposed. Ex. 1001, Abstract, 1:64-66, 3:39-55, FIG. 2.

97. These described pillow designs create an "airflow channel," which enables air (and heat) that flows into the pillow through the top and bottom panels to then flow out of the pillow through the gusset. Ex. 1001, Abstract, 1:36-40, 2:5-15, 4:13-19. As explained in the Gusseted Pillow Patents (and depicted in the figure above), the gusset has "sufficient width to separate the first panel 16 from

second panel 18 so as to define an air flow channel therethrough." Ex. 1001, 2:5-8, FIG. 2. This configuration provides "ventilation" inside the pillow (*i.e.*, between each panel and fill material) and allows heat to dissipate out of the pillow through the gusset. Ex. 1001, 1:37-39, 2:11-15. With air flowing in and out of the pillow in this manner, these designs minimize heat transfer into the fill material, thereby significantly reducing heat buildup inside the pillow and enhancing user comfort. Ex. 1001, Abstract, 1:36-40 (explaining that these gusset designs "permit[] a cooling effect while a user is resting or sleeping"), 2:5-15 ("[w]ith pressure and/or heat applied to one or both of the first and second panels 16, 18, the gusset 20 provides venting therethrough of the interior of the cover 12 [which] enhance[s] the comfort of a user"), 4:13-19; 4:31-36.

98. Instrumental to many of the advantages provided by the Gusseted Pillow Patents is that the gusset includes a highly porous configuration (and, in certain embodiments, has substantially greater porosity than the two fabric panels), thereby increasing the flow of air and heat out of the pillow through the gusset. In particular, this is accomplished through the use of a gusset having an "open cell construction."

99. The phrase "open cell construction" is expressly defined in the Gusseted Pillow Patents as being: "a construction **[either] [1]** having overall porosity greater than the inherent porosity of the constituent material **<u>or</u> [2]**

inherently having high porosity." Ex. 1001, 1:41-44 (emphasis added). This definition sets forth two different categories of open cell constructions: (i) transforming (*e.g.*, arranging or modifying) a constituent material so as to form a construction having a greater overall porosity (*i.e.*, the first category in the definition, referred to as "Transforming Constituent Materials"); and (ii) forming a construction from an existing base material that already has high porosity, thereby resulting in the construction also inherently having high porosity (*i.e.*, the second category in the definition, referred to as "Inherently Porous Base Materials").

100. It is my opinion that one of ordinary skill in the art would understand that there is a tension involved in using such "open cell" constructions in pillow design. This tension is centered around two concerns. On one hand, as described above the "open cell" constructions allow for the transfer of heat. On the other hand, however, "open cell" designs also allow for increased contamination potential. These highly porous open cells may allow for increased accumulation of foreign materials inside the pillow. For example, these open cells may allow for the increased accumulation of contaminants such as bodily fluids (sweat, mucus, blood), pollens, dirt, dust, etc. In turn, the presence of contaminants and the pillow's environment then allow for the growth of foreign bodies (e.g., bacteria, fungus), which can then lead to sickness or allergic reaction. The overall effects of which are often exacerbated since people tend not to change pillows frequently

enough. Sleepgram Luxury Pillow (Ex. 2012), p. 1-2 ("Many people don't change their pillows that often and unknowingly expose themselves to all sorts of accumulative germs. They'll wash their pillow cases and think that does enough to keep their pillows clean; however, they never see the mold, bacteria, and dust mites that flourish on the fluff that grows inside their pillow. Pillows should be replaced at least every three months"). Accordingly, in my opinion, a person of ordinary skill in the art would see the use of open cell constructions in pillow designs to be a non-intuitive choice.

101. As explained in the Gusseted Pillow Patents, these open cell constructions may be defined by various structures and/or materials. Ex. 1001, Abstract, 1:35-37, 2:20-21. The patent discloses at least three separate and distinct "configurations" or embodiments for the open cell construction of the gusset, examples of which are shown in FIGS. 3-5, respectively. Two of these embodiments correspond to the Transforming Constituent Materials category of open cell constructions from the definition, namely: (1) arranging strands of material in a manner (*e.g.*, interlaced, spaced apart, or mesh configuration) such that open cells are defined between the strands (the "Arranging Strands Embodiment"); and (2) creating larger apertures in a base material in order to define the open cells (the "Creating Apertures Embodiment"). Ex. 1001, 2:20-46, 2:65-67, FIGS. 3-4. The third embodiment corresponds to the Inherently Porous

Base Materials category of open cell constructions, which uses an existing base material that is inherently highly porous, such as a 3D spacer fabric or other material that is substantially more porous than the material(s) used to form the two panels (the "Using High-Porosity Materials Embodiment"). Ex. 1001, 2:47-52, 2:65-67, FIG. 5.

102. Figure 3 and the corresponding description are directed to the Arranging Strands Embodiment, in which the open cell construction is formed by strands arranged so as to define open cells between the strands (*e.g.*, in an interlaced or spaced-apart manner or mesh configuration). I have provided an annotated version of figure 3 to illustrate an example of this claimed configuration.

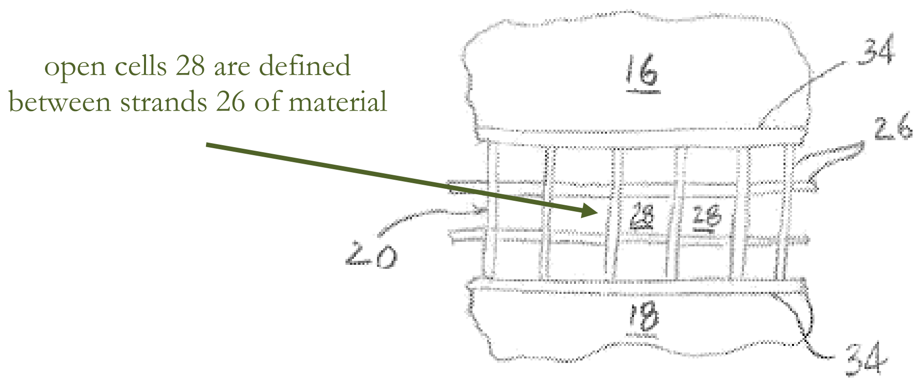


FIG. 3

103. As explained in the specification, the open cell construction of the gusset shown in FIG. 3 is "defined by a plurality of interlaced or spaced-apart strands" where the "strands [] are arranged so that **open cells 28 are defined therebetween**." Ex. 1001, 2:20-27 (emphasis added); *see also* Ex. 1001, 2:21-24

(the "interlaced or spaced-apart strands 26 [can be] arranged randomly or in various patterns, such as a 'x' pattern (FIG. 1) or a rectangular pattern (FIG. 3)"). As can be seen from these figures, the interlaced or spaced-apart strands can form a "mesh configuration." As can be seen, in this Arranging Strands Embodiment, the open cell constructions are formed by strands (*i.e.*, constituent material) arranged such that the construction has a greater overall porosity than the constituent material itself. Accordingly, this embodiment corresponds to the Transforming Constituent Materials open cell category.

104. In turn, Figure 4 and the corresponding description are directed to the Creating Apertures Embodiment, in which the open cell construction is formed by creating larger apertures (*i.e.*, holes) in a base material that define the open cells. I have provided an annotated version of figure 4 to illustrate an example of this claimed configuration.

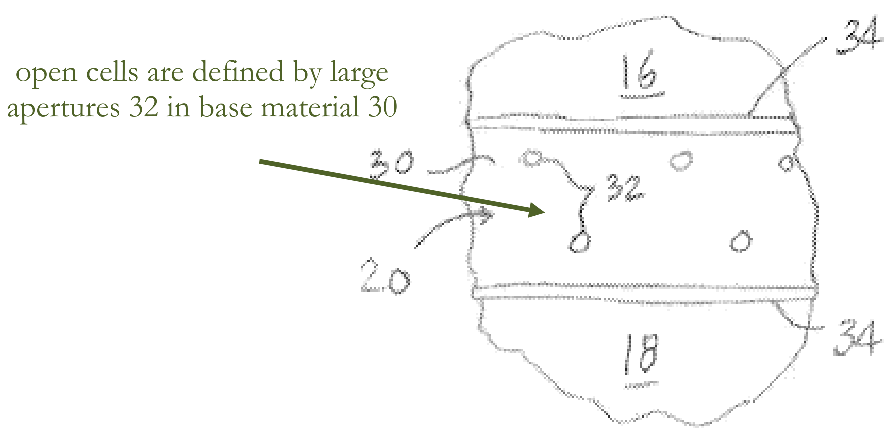


FIG. 4

105. As explained in the specification, the open cell construction of the gusset shown in FIG. 4 is "formed of a base material [and] [a]pertures 32 may be defined in the base material 30 with the **apertures 32 defining the open cells** of the gusset." Ex. 1001, 2:36-40 (emphasis added). In particular, these "apertures 32 are larger in size than any pores that may be inherently defined in the base material 30." Ex. 1001, 2:40-46. Thus, in this Creating Apertures Embodiment, the open cell constructions are formed by larger holes created in a base (*i.e.*, constituent) material, such that the construction has a greater overall porosity than the constituent material itself. Accordingly, like the Arranging Strands Embodiment above, this embodiment also corresponds to the Transforming Constituent Materials category of open cell constructions.

106. Figure 5 and the corresponding description are directed to the Using High-Porosity Materials Embodiment, in which the open cell constructions are formed by using an existing base material that is already highly porous. I have provided an annotated version of figure 5 to illustrate an example of this claimed configuration.

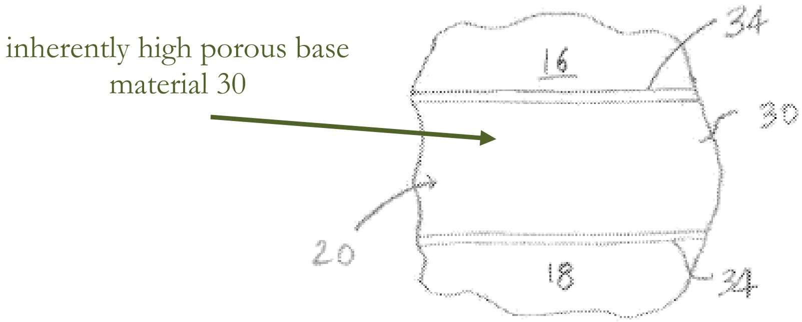
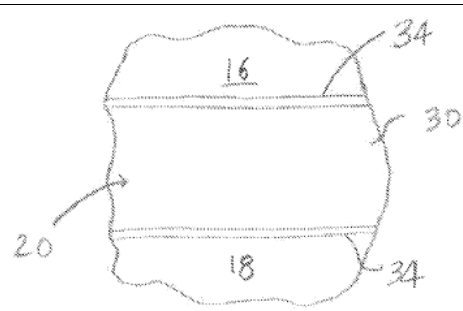
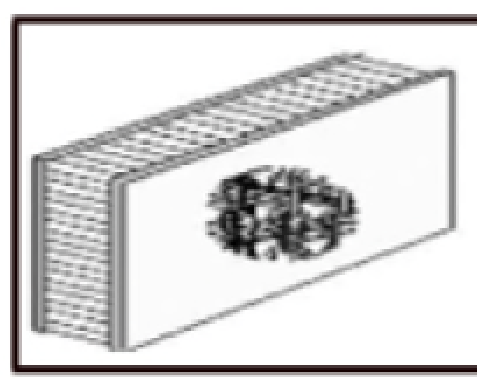


FIG. 5

107. As described in the specification, the open cell construction of the gusset shown in FIG. 5 is "formed with the base material 30 being inherently significantly porous." Ex. 1001, 1:41-44, 2:47-49. The specification explains that one example of such a base material is 3D spacer fabric, which "is inherently highly porous." Ex. 1001, 2:49-51. The specification also explains that, as a result, the "porosity of the base material 30 may be substantially greater than the porosity of the material forming the first panel 16 and/or substantially greater than the porosity of the material forming the second panel 18." Ex. 1001, 2:55-58. Thus, in this Using High-Porosity Materials Embodiment, the open cell constructions are formed from a base material that inherently has high porosity (*e.g.*, a base material that is substantially more porous than the materials of the two panels), such that the resulting construction is also inherently highly porous. Accordingly, unlike the two embodiments above, this embodiment corresponds to the Inherently Porous Base Materials category of open cell constructions.

108. As discussed above, the Gusseted Pillow Patents provide an open cell band between the two panels of the pillow cover that enables airflow between each panel and the fill material, and define an airflow channel in which air flows into the pillow through the panels and then flows out of the pillow through the gusset. Ex. 1001, 2:5-15. These pillow designs provide a number of significant benefits, such as increased ventilation and heat dissipation between the panels and fill material and minimized buildup of heat inside the pillow (*e.g.*, within the fill material), thereby enhancing the comfort and cooling effects to a user. *Id*. at Abstract, 1:33-40, 2:5-15, 4:5-36.

109. In contrast to figures 3 and 4, no delineated cell can be seen in figure 5. This is consistent with other exemplary 3-D spacer fabric forms.

 F/G. 5	
Ex. 1001, FIG. 5	3-D Fabrics, p. 20

110. This is also in contrast to how the "cells" are created in figures 3 and 4. In a 3-D spacer material, which is inherently highly-porous material, there need be no defined cells at all. However, in the embodiments of figure 3, strands are arranged, while for figure 4 embodiments, material is removed, each with the purpose of clearly defining and delineating a cell in order to increase or create porosity. This being said, however, the '134, '332, and '883 Patents teach the ability to combine the various techniques for creating an open cell gusset. Ex. 1001, 2:65-67 ("The gusset 20 may include one or more of the open cell configurations described above in connection with FIGS. 3-5 singularly or in any combination").

VII. Construction of Certain Claim Terms

A. "open cell construction"

111. In general, the independent claims of the '134, '332, and '883 Patents are all directed to a "pillow" that includes: (i) two opposing panels and a (ii) gusset joining the two panels. Many independent claims of the '134, '332, and '883 Patents also require that the gusset is formed of an "open cell construction."

112. In the '134 Patent the independent claims are directed to different types of open cell constructions for the claimed gusset. The chart below maps each independent claim's specifically recited structure for the open cell construction to one of the three different embodiments disclosed in the specification.

Claim	Relevant Claim Language	Description In The Specification	Category/Embodiment
1	said gusset being formed of an open cell construction, said open cell construction is formed by interlaced or spaced-apart strands	"With reference to FIG. 3, the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26, arranged randomly or in various patterns, such as an "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3) . . . so that open cells 28 are defined therebetween." Ex. 1001, 2:21-27; *see also* FIG. 3.	**Transforming Constituent Materials/ Arranging Strands**
11	said open cell construction is formed by apertures defined in said base material, said apertures being larger than any pores inherently defined in said base material	"With reference to FIG. 4, the gusset 20 may be formed of a base material 30 . . . Apertures 32 may be defined in the base material 30 with the apertures 32 defining the open cells of the gusset 20. The apertures 32 are larger in size than any pores that may be inherently defined in the base	**Transforming Constituent Materials/** **Creating Apertures**

Claim	Relevant Claim Language	Description In The Specification	Category/Embodiment
		material 30." Ex. 1001, 2:36-41; *see also* FIG. 4.	
17	said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel	"[W]ith reference to FIG. 5, the gusset 20 may be formed with the base material 30 being inherently significantly pourous [such as a] base material [that is] formed of a polyester 3D spacer fabric." Ex. 1001, 2:47-58; *see also* FIG. 5.	**Inherently Porous Base Materials/Using High-Porosity Materials**
22	said gusset being formed of an open cell construction, said gusset including 3D spacer material	"[W]ith reference to FIG. 5, the gusset 20 may be formed with the base material 30 being inherently significantly pourous . . . The porosity of the base material 30 may be substantially greater than the porosity of the material forming the first panel 16 and/or substantially greater	**Inherently Porous Base Materials/Using High-Porosity Materials**

Claim	Relevant Claim Language	Description In The Specification	Category/Embodiment
		than the porosity of the material forming the second panel 18." Ex. 1001, 2:47-50; *see also* FIG. 5.	

113. In the '332 Patent, the "open cell" limitations of claims 13, 22, 33 and 34 are directed to different types of open cell constructions for the claimed gusset. The chart below maps each claim's specifically recited structure for the open cell construction to one of the three different embodiments disclosed in the specification. The "open cell" claims of the '332 Patent only cover two of three embodiments.

Claim	Relevant Claim Language	Description In The Specification	Category/Embodiment
13	said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said	"[W]ith reference to FIG. 5, the gusset 20 may be formed with the base material 30 being inherently significantly pourous [such as a] base material [that is] formed of a polyester 3D spacer	**Inherently Porous Base Materials/Using High-Porosity Materials**

	second panel	fabric." Ex. 1001, 2:47-58; *see also* FIG. 5.	
22	said gusset is formed of an open cell construction, said open cell construction being formed by strands defining a mesh configuration	"With reference to FIG. 3, the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26, arranged randomly or in various patterns, such as an "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3) . . . so that open cells 28 are defined therebetween." Ex. 1001, 2:21-27; *see also* FIG. 3.	**Transforming Constituent Materials/ Arranging Strands**
33	said gusset is formed of an open cell construction, said open cell construction being formed by interlaced strands	"With reference to FIG. 3, the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26, arranged randomly or in various patterns, such as an "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3) . . . so that	**Transforming Constituent Materials/ Arranging Strands**

		open cells 28 are defined therebetween." Ex. 1001, 2:21-27; *see also* FIG. 3.	
34	said gusset is formed of an open cell construction, said open cell construction being formed by spaced-apart strands	"With reference to FIG. 3, the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26, arranged randomly or in various patterns, such as an "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3) . . . so that open cells 28 are defined therebetween." Ex. 1001, 2:21-27; *see also* FIG. 3.	**Transforming Constituent Materials/ Arranging Strands**

114. In the '883 Patent, the "open cell" limitations of claims 14-15 and 18 are directed to different types of open cell constructions for the claimed gusset. The chart below maps each claim's specifically recited structure for the open cell construction to one of the three different embodiments disclosed in the specification. The "open cell" claims of the '883 Patent only cover two of three embodiments.

Claim	Relevant Claim Language	Description In The Specification	Category/Embodiment
14/15	said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel.	"[W]ith reference to FIG. 5, the gusset 20 may be formed with the base material 30 being inherently significantly pourous [such as a] base material [that is] formed of a polyester 3D spacer fabric." Ex. 1001, 2:47-58; *see also* FIG. 5.	**Inherently Porous Base Materials/Using High-Porosity Materials**
18	said gusset is formed of an open cell construction, said open cell construction being formed by strands defining a mesh configuration	"With reference to FIG. 3, the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26, arranged randomly or in various patterns, such as an "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3) . . . so that open cells 28 are defined therebetween." Ex. 1001, 2:21-27; *see also* FIG. 3.	**Transforming Constituent Materials/ Arranging Strands**

115. The ‘134, ‘332, and ‘883 Patents expressly define the term “open cell construction” as being a “construction having overall porosity greater than the inherent porosity of the constituent material or inherently having high porosity.” Ex. 1001, 1:41-44. As discussed above, it is my opinion that one of ordinary skill in the art would understand that this definition sets forth two different categories of open cell constructions, namely: (i) Transforming Constituent Materials (*i.e.*, to form constructions having an overall porosity greater than the inherent porosity of the constituent material); and (ii) Inherently Porous Base Materials (*i.e.*, to form constructions that also inherently have high porosity).

116. The specification also discloses three separate and distinct embodiments that use specific structures and/or materials to form these open cell constructions. Two embodiments – the Arranging Strands Embodiment (FIG. 3) and the Creating Apertures Embodiment (FIG. 4) – arrange or modify materials to form constructions having a greater overall porosity, which, in my opinion, one of ordinary skill in the art would clearly understand to correspond to the first category in the definition.

117. The third embodiment – Using High-Porosity Materials Embodiment (FIG. 5) – forms open cell constructions from an existing base material that is

already highly porous which, in my opinion, one of ordinary skill in the art would clearly understand to correspond to the second category in the definition.

118. The term "open cell construction" is expressly recited in many of challenged claims of the '134, '332, and '883 Patents as part of a larger phrase directed to this feature. Many of these phrases expressly specify a particular structure for the open cell construction that directly corresponds to one of the three open cell embodiments above. For example, claim 1 of the '134 Patent requires that the "open cell construction be[] formed by interlaced or spaced-apart strands" (*i.e.*, the Arranging Strands Embodiment). As another example, claim 11 of the '134 Patent requires that the "open cell construction is formed by apertures defined in said base material . . . being larger than any pores inherently defined in said base material" (*i.e.*, the Creating Apertures Embodiment). As yet another example, claim 17 of the '134 Patent requires that the "open cell construction is formed by porosity of said base material being substantially greater than porosity of material[s] forming said first [and second] panel[s]" (*i.e.*, the Using High-Porosity Materials Embodiment). As a final example, claim 18 of the '883 Patent requires that the "open cell construction being formed by strands defining a mesh configuration" (*i.e.*, the Arranging Strands Embodiment).

119. In my opinion one of ordinary skill in the art would understand that the claim language itself makes clear that each claim is directed to one of the three

open cell embodiments disclosed in the specification and, in turn, corresponds to one of the two categories of open cell constructions set forth in the inventor's definition. This understanding is further confirmed by the prosecution history of the '134 Patent. During prosecution these claim phrases setting forth the particular open cell structures were added to the claims during prosecution in order to make clear that certain claims are directed to a particular open cell embodiment. *See* Ex. 1003 at 45-48, 55-56 (the Examiner refusing to give patentable weight to the phrase "open cell construction" standing alone since, according to the Examiner, "the structural features that are used to define this term are not present in the claim").

1. "said open cell construction is formed by interlaced or spaced-apart strands" ('134 patent independent claim 1, '332 patent independent claims 33 and 34)

120. It is my understanding that, in the Response, Patent Owner has proposed that the broadest reasonable interpretation of the claim term "said open cell construction is formed by interlaced or spaced-apart strands" is "a construction in which open cells are defined by strands arranged in an interlaced or spaced-apart manner, such that the overall porosity is greater than the porosity of the constituent material itself." I agree with this proposed interpretation.

121. As discussed above, the term "open cell construction" is explicitly defined in the specification of the '134, '332, and '883 Patents as: "a construction

having overall porosity greater than the inherent porosity of the constituent material or inherently having high porosity." Ex. 1001 1:41-44; Pet. at 19. As also explained above, this definition sets forth two separate categories, namely: (i) constructions formed by transforming (*e.g.*, arranging or modifying) a constituent material (*i.e.*, Transforming Constituent Materials); and (ii) constructions formed from a base material that, by itself, has high porosity (*i.e.*, Inherently Porous Base Materials). The specification discloses two separate embodiments where a constituent material is arranged or modified to define the open cell construction – the Arranging Strands Embodiment (FIG. 3) and the Creating Apertures Embodiment (FIG. 4). The specification also discloses a third embodiment that uses an existing base material that is inherently highly porous to form the open cell construction (FIG. 5).

122. In my opinion, one of ordinary skill in the art would understand that the claims of the '134, '332, and '883 Patents directly track these three different open cell embodiments. For example, one of ordinary skill in the art would clearly understand that claim 1 of the '134 Patent is directed to the Arranging Strands Embodiment. Ex. 1001, 2:20-35 ("With reference to FIG. 3, the **gusset 20 may be defined by a plurality of interlaced or spaced-apart strands** 26 arranged randomly or in various patterns, such as a "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3). The strands 26 may be of various materials, including, e.g.,

polyester, and may be elastic or inelastic. The **strands 26 are arranged so that open cells 28 are defined therebetween**") (emphasis added). Here, the open cell phrase claim 1 expressly requires that the open cell construction be "formed by interlaced or spaced-apart strands."

123. Also, this language was added to claim 1 of '134 Patent during prosecution to make clear that the claim is directed to the Arranging Strands Embodiment. *See* Ex. 1003 at 45 (amending the first claim by adding "said open cell construction is formed by interlaced or spaced-apart strands").

124. At least based on the above, it is my opinion that one of ordinary skill in the art would understand that Patent Owner's construction for this phrase is aligned with the express claim language, and fully supported by the specification and prosecution history. This construction takes the explicit definition for the term "open cell construction" and applies it to the particular open cell structure recited in the claim.

125. In particular, it is my opinion that one of ordinary skill in the art would clearly understand that this claim phrase: (1) is directed to the Arranging Strands Embodiment (FIG. 3), i.e., "a construction in which open cells are defined by strands arranged in an interlaced or spaced-apart manner"; and (2) corresponds to the Transforming Constituent Materials category of open cell constructions in

the inventor's definition, i.e., a construction in which the "overall porosity is greater than the porosity of the constituent material."

2. "said open cell construction being formed by strands defining a mesh configuration" ('332 Patent dependent claim 22 and '883 Patent dependent claim 18)

126. It is my understanding that, in the Response, Patent Owner has proposed that the broadest reasonable interpretation of the claim term "said open cell construction being formed by strands defining a mesh configuration" is "a construction in which open cells are defined by strands arranged in mesh configuration, such that the overall porosity is greater than the porosity of the constituent material itself." I agree with this proposed interpretation.

127. In my opinion, one of ordinary skill in the art would understand Figures 1 and 3 of the '332 Patent to depict gussets of a mesh configuration. These particular examples conform to the description in the specification. Ex. 1001 2:20-24 ("the gusset 20 may be defined by a plurality of interlaced or spaced-apart strands 26 arranged randomly or in various patterns, such as a "x" pattern (FIG. 1) or a rectangular pattern (FIG. 3)").

128. In particular, it is my opinion that one of ordinary skill in the art would clearly understand that this claim phrase: (1) is directed to the Arranging Strands Embodiment (FIG. 3), i.e., "), i.e., "a construction in which open cells are defined by strands arranged in mesh configuration"; and (2) corresponds to the

Transforming Constituent Materials category of open cell constructions in the inventor's definition, i.e., a construction in which the "overall porosity is greater than the porosity of the constituent material."

3. "said open cell construction is formed by apertures defined in said base material, said apertures being larger than any pores inherently defined in said base material" ('134 Patent independent claim 11)

129. It is my understanding that, in the Response, Patent Owner has proposed that the broadest reasonable interpretation of the claim term "said open cell construction is formed by apertures defined in said base material, said apertures being larger than any pores inherently defined in said base material" is "a construction in which open cells are defined by holes created in a constituent material that are larger than any pores naturally occurring in the material, such that the overall porosity is greater than the porosity of the constituent material itself." I agree with this proposed interpretation.

130. In my opinion, one of ordinary skill in the art would clearly understand that in independent claim 11 the open cell claim phrase is directed to the Creating Apertures Embodiment (FIG. 4). Here, the claim language expressly requires that the open cell construction be "formed by apertures defined in said base material said apertures being larger than any pores inherently defined in said base material." This directly tracks the description of this embodiment in the

specification. Ex. 1001, 2:36-46 ("With reference to FIG. 4, the gusset 20 may be formed of a base material 30, which is preferably a textile, such as a polyester textile. **Apertures 32 may be defined in the base material 30 with the apertures 32 defining the open cells of the gusset 20. The apertures 32 are larger in size than any pores that may be inherently defined in the base material** 30") (emphasis added). Also, this language was added to claim 11 of the '134 Patent during prosecution to make clear that the claim is directed to the Creating Apertures Embodiment. *See* Ex. 1003 at 46.

131. At least based on the above, it is my opinion that one of ordinary skill in the art would understand that Patent Owner's construction for this phrase is consistent with the specific open cell structure expressly recited in this phrase, *i.e.*, "a construction in which open cells are defined by holes created in a constituent material that are larger than any pores naturally occurring in the material," as well as the corresponding Transforming Constituent Materials category of open cell constructions in the inventor's definition, *i.e.*, a construction in which the "overall porosity is greater than the porosity of the constituent material."

4. "said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel" ('134 Patent independent claim 17, '332 Patent dependent claim 13, '883 Patent dependent claims 14-15)

132. It is my understanding that, in the Response, Patent Owner has proposed that the broadest reasonable interpretation of the claim term "said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel" is "a construction made up of a constituent material that, by itself, has substantially higher porosity than the material of the first and second panels." I agree with this proposed interpretation.

133. In my opinion, one of ordinary skill in the art would clearly understand that in independent claim 17 the open cell claim phrase is directed to the Using High-Porosity Materials Embodiment (FIG. 5). Here, the claim language expressly requires that the open cell construction be "formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel." This directly tracks the description of this embodiment in the specification. Ex. 1001, 2:47-64 ("gusset 20 may be formed with the base material 30 being inherently significantly porous"). Also, this same language was added to certain other claims during prosecution to make clear that they are directed to the Using High-Porosity Materials Embodiment. *See* Ex. 1003 at 47. Additionally, as discussed above, one of ordinary skill in the art would clearly understand that this embodiment corresponds to the second category of open cell constructions set forth

in the inventor's definition of "open cell construction," *i.e.*, the Inherently Porous Base Materials category.

134. At least based on the above, it is my opinion that one of ordinary skill in the art would understand that Patent Owner's construction for this phrase is consistent with the specific open cell structure expressly recited in this phrase, *i.e.*, "a construction made up of a constituent material [having] substantially higher porosity than the material of the first and second panels," as well as the corresponding Inherently Porous Base Materials category of open cell constructions in the inventor's definition, *i.e.*, a construction "that, by itself, has substantially higher porosity."

B. "said pillow is configured to have air enter the cavity through pores in the first and second panels and have the air exit the cavity through pores in the gusset" ('332 Patent dependent claim 16 and '883 Patent independent claim 1)

135. It is my understanding that, in the Response, Patent Owner has proposed that the broadest reasonable interpretation of the claim term "said pillow is configured to have air enter the cavity through pores in the first and second panels and have the air exit the cavity through pores in the gusset"" is "the pillow is designed to have air which enters the pillow through the first or second panels then exit the pillow through the gusset." I agree with this proposed interpretation.

136. As I discussed above, the pillow designs discussed in the '134, '332, and '883 Patents provide an airflow channel in which air flows into the pillow through the two panels and out through the gusset. This airflow channel provides ventilation between the panels and the fill material and minimizes heat buildup in the fill material, thereby enhancing cooling effects and comfort for the user. In my opinion, one of ordinary skill in the art would have understood that dependent claim 16 of the '332 Patent and independent claim 1 of the '883 Patent explicitly recite this airflow feature, by requiring that: "said pillow is configured to have air enter the cavity through pores in the first and second panels and have the air exit the cavity through pores in the gusset."

137. As can seen the express claim language initially refers to "air" entering the cavity through the panels, and then subsequently refers to "the air," (i.e., the same air) exiting the cavity through the gusset. Accordingly in my opinion, one of ordinary skill in the art would have understood the claim language to explicitly require that the pillow be configured to have air which enters the cavity through the first and second panels to then have this same air exit the cavity through the gusset.

138. To illustrate the meaning of this claim it may be helpful to provide some airflow examples framed in the context of the structures described in the '134, '332, and '883 Patents and how the relate to the claim language:

- In my opinion, one of ordinary skill in the art would have understood that air which enters through a pillow structure other than a panel (e.g., gusset) is irrelevant to this particular claim language. This is because the claim language only addresses air which enters through the panels. In other words, the claim does not require/restrict air to/from entering through the gusset.
- Similarly, in my opinion, one of ordinary skill in the art would have understood that where air that has entered through a pillow structure other than a panel (e.g., a gusset) eventually exits the pillow is similarly irrelevant. This is also because the claim language only addresses air which enters through the panels. In other words, the claim does not require/restrict air which enters through a structure other than a gusset to/from exiting the pillow through any pillow structure (e.g., gusset, panel, or some other structure).

139. Here, the claim language is simple and plain. The claim language makes clear that air which enters through a panel – then exits through the gusset. As demonstration of this clarity, consider a situation where air enters a hypothetical pillow through a panel which then proceeds to exit through a panel. In this example, it is clear that that air entered through one of the panels as recited in the claim but that the pillow was not **configured to** have that air exit through the

gusset. This result contradicts the express claim language and thus does not teach the claim.

140. In my opinion one or ordinary skill in the art would have understood that having air which enters the pillow through the first or second panels then exit the pillow through the gusset is also consistent with the specification. In my opinion one of ordinary skill in the art would have understood that the specification describes an airflow channel where pressure or heat applied to one of the two panels enables venting of air into the cavity through the panels and out of the cavity through the gusset. Ex. 1001, 2:10-13 ("With pressure and/or heat applied to one or both of the first and second panels 16, 18, the gusset 20 provides venting therethrough of the interior of the cover 12"), 1:37-40 ("a pillow is provided allowing for lateral ventilation between opposing panels. This permits a cooling effect while a user is resting or sleeping").

141. Additionally, the '134, '332, and '883 Patents explain that this air flow and cooling effect may be further enhanced with the use of an inner cover. Ex. 1001, 4:19-36 ("With the gusset 20 being of open cell construction, air exchange about the inner cover 48 is permitted [which] allows for heat dissipation and minimal heat collection within the pillow 10 [and,] because the inner cover 48 acts as an air barrier during use, heat transfer by air flow into the fill material 14 may be reduced"). Thus, in my opinion one of ordinary skill in the art would have

understood that the specification confirms that the claimed pillows are designed to have air which enters the pillow through a panel then exit the pillow through the gusset (*i.e.*, directional air flow). Accordingly, in my opinion one of ordinary skill in the art would have understood that the air flow channel described in the '134, '332, and '883 Patents discloses air flowing through the panels.

142. In my opinion, one of ordinary skill in the art would have understood that the specification provides additional support for air flow flowing through the panels. For example, the '134, '332, and '883 Patents specifically teaches that the panels "may be partially or wholly formed with open cell construction." Ex. 1001, 4:53-61.

143. In my opinion, one of ordinary skill in the art would have understood that the claims also provide support for air flowing through the panels. In particular, the base claim from which claim 16 depends (i.e., independent claim 1) explicitly recites that "said first panel and said second panel each comprise a **porous material**." '332 Patent, claim 1 (emphasis added). Because the materials of the panels are required to be "porous," in my opinion, one of ordinary skill in the art would have understood that air flows through the panels.

144. In fact, independent claim 1 requires that both the panels and gusset are made from porous materials. Because both panels are porous, air flow would be expected through these structures. In my opinion, one of ordinary skill in the art

would have understood that claim 1 does not restrict the direction of air flow through these structures. In my opinion, one of ordinary skill in the art would have understood that claim 16 narrows the scope of claim 1 by specifying an airflow direction for which air enters through the panels. This air exits through the gusset.

VIII. Summary of Rasmussen

145. Rasmussen is primarily directed to a pillow having a foam core. Rasmussen, Abstract, ¶ [0003]-[0005] (discussing the use of foam especially visco-elastic foam in pillows). A plurality of lobes extend from the foam core. Rasmussen, ¶ [0014] ("pillow 100 comprises a core 110 having a plurality of lobes 120, 130 extending from a central portion of the core 110"). These lobes give Rasmussen's pillow an unconventional shape. *See* Rasmussen, FIG. 1. According to Rasmussen, "lobed shape of the pillow 100 provides a number of support surfaces for a user. For example, the lobed shapes can enhance breathing of a user resting his or her head against the pillow." Rasmussen, ¶ [0014].

146. Rasmussen further explains the construction of the "core." Rasmussen, ¶ [0015] ("core 110 of the illustrated pillow 100 includes a top layer 140, a bottom layer 150 opposite the top layer 140, and sidewalls 160 connecting the top layer 140 and the bottom layer 150. The top layer 140, bottom layer 150 and sidewalls 160 define a cavity 170 shaped to receive filler material 180").

According to Rasmussen, the pillow "core" through its box-like shape "provides enhanced support to a user, as well as providing space for the filler material 180." Rasmussen, ¶ [0015]. Rasmussen teaches that the top layer, bottom layer and sidewalls may be joined in a number ways (e.g., adhesives, zippers, laces, hook and loop, buttons) which allow access to the cavity. Rasmussen, ¶ [0015], ¶ [0018].

147. A significant portion of Rasmussen is devoted to explaining the physical characteristics of the foam making up the top and bottom layers of the core. Rasmussen, ¶ [0019]-[0028]. Initially, Rasmussen discusses the use of non-reticulated foams in the top and bottom layers. Rasmussen, ¶ [0019]-[0021]. Next, Rasmussen teaches utilizing reticulated (skeletal) "visco-elastic foam for the top layer 140 and/or bottom layer 150 of the pillow 100…[which] can provide significantly increased ventilation for the top and/or bottom layer 140, 150 of the pillow 100, thereby enhancing the ability of the pillow 100 to transport heat away… [and] can also enhance the ability of the pillow 100 to wick moisture away from the user's body thereon." Rasmussen, ¶ [0022]-[0023].

148. For the sidewalls, Rasmussen explains the "pillow 100 is provided with sidewalls 160 that are highly porous, and therefore provide a significant degree of ventilation for the pillow, allowing air to enter and exit the pillow 100 readily through the sides of the pillow 100." Rasmussen, ¶ [0029]. According to

Rasmussen, “this capability is achieved through use of a 3D textile core sidewall 160, which has the added benefit of providing structural strength to the pillow 100 to retain the box-shaped core.” Rasmussen, ¶ [0029]. But “other breathable fabrics can instead be used as desired.” Rasmussen, ¶ [0029].

149. More specifically, Rasmussen provides that the “sides of the core can be defined by highly porous material (such as a 3D textile material).” Rasmussen, ¶ [0006]. In certain embodiments, the side layer “core” is more permeable than the top and/or bottom layer of the “core.” Rasmussen, ¶ [0007]-[0008].

150. Next, like the top and bottom layers of the core, Rasmussen goes onto greater detail regarding the physical characteristics of the fill material, which is “a supportive layer providing a relatively stiff but flexible and resilient substrate.” Rasmussen, ¶ [0031], ¶ [0030]-[0045] (detailing physical characteristics and makeup of the fill).

151. Lastly, Rasmussen describes the actual “cover” of the pillow. According to Rasmussen, “cover 190 can include a top portion 200, a bottom portion 210 opposite the top portion 200, and side portions 220 extending between the top portion 200 and the bottom portion 210.” Rasmussen, ¶ [0048]. Like the “core,” the portions of the cover may be joined in a number ways (e.g., adhesives, zippers, laces, hook and loop, buttons) and may joined to the core itself in similar fashion. Rasmussen, ¶ [0052]-[0053].

152. In discussing the makeup of the cover, Rasmussen describes the potential porosity of the side portions of the cover, "which may improve the micro climate of the pillow." Rasmussen, ¶ [0050], *see also,* ¶ [0049] ("side portions 220 of the cover 190 can be highly porous (e.g., made of a 3D textile material or a velour or stretch velour material)." According to Rasmussen, the top portion of the cover may be less porous than the side (or bottom) portions. Rasmussen, ¶ [0050], ¶ [0006]. In some embodiments, the "cover 190 is manufactured such that the bottom and side portions 210, 220 of the cover 190 are composed of the same material, and wherein the material of the top portion 200 is different." Rasmussen, ¶ [0051].

153. In my opinion, one of ordinary skill in the art would not have understood Rasmussen to provide enough guidance regarding how to transform constituent materials making up the alleged gusset to arrive at the specific open cell structures claimed in the '134, '332, and '883 Patents. Instead, Rasmussen merely refers the reader to an already porous material, namely "highly porous" "3-D textile." Rasmussen, ¶[0006]-[0007], [0029], [0049].

IX. Analysis of Rasmussen with Respect to the Claims of '134, '332 and '883 Patents

A. Rasmussen does not disclose a "gusset being formed of an open cell construction, said open cell construction is formed by interlaced or spaced-apart strands" ('134 patent independent claim 1, '332 patent independent claims 33 and 34)

154. ‘134 Patent independent claim 1 requires that the open cell construction of the gusset “is formed by interlaced or spaced-apart strands.” ‘332 Patent independent claim 33 requires that the open cell construction of the gusset is “formed by interlaced strands.” 332 Patent independent claim 33 requires that the open cell construction of the gusset is “formed by spaced-apart strands.” As discussed above, it is my opinion that one of ordinary skill in the art would understand that this claim language requires that “**open cells** are defined by strands arranged in an interlaced or spaced-apart manner.” Thus, one of ordinary skill in the art would understand the claimed gusset to require such “**open cells**.”

155. In my opinion one of ordinary skill in the art would understand that these opens cells are used to provide a “construction having overall porosity greater than the inherent porosity of the constituent materials.” Ex. 1001 1:41-44. Arrangement of the interlaced/spaced-apart strands to create “open cells” enables the construction to have overall porosity greater than the inherent porosity of the constituent materials (i.e., the stands), which is the primary purpose of the claimed embodiment. Therefore, this interpretation also conforms to the definition provided in the patent specification.

156. This understanding is further confirmed by the physical description provided in the ‘134, ‘332, and ‘883 Patents. Specifically, the ‘134, ‘332, and ‘883 Patents specification describes that the strands themselves define the “[t]he strands

26 are arranged so that **open cells** 28 are defined therebetween." Ex. 1001, 2:26-27 (emphasis added), FIG. 3. An annotated version of figure 3 below illustrates this teaching.

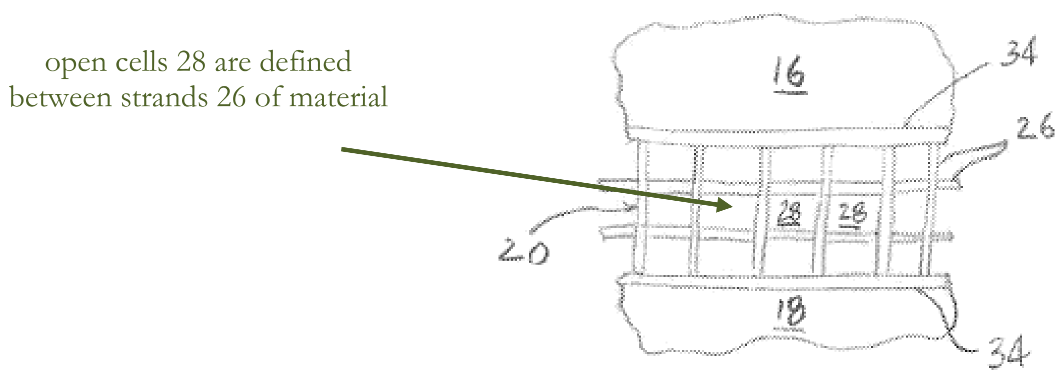
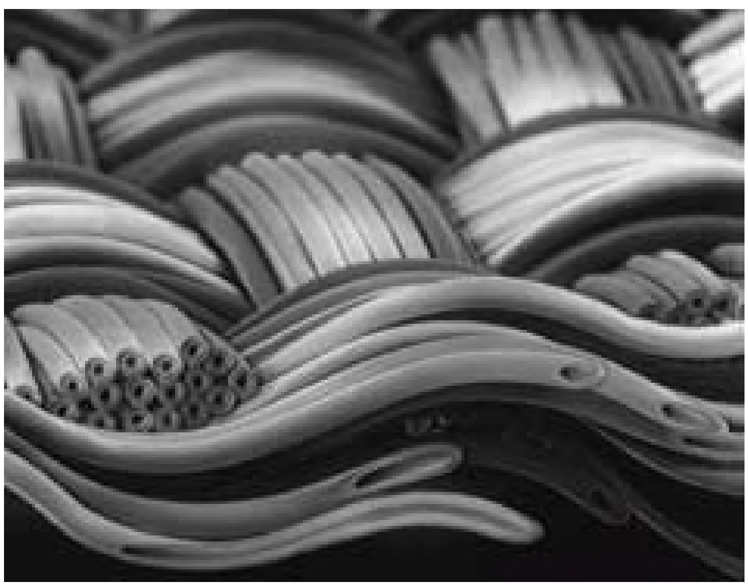


FIG. 3

157. Clearly, arranging strands of materials to create large openings between the materials allows more air to pass through the resulting construction, when compared to a solid construction of the same dimensions and material. This is because one of ordinary skill in the art would understand that porosity itself is a measure of the void (i.e. "empty") spaces in a material, and is a fraction of the volume of voids over the total volume. Dictionary of Textiles, p. 476.

158. As discussed above, many fabrics have strands which are knitted or woven together to form complex patterns. As can be seen from the above examples, these patterns (even highly porous ones), do not require the presence of "open cell" structures. For example, tight formed structures do not have such "open cells." These structures can be further layered to form 3-D textiles.

159. Despite being tightly-formed and layered, these structures are highly porous. This is true because the material of the structure itself can be highly porous. For example, wool, alpaca or llama hair tend to trap air in void spaces. Manufacturing Processes, p. 490 ("Hollow fibres, such as llama and alpaca hair"), p. 495 ("The fibres from these animals are partially hollow, making them lightweight with good insulation properties."). Because they are hollow inside, these yarns are inherently highly porous. A very tight fabric that is made of hollow fibers can provide porosity through the hollow core of the fibers, as shown in the illustration below:



https://www.textileweb.com/doc/meryl-nexten-0001 (Ex. 2013)

160. Another example of an inherently highly porous materials are crimped fiber yarns, which are yarns formed of bent rather than straight fibers (e.g., wool which has a natural crimp) and yarns made of irregular fiber cross-sectional

shapes. These yarns are inherently highly porous because either the bent/crimped nature of the individual fibers creates larger airgaps between them or the irregular cross sectional shapes leave gaps between fibers when they are packed to touch each other. This is in contrast to typical yarn fibers which are straight and can thus engage more closely along their respective lengths. Encyclopedia of Textiles, p. 241 ("In **contrast to cotton and other cellulosic fibers**, wool is distinguished also by crimps in the fiber, sometimes as many as 30 per inch of length. **These crimps create many tiny air pockets** which impart to wool a resilient, spongy texture.") (emphasis added).

161. Accordingly, by choosing a highly porous material, one of ordinary skill in the art would understand that such fibers need not be interlaced or spaced-apart to create a porous material using open cells. In my opinion, under Petitioner's implicit interpretation of this claim, the claim would be covered by a gusset composed of virtually any type of fabric or textile regardless of its physical structure as long as it was "highly porous."

162. It is quite common to create porous 3-D textiles without arranging strands. For example, non-woven 3-D materials may be created using needle punching to entangle individual fibers. 3-D Fibrous Assemblies, p. 25 ("Most of the processes described in the literature are based on production of 3-D non-wovens using regular manufacturing processes, i.e., needle punching"); 3-D

Fabrics, p. 99. This needle punching creates numerous holes and thus a porous material.

B. Rasmussen does not disclose an "open cell construction being formed by interlaced strands" ('332 Patent independent claim 33)

163. Contrary to Petitioner's expert's analysis one of ordinary skill in the art would not have understood 3-D textiles to necessarily have interlaced strands. For example, there are 3-D fabric structures which do not interlace strands and are termed (not surprisingly) "Non-Interlaced 3D Fabrics."

164. An example of such a "non-interlaced 3D fabric" is depicted below. These textiles can be produced on a conventional 2D weaving device. Textile Progress, p. 3. As Textile Progress teaches, the strands making up the structure are not interlaced but are instead held together by the bindings in two mutually perpendicular directions. Textile Progress, p. 4 ("Interlacement does not take place between the three sets of yarns used. The woven structure so formed is held together by the bindings of two mutually perpendicular directions. Thus, the three series of yams lie almost perpendicular to one another, without interlacement, in the 3D fabric so formed").

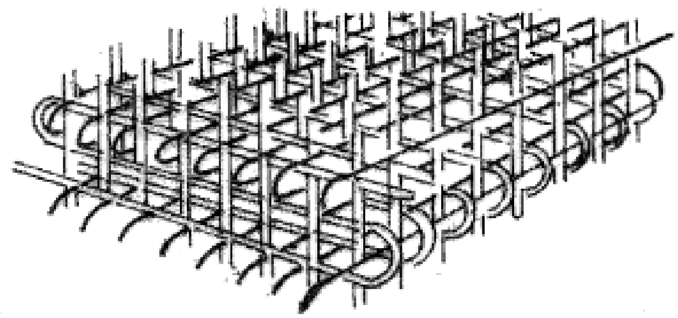


Figure 2. Non-interlaced 3D fabric (noobed) with three perpendicular sets of yarns.

C. Rasmussen does not disclose a "gusset being formed of an open cell construction and a base material, and said open cell construction is formed by apertures defined in said base material, said apertures being larger than any pores inherently defined in said base material" ('134 Patent independent claim 11)

165. Independent claim 11 requires that the open cell construction of the gusset "is formed by apertures defined in said base material, said apertures being larger than any pores inherently defined in said base material." As discussed above , this limitation requires that "**open cells** are defined by holes created in a constituent material that are larger than any pores naturally occurring in the material, such that the overall porosity is greater than the porosity of the constituent material itself." As discussed above, it is my opinion that one of ordinary skill in the art would understand that this claim language requires that "**open cells** are formed by apertures defined in said base material." Thus, one of ordinary skill in the art would understand the claimed gusset to require such "**open cells**."

166. In my opinion one of ordinary skill in the art would understand that these open cells are used to provide a "construction having overall porosity greater than the inherent porosity of the constituent materials." Ex. 1001, 1:41-44. Creating apertures/holes in a base material that are larger than any pores inherently defined in the base material to define "open cells" enables the construction to have overall porosity greater than the inherent porosity of the constituent materials (i.e., the stands), which is the primary purpose of the claimed embodiment. Therefore, this interpretation also conforms to the definition provided in the patent specification.

167. This understanding is further confirmed by the physical description provided in the '134, '332, and '883 Patents. Specifically, the '134, '332, and '883 Patents specification describes that the "[a]pertures 32 may be defined in the base material 30 with the **apertures 32 defining the open cells of the gusset** 20. The apertures 32 are larger in size than any pores that may be inherently defined in the base material 30." Ex. 1001, 2:38-41 (emphasis added), FIG. 4. An annotated version of figure 4 below illustrates this teaching.

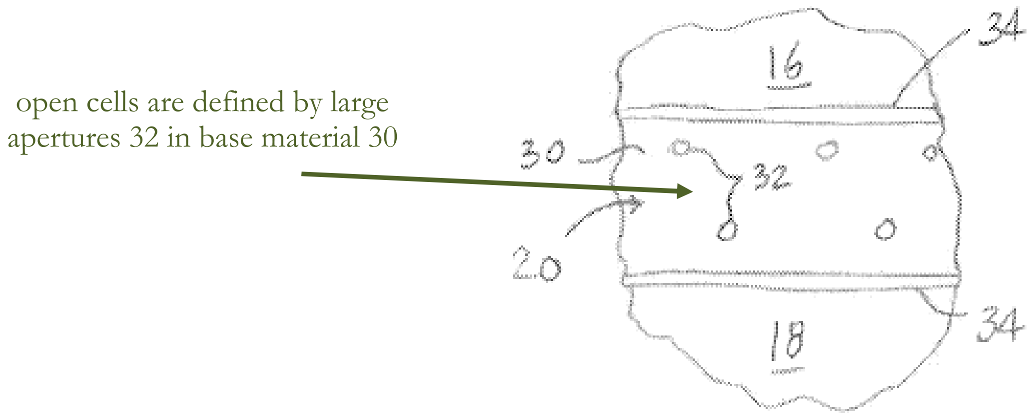
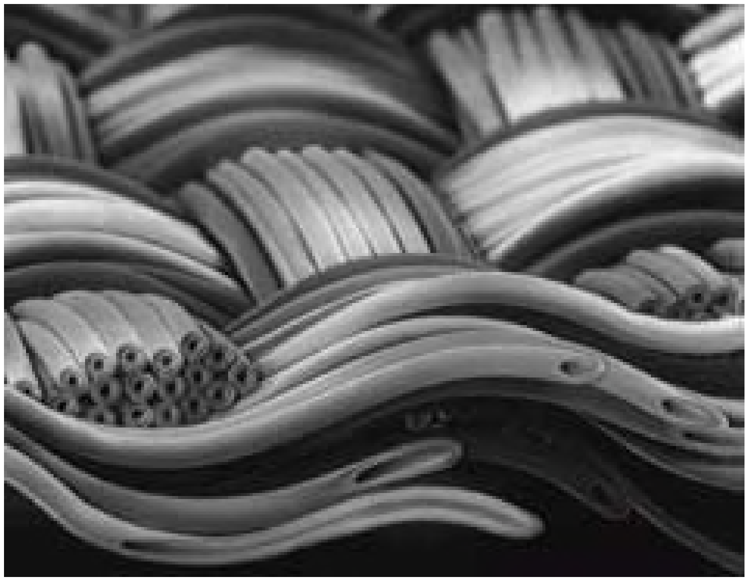


FIG. 4

168. There are however many examples of highly porous 3-D textiles that do not contain "macro pores." For example, highly porous 3-D textiles can be created using highly porous base material. An example of highly porous base materials include hollow fiber yarns which are yarns formed from hollow fibers (e.g., alpaca or llama hair). Manufacturing Processes, p. 490 ("Hollow fibres, such as llama and alpaca hair"), p. 495 ("The fibres from these animals are partially hollow, making them lightweight with good insulation properties."). Because they are hollow inside, these yarns are inherently highly porous. A very tight and impervious fabric that is made of hollow fibers can provide porosity through the hollow core of the fibers, as shown in the illustration below:



https://www.textileweb.com/doc/meryl-nexten-0001

169. Another example of an inherently highly porous base material are crimped fiber yarns, which are yarns formed of bent rather than straight fibers (e.g., wool which has a natural crimp) and yarns made of irregular fiber cross-sectional shapes. These yarns are inherently highly porous because either the bent/crimped nature of the individual fibers creates larger airgaps between them or the irregular cross sectional shapes leave gaps between fibers when they are packed to touch each other. This is in contrast to typical yarn fibers which are straight and can thus engage more closely along their respective lengths. Encyclopedia of Textiles, p. 241 ("In **contrast to cotton and other cellulosic fibers**, wool is distinguished also by crimps in the fiber, sometimes as many as 30 per inch of length. **These crimps create many tiny air pockets** which impart to wool a resilient, spongy texture.") (emphasis added).

170. In my opinion, Petitioner's expert's analysis with respect to this limitation is erroneous. I understand that Petitioner's expert identifies the individual fibers (e.g. polyester fibers) as the "base material." Pet. at 44; Rhodes Dec., ¶ 126. Here, I will accept the premise that the "base material" is a fiber (e.g., polyester fiber). Then in my opinion one of ordinary skill in the art would understand that in order to satisfy the requirements of this limitation an aperture must be created in the base material.

171. Theoretically an aperture could be created in an already manufactured synthetic fiber (such as polyester) by drilling a whole in the core of the fiber and by drilling it to the entire length of the fiber. This is highly impractical, however, because the fibers themselves are of the order of 0.00005 inches in diameter and millions of such holes need to be drilled because there are millions of fibers in the gusset fabric alone. Separation of a yarn/strand (i.e., bundle of fibers), such as in a cotton yarn) is a little more practical but still not a typical process. An example of this process is the air-jet texturing discussed above.

172. Regardless of whether the "base material" is polyester fiber or yarn, it is my opinion that one of ordinary skill in the art would understand that Petitioner's analysis confuses this embodiment with that of claim 1. Specifically, Petitioner's expert explains that the "apertures/pores [are] formed during the

knitting process used to form the 3D spacer fabric from the particular base fibers." Rhodes Dec., ¶ 127.

173. One of ordinary skill in the art would recognize that knitting does not alter the fundamental properties of the yarn itself, but merely loops the yarn to create larger stable structures. 3-D Fibrous Assemblies, p. 4-5 ("Knitted fabrics are textile structures assembled from basic construction units called loops. There exist two basic technologies for manufacturing knitted structures: weft and warp-knitted technology"); 3-D Fibrous Assemblies, p. 17 ("Knitting is the interlocking of one or more yarns through a series of loops").

174. Thus, by knitting the apertures/pores would be defined between the strands/fibers of the base material ("[t]he strands 26 are arranged so that **open cells** 28 are defined therebetween." Ex. 1001, 2:26-27 (emphasis added), FIG. 3) **not in** the fibers itself in contrast to the express requirements of the claim.

D. Rasmussen does not disclose a "gusset being formed of an open cell construction and a base material, and said open cell construction is formed by porosity of said base material being substantially greater than porosity of material forming said first panel and substantially greater than porosity of material forming said second panel" ('134 Patent independent claim 17, '332 Patent dependent claim 13, '883 Patent dependent claims 14-15)

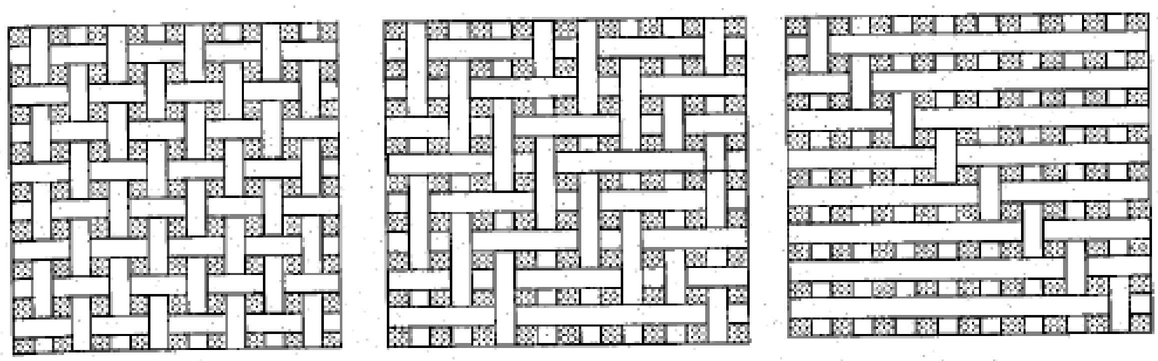
175. I understand that for this limitation Petitioner primarily relies on two paragraphs of Rasmussen. For Petitioner's "core" mapping, Petitioner cites to Rasmussen disclosing that "[t]he side layer is more permeable than the top layer and the bottom layer." Rasmussen, ¶ [0008]; Pet. at 46. For Petitioner's "cover" mapping, Petitioner cites to Rasmussen disclosing that "the top portion 200 and bottom portion 210 of the cover 190 are less porous than the side portions 220 of the cover 190" Rasmussen, ¶ [0050]; Pet. at 46.

176. In my opinion one of ordinary skill in the art would have understood that in these paragraphs Rasmussen at most teaches that Petitioner's alleged gusset as a whole is more porous than the alleged panels. In these cited sections, one of ordinary skill in the art would have understood that Rasmussen fails to teach that it is the "base material" itself that is more porous than the materials of the first and second panels as recited by the claims.

177. For example, the alleged gusset and panels may be made of the same base material (e.g., polyesters). One of ordinary skill in the art would have recognized that the alleged gusset could be made more porous by arrangement of the "base material" of the gusset. In particular, it is well known that knit and woven structures formed of the same base materials can be made more or less porous by adjusting the tightness of the pattern. For example, the cover factor (total covering capacity of fibers and yarns) and hence the porosity of a woven

fabric can be changed by simply changing the weave pattern (fabrics of the same basis weight representing plain, twill satin, etc. weaves have different porosities). Woven fabric porosity can also be varied by changing the linear density (count) of the yarn and also by changing the number of warp threads per inch and number weft threads per inch. Similarly, the porosity of the knit fabric can be changed extensively by changing loop length, loop geometry, loop density, yarn count, yarn twist, etc.

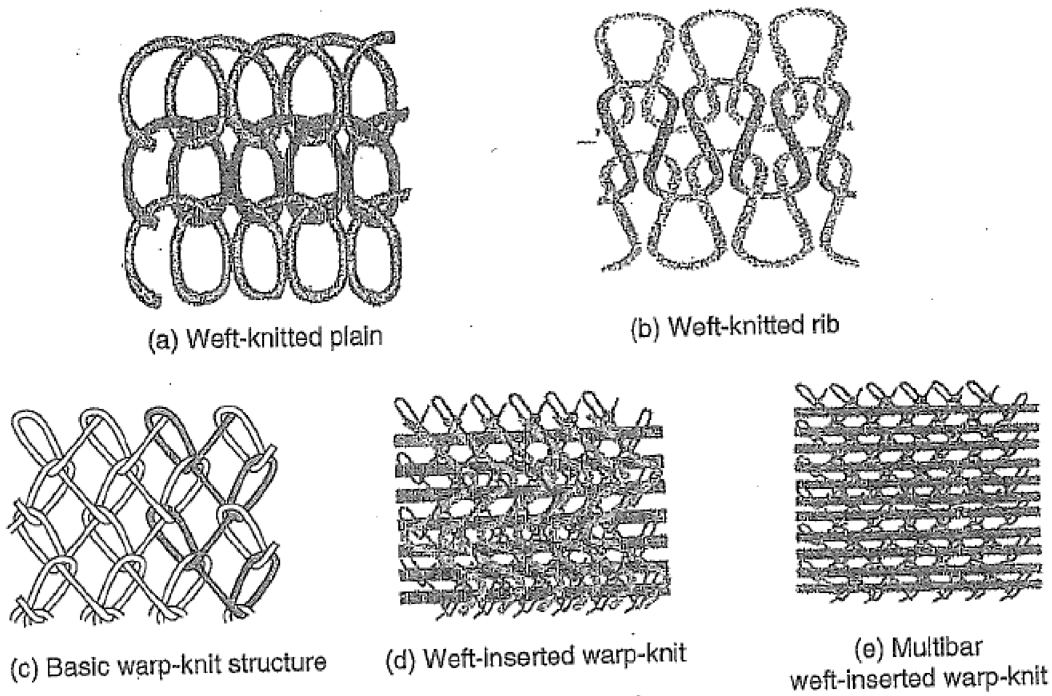
The figures below illustrate change in fabric tightness based on weave pattern.


(a) Plain weave (b) Twill weave (c) 8-end satin weave

1.1 Basic weaves.

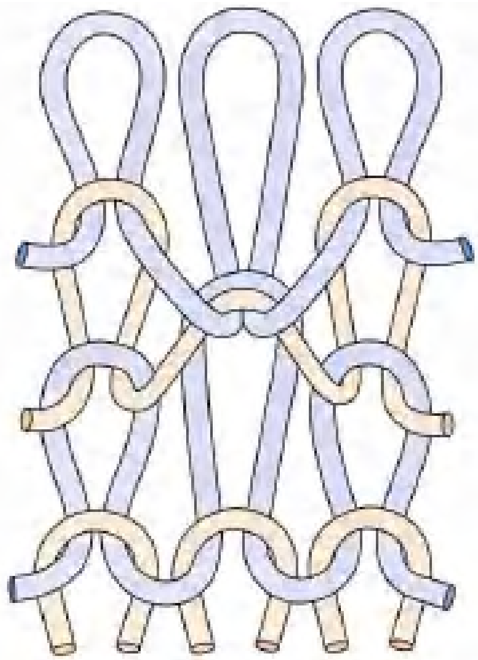
3-D Fibrous Assemblies, p. 3.

The figures below illustrate changing porosity in knitted fabrics by changing loop geometry and loop length.



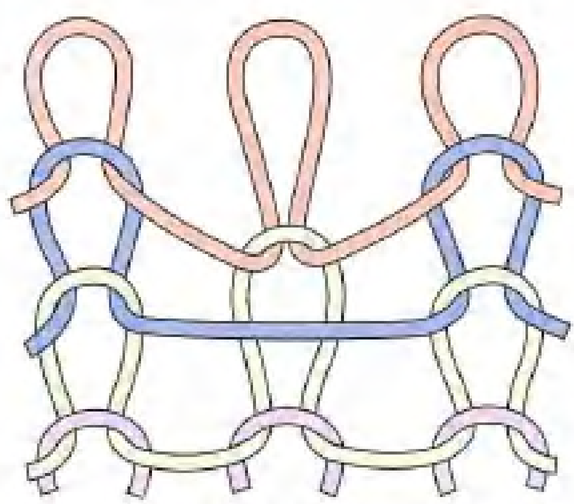
1.3 Schematic representations of weft- and warp-knitted structures.

3-D Fibrous Assemblies, p. 5.



Single-needle, single-course tuck stitch

Kadolph Textiles, p. 320.



Float stitch

Kadolph Textiles, p. 320.

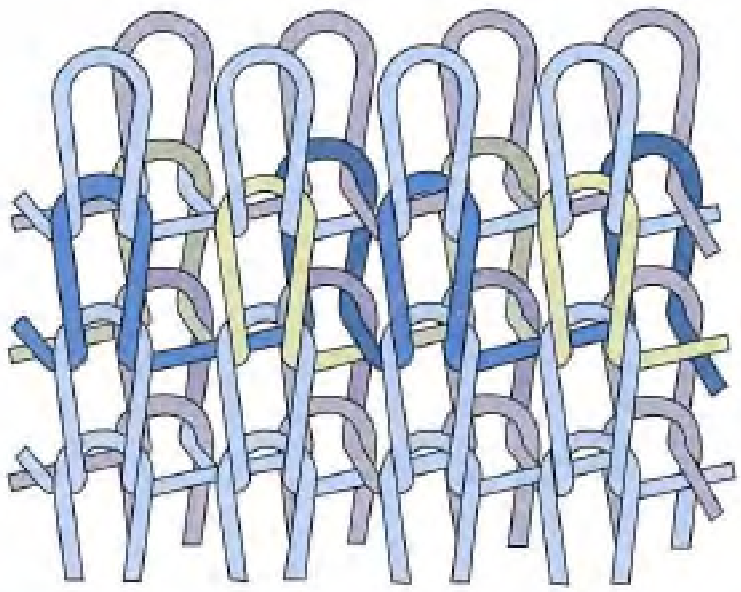


Figure 14.28 Interlock (diagram offset for clarity).

Kadolph Textiles, p. 328

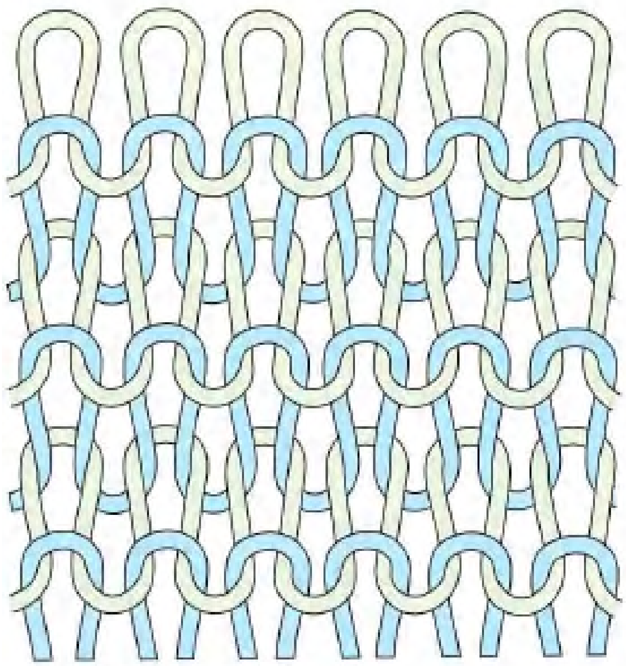


Figure 14.29 Purl fabric.

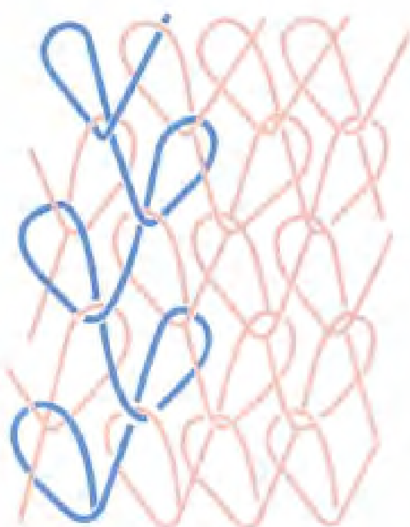


Figure 14.30 Warp-knitting stitch.

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Kadolph Textiles, p. 329

178. In my opinion, at least because porosity can be adjusted by weaving patterns of base material, one of ordinary skill in the art would have understood that even if the alleged gusset as a whole is more porous than the first and second panels it is not inherent that the "base material" of the gusset has substantially greater porosity than that of the material forming the first and second panels.

E. One of ordinary skill in the art would not have modified Rasmussen's lobed design to have a rectangular footprint ('134 Patent dependent claims 2 and 12, '332 Patent dependent claim 4, '883 Patent dependent claim 5)

179. In my opinion, one of ordinary skill in the art would have recognized that modifying Rasmussen to take on a rectangular form would have modified Rasmussen's principal of operation. More specifically, Rasmussen teaches a pillow with a plurality of lobes, which provide a number of benefits, including: enhanced breathing and support. Rasmussen, ¶ [0014] ("The lobed shape of the pillow 100 provides a number of support surfaces for a user. For example, the lobed shapes can enhance breathing of a user resting his or her head against the pillow 100 (e.g., when sleeping on the user's side or stomach), and can also provide support for the shoulder and/or neck of the user when the user is sleeping on his or her side or back."), FIG. 1.

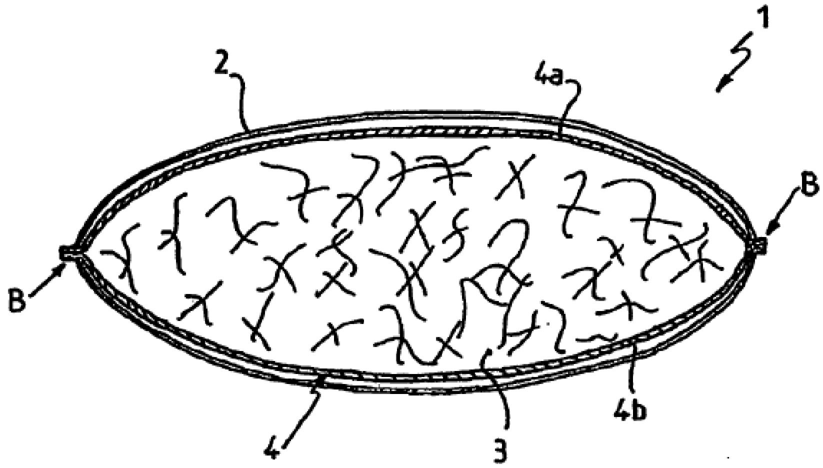
180. In my opinion, one of ordinary skill in the art would have recognized Rasmussen's limited applicability to conventional rectangular designs because

Rasmussen does not even discuss a rectangular pillow shape despite a rectangular form being the predominant pillow shape long before Rasmussen.

F. Rasmussen in view of Vuiton does not teach said inner cover is formed by one or more layers of a material selected from the group consisting of a non-woven, knit, woven materials and combinations thereof such that said inner cover is relatively resistant to air flow therethrough ('134 Patent dependent claims 15 and 20)

181. I understand that with respect to this limitation, Petitioner relies on Vuiton's description of a plastic layer for teaching this feature. Pet. at 63. Specifically, Petitioner argues that Vuiton teaches that its inner casing may be coated with a plastic layer to "provid[e] a barrier to the migration of bacteria towards the inside of the pillow." Pet. at 62.

182. In my opinion, this characterization of Vuiton is erroneous. One of ordinary skill in the art would have understood that Vuiton teaches that the connection between the inner casing and outer casing prevents this bacterial migration not the plastic layer. Vuiton, ¶ [0013] ("inner casing 4 is connected to the outer casing 2 thereby providing a barrier against the migration of bacteria towards the inside of the pillow"). This connection between the casings can be seen in FIG. 1 (reproduced below).



183. One of ordinary skill in the art would have understood Vuiton's plastic layer to be a laminate layer ("film") that would be thermally or adhesively bonded to the outer surface of the inner casing. This (understanding/interpretation) comes from the fact that 'plastic' is a molecularly cross-linked and solidified polymer material that cannot be coated with a brush. Textile Directory (Ex. 2014), p. 118 ("Bonded fabrics often combine film and another fabric for functional use. For example, film can be laminated to the face of a cotton calico for a water-resistant fabric").

184. Because plastic is non-porous it would render the inner casing totally impermeable to air. Textile Directory, p, 118 ("Film, usually produced from a plastic material, is not made from fiber at all. Although still a two-dimensional surface like other fabrics, film is neither porous nor breathable") (emphasis added)

185. In my opinion, one of ordinary skill in the art would have understood that making the "inner cover []**relatively resistant** to air flow therethrough," still requires some amount of air to flow through the pillow. Having some airflow prevents uncomfortable ballooning effects associated with airtight pillows, such as ballooning. Fry (Ex. 2015), ¶ [0010] ("A monolithic coating the fabric of an entire pillow results in a pillow that traps air. If a pillow traps air, it becomes uncomfortable because it gives a user the feeling that they are resting on a balloon filled with air as opposed to a traditional pillow that allows air to egress through the pillow covering").

186. Accordingly, by virtue of the application of the plastic layer Vuiton's inner casing is impermeable to airflow. Thus, in my opinion one of ordinary skill in the art would have understood that Vuiton's inner casing is not **relatively resistant to air flow therethrough**. Instead, it is totally resistant to airflow which does not teach or suggest the requirements of the claim.

187. Additionally, the claim requires that non-woven, knit, woven materials and combinations thereof such that said inner cover is relatively resistant to air flow therethrough. In my opinion, one of ordinary skill in the art would not have considered a plastic to be fabric or a non-woven or woven material. Textile Directory, p, 118 ("Film, usually produced from a plastic material, is not made from fiber at all."). This plastic layer is instead bonded to Vuiton's non-woven

inner casing, which demonstrates the understanding that the plastic layer and non-woven fabric are two separate components. Vuiton, ¶ [0013](“inner casing 4 consisting of two panels 4a, 4b made from non-woven fabric”) ¶ [0023] (“upper and lower panels of the inner casing may, in the context of medical applications, be coated with a plastic layer on the outer surface.”). Use of fabric materials to make the inner cover relatively resistant to airflow would avoid some of the problems associated with plastics, such problems include increased noise due to the plastic and ballooning due to plastic’s impermeability.

G. One of ordinary skill in the art would not have modified Rasmussen’s alleged inner cover to be relatively resistant to airflow (‘134 Patent dependent claims 15 and 20)

188. Rasmussen’s disclosure highlights the airflow between the top and bottom layers as well as between the sides as a benefit. Rasmussen, ¶ [0024] (“foam in the top layer 140 and/or bottom layer 150 enables significantly higher airflow into, out of, and through the top layer 140 and bottom layer 150 – a characteristic of the top layer 140 and bottom layer 150 that can reduce heat in the respective layer”), ¶ [0029] (“pillow 100 is provided with sidewalls 160 that are highly porous, and therefore provide a significant degree of ventilation for the pillow, allowing air to enter and exit the pillow 100 readily through the sides of the pillow 100”).

189. In my opinion, one of ordinary skill would have understood that without further modification, using a non-woven inner cover that is relatively resistant to air flow therethrough would tend to trap heat in Rasmussen's filler material. Thus, surrounding Rasmussen's foam core with a non-woven inner cover that is relatively resistant to airflow, as proposed by Petitioner, would appear to directly contradict the principal design purpose of increased airflow described in Rasmussen. *See also*, Rasmussen, ¶ [0024], ¶ [0029]. Thus, because it would have trapped heat, in my opinion, one of the ordinary skill in the art would not have used an inner cover that is relatively resistant to airflow in Rasmussen's design.

H. Rasmussen does not teach a pillow "configured to have air enter the cavity through pores in the first and second panels and have the air exit the cavity through pores in the gusset" ('332 Patent dependent claim 16 and '883 Patent independent Claim 1)

190. As discussed above, it is my opinion that one of ordinary skill in the art would have understood the claim phrase "configured to have air enter the cavity through pores in the first and second panels and have the air exit the cavity through pores in the gusset" to mean that air which enters the pillow through the first and/or second panels exits the pillow through the gusset not the panels.

191. In contrast, I understand that Petitioner takes the position that the claim allows the air entering through the panels to exit through the panels. *See* '883 Pet. at 33, fn. 2. In arguing this position, Petitioner points to the asserted panels

and gusset individually and relies simply on the porosity of Rasmussen's components to teach the required airflow direction. Thus, Petitioner's analysis does not make the connection to the required direction of airflow through the cavity (i.e., into the panels and out of the gusset).

192. The '134, '332, and '883 Patents, however, teach that proper airflow is not based solely on the porosity of the gusset and panels. According to the patent specifications, the required direction of airflow may be provided using an "open cell" gusset of sufficient width and be enhanced with an inner cover. Ex. 1001, 2:5-8 ("it is preferred that the gusset 20 have sufficient width to separate the first panel 16 from the second panel 18 so as to define an air flow channel therethrough"), 4:19-36 ("To enhance the cooling effect, it is preferred that an inner cover 48 be provided, located inside the cover 12, in which the fill material 14 is disposed…. The inner cover 48 acts as a barrier against air flow into the fill material 14. With the gusset 20 being of open cell construction, air exchange about the inner cover 48 is permitted. This allows for heat dissipation and minimal heat collection within the pillow 10. In addition, because the inner cover 48 acts as an air barrier during use, heat transfer by air flow into the fill material 14 may be reduced").

193. As discussed above, it is my opinion that one of ordinary skill in the art would have recognized that a gusset of sufficient width would create an air gap

between the panels and fill where convection currents would develop, which would be able to carry air out of the pillow through the gusset. As also discussed above, it is my opinion that one of ordinary skill in the art would have also recognized that the inner cover would help to maintain the air gap created by the gusset by restricting the movement of the fill and preventing it from filling the air gap and in also preventing heat from entering the fill, which would aid pillow cooling.

194. Rasmussen describes how "visco-elastic foam in the top layer 140 and/or bottom layer 150 enables significantly higher airflow into, out of, and through the top layer 140 and bottom layer 150 – a characteristic of the top layer 140 and bottom layer 150 that can reduce heat in the respective layer." Rasmussen, ¶ [0024]. In my opinion, one of ordinary skill in the art would have understood this teaching to mean that air entering through the top and/or bottom layer is allowed to exit through the top and bottom layer and does not address airflow from the panels to the sidewall.

195. Rasmussen also describes how "the pillow 100 is provided with sidewalls 160 that are highly porous, and therefore provide a significant degree of ventilation for the pillow, allowing air to enter and exit the pillow 100 readily through the sides of the pillow 100." Rasmussen, ¶ [0029]. In my opinion, one of ordinary skill in the art would have understood this teaching to mean that air may

enter and exit through the sidewall and simply does not address the direction of air entering through the top and bottom layers of the core.

196. Rasmussen also provides that "side portions 220 of the cover 190 can be highly porous… side portions 220 of the cover 190, and in… can permit significant ventilation into and out of the pillow." Rasmussen, ¶ [0049]. In my opinion, one of ordinary skill in the art would have not understood this teaching to have addressed the direction of air entering the top and bottom portions of the cover.

197. In my opinion, one of ordinary skill in the art would have understood that permitting air to enter and exit back through the panels would not cause the pillow to "balloon." In fact, allowing air to exit the pillow through both the panels and gusset would only lessen any potential "ballooning" because more air can exit the pillow in such a configuration. Also, allowing air entering through the panels to exit through the panels in addition to the gusset may keep the pillow itself cooler but would tend to reduce user comfort since warmer air would likely be expelled into the user.

I. Rasmussen does not disclose "said inner cavity is filled with a fill material configured to facilitate support of said pillow in a specific position of sleep" ('883 Patent dependent claim 20)

198. In my opinion, one of ordinary skill in the art would have understood that both Rasmussen describes shaping or molding the entire surface of the pillow.

Basically, these references describe curving or shaping the entire pillow form to provide some support (e.g., to a shoulder) or cutting away areas to provide increased pathways for breathing. For example, Rasmussen teaches using a number of "lobes." Rasmussen, ¶ [0014] ("lobed shape of the pillow 100 provides a number of support surfaces for a user… the lobed shapes can enhance breathing of a user… and can also provide support for the shoulder and/or neck"). An example of a lobed pillow is shown in FIG. 1 of Rasmussen (reproduced below).

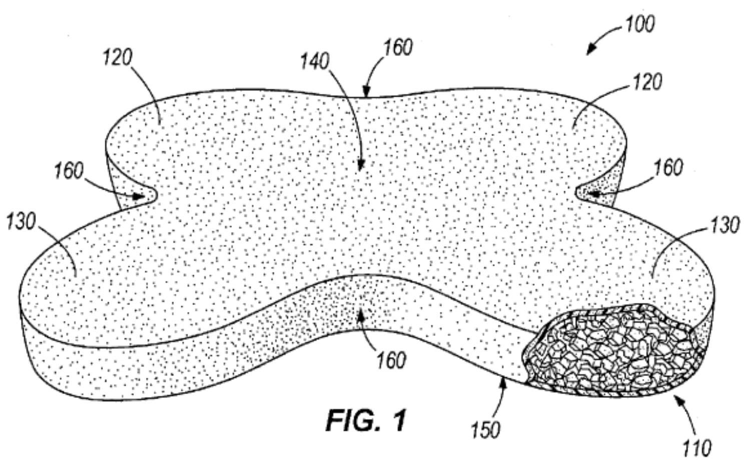


FIG. 1

199. In my opinion, one of ordinary skill in the art would have recognized the approach of Rasmussen to be different from the one taught and claimed in the '883 Patent. More specifically, the '883 Patent teaches configuring the fill independently of the outer pillow form. *See* Ex. 1001, 3:39-55. ("For example, with the pillow 10 being intended for a stomach sleeping position, the pillow 10 may be provided with a fill of microfiber; with the pillow 10 being intended for a

back sleeping position, the pillow 10 may be provided with a fill of a blend of conjugate and hollow slick fiber; and, with the pillow 10 being intended for a side sleeping position, the pillow 10 may be provided with a fill of cluster/ball fiber.”). By configuring the fill independently to support a specific position of sleep, the pillow can retain a familiar (e.g., a rectangular) or other shapes while also accommodating a preferred sleep position. Ex. 1001, 3:56-4:4 (“The pillow 10 may be of various configurations. In a preferred embodiment, the pillow 10 is provided with increased height at central portions, as shown in FIGS. 1 and 2. The fill material 14 is configured to provide the desired shape. More preferably, the first and second panels 16, 18 may be arcuately bowed-out in opposing directions (e.g., being convexly arc-shaped in opposing directions)”); Ex. 1001, FIGS. 2-4. An example of a pillow with a fill material configured to support a “stomach sleeper” is illustrated in FIG. 1 of the ‘883 Patent (reproduced below).

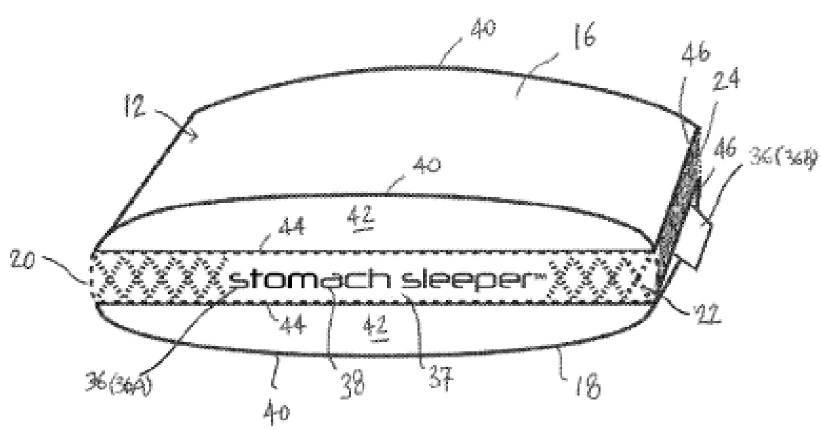


FIG. 1

In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on September 29, 2017

P. Radhakrishna

Dr. Radhakrishnaiah Parachuru