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(54) METHOD OF FORMING A MOLDED NONWOVEN KNITTED MATERIAL

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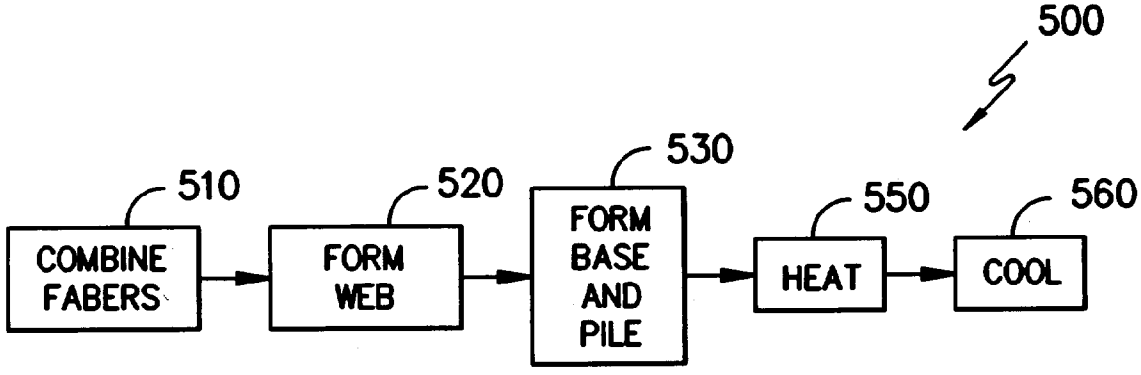
(57) **ABSTRACT**

A nonwoven textile formed of first fibers and second fibers. The first fibers are standard polyester staple fibers and the second fibers are staple fibers of a blend of polyester material having a melt temperature below the material of the first fibers and above the mold temperature of a subsequent molding process. The nonwoven textile has a base area and a pile area extending from the base area. The pile area is the combination of first fibers and second fibers oriented generally perpendicular to the planar direction of the textile. The base area is a knitted portion of the first fibers and the second fibers. The nonwoven textile can also include a cover area being a knitted portion of the first fibers and second fibers disposed on the pile area opposite to the base area.



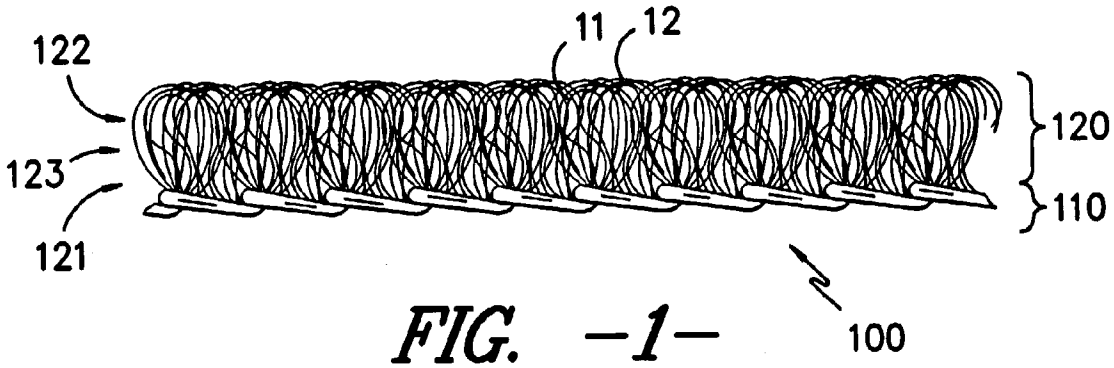


FIG. -1-

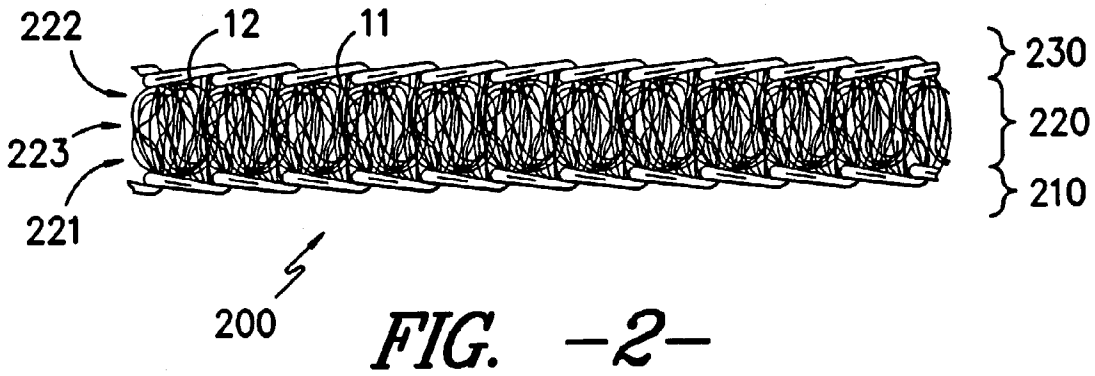


FIG. -2-

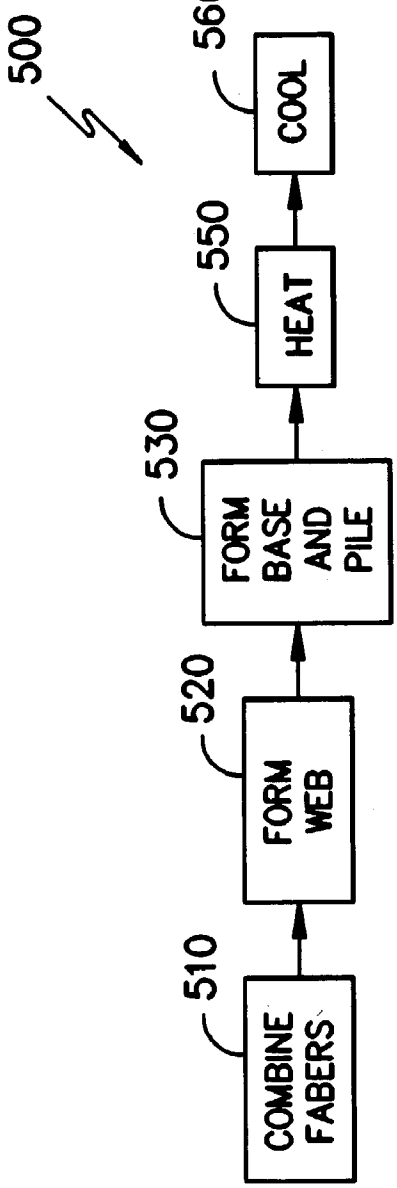

500
510
COMBINE FABERS
520
FORM WEB
530
FORM BASE AND PILE
550
HEAT
560
COOL

FIG. -3-

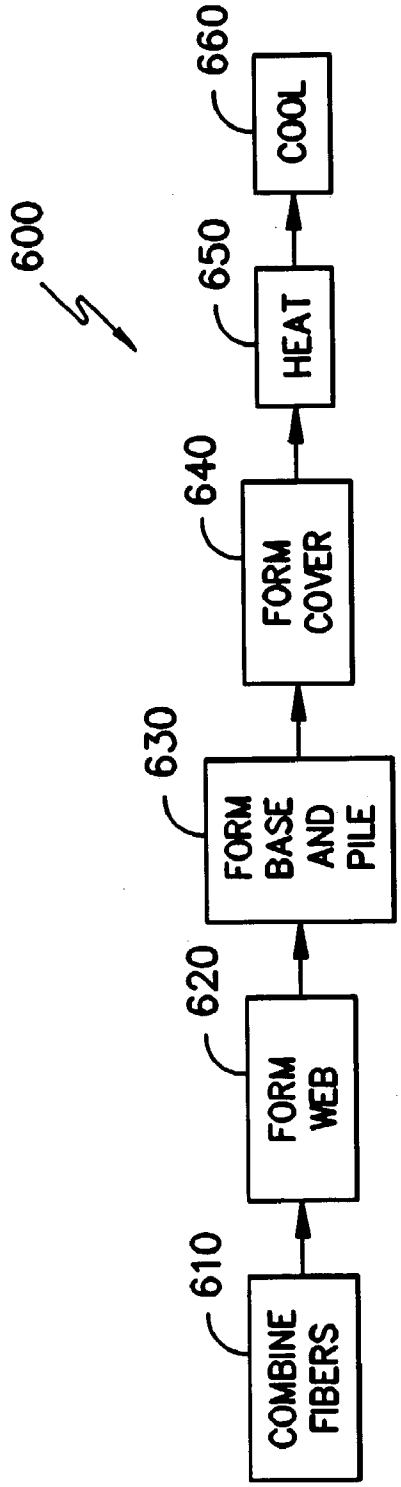

600
610
COMBINE FIBERS
620
FORM WEB
630
FORM BASE AND PILE
640
FORM COVER
650
HEAT
660
COOL

FIG. -4-

METHOD OF FORMING A MOLDED NONWOVEN KNITTED MATERIAL

BACKGROUND

[0001] The present invention relates to a nonwoven material, and in particular, to a nonwoven material that can be used for replacement of foam for the backing of materials, and the method of producing the same.

[0002] Polyurethane foams are often used as fabric backings for vehicle interior materials in the transportation industry. Typically these foams are adhered to the backs of textile face materials of polyester, vinyl, or leather. The polyester materials are typically of a knit, woven, or nonwoven construction.

[0003] These foam backed composites have a cushion affect which can offer comfort or a luxurious feel in contact areas, and allow engineering tolerances in final assembly at component interfaces. Additionally these properties can be maintained in typical automotive construction processes which might include but are not limited to molding and contouring.

[0004] Nevertheless, there are several disadvantages to using polyurethane foam as a backing on polyester materials. First the composite product consisting of two dissimilar materials is difficult to separate into its individual entities and therefore is difficult to recycle. Second, the polyurethane foam backed material can emit a high number of volatile materials which contribute to 'fogging' of automotive interiors, and the foam itself will oxidize over time leading to a color change in the material. Because of these disadvantages, the automotive industry has continued to look for another material that would provide the cushion properties of polyurethane foam at similar costs.

[0005] One material which has received attention in this regard is polyester nonwovens. These materials can provide a suitable backing to most polyester face fabrics and can be made into a composite material with industry recognized techniques. To date, however, in order to obtain cushions of similar thickness to those currently being used with polyurethane foams, an economically deficient amount of material was required.

[0006] Recent technologies of perpendicular laid, thermally bonded nonwovens, including air laid and "Struto" nonwoven techniques, have strived to provide this cushion with an economical and weight advantage to previous nonwoven technologies. These techniques orient the staple fibers into a vertical position and allow increased material thickness without the increased material usage. While these techniques have been successful in obtaining increased composite thicknesses at reasonable weights and cost, the structural integrity of the present resulting product has been unacceptable for many automotive interior uses without the incorporation of a bicomponent crosslinking fiber. The use of these crosslinking fibers has heretofore caused problems in many downstream processes due to reorientation and stiffness from the fibers when heated in downstream processes such as molding or contouring.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1** is a cross-sectional view of an embodiment of the present invention having a base area and a pile area.

[0008] **FIG. 2** is a cross-sectional view of another embodiment of the present invention having a base area, a pile area, and a cover area.

[0009] **FIG. 3** is a block diagram illustrating one embodiment of a method for forming the nonwoven web from **FIG. 1**.

[0010] **FIG. 4** is a block diagram illustrating one embodiment of a method for forming the nonwoven web from **FIG. 2**.

DETAILED DESCRIPTION

[0011] Referring now to **FIGS. 1 and 2**, there is shown embodiments of the present invention, illustrated as nonwoven textiles **100** and **200**, respectively. The nonwoven textiles **100/200** are generally formed with a combination of first fibers **11** and second fibers **12**.

[0012] Referring now to **FIG. 1**, there is shown an cross-sectional view of an embodiment of the present invention, illustrated as the nonwoven textile **100** having a base area **110** and a pile area **120**. The base area **110** is a woven or knitted zone of the first fibers **11** and the second fibers **12** extending along a length of the nonwoven textile **100**. The pile area **120** is an area of the first fibers **11** and the second fibers **12** with a first end **121** emerging from the base area **110**, a second end **122** disposed away from the first end **121**, and a middle section **123** between the first end **121** and the second end **122**. The second end **122** of the pile area **120** can be loops of the first fibers **11** and second fibers **12**, free ends of the first fibers **11** and second fibers **12**, or a combination thereof.

[0013] Referring now to **FIG. 2**, there is shown an cross-sectional view of an embodiment of the present invention, illustrated as the nonwoven textile **200** having a base area **210**, a pile area **220**, and a cover area **230**. The base area **210** is a woven or knitted zone of the first fibers **11** and the second fibers **12** extending along a length of the nonwoven textile **200**. The cover area **230** is a woven or knitted zone of the first fibers **11** and the second fibers **12** extending along a length of the nonwoven textile **100** opposite to the base area **210**. The pile area **220** is an area of the first fibers **11** and the second fibers **12** with a first end **221** emerging from the base area **210**, a second end **222** emerging from the cover area **230**, and a middle section **223** between the first end **221** and the second end **222**, thereby making the pile area **220** a continuous sheet of material spacing apart the base material **210** and the cover material **230**.

[0014] In the pile area **120/220**, the first fibers **11** and the second fibers **12** are oriented between about 45° and about 90° from the planar direction of the nonwoven web **100/200**. In a preferred embodiment, the first fibers **11** and the second fibers **12** are oriented generally perpendicular to the planar direction of the nonwoven web **100/200** in the pile area **120/220**. The nonwoven web **100/200** is stabilized due to the fusing of various second fibers **12** with first fibers **11**.

[0015] Referring back now to **FIGS. 1 and 2**, the first fibers **11** comprise from about 30% to about 90% by weight of the nonwoven textile **100/200**, and the second fibers comprise from about 10% to about 70% by weight of the nonwoven textile **100/200**. In one embodiment, the first fibers **11** comprise from about 70% to about 90% by weight of the nonwoven textile **100/200**, and the second fibers

comprise from about 10% to about 30% by weight of the nonwoven textile **100/200**. In yet another embodiment, the first fibers **11** comprise about 80% by weight of the nonwoven textile **100/200**, and the second fibers comprise about 20% by weight of the nonwoven textile **100/200**.

[**0016**] The first fibers **11** are typically staple polyester fibers formed of standard polyester staple fibers of between about 1 and about 18 denier per filament. In one embodiment, the first fibers **11** have a denier per filament of about 6 or about 15 depending on the application or desired final qualities of the nonwoven textile **100/200**. In yet another embodiment, all or a portion of, the first fibers **11** are of hollow-fil makeup to impart additional cushion to the nonwoven textile **100/200**. It is also contemplated that the first fibers **11** can be a blend of different fibers formed from different materials.

[**0017**] The second fibers **12** are formed of a material having a lower melting point than the material of the first fibers **11**. Also, the second fibers **12** have a melting point above the mold temperature that the nonwoven textile **100/200** will experience in a subsequent molding process. In one embodiment where the first fibers **11** are staple polyester fibers formed of standard polyester, the second fibers **12** can be staple polyester fibers formed of blend such as a blend of an aliphatic group with polyester. In another embodiment, the second fibers **12** can be a multi-component, such as a core and sheath fiber, with one of the components (such as the sheath) having a melt temperature lower than the material of the first fibers **11**. It is also contemplated that the second fibers **12** can be a blend of different fibers formed from different materials. The second fibers **12** are typically staple fibers of between about 1 and about 18 denier per filament. In one embodiment, the second fibers **12** have a denier per filament of about 3.

[**0018**] The nonwoven textiles**l00/200** are of the type that can be used as a backing for materials such as textile face materials, or in certain applications the base area **110/210** and/or the cover area **230** can be used as the face material. In embodiments where the nonwoven textile **100/200** are used as a backing material, the base area **110/210** and/or the cover area **230** are typically formed with a stitch gauge of from about 12 gauge to about 30 gauge. In an embodiment where the base area **110/210** and/or the cover area **230** are used as the face material; they are typically formed with a stitch gauge of at least about 30 gauge, usually from about 30 gauge to about 64 gauge.

[**0019**] The nonwoven textiles **100/200** can be molded in a subsequent process at a mold temperature below the melt temperature of the second fibers **12**, without substantial degradation of the resilience of the nonwoven textile **100/200**. When the first fibers **11** and the second fibers **12** of the nonwoven textile **100/200** are both polyester, the nonwoven textiles **100/200** are more readily recyclable.

[**0020**] In one embodiment, the nonwoven textile**l00/200** has a thickness of from about 2 mm to about 20 mm and a density of from about 50 g/m^2 to about 800 g/m^2. In an embodiment for use in a panel application such as automotive headliners, the nonwoven textile **100/200** can have a thickness of from about 2 mm to about 5 mm, and a density of from about 100 g/m^2 to about 300 g/m^2. In an embodiment for use in a cushion application such as upholstry, the nonwoven textile **100/200** can have a thickness for from about 3 mm to about 15 mm, and a density of from about 100 g/m^2 to about 500 g/m^2.

[**0021**] A method of forming the nonwoven web **100** of **FIG. 1** is illustrated in **FIG. 3** as the process **500**. The process **500** generally includes the steps of combining fibers **510**, positioning the combined fibers into a web **520**, forming the base area and pile area **530**, heating the nonwoven textile **550**, and cooling the nonwoven textile **550**.

[**0022**] The step of combining fibers **510**, includes combining the first fibers **11** and the second fibers **12**. The first fibers **11** have a higher melting point than the second fibers **12**. Additionally, the second fibers **12** have a melting point higher than the mold temperature of a subsequent molding process. In one embodiment, the first fibers **11** are formed of a standard polyester, and the second fibers **12** are formed of a lower melt temperature polyester, such as a blend of an aliphatic group and polyester. The first fibers **11** and the second fibers **12** are combined in a ratio such that the first fibers **11** comprise from about 30% to about 90% by weight of the nonwoven textile **100/200**, and the second fibers comprise from about 10% to about 70% by weight of the combination. In one embodiment, the first fibers **11** comprise from about 70% to about 90% by weight of combination, and the second fibers comprise from about 10% to about 30% by weight of the combination. In yet anotherembodiment, the first fibers **11** comprise about 80% by weight of the combination, and the second fibers comprise about 20% by weight of the combination. The first fibers **11** and the second fibers **12** are between about 1 and about 18 denier. In one embodiment, the first fibers **11** have a denier per filament of about 6 or about 15, depending on the application or desired final qualities of the combination, and the second fibers **12** have a denier per filament of about 3. Additionally, all, or a portion of, the first fibers **11** can be of a hollow-fil makeup to impart additional cushion in the nonwoven textile **100/200**.

[**0023**] In the positioning step **520**, the combined first fibers **11** and second fibers **12** are positioned into a planar layer or web by carding or the like. In the web, the fibers are generally linear to the machine direction of the web.

[**0024**] After the first fibers **11** and the second fibers **12** are positioned into the planar web, the base area **110** and the pile area **120** is formed from the web. The base area and pile area are formed with a row of knitting needles. The planar web is brought over the knitting needles to form a pile loop. The knitting needles retract to pull a lower portion of the planar web into a knit loop for forming the base area **110** of knitted nonwoven material and the knitted material is moved forward. After the knitted loop is formed and the knitted material is moved forward, the needles are extended and the process is repeated beginning with bringing the nonwoven web over the knitting needles to form another pile loop. This process is repeated until the desired length of the textile is formed.

[**0025**] After the base area **110** and pile area **120** are formed, the textile is heated to a temperature above the melting point of the second fibers **12** in the heating step **550**. The heating step causes the second fibers **12** to fuse with the first fibers **11**. Preferably, the textile is not heated above the melting point of the first fibers **11**. When the first fibers **11** are formed of a standard polyester, the temperature of the

heating step **550** typically does not exceed 230° C. In an embodiment where the first fibers **11** are formed of standard polyester, and the second fibers **12** are formed of a blend such as a blend of an aliphatic group and polyester, the textile is heated to a temperature between about 115° C. and about 230° C., and preferably between about 160° C. and about 200° C.

[**0026**] After the textile is heated to fuse the second fibers **12** with the first fibers **11**, the textile is cooled in the cooling step **560** to a temperature below the melting point of the second fibers **12**, thereby forming the nonwoven textile **100**.

[**0027**] A method of forming the nonwoven web **200** of **FIG. 2** is illustrated in **FIG. 4** as the process **600**. The process **600** generally includes the steps of combining fibers **610**, positioning the combined fibers into a web **620**, forming the base area and pile area **630**, forming the cover area **640**, heating the nonwoven textile **650**, and cooling the nonwoven textile **660**. The combining step **610**, positioning into a web step **620**, and forming the base area and pile area step **630** in forming the nonwoven textile **200** are each the same as the corresponding steps **510**, **520**, and **530** in forming the nonwoven textile **100**.

[**0028**] In the step **640** of forming the cover area **230**, a row of needles engage the tops of the pile loops formed from the nonwoven web. The knitting needles retract to draw a portion of the nonwoven material into a knitted loop for forming the cover area **230**, and then the textile material is moved forward. After the knitted loop is formed and the material is moved forward, the needles are extended to repeat the process. The process is repeated until the cover area **230** is formed over the desired length of the textile. The needle density, needle stroke length, needle movement, and/or other techniques known in the knitting industry can be varied to achieve different properties in the cover area **230** as compared to the base area **210**.

[**0029**] A nonwoven textile **100**/**200** formed from the process **500**/**600** with a polyester material, will typically permit a molding operation using a temperature between about 115° C. and about 220° C., and retain the ability to return to its orignial thickness. In one embodiment, the nonwoven textile **100**/**200** will retain the ability to return to its original thickness after being subjected to a molding process with a mold temperature from about 140° C. to about 170° C.

[**0030**] In one example of the present invention, a nonwoven web was formed from first fibers being a blend of KOSA T-209 and T-210 polyester fibers, and second fibers of a KOSA T-252 polyester. The first fibers are a blend of 50% by total weight of the T-209 polyester staple fibers with a size of 6 denier per filament, and 50% by total weight of the T-210 polyester staple with a size of 15 denier per filament. The second fibers are the T-252 polyester staple fibers with a size of 3 denier per filament. The first fibers and the second fibers are combined with a ratio of 80% of total weight the first fibers and 20% by total weight of the second fibers. These fibers were formed by the processes of the present invention specified above into a nonwoven textile having a base area of 14 gauge, a cover area of about 22 gauge, and a overall thickness of about 3 mm.

What is claimed is:

1. A nonwoven textile for use in a molding process having a mold temperature, said nonwoven textile comprising:

a plurality of first fibers having a first fiber melt temperature, the first melt temperature being greater than the mold temperature;

a plurality of second fibers having a second fiber melt temperature being lower than the first fiber melt temperature of said first fibers and greater than the mold temperature;

wherein a first plurality of said first fibers and said second fibers are secured together in a base area and a second plurality of said first fibers and said second fibers extend from said base area as a pile area; and

wherein said first fibers and said second fibers are bonded together into a planar textile.

2. The nonwoven textile according to claim 1, wherein said first plurality of said first fibers and said second fibers in said base area are secured together with knitted loops of said first plurality of first fibers and second fibers.

3. The nonwoven textile according to claim 2, wherein the knitted loops of said base area have a stitch gauge of from about 12 gauge to about 30 gauge.

4. The nonwoven textile according to claim 2, wherein the knitted loops of said base area have a stitch gauge of from about 30 gauge to about 60 gauge.

5. The nonwoven textile according to claim 2, wherein the knitted loops of said base area have a stitch gauge of about 30 gauge or greater.

6. The nonwoven textile according to claim 1, wherein said second plurality of said first fibers and said second fibers in said pile area are oriented about 45 and about 90 from the planar direction of the nonwoven textile.

7. The nonwoven textile according to claim 1, wherein said second plurality of said first fibers and said second fibers in said pile area are oriented about perpendicular to the planar direction of the nonwoven textile.

8. The nonwoven textile according to claim 1, wherein said first fibers comprise from about 30% to about 90% of the total weight of the nonwoven textile.

9. The nonwoven textile according to claim 1, wherein said first fibers comprise from about 70% to about 90% of the total weight of the nonwoven textile.

10. The nonwoven textile according to claim 1, wherein said first fibers comprise about 80% of the total weight of the nonwoven textile.

11. The nonwoven textile according to claim 1, wherein said second fibers comprise from about 10% to about 70% of the total weight of the nonwoven textile.

12. The nonwoven textile according to claim 1, wherein said second fibers comprise from about 10% to about 30% of the total weight of the nonwoven textile.

13. The nonwoven textile according to claim 1, wherein said second fibers comprise about 20% of the total weight of the nonwoven textile.

14. The nonwoven textile according to claim 1, wherein said first fibers and said second fibers are formed of the same based material.

15. The nonwoven textile according to claim 14, wherein said first fibers and said second fibers are both a polyester based material.

16. The nonwoven textile according to claim 15, wherein the second fibers are a blend of an aliphatic group and polyester.

17. The nonwoven textile according to claim 1, wherein said first fibers are between about 1 denier per filament and about 18 denier per filament.

18. The nonwoven textile according to claim 1, wherein said first fibers are about 6 denier per filament.

19. The nonwoven textile according to claim 1, wherein said first fibers are about 15 denier per filament.

20. The nonwoven textile according to claim 1, wherein said first fibers are hollow.

21. The nonwoven textile according to claim 1, wherein said first fibers are a blend of different fibers formed from different materials.

22. The nonwoven textile according to claim 1, wherein said second fibers are between about 1 denier per filament and about 18 denier per filament.

23. The nonwoven textile according to claim 1, wherein said second fibers are about 3 denier per filament.

24. The nonwoven textile according to claim 1, wherein the second fibers are a multicomponent fiber, with at least one of the components being the portion of the second fiber,having the second melt temperature.

25. The nonwoven textile according to claim 1, wherein said second fibers are a blend of different fibers formed from different materials.

26. The nonwoven textile according to claim 24, wherein said second fibers have a core and a sheath, and wherein the component of the second fibers having the second melt temperature is the sheath.

27. The nonwoven textile according to claim 1, further including a third plurality of first fibers and second fibers being secured together as a cover area on the opposite end of the pile area from the base area.

28. The nonwoven textile according to claim 27, wherein said first plurality of said first fibers and said second fibers in said base area are secured together with knitted loops of said first plurality of first fibers and second fibers.

29. The nonwoven textile according to claim 28, wherein the knitted loops of said base area have a stitch gauge of from about 12 gauge to about 30 gauge.

30. The nonwoven textile according to claim 28, wherein the knitted loops of said base area have a stitch gauge of about 30 gauge or greater.

31. The nonwoven textile according to claim 28, wherein the knitted loops of said base area have a stitch gauge of from about 30 gauge to about 60 gauge.

32. The nonwoven textile according to claim 27, wherein said third plurality of said first fibers and said second fibers in said cover area are secured together with knitted loops of said third plurality of first fibers and second fibers.

33. The nonwoven textile according to claim 32, wherein the knitted loops of said base area have a stitch gauge of from about 12 gauge to about 30 gauge.

34. The nonwoven textile according to claim 32, wherein the knitted loops of said base area have a stitch gauge of about 30 gauge or greater.

35. The nonwoven textile according to claim 32, wherein the knitted loops of said base area have a stitch gauge of from about 30 gauge to about 60 gauge.

36. The nonwoven textile according to claim 27, wherein said second plurality of said first fibers and said second fibers in said pile area are oriented about 45 and about 90 from the planar direction of the nonwoven textile.

37. The nonwoven textile according to claim 27, wherein said second plurality of said first fibers and said second fibers in said pile area are oriented about perpendicular to the planar direction of the nonwoven textile.

38. The nonwoven textile according to claim 27, wherein said first fibers comprise from about 30% to about 90% of the total weight of the nonwoven textile.

39. The nonwoven textile according to claim 27, wherein said first fibers comprise from about 70% to about 90% of the total weight of the nonwoven textile.

40. The nonwoven textile according to claim 27, wherein said first fibers comprise about 80% of the total weight of the nonwoven textile.

41. The nonwoven textile according to claim 27, wherein said second fibers comprise from about 10% to about 70% of the total weight of the nonwoven textile.

42. The nonwoven textile according to claim 27, wherein said second fibers comprise from about 10% to about 30% of the total weight of the nonwoven textile.

43. The nonwoven textile according to claim 27, wherein said second fibers comprise about 20% of the total weight of the nonwoven textile.

44. The nonwoven textile according to claim 27, wherein said first fibers and said second fibers are formed of the same based material.

45. The nonwoven textile according to claim 44, wherein said first fibers and said second fibers are both a polyester based material.

46. The nonwoven textile according to claim 45, wherein the second fibers are a blend of an aliphatic group and polyester.

47. The nonwoven textile according to claim 27, wherein said first fibers are between about 1 denier per filament and about 18 denier per filament.

48. The nonwoven textile according to claim 27, wherein said first fibers are about 6 denier per filament.

49. The nonwoven textile according to claim 27, wherein said first fibers are about 15 denier per filament.

50. The nonwoven textile according to claim 27, wherein said first fibers are hollow.

51. The nonwoven textile according to claim 27, wherein said first fibers are a blend of different fibers formed from different materials.

52. The nonwoven textile according to claim 27, wherein said second fibers are between about 1 denier per filament and about 18 denier per filament.

53. The nonwoven textile according to claim 27, wherein said second fibers are about 3 denier per filament.

54. The nonwoven textile according to claim 27, wherein the second fibers are a multicomponent fiber, with at least one of the components being the portion of the second fiber having the second melt temperature.

55. The nonwoven textile according to claim 54, wherein said second fibers have a core and a sheath, and wherein the component of the second fibers having the second melt temperature is the sheath.

56. The nonwoven textile according to claim 27, wherein said second fibers are a blend of different fibers formed from different materials.

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