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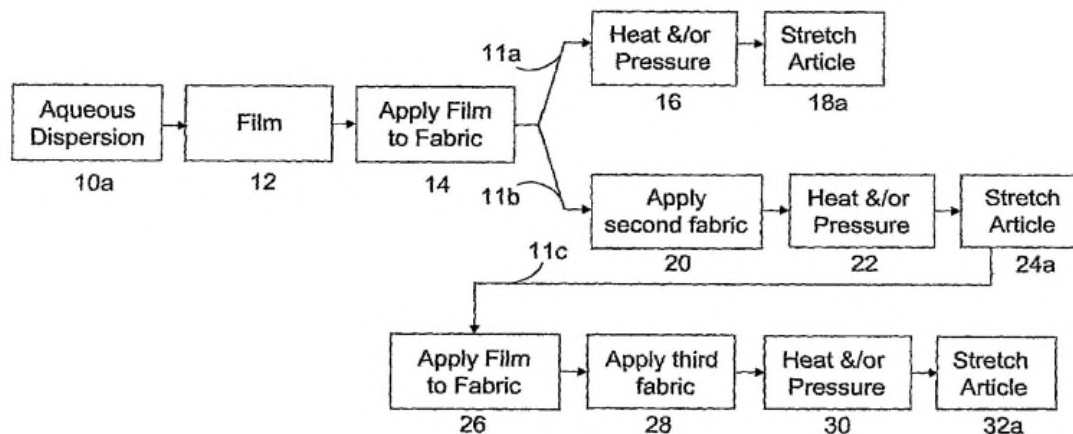
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SOLVENT FREE AQUEOUS POLYURETHANE DISPERSIONS AND SHAPED ARTICLES THEREFROM



(57) Abstract: An article comprising an adhesive, a stretch member and a substrate wherein the adhesive is used to attach the stretch member to the fabric in a folded hem arrangement. The adhesive can be a tape made from an aqueous polyurethane dispersion and the stretch member can be a spandex fiber.

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**INTERNATIONAL SEARCH REPORT**

International application No  
**PCT/US2006/004894**

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>				
INV. C08G18/12	C08G18/08	C08G18/48	C08G18/76	B32B27/08
B32B27/12	B32B27/40	C09J175/00	C09J7/02	

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
**C08G B32B C09J A41D**

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**EPO-Internal, WPI Data, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 308 115 A (POLYVINYL CHEMIE HOLLAND B.V; ICI RESINS BV) 22 March 1989 (1989-03-22) page 3, lines 10-17; example 12	1-68, 81-85,89
A	EP 1 431 321 A (IMPERIAL CHEMICAL INDUSTRIES PLC) 23 June 2004 (2004-06-23) example B	1-68, 81-85,89
A	EP 0 220 000 A (POLYVINYL CHEMICALS INC; ZENECA INC) 29 April 1987 (1987-04-29) examples 2,B	1-68, 81-85,89
A	WO 99/50329 A (THE DOW CHEMICAL COMPANY; TABOR, RICK, L; WILLKOMM, WAYNE, R) 7 October 1999 (1999-10-07) claim 1; example 1	1-68, 81-85,89
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Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

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## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/004894

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2004/074343 A (DOW GLOBAL TECHNOLOGIES INC; THIEDE, VERENA; LOPEZ, NETZA, B; PELLACAN) 2 September 2004 (2004-09-02) example 1	1-68, 81-85,89
X	US 3 560 292 A (OTTO BUTTER) 2 February 1971 (1971-02-02) figure 3 column 2, lines 57-59 column 2, lines 34-36	69-80
X	US 3 828 367 A (BOURGEOIS A,FR) 13 August 1974 (1974-08-13) figure 2 column 5, lines 42-44 column 4, lines 39-43	69-80
X	EP 0 708 163 A (TOYO CLOTH CO., LTD; TOYO KNITTING CO., LTD) 24 April 1996 (1996-04-24) claim 1; figure 2	69-80
X	US 2005/022920 A1 (FOWLER RICK) 3 February 2005 (2005-02-03) paragraphs [0052] - [0056]; figure 2	69-80
P,X	EP 1 604 807 A (MACPI S.P.A. PRESSING DIVISION) 14 December 2005 (2005-12-14) paragraph [0020]; figures 23,34	69,70, 72-80
P,X	EP 1 609 832 A (VAN DE VELDE NV) 28 December 2005 (2005-12-28) claim 1; figure 1	69,70, 72-80
X	WO 2004/098333 A (BHA TECHNOLOGIES, INC; WILSON, FREDERIC, T; KING, CLARE; BASTIANELLI,) 18 November 2004 (2004-11-18) page 12, line 30 - page 13, line 26; figure 2	86-88
X	US 2002/160259 A1 (KINN LARRY L ET AL) 31 October 2002 (2002-10-31) paragraphs [0038], [0039]; example 2; table 1	86,88
X	US 6 018 819 A (KING ET AL) 1 February 2000 (2000-02-01) column 4, line 44 - column 5, line 1; figure 10	86,88
X	US 6 245 695 B1 (MARUO KATSUYA ET AL) 12 June 2001 (2001-06-12) column 21, lines 65-67; claim 7	86,88
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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2006/004894

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 1 619 018 A (MC TECH GROUP, INC) 25 January 2006 (2006-01-25) paragraphs [0034], [0062]; figure 1; table 1 -----	86,87
X	GB 795 523 A (THE BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION) 28 May 1958 (1958-05-28) claim 1 -----	90
X	US 2004/065445 A1 (ABERCROMBIE SIMPSON NEIL ANDREW ET AL) 8 April 2004 (2004-04-08) paragraph [0072] -----	90
X	US 5 833 320 A (KANEKO ET AL) 10 November 1998 (1998-11-10) claims 18,19; figures 28,29 -----	90
X	US 2001/015141 A1 (ANDERSON D. W) 23 August 2001 (2001-08-23) paragraph [0009]; claim 1; figure 1 -----	90
X	US 2004/122411 A1 (HANCOCK-COOKE CATHERINE M) 24 June 2004 (2004-06-24) paragraph [0063]; figure 5 -----	90

Form PCT/ISA/210 (continuation of second sheet) (April 2005)



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2006/004894

## Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

## 1. claims: 1-68,81-85,89

Prepolymer prepared from a polyol (a), a mixture of 2,4' and 4,4'-MDI in a ratio of 65:35 - 35:65 (b) and a diol comprising a carboxylic acid group (c). The prepolymer is solvent-free (claims 1-11). Process for making the prepolymer comprising combining components (a)-(c) in a solvent-free system (claims 12-16), a solvent-free aqueous polyurethane dispersion comprising said prepolymer and a monofunctional dialkyl amine compound (e)(claims 17-28), the process for making a solvent-free aqueous polyurethane dispersion comprising said prepolymer (claims 29-32), the shaped article derived from said solvent-free aqueous dispersion (claims 33-35,59-65,81-85,89), an article comprising said shaped article (claims 36,37,40-50), a garment comprising said article (claims 38,39,51,52), an article comprising a substrate coated with said aqueous dispersion (claims 53,55,56,66-68), the process for forming the article of claim 53 (claim 54), a garment comprising the molded article comprising a substrate coated with said aqueous dispersion (claims 57,58).

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## 2. claims: 69-80

An article comprising an adhesive, a stretch member and a substrate, wherein the adhesive is used to attach the stretch member to the substrate in a folded hem arrangement (claim 69-74), a method of making the article of claim 69 (claims 75,76) and a garment comprising the article of claim 69 (claims 77-80).

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## 3. claims: 86-88

A laminate comprising an article and a substrate characterized by parameters (AATCC-150-2001, ASTM E96-00, ASTM d737-96)(claims 86-88).

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## 4. claim: 90

An article comprising a shaped article wherein the article has a modulus and a length, said modulus varies along the length of the article (claim 90).

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/004894

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 0308115	A	22-03-1989	CA 1341075 C	08-08-2000
			DE 3876557 D1	21-01-1993
			DE 3876557 T2	15-04-1993
			ES 2053749 T3	01-08-1994
			JP 1104651 A	21-04-1989
			JP 2726679 B2	11-03-1998
			MX 169506 B	08-07-1993
			US 5137961 A	11-08-1992
			EP 1431321	A
AU 2003293711 A1	09-07-2004			
BR 0316679 A	11-10-2005			
CA 2505404 A1	01-07-2004			
CN 1729222 A	01-02-2006			
DE 60300454 D1	04-05-2005			
DE 60300454 T2	01-09-2005			
WO 2004055086 A1	01-07-2004			
ES 2239297 T3	16-09-2005			
GB 2397578 A	28-07-2004			
MX PA05005688 A	26-07-2005			
PT 1431321 T	29-07-2005			
US 2005256252 A1	17-11-2005			
EP 0220000	A	29-04-1987		
			AU 6312086 A	09-04-1987
			BR 8604816 A	07-07-1987
			CA 1289967 C	01-10-1991
			DE 3689604 D1	17-03-1994
			DE 3689604 T2	13-10-1994
			JP 2537499 B2	25-09-1996
			JP 62109813 A	21-05-1987
			NZ 217701 A	29-05-1989
			US 4801644 A	31-01-1989
			WO 9950329	A
AU 746676 B2	02-05-2002			
AU 3460699 A	18-10-1999			
BR 9909425 A	21-11-2000			
CA 2326523 A1	07-10-1999			
CN 1125840 C	29-10-2003			
DE 69901893 D1	25-07-2002			
DE 69901893 T2	09-01-2003			
DK 1066333 T3	14-10-2002			
EP 1066333 A1	10-01-2001			
ES 2175964 T3	16-11-2002			
JP 2002509959 T	02-04-2002			
PL 343513 A1	27-08-2001			
PT 1066333 T	30-09-2002			
TR 200003617 T2	21-06-2001			
TW 487714 B	21-05-2002			
ZA 200005145 A	23-08-2001			
WO 2004074343	A	02-09-2004	BR PI0406962 A	10-01-2006
			CA 2516024 A1	02-09-2004
			CN 1747980 A	15-03-2006
			EP 1592727 A1	09-11-2005
			MX PA05008585 A	04-11-2005

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/004894

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3560292	A	02-02-1971	DE 1610765 A1 18-02-1971
			FR 1552418 A 03-01-1969
			GB 1198367 A 15-07-1970
US 3828367	A	13-08-1974	DE 2146808 A1 10-08-1972
			FR 2112075 A5 16-06-1972
			GB 1356603 A 12-06-1974
EP 0708163	A	24-04-1996	AU 2040295 A 02-05-1996
			JP 8120231 A 14-05-1996
US 2005022920	A1	03-02-2005	US 2003138586 A1 24-07-2003
EP 1604807	A	14-12-2005	CN 1706297 A 14-12-2005
			US 2005274460 A1 15-12-2005
EP 1609832	A	28-12-2005	BE 1016082 A3 07-02-2006
WO 2004098333	A	18-11-2004	CA 2534755 A1 18-11-2004
			CN 1791338 A 21-06-2006
			EP 1622475 A2 08-02-2006
			US 2004216332 A1 04-11-2004
US 2002160259	A1	31-10-2002	NONE
US 6018819	A	01-02-2000	NONE
US 6245695	B1	12-06-2001	WO 9840438 A1 17-09-1998
EP 1619018	A	25-01-2006	NONE
GB 795523	A	28-05-1958	NONE
US 2004065445	A1	08-04-2004	NONE
US 5833320	A	10-11-1998	NONE
US 2001015141	A1	23-08-2001	US 6257133 B1 10-07-2001
US 2004122411	A1	24-06-2004	AU 2003270586 A1 29-07-2004
			EP 1578326 A1 28-09-2005
			MX PA05005886 A 29-08-2005
			WO 2004060235 A1 22-07-2004





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13/842,365 15 March 2013 (15.03.2013) US
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- (72) **Inventors:** WALVIUS, Susan; 169 Captain Lowman Road, Chapin, South Carolina 29063 (US). MARCINIAK, Michelle; 127 Landstone Circle, Irmo, South Carolina 29063 (US).
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KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

**Published:**

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(54) **Title:** BEDDING AND SLEEPWEAR

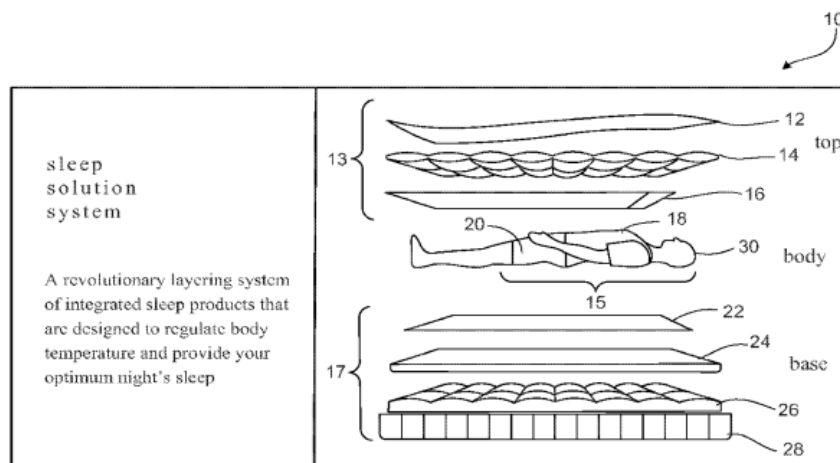


FIG. 1

(57) **Abstract:** A first item of sleepwear or bedding is to be used as part of a sleep system and a second item of sleepwear or bedding is to be used with the first item as part of the sleep system. At least one of the first item and second item comprises a performance fabric. The first item dissipates moisture and heat from a body of a user from an inside of the first item to an outside of the first item. The second item dissipates moisture and heat that has been dissipated by the first item.

WO 2014/150901 A1

## BEDDING AND SLEEPWEAR

### BACKGROUND

5 This description relates to bedding and sleepwear.

The quality of the experience of being in bed (for example, sleeping) is affected by the nature of the sleepwear being worn and of the bedding on the bed.

Typical sleepwear is designed to be fashionable and constructed of materials (for example, cotton or blends of cotton) that look good, wear well, can be cleaned  
10 easily, and feel good against the skin.

Typical bedding also is designed to be fashionable and is made of materials that look good, wear well, and can be cleaned easily. Some items of bedding, such as bed sheets and pillow cases are also made of materials that feel good against the skin. Other items of bedding, such as mattress pads, gel pads, blankets, comforters, and duvets are  
15 designed to exhibit other properties, such as softness, size, loft, warmth, shape, and absorption.

Although the general view has been that imparting warmth to the user should be a primary function of sleepwear and bedding, novel bed sheets and pillowcases marketed by SHEEX, Inc., of Irmo, South, Carolina, are made of performance fabrics  
20 that are designed to do a better job of keeping the user cool, breathing, wicking moisture, and stretching .

### SUMMARY

In general, in an aspect, a combination includes first item of sleepwear or  
25 bedding to be used as part of a sleep system and a second item of sleepwear or bedding to be used with the first item as part of the sleep system. At least one of the first item and second item comprises a performance fabric. The first item dissipates moisture and heat from a body of a user from an inside of the first item to an outside of the first item. The second item dissipates moisture and heat that has been dissipated by the first item.

Implementations may include one or more of the following features. Both the first item and the second item comprise performance fabrics. The performance fabric comprises a knitted fabric. The performance fabric comprises a man-made fiber. The performance fabric comprises a gauge of at least the gauge values referred to in the patent applications incorporated above. At least one of the first item and second item  
5 comprises an item of sleepwear, and the item of sleepwear is close-fitting. At least one of the first item and second item is to be in contact with the user's skin. The item that is in contact with the user's skin comprises an item of sleepwear. The first item is in contact with skin of the user, and the second item is in contact with the first item. The  
10 item comprises sleepwear that is sized and shaped for a female user. The item comprises sleepwear that is sized and shaped for a male user.

The item comprises a bed sheet. The item comprises a pillow case. The item comprises a blanket. The item comprises a comforter. The item comprises a duvet cover. The item comprises a blanket. The item comprises a gel topper. The item  
15 comprises a mattress pad. The item comprises a mattress pad topper. The item comprises a pillow.

The item comprises a V-neck tee. The item comprises a cami adjustable tank. The item comprises a sleep bra. The item comprises a racer back tank. The item comprises a Capri pant. The item comprises a boxer short. The item comprises a boy  
20 short. The item comprises a gym sleep short. The item comprises a fold over pant. The item comprises at least one of a cap sleeve tunic, nightie, romper, sleep Henley, hooded robe, double strap tank, V-neck sleep tank dress, V-neck sleep dress, perfect tank, yoke legging, drawstring pants, pajama shorts with tiered hem, pocket tee and short pajama short set, and long sleeve cover up. The item comprises at least one of a tank, a  
25 colorblock tee, sleeveless v-tee, v-tee, hoody, Henley, paneled long sleeve cover up, long robe, long pant, long short, boxer, paneled boxer short, drawstring short, drawstring pant, and boxer brief.

The item of sleepwear comprises fashion-related elements. The item of sleepwear comprises compression elements. The item of sleepwear comprises mesh  
30 elements. At least one of the items comprises a base item. At least one of the items comprises a top item. The first item and the second item comprise items of sleepwear that are layered one on the other. The first item and the second item comprise items of

bedding that are layered one on the other. There is a third item of sleepwear or bedding; one of the items comprises a base item of bedding, one of the items comprises an item of sleepwear, and one of the items comprises a top item of bedding.

Three is also packaging to contain both the first item in the second item. The  
5 packaging comprises information about the use of the first item in the second item in a sleep system. The first item and the second item are displayed in close proximity to one another for purchase by the user.

In general, in an aspect, an item of sleepwear is close fitting and comprises a knitted performance fabric.

10 Implementations may include one or more of the following features. The item of sleepwear comprises stitched together pieces of the knitted performance fabric. The item of sleepwear comprises fashion elements. The item is to be in contact with the user's skin. The item is sized and shaped for a female user. The item is sized and shaped for a male user.

15 The item comprises a V-neck tee. The item comprises a cami adjustable tank. The item comprises a sleep bra. The item comprises a racer back tank. The item comprises a Capri pant. The item comprises a boxer short. The item comprises a boy short. The item comprises a gym sleep short. The item comprises a fold over pant. The item comprises at least one of a cap sleeve tunic, nightie, romper, sleep Henley, hooded  
20 robe, double strap tank, V-neck sleep tank dress, V-neck sleep dress, perfect tank, yoke legging, drawstring pants, pajama shorts with tiered hem, pocket tee and short pajama short set, and long sleeve cover up. The item comprises at least one of a tank, a colorblock tee, sleeveless v-tee, v-tee, hoody, Henley, paneled long sleeve cover up, long robe, long pant, long short, boxer, paneled boxer short, drawstring short,  
25 drawstring pant, and boxer brief. The item comprises compression elements. The item comprises mesh elements. The item comprises sleeve pieces. The item comprises leggings.

The item is a bedding item that comprises at least two joined pieces of a performance fabric. The performance fabric comprises a knit fabric. The item is a  
30 sleepwear item that comprises pieces joined by flat lock seaming. The item is a sleepwear item that comprises pieces joined by flat seaming. The item is a sleepwear item that comprises flat lock hems. The item is a sleepwear item that comprises mesh



inserts. The item is a sleepwear item that comprises a logo. The item is a sleepwear item that comprises logo elastic trim. The item is a sleepwear item that comprises color block designs.

In general, in an aspect, a combination includes first item of sleepwear or bedding to be used as part of a sleep system and a second item of sleepwear or bedding to be used with the first item as part of the sleep system. At least one of the first item and second item comprises a performance fabric, and a retail package holds both the first item and the second item for sale at retail.

In general, in an aspect, a combination includes a retail display device on which are displayed a first item of sleepwear or bedding to be used as part of a sleep system and a second item of sleepwear or bedding to be used with the first item as part of the sleep system. An informational device informs a purchaser that the first item and the second item are to be used together as part of the sleep system.

In general, in an aspect, heat and moisture are dissipated from a body of a person who is in bed by dissipating heat and moisture from the person's skin through a close-fitting sleepwear item made of a performance knit fabric of at least xxx gauge and dissipating the heat and moisture from outside the sleepwear through a bedding item made of a performance knit fabric of at least the gauge values referred to in the patent applications incorporated above.

These and other aspects, features, and implementations, and combinations of them can be expressed as methods, apparatus, systems, components, means and steps for performing functions, and in other ways.

Other features and advantages will be apparent from the following description and from the claims.

25

## DESCRIPTION

Figure 1 is a schematic exploded perspective side view of a sleep system environment.

Figure 2 is an illustration of a sleep system environment.

Figures 3A – 46 are front and back views of sleepwear.

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Figure 47 is a pattern for a sleepwear garment.

Figure 48 is a pattern for a performance fitted sheet.

Figure 49 is a pattern for a performance top sheet.

Figure 50 is a pattern for a performance pillowcase.

Figure 51 is a perspective view of a retail package.

Figure 52 is a perspective view of a retail display stand.

5 Here we describe ways of designing, patterning, constructing, and marketing individual items of bedding, individual items of sleepwear, and combinations of items of bedding and items of sleepwear, in a way that intends them to be used and to work together as what we call a system. The system achieves particular functional and environmental effects to make being in bed can be made more pleasant, restful,  
10 comfortable, and satisfying. Among other things, by the selection of fabrics, patterns, and other characteristics of the items of bedding and sleepwear, the combinations of bedding and sleepwear items in the system can achieve controlled thermal, breathing, and wicking qualities. The qualities help to regulate body temperature and moisture to promote deeper and more restorative sleep, for example. The system can yield a total,  
15 personalized system that offers good feel, fit, temperature control, breathability, moisture transport, and durability.

We use the terms sleep, or sleeping, or sleep system sometimes for convenience to refer broadly to any kind of activity associated with being in bed, whether active or sedentary, including, resting, reading, talking, sleeping, convalescing, and others.

20 In some implementations, the system involves using a combination of unique breathable performance fabric bedding with breathable performance fabric sleepwear constructed of a high-gauge circular-knit performance fabric. In these implementations, this fabric provides performance attributes that are beneficial to the user, including breathability, moisture transport, and heat transfer. The unique construction of the  
25 performance fabrics enables the movement of air, heat and moisture through the material from one surface to the opposite surface, for example, to a much greater degree than cotton would allow.

Referring to figure 1, a sleep system 10 (as mentioned earlier we use the word sleep as a very broad proxy for any kind of activity that may go on in bed) can include  
30 any two or more bedding or sleepwear items 12, 14, 16, 18, 20, 22, 24, 26, and 28, that work together to make a person 30 who is in the bed, drier, cooler, more comfortable, and more relaxed. In some implementations, at least one of the items of the system is an

item of sleepwear 18, 20, and a second item is an item of bedding 12, 14, 16, 22, 24, 26, or 28. In some implementations, the items in the system are all items of bedding or all items of sleepwear. The items of the system can be categorized as top items 13 (including items 12, 14, and 16) that are positioned above the user, base items 17  
5 (including items 22, 24, 26, and 28) that are located below the user, and sleepwear items 19 (including items) 18 and 20 that are worn by the user.

The items of a given system are designed to work together to provide excellent body-heat dissipation that is critical in maintaining consistently optimized thermal conditions for better sleep. In some implementations of the system, each component's  
10 contribution to improved comfort for the user is optimized.

The sleepwear items 18, 20 are designed to be in close contact with the skin over a substantial part of the item that is worn on the body of the user 15 of the sleep system. In general, the sleepwear items are designed not to provide air space or air pockets between the skin of the user and the items. The air in such spaces tends to heat  
15 up from the user's body and inhibit the dissipation of heat and water vapor from the user's skin. By designing the sleepwear items to be in contact with the user's skin, moisture wicking and heat dissipation are achieved.

Therefore, in some implementations, the sleepwear items are form-fitting. A form-fitting garment is an article of clothing that, for example, follows the contours of  
20 the part of the body being covered. . Body heat and moisture are directed away from the skin with minimal tenting of the items.

The top components 13 are meant to drape over the user. Drape means, for example, to arrange loosely or casually over the user, e.g., the blankets and sheets are draped over the user. Top layer components may include sheets 16, comforters 14,  
25 duvet covers, blankets, and throws 12, among others. Any kind of bedding item can be designed and fabricated in a way to make it suitable and useful as a component of the system. One or any number of the top layer components may be used alone, or in conjunction with the sleepwear items. The top layer components provide moisture-transport and heat-transfer properties that supplement the moisture-transport and heat  
30 transfer properties of the sleepwear items. For example, in some implementations, heat and moisture that have been dissipated by the user's body through the sleepwear may be further dissipated through the top layer items and out into the ambient air. Therefore,

heat and moisture that are dissipated by the sleepwear are not then trapped in the space between the sleepwear and the top items, but can be further dissipated. The top layer items need not fit tightly around the user. Most users do not wrap themselves up tightly in their sheets and blankets. Tenting and the formation of some air pockets surrounding the user may occur between the top items and the sleepwear in normal use of the products by the user. When more than one top item is part of the system, each of them contributes to the dissipation of heat and moisture into the ambient air. The performance fabrics used for these items have qualities that contribute to this dissipation.

10 In some implementations, one or more of the base items are layered under the user. Base components of a given system may include any two or more of sheets 22, gel toppers 24, mattress pads 26, mattress pad toppers 18, pillows 30, and pillow cases 32. The base items may be used alone or in conjunction with sleepwear items and the top layer components. The base layer components provide moisture-transport and heat-  
15 transfer properties that enhance the moisture-transport and heat transfer properties of the sleepwear items and the top layer components. For example, in some implementations, heat and moisture that have been dissipated by the user's body through the sleepwear may be further dissipated through the base layer items and into the mattress from which they are eventually dissipated to the ambient air. Therefore,  
20 heat and moisture that are dissipated by the sleepwear are not then trapped in the space between the sleepwear and the base items, but can be further dissipated. When more than one base item is part of the system, each of them contributes to the dissipation of heat and moisture toward the mattress. The performance fabrics used for these items have qualities that contribute to this dissipation.

25 In addition to layering of top and base items, the sleepwear may be layered also by wearing two or more sleepwear items, one on top of another. Dissipation of heat and moisture through multiple layers provides similar benefits to the ones already described.

Referring to figure 2, the sleep system 10 is designed to be marketed to and  
30 used by both men 40 and women 42. Bedding components including top layer components and base layer components can be used by any user. Sleepwear components include garments with gender-specific elements designed to be either



female sleepwear 44 worn by a female user or male sleepwear 46 worn by a male user. Marketing images 45 such as the one shown in figure 2 are intended to illustrate and promote the use of a combination of performance sleepwear items and performance bedding items as part of a system of the kind that is the subject of our description.

5 All components in the system are able to improve environmental conditions for uninterrupted, better-quality sleep, and are effective when used in combination. Layering the bedding and sleepwear with the sleepwear in close contact to the skin provides a performance benefit.

An example of a female sleepwear item, a V-neck tee 50, designed to be worn  
10 by a female user as part of the sleep system is shown in figures 3A and 3B. The V-neck tee 50 has a front 51 as shown in figure 3A and a back 52 shown in figure 3B. The V-neck tee 50 has a neck 54, a body 66, and sleeves 65.

The neck 54 of the V-neck tee 50 takes the shape of a low V in the front part of the neck 55 and extends across the neck in a slightly curved manner across the back  
15 part of the neck 56. The neck has a logo band 57. The logo band color 59 may be the same color or a color contrasting to the body color 58 of the V-neck tee.

The length 60 of the V-neck tee may be such that the tee reaches, or is above or below the hip bone of the wearer. The width 62 of the tee is not uniform below where the sleeves 65 attach to the body of the shirt 66. Rather the width decreases and then  
20 increases along the length of the tee, creating curvature 63 meant to flatter the shape of the wearer and to promote contact between the performance fabric and the skin over a substantial portion of the area of the tee. The front 51 of the tee may contain a logo 70. The logo 70 may in a logo color 71 contrasting to the body color 58 of the V-neck tee.

The V-neck tee terminates in a shirt hem 75. The hem may be the same color as  
25 the neck 54, the same as the body color 58, or a different color. The hem is a flatlock hem. The stitch color 78 of the flatlock hem may be the same color as the neck 54, the body color 58, the shirt hem color 75 or a different color. The sleeves 65 also have sleeve hems 76. The sleeve hems 76 may be the same color as the neck 54, the body color 58, the shirt hem color 75 or a different color.

30 Thus, in some implementations of items of sleepwear, both functional features (close fitting, performance fabrics, for example) are combined with fashion features

(shape, size, colors, finish, neckline, and others). Similar combinations of functional and fashion features are illustrated by other examples discussed below.

Another example of a female sleepwear item, a cami adjustable tank 80, designed to be worn by a female user as part of the sleep system is shown in figures 5 4A, 4B, and 4C. The cami adjustable tank 80 has a front 81 as shown in figure 4A and a back 82 shown in figures 4B and 4C. The cami adjustable tank 80 has a body 83, straps 90, and a shelf bra 100.

The body 83 has a front length 84 and a back length 85. The back length 85 may be shorter than the front length 84. The front length 84 is the length from the bottom of the tank to the bottom of the neckline. The neckline at the front of the body 83 is not 10 straight across but rather has two points 86 at top. Width 87 of the cami adjustable tank is not constant along the front or back length 84, 85. Rather the width decreases and then increases along the length 84, 85, creating curvature 89 meant to flatter the shape of the wearer and increase the amount of direct contact between the fabric and the 15 user's skin. The body is of body color 88. The front 81 of the tee may contain a logo 70. The logo 70 may be in a logo color 71 contrasting to the body color 88 of the V-neck tee.

The cami adjustable tank 80 has at least one set of straps 90. The first set of straps 91 contains two straps that are attached symmetrically on either side at the top of 20 the back 82 of the tank and to the points 86 in front. The first set of straps has some uniform width 92. The straps contain an adjustment mechanism 94 which permits the shortening or lengthening of the effective length of the straps 91. Adjustment mechanism may be any adjustment mechanism known in the art. The straps are strap color 96.

25 As best seen in figure 4C, the cami adjustable tank 80 contains a shelf bra 100. The shelf bra is layered underneath the body 83 and has a second set of straps 102 of width 104 and color 105. Both sets of straps 91, 102 attach at the mesh trim 106 at the neck 107. The mesh trim 106 can be of color 108.

The bottom of the cami adjustable tank terminates in a tank hem 110. The hem 30 may be the same color as the mesh trim 108, the same as the body color 88, or a different color. The hem is a flat lock hem. The stitch color 112 of the flat lock hem may be the same color as the mesh trim 108, the body color 88, or a different color.

The front 81 and back 82 of the cami adjustable tank also sewn together along seams 114. Seams 114 are comfort flat seaming. Seam color 116 may be the same as body color 88, or a different color.

The cami adjustable slip dress 120 shown in front and back view in figure 5A and 5B is another example of a female sleepwear item. The cami adjustable slip dress 120 has many of the features of the cami adjustable tank 80. The front length 124 and back length 125 of the cami adjustable slip dress 120 is meant to fall lower than the user's hip. The front length 124 and back length 125 of the cami adjustable slip dress 120 can be such that the hem 130 falls between the wearer's hip and knee.

Another example of a female sleepwear item is a sleep bra 140. The front 141 is shown in figure 6A and back 142 in figure 6B. The front of sleep bra 140 has a length 144 which is the shortest length from the neck 145 to the hem 147. Symmetric around the neck 145 are two points 146 which attach to the straps 150 at the front. At the back the straps 150 have a common attachment point at the top of the center back. The length 145 is the back length from this point to the hem 147. Adjustable mechanism 154 in the strap permits the shortening or lengthening of the effective length of the straps. The straps are strap color 156.

The hem 147 has a logo satin band 158 containing logo 70. Sleep bra 140 is sewn together using comfort flat seaming. The colors of any of the parts may be the same, or different from each other.

Another example of a female sleepwear item is a racer back tank 160. Referring to figures 7A and 7B showing the front 161 and back 162, racer back tank 162 contains the logo 70 that may be located near the neck 164 or hem 168. The neck 164 of the racer back tank is curved, continuing seamlessly into straps 165. On the back, strap 165 arch together to form a single midline strap 166 in the racer back style.

Another example of a female sleepwear item is long pant 180. The long pant is shown in figures 8A and 8B. Length 184 causes the pant to fall at or around the wearer's ankle. The pant has a satin logo waistband 186 containing logo 70. The hem 188 has a mesh trim 189. Parts of long pant 180 are joined together by comfort flat seaming 190.

Capri pant 200 shown in figures 9A and 9B is similar to long pant 180, however the length 205 is chosen such that the hem 208 falls on or around the wearer's knee.

Boxer short 220 is shown in figures 10A and 10B. Its features are similar to the capri and long pant, however length 224 is such that the hem 228 falls on or around the wearer's crotch. Additionally the front 221 has a faux button detailing 230 just below the waistband 226.

5 Boyshort 240 is shown in figures 11A and 11B. Its features are similar to the capri and long pant, however length 224 is such that the hem 228 falls on or around the wearer's crotch.

Gym sleep short 260 is shown in figures 12A and 12B. Its features including length are similar to the boxer short 220. Gym sleep 260 includes a waistband 266  
10 which contains a fold 269 which allows for a drawstring 271. Additionally the hem 268 has an overlapping mesh trim 269 at the leg.

Another example of a female sleepwear item is foldover pant 280. The foldover pant is shown in figures 13A and 13B. Length 284 causes the pant to fall at or around the wearer's ankle. The pant has a waistband 187 that is folded. The hem 188 has a  
15 mesh trim 189, and a logo 70 is located near the hem. Parts of long pant 180 are joined together by comfort flat seaming 190.

There are of course other female sleepwear garments that have features similar to the features described above. These garments include a cap sleeve tunic, nightie, romper, sleep Henley, hooded robe, double strap tank, V-neck sleep tank dress, V-neck  
20 sleep dress, perfect tank, yoke legging, drawstring pants, pajama shorts with tiered hem, pocket tee and short pajama short set, and long sleeve cover up shown in figures 14 through figure 27.

An example of a male sleepwear item 24, a V-neck tee 450, designed to be worn by a male user 25 as part of the sleep system 10 is shown in figures 28A and 28B.  
25 The V-neck tee 450 has a front 451 as shown in figure 28A and a back 452 shown in figure 28B. The V-neck tee 450 has a neck 454, a body 466, and sleeves 465.

The neck 454 of the V-neck tee 450 takes the shape of a low V in the front part of the neck 455 and extends across the neck in a slightly curved manner across the back part of the neck 456. The neck has a logo band 457. The logo band color 459 may be  
30 the same color or a color contrasting to the body color 458 of the V-neck tee. The neck 454 may also have contrast inner logo tape 453.



The length 460 of the V-neck tee may be such that the tee reaches, or is above or below the hip bone of the male user 25. The width 462 of the tee is uniform below where the sleeves 465 attach to the body of the shirt 466. The front 451 of the tee may contain a logo 70. The logo 70 may in a logo color 471 contrasting to the body color 458 of the V-neck tee.

The V-neck tee terminates in a shirt hem 475. The hem may be the same color as the neck 454, the same as the body color 458, or a different color. The hem is a flat lock hem. The stitch color 478 of the flat lock hem may be the same color as the neck 454, the body color 458, or a different color. The sleeves 465 also have sleeve hems 476. The sleeve hems 476 may be the same color as the neck 454, the body color 458, the shirt hem color 475 or a different color.

Another example of a male sleepwear item 24, a crew tee 480, designed to be worn by a male user 25 as part of the sleep system 10 is shown in figures 29A and 29B. The crew tee 480 has a front 481 as shown in figure 29A and a back 482 shown in figure 29B. The features of crew tee 480 are similar to V-neck tee 450, however the front of the neck 485 of the crew tee 480 has a crew neck style, that is slightly curved rather than a low V.

There are other examples of male sleepwear that have features similar to the ones described above. These items include tank, a color block tee, sleeveless v-tee, v-tee, hoody, Henley, paneled long sleeve cover up, long robe, long pant, long short, boxer, paneled boxer short, drawstring short, drawstring pant, and boxer brief shown in figures 30A through figure 44B.

Other examples of sleepwear components 600, 620, 630 of more complex design, function, and fashion are shown in figure 45 and 46. In these examples, portions of the sleepwear fit the user so tightly as to cause compression of portions of the user's body. This compression provides the user with added benefits including muscle support and regeneration, enhanced blood flow resulting in improved circulation, and greater relaxation. Sleepwear items intended for a male user is shown in figure 45 and a sleepwear items intended for a female user 21 is shown in figure 46.

For the male user, the sleepwear items include a torso piece 612, sleeve pieces 614, 616, and pants 618. For the female user, the sleepwear items can include an upper body piece 622, pants 624, and leggings 632, 634. The pieces can be worn separately or

together, and can be layered with other items of sleepwear or bedding. Each of the pieces can be assembled from three different materials. One material is a mesh (shown cross-hatched in the figures) that is used for a variety of panels 649 and is made of a material that achieves a high rate of ventilation of air around the skin that is in contact  
5 with the mesh.

The second material is a high-performance fabric of the kind discussed above and used for a variety of other panels 651.

The third material is a fabric that is used for providing the compression mentioned earlier. The compression panels 647 can serve, for example, the biceps, the  
10 quads, the calves, and the feet, as shown. A wide elastic waistband 642 can be provided on the pants.

As discussed earlier, the sleepwear system also includes bedding components. Some of these components, for example sheets, are described in the United States patent applications that are incorporated by reference above. Those applications also  
15 describe the characteristics of performance fabrics that can be used.

As mentioned earlier, top layer components may include sheets, comforters, duvet covers, blankets, and throws. Base layer components may include sheets, gel toppers, mattress pads, mattress pad toppers, pillows, and pillow cases. Each of the items of sleepwear can be assembled by cutting material to form pieces according to  
20 predesigned patterns and assembling the pieces using stitching, adhesives, heat, or any other assembly method that will provide an effective bond.

Figure 47 shows an example of how a sleepwear item can be constructed. Shown are the pieces that are to be assembled from a pattern for a cami adjustable slip dress 500. Patterns for sleepwear items are provided for all of the different sizes to be  
25 marketed. The patterns are intended to yield close-fitting sleepwear items for each size.

To construct the garment shown in figure 47, 5 mm flat seams 502 are used at locations near the sides 504 and back 506. Seams are not located at the sides 505. A 2 cm hem 508 is at the bottom of the garment 510. The top 512 has a 4 mm internal decorated cover stitch seam 514. Straps 516 have a flatseam 518 in the center and is 1  
30 stitch in circumference. Inner shelf bra 520 is sewn near the top 512.

Figure 48 shows an example of how a base layer component can be constructed. Shown is a pattern for a fitted sheet 530. The fitted sheet has a length L and width W

and is encased with elastic around the entire perimeter. The fitted sheet is composed of at least three pieces 531, 533, 535 sewn together. Figure 49 shows an example of how a top layer component can be constructed. Shown is a pattern for a top sheet 550. The top sheet has a length L and width W, and a four inch top hem 538. The top sheet is  
5 composed of at least three pieces 539, 541, 54 sewn together.

Figure 50 shows an example of how a base layer component can be constructed. Shown is a pattern for a pillowcase 570. The pillowcase has a length L and width W and a four inch hem.

As shown in figure 51, any two or more items 601, 603 of bedding, sleepwear,  
10 or combinations of them can be packaged together 608 in a box, bag, or other retailing container 602 for shipment, shelving, marketing, sale, and use by the consumer. The packaging can bear marketing messages or instructions 606 describing the system, the elements of the system, the functional aspects, and other features.

As shown in figure 52, a retail display device 669 can include shelves 671, 673  
15 on which packages are displayed for purchase. A package 661 displayed on one of the shelves can contain an item of bedding or sleepwear that is part of sleep system. A package 663 displayed on the other shelf can contain a second item of bedding or sleepwear that is also part of the sleep system and can be used with the item in package 661. A sign or other display element 665 informs purchasers about the sleep system and  
20 the fact that the items in packages 661 and 663 are parts of such a sleep system and can be used together with the benefits described earlier.

This description is related to the description in United States patent applications 12/569,659, filed 9/29/09, and 61/101,049, filed 9/29/08, portions of which are  
25 included below.

Sleep problems in the United States are remarkably widespread, affecting roughly three out of four American adults, according to research by the National Sleep Foundation (NSF). Consequently, a great deal of attention has been paid to the circumstances surrounding poor sleep, along with strategies for how to improve it.

30 The implications are not merely academic. Sleep -- not only the right amount of it but also the right quality -- impacts not just day-to-day performance, but also "the

overall quality of our lives," according to the NSF. Addressing the causes of poor quality sleep, therefore, has ramifications for millions.

Though many factors contribute to sleep quality, the sleep environment itself plays a critical role, and sleep researchers routinely highlight temperature as one of the most important components in creating an environment for optimal sleep. As advised  
5 by the University of Maryland Medical Center, "a cool (not cold) bedroom is often the most conducive to sleep." The National Sleep Foundation further notes that "temperatures above 75 degrees Fahrenheit and below 54 degrees will disrupt sleep," with 65 degrees being the ideal sleep temperature for most individuals, according to the  
10 NSF.

A lower environmental temperature is not the only thermal factor associated with improved sleep. Researchers have noted a nightly drop in body temperature among healthy, normal adults during sleep. This natural cycle, when inhibited or not functioning properly, can disrupt sleep and delay sleep onset, according to medical  
15 researchers at Cornell University. Conversely, the researchers noted, a rapid decline in body temperature not only accelerates sleep onset but also "may facilitate an entry into the deeper stages of sleep."

Therefore, maintaining an appropriately cool sleep environment and accommodating the body's natural tendency to cool itself at night should be a top  
20 priority for individuals interested in optimizing their sleep quality. Performance fabrics crafted into bedding applications would be uniquely capable of promoting cool, comfortable -and therefore better -sleep, as these advanced fabrics maximize breathability and heat transfer. Performance fabrics are made for a variety of end-use applications, and can provide multiple functional qualities, such as moisture  
25 management, UV protection, anti-microbial, thermo-regulation, and wind/water resistance.

There has been a long felt need in several industries to provide improved bedding to help individuals get better sleep. Such improved bedding would include beneficial wicking among other properties. For example, in marine, boating and  
30 recreational vehicle applications, bedding should resist moisture, fit odd-shaped mattresses and beds, and reduce mildew. Particularly with watercraft, there is a need to protect bedding, and specifically sheets, from moisture and mildew accumulation.



An additional problem with bedding, not just with marine and recreational vehicles, is the sticky, wet feeling that can occur when the bedding sheets are wet due to body sweat, environmental moisture, or other bodily fluids. In particular, when bedding is used during hot weather, or is continuously used for a long time by a person suffering from an illness, problems can arise in that the conventional bed sheet of cotton fiber or the like cannot sufficiently absorb the moisture. All of these issues lead to poor sleep.

There are width limitations in the manufacturing of high gauge circular knit fabrics, because the finished width of bedding fabrics are dictated by the machine used in its construction. Performance fabrics have sometimes been manufactured with a maximum width of under 90 inches wide, given manufacturing and technical limitations, along with the inability of alternate manufacturing processes to produce a fabric with identical performance attributes. Yet, normal bed sheet panels can be 102 by 91 inches or larger.

Circular knitting is typically used for athletic apparel. The process includes circularly knitting yarns into fabrics. Circular knitting is a form of weft knitting where the knitting needles are organized into a circular knitting bed. A cylinder rotates and interacts with a cam to move the needles reciprocally for knitting action. The yarns to be knitted are fed from packages to a carrier plate that directs the yarn strands to the needles. The circular fabric emerges from the knitting needles in a tubular form through the center of the cylinder.

Further, the machinery that is used for bedding is very different than for athletic wear. For example, bedding manufacturing equipment is not equipped to sew flatlock stitching or to provide circular knitting. Bed sheets typically are knit using a process known as warp knitting, a process capable of producing finished fabrics in the widths required for bedding. This method, however, cannot be employed to produce high-quality performance fabrics. Warp knitting is not capable of reproducing these fabrics' fine tactile qualities nor their omni-direction stretch properties, for example.

Circular knitting must be employed to produce a performance fabric that retains these fabric's full range of benefits and advantages. However, in order to produce a fabric of the proper width for bedding applications, a circular knit machine of at least 48 inches in diameter would be necessary.

Further, athletic sewing factories are typically not equipped to sew and handle large pieces of fabrics so that equipment limitations do not allow for the manufacture of bedding sheets.

Briefly described here is a high gauge circular knit fabric for use in bedding,  
5 and a method for manufacturing such bedding. The bedding fabric has superior performance properties, while allowing for manufacture by machinery presently available and in use. In order to achieve a finished width of the size needed to create sheet-sized performance fabric, a high gauge circular knit machine of at least 48 inches in diameter is necessary. And while warp knitting machines are available that can  
10 produce wider fabrics, this method will not provide a fabric with the tactile qualities required, nor provide a fabric with omni-directional stretch.

A method of making a finished fabric can comprise at least two discrete performance fabric portions, and joining at least two discrete performance fabric portions to form the finished fabric. Forming the at least two discrete performance  
15 fabric portions can comprise knitting at least two discrete performance fabric portions, and more preferably, circular knitting at least two discrete performance fabric portions. Joining the at least two discrete performance fabric portions to form the finished fabric can comprise stitching at least two discrete performance fabric portions together to form the finished fabric.

20 The at least two discrete performance fabric portions can have different fabric characteristics. Fabric characteristics as used herein include, among other things, moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance and water resistance.

The finished fabric can be used in, among other applications, residential  
25 settings, or in marine, boating and recreational vehicle environments.

The sheets offer enhanced drape and comfort compared to traditional cotton bedding, and are as fine as silk, yet provide the benefits of high elasticity and recovery along with superior breathability, body-heat transport, and moisture management as compared to traditional cotton bedding.

30 Conventional fitted sheets can bunch and slide on standard mattress sizes. Furthermore, if the fitted bed sheets do not fit properly, they do not provide a smooth surface to lie on.

The high gauge circular knit fabrics stretch to fit and offer superior recovery on the mattress allowing the fabric to conform to fit the mattress without popping off the comers of the mattress or billowing. The performance fabric can include spandex, offers a better fit than conventional bedding products, can accommodate larger or  
5 smaller mattress sizes with a single size sheet, and can conform to mattresses with various odd dimensions.

Spandex -or elastane -is a synthetic fiber known for its exceptional elasticity. It is stronger and more durable than rubber, its major non-synthetic competitor. It is a polyurethane-polyurea copolymer that was invented by DuPont. "Spandex" is a generic  
10 name, and an anagram of the word "expands." "Spandex" is the preferred name in North America; elsewhere it is referred to as "elastane." The most famous brand name associated with spandex is Lycra, a trademark of Invista.

The high gauge circular knit fabric offers durability in reduced pilling and pulling when compared to other knit technologies, and offer reduced wrinkles and  
15 enhanced color steadfastness

Performance fabric can allow for a one-size fitted sheet that can actually fit two different size mattresses. For example, the full fitted sheet can fit on both the full and queen size bed. The twin fitted sheet will also fit an XL twin. In a boating application, sheets can be produced to fit almost every custom boat mattress.

20 Testing conducted at the North Carolina State University (NCSU) Center for Research on Textile Protection and Comfort confirms that the performance fabrics provide a cooler sleeping environment than cotton. Performance bedding was tested side-by-side with commercially available cotton bed sheets in a series of procedures designed to measure each product's heat-and moisture-transport properties, as well as  
25 warm/cool-to-touch thermal transport capabilities.

Across all tests, the performance fabrics in bedding outperformed cotton, demonstrating the performance fabric's superiority in establishing and maintaining thermal comfort during sleep. This advantage is evident to users from the very onset, as NCSU testing indicates that, on average, performance bedding offers improved heat  
30 transfer upon initial contact with the skin, resulting in a cooler-to-the-touch feeling.

During sleep, high gauge circular knit performance bedding helps to maintain thermal comfort by trapping less body heat and breathing better than cotton.

Testing has demonstrated that performance bedding made out of performance fabrics transfers heat away from the body up to two times more effectively than cotton. This is critically important not only for sustained comfort during sleep, but also in terms of enabling the body to cool itself as rapidly as possible to facilitate sleep onset.

5 In addition to trapping less heat, performance bedding breathes better than cotton -up to 50% better, giving performance bedding a strong advantage in terms of ventilation and heat and moisture transfer.

The performance advantage over cotton holds true for simulated dry and wet skin conditions, confirming that certain performance fabrics in bedding are better suited than cotton at managing moisture (e.g., sweat) to maintain thermal comfort. In addition to wicking moisture away from the skin through capillary action, the performance fabric's advanced breathability further enables heat and moisture transfer through evaporative cooling. As a result, the user is kept cooler, drier and more comfortable than with cotton.

15 The performance bedding holds a distinct advantage over cotton in enabling, accommodating and maintaining optimum thermal conditions for sleep, which in turn can lead to faster sleep initiation and deeper, more restorative sleep.

A sheet has dimensions of 102 inches in length and 91 inches in width. The material is manufactured from performance fabric, which can include, for example, varying amounts of one or more of Lycra, Coolmax, Thermax and Thermastat. The fabric is treated so that the fabric has antimicrobial properties. By using circular-knit performance fabric, the fabric is able to provide elasticity in all four directions. This property allows for the sheet to fit extraordinary mattress, cushion and bedding shapes, as well as providing better fits for traditional rectangular sheets. By using performance fabrics, the sheet has elastic properties that allow stretching. In addition, by using circular-knit performance fabric, the resulting bedding retains an exceptionally fine tactile quality critical for providing maximum levels of enhanced comfort.

An alternative to circular knitting is non-circular knitting -for example, warp knitting. This method can achieve widths greater than circular knitting. Industrial warp knit machines, for example, can produce tricote warp knit fabrics up to 130-140 inches in width. Circular knitting, however, is less expensive, as it requires less set-up time. Circular knitting also provides greater multidirectional stretch.



In order to provide a sheet that exceeds the maximum dimensions of fabric that can be produced by available circular knitting machines, flat lock stitching is used to join a plurality of portions resulting in a sheet that is 91 inches wide (as shown). Piping can be included in close proximity to the stitching. The stitching can be the same color as the fabric of the sheet portions, or different color(s). The piping can be 3/4 inch straight piping without a cord or other filler. The stitching is 16 stitches per inch. Piping can be included at one end of the sheet and can be the same or a different color as the sheet fabric.

For a fitted sheet, the sheet can include an elastic portion surrounding the edge of the fitted sheet to better keep the fitted sheet in place when placed on a mattress or other sleeping surface. A cord can be sewn into the edge of the fitted sheet and cinched around the mattress or other sleeping surface to better hold the fitted sheet in place.

A sheet can have dimensions of 91 inches wide and 102 inches in length. Stitching is 34 inches from an interior edge of a main portion and another stitch at edge of the sewn-on portion. Flat lock stitching can be used for the stitching. Piping can be applied at or in proximity to the stitching.

In a non-rectangular sheet, elastic can be included around the edge of the fitted sheet to better maintain the fitted sheet in position when placed on a sleeping surface. Pull ties can be installed at various locations around the edge of the fitted sheet in order to assist in maintaining the fitted sheet secured to the sleeping surface. The pull tie can be cinched to increase tension around the edge of the fitted sheet. Stitching can be used for securing the portions of the sheet together.

The sheet can be assembled through stitching of differing fabrics for generating performance zones in the sheet. For example, one zone can have higher wicking properties than the other zones since this area is where the majority of the individual body rests. Other areas can have higher spandex or other elastic fabric properties so that the fit around a sleeping surface is improved. One area may have thermal properties such as increased cooling since this area is generally where the individual's head lies. In an exemplary embodiment, the pillow covers of pillows used by the individual also have differing properties from the remainder of the sheet, e.g., thermal properties.

Bedding materials can be constructed that have superior performance properties while allowing for manufacture by machinery presently available and in use. More

specifically, a new method for fabricating a covering and or sheets in bedding can be used. When using a traditional circular knitting machine, the high gauge performance fabrics can only be made to a maximum size of 72.5 inches without losing the integrity of the spandex in the fabric. Yet, normal sheet panels are 102 x 91 inches. This presents  
5 problems when manufacturing sheets from performance fabrics.

Additionally, special stitching techniques must be used given the thread density of the fabric. Using this special stitching, panels are sewn together to produce bedding or a sheet that is the proper size for standard bed sheets. Because discrete  
10 portions/panels are used in the manufacture of the present fabrics, panels can be selected that provide different properties for different areas of the bedding. Stitching or seams on the sheet can also allow for the ease of making the bed. Because the bedding is made from performance fabric with spandex, it stretches to permit multiple and custom sizing for applications in cribs, recreational vehicles and boats.

Circular knitting machines used for high gauge performance bedding fabrics are  
15 called high-gauge circular knitting machines, because of dense knitting with thin yarn. High gauge generally denotes 17 gauges or more. Seventeen gauges indicate that 17 or more cylinder needles are contained in one inch. Circular knitting machines of less than 17 gauges are referred to as low-gauge circular knitting machines. The low-gauge circular knitting machines are often used to knit outerwear.

"Yarn count" indicates the linear density (yarn diameter or fineness) to which  
20 that particular yarn has been spun. The choice of yarn count is restricted by the type of knitting machine employed and the knitting construction. The yarn count, in turn, influences the cost, weight, opacity, hand and drape of the resulting knitted structure. In general, staple spun yarns tend to be comparatively more expensive the finer their  
25 count, because finer fibers and a more exacting spinning process are necessary in order to prevent the yarn from showing an irregular appearance.

A top width in the 90-inch range is currently possible using a circular knit fabric formed on a 36-38-inch diameter machine, although higher levels of spandex in the performance fabric tend to pull the width in. In just one example, on a 30-inch diameter  
30 machine, the spandex can reduce an otherwise 94-inch circumference fabric tube to one with a 60-65 inch finished width.

A major limitation in finished width is not strictly a knitting concern but also concerns finishing. With performance fabric, it tends to sag in the middle -increasingly so with greater widths -- making finishing difficult to impossible above a certain threshold. A possible 90-inch finished width is contingent upon having a good finishing  
5 set-up capable of handling the present performance fabric. This potential for difficulties would only become compounded at the larger widths required for bed sheets.

In one process, fabric undergoes a heat setting finishing process. Applying a moisture-wicking finish to another fabric -- like cotton -- that can be produced at larger widths appears unlikely to match the moisture-control properties of the present fabric,  
10 as polyester itself is naturally moisture-resistant and there are physical actions (e.g. capillary action) at play. Further, the use of cotton comes at the expense of breathability and heat-transfer capabilities (as confirmed by laboratory testing) and stretchability.

Other implementations are within the scope of the following claims.

## CLAIMS

1. An apparatus comprising  
a first item of sleepwear or bedding to be used as part of a sleep system,  
a second item of sleepwear or bedding to be used with the first item as part of  
5 the sleep system,  
at least one of the first item and second item comprising a performance fabric,  
the first item to dissipate moisture and heat from a body of a user from an inside  
of the first item to an outside of the first item,  
the second item to dissipate moisture and heat that has been dissipated by the  
10 first item.
2. The apparatus of claim 1 in which both the first item in the second item  
comprise performance fabrics.
3. The apparatus of claim 1 in which the performance fabric comprises a knitted  
fabric.
- 15 4. The apparatus of claim 1 in which the performance fabric comprises a man-  
made fiber.
6. The apparatus of claim 1 in which at least one of the first item and second item  
comprises an item of sleepwear, and the item of sleepwear is close-fitting.
7. The apparatus of claim 1 in which at least one of the first item and second item  
20 is to be in contact with the user's skin.
8. The apparatus of claim 7 in which the item that is in contact with the user's skin  
comprises an item of sleepwear.
9. The apparatus of claim 1 in which the first item is in contact with skin of the  
user, and the second item is in contact with the first item.
- 25 10. The apparatus of claim 1 in which moisture is dissipated.
11. The apparatus of claim 1 in which heat is dissipated.
12. The apparatus of claim 1 in which one of the items comprises sleepwear that is  
sized and shaped for a female user.
13. The apparatus of claim 1 in which one of the items comprises you were that is  
30 sized and shaped for a male user.
14. The apparatus of claim 1 in which one of the items comprises a bed sheet.
15. The apparatus of claim 1 in which one of the items comprises a pillow case.



16. The apparatus of claim 1 in which one of the items comprises a blanket.
17. The apparatus of claim 1 in which one of the items comprises a comforter.
18. The apparatus of claim 1 in which one of the items comprises a duvet cover.
19. The apparatus of claim 1 in which one of the items comprises a blanket.
- 5 20. The apparatus of claim 1 in which one of the items comprises a gel topper.
21. The apparatus of claim 1 in which one of the items comprises a mattress pad.
22. The apparatus of claim 1 in which one of the items comprises a mattress pad topper.
23. The apparatus of claim 1 in which one of the items comprises a pillow.
- 10 24. The apparatus of claim 1 in which one of the items comprises a V-neck tee.
25. The apparatus of claim 1 in which one of the items comprises a cami adjustable tank.
26. The apparatus of claim 1 in which one of the items comprises a sleep bra.
27. The apparatus of claim 1 in which one of the items comprises a racer back tank.
- 15 28. The apparatus of claim 1 in which one of the items comprises a Capri pant.
29. The apparatus of claim 1 in which one of the items comprises a boxer short.
30. The apparatus of claim 1 in which one of the items comprises a boy short.
31. The apparatus of claim 1 in which one of the items comprises a gym sleep short.
32. The apparatus of claim 1 in which one of the items comprises a fold over pant.
- 20 33. The apparatus of claim 1 in which one of the items comprises at least one of a cap sleeve tunic, nightie, romper, sleep Henley, hooded robe, double strap tank, V-neck sleep tank dress, V-neck sleep dress, perfect tank, yoke legging, drawstring pants, pajama shorts with tiered hem, pocket tee and short pajama short set, and long sleeve cover up.
- 25 34. The apparatus of claim 1 in which one of the items comprises at least one of a tank, a colorblock tee, sleeveless v-tee, v-tee, hoody, Henley, paneled long sleeve cover up, long robe, long pant, long short, boxer, paneled boxer short, drawstring short, drawstring pant, and boxer brief.
35. The apparatus of claim 1 in which one of the items comprises an item of  
30 sleepwear and the item of sleepwear comprises fashion-related elements.
36. The apparatus of claim 1 in which one of the items comprises an item of sleepwear and the item of sleepwear comprises compression elements.

37. The apparatus of claim 1 in which one of the items comprises an item of sleepwear and the item of sleepwear comprises mesh elements.
38. The apparatus of claim 1 in which at least one of the items comprises a base item.
- 5 39. The apparatus of claim 1 in which at least one of the items comprises a top item.
40. The apparatus of claim 1 in which the first item and the second item comprise items of sleepwear that are layered one on the other.
41. The apparatus of claim 1 in which the first item in the second item comprise items of bedding that are layered one on the other.
- 10 42. The apparatus of claim 1 also comprising a third item of sleepwear or bedding and in which one of the items comprises a base item of bedding, one of the items comprises an item of sleepwear, and one of the items comprises a top item of bedding.
43. The apparatus of claim 1 also comprising packaging to contain both the first item in the second item.
- 15 44. The apparatus of claim 43 in which the packaging comprises information about the use of the first item in the second item in a sleep system.
45. The apparatus of claim 1 in which the first item and the second item are displayed in close proximity to one another for purchase by the user.
46. An apparatus comprising
- 20 an item of sleepwear that is close fitting and comprises a knitted performance fabric.
47. The apparatus of claim 46 in which the item of sleepwear comprises stitched together pieces of the knitted performance fabric.
48. The apparatus of claim 46 in which the item of sleepwear comprises fashion
- 25 elements.
49. The apparatus of claim 46 in which the item is to be in contact with the user's skin.
50. The apparatus of claim 46 in which the item is sized and shaped for a female user.
- 30 51. The apparatus of claim 46 in which the item is sized and shaped for a male user.
52. The apparatus of claim 46 in which the item comprises a V-neck tee.
53. The apparatus of claim 46 in which the item comprises a cami adjustable tank.

54. The apparatus of claim 46 in which the item comprises a sleep bra.
55. The apparatus of claim 46 in which the item comprises a racer back tank.
56. The apparatus of claim 46 in which the item comprises a Capri pant.
57. The apparatus of claim 46 in which the item comprises a boxer short.
- 5 58. The apparatus of claim 46 in which the item comprises a boy short.
59. The apparatus of claim 46 in which the item comprises a gym sleep short.
60. The apparatus of claim 46 in which the item comprises a fold over pant.
61. The apparatus of claim 46 in which the item comprises at least one of a cap  
sleeve tunic, nightie, romper, sleep Henley, hooded robe, double strap tank, V-neck  
10 sleep tank dress, V-neck sleep dress, perfect tank, yoke legging, drawstring pants,  
pajama shorts with tiered hem, pocket tee and short pajama short set, and long sleeve  
cover up.
62. The apparatus of claim 46 in which the item comprises at least one of a tank, a  
colorblock tee, sleeveless v-tee, v-tee, hoody, Henley, paneled long sleeve cover up,  
15 long robe, long pant, long short, boxer, paneled boxer short, drawstring short,  
drawstring pant, and boxer brief.
63. The apparatus of claim 46 in which the item comprises compression elements.
64. The apparatus of claim 46 in which the item comprises mesh elements.
65. The apparatus of claim 46 in which the item comprises sleeve pieces.
- 20 66. The apparatus of claim 46 in which the item comprises leggings.
67. The apparatus of claim 1 in which one of the items is a bedding item that  
comprises at least two joined pieces of a performance fabric.
68. The apparatus of claim 1 in which the performance fabric comprises a knit  
fabric.
- 25 69. The apparatus of claim 1 in which one of the items is a sleepwear item that  
comprises pieces joined by flat lock seaming.
70. The apparatus of claim 1 in which one of the items is a sleepwear item that  
comprises pieces joined by flat seaming.
71. The apparatus of claim 1 in which one of the items is a sleepwear item that  
30 comprises flat lock hems.
72. The apparatus of claim 1 in which one of the items is a sleepwear item that  
comprises mesh inserts.

73. The apparatus of claim 1 in which one of the items is a sleepwear item that comprises a logo.
74. The apparatus of claim 1 in which one of the items is a sleepwear item that comprises logo elastic trim.
- 5 75. The apparatus of claim 1 in which one of the items is a sleepwear item that comprises color block designs.
76. An apparatus comprising  
a first item of sleepwear or bedding to be used as part of a sleep system,  
a second item of sleepwear or bedding to be used with the first item as part of  
10 the sleep system,  
at least one of the first item and second item comprising a performance fabric,  
and  
a retail package holding both the first item and the second item for sale at retail.
77. An apparatus comprising  
15 a retail display device on which are displayed a first item of sleepwear or  
bedding to be used as part of a sleep system and a second item of sleepwear or bedding  
to be used with the first item as part of the sleep system, and  
an informational device that informs a purchaser that the first item and the  
second item are to be used together as part of the sleep system.
- 20 78. A method comprising  
dissipating heat and moisture from a body of a person who is in bed by  
dissipating heat and moisture from the person's skin through a close-fitting  
sleepwear item made of a performance knit fabric, and  
dissipating the heat and moisture from outside the sleepwear through a bedding  
25 item made of a performance knit fabric.



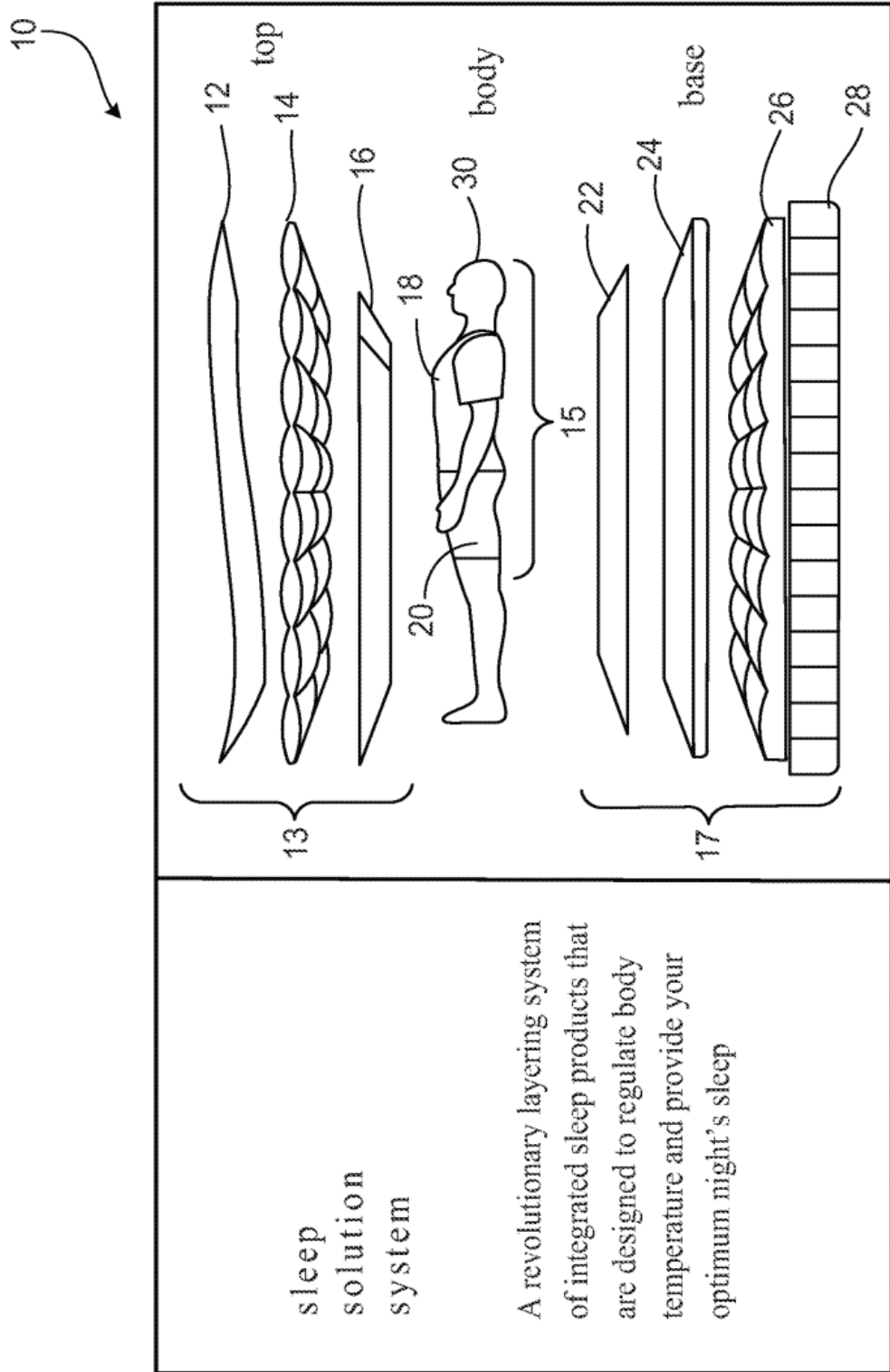


FIG. 1

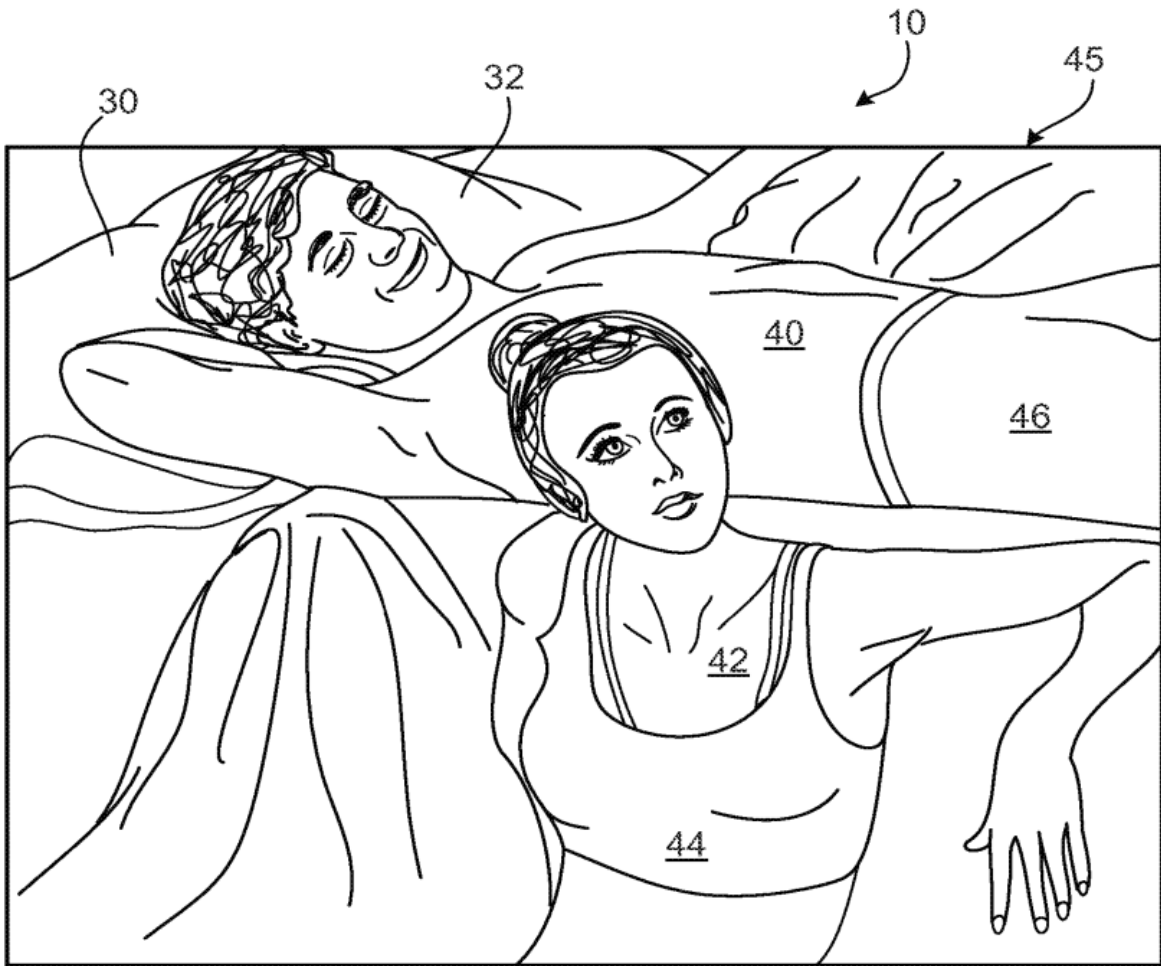
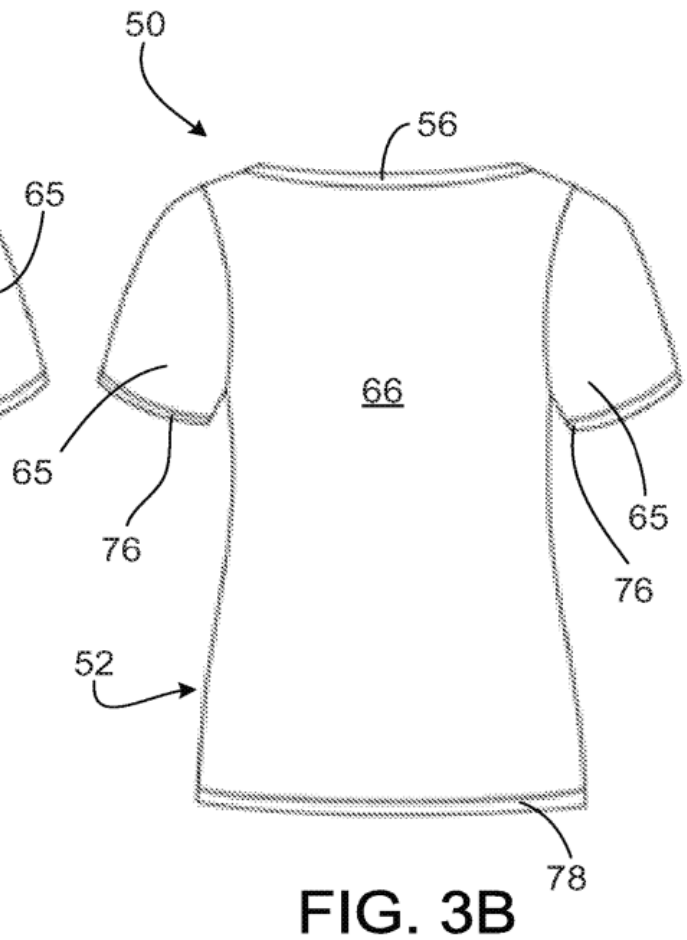
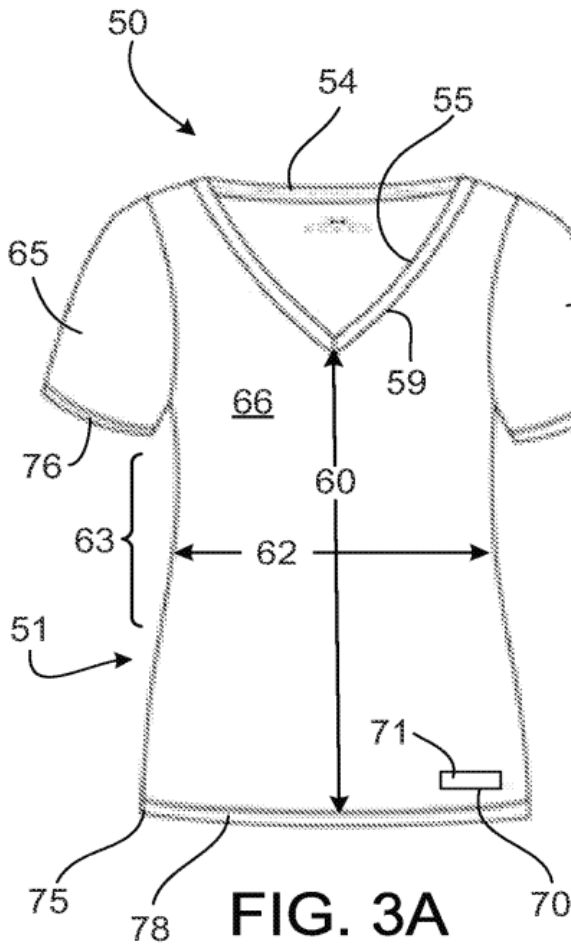


FIG. 2



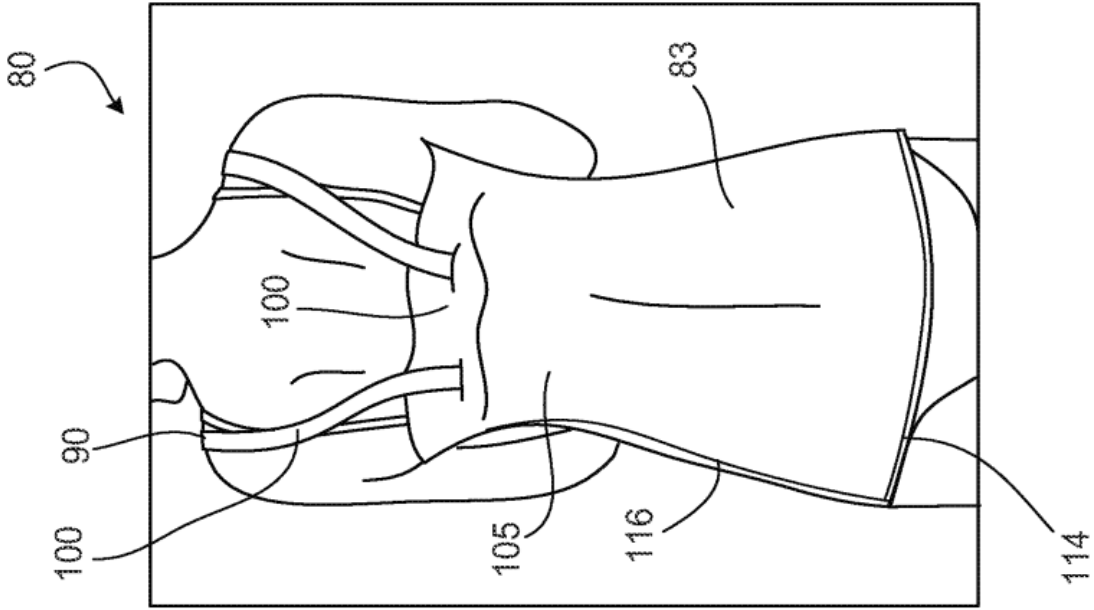


FIG. 4C

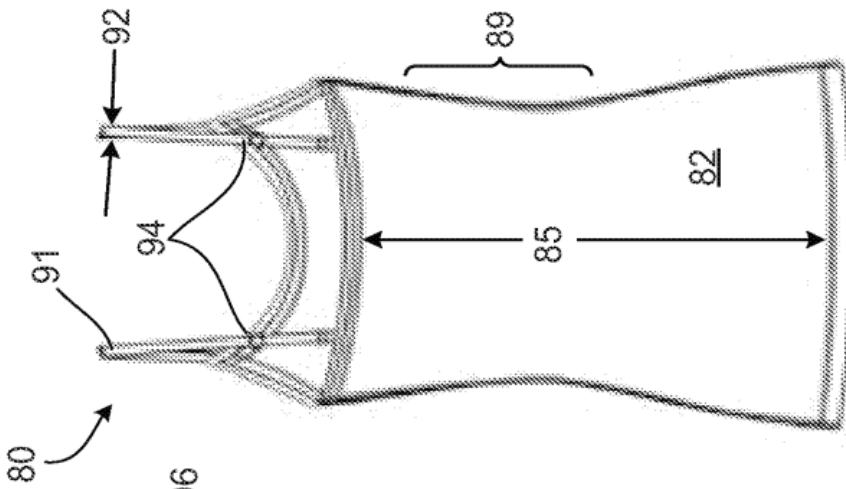


FIG. 4B

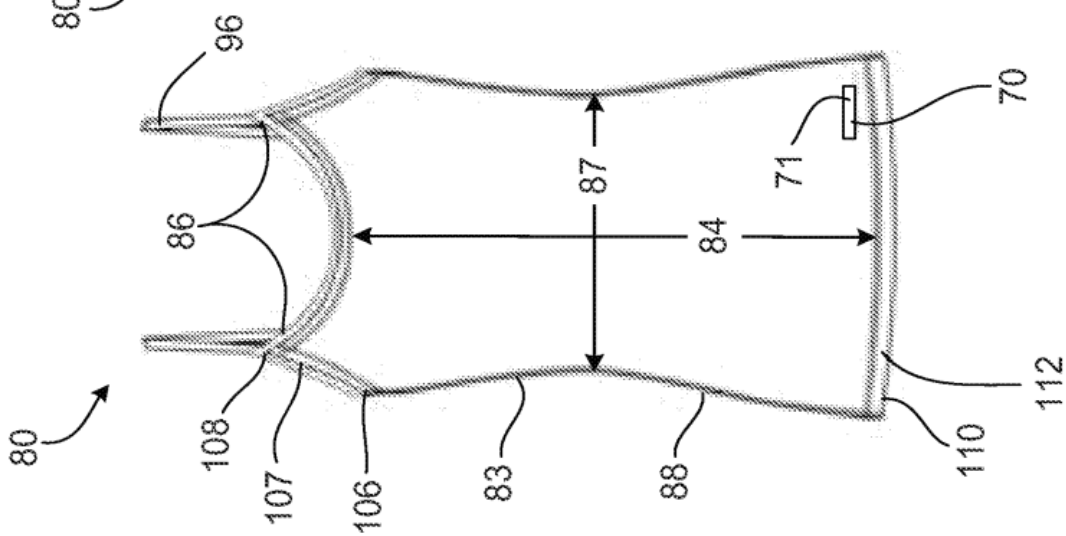


FIG. 4A



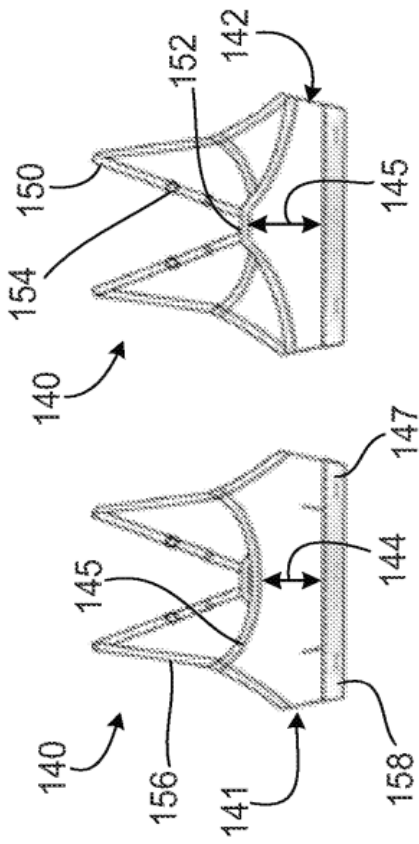


FIG. 6B

FIG. 6A

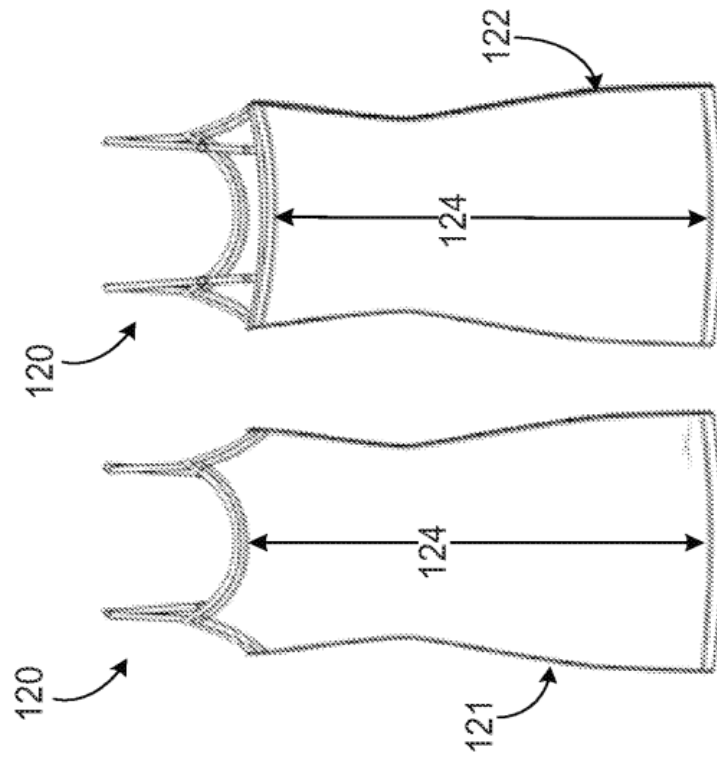


FIG. 5B

FIG. 5A

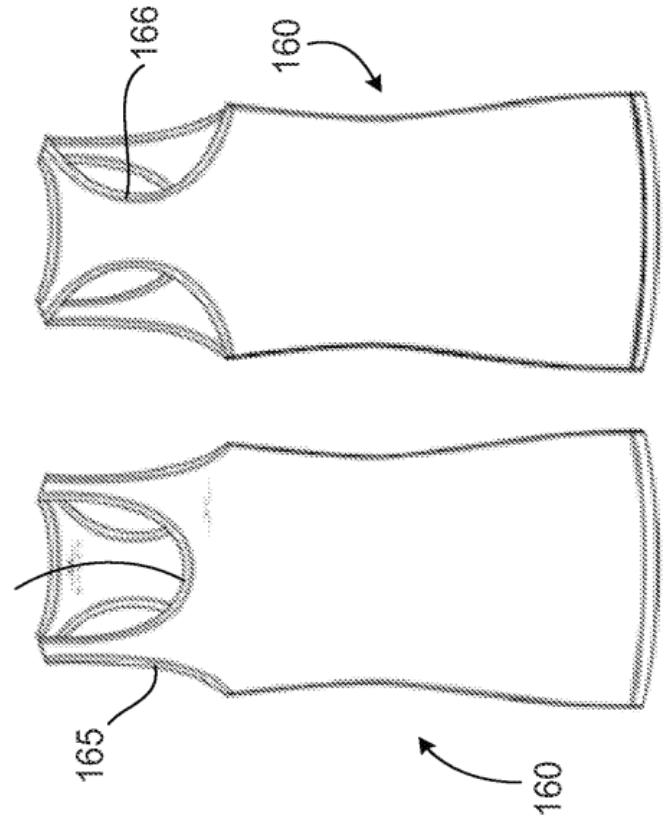


FIG. 7B

FIG. 7A

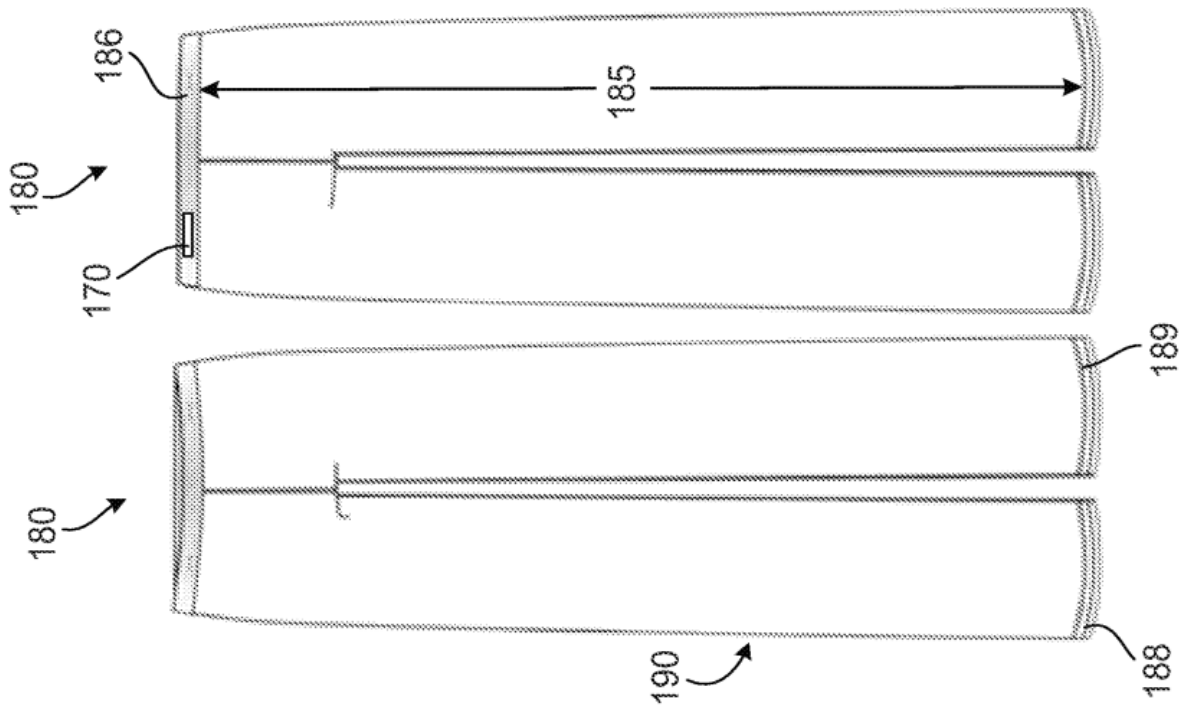


FIG. 8A FIG. 8B

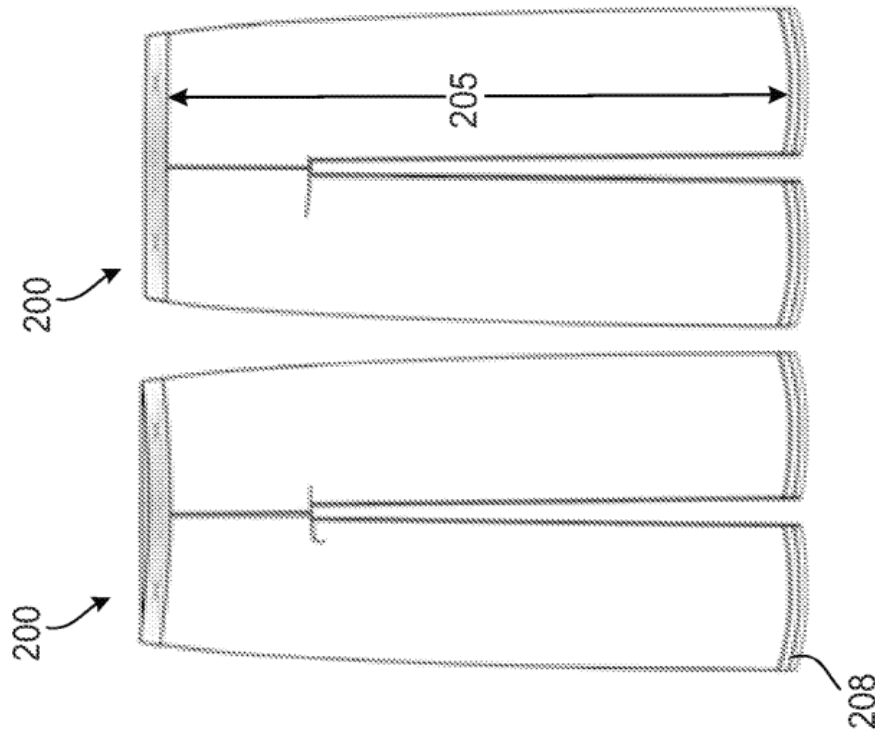


FIG. 9A FIG. 9B

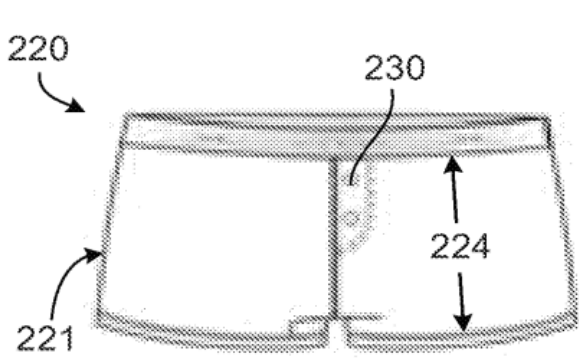


FIG. 10A

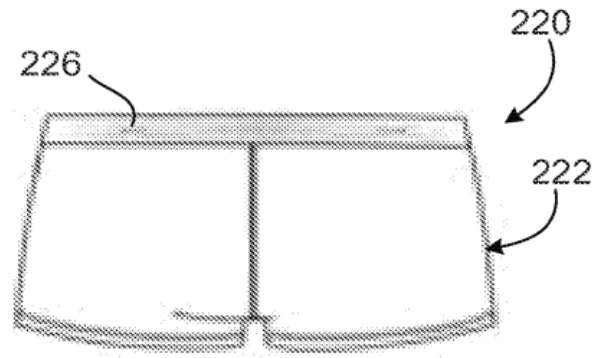


FIG. 10B

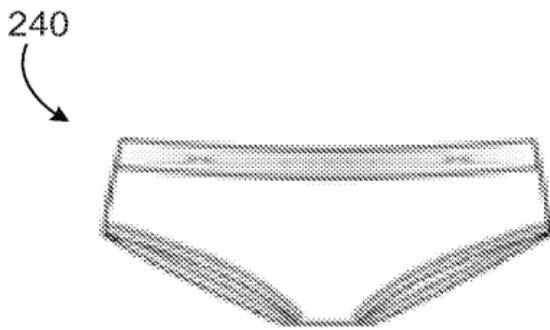


FIG. 11A

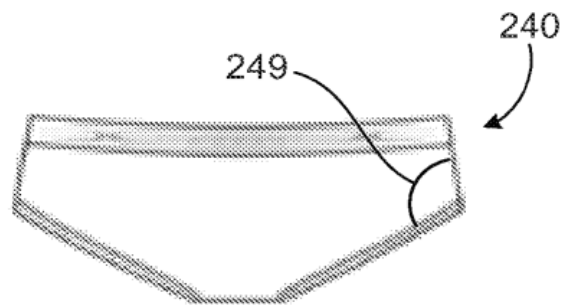


FIG. 11B

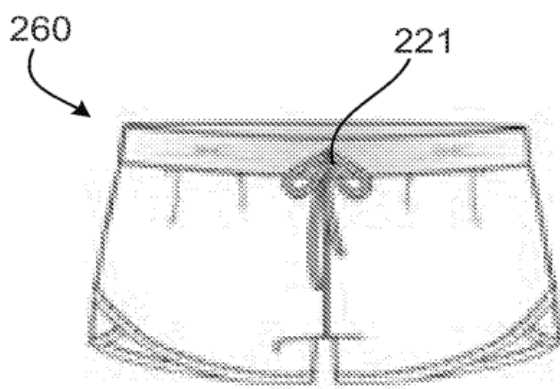


FIG. 12A

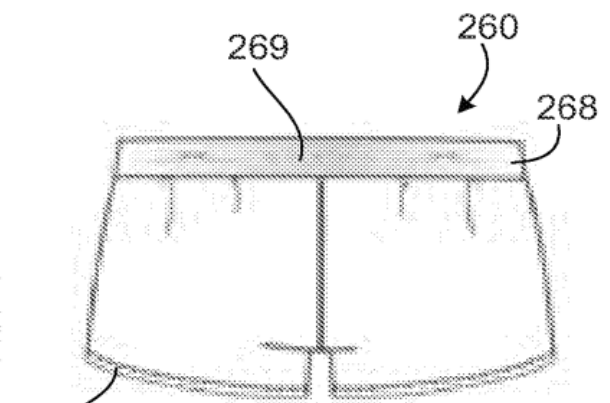


FIG. 12B

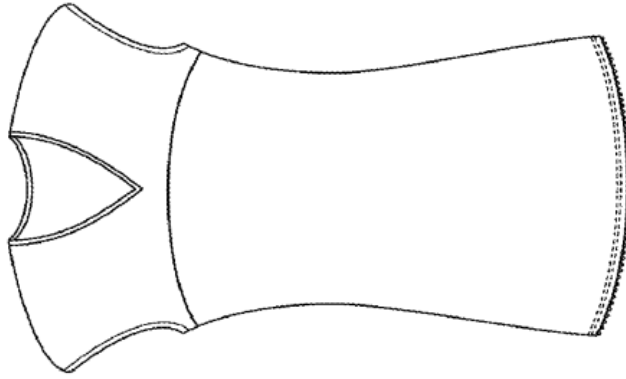


FIG. 14

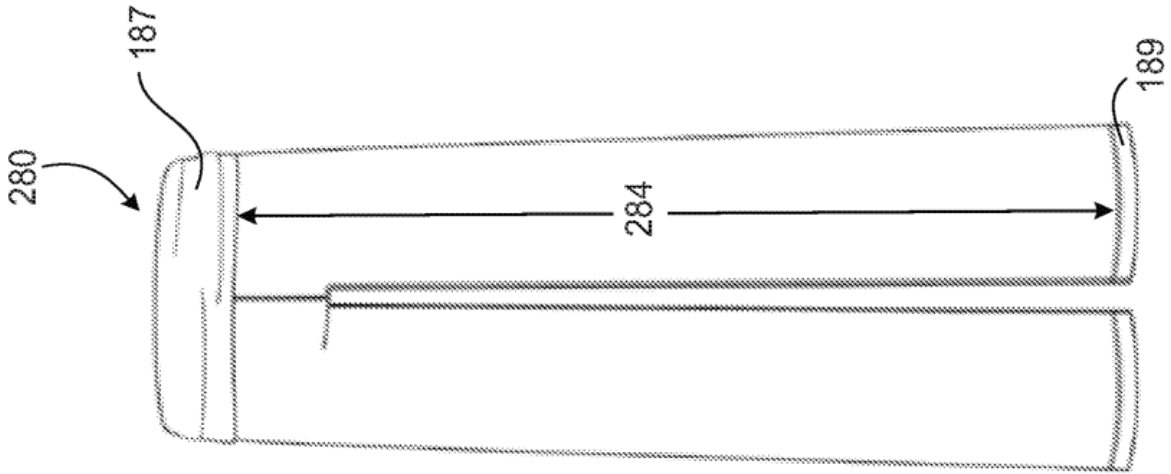


FIG. 13B

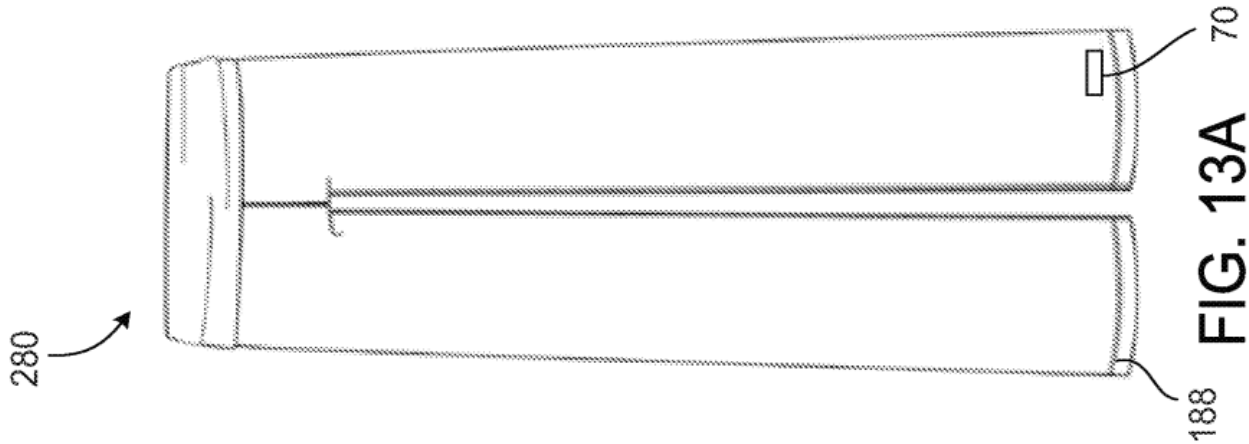


FIG. 13A



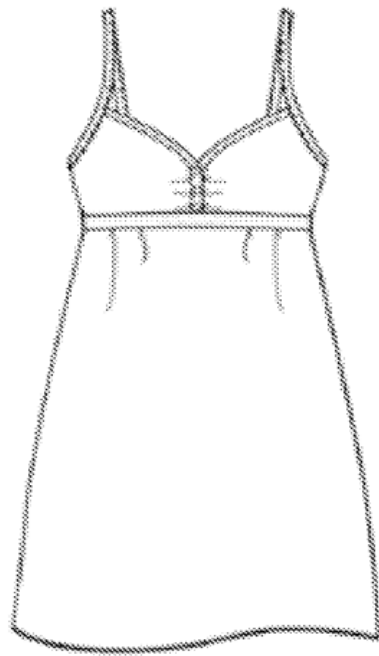


FIG. 15A

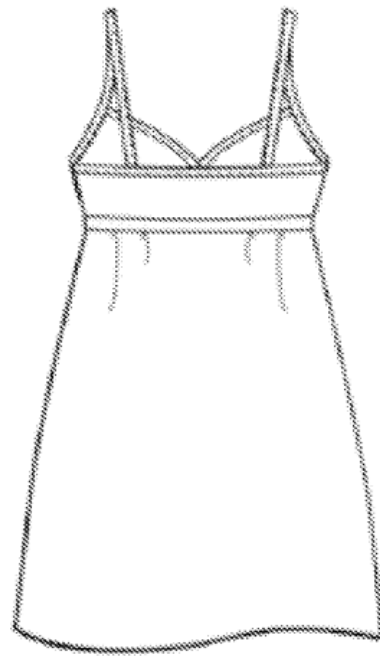


FIG. 15B

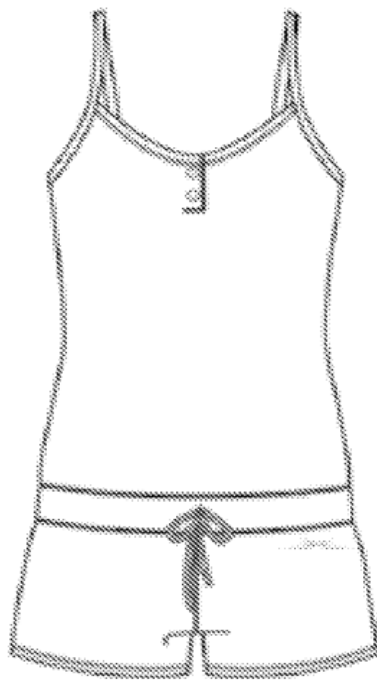


FIG. 16A

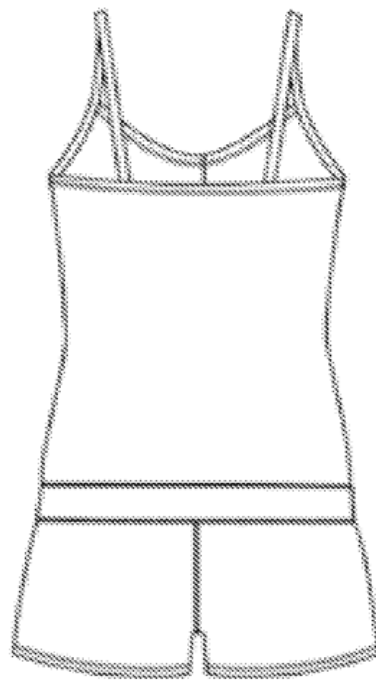
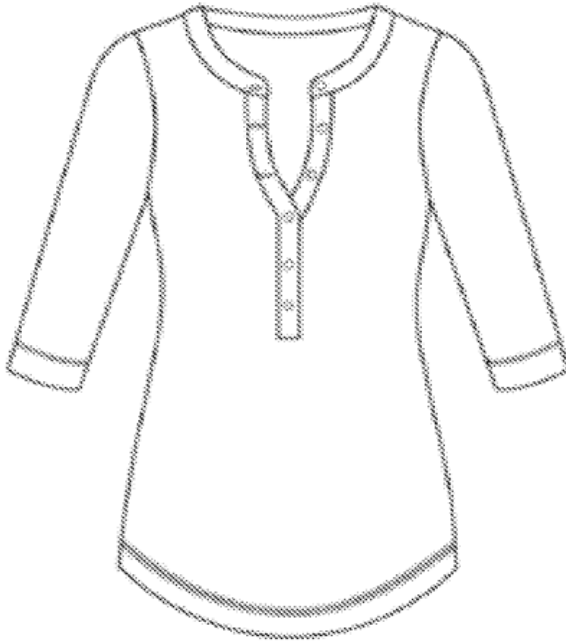
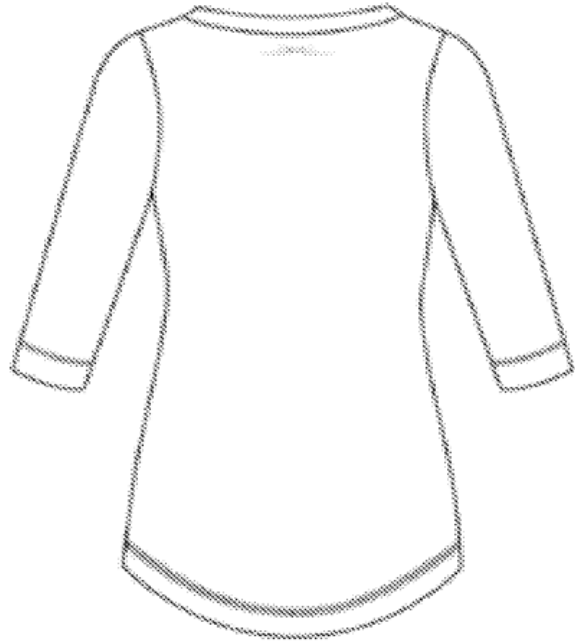


FIG. 16B



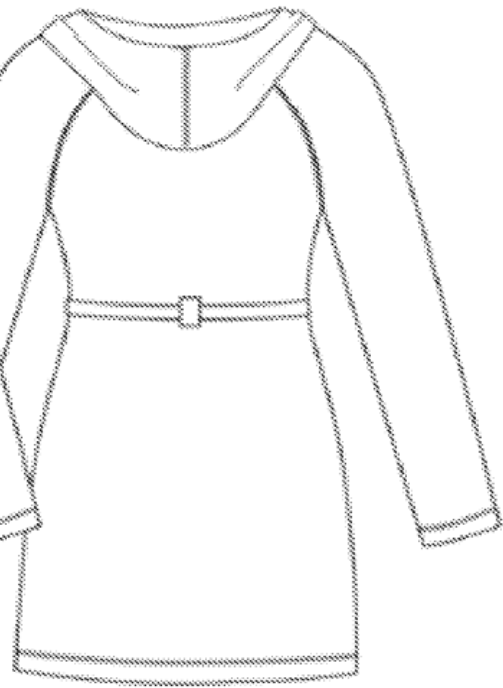
**FIG. 17A**



**FIG. 17B**



**FIG. 18A**



**FIG. 18B**

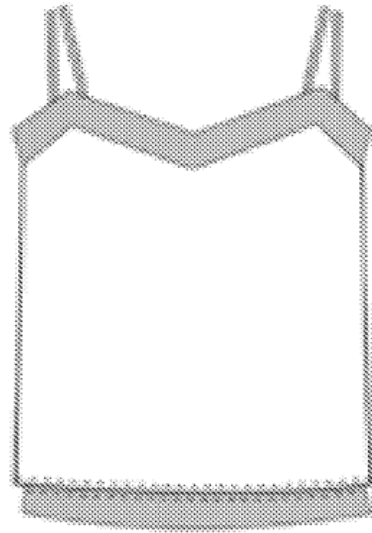


FIG. 19A

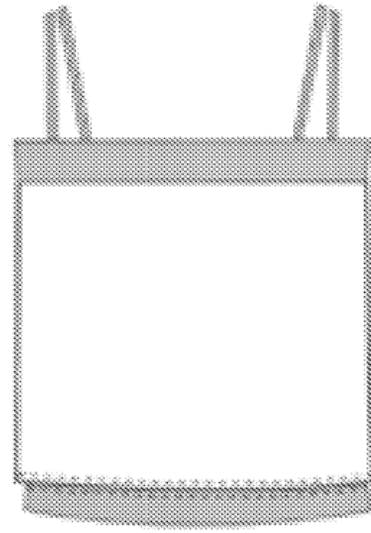


FIG. 19B

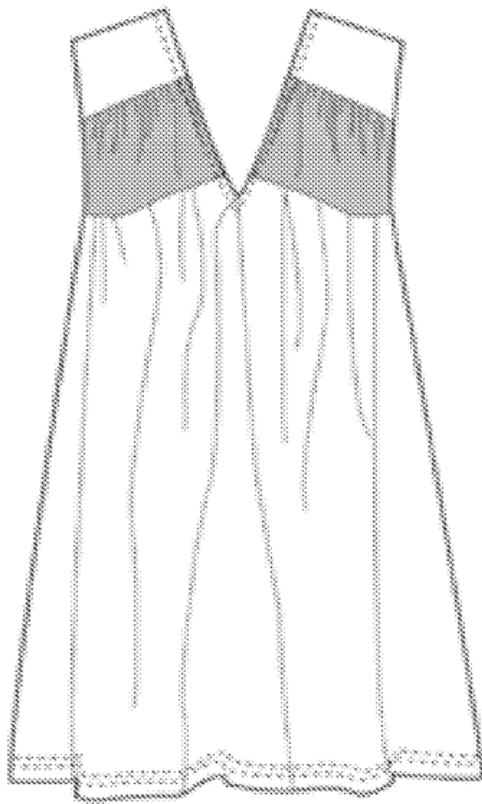


FIG. 20A

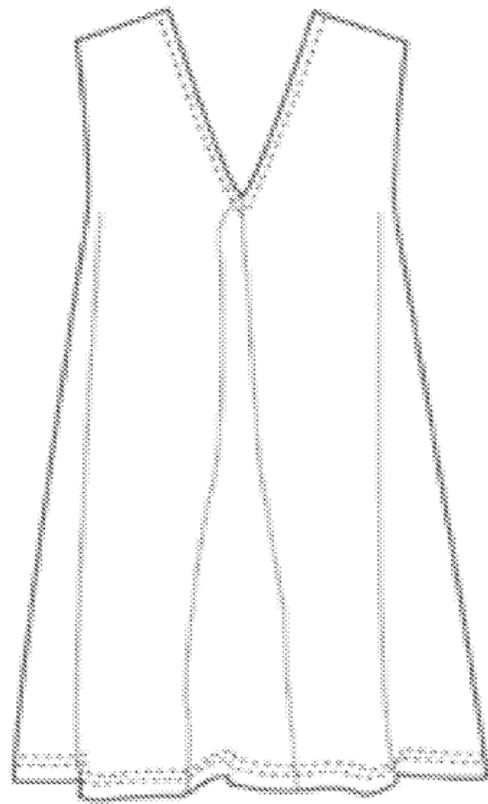


FIG. 20B

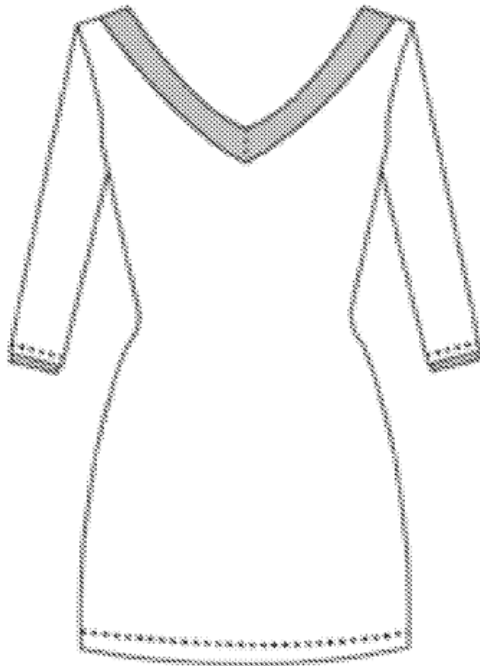


FIG. 21A

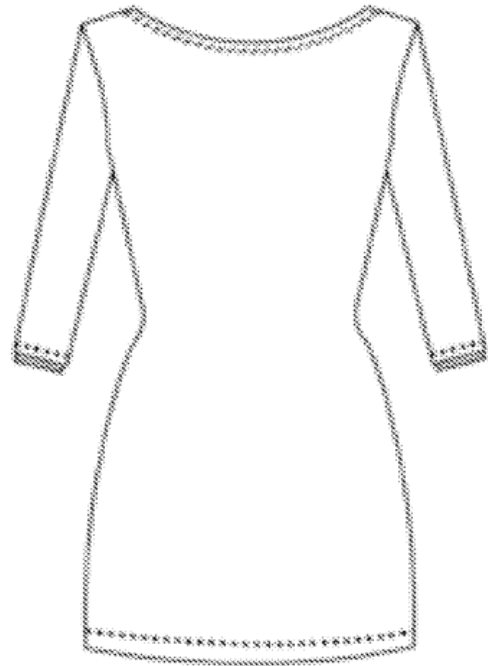


FIG. 21B



FIG. 22A



FIG. 22B



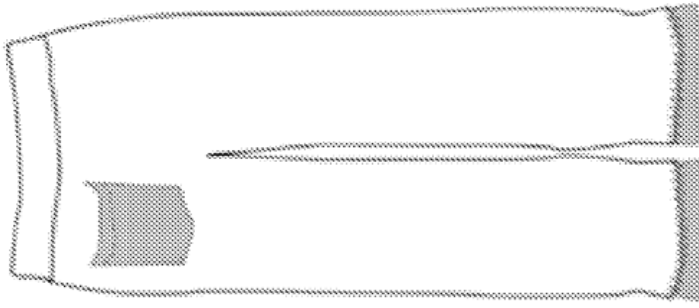


FIG. 24B

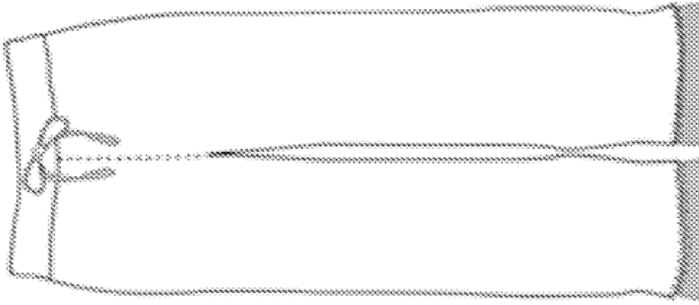


FIG. 24A



FIG. 23B



FIG. 23A

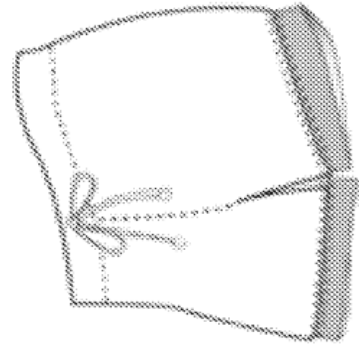


FIG. 25

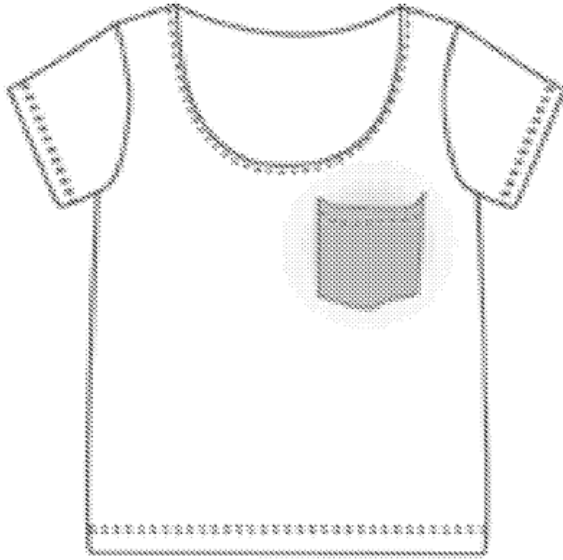


FIG. 26A

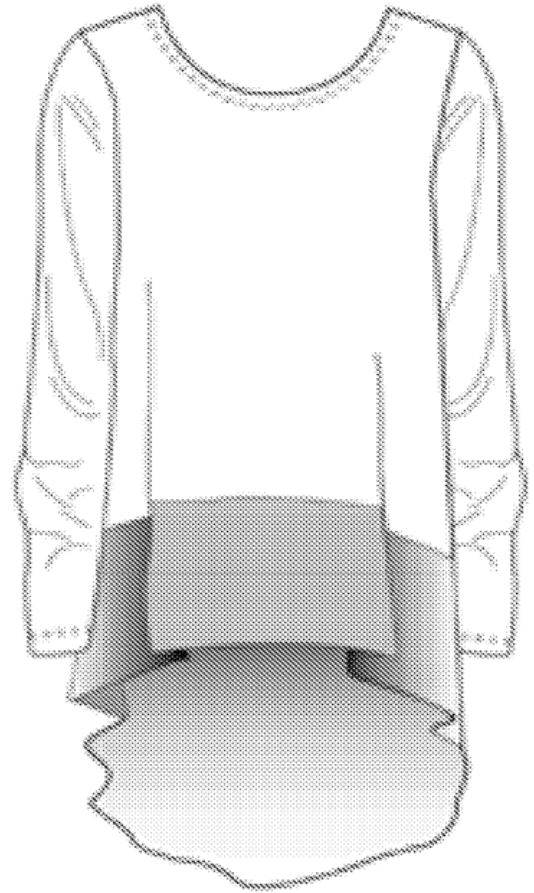


FIG. 27

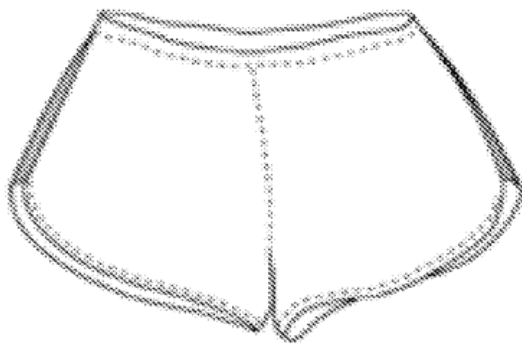
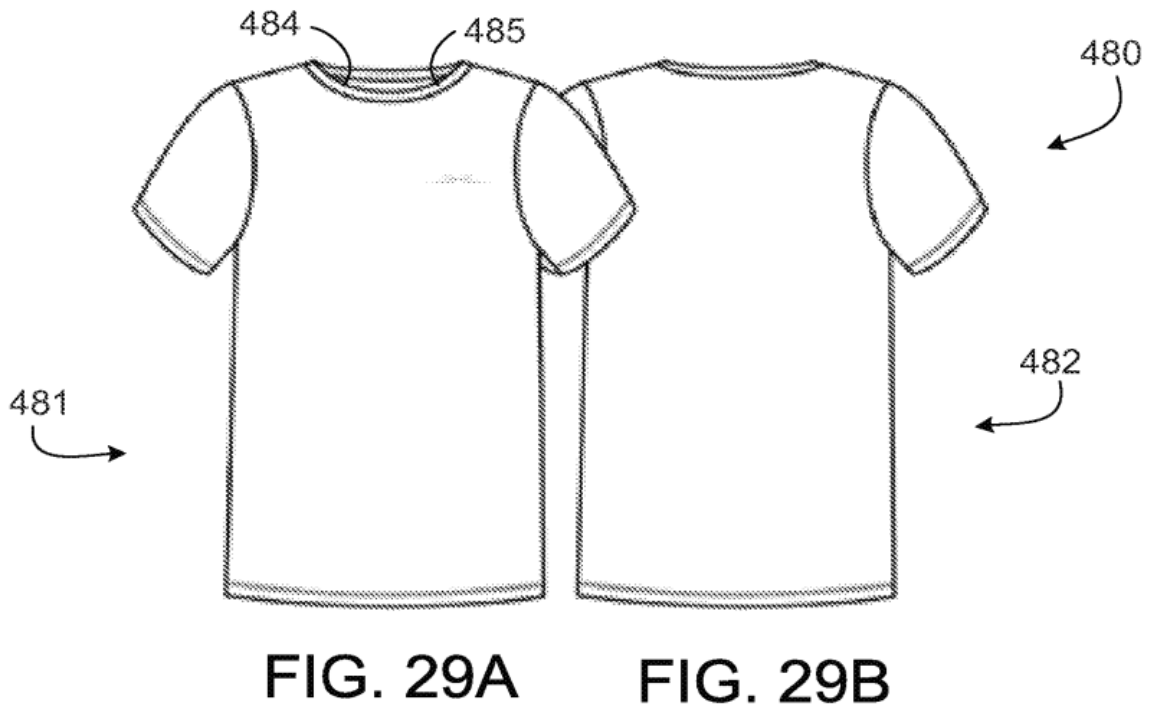
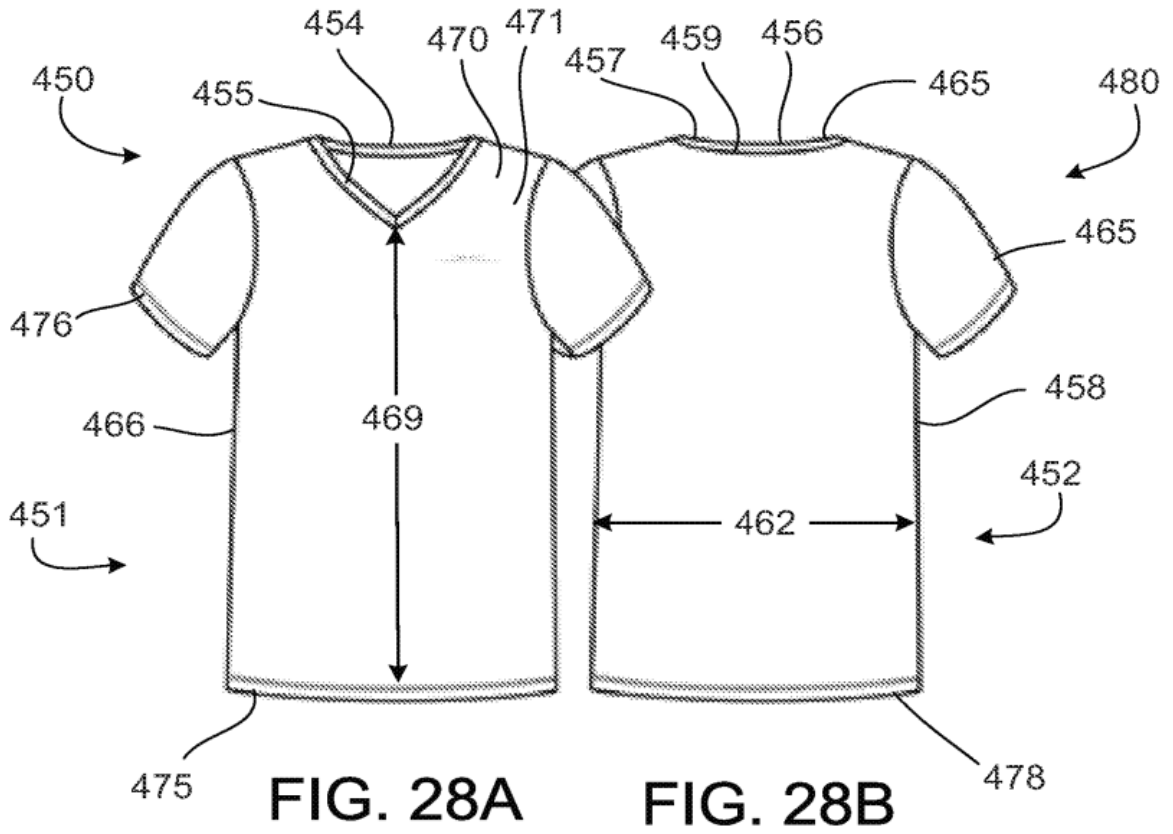
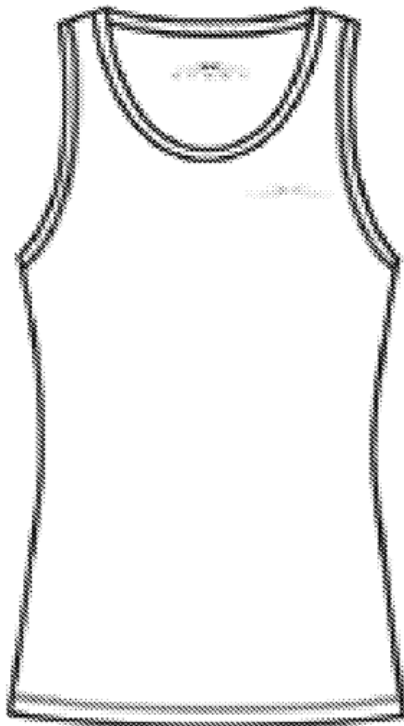
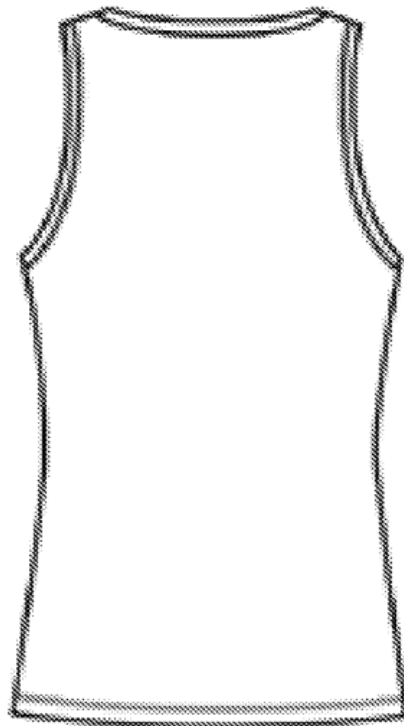


FIG. 26B

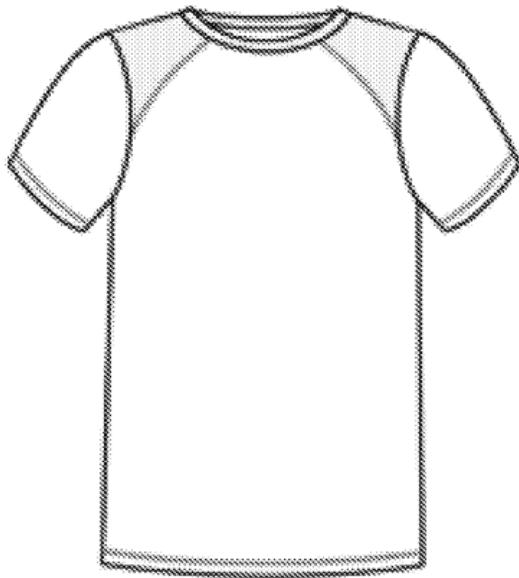




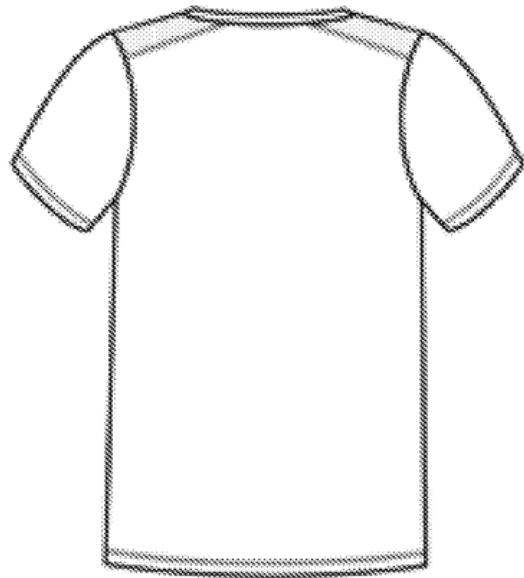
**FIG. 30A**



**FIG. 30B**



**FIG. 31A**



**FIG. 31B**



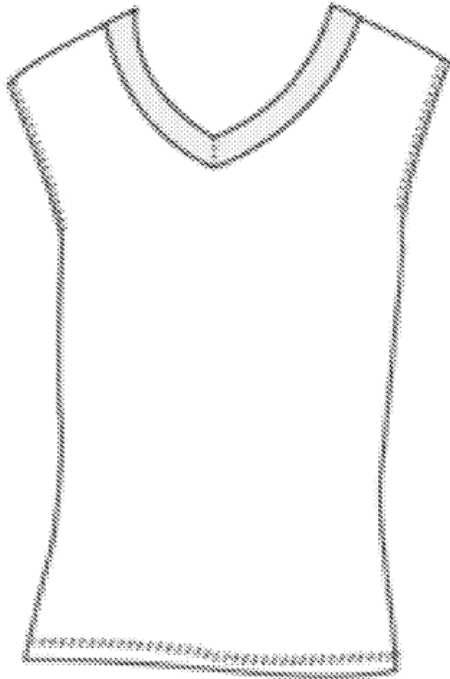


FIG. 32

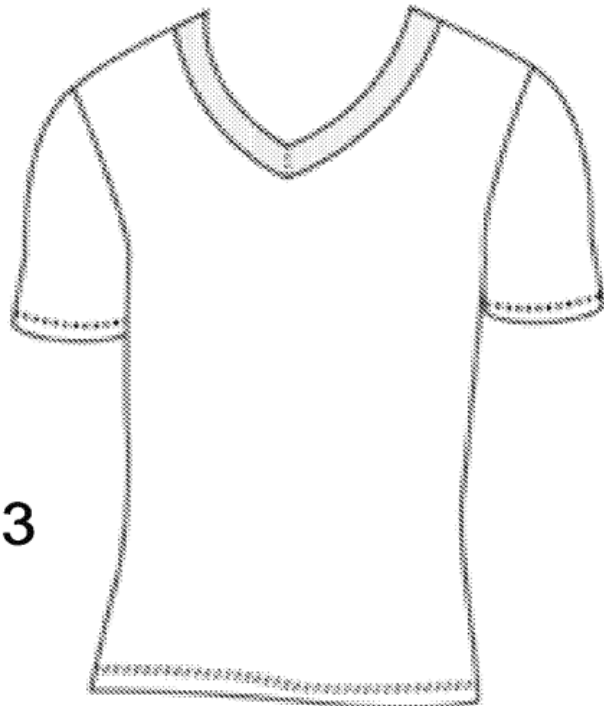
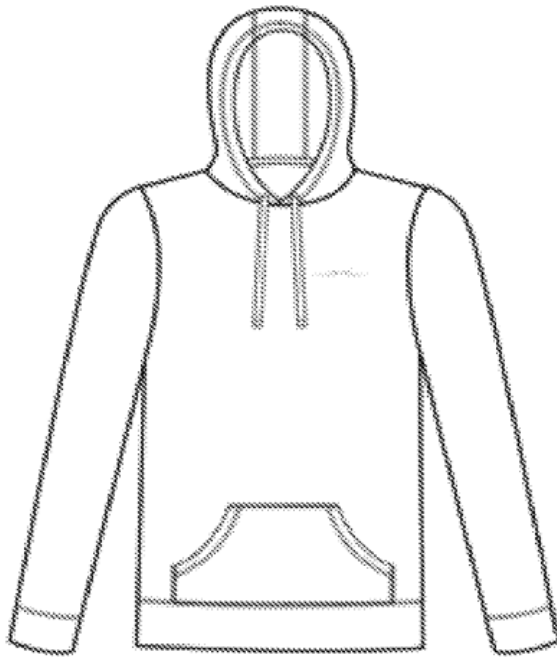
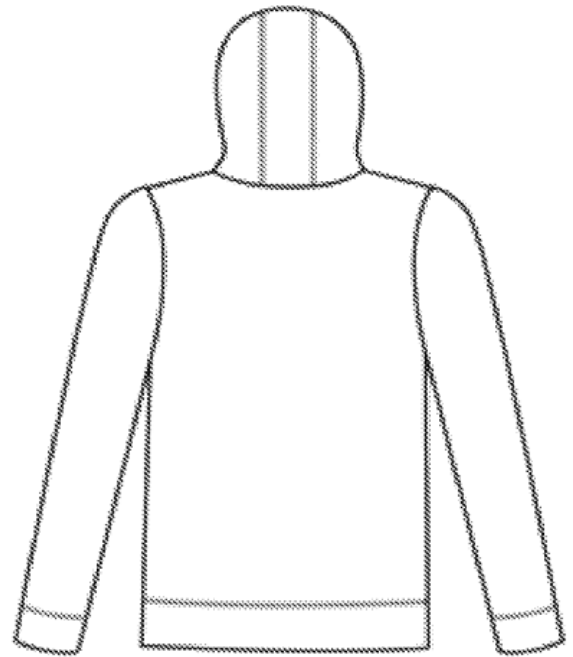


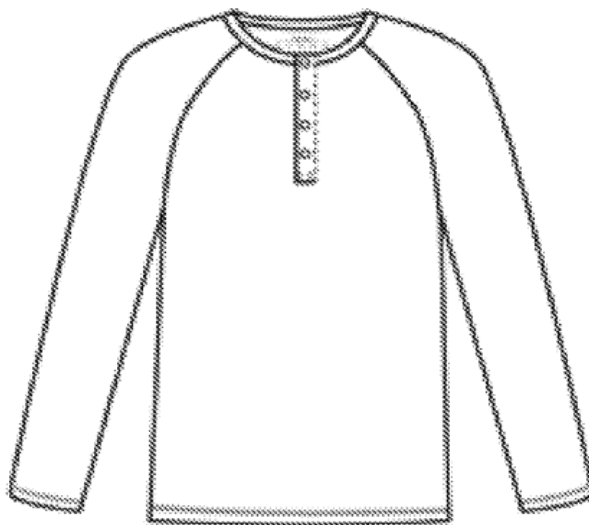
FIG. 33



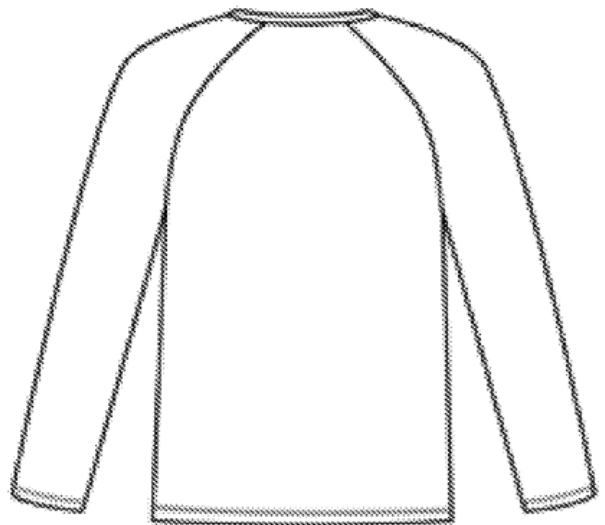
**FIG. 34A**



**FIG. 34B**



**FIG. 35A**



**FIG. 35B**

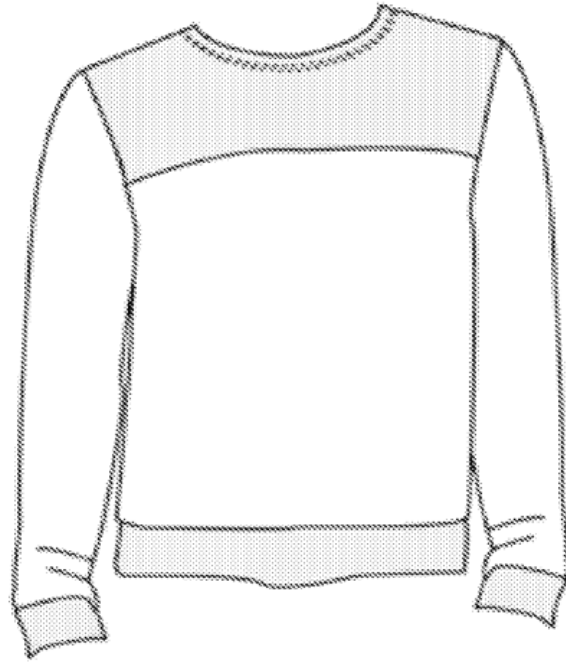


FIG. 36

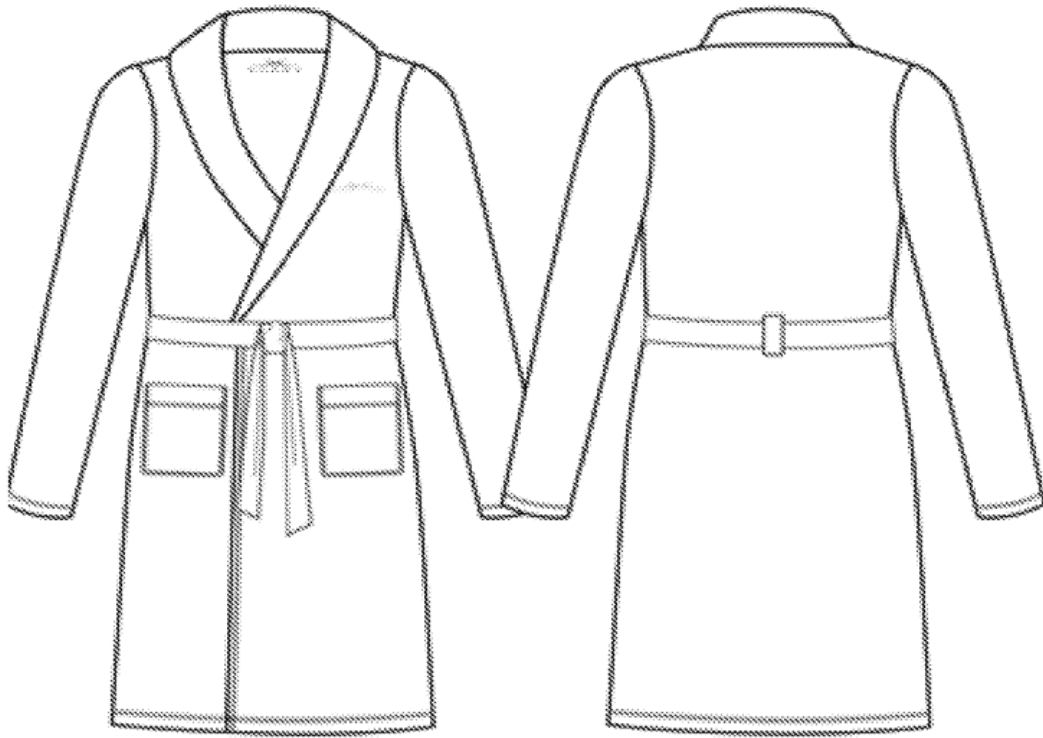


FIG. 37A

FIG. 37B

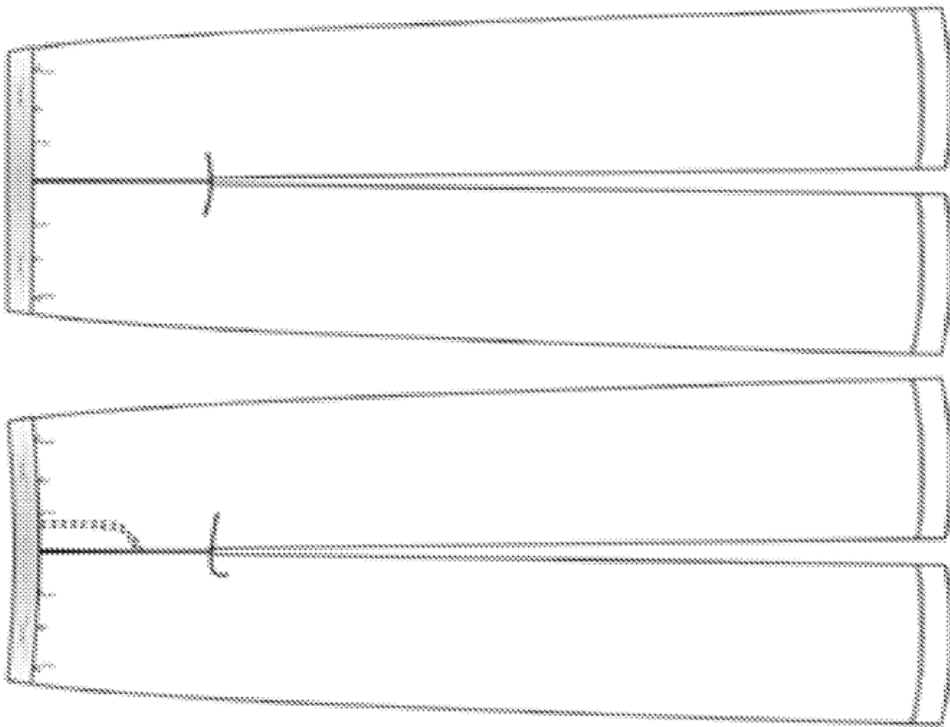


FIG. 38A FIG. 38B

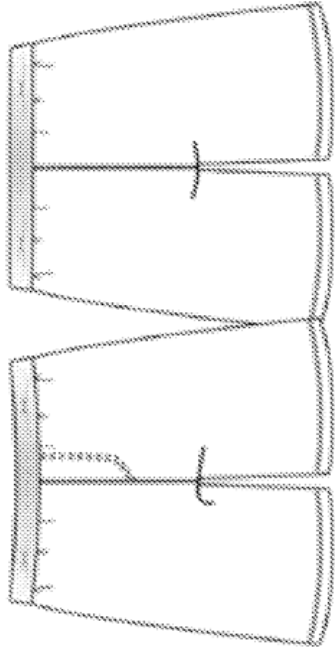


FIG. 39A FIG. 39B

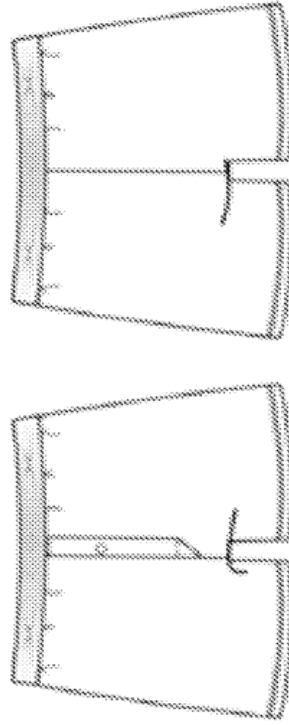


FIG. 40A FIG. 40B

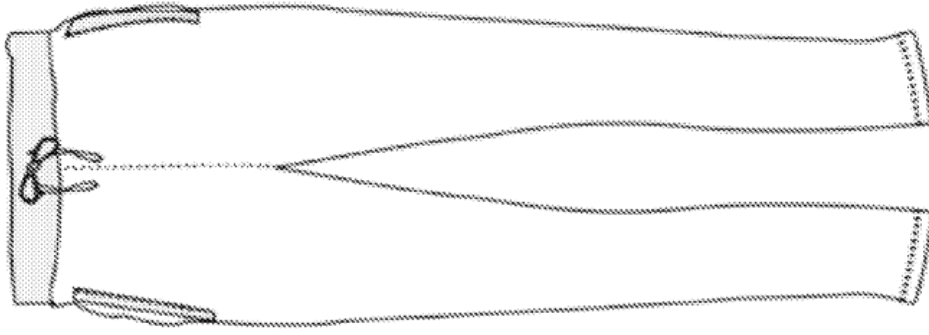


FIG. 43

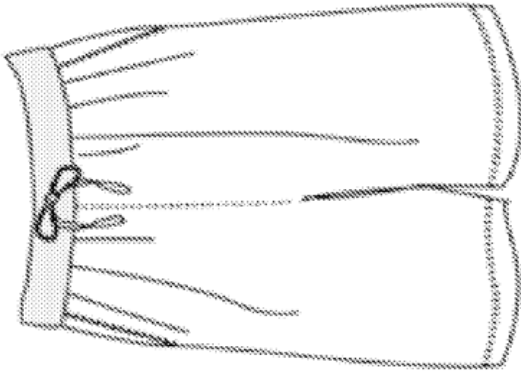


FIG. 42

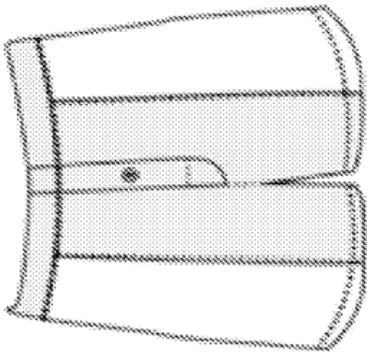


FIG. 41

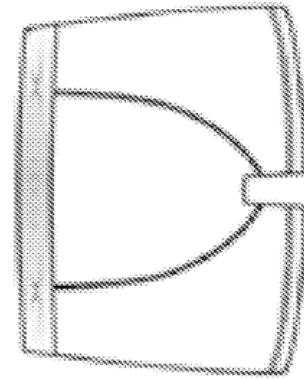


FIG. 44B

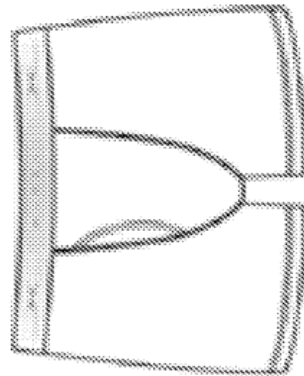


FIG. 44A



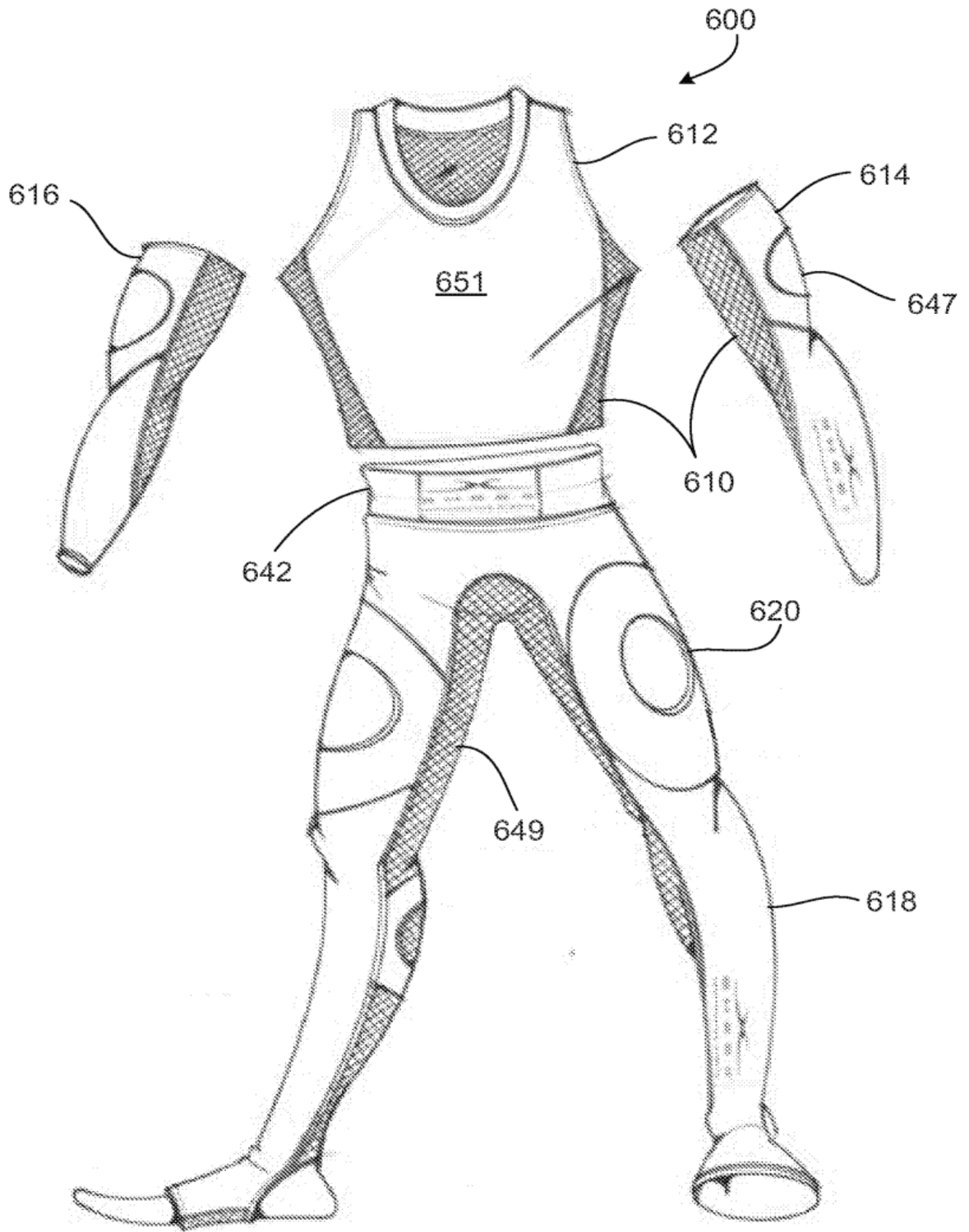


FIG. 45

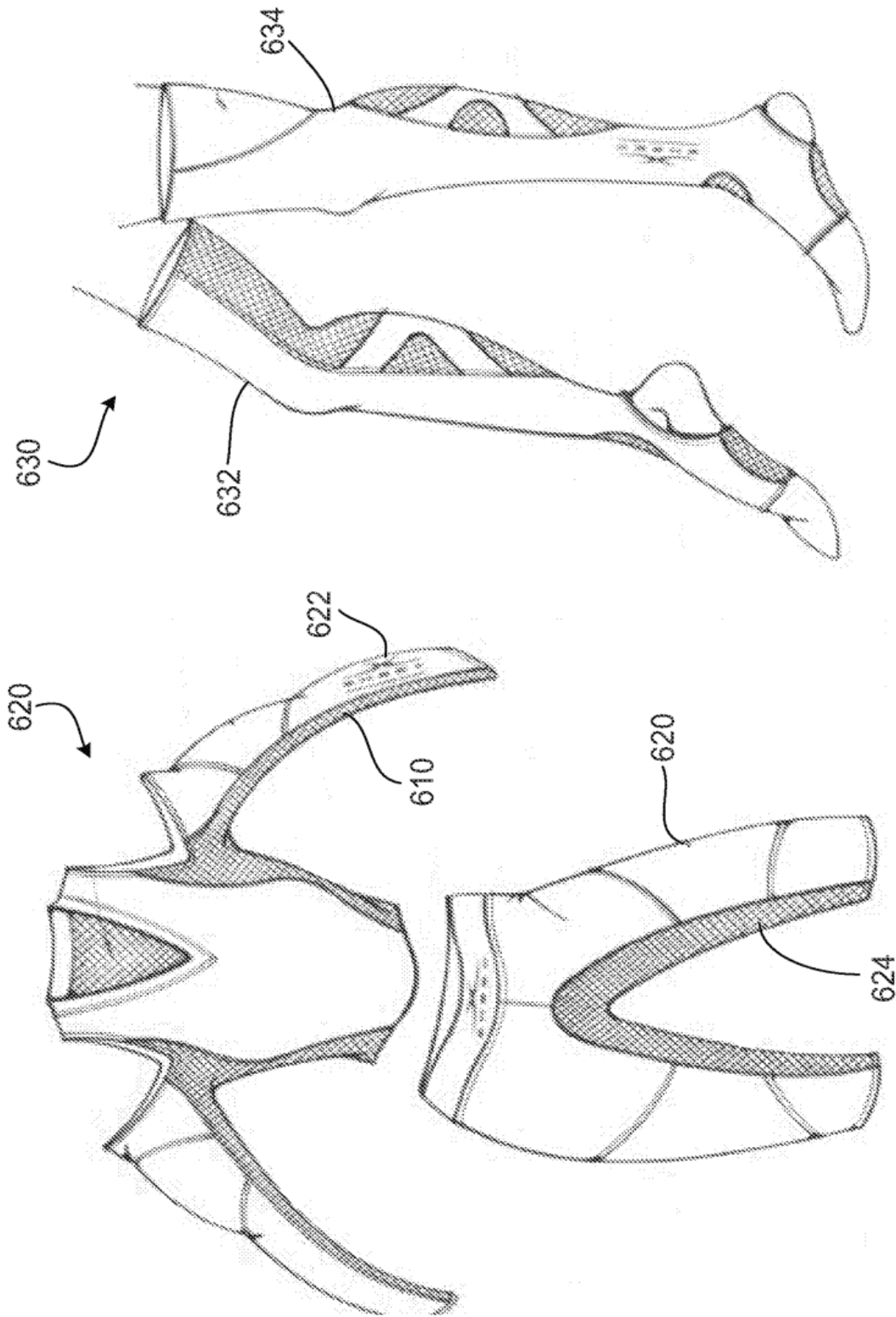


FIG. 46

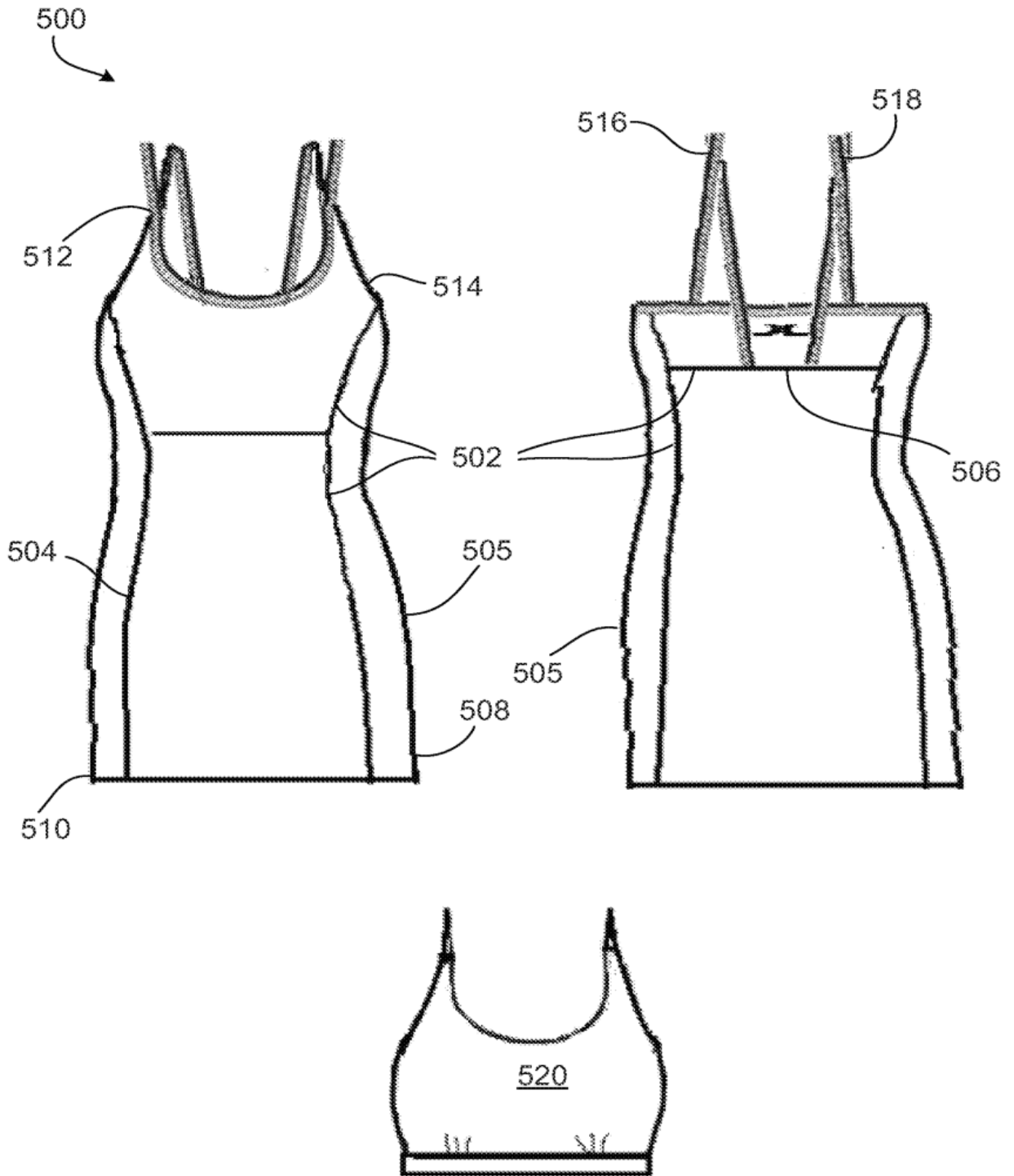


FIG. 47

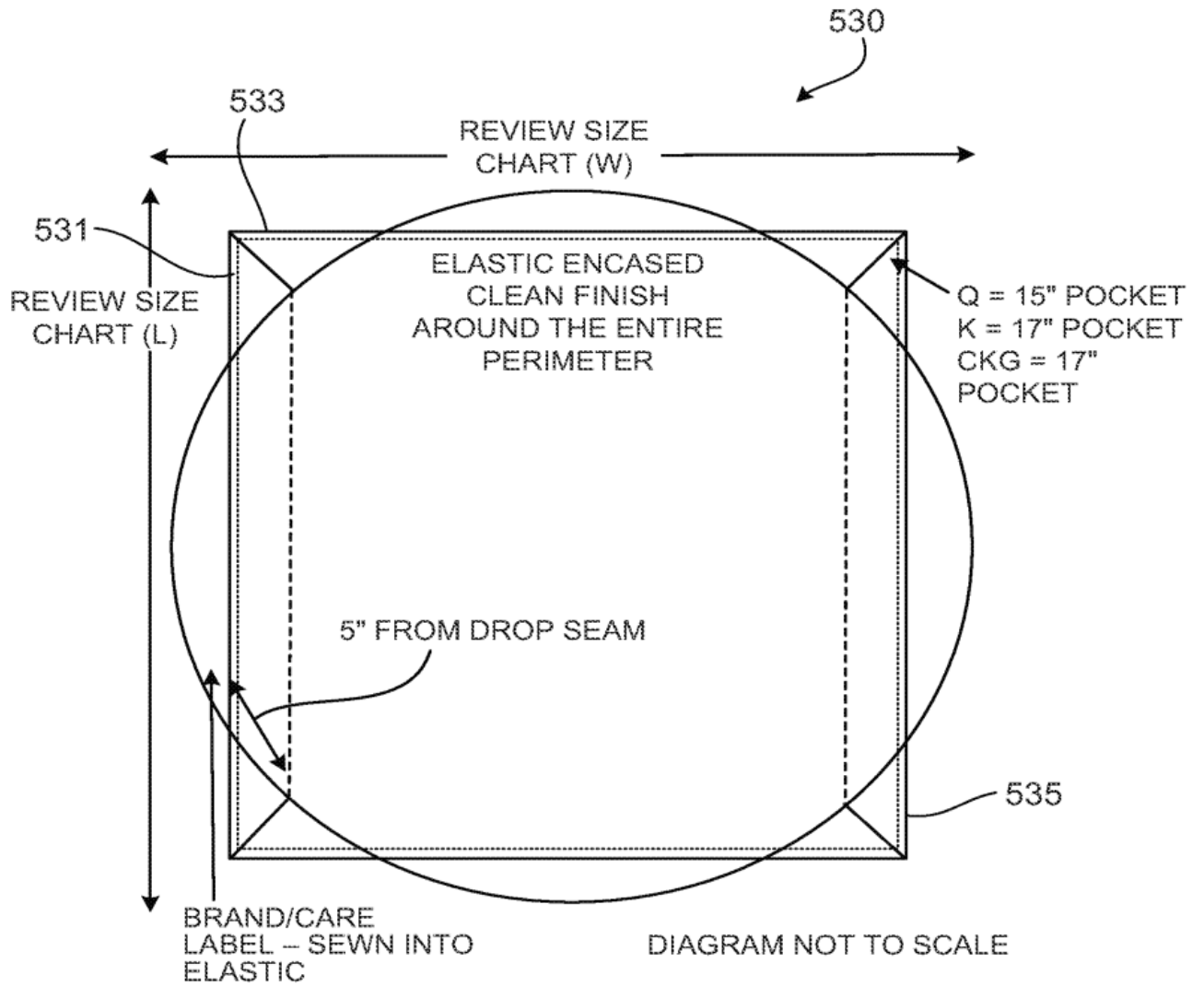


FIG. 48

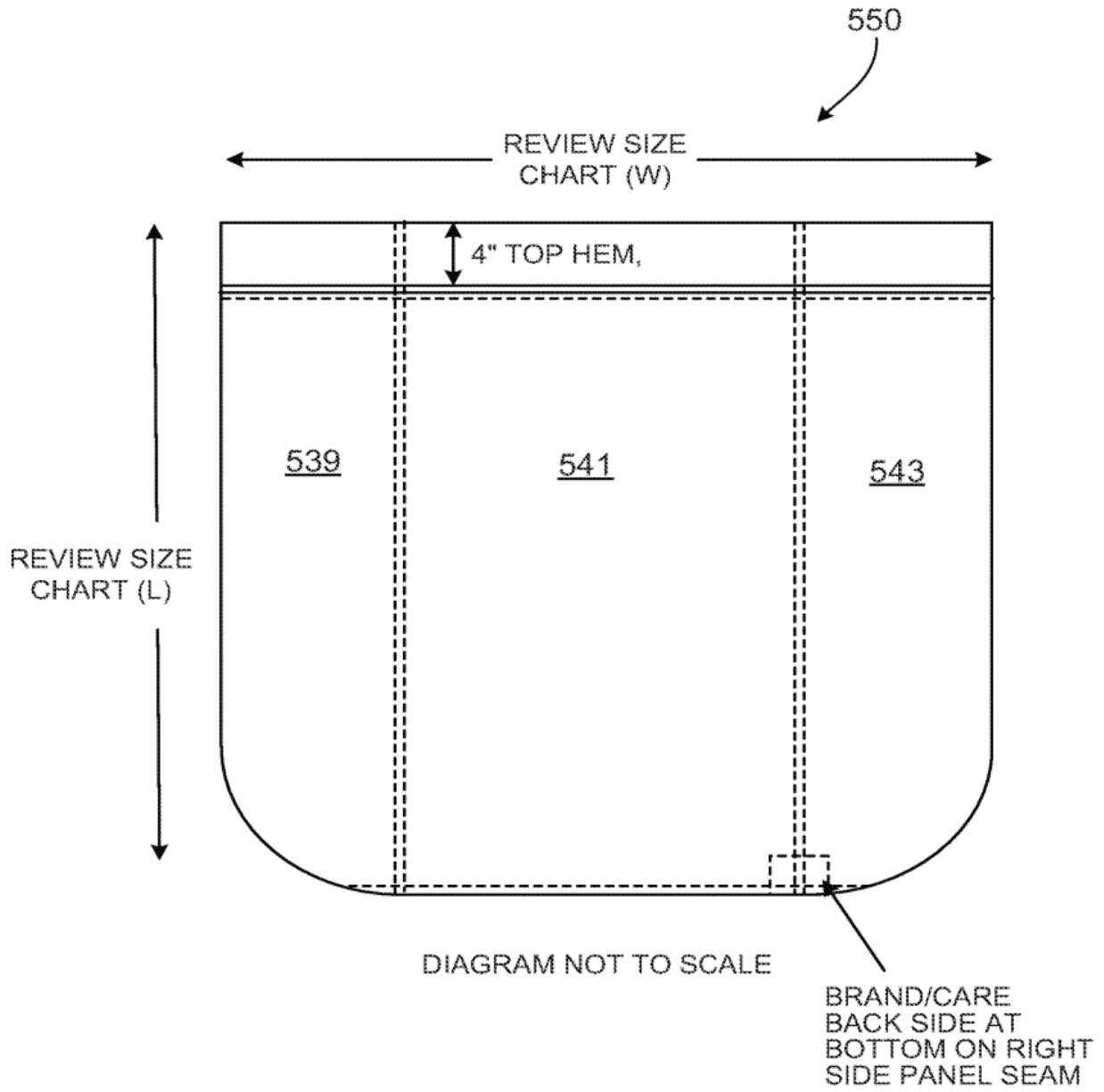


FIG. 49



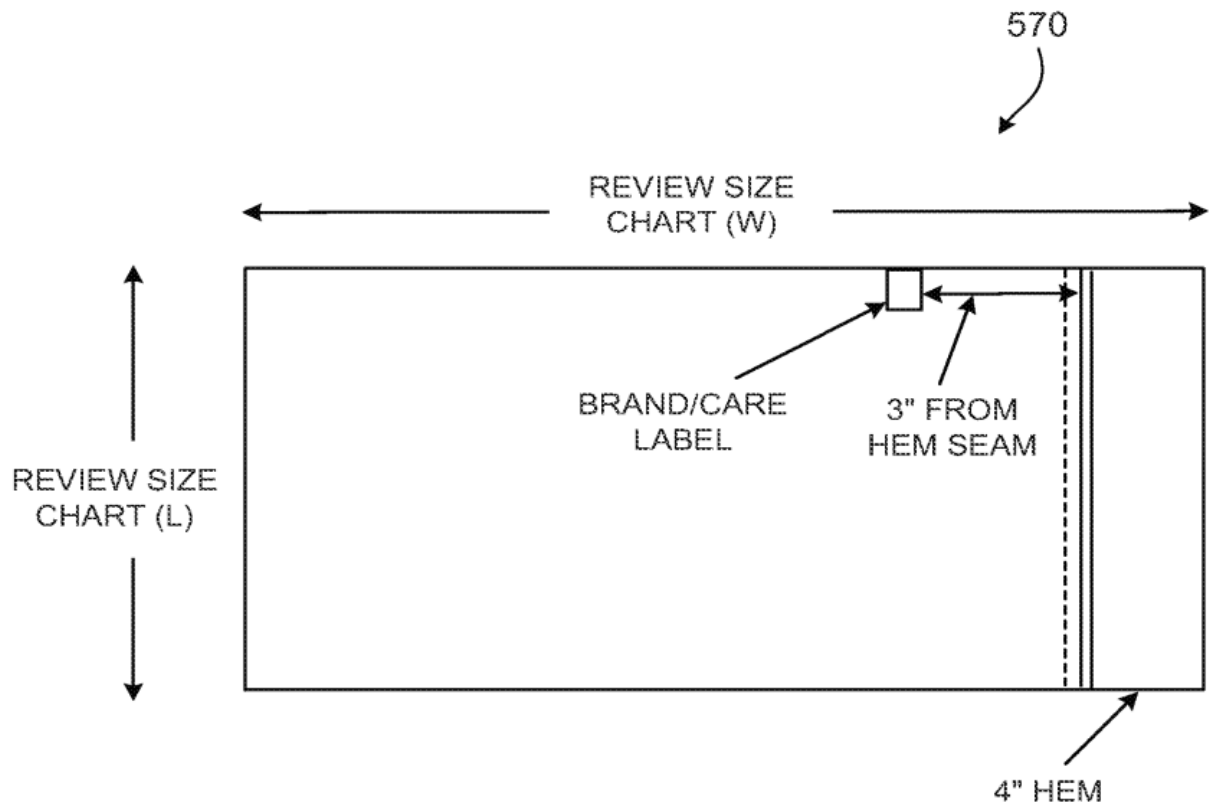


FIG. 50

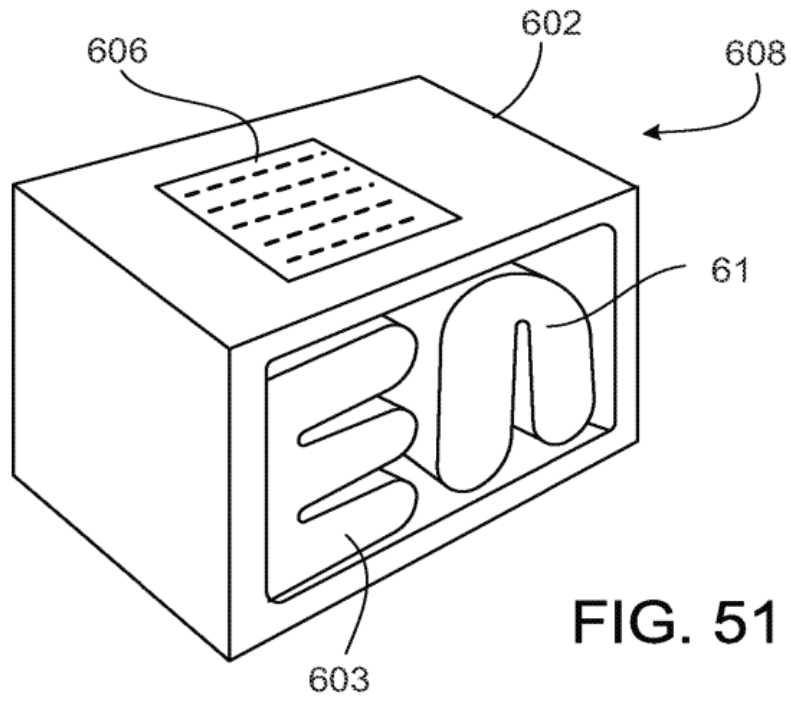


FIG. 51

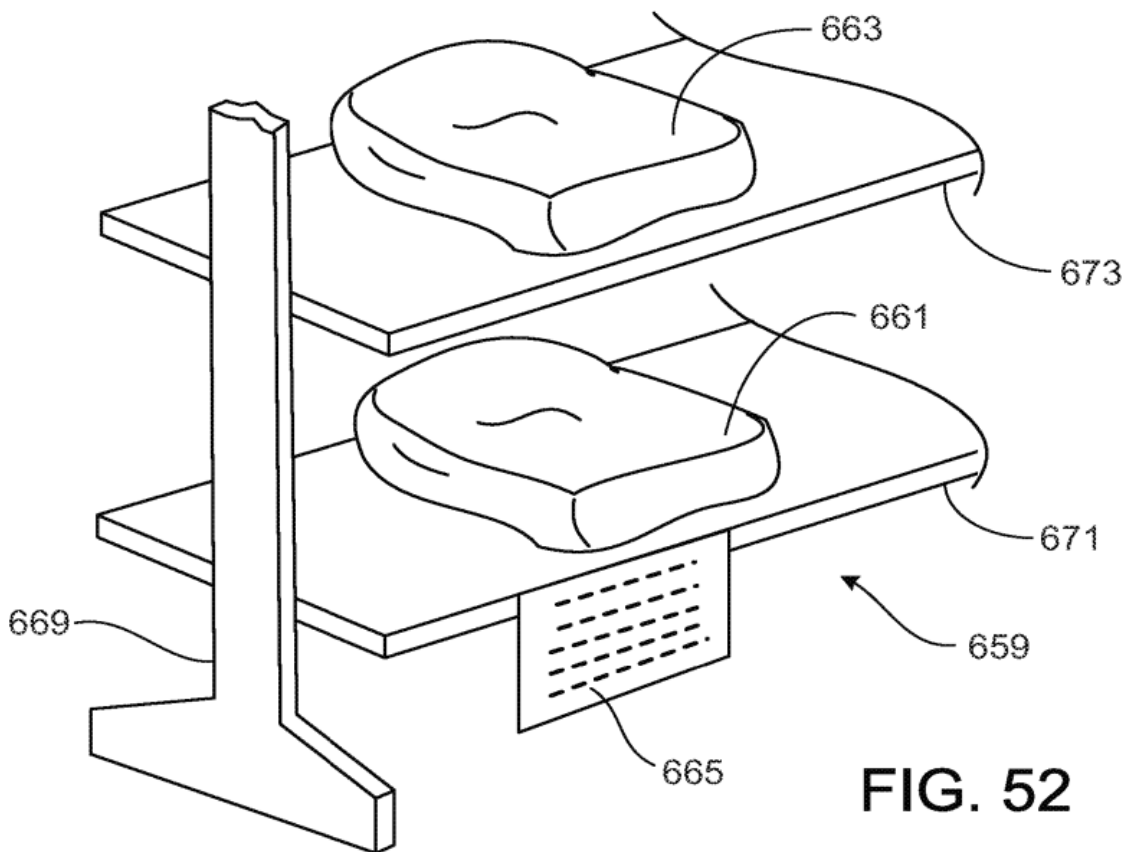


FIG. 52

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2014/024493

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - A47G 9/02 (2014.01) USPC - 2/83 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(8) - A41D 10/00; A47G 9/02; D04B 1/22 (2014.01) USPC - 2/23,83,227; 5/482,495,630; 66/170 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - A41D 10/00; A47G 9/02; D04B 1/22 (2014.02) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatBase, Google Patents, Google, Internet Archive Wayback Machine, YouTube		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	SHEEX. Store [online]. Sheex Corporation. 19 January 2013 [retrieved on 16 June 2014]. Retrieved from the internet: <URL: <a href="https://web.archive.org/web/20130119131453/http://sheex.com/">https://web.archive.org/web/20130119131453/http://sheex.com/</a> > entire document	1,2,4,6-19,21-42,67,69,70,72-75 ----- 3,20,43-45,51,63,64,68,71,77,78
X ----- Y	DAVIDSON. 'Cool' fabric to sleep in. The Boulder County Business Report. 08 December 2005 [retrieved on 16 June 2014]. Retrieved from the internet: <URL: <a href="https://web.archive.org/web/20070111053132/http://www.coolsets.com/documents/Boulder_Bus_Report_11-29-05.pdf">https://web.archive.org/web/20070111053132/http://www.coolsets.com/documents/Boulder_Bus_Report_11-29-05.pdf</a> > entire document	46-50,52-62,65,66 ----- 3,45,51,63,64,68,71,78
X ----- Y	DOLL. Sheex Sheets Review. 02 December 2012 [retrieved on 16 June 2014]. Retrieved from the internet: <URL: <a href="http://www.youtube.com/watch?v=X8sfl7TjYA0">http://www.youtube.com/watch?v=X8sfl7TjYA0</a> > entire document	76 ----- 43,44
Y	US 2007/0226911 A1 (GLADNEY et al) 04 October 2007 (04.10.2007) entire document	20
Y	US 947,140 A (WOLKERSTORFER) 18 January 1910 (18.01.1910) entire document	77
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
Date of the actual completion of the international search 19 June 2014	Date of mailing of the international search report 15 JUL 2014	
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774	

Form PCT/ISA/210 (second sheet) (July 2009)

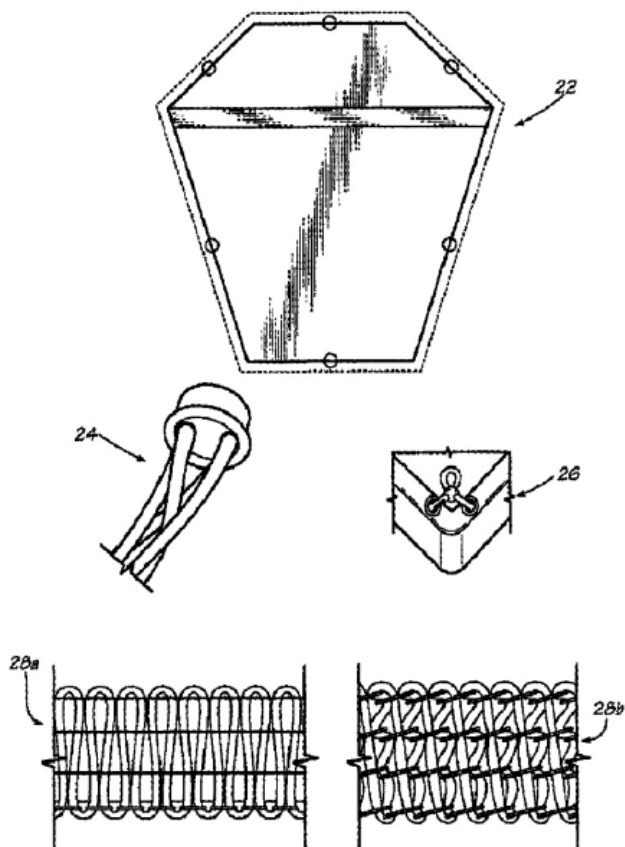
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 (87) Date publication PCT/PCT Publication Date: 2010/04/01  
 (45) Date de délivrance/Issue Date: 2013/09/17  
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 (30) Priorité/Priority: 2008/09/29 (US61/101,049)

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*D03D 11/00* (2006.01)  
 (72) Inventeurs/Inventors:  
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MARCINIAK, MICHELLE MARIE, US  
 (73) Propriétaire/Owner:  
SHEEX, INC., US  
 (74) Agent: SMART & BIGGAR

(54) Titre : SYSTEME DE TISSU  
 (54) Title: FABRIC SYSTEM



(57) **Abrégé/Abstract:**

Bedding material including a first fabric section manufactured from performance fabric and having a first and second side; and, a second fabric section attached to the first side of the first fabric section. Additionally, a third fabric section can be attached to the

(57) **Abrégé(suite)/Abstract(continued):**

second side of the first fabric section. The first fabric section can be attached to the second fabric section through a flatlock stitch. The first fabric section can include a first zone and a second zone wherein the first zone contains different performance properties from the second zone and the first zone can have thermal or moisture wicking properties.



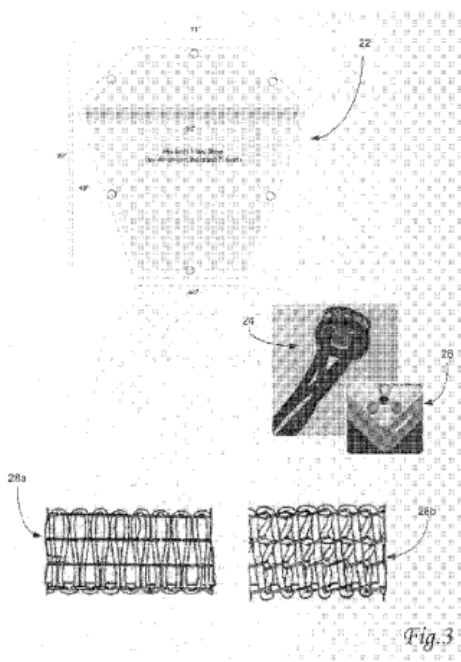
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(19) World Intellectual Property Organization  
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*D04B 21/14* (2006.01) *D03D 11/00* (2006.01)
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- (22) **International Filing Date:**  
29 September 2009 (29.09.2009)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
61/101,049 29 September 2008 (29.09.2008) US
- (71) **Applicant (for all designated States except US):** SHEEX LLC [US/US]; 169 Captain Lowman Road, Chapin, SC 29036 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** WALVIUS, Susan, Katherine [US/US]; 169 Captain Lowman Road, Chapin, SC 29036 (US). MARCINIAK, Michelle, Marie [US/US]; 169 Captain Lowman Road, Chapin, SC 29036 (US).
- (74) **Agent:** SCHNEIDER, Ryan, A.; Troutman Sanders LLP, Bank of America Plaza, 600 Peachtree Street, N.E., Suite 5200, Atlanta, GA 30308-2216 (US).
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
- with international search report (Art. 21(3))
  - before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

[Continued on next page]

(54) Title: FABRIC SYSTEM



(57) **Abstract:** Bedding material including a first fabric section manufactured from performance fabric and having a first and second side; and, a second fabric section attached to the first side of the first fabric section. Additionally, a third fabric section can be attached to the second side of the first fabric section. The first fabric section can be attached to the second fabric section through a flatlock stitch. The first fabric section can include a first zone and a second zone wherein the first zone contains different performance properties from the second zone and the first zone can have thermal or moisture wicking properties.

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**WO 2010/037082 A3** 

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(88) Date of publication of the international search report:  
8 July 2010

## FABRIC SYSTEM

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates generally to fabric systems, and more specifically to bed coverings constructed of high gauge circular knitted fabrics that accommodate and maintain optimum thermal conditions for sleep, which in turn can lead to faster sleep initiation and deeper, more restorative sleep.

#### 2. Description of Related Art

Sleep problems in the United States are remarkably widespread, affecting roughly three out of four American adults, according to research by the National Sleep Foundation (NSF). Consequently, a great deal of attention has been paid to the circumstances surrounding poor sleep, along with strategies for how to improve it.

The implications are not merely academic. Sleep – not only the right amount of it but also the right quality – impacts not just day-to-day performance, but also “the overall quality of our lives,” according to the NSF. Addressing the causes of poor quality sleep, therefore, has ramifications for millions.

Though many factors contribute to sleep quality, the sleep environment itself plays a critical role, and sleep researchers routinely highlight temperature as one of the most important components in creating an environment for optimal sleep. As advised by the University of Maryland Medical Center, “a cool (not cold) bedroom is often the most conducive to sleep.” The National Sleep Foundation further notes that “temperatures above 75 degrees Fahrenheit and below 54 degrees will disrupt sleep,” with 65 degrees being the ideal sleep temperature for most individuals, according to the NSF.

A lower environmental temperature is not the only thermal factor associated with improved sleep. Researchers have noted a nightly drop in body temperature among healthy, normal adults during sleep. This natural cycle, when inhibited or not functioning properly, can disrupt sleep and delay sleep onset, according to medical researchers at Cornell University. Conversely, the researchers noted, a rapid decline in body temperature not only accelerates sleep onset but also “may facilitate an entry into the deeper stages of sleep.”

Therefore, maintaining an appropriately cool sleep environment and accommodating the body's natural tendency to cool itself at night should be a top priority for individuals interested in optimizing their sleep quality. Performance fabrics crafted into bedding applications would be uniquely capable of promoting cool, comfortable – and therefore better – sleep, as these advanced fabrics maximize breathability and heat transfer. Performance fabrics are made for a variety of end-use applications, and can provide multiple functional qualities, such as moisture management, UV protection, anti-microbial, thermo-regulation, and wind/water resistance.

There has been a long felt need in several industries to provide improved bedding to help individuals get better sleep. Such improved bedding would include beneficial wicking among other properties. For example, in marine, boating and recreational vehicle applications, bedding should resist moisture, fit odd-shaped mattresses and beds, and reduce mildew. Particularly with watercraft, there is a need to protect bedding, and specifically sheets, from moisture and mildew accumulation.

An additional problem with bedding, not just with marine and recreational vehicles, is the sticky, wet feeling that can occur when the bedding sheets are wet due to body sweat, environmental moisture, or other bodily fluids. In particular, when bedding is used during hot weather, or is continuously used for a long time by a person suffering from an illness, problems can arise in that the conventional bed sheet of cotton fiber or the like cannot sufficiently absorb the moisture. All of these issues lead to poor sleep.

To date, performance fabric bedding products are not known. There are width limitations in the manufacturing of high gauge circular knit fabrics, because the finished width of bedding fabrics are dictated by the machine used in its construction. At present, performance fabrics are manufactured with a maximum width of under 90 inches wide, given present manufacturing and technical limitations, along with the inability of alternate manufacturing processes to produce a fabric with identical performance attributes. Yet, normal bed sheet panels can be 102 by 91 inches or larger. Thus, performance fabrics cannot yet be used for bed sheets.

Some conventional solutions for the above issues that hinder a good night's sleep include United States Patent 4,648,186, which discloses an absorbent wood pulp cellulose fiber that is provided in a variety of sizes and is placed under a mattress. The wood pulp is water absorbent and acts to capture moisture to prevent such moisture from being retained by the bedding or the

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bedding sheets. However, this proposed solution does not interact with the bedding or the bedding sheets, but merely acts as a sponge for moisture that is in proximity to the target bedding.

United States Patent 5,092,088 discloses a sheet-like mat comprised of a mat cover, the inside of which is divided into a plurality of bag-like spaces, and a drying agent packed into a bag and contained in the bag-like spaces in such a manner that the drying agent cannot fall out of the bag-like spaces. A magnesium sulfate, a high polymer absorbent, a silica gel or the like can be used as the drying agent. As can be seen, this proposed solution to moisture in bedding is cumbersome and chemically-based.

In the athletic apparel industry, moisture wicking fabric has been used to construct athletic apparel. For example, United States Patent 5,636,380 discloses a base fabric of Coolmax<sup>TM</sup> high moisture evaporation fabric having one or more insulating panels of Thermax<sup>TM</sup>B or Thermostat<sup>TM</sup>Q hollow core fiber fabric having moisture wicking capability and applied to the inner side of the garment for skin contact at selected areas of the body where muscle protection is desired. However, this application cannot be applied to bedding sheets due to the limitations of the size of the performance fabrics manufactured. Further, performance fabric such as this type cannot be easily stitched together as the denier is so fine that stitching this fabric results in the stitching simply falling apart.

Circular knitting is typically used for athletic apparel. The process includes circularly knitting yarns into fabrics. Circular knitting is a form of weft knitting where the knitting needles are organized into a circular knitting bed. A cylinder rotates and interacts with a cam to move the needles reciprocally for knitting action. The yarns to be knitted are fed from packages to a carrier plate that directs the yarn strands to the needles. The circular fabric emerges from the knitting needles in a tubular form through the center of the cylinder. This process is described in United States Patent 7,117,695. However, the machinery presently available for this method of manufacture can only produce a fabric with a maximum width of approximately 90 inches. Therefore, this process has not been known to manufacture sheets, since sheets can have dimensions of 91 inches by 102 inches or greater.

Further, the machinery that is used for bedding is very different than for athletic wear. For example, bedding manufacturing equipment is not equipped to sew flatlock stitching or to provide circular knitting. Bed sheets typically are knit using a process known as warp knitting, a



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process capable of producing finished fabrics in the widths required for bedding. This method, however, cannot be employed to produce high-quality performance fabrics. Warp knitting is not capable of reproducing these fabrics' fine tactile qualities nor their omni-direction stretch properties, for example.

5                   Circular knitting must be employed to produce a performance fabric that retains these fabric's full range of benefits and advantages. However, in order to produce a fabric of the proper width for bedding applications, a circular knit machine of at least 48 inches in diameter would be necessary. Manufacturing limitations therefore preclude the construction of performance fabrics at proper widths for bedding. The industry is unsure if it  
10 could actually knit and then finish performance fabrics at these large sizes, even if the machinery were readily available.

Further, athletic sewing factories are typically not equipped to sew and handle large pieces of fabrics so that equipment limitations do not allow for the manufacture of bedding sheets.

15                   What is needed, therefore, is a bedding system that utilizes performance fabrics and their beneficial properties, the design of which acknowledges and addresses limitations in the manufacture of these fabrics. It is to such a system that some embodiments disclosed herein are primarily directed.

#### **BRIEF SUMMARY OF THE INVENTION**

20                   According to one aspect of the present invention, there is provided a method of making a finished fabric at least 90 inches wide comprising: forming at least two discrete performance fabric portions, that are to be joined to form the finished fabric, at least one of the discrete performance fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a  
25 proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and joining the at least two discrete performance fabric portions to form the finished fabric.

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According to another aspect of the present invention, there is provided a method of making a finished fabric at least 90 inches wide comprising: circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and stitching the at least two discrete performance fabric portions together to form the finished fabric.

According to still another aspect of the present invention, there is provided a method of making a bed sheet at least 90 inches wide from performance fabric comprising: circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; stitching the at least two discrete performance fabric portions together; and heat setting finishing the stitched at least two discrete performance fabric portions to form the finished bed sheet.

According to yet another aspect of the present invention, there is provided a finished fabric at least 90 inches wide comprising: a first circular knitted performance fabric knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and a second circular knitted performance fabric; wherein the first and second performance fabrics are discrete; and wherein the first and second performance fabrics are joined to form the finished fabric.

According to a further aspect of the present invention, there is provided a bedsheet comprising a performance fabric of a man-made fiber, the performance fabric circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch

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circumference without losing integrity of the fabric, the performance fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

According to yet a further aspect of the present invention, there is provided a  
5 bedsheet comprising a circularly knit fabric knit at a high gauge and including a high performance man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

According to still a further aspect of the present invention, there is provided a  
10 bedsheet comprising a knit fabric that includes polyurethanepolyurea copolymer fiber in a proportion that, if circularly knit at a high gauge, could be knit at no more than a 72.5 inch circumference without losing the integrity of the polyurethanepolyurea copolymer fiber.

According to another aspect of the present invention, there is provided a  
bedsheet that is sufficiently stretchable to fit a standard rectangular bed and a smaller, non-rectangular marine bed, the bedsheet being formed at least in part of a performance fabric that  
15 has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

According to yet another aspect of the present invention, there is provided a  
bedsheet that is sufficiently stretchable to fit either a crib or a standard adult bed, the bedsheet  
20 being formed at least in part of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

According to another aspect of the present invention, there is provided a  
25 method of making a finished fabric at least 90 inches wide comprising circular knitting at least two discrete fabric portions, at least one of the fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a

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synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; stitching the at least two discrete fabric portions; and heat setting finishing the stitched at least two discrete fabric portions.

5           According to still another aspect of the present invention, there is provided a method of making a bed sheet at least 90 inches wide from performance fabric comprising circular knitting at least two discrete fabric portions, at least one of the fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly  
10 knit at no more than a 72.5 inch circumference without losing integrity of the fabric; the two discrete fabric portions having different fabric characteristics including at least one of the following: moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance, and water resistance; stitching the at least two discrete fabric portions together; heat setting finishing the stitched at least two discrete fabric portions to form a finished bed  
15 sheet; and providing piping to the finished bed sheet.

          According to yet another aspect of the present invention, there is provided a finished fabric at least 90 inches wide comprising: a first circular knitted fabric portion; and a second circular knitted fabric portion, and at least one of the circular knitted fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the  
20 performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; wherein the first and second fabric portions are discrete; and wherein the first and second fabric portions are joined to form the finished fabric.

          According to a further aspect of the present invention, there is provided a bed  
25 sheet comprising a fabric of a man-made fiber, the fabric circularly knit at a high gauge, the fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric, and the



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fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

According to yet a further aspect of the present invention, there is provided a bed sheet comprising a circularly knit fabric knit at a high gauge and including a high  
5 performance man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

According to still a further aspect of the present invention, there is provided a bed sheet comprising a fabric circularly knit of a man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing  
10 integrity of the fabric, the fabric having a gauge of at least 17 gauges, and the fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

According to another aspect of the present invention, there is provided a method comprising: forming at least two discrete performance fabric portions that are to be  
15 joined, at least one of the discrete performance fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the performance fabric were circularly knit at greater  
20 than a 72.5 inch circumference; and joining at least two discrete performance fabric portions along respective edges of the two portions to form a finished fabric at least 90 inches wide.

According to still another aspect of the present invention, there is provided a method comprising: circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions comprising a performance fabric that has been  
25 circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the performance fabric were circularly knit at greater than a 72.5 inch



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circumference; stitching at least two discrete performance fabric portions along respective edges of the two portions to form a bed sheet at least 90 inches wide; and heat setting finishing the stitched at least two discrete performance fabric portions.

According to yet another aspect of the present invention, there is provided a  
5 method comprising circular knitting at least two discrete fabric portions, at least one of the discrete fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the  
10 performance fabric were circularly knit at greater than a 72.5 inch circumference; the two discrete fabric portions having different fabric characteristics including at least one of the following: moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance, and water resistance; stitching at least two discrete fabric portions together along respective edges of the two portions; heat setting finishing the stitched at least two discrete  
15 fabric portions to form a finished bed sheet at least 90 inches wide; and providing piping to the finished bed sheet.

According to a further aspect of the present invention, there is provided a finished fabric at least 90 inches wide comprising: a first circular knitted fabric portion; and a  
20 second circular knitted fabric portion, at least one of the circular knitted fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the performance fabric were circularly knit at greater than a 72.5 inch circumference; wherein the first and second fabric  
25 portions are discrete; and wherein the first and second fabric portions are joined along respective edges of the two portions to form the finished fabric.

According to yet a further aspect of the present invention, there is provided a bed sheet comprising a fabric of a man-made fiber, the fabric having been knit at 17 gauges or

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higher, the fabric having an elasticity such that the fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the fabric were circularly knit at greater than a 72.5 inch circumference, and the fabric having higher breathability, higher heat transfer, and  
5 higher moisture wicking characteristics than a cotton fabric.

According to still a further aspect of the present invention, there is provided a bed sheet comprising a fabric circularly knit at 17 gauges or higher and including a high performance man-made fiber, the fabric having an elasticity such that the fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a  
10 finishing process, such that the sag would interfere with the finishing process if the fabric were circularly knit at greater than a 72.5 inch circumference.

According to another aspect of the present invention, there is provided a bed sheet comprising a fabric circularly knit of a man-made fiber, the fabric having a gauge of at least 17 gauges, the fabric having an elasticity such that the fabric has a tendency to sag by an  
15 amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the fabric were circularly knit at greater than a 72.5 inch circumference, and the fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

Briefly described, in preferred form, one embodiment is a high gauge circular  
20 knit fabric for use in bedding, and a method for manufacturing such bedding. The bedding fabric has superior performance properties, while allowing for manufacture by machinery presently available and in use. In order to achieve a finished width of the size needed to create sheet-sized performance fabric, a high gauge circular knit machine of at least 48 inches in diameter is necessary. And while warp knitting machines are available that can produce wider  
25 fabrics, this method will not provide a fabric with the tactile qualities required, nor provide a fabric with omni-directional stretch.

In an exemplary embodiment, there is provided a method of making a finished fabric comprising at least two discrete performance fabric portions, and joining at least two

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discrete performance fabric portions to form the finished fabric. Forming the at least two discrete performance fabric portions can comprise knitting at least two discrete performance fabric portions, and more preferably, circular knitting at least two discrete performance fabric portions. Joining the at least two discrete performance fabric portions to form the finished  
5 fabric can comprise stitching at least two discrete performance fabric portions together to form the finished fabric.

The at least two discrete performance fabric portions can have different fabric characteristics. Fabric characteristics as used herein include, among other things, moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance and water  
10 resistance.

The finished fabric can be used in, among other applications, residential settings, or in marine, boating and recreational vehicle environments.

The present sheets offer enhanced drape and comfort compared to traditional cotton bedding, and are as fine as silk, yet provide the benefits of high elasticity and recovery  
15 along with superior breathability, body-heat transport, and moisture management as compared to traditional cotton bedding.

Conventional fitted sheets can bunch and slide on standard mattress sizes. Furthermore, if the fitted bed sheets do not fit properly, they do not provide a smooth surface to lie on. Some embodiments disclosed herein may overcome these issues.

20 The present high gauge circular knit fabrics stretch to fit and offer superior recovery on the mattress allowing the fabric to conform to fit the mattress without popping off the corners of the mattress or billowing. The performance fabric can include spandex, offers a better fit than conventional bedding products, can accommodate larger or smaller mattress sizes with a single size sheet, and can conform to mattresses with various odd dimensions.

25 Spandex - or elastane - is a synthetic fiber known for its exceptional elasticity. It is stronger and more durable than rubber, its major non-synthetic competitor. It is a polyurethane-polyurea copolymer that was invented by DuPont. "Spandex" is a generic

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name, and an anagram of the word "expands." "Spandex" is the preferred name in North America; elsewhere it is referred to as "elastane." The most famous brand name associated with spandex is Lycra, a trademark of Invista.

The present high gauge circular knit fabric offers durability in reduced pilling  
5 and pulling when compared to other knit technologies, and offer reduced wrinkles and enhanced color steadfastness.

In a preferred embodiment, the present performance fabric can allow for a one-size fitted sheet that can actually fit two different size mattresses. For example, the full fitted sheet of some embodiments can fit on both the full and queen size bed. The twin fitted sheet  
10 of some embodiments will also fit an XL twin. In a boating application, some embodiments can be produced to fit almost every custom boat mattress.

Testing of some embodiments conducted at the North Carolina State University (NCSU) Center for Research on Textile Protection and Comfort confirms that the present performance fabrics provide a cooler sleeping environment than cotton. Performance  
15 bedding was tested side-by-side with commercially available cotton bed sheets in a series of procedures designed to measure each product's heat- and moisture-transport properties, as well as warm/cool-to-touch thermal transport capabilities.

Across all tests, the present performance fabrics in bedding outperformed cotton, demonstrating the performance fabric's superiority in establishing and maintaining  
20 thermal comfort during sleep. This advantage is evident to users from the very onset, as NCSU testing indicates that, on average, performance bedding of some embodiments offers improved heat transfer upon initial contact with the skin, resulting in a cooler-to-the-touch feeling.

During sleep, high gauge circular knit performance bedding of some  
25 embodiments helps to maintain thermal comfort by trapping less body heat and breathing better than cotton. Testing has demonstrated that performance bedding made out of performance fabrics transfers heat away from the body up to two times more effectively than



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cotton. This is critically important not only for sustained comfort during sleep, but also in terms of enabling the body to cool itself as rapidly as possible to facilitate sleep onset. In addition to trapping less heat, performance bedding breathes better than cotton - up to 50% better, giving performance bedding a strong advantage in terms of ventilation and heat and

5 moisture transfer.

The performance advantage over cotton holds true for simulated dry and wet skin conditions, confirming that certain performance fabrics in bedding are better suited than cotton at managing moisture (e.g., sweat) to maintain thermal comfort. In addition to wicking moisture away from the skin through capillary action, the performance fabric's advanced

10 breathability further enables heat and moisture transfer through evaporative cooling. As a result, the user is kept cooler, drier and more comfortable than with cotton.

The present performance bedding holds a distinct advantage over cotton in enabling, accommodating and maintaining optimum thermal conditions for sleep, which in turn can lead to faster sleep initiation and deeper, more restorative sleep.

15 These and other objects, features and advantages will become more apparent upon reading the following specification in conjunction with the accompanying drawings.

#### **BRIEF DESCRIPTION OF THE FIGURES**

**Fig. 1** illustrates a preferred embodiment of the present invention.

**Fig. 2** illustrates another preferred embodiment of the present invention.

20 **Fig. 3** illustrates a further preferred embodiment of the present invention.

**Fig. 4** illustrates another preferred embodiment of the present invention.

#### **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

Although preferred embodiments of the invention are explained in detail, it is to be understood that other embodiments are contemplated. Accordingly, it is not intended that the



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invention is limited in its scope to the details of construction and arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or carried out in various ways. Also, in describing the preferred embodiments, specific terminology will be resorted to for the sake of clarity.

- 5                   It must also be noted that, as used in the specification and the appended claims, the singular forms "a", "an" and "the" include plural referents unless the context clearly dictates otherwise. For example, reference to a sheet or portion is intended also to include the

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manufacturing of a plurality of sheets or portions. References to a sheet containing “a” constituent is intended to include other constituents in addition to the one named.

Also, in describing the preferred embodiments, terminology will be resorted to for the sake of clarity. It is intended that each term contemplates its broadest meaning as understood by those skilled in the art and includes all technical equivalents which operate in a similar manner to accomplish a similar purpose.

Ranges may be expressed herein as from “about” or “approximately” one particular value and/or to “about” or “approximately” another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value.

By “comprising” or “containing” or “including” is meant that at least the named compound, element, particle, or method step is present in the composition or article or method, but does not exclude the presence of other compounds, materials, particles, method steps, even if the other such compounds, material, particles, method steps have the same function as what is named.

It is also to be understood that the mention of one or more method steps does not preclude the presence of additional method steps or intervening method steps between those steps expressly identified. Similarly, it is also to be understood that the mention of one or more components in a fabric or system does not preclude the presence of additional components or intervening components between those components expressly identified.

Referring now in detail to the drawing figures, wherein like reference numerals represent like parts throughout the several views, the present invention of **Figs. 1 and 4** provides a sheet **10** shown having dimensions of 102 inches in length and 91 inches in width. The material is manufactured from performance fabric, which can include, for example, varying amounts of one or more of Lycra, Coolmax, Thermax and Thermastat. In a preferred embodiment, the fabric is treated so that the fabric has antimicrobial properties. By using circular-knit performance fabric, the fabric is able to provide elasticity in all four directions. This property allows for the sheet to fit extraordinary mattress, cushion and bedding shapes, as well as providing better fits for traditional rectangular sheets. By using performance fabrics, the sheet has elastic properties that allow stretching in the directions shown as **30**. In addition, by using circular-knit performance

fabric, the resulting bedding retains an exceptionally fine tactile quality critical for providing maximum levels of enhanced comfort.

An alternative to circular knitting is non-circular knitting – for example, warp knitting. This method can achieve widths greater than circular knitting. Industrial warp knit machines, for example, can produce tricote warp knit fabrics up to 130-140 inches in width. Circular knitting, however, is less expensive, as it requires less set-up time. Circular knitting also provides greater multidirectional stretch.

In order to provide a sheet that exceeds the maximum dimensions of fabric that can be produced by available circular knitting machines, flat lock stitching **12** is used to join a plurality of portions resulting in a sheet that is 91 inches wide (as shown). In an exemplary embodiment, piping **11** can be included in close proximity to the stitching. The stitching can be the same color as the fabric of the sheet portions, or different color(s). The piping can be 3/4 inch straight piping without a cord or other filler. In one preferred embodiment, the stitching is 16 stitches per inch. Piping **11** can be included at one end of the sheet and can be the same or a different color as the sheet fabric.

For a fitted sheet, the sheet can include an elastic portion surrounding the edge of the fitted sheet to better keep the fitted sheet in place when placed on a mattress or other sleeping surface. A cord can be sewn into the edge of the fitted sheet and cinched around the mattress or other sleeping surface to better hold the fitted sheet in place.

Referring to **Fig. 2**, a sheet is shown having dimensions of 91 inches wide and 102 inches in length. In this embodiment, stitching **14** is shown 34 inches from an interior edge **18** of a main portion **16** and another stitch **14** at edge **20** of the sewn-on portion. Flat lock stitching can be used for the stitching. Piping can be applied at or in proximity to the stitching.

Referring to **Fig. 3**, a non-rectangular shaped sheet is shown. In this exemplary embodiment, elastic can be included around the edge of the fitted sheet to better maintain the fitted sheet in position when placed on a sleeping surface. In one embodiment, pull ties **24** can be installed at various locations around the edge of the fitted sheet in order to assist in maintaining the fitted sheet secured to the sleeping surface. The pull tie can be cinched to increase tension around the edge of the fitted sheet as shown by **26**.

Stitching used for securing the portions of the sheet together can include that shown as **28a**. In another embodiment, the stitching used for securing the portion of fabric together is shown as **28b**.

Referring to **Fig. 4**, yet another preferred embodiment of the invention is shown. In this embodiment, the sheet can be assembled through stitching of differing fabrics for generating performance zones in the sheet. For example, zone **32** can have higher wicking properties than the other zones since this area is where the majority of the individual body rests. Areas **34a** through **34d** can have higher spandex or other elastic fabric properties so that the fit around a sleeping surface is improved. Area **36** may have thermal properties such as increased cooling since this area is generally where the individual's head lies. In an exemplary embodiment, the pillow covers of pillows used by the individual also have differing properties from the remainder of the sheet, e.g., thermal properties.

The present invention encompasses the construction of bedding materials that have superior performance properties while allowing for manufacture by machinery presently available and in use. More specifically, the invention is related to a new method for fabricating a covering and or sheets in bedding. When using the circular knitting machine, the high gauge performance fabrics can only be made to a maximum size of 72.5 inches without losing the integrity of the spandex in the fabric. Yet, normal sheet panels are 102 x 91 inches. This presents problems when manufacturing sheets from performance fabrics.

Additionally, special stitching techniques must be used given the thread density of the fabric. Using this special stitching, panels are sewn together to produce bedding or a sheet that is the proper size for standard bed sheets. Because discrete portions/panels are used in the manufacture of the present fabrics, panels can be selected that provide different properties for different areas of the bedding (**Fig. 4**). Stitching or seams on the sheet can also allow for the ease of making the bed. Because the bedding is made from performance fabric with spandex, it stretches to permit multiple and custom sizing for applications in cribs, recreational vehicles and boats.

Circular knitting machines used for high gauge performance bedding fabrics are called high-gauge circular knitting machines, because of dense knitting with thin yarn. High gauge generally denotes 17 gauges or more. Seventeen gauges indicate that 17 or more cylinder



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needles are contained in one inch. Circular knitting machines of less than 17 gauges are referred to as low-gauge circular knitting machines. The low-gauge circular knitting machines are often used to knit outerwear.

“Yarn count” indicates the linear density (yarn diameter or fineness) to which that particular yarn has been spun. The choice of yarn count is restricted by the type of knitting machine employed and the knitting construction. The yarn count, in turn, influences the cost, weight, opacity, hand and drape of the resulting knitted structure. In general, staple spun yarns tend to be comparatively more expensive the finer their count, because finer fibers and a more exacting spinning process are necessary in order to prevent the yarn from showing an irregular appearance.

A top width in the 90-inch range is currently possible using a circular knit fabric formed on a 36-38-inch diameter machine, although higher levels of spandex in the performance fabric tend to pull the width in. In just one example, on a 30-inch diameter machine, the spandex can reduce an otherwise 94-inch circumference fabric tube to one with a 60-65 inch finished width.

A major limitation in finished width is not strictly a knitting concern but also concerns finishing. With performance fabric, it tends to sag in the middle – increasingly so with greater widths – making finishing difficult to impossible above a certain threshold. A possible 90-inch finished width is contingent upon having a good finishing set-up capable of handling the present performance fabric. This potential for difficulties would only become compounded at the larger widths required for bed sheets.

In a preferred process, the present fabric undergoes a heat setting finishing process. Applying a moisture-wicking finish to another fabric – like cotton – that can be produced at larger widths appears unlikely to match the moisture-control properties of the present fabric, as polyester itself is naturally moisture-resistant and there are physical actions (e.g. capillary action) at play. Further, the use of cotton comes at the expense of breathability and heat-transfer capabilities (as confirmed by laboratory testing) and stretchability.

Numerous characteristics and advantages have been set forth in the foregoing description, together with details of structure and function. While the invention has been disclosed in several forms, it will be apparent to those skilled in the art that many modifications, additions, and deletions, especially in matters of shape, size, and arrangement of parts, can be made therein.



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Therefore, other modifications or embodiments as may be suggested by the teachings herein are particularly reserved as they fall within the breadth and scope of the claims here appended.

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CLAIMS:

1. A method of making a finished fabric at least 90 inches wide comprising:  
  
forming at least two discrete performance fabric portions, that are to be joined to form the finished fabric, at least one of the discrete performance fabric portions being  
5 formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and  
  
joining the at least two discrete performance fabric portions to form the finished fabric.
- 10 2. The method according to Claim 1, wherein forming the at least two discrete performance fabric portions comprises knitting the at least two discrete performance fabric portions.
3. The method according to Claim 1, wherein forming the at least two discrete performance fabric portions comprises circular knitting the at least two discrete performance  
15 fabric portions.
4. The method according to any one of Claims 1 to 3, wherein joining the at least two discrete performance fabric portions to form the finished fabric comprises stitching the at least two discrete performance fabric portions together to form the finished fabric.
5. The method of any one of Claims 1 to 4, wherein the at least two discrete  
20 performance fabric portions are joined by flatlock stitching.
6. The method of any one of Claims 1 to 5, comprising  
  
heat setting finishing the joined at least two discrete fabric portions.
7. The method of any one of Claims 1 to 6, wherein the finished fabric comprises a bed sheet.

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8. The method of Claim 7, further comprising providing piping to the bed sheet.
9. The method according to any one of Claims 1 to 8, wherein the at least two discrete fabric portions have different fabric characteristics.
10. A method of making a finished fabric at least 90 inches wide comprising:
  - 5 circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and
  - 10 stitching the at least two discrete performance fabric portions together to form the finished fabric.
11. The method according to Claim 10, wherein the finished fabric comprises a bed sheet.
12. The method according to Claim 10 or 11, further comprising heat setting  
15 finishing the finished fabric.
13. The method according to any one of Claims 10 to 12, further comprising providing piping to the finished fabric.
14. A method of making a bed sheet at least 90 inches wide from performance fabric comprising:
  - 20 circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric;

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stitching the at least two discrete performance fabric portions together; and

heat setting finishing the stitched at least two discrete performance fabric portions to form the finished bed sheet.

15. The method according to Claim 14, further comprising providing piping to the  
5 finished bed sheet.

16. The method according to Claim 14 or 15, wherein the at least two discrete performance fabric portions have different fabric characteristics.

17. The method according to Claim 16, wherein fabric characteristics are moisture  
10 management, or UV protection, or anti-microbial, or thermo-regulation, or wind resistance or water resistance.

18. A finished fabric at least 90 inches wide comprising:

a first circular knitted performance fabric knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; and

15 a second circular knitted performance fabric;

wherein the first and second performance fabrics are discrete; and

wherein the first and second performance fabrics are joined to form the finished fabric.

19. The finished fabric of Claim 18, wherein the finished fabric comprises a bed  
20 sheet.

20. The finished fabric of Claim 18 or 19, further comprising piping.

21. The finished fabric of any one of Claims 18 to 20, wherein the first and second performance fabrics have different fabric characteristics.

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22. The finished fabric of Claim 21, wherein fabric characteristics are moisture management, or UV protection, or anti-microbial, or thermo-regulation, or wind resistance or water resistance.

23. A bedsheet comprising a performance fabric of a man-made fiber, the  
 5 performance fabric circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric, the performance fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

10 24. The bedsheet of Claim 23 in which the fabric is knit of the man-made fiber.

25. The bedsheet of Claim 23 or 24 in which the fabric has a gauge of at least 17 gauges.

26. The bedsheet of any one of Claims 23 to 25, being stretchable to fit either a baby crib or an adult bed.

15 27. A bedsheet comprising a circularly knit fabric knit at a high gauge and including a high performance man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

28. The bedsheet of Claim 27 in which the bedsheet comprises at least two sections of the circularly knit fabric.

20 29. A bedsheet comprising a knit fabric that includes polyurethanepolyurea copolymer fiber in a proportion that, if circularly knit at a high gauge, could be knit at no more than a 72.5 inch circumference without losing the integrity of the polyurethanepolyurea copolymer fiber.

30. A bedsheet that is sufficiently stretchable to fit a standard rectangular bed and a  
 25 smaller, non-rectangular marine bed, the bedsheet being formed at least in part of a performance fabric that has been circularly knit at a high gauge, the performance fabric



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comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

31. A bedsheet that is sufficiently stretchable to fit either a crib or a standard adult bed, the bedsheet being formed at least in part of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.

32. A method of making a finished fabric at least 90 inches wide comprising circular knitting at least two discrete fabric portions, at least one of the fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric;

stitching the at least two discrete fabric portions; and

heat setting finishing the stitched at least two discrete fabric portions.

33. A method of making a bed sheet at least 90 inches wide from performance fabric comprising circular knitting at least two discrete fabric portions, at least one of the fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric; the two discrete fabric portions having different fabric characteristics including at least one of the following: moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance, and water resistance;

stitching the at least two discrete fabric portions together;

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heat setting finishing the stitched at least two discrete fabric portions to form a finished bed sheet; and

providing piping to the finished bed sheet.

34. A finished fabric at least 90 inches wide comprising:

5 a first circular knitted fabric portion; and a second circular knitted fabric portion, and at least one of the circular knitted fabric portions being formed of a performance fabric that has been circularly knit at a high gauge, the performance fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric;

10 wherein the first and second fabric portions are discrete; and

wherein the first and second fabric portions are joined to form the finished fabric.

35. The finished fabric of Claim 34, further comprising piping.

36. The finished fabric of Claim 34 or 35, wherein the first and second fabrics have  
15 different fabric characteristics.

37. The finished fabric of Claim 36, wherein at least one of the fabric characteristics comprises moisture management.

38. The finished fabric of Claim 36 or 37, wherein at least one of the fabric characteristics comprises UV protection.

20 39. The finished fabric of any one of Claims 36 to 38, wherein at least one of the fabric characteristics comprises anti-microbial properties.

40. The finished fabric of any one of Claims 36 to 39, wherein at least one of the fabric characteristics comprises thermo-regulation.

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41. The finished fabric of any one of Claims 36 to 40, wherein at least one of the fabric characteristics comprises wind resistance.
42. The finished fabric of any one of Claims 36 to 41, wherein at least one of the fabric characteristics comprises water resistance.
- 5 43. The finished fabric of any one of Claims 34 to 42, wherein the performance fabric portion comprises a man-made fiber that has higher breathability than a cotton fabric.
44. The finished fabric of any one of Claims 34 to 42, wherein the performance fabric portion comprises a man-made fiber that has higher heat transfer than a cotton fabric.
45. The finished fabric of any one of Claims 34 to 42, wherein the performance  
10 fabric portion comprises a man-made fiber that has higher moisture wicking characteristics than a cotton fabric.
46. The finished fabric of any one of Claims 34 to 45, having a gauge of at least 17 gauges.
47. The finished fabric of any one of Claims 34 to 46, comprising a bed sheet.
- 15 48. The finished fabric of Claim 47, wherein the bed sheet is sufficiently stretchable to fit a standard rectangular bed and a smaller, non-rectangular marine bed.
49. The finished fabric of Claim 47, wherein the bed sheet is sufficiently stretchable to fit either a crib or a standard adult bed.
50. The finished fabric of any one of Claims 34 to 49, comprising a knit fabric that  
20 includes polyurethanepolyurea copolymer fiber.
51. The finished fabric of Claim 50, wherein the polyurethanepolyurea copolymer fiber is included in the knit fabric in a proportion that, if circularly knit at a high gauge, the knit fabric could be knit at no more than a 72.5 inch circumference without losing integrity of the polyurethanepolyurea copolymer fiber.

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52. A bed sheet comprising a fabric of a man-made fiber, the fabric circularly knit at a high gauge, the fabric comprising a synthetic material in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric, and the fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.
53. The bed sheet of Claim 52 wherein the fabric comprises a finished fabric comprising:
- a first circular knitted fabric portion; and
  - a second circular knitted fabric portion;
- 10 at least one of the fabric portions comprising a performance fabric portion;
- the first and second fabric portions being discrete and joined to form the finished fabric.
54. The bed sheet of Claim 52 or 53, comprising piping.
55. The bed sheet of Claim 53, wherein the first and second fabric portions have
- 15 different fabric characteristics.
56. The bed sheet of Claim 55, wherein at least one of the fabric characteristics comprises moisture management.
57. The bed sheet of any one of Claims 52 to 56 in which the fabric is knit of the man-made fiber.
- 20 58. The bed sheet of any one of Claims 52 to 57 in which the fabric has a gauge of at least 17 gauges.
59. The bed sheet of Claim 52 in which the fabric is circularly knit.

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60. The bed sheet of any one of Claims 52 to 59, being stretchable to fit either a baby crib or an adult bed.
61. The bed sheet of any one of Claims 52 to 59, that is sufficiently stretchable to fit a standard rectangular bed and a smaller, non-rectangular marine bed.
- 5 62. The bed sheet of any one of Claims 52 to 59 that is sufficiently stretchable to fit either a crib or a standard adult bed.
63. The bed sheet of any one of Claims 52 to 62, that is at least 90 inches wide.
64. The bed sheet of any one of Claims 52 to 62, having dimensions of approximately 102 inches in length and approximately 91 inches in width.
- 10 65. The bed sheet of any one of Claims 52 to 64, comprising a pull tie that can be cinched to increase tension around an edge of the bed sheet.
66. The bed sheet of Claim 55 or 56, wherein at least one of the fabric characteristics is UV protection.
67. The bed sheet of Claim 55 or 56, wherein at least one of the fabric  
15 characteristics is anti-microbial fabric.
68. The bed sheet of Claim 55 or 56, wherein at least one of the fabric characteristics is thermo-regulation.
69. The bed sheet of Claim 55 or 56, wherein at least one of the fabric characteristics is wind resistance.
- 20 70. The bed sheet of Claim 55 or 56, wherein at least one of the fabric characteristics is water resistance.
71. A bed sheet comprising a circularly knit fabric knit at a high gauge and including a high performance man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric.



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72. The bed sheet of Claim 71, that is at least 90 inches wide.

73. The bed sheet of Claim 71 or 72, in which the bed sheet comprises at least two portions of the circularly knit fabric.

74. The bed sheet of any one of Claims 71 to 73, in which the fabric comprises  
5 polyurethanepolyurea copolymer fiber.

75. The bed sheet of Claim 74, in which the polyurethanepolyurea copolymer fiber is included in the fabric in a proportion such that, if circularly knit at a high gauge, the fabric could be knit at no more than a 72.5 inch circumference without losing integrity of the polyurethanepolyurea copolymer fiber.

10 76. A bed sheet comprising a fabric circularly knit of a man-made fiber in a proportion such that the fabric could be circularly knit at no more than a 72.5 inch circumference without losing integrity of the fabric, the fabric having a gauge of at least 17 gauges, and the fabric having higher breathability, higher heat transfer, and higher moisture wicking characteristics than a cotton fabric.

15 77. A method comprising:

forming at least two discrete performance fabric portions that are to be joined, at least one of the discrete performance fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a  
20 threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the performance fabric were circularly knit at greater than a 72.5 inch circumference; and

joining at least two discrete performance fabric portions along respective edges of the two portions to form a finished fabric at least 90 inches wide.

25 78. The method of claim 77, wherein forming at least two discrete performance fabric portions comprises knitting at least two discrete performance fabric portions.

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79. The method of claim 77, wherein joining at least two discrete performance fabric portions to form the finished fabric comprises stitching at least two discrete performance fabric portions together to form the finished fabric.

80. The method of claim 77, further comprising providing piping to the finished  
5 fabric.

81. The method of claim 77, wherein the at least two discrete performance fabric portions have different fabric characteristics.

82. The method of claim 81, wherein fabric characteristics are selected from the group consisting of moisture management, UV protection, anti-microbial, thermo-regulation,  
10 wind resistance and water resistance.

83. The method of claim 77, wherein the two discrete performance fabric portions are joined by flatlock stitching.

84. The method of claim 77, comprising  
heat setting finishing the joined at least two discrete fabric portions.

15 85. The method of claim 77 wherein the finished fabric comprises a bed sheet.

86. A method comprising:

20 circular knitting at least two discrete performance fabric portions, at least one of the discrete performance fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the performance fabric were circularly knit at greater than a 72.5 inch circumference;

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stitching at least two discrete performance fabric portions along respective edges of the two portions to form a bed sheet at least 90 inches wide; and

heat setting finishing the stitched at least two discrete performance fabric portions.

- 5 87. The method of claim 86, wherein forming at least two discrete performance fabric portions comprises knitting at least two discrete performance fabric portions.
88. The method of claim 86, wherein joining at least two discrete performance fabric portions comprises stitching at least two discrete performance fabric portions together to form a finished bed sheet.
- 10 89. The method of claim 86, further comprising providing piping to a finished bed sheet.
90. The method of claim 86, wherein the at least two discrete performance fabric portions have different fabric characteristics.
91. The method of claim 90, wherein fabric characteristics are selected from the  
15 group consisting of moisture management, UV protection, anti-microbial, thermo-regulation, wind resistance and water resistance.
92. The method of claim 86, wherein the two discrete performance fabric portions are joined by flatlock stitching.
93. A method comprising  
20 circular knitting at least two discrete fabric portions, at least one of the discrete fabric portions comprising a performance fabric that has been circularly knit at 17 gauges or higher, the performance fabric having an elasticity such that the performance fabric has a tendency to sag by an amount that is greater than a threshold amount of sag determined by a finishing process, such that the sag would interfere with the finishing process if the  
25 performance fabric were circularly knit at greater than a 72.5 inch circumference;