(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 November 2017 (30.11.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/205602 A1

(51) International Patent Classification:
A41D 31/00 (2006.01) *D02G 3/38* (2006.01)
D02G 3/02 (2006.01) *D02G 3/44* (2006.01)
D02G 3/12 (2006.01) *D04B 1/24* (2006.01)
D02G 3/22 (2006.01)

(21) International Application Number:
PCT/US2017/034430

(22) International Filing Date:
25 May 2017 (25.05.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
15/164,352 25 May 2016 (25.05.2016) US

(71) Applicant: **SUPREME CORPORATION** [US/US]; P.O. Box 848, Hickory, NC 28603 (US).

(72) Inventors: **THRELKELD, James, O.**; 1007 Cranston Crossing Place, Indian Trail, NC 28079 (US). **CARRIGAN, Sherry**; c/o Supreme Corporation, P.O. Box 848, Hickory, NC 28603 (US). **KOLMES, Matthew, L.**; 8012 Norman Pointe Drive, Denver, NC 28037 (US).

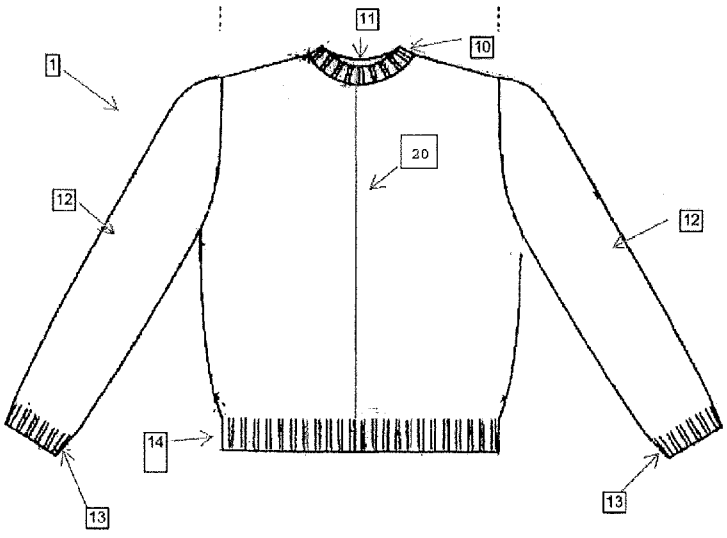
(74) Agent: **MASON, Derek, J.**; Oblon, McClelland, Maier & Neustadt, L.L.P., 1940 Duke Street, Alexandria, VA 22314 (US).

(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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, ST, 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).

(54) Title: CUT, SLASH AND/OR ABRASION RESISTANT PROTECTIVE FABRIC, AND LIGHTWEIGHT SHAPED KNIT GARMENT MADE THEREFROM, HAVING IMPROVED COLOR CONSISTENCY AND CUT RESISTANCE

FIG. 1



(57) Abstract: A cut, slash and/or abrasion resistant shaped knit garment having both high cut resistance and preferably light fabric weight, a cut resistance of at least 4, preferably at least 5 (as measured by ASTM-F1790-97) and preferably a fabric weight of no more than 27.9 ounces/square yard (OPSY).

[Continued on next page]

WO 2017/205602 A1

Published:
— *with international search report (Art. 21(3))*

TITLE

CUT, SLASH AND/OR ABRASION RESISTANT PROTECTIVE FABRIC, AND LIGHTWEIGHT SHAPED KNIT GARMENT MADE THEREFROM, HAVING IMPROVED COLOR CONSISTENCY AND CUT RESISTANCE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lightweight protective fabric that is cut, slash and/or abrasion resistant, and garments made therefrom.

2. Discussion of the Background

In many industries and professions there is a need for protective wear that is cut and/or abrasion resistant, yet lightweight and comfortable for the wearer. From maintenance workers crawling through HVAC ventilation shafts to weekend warriors participating in various sporting events, many individuals need protection from cuts and scrapes as they go about their daily activities.

Typical examples of previous garments and modular systems are disclosed in U.S. Publication No. 2004/0199983 to Gillen; U.S. Patent No. 6,892,392 to Crye; U.S. Patent No. 6,698,024 to Graves; U.S. Patent No. 6,263,509 to Bowen; U.S. Patent No. 6,185,745 to Alger; U.S. Patent No. 6,182,288 to Kibbee; U.S. Patent No. 6,158,056 to Riley; U.S. Patent No. 6,029,270 to Ost; U.S. Patent No. 5,894,600 to Chenefront; U.S. Patent No. 5,754,982 to Gainer; U.S. Patent No. 5,718,000 to Ost; U.S. Patent No. 5,717,999 to Lurry; U.S. Patent No. 5,673,836 to Bush; U.S. Patent No. 5,584,737 to Luhtala; U.S. Patent No. 5,495,621 to Kibbee; U.S. Patent No. 5,072,453

to Widder; U.S. Patent No. 5,060,314 to Lewis; U.S. Patent No. 4,497,069 to Braunhut; and U.S. Patent No. 4,467,476 to Herbert, the disclosures of which are incorporated by reference herein in their entirety.

One industry where such protection is particularly important is the glass industry, where workers are subjected to frequent exposure to sharp edges of glass, either from large float glass panes to smaller glass panes, or from broken edges in the case of a mishap.

Another industry where such protection is particularly important is in law enforcement or the military, in which cut and slash protection can mean the difference between life and death. In these industries, it is also important to be able to provide consistent black colored garments, for stealth use in night operations.

However, these and other known such garments suffer from numerous disadvantages. The garments are often unable to provide a satisfactory level of protection to a wearer of the garment, are easily damaged, are unwieldy and uncomfortable to the wearer, do not permit airflow therethrough, do not permit the escape of excess water vapor from the skin of the wearer, and often require the use of specialized over- or undergarments. Most of the modular systems in these patents require a central vest portion to be present in order to attach the other parts of the system.

Previous protective wear in the glass industry suffers from a variety of drawbacks, such as insufficient coverage of the wearer, the presence of metal grommets or other attachment devices which can scratch the surfaces of softer glass, inability to stretch in all directions, and often insufficient cut resistance or weak spots in the areas of seams.

An additional difficulty in preparing cut, slash and abrasion resistant fabrics and garments, is that in order to achieve sufficient cut and slash protection using high-performance fibers, the garments typically end up being too bulky, too heavy, and are difficult to put together, as the fabric cannot be readily cut to necessary size and shape without taking a high toll on the cutting apparatus.

Thus there is a need for a fabric that is cut, slash and/or abrasion resistant, and breathable while remaining lightweight. There is also a need for a method for preparing garments or coverings from such fabrics and the garments and coverings made therefrom. There is particularly a need for a protective garment that is lightweight, provides improved cut and/or abrasion resistance and covers particularly the vulnerable areas of the wearer, and provides a consistent color, preferably black (or "black black") for use in nighttime operations, particularly in law enforcement or military operations.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome these or other disadvantages of known cut, slash and/or abrasion resistant fabrics.

It is a further object of the present invention to provide a method to prepare a cut, slash and/or abrasion resistant garment or covering that is able to provide a satisfactory level of cut, slash and/or abrasion resistance protection to the wearer, able to resist damage, is light-weight, comfortable, able to permit airflow therethrough, and able to permit the escape of excess water vapor from the skin of the wearer.

These and other objects of the present invention can be provided by a shaped knit garment, wherein the entire garment comprises at least one cut, slash and/or abrasion resistant yarn, wherein the shaped knit fabric panel has a cut resistance of at

least 4, preferably at least 5 (as measured by ASTM-F1790-97) and preferably a fabric weight of no more than 27.9 ounces/square yard (OPSY), wherein the garment is prepared using one or more shaped knit fabric panels which are joined using one or more cut, slash and/or abrasion resistant composite yarns, to provide the seams with the same cut, slash and/or abrasion resistance as the shaped knit fabric panels of the garment.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention, and many of the attendant advantages thereof, will be readily ascertained and obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 is an exemplary embodiment of a sweater according to the present invention.

Figures 2A-2C show shaped knit fabric panels according to a preferred embodiment of the present invention, as would be used to assemble a sweater according to Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

The term "fiber" as used herein refers to a fundamental component used in the assembly of yarns and fabrics. Generally, a fiber is a component which has a length dimension which is much greater than its diameter or width. This term includes ribbon, strip, staple, and other forms of chopped, cut or discontinuous fiber and the like having a regular or irregular cross section. "Fiber" also includes a plurality of any one of the above or a combination of the above.

As used herein, the term "high performance fiber" means that class of synthetic or natural non-glass fibers having high values of tenacity greater than 10 g/denier, such that they lend themselves for applications where high abrasion and/or cut resistance is important. Typically, high performance fibers have a very high degree of molecular orientation and crystallinity in the final fiber structure. An example of such would be high molecular weight polyethylene (HMWPE) or extended chain polyolefins.

The term "filament" as used herein refers to a fiber of indefinite or extreme length such as found naturally in silk. This term also refers to manufactured fibers produced by, among other things, extrusion processes. Individual filaments making up a fiber may have any one of a variety of cross sections to include round, serrated or crenular, bean-shaped or others.

The term "yarn" as used herein refers to a continuous strand of textile fibers, filaments or material in a form suitable for knitting, weaving, or otherwise intertwining to form a textile fabric. Yarn can occur in a variety of forms to include a spun yarn consisting of staple fibers usually bound together by twist; a multi filament yarn consisting of many continuous filaments or strands; or a mono filament yarn which consist of a single strand.

The term “composite yarn” (or “engineered yarn”) refers to a yarn prepared from two or more yarns (or “ends”), which can be the same or different. Composite yarn can occur in a variety of forms wherein the two or more ends are in differing orientations relative to one another, so long as the final composite yarn containing the two or more ends is stably assembled (i.e. will remain intact unless forcibly separated or disassembled). The two or more ends can, for example, be parallel, wrapped one around the other(s), twisted together, or combinations of any or all of these, as well as

other orientations, depending on the properties of the composite yarn desired. Suitable composite yarns, which may be formed into fabric by any desired process, preferably knit or woven into the fabric, include, but are not limited to, those as described in U.S. Patent No. 4,777,789, U.S. Patent No. 4,838,017, U.S. Patent No. 4,936,085, U.S. Patent No. 5,177,948, U.S. Patent No. 5,628,172, U.S. Patent No. 5,632,137, U.S. Patent No. 5,644,907, U.S. Patent No. 5,655,358, U.S. Patent No. 5,845,476, U.S. Patent No. 6,212,914, U.S. Patent No. 6,230,524, U.S. Patent No. 6,341,483, U.S. Patent No. 6,349,531, U.S. Patent No. 6,363,703, U.S. Patent No. 6,367,290, and U.S. Patent No. 6,381,940, each to Kolmes, the contents of each of which are hereby incorporated by reference. Another term by which composite yarns are known is "engineered yarn".

The present invention relates to a shaped knit protective garment having a cut resistance of at least 4, preferably at least 5, according to the ASTM-F1790-97.

The shaped knit protective garment of the present invention comprises sufficient cut, slash and/or abrasion resistant yarn to provide the fabric with the necessary level of cut resistance, such that the fabric has a cut resistance of at least 4, preferably at least 5, as measured by ASTM-F1790-97, the entire contents of which are hereby incorporated by reference. In an additional embodiment, the shaped knit protective garment of the present invention has a cut resistance of at least 1500 as measured by ASTM-F1790-2005, the entire contents of which are hereby incorporated by reference. These cut, slash and/or abrasion resistant yarns can be any high performance yarn, a composite yarn, a yarn blend comprising one or more high performance or composite yarns, etc. Preferably, the cut, slash and/or abrasion resistant yarns comprise one or more yarns selected from polyolefins (such as ultra high molecular weight polyethylene or extended chain polyolefin), aramids,

continuous filament glass fiber, filament stainless steel, and flat or spun synthetic thermoplastic yarns, such as polyester or nylon. The garment preferably has a cut resistance of from 1500 to 6200, more preferably from 2000 to 6200, most preferably having a cut resistance in the area of the cuffs of 2500 to 6200. The garment preferably is a jacket and most preferably is made from 100% of one or more cut, slash and/or abrasion resistant yarns, including the yarns making up the shaped knit panels, as well as including the yarn with which the panels are joined together (i.e. all yarns used in construction of the garment are cut, slash and/or abrasion resistant). In this preferred embodiment, the only portion of the jacket that would not be made of the one or more cut, slash and/or abrasion resistant yarns is the zipper on the front (or back) of the jacket, which is preferably a plastic zipper that is fully hidden during manufacturing and use. It can not damage glass products, and stops short of the top of the neck to avoid pinching.

In addition, the knitting of the garment may be performed, if desired, by plaiting the yarns during knitting. Within the context of the present invention, the term "plaiting" is given its normal meaning within the art, namely "plaiting" applies to knitting two different yarns simultaneously in the same row of stitches, such that one of the yarns covers the other.

In a less preferred embodiment, the garment may contain one or more cut, slash and/or abrasion resistant yarns, either alone or in combination with any other natural or synthetic fiber. Such natural or synthetic fibers include, but are not limited to, cotton, wool, nylon, polyester, rayon, cellulose acetate, etc. and in conjunction with using Lycra or Spandex for improved characteristics.

The fabric of the present invention further has a fabric weight that is sufficiently lightweight to be practical for wearing, having a fabric weight of no more

than 27.9 ounces/square yard (OPSY), preferably a fabric weight of from 7 to 27.9 OPSY, more preferably from 8 to 20 OPSY, most preferably from 8 to 17 OPSY.

The protective garments of the present invention are made from the protective fabric and can be any form of garment, including, but not limited to, shirts (including tee-shirts, and with or without sleeves), socks, sweaters, jackets, vests, undergarments (including, but not limited to, pantyhose), pants, jumpsuits, dickeys, head coverings, and sleeves. For high risk industries, the protective garment is preferably a sweater or jacket. The sweater or jacket can be entirely a shaped knit garment, having no zipper or other connective device, or can have a connective device such as a zipper, or hook and loop connetors (such as VELCRO-type closures). When a zipper is present, it is preferred that the zipper is made of a material, such as plastic, that will not damage the products being handled in the industry, such as glass. The protective garment of the present invention can provide one or more of the following advantages, including the prevention or reduction of injury to the wearer, resistance to damage, and light-weight construction. In a preferred embodiment of the invention, the protective garment comprises a fabric made entirely from cut, slash and/or abrasion resistant composite yarns. The garments are made according to any known method useful for preparing garments from fabrics. Preferably, the garments are made by shaped knitting during preparation of the fabric. Shaped knitting is a process by which the various panels of a garment are formed directly in the shape needed for assembly, during the knitting process. In shaped knitting, the knitting machine can perform the following steps:

1. transferring: this is the transfer of one or more stitches from the front needle bed to the back needle bed of the knitting machine, or from the back needle bed to the front needle bed;

2. racking: this is the movement of the back and front needle beds relative to one another to the left or right, up to an inch; and

3. stitch movement: this results from the transfer back to the original needle bed after the initial transferring, and racking have occurred.

These steps provide the ability for the shaped knit garment to have a desired shape that cannot be prepared using a typical glove knitting machine, which can only perform tubular knitting, typically up to 4 inches in diameter at most. This shaped knitting is preferred for the present invention, since the fabrics of the present invention have cut and slash resistance and are therefore extremely difficult to cut using conventional fabric cutting means. While it is possible to cut the fabric, the cutting process is very hard on the cutting surfaces, significantly reducing the interval between servicing of the cutting equipment, and thus increasing the cost of operations. Accordingly, shaped knitting is preferably used to prepare the panels of fabric which are assembled to prepare the present invention garments. These panels are then linked together to form the garment. Many types of seam construction can be used to attach panels to one another. Since these panels have been shaped during their construction, linking, looping of collars or cup seaming are the most preferred, due to the higher comfort provided by the seam against the wearer's skin as well as strength. The Knit Construction may be in various Gauges such as 3, 4, 5, 6, 7, 8, 10, 12, 13, 14, 16, and 18 gauges wherein within the context of the present invention, the term "gauge" means needles per inch on the specific machine on which the pieces are knit. By way of example, 18 Gauge would normally make a fine textured piece, whereas a 3 gauge piece would normally be of a coarser texture.

In a preferred embodiment, the fabric is prepared into a garment or other type of covering that is seamless. Such garments or coverings can be prepared using a

knitting machine such as the "WholeGarment" machine sold by Shima Seiki of Japan, or the Knit-To-Wear machinery of Stoll Gmbh. of Germany. These garments could have any desired construction, but would typically be substantially tubular knit in construction, although the tubular construction could have apertures through which appendages could protrude when wearing the garment.

The preferred jacket or sweater garment of the present invention provides the following advantages, among others:

1) As a knit, the garment can stretch in every direction providing superior comfort and closer fit than any woven fabric, which stretches only on the bias, can offer.
2) The jacket has greater cut resistance than protection currently being used, testing at a cut level 5 according to ASTM 1790-97.
3) The extra yarn in the most preferred extended cuff eliminates the need for additional guarding in the wrist area and it is not removable for safety.
4) In the application tested, the life expectancy of a woven aramid jacket was approximately (3) months. The garment of the present invention has shown a life expectancy exceeding 8 months or more, with typically only minor damage to the lower front waist area.
5) Flexing the arm of a conventional aramid jacket can expose an area of the wrist between the lower cuff of the jacket and the cuff of a glove. The preferred jacket of the present invention has an elastic loop fixed into the inside of the cuff to be placed over the thumb holding the cuff in position and eliminating this potentially hazardous situation.
6) The present invention preferred jacket has no metal grommets for extra protection, or breath-ability. The use of the shaped knit fabric in constructing

the present invention preferred garment permits the fabric to breathe well and does not need this extra protection.

7) Grommets can scratch soft glass surfaces. The most preferred jacket embodiment of the present invention has a comfortable full length zipper, made of plastic (not brass or other metal) that is fully hidden during manufacturing. It can not damage glass products, and preferably stops short of the top of the neck to avoid pinching.

8) The preferred garment of the present invention is linked together with the same (or a different) composite yarn as that from which the jacket is made. This eliminates any weak areas and is not as subject to failure.

9) The preferred semi-turtleneck collar (preferably 2" in width) is most preferably a two bed full rib construction and is doubled over for extra protection and comfort.

10) The upper sleeves of the preferred jacket embodiment can be made in any desired color, particularly in a high visibility color such as bright orange, for high visibility to management, while the remainder of the jacket can be any desired color, preferably a muted color such as grey to hide dirt between launderings.

11) The garment of the present invention is washable, washable in bleach, soft, comfortable, and generally maintenance-free. It does not break down with UV light, most chemicals, salt water, or temperature extremes.

12) The garment of the present invention can be made in many colors, and, if desired, can be made permanently antimicrobial. This antimicrobial treatment, described in U.S. Patent application 10/785,060, the entire contents of which

are hereby incorporated by reference, can withstand up to (50) launderings and is completely safe containing no polluting heavy metals.

In preparing the garment of the present invention, the garment can be further modified and specialized by any one or more of the following:

1) Attaching patches of cut and/or abrasion resistant material to specific areas where necessary.

2) Changing the yarn in certain areas of the garment to provide different feel, look, color, etc.

3) Adding or removing yarn ends in any area of a garment to provide varying feel, thickness, density, etc.

4) Changing the physical knit stitch structure in any area of a garment to change feel, look, breathability, etc.

5) Changing the knitting gauge within a garment, again to alter the feel, look, density, thickness, etc.

Further, the yarns used in the present invention garment can be subjected to any of a variety of treatments conventional in the art, or described in the above noted "Kolmes" patents, such as fire retardant treatment, antimicrobial treatments, or surface coatings of the yarn or knit fabric to provide or enhance a desired property. The present invention garment can also be provided in any desired color, by dyeing the finished garment, forming the garment from previously colored yarns, or a combination thereof.

The fabric of a preferred embodiment of the present invention is made with at least one yarn comprising a core and one or more sheath wrap layers. The core is preferably at least one high performance yarn having a total denier from 100 to 400 denier, which can be a single end of the desired denier or can be a combination of multiple ends. In a most preferred embodiment, the core comprises a single end of 300 denier high performance yarn. In an alternative preferred emdobiment, the core comprises three ends of 100 denier high performance yarn. In order to provide consistent color throughout the fabric, the core yarn can be dyed the same color as the wrap layers. The wrap layers preferably each comprise a synthetic or natural fiber, such as polyester, nylon, cotton, etc., being wrapped around the core in from 1 to 100 tpi (turns-per-inch), preferably 3 to 26 tpi, in either the "s" or "z" direction. When more than one wrap is used, each wrap layer is preferably wrapped in the opposite layer of the wrap layer adjacent to it. The wrap layers preferably are from 15 to 500 denier, more preferably 50 to 400 denier, most preferably 70 to 300 denier, and are most preferably polyester or nylon. In order to provide consistent color of the fabric made from the yarn, and thus prevent a grey or "heathered" look, one option is to wrap each layer at a higher tpi of 7 to 32 tpi, in order to more completely cover the core. In those instances, it may not be necessary to dye the core yarn, which may be particularly helpful if the core yarn is made of fiberglass, which can be difficult to adequately dye.

When the composite yarn uses fiberglass as the core, knitting can be very tough on the composite yarn because of the radius needed to knit, and this then fractures the glass and leads to filamentation of the fibers. This filamentation leads to the garment looking fuzzy or hairy, and this filamentation continues to grow as the garment is laundered. The present inventors have discovered that one can prevent this

filamentation problem, while improving cut resistance of the resulting yarn and fabric, by coating the core yarn with a polyurethane coating. The polyurethane can be any commercially available, preferably water soluble, polyurethane. The core yarn can be coated using any conventional method, such as spraying, dipping, or application using a roller. The individual fibers can be coated and formed into an end, or the end can be formed and coated as a bundle. Typical polyurethane catalysts and crosslinkers can be used if desired, in order to harden the polyurethane upon coating. Once coated, the coated yarn/fiber can be heated if desired in order to initiate or accelerate curing of the polyurethane.

The resulting yarn formed from the coated core has been found to provide significantly improved cut resistance compared to a non-coated core containing yarn. The non-coated core containing yarn typically has a cut resistance level of 4 under ASTM 1790-97, while the coated core containing yarn of the present invention has been found to provide a cut resistance of at least level 5 under ASTM 1790-97. This cut resistance can also be achieved and/or improved upon by using a plurality of ends, preferably 3 or more ends, of the coated core yarn. While not wishing to be bound by any particularly theory of operation, it is believed that upon trying to cut the resulting yarn, the 3 ends within the core are moving (especially with a stainless steel blade) away from the blade and not allowing the blade to bite into the yarns, and cut them.

In a most preferred embodiment, the composite yarn of the present invention comprises one or more ends of high performance yarn as the core, wherein the one or more ends have been coated with a polyurethane coating, and one or more wrap layers of a synthetic or natural fiber, with successive wrap layers being wound in opposite directions from one another (either the "s" or "z" direction). Each yarn component may be dyed, if desired. In a most preferred embodiment, the core and wrap yarns are

each dyed black, in order to provide a true black color (or "black black" as used in the textile industry).

EXAMPLES

As an example of a garment prepared according to the present invention, Figure 1 shows an example of a knit sweater or jacket construction. The sweater can have any desired measurements, depending on the size of the intended wearer. Such sizes and the needed measurements are well known in the art. For example, a knit sweater (1) as shown in Fig. 1 would typically have a rib (10) around the neck opening (11) approximately 1 inch wide, with a front neck drop of 4-4.75 inches and a back neck drop of about 1 inch. The sleeves (12) would typically have a rib (13) at the end approximately 2.5 inches wide. The bottom of the sweater torso would likewise have a rib (14) of approximately 2.5 inches width. The line indicates as (20) represents a zipper, which may optionally be present, depending on whether the garment is a sweater (no zipper) or a jacket (with zipper).

Figures 2A-2C show the shaped knit fabric panels that would be used to prepare a preferred embodiment of sweater similar to that in Figure 1. Fig. 2A shows a shaped knit panel that would be used to prepare the sleeves of a sweater such as in Fig. 1. The sleeve would be formed by joining the right and left edges of the shaped panel in a seam to form a substantially cylindrical sleeve that tapers from one end to the other, with the wider end then being attached to the torso panels. Fig. 2B shows a shaped knit panel that would be used to form a front or back panel of the sweater (with the primary difference being the amount of neck drop). A front panel and back panel would be joined together along the appropriate edges, leaving openings for the neck and sleeves and bottom opening. Fig. 2C shows a knit rib portion that would

then be attached to the neck opening formed by joining of the front and back torso panels. The sizes and measurements of the various panels would be readily ascertainable by one of ordinary skill in the knitting and sewing arts.

The following embodiments further describe the present invention:

Embodiment 1. A shaped knit garment, comprising:

one or more fabric panels prepared from at least one cut, slash and/or abrasion resistant composite yarn, wherein the composite yarn comprises a core yarn and one or more wrapped yarn layers, wherein when more than one wrap layer is present, each wrap layer is wrapped in a direction opposite any adjacent wrap layer, wherein the shaped knit garment has a cut resistance of at least 5 (as measured by ASTM-F1790-97).

Embodiment 2. The shaped knit garment of embodiment 1, wherein the fabric weight is no more than 27.9 OPSY.

Embodiment 3. The shaped knit garment of one of embodiments 1 or 2, wherein the core yarn is a high performance yarn.

Embodiment 4. The shaped knit garment of any one of embodiments 1 to 3, wherein the core yarn is a member selected from the group consisting of aramid yarns, ultra-high molecular weight polyethylene yarns, and fiberglass.

Embodiment 5. The shaped knit garment of any one of embodiments 1 to 4, wherein the core yarn is a single end of the high performance yarn.

Embodiment 6. The shaped knit garment of any one of embodiments 1 to 5, wherein the core yarn is a plurality of ends of the high performance yarn.

Embodiment 7. The shaped knit garment of any one of embodiments 1 to 6, wherein the core yarn has been coated with a polyurethane coating.

Embodiment 8. The shaped knit garment of embodiment 7, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a single end.

Embodiment 9. The shaped knit garment of embodiment 7, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a plurality of ends.

Embodiment 10. The shaped knit garment of any one of embodiments 7 or 8, wherein the core yarn comprises a single end, and the end is coated with the polyurethane coating.

Embodiment 11. The shaped knit garment of any one of embodiments 7 or 9, wherein the core yarn comprises a plurality of ends, and each of the plurality of ends is coated with the polyurethane coating.

Embodiment 12. The shaped knit garment of any one of embodiments 1 to 11, wherein the garment is a member selected from the group consisting of shirts, socks, sweaters, jackets, vests, undergarments, pants, jumpsuits, dickeys, and head coverings.

Embodiment 13. The shaped knit garment of any one of embodiments 1 to 12, wherein the shaped knit garment is a sweater or jacket.

Embodiment 14. The shaped knit garment of any one of embodiments 1 to 13, wherein the garment is a jacket having a zipper from neck to waist.

Embodiment 15. The shaped knit garment of embodiment 14, wherein the zipper is on a front portion of the jacket.

Embodiment 16. The shaped knit garment of embodiment 14, wherein the zipper is on a back portion of the jacket.

Embodiment 17. The shaped knit garment of any one of embodiments 1 to 16, wherein each of the core and wrap layers are dyed.

Embodiment 18. The shaped knit garment of any one of embodiments 1 to 17, wherein each of the wrap layers is wrapped at from 7 to 32 turns per inch (tpi).

Embodiment 19. A composite yarn comprising:

a core yarn and one or more wrapped yarn layers, wherein when more than one wrap layer is present, each wrap layer is wrapped in a direction opposite any adjacent wrap layer, wherein the composite yarn has a cut resistance of at least 5 (as measured by ASTM-F1790-97).

Embodiment 20. The composite yarn of embodiment 19, wherein the core yarn is a high performance yarn.

Embodiment 21. The composite yarn of one of embodiments 19 or 20, wherein the core yarn is a member selected from the group consisting of aramid yarns, ultra-high molecular weight polyethylene yarns, and fiberglass.

Embodiment 22. The composite yarn of any one of embodiments 19 to 21, wherein the core yarn is a single end of the high performance yarn.

Embodiment 23. The composite yarn of any one of embodiments 19 to 21, wherein the core yarn is a plurality of ends of the high performance yarn.

Embodiment 24. The composite yarn of any one of embodiments 19 to 23, wherein the core yarn has been coated with a polyurethane coating.

Embodiment 25. The composite yarn of embodiment 24, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a single end.

Embodiment 26. The composite yarn of embodiment 24, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a plurality of ends.

Embodiment 27. The composite yarn of any one of embodiments 24 or 25, wherein the core yarn comprises a single end, and the end is coated with the polyurethane coating.

Embodiment 28. The composite yarn of any one of embodiments 24 or 26, wherein the core yarn comprises a plurality of ends, and each of the plurality of ends is coated with the polyurethane coating.

Embodiment 29. The composite yarn of any one of embodiments 19 to 28, wherein each of the core and wrap layers are dyed.

Embodiment 30. The composite yarn of any one of embodiments 19 to 29, wherein each of the wrap layers is wrapped at from 7 to 32 turns per inch (tpi).

Numerous additional modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

CLAIMS

1. A shaped knit garment, comprising:

one or more fabric panels prepared from at least one cut, slash and/or abrasion resistant composite yarn, wherein the composite yarn comprises a core yarn and one or more wrapped yarn layers, wherein when more than one wrap layer is present, each wrap layer is wrapped in a direction opposite any adjacent wrap layer, wherein the shaped knit garment has a cut resistance of at least 5 (as measured by ASTM-F1790-97).

2. The shaped knit garment of claim 1, wherein the fabric weight is no more than 27.9 OPSY.

3. The shaped knit garment of claim 1, wherein the core yarn is a high performance yarn.

4. The shaped knit garment of claim 3, wherein the core yarn is a member selected from the group consisting of aramid yarns, ultra-high molecular weight polyethylene yarns, and fiberglass.

5. The shaped knit garment of claim 3, wherein the core yarn is a single end of the high performance yarn.

6. The shaped knit garment of claim 3, wherein the core yarn is a plurality of ends of the high performance yarn.

7. The shaped knit garment of claim 3, wherein the core yarn has been coated with a polyurethane coating.

8. The shaped knit garment of claim 7, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a single end.

9. The shaped knit garment of claim 7, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a plurality of ends.

10. The shaped knit garment of claim 7, wherein the core yarn comprises a single end, and the end is coated with the polyurethane coating.

11. The shaped knit garment of claim 7, wherein the core yarn comprises a plurality of ends, and each of the plurality of ends is coated with the polyurethane coating.

12. The shaped knit garment of claim 1, wherein the garment is a member selected from the group consisting of shirts, socks, sweaters, jackets, vests, undergarments, pants, jumpsuits, dickeys, and head coverings.

13. The shaped knit garment of claim 1, wherein the shaped knit garment is a sweater or jacket.

14. The shaped knit garment of claim 13, wherein the garment is a jacket having a zipper from neck to waist.

15. The shaped knit garment of claim 14, wherein the zipper is on a front portion of the jacket.

16. The shaped knit garment of claim 14, wherein the zipper is on a back portion of the jacket.

17. The shaped knit garment of claim 1, wherein each of the core and wrap layers are dyed.

18. The shaped knit garment of claim 1, wherein each of the wrap layers is wrapped at from 7 to 32 turns per inch (tpi).

19. A composite yarn comprising:

a core yarn and one or more wrapped yarn layers, wherein when more than one wrap layer is present, each wrap layer is wrapped in a direction opposite any adjacent wrap layer, wherein the composite yarn has a cut resistance of at least 5 (as measured by ASTM-F1790-97).

20. The composite yarn of claim 19, wherein the core yarn is a high performance yarn.

21. The composite yarn of claim 19, wherein the core yarn is a member selected from the group consisting of aramid yarns, ultra-high molecular weight polyethylene yarns, and fiberglass.

22. The composite yarn of claim 20, wherein the core yarn is a single end of the high performance yarn.

23. The composite yarn of claim 20, wherein the core yarn is a plurality of ends of the high performance yarn.

24. The composite yarn of claim 19, wherein the core yarn has been coated with a polyurethane coating.

25. The composite yarn of claim 24, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a single end.

26. The composite yarn of claim 24, wherein the core yarn has been formed by coating individual fibers with the polyurethane coating, and combining the coated fibers into a plurality of ends.

27. The composite yarn of claim 24, wherein the core yarn comprises a single end, and the end is coated with the polyurethane coating.

28. The composite yarn of claim 24, wherein the core yarn comprises a plurality of ends, and each of the plurality of ends is coated with the polyurethane coating.

29. The composite yarn of claim 19, wherein each of the core and wrap layers are dyed.

30. The composite yarn of claim 19, wherein each of the wrap layers is wrapped at from 7 to 32 turns per inch (tpi).

FIG. 1

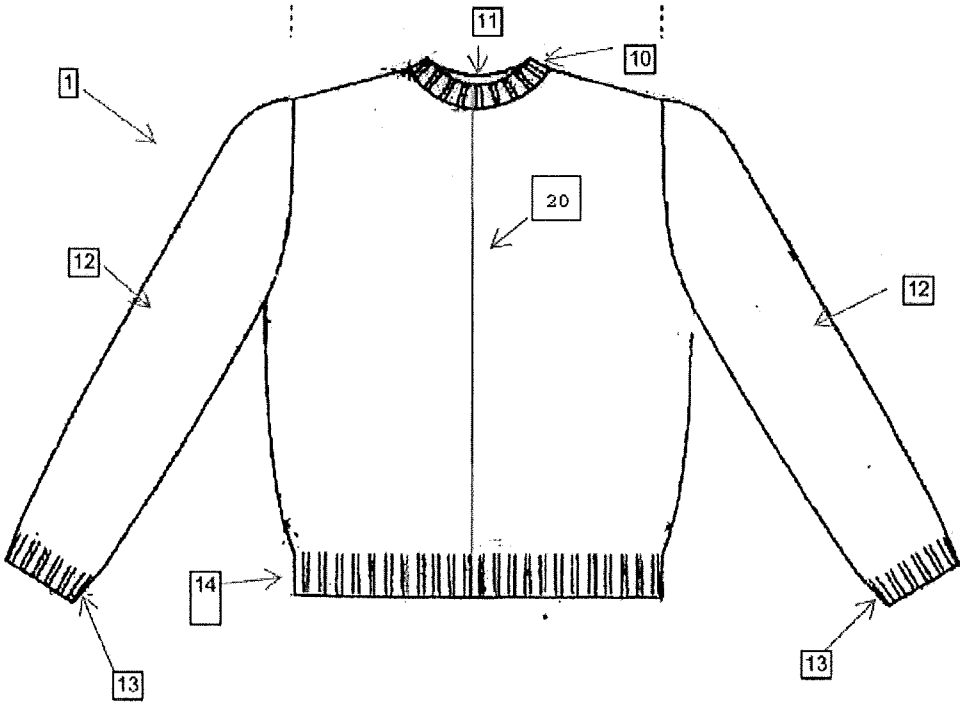


FIG. 2A

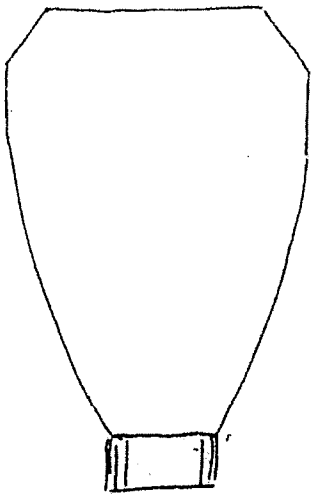


FIG. 2C

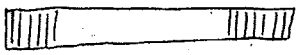
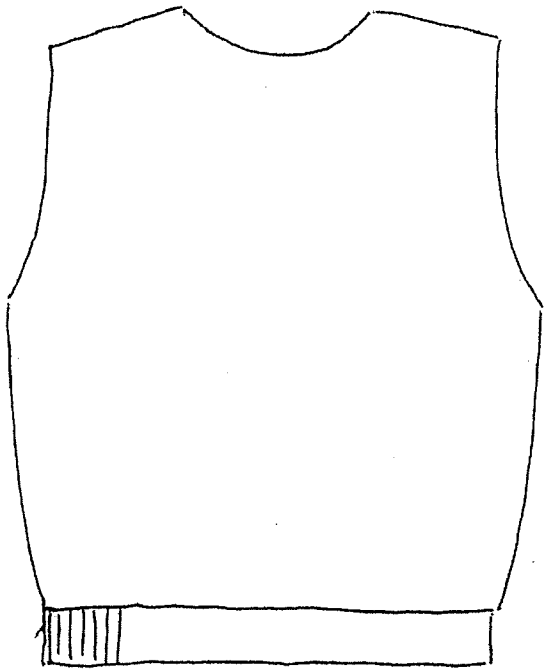


FIG. 2B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/34430

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A41D 31/00, D02G 3/02, D02G 3/12, D02G 3/22, D02G 3/38, D02G 3/44, D04B 1/24 (2017.01)
CPC - A41D 31/0011, A41D 31/0055, D02G 3/00, D02G 3/02, D02G 3/38, D02G 3/44, D02G 3/442, D04B 1/22, D04B 1/24

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)
See Search History Document

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ---- Y	US 2005/0086924 A1 (Kolmes) 28 April 2005 (28.04.2005) entire document, especially Title, Abstract, figs.1-5, para[0010], [0020]-[0023], [0026]-0029], [0040]-[0042].	1, 12-13, 17-19, 29-30 ---------- 24-28
Y	US 6,260,344 B1 (Chakravarti) 17 July 2001 (17.07.2001) entire document, especially Title, Abstract, figs. 1-2, col 1, ln 18-67, col 3, ln 40-59, col 4, ln 54-63.	1-11, 13-16, 19-23
Y	US 2009/0019612 A1 (Schulein et al.) 22 January 2009 (22.01.2009) entire document, especially Title, Abstract, figs. 1, para[0023]-[0027].	1-11, 13-16, 19-23
Y	US 2007/0193440 A1 (Morissette et al.) 23 August 2007 (23.08.2007) entire document, especially Title, Abstract, figs. 1, para[0044].	7-11, 24-28
A	US 2007/0271965 A1 (Kolmes et al.) 29 November 2007 (29.11.2007) entire document.	1-30

☐ 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
"E" earlier application or patent but published on or after the international filing date
"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)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2017	25 AUG 2017
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. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)