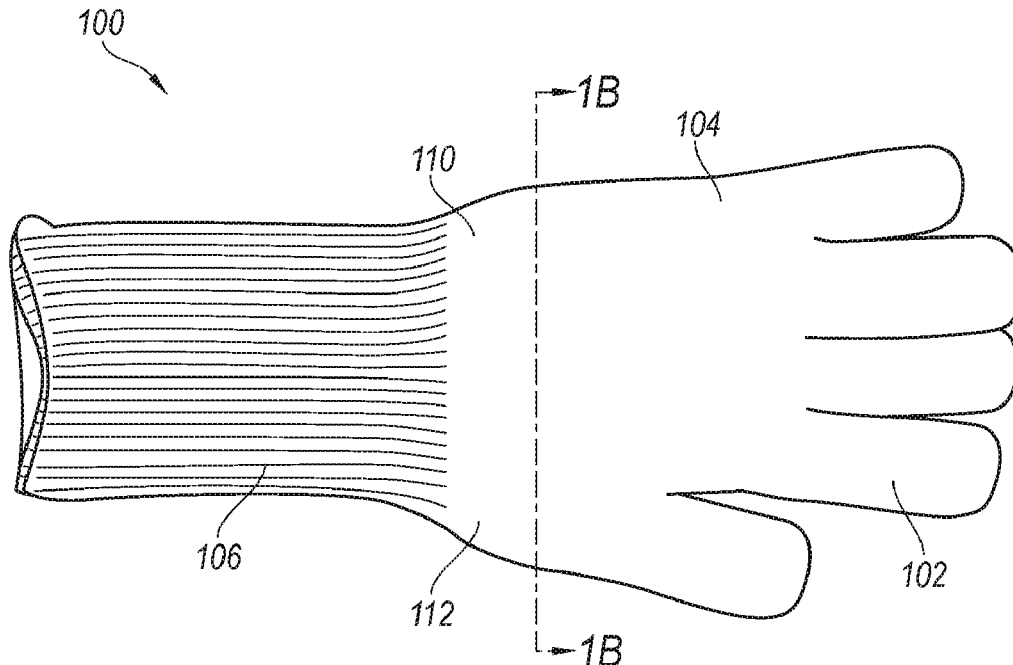




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(19) **United States**(12) **Patent Application Publication**
Williams(10) **Pub. No.: US 2017/0027256 A1**(43) **Pub. Date: Feb. 2, 2017**(54) **LINED CLOTHING ARTICLES AND
METHODS OF MANUFACTURING***A41D 19/00* (2006.01)*A41D 27/24* (2006.01)(71) Applicant: **Danalco, Inc.**, Duarte, CA (US)(52) **U.S. Cl.**CPC *A41D 27/02* (2013.01); *A41D 19/001*
(2013.01); *A41D 27/24* (2013.01); *A41B*
11/005 (2013.01); *A41D 19/01523* (2013.01);
A41D 19/01558 (2013.01); *A41D 2500/10*
(2013.01); *A41D 2400/10* (2013.01)(72) Inventor: **Cole Williams**, Binbridge Island, WA
(US)(21) Appl. No.: **15/141,740**(22) Filed: **Apr. 28, 2016****Related U.S. Application Data**(63) Continuation of application No. 13/789,599, filed on
Mar. 7, 2013, now abandoned.(60) Provisional application No. 61/609,208, filed on Mar.
9, 2012.**Publication Classification**(51) **Int. Cl.***A41D 27/02* (2006.01)*A41D 19/015* (2006.01)*A41B 11/00* (2006.01)(57) **ABSTRACT**

Articles of clothing, such as gloves having a substantially seamless inner liner and methods of manufacturing the same are disclosed herein. In one embodiment, a process for manufacturing a glove comprises stretching an outer layer inside-out over a glove form, such that an interior surface of the outer layer faces outward. A liner having a first side and a second side opposite the first side is cut from a fabric, such as fleece. An adhesive is deposited in an adhesive pattern onto the first side of the liner. The adhesive fuses to the interior surface of the outer layer in a heat/pressure procedure, thereby affixing the first side of the liner to the interior surface of the outer layer to form the glove. The glove is removed from the glove form and inverted to a right-side-out configuration, thereby compressing the outer layer and the liner.



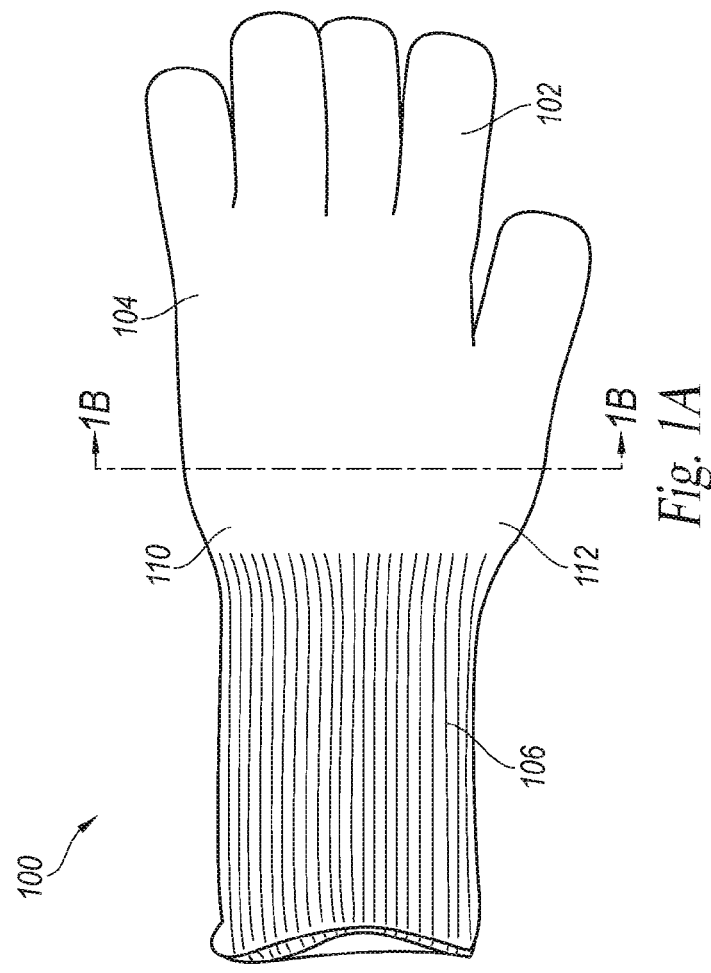


Fig. 1A

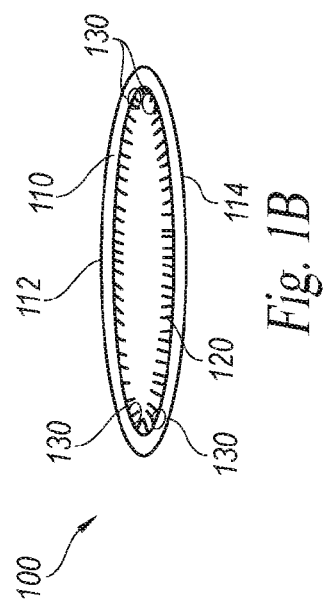


Fig. 1B

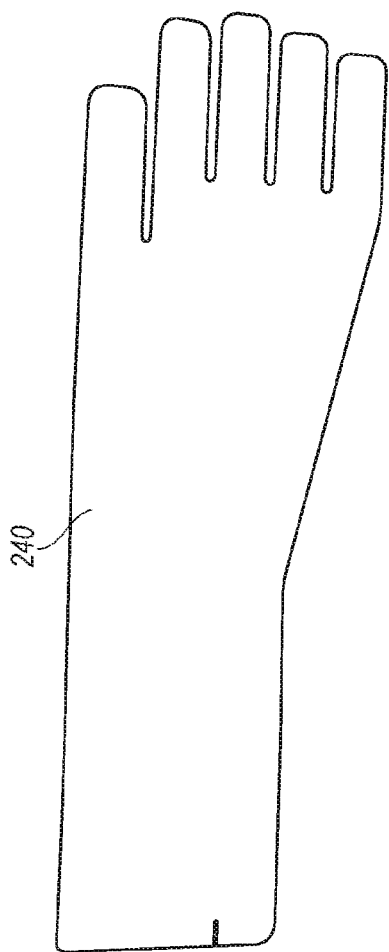


Fig. 2

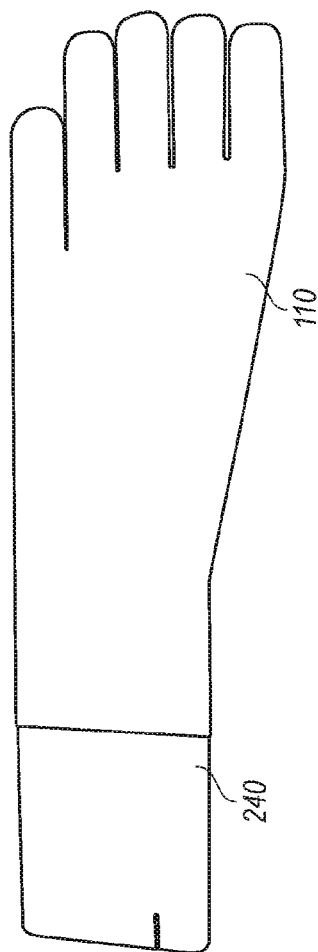


Fig. 3

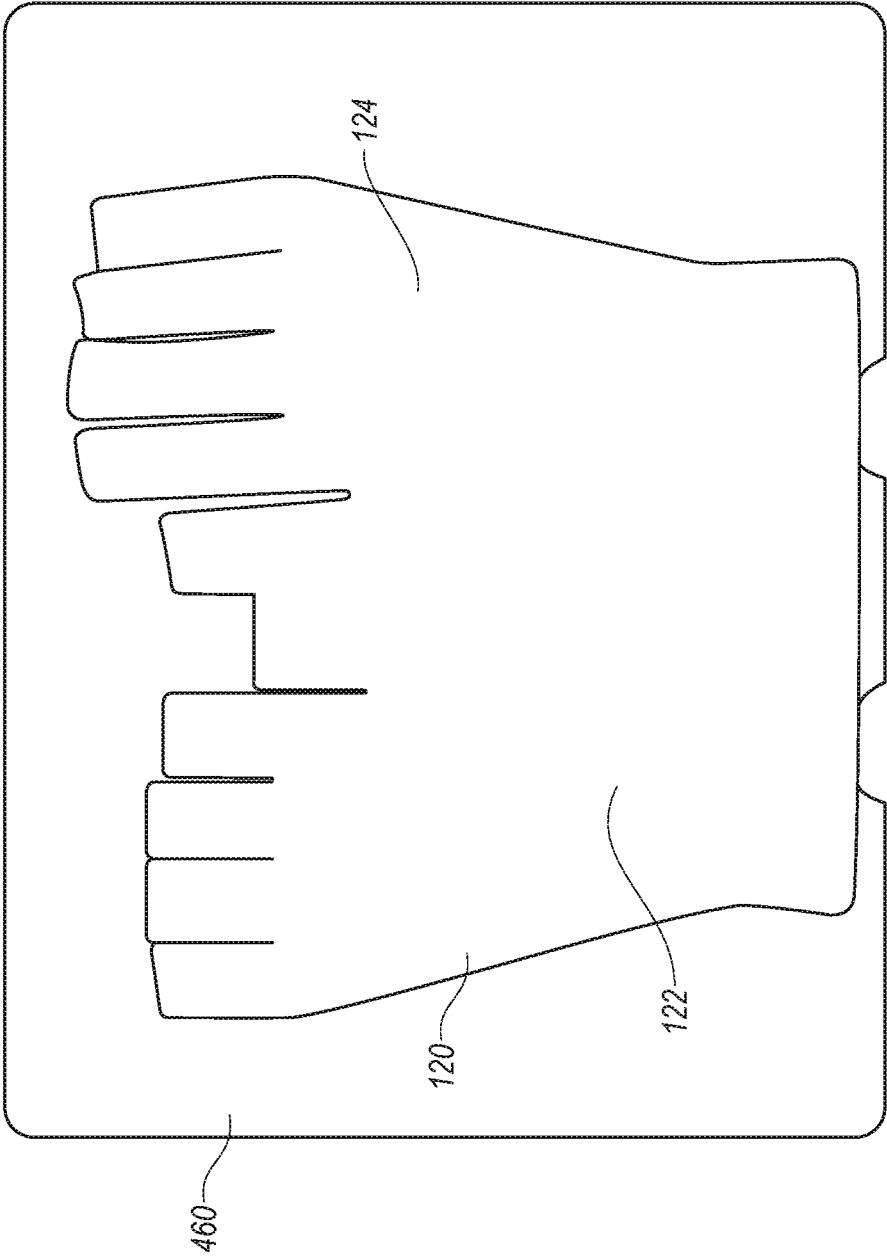


Fig. 4

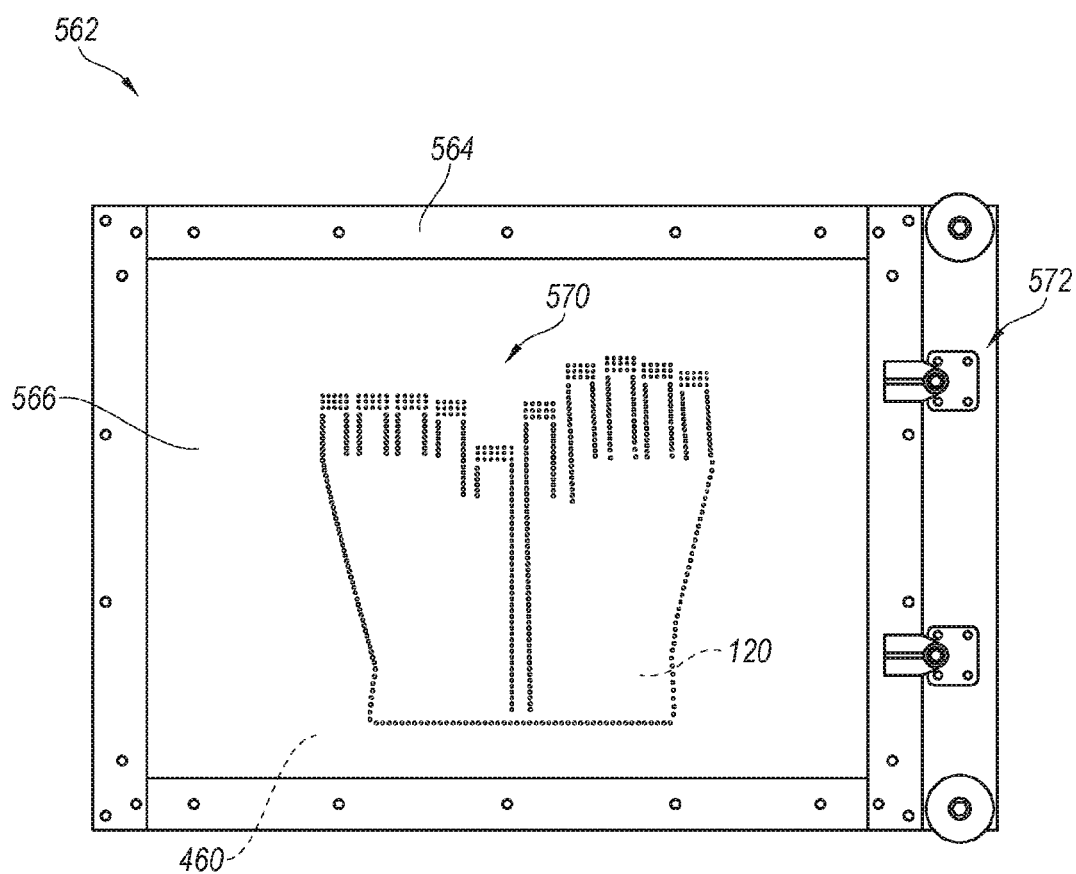


Fig. 5

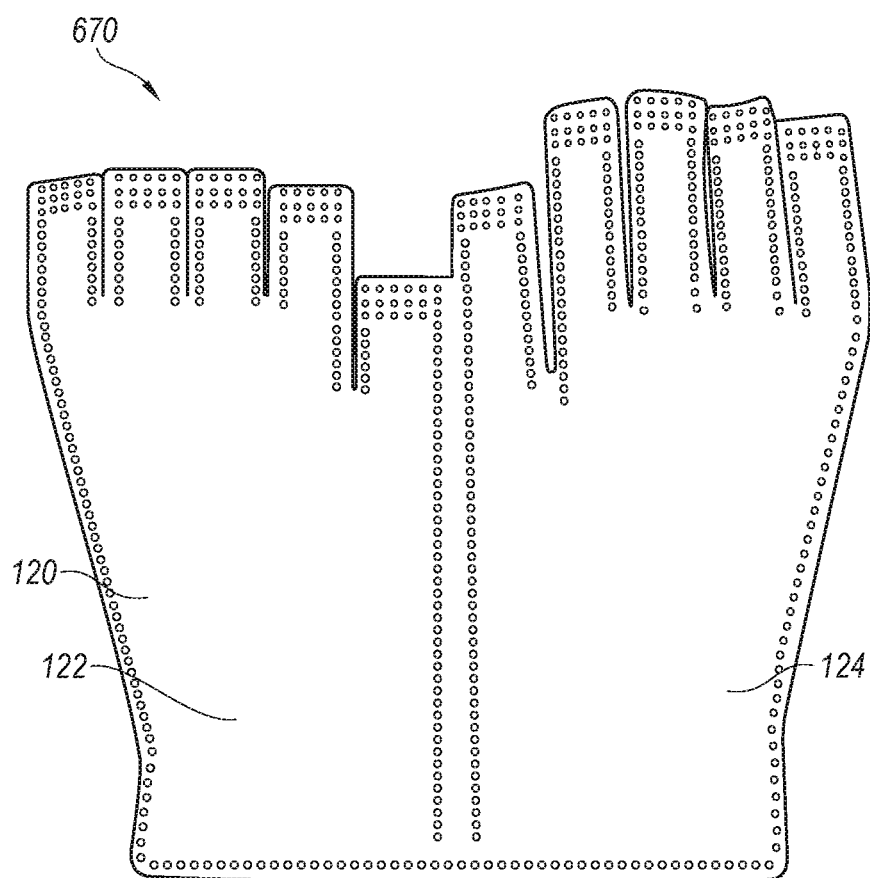


Fig. 6A

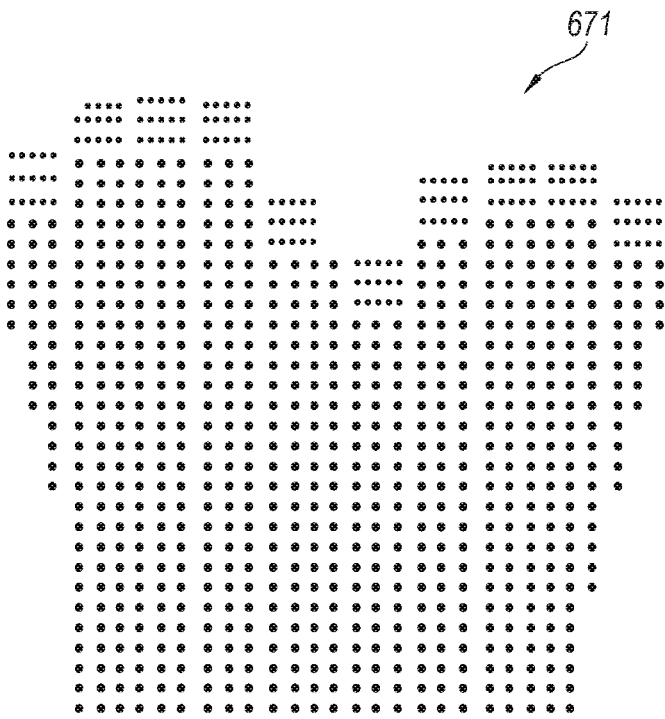


Fig. 6B

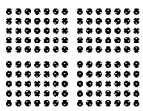


Fig. 6C

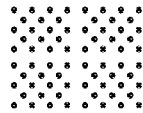


Fig. 6D

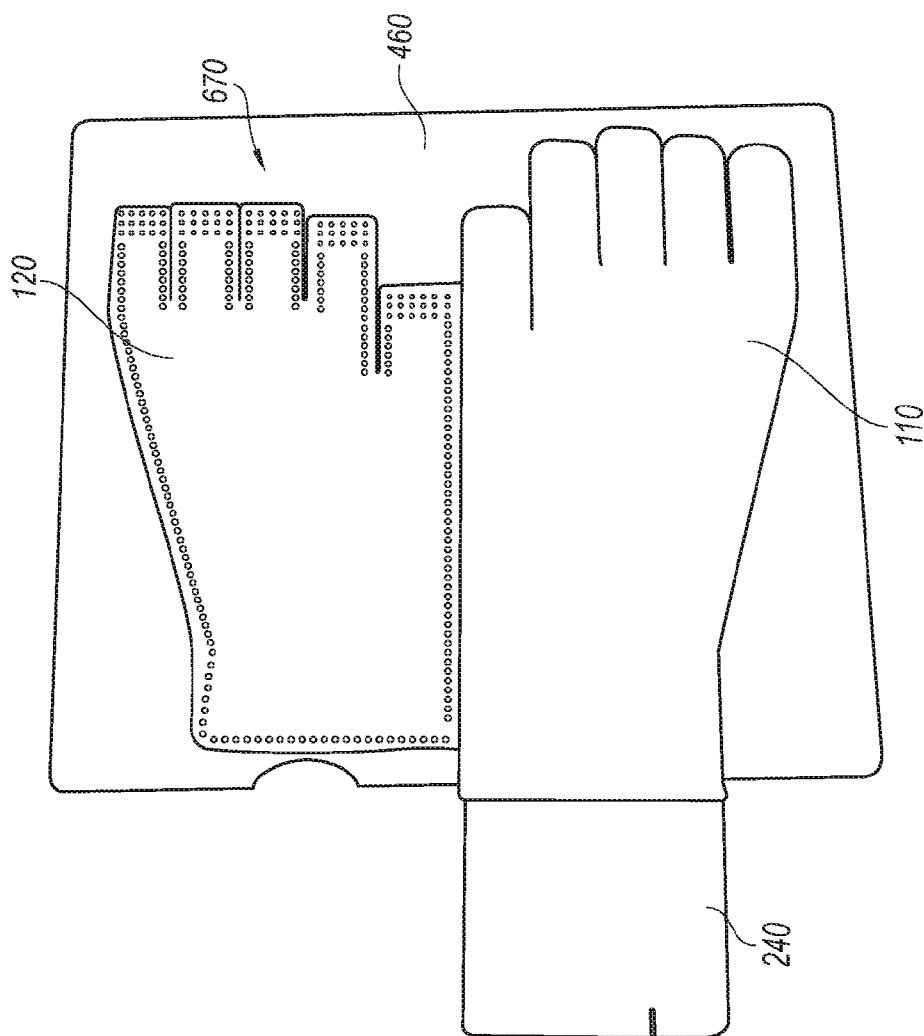


Fig. 7

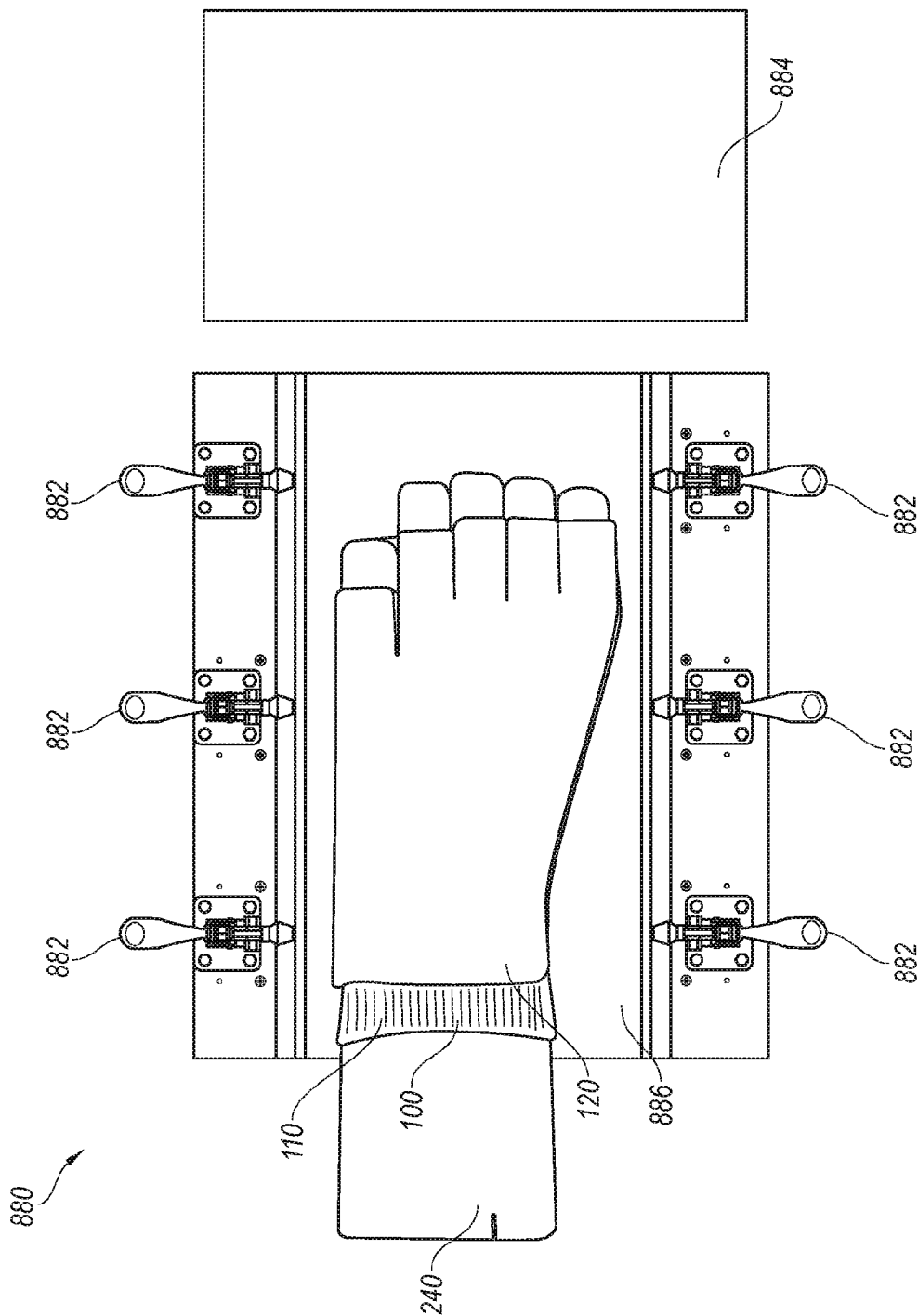


Fig. 8

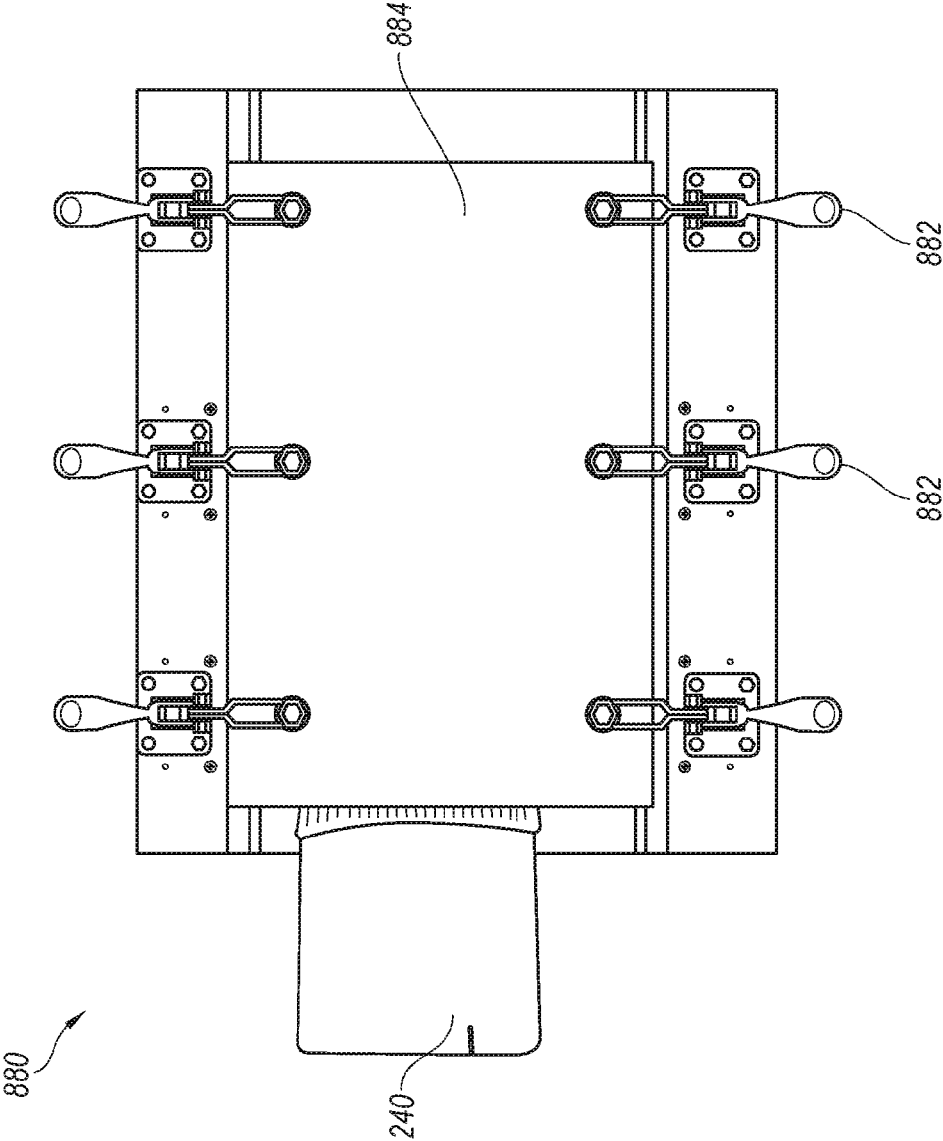


Fig. 9

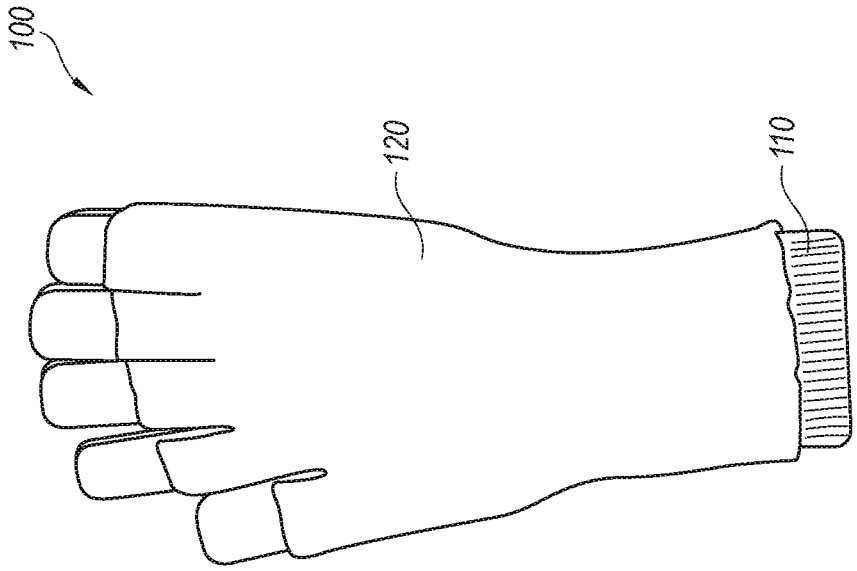


Fig. 10B

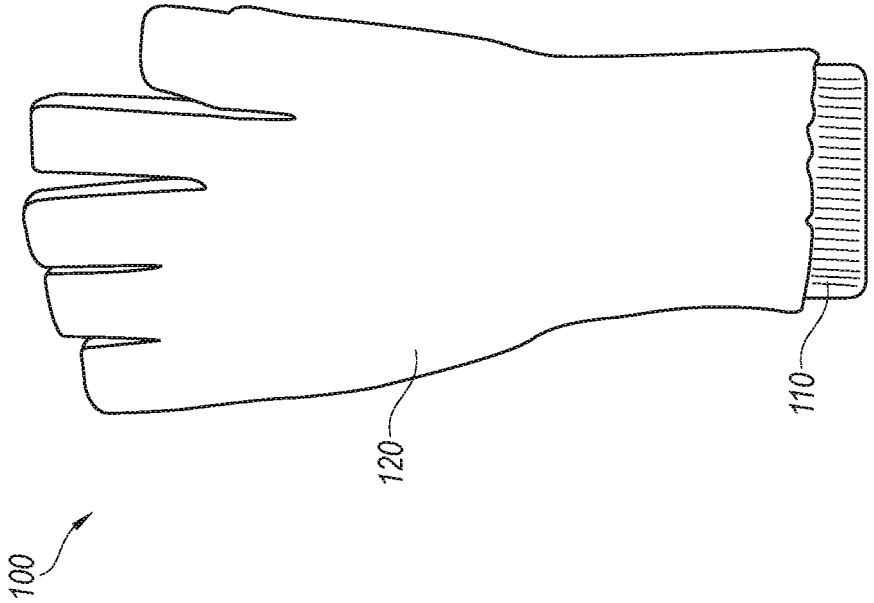


Fig. 10A

LINED CLOTHING ARTICLES AND METHODS OF MANUFACTURING

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application is a continuation of U.S. patent application Ser. No. 13/789,599, filed Mar. 7, 2013 and titled LINED CLOTHING ARTICLES AND METHODS OF MANUFACTURING, which claims priority to and the benefit of U.S. Provisional Patent Application No. 61/609,208, filed Mar. 9, 2012 and titled LINED KNIT GLOVES AND METHODS OF MANUFACTURING, both of which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

[0002] The present disclosure relates to seamless clothing articles having an inner liner and methods of manufacturing the same. Particular embodiments are directed to knit gloves having a seamless inner liner.

BACKGROUND

[0003] Many gloves are made by cutting sheets of fabric into multiple pieces per a predetermined pattern and then sewing these pieces together, thereby completing a glove assembly. This production/assembly method is sometimes referred to as a cut-and-sewn glove. Although cut-and-sewn gloves are quite common, they also have several drawbacks. For example, the stitched seams often split, and cut-and-sewn gloves can also be uncomfortable because the seams may rub against the wearer's hand. Cut-and-sewn gloves may also not have the desired degree of flexibility because the seams tend to bind or otherwise restrict movement at the finger joints.

[0004] Another existing method of making gloves is knitting a seamless, one-piece glove. Knit gloves are made using specialty automated knitting machines that knit seamless, one piece gloves in accordance with the computer program controlling the machine. Unlike cut-and-sewn gloves, knit gloves are made by directly converting yarns into a complete glove such that no sheets of fabric are required. Knit gloves by themselves, however, can be relatively thin and may not provide the insulative properties desired by a user. Linings can be cut and sewn to the knit gloves, but then the gloves will likely have the same drawbacks mentioned above relating to splitting, restriction, and discomfort. Manufacturing knit gloves with a comfortable, flexible, and durable inner liner is accordingly particularly challenging.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1A is a top view of a palm side of a glove in accordance with embodiments of the present invention. FIG. 1B is a cross-sectional view of the glove along line B-B of FIG. 1A.

[0006] FIG. 2 is a top view of a glove form configured in accordance with embodiments of the technology.

[0007] FIG. 3 is a top view of an outer layer of a glove that has been turned inside-out and then stretched over the glove form of FIG. 2.

[0008] FIG. 4 is a top view of a glove liner positioned on a substrate.

[0009] FIG. 5 is a top view of the substrate of FIG. 4 positioned in an adhesive printing device.

[0010] FIG. 6A is a top view of the glove liner of FIG. 4 having a spot pattern of adhesive.

[0011] FIG. 6B is an illustration of a glove liner having spot pattern of adhesive in accordance with further embodiments of the technology.

[0012] FIGS. 6C and 6D are illustrations of spot patterns of adhesive in accordance with still further embodiments of the technology.

[0013] FIG. 7 is a top view of an outer layer of the glove attaching to the liner of FIG. 6A.

[0014] FIG. 8 is a top view of the glove of FIG. 7 positioned in a clamping device.

[0015] FIG. 9 is a top view of the clamping device of FIG. 8.

[0016] FIGS. 10A and 10B are top views of the back interior surface and palm interior surface, respectively, of the assembled glove.

DETAILED DESCRIPTION

[0017] Several embodiments of the technology are directed to clothing articles, such as seamless gloves, with an inner liner. For example, in the case of gloves, the liner can be a single piece of an insulating material, such as fleece, spot-attached to the interior surface of an outer layer with adhesive. The inner liner can be attached to the outer layer when the outer layer is inside-out and in a partially stretched state. When the outer layer is in an unstretched state and is in "right-side-out" position with the inner liner adhered therein, the edges of the inner liner are firmly pressed together to provide a substantially seamless interior.

[0018] In another embodiment, a clothing article can include an outer layer, such as a knit outer layer, having an interior surface and an exterior surface opposite the interior surface. The clothing article can further include a liner having a first side, a second side opposite the first side, and a perimeter portion. An adhesive can be positioned between the first side of the liner and the interior surface of the knit outer layer. The perimeter portion of the liner can be compressed or merged into itself to form a generally seamless second side of the liner. In particular embodiments, the clothing article comprises a glove, sock, or hat.

[0019] In some embodiments, the adhesive is distributed in an adhesive pattern having adhesive spotting. The adhesive spotting can have different concentrations or densities on different portions of the liner. For example, in the case of gloves, the adhesive spotting may have a first spotting density on a finger or fingertip portion of the liner and a different spotting density on a center or palm portion of the liner. In further embodiments, the adhesive pattern includes adhesive spotting generally adjacent to the perimeter portion of the liner. In other embodiments, the adhesive pattern comprises a grid pattern. In some embodiments, the adhesive comprises a one-part epoxy or a two-part epoxy. In some embodiments, at least one of the outer layer or the liner comprises fleece, wool, cotton, canvas, or leather. In particular embodiments, at least a portion of the outer layer comprises electrically conductive fibers.

[0020] In another embodiment, a process for manufacturing a glove includes stretching an outer layer inside-out over a glove form, such that an interior surface of the outer layer faces outward. The process further includes cutting a liner having a first side and a second side opposite the first side. An adhesive is deposited in an adhesive pattern onto the first side of the liner. The adhesive is fused to the interior surface

of the outer layer, thereby affixing the first side of the liner to the interior surface of the outer layer to form the glove. In some embodiments, the fusing comprises at least one of a heat or pressure treatment, and, in some cases, can include clamping the liner to the outer layer. The process includes removing the glove from the glove form and inverting the glove to a right-side-out configuration, thereby compressing at least a portion of the outer layer and the liner.

[0021] Specific details of several embodiments of the technology are described below with reference to FIGS. 1-10B. Other details describing well-known structures and systems often associated with clothing and clothing manufacture have not been set forth in the following disclosure to avoid unnecessarily obscuring the description of the various embodiments of the technology. Many of the details, dimensions, angles, and other features shown in the Figures are merely illustrative of particular embodiments of the technology. Accordingly, other embodiments can have other details, dimensions, angles, and features without departing from the spirit or scope of the present technology. A person of ordinary skill in the art, therefore, will accordingly understand that the technology may have other embodiments with additional elements, or the technology may have other embodiments without several of the features shown and described below with reference to FIGS. 1-10B.

[0022] FIG. 1A is a top view a palm side of a glove **100** in accordance with an embodiment of the technology. FIG. 1B is a cross-sectional view of the glove **100** along line B-B of FIG. 1A. Referring to FIGS. 1A and 1B together, the glove **100** includes a palm side **112** and a back side **114** (FIG. 1B), and comprises a finger portion **102** distal to a palm portion **104**, and a forearm portion **106** proximal to the palm portion **104**. At least a portion of the glove **100** is layered, and comprises an exterior outer layer **110** and a liner **120** (FIG. 1B) lining at least a portion of the interior surface of the outer layer **110**. In several embodiments, the liner **120** is spot-attached to the outer layer **110** with adhesive **130**. As will be described in more detail below, the liner **120** can be a single-piece liner providing a substantially seamless interior portion of the glove **100**.

[0023] In several embodiments, the outer layer **110** is a seamless knit glove having an ultrafine gauge (e.g. from about 10 gauge to about 18 gauge). In other embodiments, the outer layer **110** can have a cut-and-sew construction. The outer layer **110** can comprise various types of materials, including cotton, polyester, synthetics, Kevlar, nylon, etc. In particular embodiments, for example, the yarn includes the flame-resistant Nomex®, an aramid fiber, (Nomex N303) produced by The DuPont Company. The outer layer **110** can be knit of any of a variety of yarns, such as yarns that incorporate an elastane fiber (e.g., Lycra® spandex made by Invista, Inc). Outer layers **110** that include an elastane fiber exhibit good stretch and return characteristics (e.g., elasticity) which provides good form fitting (e.g., close fitting to the human hand). Also, a single sized glove can fit a variety of hand sizes because the elasticity allows small gloves to expand and comfortably fit larger hands. The outer layer **110** can be manufactured using knitting machines that are computer controlled to automatically produce a one-piece, seamless glove to which the liner **120** can be attached. Suitable computer-controlled glove knitting machines for producing basic knit fabric gloves are well known in the trade, such as the computer controlled knitting machines made by Shima Seiki Mfg. Ltd. of Wakayama, Japan.

[0024] In further embodiments, various materials can be used to enhance the glove's construction and provide for special uses for the glove **100**. For example, the glove **100** can include leather fingerpads or palm pads that can be bonded or otherwise affixed to the outer layer **110**, polyvinyl emulsion printed and cured onto the glove palm to enhance the gripping surface, rubber-like foam material (e.g., neoprene) to shock-isolate the palm of the hand from vibrations (e.g., from a jack-hammer), or heavier weight material on the back of the glove than on the palm (or vice-versa) to increase thermal insulation. In some embodiments, the outer layer **110** materials can be selected for having particular properties such as flame- or water-resistance, high durability, or grip features (i.e., high-friction). For example, the glove **100** can include wear-resistant portions on the places of the glove **100** most likely to be abused or abraded, or areas that are used to grip items or protect a person's hand. Similarly, in the case of socks, in some embodiments a manufactured sock can include multiple layers on a portion of the sock (e.g., the bottom of the sock) to provide, as an example, increased insulative, absorptive, or durability characteristics. For example, a multi-layer sock can include one or multiple layers of liner, outer layer, waterproof material, wear-resistant material, and/or other layer.

[0025] In still further embodiments, a portion of the glove **100**, such as the fingertip region of the outer layer **110**, can include metallic or other electrically conductive material fibers that engage the fingertips of the wearer's hand to allow the wearer to operate capacitive touch screen devices such as mobile phones or tablets without removing the glove from the user's hands. In particular embodiments, silver-coated nylon fibers are knit into the outer layer in the fingertip area of one or more fingers (including the thumb). These electrically conductive fibers are sufficiently flexible so as to avoid sacrificing tactile perception or finger dexterity. In further embodiments, such conductive fibers or wires are positioned between the outer layer **110** and the liner **120**.

[0026] FIGS. 2-10B illustrate stages of an embodiment of manufacturing an article of clothing, such as the glove **100**, in accordance with the technology. FIGS. 2-10B, more specifically, illustrate stages of manufacturing and attaching the liner **120** to the interior surface of the outer layer **110**. As mentioned above, in several embodiments, the liner **120** is spot attached to the outer layer **110** with adhesive **130** when the outer layer **110** is in an inside-out orientation and in a stretched configuration. The outer layer **110** is later returned to a "right-side-out" position and is allowed to relax and return to an unstretched configuration, providing a substantially seamless, lined interior. While FIGS. 2-10B illustrate this method in the context of glove manufacturing, these steps can be applied to create other clothing articles such as lined hats, socks, shirts, pants, or other apparel.

[0027] FIG. 2 is a top view of a glove form **240** configured in accordance with embodiments of the technology. FIG. 3 is a top view of the outer layer **110** of the glove **100** in an inside-out configuration stretched over the glove form **240**. In some embodiments, the glove form **240** is sized to be larger than the outer layer **110** in the outer layer's unstretched, or resting state so the glove will stretch at least radially (or laterally) when positioned on the form. In some embodiments, for example, the finger portion of the glove form **240** has a width of from about 5 inches to about 6 inches, compared to a narrower width of the glove **100**. The

glove form **240** can have the same or different widths at different portions (e.g., the finger and palm portions).

[0028] The difference in dimensions between the outer layer **110** and the glove form **240** (i.e., how much wider/longer the glove form **240** is than the outer layer **110**) can vary in alternate embodiments to produce gloves having different resulting properties. For example, the wider the glove form **240**, the greater the resulting compression when the outer layer **110** is removed from the glove form **240** after the liner **120** has been attached. The narrower the glove form **240**, the less the resulting compression when the outer layer **110** is removed from the glove form **240**. The preferred degree of compression (and the corresponding preferred glove form **240** size) can be selected depending on various factors, such as the material selections for the outer layer **110** and the liner **120**, and the acceptable level of compression/expansion stress that can be applied to these materials.

[0029] The glove form **240** can be made of metal or other materials having sufficient stiffness to provide a form for stretching the outer layer **110** without buckling. In several embodiments, the glove form **240** is made of aluminum (e.g., sheet aluminum). The glove form **240** can have a constant thickness or can have different thicknesses at different portions.

[0030] FIGS. 4-6 illustrate steps of preparing the liner **120** for attachment to the stretched outer layer **110**. Referring first to FIG. 4, the entire liner **120** is a one-piece liner cut from a sheet of fabric. The liner **120** can be made of knit, woven, felted, non-woven, molded, cast, leather, or other sheet goods. In some embodiments, the liner **120** comprises fleece, wool, cotton, canvas, leather, blends, or other materials chosen for particular properties, such as insulative properties, water resistance, flame resistance, etc. In a particular embodiment, the liner **120** comprises POLARTEC® Thermal FR with Nomex (Style #2200). In further embodiments, the liner **120** comprises multiple layers of fleece or other materials, or other combinations of materials. In the case of a multi-layer liner, the layers of the liner **120** can be attached to one another via sewing, adhesive, or fabric fastening means.

[0031] In several embodiments, the liner **120** comprises a single piece of material that will cover both the palm and back sides of a user's hand. In the illustrated embodiment, for example, the liner **120** comprises a back side **124** integrally connected to a palm side **122**, and the palm-side **122** has a shorter finger portion than the back side **124**. In this embodiment, the palm side **122** extends only up to approximately the second knuckle of the user, so that portion of the liner will not cover the wearer's fingertips. This construction allows the user's fingertips to directly contact the electrically conductive fibers in the fingertip areas of the glove **100** without interference from the liner **120**. This construction also provides the user's fingertips with improved dexterity and tactile function when wearing the gloves because there is less material (i.e., no liner **120**) between the fingertips and an object being handled. In further embodiments, the liner **120** can extend the entire length of the finger portion (i.e., does not stop at the second knuckle). In yet other embodiments, the liner **120** can be shaped and sized so more of the finger portion (or only some of the finger portions) are liner-free. In some embodiments, the liner **120** can be cut with the use of a die, such as a steel rule die.

[0032] As shown in FIG. 4, the liner **120** can be positioned on a substrate **460** for further processing. The glove liner **120** can simply rest on the substrate **460** or can be releasably attached to the substrate **460** with clips, wires, latches, clamps, or other mechanisms. The glove liner **120** can be a single material type or can be a combination of materials. For example, in particular embodiments, the liner comprises a first material on the palm side **122** and a second material on the back side **124**.

[0033] FIG. 5 is a top view of the substrate **460** and liner **120** positioned in a printing device **562** in accordance with embodiments of the technology. The printing device **562** of the illustrated embodiment includes a hinged arm **564** framing a printing screen **566** that is alternately movable on hinges **572** to cover and expose the liner **120** and substrate **460**.

[0034] The printing screen **566** can comprise a generally flat plate having an aperture pattern **570** corresponding to a desired adhesive pattern for the liner **120**. The apertures in the pattern extend fully through the printing screen and are in direct communication with the liner **120**. The printing screen **566** can be a metal material, such as aluminum or steel, or other material having sufficient strength and stiffness to support processing. As will be discussed in further detail below, the aperture pattern **570** can vary in different embodiments of the technology.

[0035] An adhesive can be spread over the printing screen **566**, causing the adhesive to fill only the individual apertures in the aperture pattern **570** and be applied to the liner **120** in an arrangement matching the aperture pattern **570**. The printing screen **566** accordingly functions like a silk screen. The adhesive can be dispersed over the printing screen **566** with a spreader, such as a squeegee. This can ensure that the adhesive will uniformly fill all the apertures in the aperture pattern **570** such that the adhesive will be deposited on, and remain on, the liner **120** when the printing screen is lifted off of the liner, thereby making a complete, uniform adhesive distribution in the adhesive pattern on the liner **120**.

[0036] The individual apertures in the aperture pattern **570** can have varying diameters in various embodiments of the technology. In particular embodiments, the individual apertures are about 0.068 inch in diameter. In another embodiment, the individual apertures can have larger diameters, such as about 0.094 inch in diameter. The individual apertures may or may not have a consistent diameter across the aperture pattern **570**. The individual apertures can be spaced apart by a range of dimensions (e.g., 0.250 inch in one embodiment). The apertures can be larger or smaller or in shapes other than circles in further embodiments, and can be spaced apart by different distances. The adhesive can be applied in different thicknesses with the printing screen **566**. In a particular embodiment, the adhesive is applied while using a screen made of 0.026 inch thick sheet metal. The amount of adhesive applied using the screen printing technique may be varied by using screens made of differing thickness.

[0037] In one embodiment, a one-component epoxy adhesive is used. In a particular embodiment, the adhesive is manufactured by Epoxies Etc. of Cranston, R.I., and is product number 10-3782. As will be discussed in further detail below, the adhesive can be heat-activated to cure. In another embodiment, the adhesive comprises Grilltex® 8E P2-2 made by Ems-Chemie Inc., of Sumter, S.C. The

particle size of Grilltex® is approximately from about 200 to about 300 microns, and the activation temperature is approximately 275° F.

[0038] In further embodiments, a 2-part epoxy type adhesive can be used. The adhesive can begin as two fluids mixed together in particular proportions and applied as a liquid. In a short time, by means of a chemical reaction, the two liquids become a solid bond. The epoxy can exhibit shore hardness of D-80. In a particular embodiment, 3M® Epoxy Adhesive #DP-460 Off-White 2-part Epoxy can be used. In other embodiments, other 2-part epoxies can be used.

[0039] In still further embodiments, an ultra-violet (UV) light activated adhesive can be used. The adhesive can exhibit a hardening delay after activation to allow an extended processing time. In a particular embodiment, the UV light-activated product Loctite® 3355 can be used. The Loctite® can cure at room temperature or rapidly cure when exposed to low temperature heat. In other embodiments, other UV-activated adhesives can be used.

[0040] In another embodiment, a B-stageable epoxy adhesive can be used. The adhesive can be exposed to low temperature curing into a B-stage that can later be re-liquefied and cured after glove assembly and clamping at an even more elevated temperature. In a particular embodiment, Epoxy Technology EPO-TEK® B9021-13 can be used, but other materials can be used in other embodiments.

[0041] FIG. 6A is a top view of the glove liner 120 having a spot pattern 670 of adhesive in accordance with embodiments of the technology. The spot pattern 670 matches the aperture pattern 570 on the printing screen 566 (FIG. 5). The spot pattern 670 can comprise a constant spotting density across the entirety of the liner 120, or can include different spotting densities at different positions on the liner 120. In some embodiments, a greater spotting density is applied to locations on the liner 120 expected to be subjected to the largest amount of movement or fatigue, such as the fingers or fingertips. In the illustrated embodiment, the spot pattern 670 outlines the perimeter of each of the palm and back sides 122, 124 of the liner 120. The spot pattern 670 further outlines the perimeter of individual fingers, with a plurality of rows of adhesive spots at the top of each finger portion. In further embodiments, the spot pattern 670 can include more or fewer adhesive spots in the same or alternate locations on the liner 120. For example, in other embodiments, the spot pattern 670 can include adhesive in the central palm portion of the liner 120 and the adhesive can form lines or regions rather than individual spots. For example, a pattern of adhesive can be applied to define channels or pathways between the liner 120 and the outer layer 110. These pathways can be configured to receive other items disposed between the layers, such as heating elements, wires, optic fibers, communication elements, padding, lights, etc. In particular embodiments, silver or another metallic or conductive material is disposed in such pathways. In another embodiment, the adhesive can be sprinkled or otherwise applied over most or all of the surface of the liner 120, before or after the liner 120 is cut to shape. In still further embodiments, the adhesive is applied to the outer layer 110 instead of or in addition to the liner 120. In further embodiments, the adhesive spots may be applied by means of dispensing individual spots controllably through syringes equipped with appropriate cannula.

[0042] FIG. 6B is an illustration of an adhesive spot pattern 671 in accordance with further embodiments of the

technology. The spot pattern 671 covers the entire liner, including a central or palm region. The spot pattern 671 includes adhesive spots that are on a grid or otherwise aligned relative to a frame of reference, such as a manufacturing tool. This can be useful in production to ensure that the adhesive is not smeared by the manufacturing tool, such as when the manufacturing tool is holding the liner 120 or other portion of the glove 100 in place during processing.

[0043] In other embodiments, still further spot patterns of adhesive can be used. For example, as shown in FIG. 6C, a tighter grid of spotting (i.e., smaller spacing providing a greater spotting density) can be used. In FIG. 6D, the adhesive is spotted in series of laterally offset rows. In some embodiments, the rows or grid arrangement of adhesive spotting can be particularly effective in adhering the liner 120 to the outer layer 110.

[0044] FIG. 7 is a top view of the liner 120 attaching to the interior surface of the outer layer 110 in accordance with embodiments of the technology. The outer layer 110 (i.e., the knit glove) is turned inside-out and positioned on the form 240, such that the outer layer 110 is in the stretched position. The outer layer 110 on the associated glove form 240 is aligned with one-half of the liner 120 so that the fingers and edges of the glove align with the finger portions and edges of the area of the liner 120. The other half of the liner 120 is lifted off the substrate 460 and folded at the edge of the glove from 240 so as to cover and align with the other side of the glove along the edges and finger portions. Accordingly, the liner 120 is aligned with the outer layer—the back side of the liner 120 is attached to the back side of the outer layer 110 and the palm side of the liner 120 is attached to the palm side of the outer layer 110, with the adhesive in the adhesive pattern 670 affixing the two layers. The one-piece liner 120 is accordingly “folded” around the outer layer 110.

[0045] In several embodiments, the liner 120 is folded around a straight edge of the glove form 240. The straight edge of the glove form 240 allows the inner liner 120 to fold easily, accurately and smoothly over the straight edge of the outer layer when on the form without buckling or bundling. This glove form 240 also allows the use of a more simple shape for the inner liner material with less waste. As shown in FIG. 8, the liner 120 extends only to the second knuckle region of the fingers on the palm side of the outer layer, leaving the fingertips exposed for the improved tactile function discussed above.

[0046] In one embodiment, the liner 120 is formed so that the finger portions are partially separated by cuts formed by the cutting die, except that the cuts terminate just before the ends of the finger portions. As a result, each of the finger portions is temporarily connected to the adjacent finger portions by a small, uncut piece of the liner material (i.e., connection portions) between the finger portions. These connection portions help keep the finger portions properly aligned relative to each other and relative to the outer glove layer 110 when the liner material is being wrapped onto the glove on the glove form. This allows for more accurate and faster positioning of the finger portions over the glove and glove form during the manufacturing process. After the liner 120 is securely adhered to the outer layer 110, the connection portions can be severed.

[0047] In further embodiments, additional liners or portions of liners may be applied in layers to create a multi-ply glove 100. For example, an additional layer can be applied in the knuckle area of the glove for additional protection.

The stretchability of the glove can be controlled or reduced by selecting the number of layers and the means by which the layers are bonded together. In still further embodiments, functional components such as a heating element, wiring, and/or controls are sandwiched between the liner 120 and the outer layer 110.

[0048] FIG. 8 is a top isometric view of the glove 100 positioned in a clamping device 880 in an unclamped configuration in accordance with embodiments of the technology. FIG. 9 is a top isometric view of the clamping device 880 in a clamped configuration. Referring to FIGS. 8 and 9 together, the clamping device includes a base portion 886, a pressure plate 884, and a plurality of clamps 882 configured to releasably compress the pressure plate 884 against the glove 100 and the base portion 886. In further embodiments, other types of clamps 882 or other securing mechanism(s) can be used. The pressure plate 884 can comprise a metal or other material with sufficient strength and stiffness to provide pressure, in conjunction with the clamps 882, to the glove 100 without buckling. This compression can further secure the liner 120 to the outer layer 110. While the illustrated embodiment includes six clamps 882, further embodiments can include more or fewer clamps 882 or other pressure-providing devices in alternate or additional locations. For example, in a particular embodiment, a single pressure-press can be applied from above the base 886 to sandwich the glove 100. In another embodiment, a groove clamp can be used on one or more lateral sides of the clamping device 880 to sandwich the base portion 886 and pressure plate 884. The groove clamp can thus interface with the clamping device 880 in a tongue-and-groove manner. In some embodiments, two groove clamps are used on opposing lateral sides of the clamping device 880. In particular embodiments, the groove clamp is made of wood.

[0049] In several embodiments, the adhesive is activated by heat. For example, the clamping device 880 can be placed between two heated platens that activate the adhesive to cause the liner 120 to affix to the outer layer 110. In some embodiments, the adhesive is activated in a convection oven fitted with a thermal controller with capacity to heat to at least 255° F. In a particular embodiment, the glove 100 is heated at 100° C. (212° F.) for approximately 1 hour, or at 120° C. (248° F.) for approximately 15 minutes. In further embodiments, the outer layer 110 and the liner 120 positioned on the glove form 240 is placed in a heater oven, outside of the clamping device 880. In some embodiments, the glove 100 is cooled (e.g., to room temperature) after heat curing and prior to removing the glove 100 from the glove form 240.

[0050] FIGS. 10A and 10B are top views of the back interior surface and palm interior surface, respectively, of the glove 100 with attached interior liner 120 in accordance with embodiments of the technology. Referring to FIGS. 10A and 10B together, the glove 100 has been removed from the glove form 240 and has compressed from a stretched state to an unstretched state. The compression of the outer layer 110 from the stretched to the unstretched state also compresses the liner 120, which causes edges of the liner 120 to mate or merge, thereby closing the adjacent edges of the liner 120. The liner 120 accordingly feels seamless to the user, as the edges have been compressed together without stitching. The glove 100 can be reversed from an inside-out configuration to a right-side-out configuration.

[0051] The gloves 100 disclosed herein offer several advantages over traditional gloves. The substantially seamless construction provides improved comfort to the user and can have enhanced durability compared to gloves with stitched seams that are potentially vulnerable to splitting. The method also produces less liner material waste than embodiments having multi-piece liners, as multi-piece liners require more unused material between the individual liner pieces.

[0052] From the foregoing, it will be appreciated that specific embodiments of the invention have been described herein for purposes of illustration, but that various modifications may be made without deviating from the spirit and scope of the invention. Further, certain aspects of the new technology described in the context of particular embodiments may be combined or eliminated in other embodiments. Moreover, while advantages associated with certain embodiments of the technology have been described in the context of those embodiments, other embodiments may also exhibit such advantages, and not all embodiments need necessarily exhibit such advantages to fall within the scope of the invention. Accordingly, the disclosure and associated technology can encompass other embodiments not expressly shown or described herein. Thus, the disclosure is not limited except as by the appended claims.

I claim:

1. A glove, comprising:

an outer layer having an interior surface, an exterior surface, a palm portion, and a finger portion;

a seamless liner having a first surface and a second surface opposite the first side, wherein the first surface of the liner is coupled to the interior surface of the outer layer; and

an adhesive between the first surface of the liner and the interior surface of the outer layer, wherein the adhesive is positioned in an adhesive pattern.

2. The glove of claim 1 wherein the adhesive pattern comprises a first adhesive spotting density in the finger portion and a second adhesive spotting density in the palm portion.

3. The glove of claim 1 wherein at least a portion of the adhesive pattern comprises a grid pattern.

4. The glove of claim 1 wherein the outer layer comprises a knit material and the liner comprises fleece, wool, cotton, canvas, or leather.

5. The glove of claim 1 wherein at least a portion of the outer layer comprises a conductive fiber.

6. A clothing article, comprising:

a knit outer layer having an interior surface and an exterior surface opposite the interior surface;

a liner having a first side, a second side opposite the first side, and an edge between the first side and the second side; and

an adhesive between the first side of the liner and the interior surface of the knit outer layer;

wherein the liner edge is compressed into itself to form a generally seamless second side of the liner.

7. The clothing article of claim 6 wherein the adhesive is distributed in a spotted adhesive pattern.

8. The clothing article of claim 7 wherein the adhesive pattern comprises a first density of adhesive spotting on a first portion of the first side of the liner and a second density

of adhesive spotting on a second portion of the first side of the liner, and wherein the first density is different from the second density.

9. The clothing article of claim 7 wherein the adhesive pattern includes adhesive spotting generally adjacent to the liner edge.

10. The clothing article of claim 6 wherein the clothing article comprises a glove, a sock, or a hat.

11. The clothing article of claim 6 wherein the adhesive comprises a one-part epoxy or a two-part epoxy.

12. A process for manufacturing a glove, comprising:
stretching a knit outer layer inside-out over a glove form, such that an interior surface of the outer layer faces outward;

cutting a liner having a first side and a second side opposite the first side;

depositing adhesive in an adhesive pattern onto the first side of the liner;

fusing the adhesive to the interior surface of the outer layer, thereby affixing the first side of the liner to the interior surface of the outer layer to form the glove; and
removing the glove from the glove form and inverting the glove to a right-side-out configuration, thereby compressing the outer layer and the liner.

13. The process of claim 12 wherein depositing adhesive in an adhesive pattern comprises spotting the adhesive on the first side of the liner.

14. The process of claim 12 wherein the first side of the liner includes a perimeter portion and a center portion, and wherein depositing adhesive in an adhesive pattern comprises depositing adhesive along the perimeter portion.

15. The process of claim 14 wherein depositing adhesive in an adhesive pattern further comprises depositing adhesive on the center portion.

16. The process of claim 12 wherein depositing adhesive in an adhesive pattern comprises depositing adhesive in a first spot pattern and a second spot pattern, and wherein the first spot pattern and second spot pattern have different spot densities.

17. The process of claim 12 wherein depositing adhesive comprises depositing a one-part or two-part epoxy adhesive.

18. The process of claim 12 wherein cutting a liner having a first side and a second side opposite the first side comprises cutting a liner having a perimeter portion between the first side and the second side, and wherein compressing the outer layer and the liner comprises merging the perimeter portion into itself.

19. The process of claim 12 wherein fusing the adhesive to the interior surface of the outer layer comprises fusing using at least one of a heat or pressure procedure.

20. The process of claim 12 wherein fusing the adhesive to the interior surface of the outer layer comprises clamping the outer layer against the liner.

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