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(54) **PROTECTIVE COMPOSITE FABRICS AND METHODS OF MANUFACTURE AND USE**

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ABSTRACT

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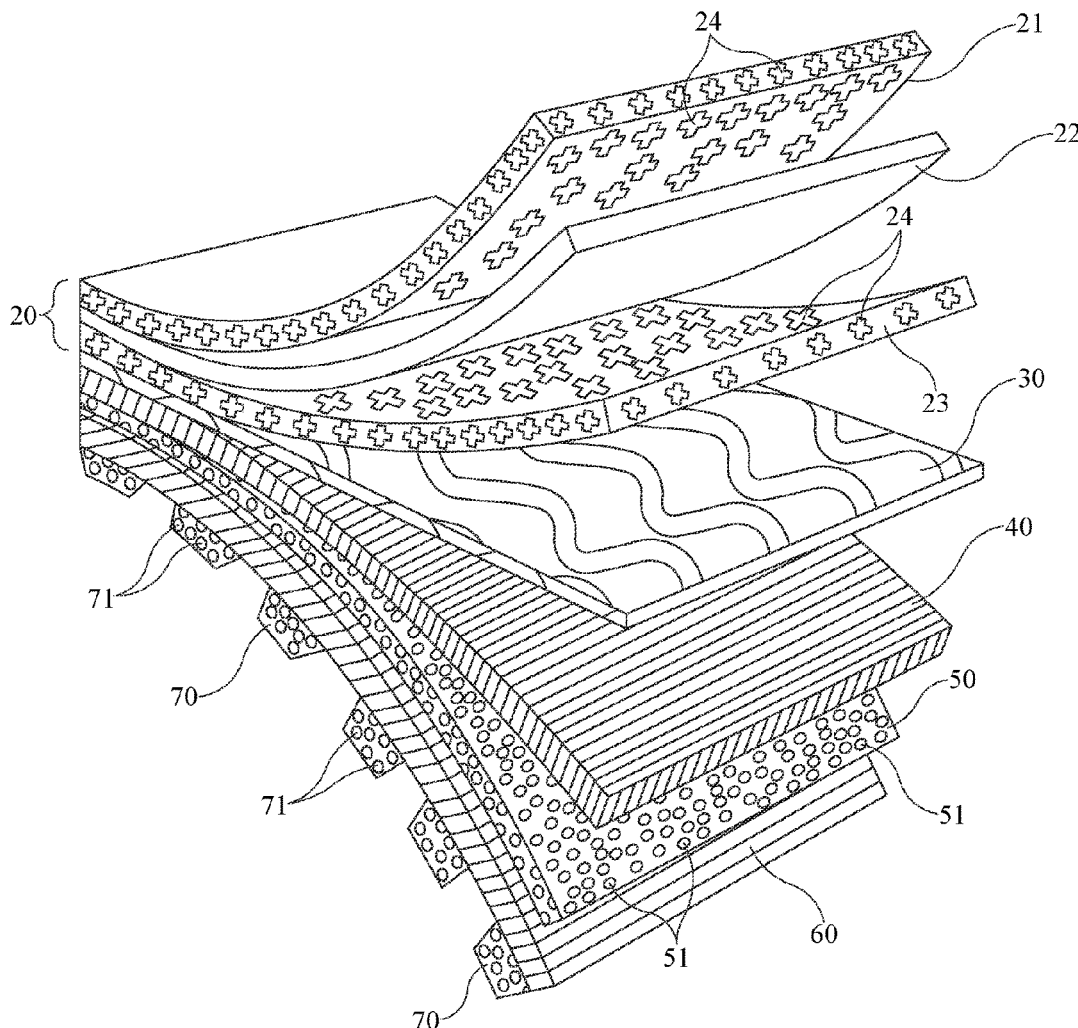
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A composite fabric includes a film, a first fibrous layer, a fabric layer, and a second fibrous layer. The film has a first side and a second side. The first fibrous layer has a first side connected to the second side of the film and a second side. The fabric layer has a first side connected to the second side of the first fibrous layer and a second side. The second fibrous layer has a first side connected to the second side of the fabric layer and a second side. The film can be a non-heat shrinking film. The composite fabric may also include one or more retaining members for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface.



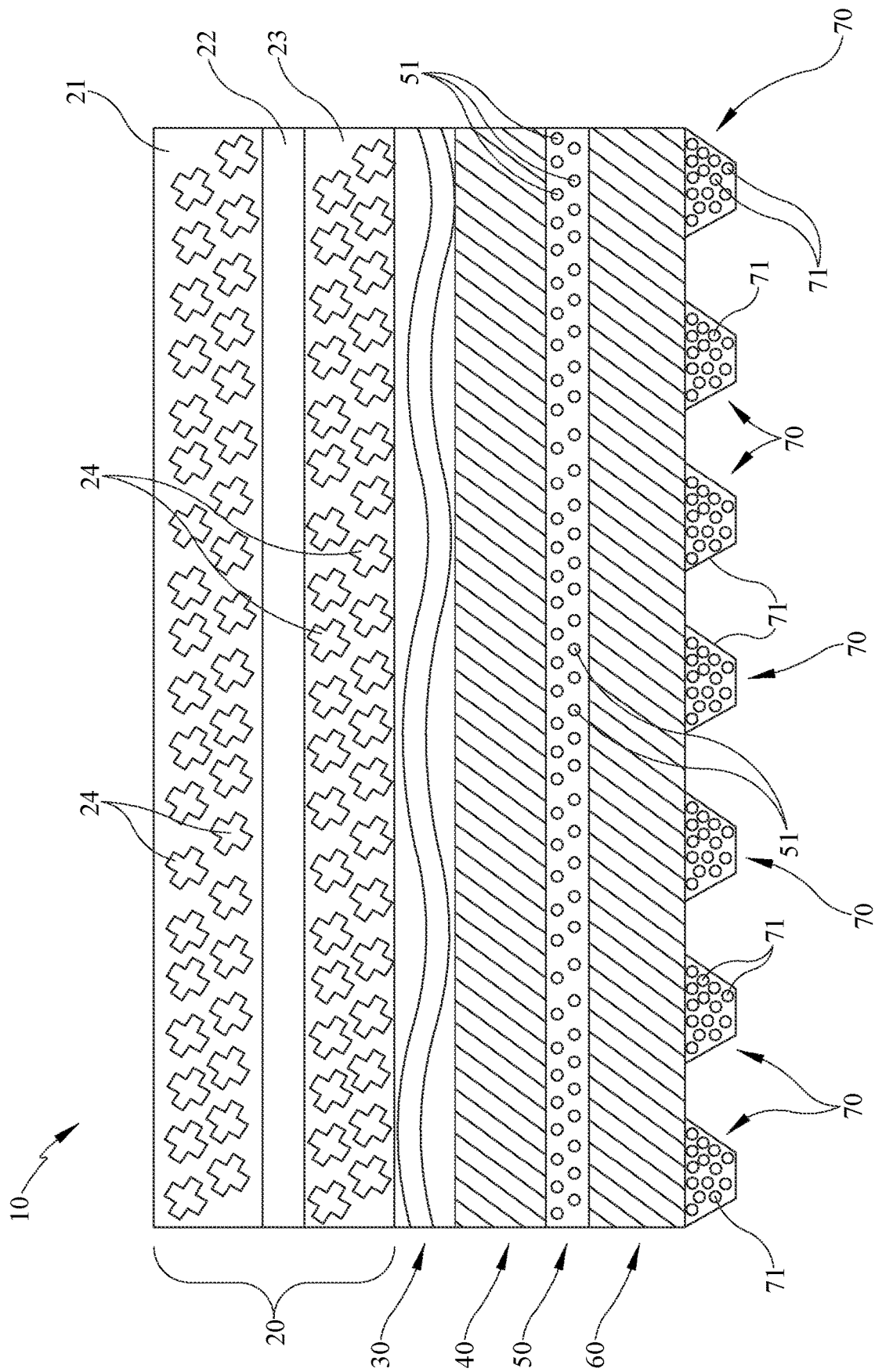


FIG. 1

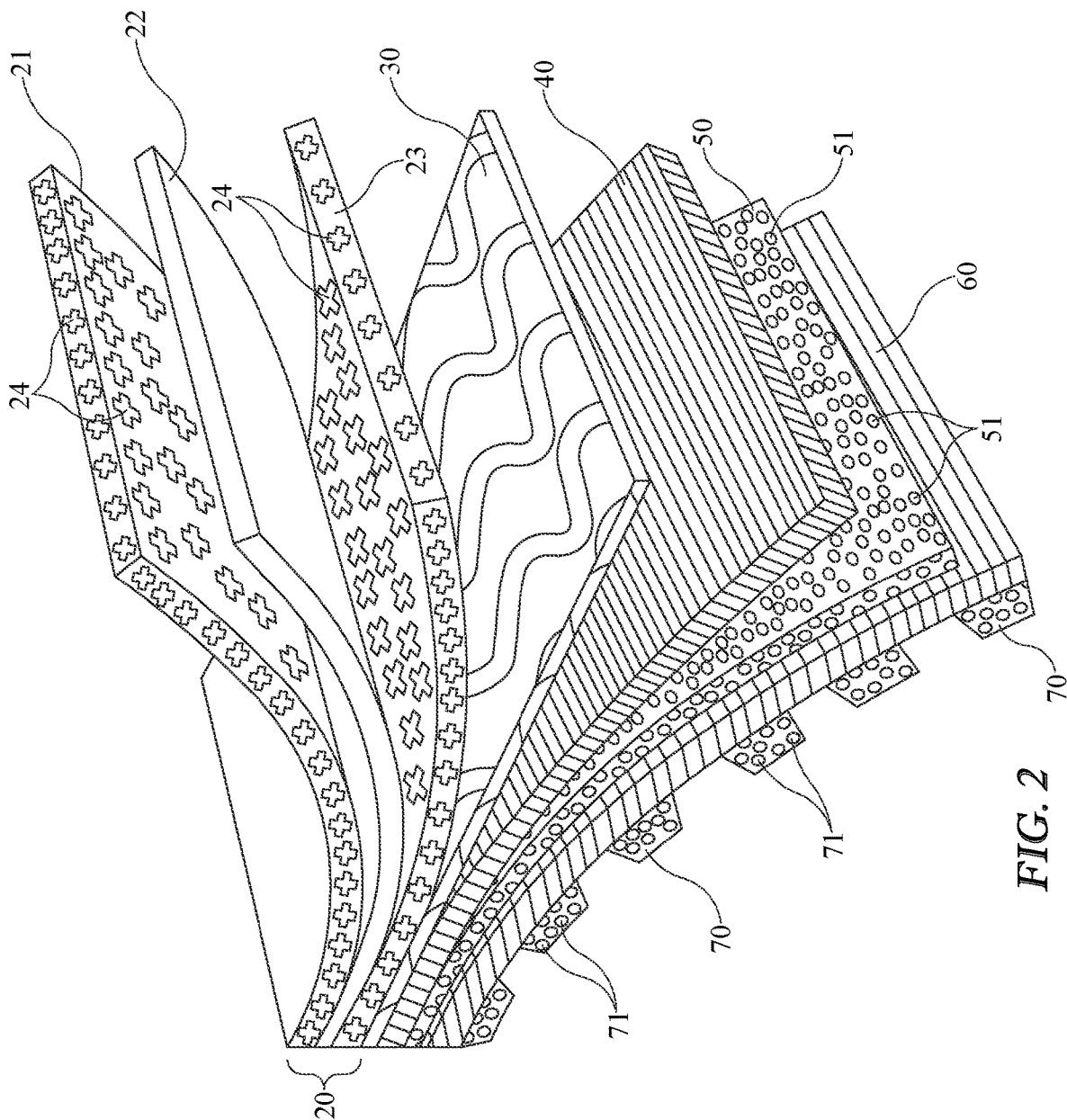
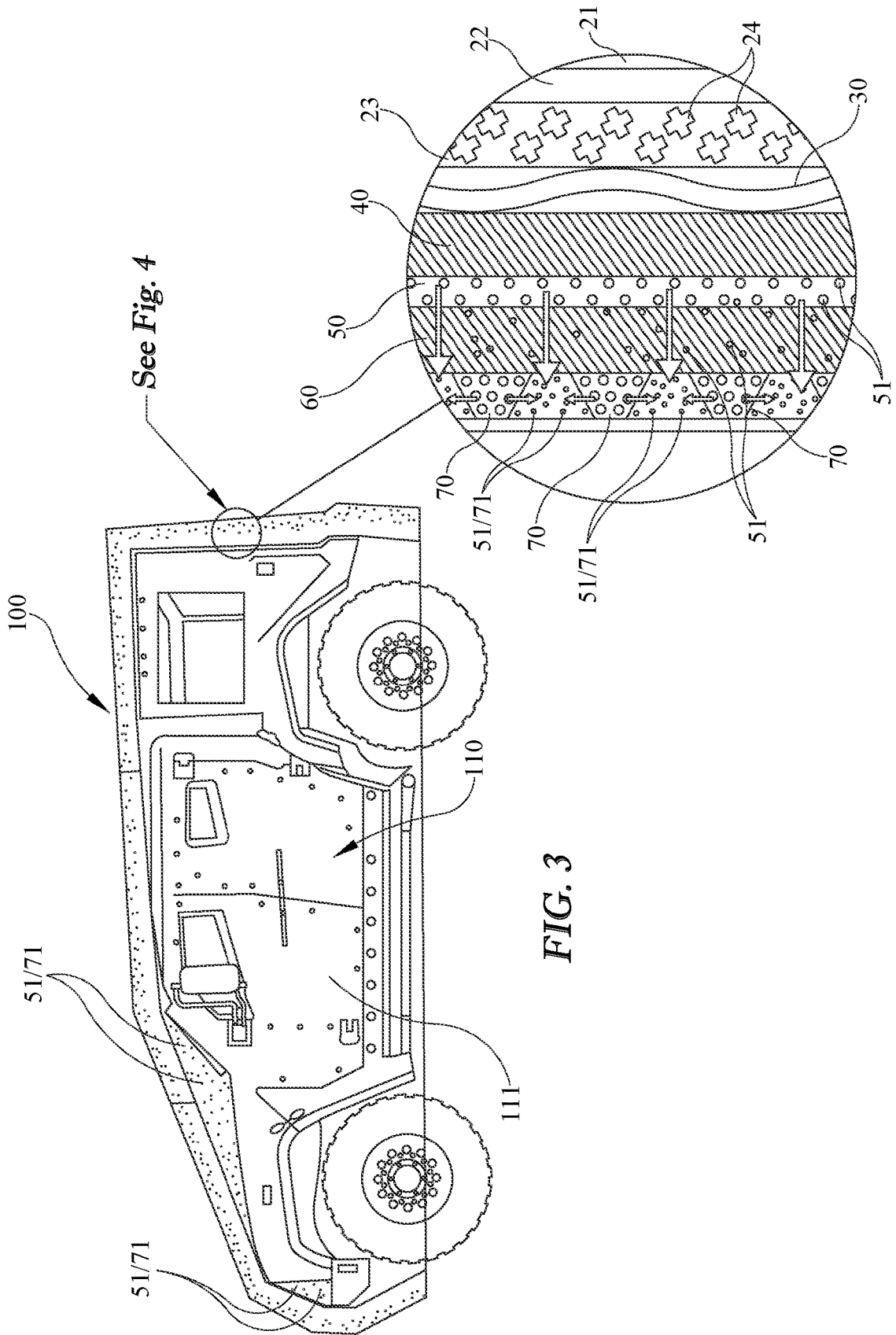


FIG. 2



See Fig. 4

FIG. 3

FIG. 4

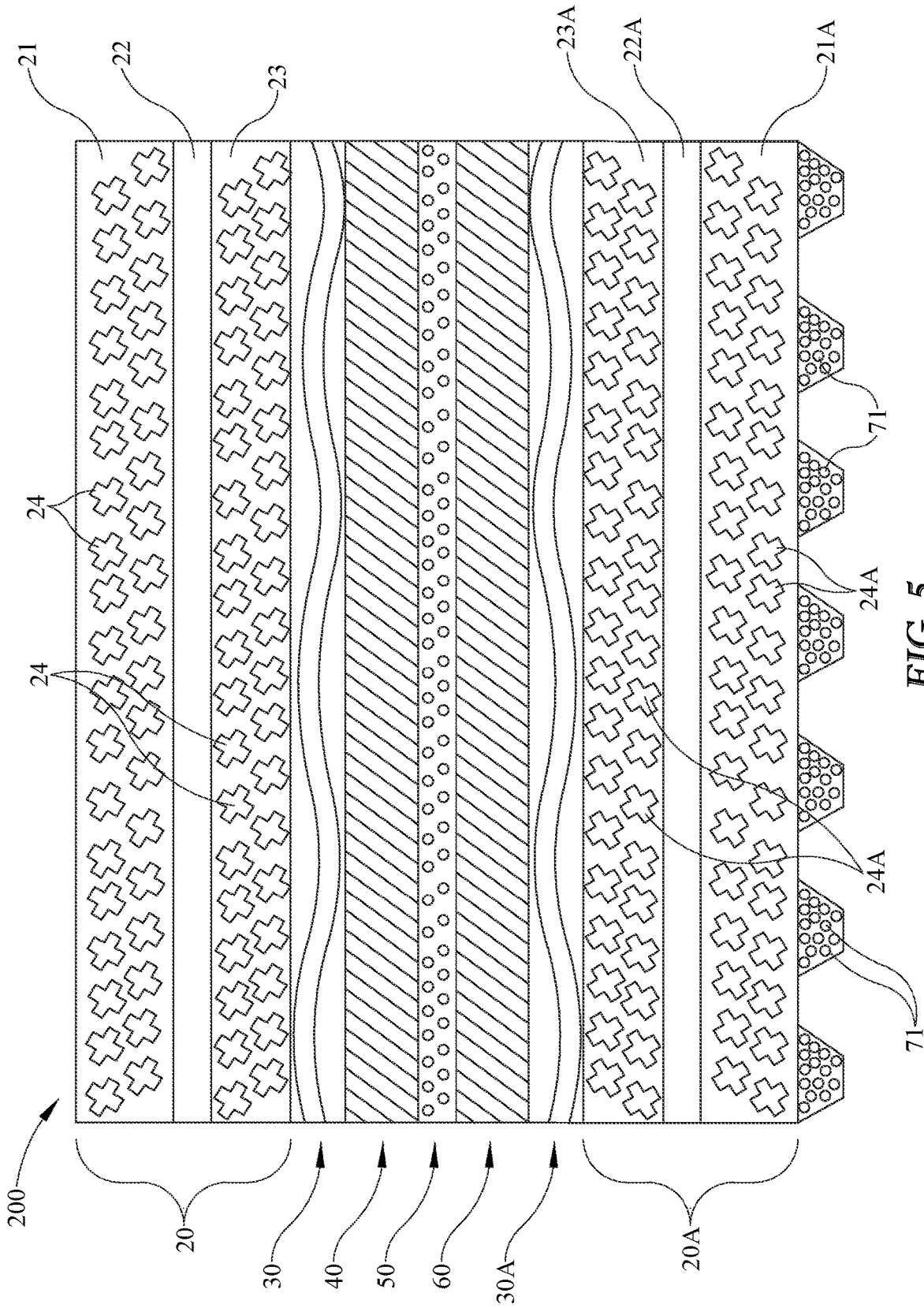


FIG. 5

PROTECTIVE COMPOSITE FABRICS AND METHODS OF MANUFACTURE AND USE

[0001] This application claims priority to U.S. Provisional application No. 63/028,814, filed on May 22, 2020.

[0002] The present invention relates to protective composite fabrics and methods of manufacturing and using protective composite fabrics.

BACKGROUND AND SUMMARY OF THE INVENTION

[0003] Protective fabrics and other constructs can be used to prevent corrosion, scratches and other damage to surfaces and objects that can result from contact with other objects, rain, wind, sunlight, the elements and other sources of harm. Examples of such fabrics and constructs are described in U.S. Pat. Nos. 6,696,120, 7,074,288, 8,828,487 and 8,883,284.

[0004] In one embodiment of the present invention, a composite fabric includes a film, a first fibrous layer, a fabric layer, a second fibrous layer, and a plurality of retaining members. The film has a first side and a second side. The first fibrous layer has a first side connected to the second side of the film and a second side. The fabric layer has a first side connected to the second side of the first fibrous layer and a second side. The second fibrous layer has a first side connected to the second side of the fabric layer and a second side. The retaining members are connected to and extend from the second side of the second fibrous layer. The retaining members are for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface.

[0005] In one embodiment, the film is a non-heat shrinking film.

[0006] In other embodiments, the retaining members include a vapor corrosion inhibitor. In certain embodiments, the retaining members include a contact corrosion inhibitor.

[0007] In another embodiment, the plurality of retaining members form at least one pocket between one or more of the plurality of retaining members, the second side of the second fibrous layer, and the surface, and the composite fabric includes a vapor corrosion inhibitor, at least a portion of which collects in one or more of the pockets.

[0008] In certain embodiments, the retaining members are constructed from epoxy. In other embodiments, the retaining members are constructed from polyurethane.

[0009] In another embodiment, the composite fabric further includes a pH modifier.

[0010] In one embodiment, the composite fabric includes an adhesive between the film and the first fibrous layer. In some embodiments the composite fabric includes a vapor corrosion inhibitor in the adhesive. In another embodiment, the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the machine direction is at least 1,000 g/cm. In yet another embodiment, the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the cross direction is at least 1,000 g/cm.

[0011] In one embodiment, the film is a multilayer film.

[0012] In another embodiment, the composite fabric includes electromagnetic shielding.

[0013] In one embodiment of the present invention, a composite fabric includes a non-heat shrinking film, a first

fibrous layer, a fabric layer, and a second fibrous layer. The film has a first side and a second side. The first fibrous layer has a first side connected to the second side of the film and a second side. The fabric layer has a first side connected to the second side of the first fibrous layer and a second side. The second fibrous layer has a first side connected to the second side of the fabric layer and a second side.

[0014] In one embodiment, the composite fabric includes a plurality of retaining members connected to and extend from the second side of the second fibrous layer. The retaining members are for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface.

[0015] In other embodiments, the retaining members include a vapor corrosion inhibitor. In certain embodiments, the retaining members include a contact corrosion inhibitor.

[0016] In another embodiment, the plurality of retaining members form at least one pocket between one or more of the plurality of retaining members, the second side of the second fibrous layer, and the surface, and the composite fabric includes a vapor corrosion inhibitor, at least a portion of which collects in one or more of the pockets.

[0017] In certain embodiments, the retaining members are constructed from epoxy. In other embodiments, the retaining members are constructed from polyurethane.

[0018] In another embodiment, the composite fabric further includes a pH modifier.

[0019] In one embodiment, the composite fabric includes an adhesive between the film and the first fibrous layer. In some embodiments the composite fabric includes a vapor corrosion inhibitor in the adhesive. In another embodiment, the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the machine direction is at least 1,000 g/cm. In yet another embodiment, the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the cross direction is at least 1,000 g/cm.

[0020] In one embodiment, the film is a multilayer film.

[0021] In another embodiment, the composite fabric includes electromagnetic shielding.

[0022] In one embodiment of the present invention, a composite fabric includes a first film, a first fibrous layer, a fabric layer, a second fibrous layer, a second film, and a plurality of retaining members. The first film has a first side and a second side. The first fibrous layer has a first side connected to the second side of the first film and a second side. The fabric layer has a first side connected to the second side of the first fibrous layer and a second side. The second fibrous layer has a first side connected to the second side of the fabric layer and a second side. The second film has a first side connected to the second side of the second fibrous layer and a second side. The retaining members are connected to and extend from the second side of the second film layer. The retaining members are for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface.

[0023] In one embodiment of the present invention, a method of producing a composite fabric includes providing a film, connecting a first fibrous layer to the film, connecting a fabric layer to the first fibrous layer, connecting a second fibrous layer to the fabric layer, and forming a plurality of retaining members on the second fibrous layer.

[0024] These and other features of the present invention will be apparent to those of skill in the art from the following detailed description of embodiments of the invention and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 is a cross sectional view of a protective composite fabric according to one embodiment of the present invention.

[0026] FIG. 2 is a partially exploded view of the protective composite fabric shown in FIG. 1.

[0027] FIG. 3 is a side view of a vehicle with a protective cover constructed from protective composite fabric according to one embodiment of the present invention applied thereto and shown in cross section.

[0028] FIG. 4 is a detail of area 4 in FIG. 3.

[0029] FIG. 5 is a cross sectional view of a protective composite fabric according to another embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0030] FIG. 1 is a cross-sectional view of a protective composite fabric 10 according to one embodiment of the present invention. In the embodiment shown composite fabric 10 generally includes a film 20, adhesive 30, a first fibrous layer 40, a fabric layer 50, a second fibrous layer 60 and a plurality of retaining members 70.

[0031] Film 20 in the embodiment shown includes a first layer 21, a second layer 22, and a third layer 23. Film 20 is produced from a non-heat shrinking thermoplastic material. In certain embodiments of the invention, first layer 21 is a polyurethane film, and in some embodiments, is a high yield strength, thermoplastic polyurethane film. Examples of materials suitable for film 20 in certain embodiments of the invention include, but are not limited to, ESTANE® 58277 TPU available from Lubrizol Advanced Materials, Inc. of Cleveland, Ohio. In the embodiment shown, second layer 22 of film 20 is a polyurethane film. Second layer 22 can be constructed from the same material as first layer 21 or from a different material. Third layer 23 of film 20 in the embodiment shown is also a polyurethane film. In certain embodiments, third layer 23 is a high yield strength polyurethane film. In certain embodiments, first layer 21 and third layer 23 are produced from the same material. Film 20 may be produced, for example, by coextruding first layer 21, second layer 22 and third layer 23 together. Film 20 can be produced by extruding cast film and and/or blown film. In one embodiment of the present invention, first layer 21, second layer 22 and third layer 23 are coextruded to form film 20.

[0032] In certain embodiments of the invention, second layer 22 of film 20 is thicker than first layer 21 and third layer 23. In one embodiment, second layer 22 constitutes approximately 60% of the total thickness of film 20 and first layer 21 and third layer 23 each constitute approximately 20% of the total thickness of film 20. In another embodiment, second layer 22 constitutes approximately 70% of the total thickness of film 20 and first layer 21 and third layer 23 each constitute approximately 15% of the total thickness of film 20.

[0033] First layer 21 and/or third layer 23 may optionally include a pH modifier 24. Relatively higher pH levels (i.e., a more alkaline environment) help prevent the growth of mold and mildew and help protect metal surfaces from corrosion. In use, first layer 21 faces outward from the surface to be protected and inhibits mold and mildew growth

on the surface of covers or other constructs made from composite fabric 10 and on fabric layer 50. Third layer 23 inhibits mold and mildew growth on fabric layer 50. In various embodiments of the present invention, pH modifiers 24 are utilized in an amount effective to produce a pH level between the composite fabric 10 and the object being protected of between about 8 and about 13. In certain embodiments of the invention, pH modifier 24 is selected to produce a pH of at least 8. Suitable pH modifiers 24 include, but are not limited to, sodium acetate, wollastonite, calcium oxide and/or calcium hydroxide. pH modifiers 24 can be added directly to the layers of film 20 or as a pH modifying component in the form of a masterbatch including one or more pH modifiers 24.

[0034] Film 20, in the embodiment shown, is an essentially waterproof construct with a high water vapor transmission rate. Film 20 thereby prevents liquid water from migrating through film 20 to the object protected by composite fabric 10, while at the same time permitting moisture vapor to pass from near the object through composite fabric 10. In certain embodiments of the invention, the water vapor transmission rate of film 20 is from about 50 g/m²/day to about 200 g/m²/day at 7.5 mils thickness. In one embodiment, the water vapor transmission rate of film 20 is at least 50 g/m²/day. Utilizing thinner films 20 can result in even greater water vapor transmission rates, including water vapor transmission rate of at least 500 g/m²/day.

[0035] Adhesive 30 joins film 20 to first fibrous layer 40. Adhesive 30 may be any adhesives sufficient to bond film 20 to first fibrous layer 40 in a manner that prevents delamination and unacceptable degradation of composite fabric 10 in use, particularly in hot, humid and/or wet environments. Examples of acceptable adhesives include, but are not limited to, polyurethane adhesives and hot melt styrene ethylene butadiene styrene (SEBS) adhesives. In one embodiment of the invention, AL1262 adhesive with a vapor corrosion inhibitor ("VCI") is utilized. In another embodiment of the invention, AL34-149-1 adhesive with VCI is utilized. These adhesives can be obtained from Adherent Laboratories, Inc. of St. Paul, Minn.

[0036] Various types of VCI's can be utilized in connection with embodiments of the present invention. These VCI's can be amines, nitrites, nitrates, triazoles, and other volatile compounds. Certain chemistries are more effective at inhibiting corrosion of certain metals. For example benzotriazole is a more effective VCI for copper, whereas cyclohexylamine carbonate is more effective for use with steel. Non limiting examples of vapor corrosion inhibitors useful in connection with embodiments of the present invention include: primary, secondary and tertiary aliphatic amines; aliphatic diamines; cycloaliphatic and aromatic amines; polymethylimines; long chain ethanolamines; imidazolines; amine salts, for example those of carbonic, carbamic, acetic, benzoic, oleic, nitrous and chromic acids; acetylenic alcohols; alkyl chromates; organic esters of nitrous acid; organic esters of phthalic acid; organic esters of carbonic acid; nitronaphthalene; nitrobenzene; amides; mixtures of nitrites with urea, urotropine, or ethanolamines; naphthols; thiourea derivatives; heterocyclic compounds 65 such as benzotriazole, tolyltriazole, and mercaptobenzothiazole and their respective salts; nitrated or sulfonated petroleum derivatives; and organic acid derivatives.

[0037] First fibrous layer 40 in certain embodiments of the invention is a spun-laced non-woven material. Acceptable materials for first fibrous layer 40 can be natural or synthetic and include organic and inorganic fibers and bioplastic

materials. Examples include, but are not limited to, cotton, viscose, rayon, acetate, polyamid, nylon, polyester, acrylic, polyethylene terephthalate (“PET”), polypropylene (“PP”), polyethylene (“PE”), polylactic acid (“PLA”), polyurethane, glass and/or other fibers suitable for producing spun-laced nonwoven material. In certain embodiments of the invention, the staple fibers used to produce first fibrous layer 40 are crimped staple fibers suitable for carding, hydroentanglement, and heat drying. Denier of the fibers utilized can vary depending on the production method. In one embodiment of the invention, the fibers have a denier of less than 3. In certain embodiments, the fibers have a denier between 0.5 and 1.5. The basis weight of first fibrous layer 40 can vary based on the intended use of composite fabric 10. In one embodiment of the invention, the basis weight of first fibrous layer 40 is between 10 g/m² and 100 g/m². In one embodiment of the invention, the basis weight of first fibrous layer 40 is 25 g/m².

[0038] Multiple samples were prepared to test the level of adhesion between films 20 and first fibrous layers 40 according to embodiments of the present invention. The samples were prepared by applying an adhesive 30 to a film 20 and laminating film 20 to a fibrous layer 40. One set of samples was prepared using AL34-149-1 adhesive (“Embodiment 1”) and another set of samples was prepared using AL1262 adhesive (“Embodiment 2”). Both adhesives included a vapor corrosion inhibitor. The samples were prepared using the following production specifications:

Film Material	Fibrous Layer Material	Sample Width	Amount of Adhesive	Line Speed	Adhesive Hopper, Hose and Head T	Air Pressure Applied Adhesive Exiting Head	Air Spray T	Roller Nip Pressure
Polyurethane	Polyester	20.32 cm	30 g/m ²	22.86 m/min	168.33° C.	4.83 N/cm ²	190.56° C.	51.71 N/cm ²

[0039] Because film 20 is produced from a non-heat shrinking thermoplastic material, it will not distort when it comes into contact with the hot adhesive.

[0040] The samples of the present invention were submerged in water for 24 hours and their saturated bond strength adhesion was tested by using a tensile testing machine and compared to their dry bond strength adhesion. The same test was performed on a prior art composite fabric product that utilizes a heat shrinkable film. The average results for five samples of the prior art and five samples of each of two embodiments of the present invention are set forth in the table below, in which “MD” indicates adhesion in the machine direction (i.e., along the length of the sample) and “CD” indicates adhesion in the cross direction (i.e., across the width of the sample). The adhesion results are reported in g/cm.

	Prior Art		Embodiment 1		Embodiment 2	
	MD	CD	MD	CD	MD	CD
Dry Bond Strength Adhesion	774.80	714.96	1,101.18	1,227.95	1,114.96	1,202.36
Wet Bond Strength Adhesion	24.80	15.75	1,220.87	1,427.95	1,198.03	1,188.58
% Adhesion Loss or Gain	-96.81%	-97.82%	10.88%	16.27%	7.48%	-1.15%

[0041] As shown in the table above, the bond strength adhesion of the prior art product degraded considerably after soaking in water. In contrast the bond strength adhesion of Embodiment 1 increased significantly. Furthermore, the bond strength adhesion of Embodiment 2 increased significantly in the machine direction and showed only minimal degradation in the cross direction.

[0042] Fabric layer 50 may be joined to first fibrous layer 40 by a hydroentanglement process, such as those used in known spunlaced production methods. Unlike prior art devices that utilize a scrim, fabric layer 50 is a continuous membrane of material. Fabric layer 50 is, in certain embodiments of the invention, a non-woven fabric material. Examples of suitable fabric materials for fabric layer 50 include, but are not limited to, knitted fabrics and spunbond fabrics made from polyamid, nylon, polypropylene, polyester, polyamide, PLA and/or polyurethane. Fabric layer 50 in certain embodiments of the invention includes vapor corrosion inhibitors 51. The VCI’s discussed above in connection with adhesive 30 are examples of VCI’s suitable for incorporation into fabric layer 50.

[0043] Second fibrous layer 60 may be made from the same materials and in the same manners as discussed above in connection with first fibrous layer 40, and may have the same physical properties. In certain embodiments of the invention, second fibrous layer 60 is identical to first fibrous layer 40. In other embodiments of the present invention, second fibrous 60 and first fibrous layer 40 are different.

Second fibrous layer 60 may be joined to fabric layer 50 by a hydroentanglement process.

[0044] As noted above, in certain embodiments of the invention, first fibrous layer 40, fabric layer 50, and/or second fibrous layer 60 may be constructed in whole or in part from PLA, such as PLA that is produced from corn or another renewable resource. Because PLA is biodegradable, composite fabrics 10 that include PLA are environmentally friendly.

[0045] Retaining members 70, in the embodiment shown, are connected to and extend from one side of second fibrous layer 60. Retaining members 70 function to resist movement, including sliding movement, of composite fabric 10 across the surface of the object being protected by cover 10. Retaining members 70 are produced from a material that will provide sufficient frictional engagement with the sur-

face of the object being protected by composite fabric 10. In one embodiment of the invention, retaining members 70 are made of polyurethane. In certain embodiments of the invention, retaining members 70 are constructed from formulation FL2030 available from Key Polymer Corporation of Lawrence, Mass. In other embodiments, retaining members 70 are made from epoxy. Retaining members 70 may be produced by utilizing a thermoset or a thermoplastic ink that is printed onto second fibrous layer 60. The ink used to produce retaining members 70 preferably has a viscosity of 30,000 centipoise or higher at ambient temperature, which assists formation of raised retaining members 70. Certain samples of embodiments of the present invention were partially produced at Spectro Coating Corp. of Leominster, Mass. on equipment that primed and dried retaining members 70 on second fibrous layer 60. Retaining members 70 may be printed onto second fibrous layer 60 either before or after laminating to film 20.

[0046] Retaining members 70 may include corrosion inhibitors 71, which may be VCI's or contact corrosion inhibitors. Contact corrosion inhibitors resist metal corrosion via contact with the metal. In embodiments of the invention that utilize corrosion inhibitors 71, the ink used to produce retaining members 70 has a pH of about 8 or higher, which results in better corrosion inhibition. The VCI's discussed in connection with vapor corrosion inhibitors 51 above are also suitable for use as corrosion inhibitors 71. Corrosion inhibitors 71 need not be the same as vapor corrosion inhibitors 51. If contact corrosion inhibitors are used, they can be located on or near the outer surface of retaining members 70.

[0047] Composite fabric 10 can be formed in any one of a number of manners. In one embodiment of the invention, first fibrous layer 40, fabric layer 50, and second fibrous layer 60 are joined together as, for example, by a hydroentanglement process as described above. Retaining members 70 are then applied to second fibrous layer 60, such as by printing as described above. Film 20 is then laminated to first fibrous layer 40 as described above. Alternatively, first fibrous layer 40, fabric layer 50, and second fibrous layer 60 are first joined together, followed by laminating film 20 to first fibrous layer 40. Retaining members 70 are then applied to second fibrous layer 60.

[0048] Composite fabric 10 can be formed into any desired configuration. For example, as shown in FIG. 3, composite fabric 10 can be formed into a custom fit cover 100 that is specially configured to protect a vehicle 110 having a surface 111. In use, retaining members 70 contact surface 111 of vehicle 110 (FIG. 4), thereby holding the remainder of cover 100 away from surface 111. In this manner, should second fibrous layer 60 become wet, retaining members 70 hold it away from surface 111, thereby keeping surface 111 drier and resisting corrosion. This configuration also creates pockets in which the VCI can collect. The pockets also assist with evaporation of condensation. Retaining members 70 also help secure cover 100 to vehicle 110, such as when high winds push cover 100 toward or relative to vehicle 110 and the friction between retaining members 70 and surface 111 resists movement of cover 100. In certain embodiments of the invention, retaining members 70 are capable of retaining cover 100 on vehicle 110 under wind speed conditions of from about 119 km/h to about 252 km/h. Furthermore, frictional heat generated by movement between retaining members 70 and surface 111 will facilitate

the release of vapor corrosion inhibitors 71, which helps prevent corrosion of vehicle 110 and surface 111. Over time, some of the vapor corrosion inhibitors 51 will also migrate from fabric layer 50 toward surface 111 of vehicle 110 and help prevent corrosion.

[0049] FIG. 5 is a cross sectional view of a composite fabric 200 according to another embodiment of the present invention. Like the embodiment of FIGS. 1 and 2, this embodiment includes film 20, adhesive 30, first fibrous layer 40, fabric layer 50, second fibrous layer 60, and retaining members 70. However, composite fabric 200 also includes a second film 20A between second fibrous layer 60 and retaining members 70. Second film 20A can be connected to second fibrous layer 60 by a second adhesive 30A in the same manner as described above for connecting film 20 to first fibrous layer 40. Second film 20A can be constructed in the same manners and from the same materials discussed above in connection with film 20. The pH modifiers 24 discussed above can also be utilized as pH modifiers 24A in connection with second film 20A. Note, however, that film 20 and film 20A (as well as pH modifiers 24 and 24A) of a particular fabric 200 do not have to be constructed in the same manner or from the same materials. Any of the adhesives discussed above that are suitable for use as adhesive 30 are also suitable for use as adhesive 30A. However, different adhesives can be used as adhesive 30 and adhesive 30A in any given composite fabric 200. In another embodiment of the invention, retaining members 70 are attached to both film 20 and second film 20A. Retaining members 70 may be printed onto film 20 and/or second film 20A either before or after laminating the films to first fibrous layer 40 and second fibrous layer 60.

[0050] Composite fabric 200 can be formed in any one of a number of manners. In one embodiment of the invention, first fibrous layer 40, fabric layer 50, and second fibrous layer 60 are first joined together, followed by laminating film 20 to first fibrous layer 40. Retaining members 70 are then applied to second film 20A, which is then laminated to second fibrous layer 60. Alternatively, first fibrous layer 40, fabric layer 50, and second fibrous layer 60 are first joined together, followed by laminating film 20 to first fibrous layer 40 and laminating second film 20A to second fibrous layer 60. Retaining members 70 are then connected to second film 20A.

[0051] In other embodiments of the invention, infrared ("IR") shielding, radio frequency ("RF") shielding, electromagnetic pulse ("EMP") shielding, high-powered microwave ("HPM") shielding, directed-energy weapons ("DEW") shielding, and/or electromagnetic interference ("EMI") shielding can be incorporated into fabrics and covers of the present invention. As used in this application, the terms "electromagnetic shielding" and "EMI shielding" include all of the forgoing types of shielding and all other types of shielding designed to block, inhibit, reduce or otherwise disrupt infrared, electronic, radio, microwave, static, magnetic and other similar forms of interference. Shielding electronics and other sensitive equipment from such interference helps isolate electrical devices from the surroundings and may protect equipment from electronic attacks, such as RFID virus attacks in which a malicious code is inserted into an RFID tag to alter or corrupt data in an RFID system or equipment.

[0052] EMI shielding can be incorporated into composite fabric 10 in a number of ways. For example, conductive

modifiers, such as carbon or metal, can be incorporated into one or more layers of composite fabric **10** to lower the surface and volume resistivity of the layers so that they can dissipate electrostatic charges and attenuate electromagnetic signals. The shielding materials can be incorporated into film, fibrous layers, fabric layer, and/or retaining members of embodiments of the present invention. The EMI shielding materials can be used to construct the film, fibrous layers, fabric layer, and/or retaining members of composite fabric **10**, can be incorporated as a component of those parts of composite fabric **10**, and/or can be applied to those parts of composite fabric **10** as a coating. In certain embodiments of the present invention, EMI shielding material is incorporated into adhesive **30**. In other embodiments, a separate layer, such as a fabric layer with EMI shielding functionality, is included in composite fabric **10** as an additional layer.

[0053] For example, in certain embodiments of the present invention, EMI shielding is provided by incorporating carbon modifiers into components of the present invention in amounts of 5 to 25%. Carbon modifiers in the form of fibers can be derived from polyacrylonitrile (“PAN”). In certain embodiments of the present invention, PAN carbon fibers are incorporated in amounts up to 10% by weight of composite fabric **10**. EMI shielding values of 30 dB to 50 dB can be achieved by incorporating approximately 50% by weight PAN carbon fibers into composite fabric **10**. Microcarbon fibers may achieve similar EMI shielding values at amounts as low as 3% by weight of composite fabric **10**. Other effective EMI shielding materials include nickel coated carbon fibers, stainless steel fibers (at levels of 5% to 10% by weight of composite fabric **10**), copper and aluminum.

[0054] In certain embodiments of the invention, EMI shielding effectiveness of between about 1 dB and about 100 dB or more can be achieved by utilizing different coatings that include aluminum, silver, nickel, copper or combinations of these materials. The coatings utilized can be solvent based or water based systems. One embodiment of the invention utilizes a water based silver coating, such as Series 599-Z6098-01 from PPG Industries, Inc. of Pittsburgh, Pa. The coating may be applied to the surface of the film, the surface of the fibrous layers, and/or the surface of the fabric layer. It can also be used to coat the individual strands of the fibrous and fabric layers. The coating system can also be added to the retaining members, used to coat the retaining members, and/or incorporated into the VCI system of the retaining members.

[0055] In certain embodiments of the present invention, one or more components of composite fabric **10** is constructed to form a Faraday cage or Faraday shield. This construction is particularly useful for blocking electromagnetic pulses, which can disrupt, degrade the performance of, and/or damage electronic components.

[0056] Covers made from composite fabrics **10** of the present invention can be manufactured by sewing, welding (such as, for example, impulse bar welding, ultrasonic welding, and RFID welding) and/or other methods. However, welded cover seams may result in better EMI shielding capabilities.

[0057] Although the present invention has been shown and described in detail, the same is by way of example only and should not be taken as a limitation on the invention. Numerous modifications can be made to the embodiments disclosed without departing from the scope of the present invention. For example, the protective cover can be formed

into configurations other than those shown and described and can be used to protect objects other than vehicles. Also, vapor corrosion inhibitors could be incorporated into adhesive **30**. Other modifications and variations are also within the scope of the invention.

1. A composite fabric, including:

- a film having a first side and a second side;
- a first fibrous layer having a first side connected to the second side of the film and a second side;
- a fabric layer having a first side connected to the second side of the first fibrous layer and a second side;
- a second fibrous layer having a first side connected to the second side of the fabric layer and a second side; and
- a plurality of retaining members for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface, the retaining members connected to and extending from the second side of the second fibrous layer.

2. The composite fabric of claim **1**, wherein the film is a non-heat shrinking film.

3. The composite fabric of claim **1**, wherein the retaining members include a corrosion inhibitor.

4. The composite fabric of claim **3**, wherein the corrosion inhibitor is a vapor corrosion inhibitor.

5. The composite fabric of claim **1**, wherein the plurality of retaining members form at least one pocket between one or more of the plurality of retaining members, the second side of the second fibrous layer, and the surface, and further including a vapor corrosion inhibitor at least a portion of which collects in one or more of the pockets.

6. The composite fabric of claim **1**, wherein the retaining members are constructed from epoxy.

7. The composite fabric of claim **1**, wherein the retaining members are constructed from polyurethane.

8. The composite fabric of claim **1**, further including a pH modifier.

9. The composite fabric of claim **1**, further including an adhesive between the film and the first fibrous layer.

10. The composite fabric of claim **9**, further including a vapor corrosion inhibitor in the adhesive.

11. The composite fabric of claim **9**, wherein the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the machine direction is at least 1,000 g/cm.

12. The composite fabric of claim **9**, wherein the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the cross direction is at least 1,000 g/cm.

13. The composite fabric of claim **1**, wherein the film is a multilayer film.

14. The composite fabric of claim **1**, further including electromagnetic shielding.

15. A composite fabric, including:

- a non-heat shrinking film having a first side and a second side;
- a first fibrous layer having a first side connected to the second side of the film and a second side;
- a fabric layer having a first side connected to the second side of the first fibrous layer and a second side; and
- a second fibrous layer having a first side connected to the second side of the fabric layer and a second side.

16. The composite fabric of claim **15**, further including a plurality of retaining members for contacting a surface on

which the composite fabric is placed and resisting movement of the composite fabric relative to the surface, the retaining members connected to and extending from the second side of the second fibrous layer.

17. The composite fabric of claim **16**, wherein the retaining members include a corrosion inhibitor.

18. The composite fabric of claim **17**, wherein the corrosion inhibitor is a vapor corrosion inhibitor.

19. The composite fabric of claim **16**, wherein the plurality of retaining members form at least one pocket between one or more of the plurality of retaining members, the second side of the second fibrous layer, and the surface, and further including a vapor corrosion inhibitor at least a portion of which collects in one or more of the pockets.

20. The composite fabric of claim **16**, wherein the retaining members are constructed from epoxy.

21. The composite fabric of claim **16**, wherein the retaining members are constructed from polyurethane.

22. The composite fabric of claim **15**, further including a pH modifier.

23. The composite fabric of claim **15**, further including an adhesive between the film and the first fibrous layer.

24. The composite fabric of claim **23**, further including a vapor corrosion inhibitor in the adhesive.

25. The composite fabric of claim **23**, wherein the adhesive adheres the film to the first fibrous layer and the water saturated bond strength adhesion between the film and the first fibrous layer in the machine direction is at least 1,000 g/cm.

26. The composite fabric of claim **23**, wherein the adhesive adheres the film to the first fibrous layer and the water

saturated bond strength adhesion between the film and the first fibrous layer in the cross direction is at least 1,000 g/cm.

27. The composite fabric of claim **15**, wherein the film is a multilayer film.

28. The composite fabric of claim **15**, further including electromagnetic shielding.

29. A composite fabric, including:

a first film having a first side and a second side;

a first fibrous layer having a first side connected to the second side of the first film and a second side;

a fabric layer having a first side connected to the second side of the first fibrous layer and a second side;

a second fibrous layer having a first side connected to the second side of the fabric layer and a second side;

a second film having a first side connected to the second side of the second fibrous layer and a second side; and

a plurality of retaining members for contacting a surface on which the composite fabric is placed and resisting movement of the composite fabric relative to the surface, the retaining members connected to and extending from the second side of the second film.

30. A method of producing a composite fabric, including: providing a film;

connecting a first fibrous layer to the film;

connecting a fabric layer to the first fibrous layer;

connecting a second fibrous layer to the fabric layer; and

forming a plurality of retaining members on the second fibrous layer.

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