June 28, 1960 W. A. CORRY 2,942,327

COATED FABRIC

Filed Aug. 15, 1957 2 Sheets-Sheet 1

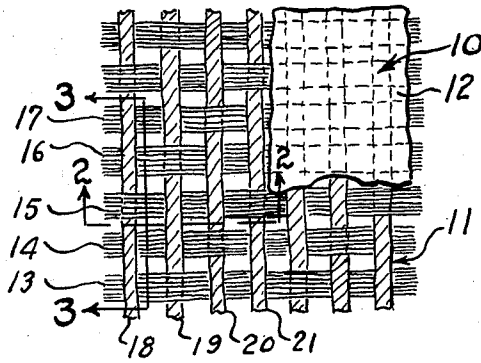

FIG. 1.

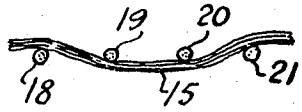

FIG. 2.

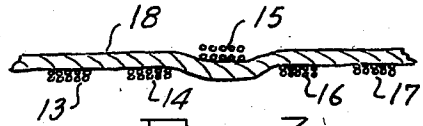

FIG. 3.

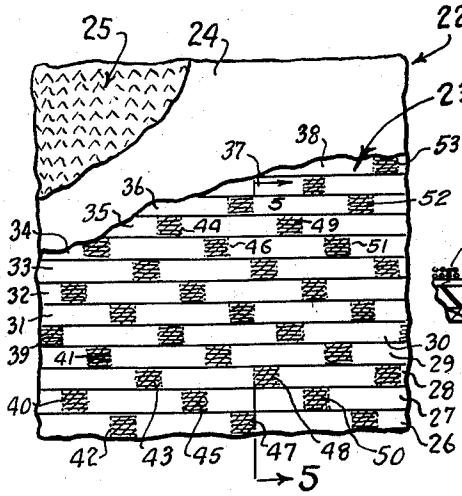

FIG. 4.

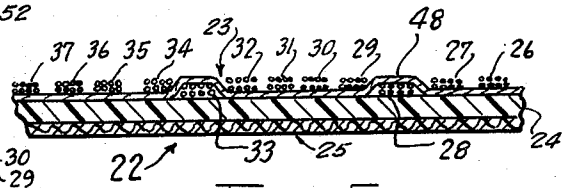

FIG. 5.

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June 28, 1960 W. A. CORRY 2,942,327

COATED FABRIC

Filed Aug. 15, 1957 2 Sheets-Sheet 2

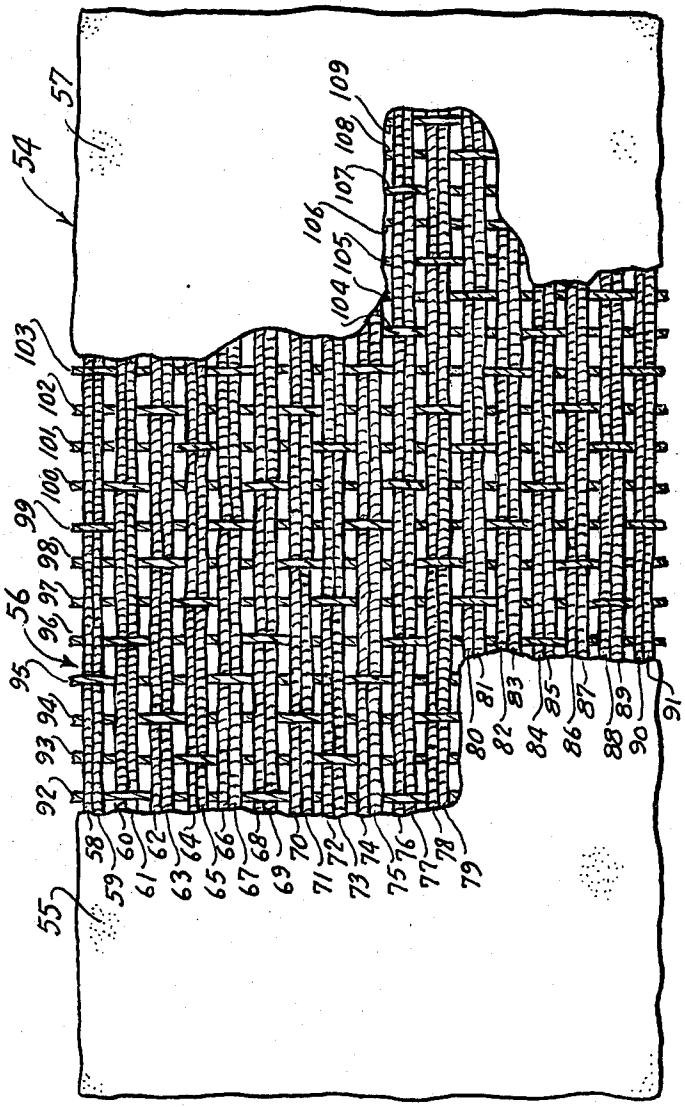

FIG. 6.

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COATED FABRIC

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10 Claims. (Cl. 28—80)

This invention relates to a coated fabric, and, in particular, to a specific fabric and to such fabric with a flexible synthetic resinous film adhered to at least one of its surfaces.

Various coated fabrics are presently available. In some such materials the bond between a synthetic resinous film and the fabric is sufficiently good that the material can withstand repeated flexings, for example as in service conditions when the coated fabric is used as upholstery. Materials having sufficiently good bonding between a flexible film and the fabric to be suited for upholstery use have heretofore been coated cotton fabrics. It has also been suggested (see U.S. Patent 2,619,705) that a fabric composed of generally parallel or untwisted continuous filament yarns as both warp and woof yarns can be coated with a flexible synthetic resinous film. In certain respects, and in particular with regard to abrasion resistance, a material made by applying a flexible, synthetic resinous film to such a fabric is substantially superior to a similarly coated cotton fabric material. However, flexible films, usually vinyl films, adhere poorly to such fabrics. As a consequence it is necessary either to apply a prime coating to the fabric, and then the desired flexible film to the prime coated fabric, or to apply a desired flexible synthetic resinous film to each side of the fabric which will strike through the fabric and adhere to itself to get adherence which is satisfactory for any use. Further, the resulting coated continuous filament yarn fabric is one wherein the coating adheres so poorly to the fabric that it is unsuited for upholstery use. So far as is known, no synthetic yarn fabric having either warp or woof yarns made up of a plurality of untwisted monofilaments was produced prior to the instant invention which had sufficient adhesion between the film and the fabric to be suitable for upholstery use.

The present invention is based upon the discovery of an article comprising a woven fabric composed of twisted staple fiber yarns and either warp or woof yarns which are generally parallel continuous filaments, and a flexible syntheic resinous film adhered to at least one surface of the fabric. The generally parallel, continuous filaments in the warp or woof yarns have either no twist or a very low twist generally in the range of ½ to 3½ turns per inch. By virtue of novel cooperation between the fabric and the film coating, such article combines, for the first time, extremely high abrasion resistance, and sufficient bond strength between the fabric and the film to suit the finished fabric for upholstery use.

It is, therefore, an object of the invention to provide an improved coated fabric.

It is a further object of the invention to provide an article which is a woven fabric composed of warp and woof yarns, one of which is a twisted staple fiber yarn, either natural or synthetic, such as spun nylon, regenerated cellulose or cotton, while the other is a high tensile strength yarn made up of a plurality of generally parallel or untwisted continuous filaments, and a flexible, synthetic resinous film adhered to at least one surface of the fabric.

Other objects and advantages will be apparent from the description which follows, reference being had to the accompanying drawings, in which—

Fig. 1 is a plan view to a greatly enlarged scale showing a coated fabric according to the invention, with the coating broken away in a part of the view to show details of the fabric weave.

Fig. 2 is a sectional view along the line 2—2 of Fig. 1 showing further details of structure in the fabric.

Fig. 3 is a view in section along the line 3—3 of Fig. 1 showing still further details of the structure of the fabric.

Fig. 4 is a plan view of a sandwich structure constituting a preferred specific coated fabric according to the invention, to a greatly enlarged scale, parts thereof being broken away to show details of the structure.

Fig. 5 is a sectional view along the line 5—5 of Fig. 4.

Fig. 6 is an enlarged plan view of still another sandwich structure according to the invention, with parts broken away to show details of the structure.

Referring now in more detail to the drawings, a coated fabric according to the invention is indicated generally at **10** in Fig. 1. The coated fabric **10** comprises a base fabric indicated generally at **11** and a coating **12** adhered to one surface thereof. The fabric **11** is made up of flat continuous filament parallel fiber yarns, some of which are designated **13, 14, 15, 16** and **17**, and twisted staple yarns, some of which are designated **18, 19, 20** and **21**.

The weave of the fabric **11** is a two over, one under pattern with respect to the twisted staple yarns, in both directions. For example, the twisted staple yarn **18** passes over the continuous filament yarns **13** and **14**, under the continuous filament yarn **15**, and over the continuous filament yarns **16** and **17**. The continuous filament yarn **13** passes under the twisted staple yarn **18**, over the twisted staple yarn **19**, and under the yarns **20** and **21**. The continuous filament yarn **14** passes under the staple yarns **18** and **19**, over the staple yarn **20**, and under the staple yarn **21**, while the continuous filament yarn **15** passes over the staple yarn **18**, under the twisted staple yarns **19** and **20**, and over the staple yarn **21**. A similar pattern continues throughout the fragment of the fabric **11** shown in Fig. 1, and, indeed, throughout an entire fabric of this type. These relationships are also represented in Figs. 2 and 3.

The film **12** can be any of many known materials suitable for use in the production of coated fabrics, its specific identity constituting no part of the instant invention. In general, such film is usually, in actual practice, a vinyl film, and most frequently a stabilized, plasticized and pigmented polyvinyl chloride or vinyl chloride copolymer. A typical formulation for such a vinyl material is given in the example hereof.

The film **12** can be applied to the fabric **11** in any of the usual ways employed to produce a coated fabric. For example, a suitably plasticized, stabilized and pigmented polyvinyl chloride composition can be heated to a temperature at which it is plastic, formed into a sheet by means of a pair of cooperating rolls, associated with a correspondingly sized sheet of the fabric **11**, with a surface of the fabric positioned adjacent a surface of the polyvinyl chloride sheet, and this assembly passed between suitably heated cooperating rolls so that the polyvinyl chloride is again converted to a plastic condition and compressed against a surface of the fabric **11** and is, after passing between the cooperating rolls and cooling, tightly bonded to the fabric **11**. If desired, the exposed surface of the film **12** can be calendered, embossed, printed, top coated, or otherwise decorated to provide any desired surface pattern.

The continuous filament yarns **13, 14, 15, 16** and **17** can be made up of a desired number of any suitable type

of filaments, so long as the filaments are disposed in generally parallel or untwisted relationships within the yarns. For example, regenerated cellulose, nylon, polyester, polyamide, or the like filaments can be employed. Regenerated cellulose filaments are usually preferred because of their ready availability and low cost. When regenerated cellulose filaments are employed in these yarns, high tenacity filaments are most desirable, i.e., filaments having a tenacity of at least 2.5 grams per denier, as frequently employed in producing tire cord. The twisted staple fiber yarns **18**, **19**, **20** and **21** can be conventional yarns as frequently employed in producing fabrics intended for coating, and can be of any desired denier.

In the art of water repellent fabrics, a sandwich or lamellar structure comprising outer lamella of fabric adhered together by a flexible sheet of natural or synthetic rubber, or of a synthetic resinous material, is excellent for many uses. For example, such a structure can be used as a top for a so-called "convertible" automobile, and is ideal from many standpoints. The flexible sheet material reinforces the fabrics, so that the structure is not easily damaged; the flexible sheet material is protected against the direct action of sunlight and the elements by the exterior fabrics; and any desired color combinations can be provided by suitable combinations of interior and exterior fabrics. Such lamellar structures rather readily can be made completely water-proof.

A difficulty with such lamellar structures, which has heretofore been insurmountable, has involved surface imperfections and grease and tar spots in twisted cotton or other natural fiber yarns from which the fabrics have been woven. Imperfections, grease and tar spots invariably mar the surfaces of such fabrics, and make lamellar structures produced therefrom aesthetically unacceptable, and millitate against their use. Fabrics have also been suggested where warp and woof yarns are composed of a bundle of substantially parallel or untwisted continuous filaments. Such fabrics are substantially free of surface imperfections, and would, therefore, be completely satisfactory aesthetically in lamellar structures of the type previously discussed, but can be bonded only with difficulty, and only with low bond strength, to a flexible film or sheet material. In fact, the bond strength in such cases is so low that the resulting product will not withstand repeated flexing to which a top of a so-called "convertible" automobile is subjected.

A specific aspect of the instant invention is based upon the discovery of a new sandwich or lamellar structure which comprises a particular fabric in a particular spatial relationship with a second fabric, which can be the same or different, and a flexible sheet material disposed between the two fabrics and adhered to adjacent surfaces of each. Such a sandwich or lamellar structure is indicated generally at **22** in Figs. 4 and 5. The lamellar structure **22** is composed of an upper fabric layer **23**, an intermediate flexible sheet or film **24**, and a lower fabric layer **25**. The fabric layer **23** includes yarns **26**, **27**, **28**, **29**, **30**, **31**, **32**, **33**, **34**, **35**, **36**, **37** and **38**, which are composed of generally parallel or untwisted regenerated cellulose or other filaments, as discussed above, and twisted cotton or other staple fiber yarns **39**, **40**, **41**, **42**, **43**, **44**, **45**, **46**, **47**, **48**, **49**, **50**, **51**, **52** and **53**. The weave pattern of the upper or exposed surface of the fabric **23** is four over and one under with respect to the continuous filament yarns **26** through **38**. It follows that the weave pattern of the underside of the fabric **23**, which is adjacent and bonded to the flexible film **24** is one under and four over with respect to the twisted cotton or other staple fiber yarns **39** through **53**. The major visible portion of the upper surface of the fabric **23** is made up of regenerated cellulose or other continuous filament yarns, so that imperfection and grease or tar spots in the twisted cotton or other fibers are not visible in the sandwich structure **22**. The underside of the fabric **22** is predominantly twisted staple fiber yarns, for example cotton, so that the bond strength between the fabric and the flexible sheet or film **24** is excellent. The fabric layer **25** can be identical with the layer **23**, in which case the predominantly twisted staple fiber yarn surface should be disposed toward the flexible sheet or film **24**, and well bonded thereto, or the layer **25** can be another fabric which adheres well to the film **24**. The presence of surface imperfections in the fabric **25**, or grease or tar spots, is relatively unimportant, since this layer is, in ordinary practice, dyed in a plain color or patterned to match or contrast with the interior furnishings of an automobile.

While other fabrics having twisted staple fiber warp or woof yarns, and woof or warp yarns, as the case may be, composed of bundles of substantially parallel or untwisted filaments, can be employed in producing the sandwich structure of Figs. 4 and 5, fabrics having the particular weave pattern represented have been found to give an optimum combination of aesthetic and physical properties required for the suggested use. The particular weave shown gives a tightly woven fabric which is, in itself, water repellent to a substantial extent, with minimum exposure, in the sandwich structure, of twisted cotton or other staple fiber yarns, and maximum bond strength.

Referring now to Fig. 6, a modified lamellar structure according to the invention is indicated generally at **54**. The lamellar structure **54** comprises a comparatively heavy flexible film **55**, a fabric indicated generally at **56** which is adhered to the underside of the film **55**, and also to the upper side of a comparatively light film **57**. The films **55** and **57** can be of any of the materials previously discussed, but should be flexible and elastomeric. The fabric **56** has **62** warp yarns per inch, which are cotton 12s singles, woven in pairs. The woof or fill yarns are 100 denier, 34 filament nylon, with a low twist of about one turn per inch, and occur approximately 53 per inch. The weave pattern can be described as a three up, one down, broken twill. The warp yarns are numbered **58** through **91**, inclusive, while the woof or fill yarns are numbered **92** through **109**, inclusive. The woof yarn **92**, for example, passes under a pair of warp yarns **58** and **59**, over a pair of warp yarns **60** and **61**, and then under three pairs of warp yarns **62** and **63**, **64** and **65**, and **66** and **67**, before again passing over a pair of warp yarns **68** and **69**. The entire weave pattern will be apparent from the representation in Fig. 6. The lamellar structure **54**, as can be seen from the following example, has excellent physical properties. Both exposed surfaces thereof are composed of a flexible elastomeric sheet material, so that it can be easily cleaned. It is admirably suited for use as a top for a so-called "convertible" automobile and also for other similar uses.

The following example, in which parts are given by weight, is presented solely for the purpose of further illustrating and disclosing the invention, and is in no way to be construed as a limitation thereon.

Example

A coated fabric according to the invention was produced according to the following procedure:

A fabric composed of 15s twisted cotton yarns and 300 denier regenerated cellulose continuous filament yarns, in the weave pattern shown in Figs. 1, 2 and 3 hereof, and discussed in connection therewith, was coated with a flexible polyvinyl chloride composition. In the specific fabric employed, the twisted cotton yarns were spaced approximately 80 per inch, and the continuous filament yarns were spaced approximately 50 per inch. The polyvinyl chloride composition was composed of 100 parts of a polyvinyl chloride which is commercially available under the trade designation "Vinylite," 63 parts of diethylhexyl phthalate as a plasticizer, three parts of a cadmium and barium soap as a stabilizer, and 30 parts of

titanium dioxide as a pigment. The polyvinyl chloride composition was blended to uniformity in a mixer in which the composition was heated to about 320° F. The uniform composition was then fed to a two roll mill and formed into a sheet having a thickness of about 0.25 inch, and corresponding in width with the identified fabric. The polyvinyl chloride film and the fabric were brought into juxtaposition and passed between a pair of cooperating rolls heated to about 330° F. to soften the film and compress it against and bond it to the fabric. A coated fabric was removed from this last-mentioned pair of cooperating rolls, and, after cooling, was subjected to the action of a calendering roll which acted directly upon the polyvinyl chloride surface. The resulting coated fabric had a gauge of 0.022 inch, the gauge of the cloth being 0.015 inch, and the gauge of the polyvinyl chloride film being 0.07 inch. The weight of the applied coating was 8.8 ounces per square yard. The tensile strength of the coated fabric was 169 pounds per inch in one yarn direction and 162 pounds per inch in the other yarn direction; the tear strength in pounds was 9.2 in one yarn direction and 8.8 in the other; and the abrasion resistance as measured with a silicon carbide coated cloth was 1109 cycles to failure. The bond strength between the film and the fabric was sufficiently high that the material was entirely suited for upholstery use.

When, for purposes of comparison, but not in accordance with the invention, the procedure described in the preceding paragraph was repeated except that 1.14 cotton twill was used instead of the identified fabric, an article was produced having a finished gauge of 0.029 inch, the gauge of the cloth being 0.024 inch and the gauge of the applied film being 0.009 inch. The weight of coating applied was 9.5 ounces per square yard. The tensile strength of the article was 144 pounds per inch in one yarn direction and 169 pounds per inch in the other yarn direction; the tear strength in pounds was 6.0 in one yarn direction and 9.7 in the other; and the abrasion resistance was only 350 cycles to failure.

The procedure described above could not be employed to apply a coating to a fabric having both warp and woof yarns composed of generally parallel or untwisted regenerated cellulose continuous filaments. When the procedure was modified either by bringing a sheet of the indicated polyvinyl chloride composition into juxtaposition with each surface of such fabric, or by first applying to the fabric a suitable preliminary coating of a "priming" or anchoring material, and then bonding the indicated polyvinyl chloride sheet to the "priming" or anchoring coating, a coated fabric was produced, but one which had insufficient bond strength to withstand repeated flexing, as is involved when such a material is used as an upholstery. In addition, most "priming" or anchoring coatings that have been used to improve the bond strength in such a coated fabric have been found adversely to affect sunlight aging and discoloration properties of the material.

The procedure described above has also been modified to produce the sandwich structure shown in Figs. 4 and 5. In this case, a film of a suitably compounded copolymer of polyisobutylene and butadiene was interposed between the fabric **23** and a cotton twill, and the resulting structure was passed through a mill composed of two rolls heated to a temperature of about 150° F., sufficient to bond the film to each of the fabrics.

A similar procedure has also been employed to produce the sandwich structure of Fig. 6. Two films of the vinyl chloride composition identified in the first paragraph of this example were produced; the fabric **56** was interposed between these films, and the resulting structure was passed through a two-roll mill heated to about 330° F., sufficient to bond each of the films to the fabric. The coating **55** had a weight of 11.5 ounces per square yard, and an adhesion to the fabric of 4.9 pounds per inch. The coating **57** had a weight of 3.4 ounces per square yard, and an adhesion to the fabric of 8.5 pounds per inch. The sandwich or lamellar structure itself had tensile and tear strengths in one direction of 167 and 5.3 pounds per inch, respectively, and in the other direction of 149 and 5.8 pounds per inch, respectively.

It will be apparent that various changes and modifications can be made from the specific details of the invention discussed herein and shown in the attached drawings without departing from the spirit and scope of the attached claims. For example, while the specific weave patterns shown and discussed are especially advantageous in that they provide, when assembled into a coated fabric, excellent physical properties for any given gauge, other weave patterns can also be employed. The essential feature of a fabric according to the invention is that either the warp or woof yarns are composed of a plurality of generally parallel continuous filaments, preferably of comparatively high tenacity, while the other yarns, warp or woof as the case may be, are of a twisted staple fiber type with cotton being the preferred natural fiber. Other changes and modifications will be apparent to one skilled in the art.

What I claim is:

1. An article comprising a woven fabric composed of warp and woof, one of which is made up of a plurality of high tensile strength continuous filaments in generally parallel arrangement and the other of which is made up of twisted staple fiber yarns, and a flexible film comprising polyvinyl chloride adhered to at least one surface of said fabric.

2. An article comprising a woven fabric composed of warp and woof, one of which is made up of a plurality of high tensile strength continuous filaments in generally parallel arrangement and the other of which is made up of twisted staple fiber yarns, and a flexible, synthetic resinous film adhered to at least one surface of said fabric.

3. An article comprising a woven fabric composed of warp and woof, one of which is made up of a plurality of high tensile strength continuous filaments in generally parallel arrangement and the other of which is made up of twisted staple fiber yarns, a second woven fabric comprising twisted staple fiber yarns, and a flexible elastomeric film bonding the said two fabrics into a lamellar structure.

4. An article comprising a woven fabric composed of warp and woof yarns, said warp and woof yarns being different, and one being twisted staple fiber yarns, while the other are high tensile strength yarns made up of a plurality of generally parallel continuous filaments, a second woven fabric comprising twisted staple fiber yarns, and a flexible, synthetic resinous film bonding the said two fabrics into a lamellar structure.

5. An article comprising a woven fabric composed of warp and woof yarns, said warp and woof yarns being different, and one being twisted staple fiber yarns, while the other are high tensile strength yarns made up of a plurality of generally parallel continuous filaments, and a flexible, elastomeric, synthetic resinous film bonded to each of the major surfaces of said fabric.

6. An article comprising a woven fabric composed of warp and woof yarns, said warp and woof yarns being different, and one being twisted staple fiber yarns, while the other are high tensile strength yarns made up of a plurality of generally parallel continuous filaments, and a flexible, vinyl chloride film bonded to each of the major surfaces of said fabric.

7. An article comprising a fabric composed of warp and woof, one of which is made up of a plurality of high tensile strength, continuous filaments in generally parallel arrangement, and the other of which is made up of a yarn of twisted staple fibers, said twisted staple fiber yarn being woven in a pattern of at least two over, one under with respect to the continuous filaments, and a synthetic resinous film adhered to at least that side of the fabric on which said yarn predominates.

8. An article comprising a fabric composed of warp and woof, one of which is made up of a plurality of synthetic filaments, and the other of which is made up of a yarn of natural fibers, said natural fiber yarn being woven in a pattern of at least two over, one under with respect to the synthetic filaments, and a synthetic resinous film adhered to at least that side of the fabric on which said yarn predominates.

9. An article comprising a fabric composed of warp and woof, one of which is made up of a plurality of high tensile strength continuous filaments in generally parallel arrangement, and the other of which is made up of a yarn of twisted staple fibers, said warp and woof being arranged in a woven pattern such that the warp predominates on one side of the fabric and the woof predominates on the other side of the fabric, and a synthetic resinous film adhered to at least that side of the fabric on which said twisted staple fiber yarn predominates.

10. An article comprising a fabric composed of warp and woof, one of which is made up of a plurality of synthetic filaments, and the other of which is made up of a yarn of natural fibers, said fabric being woven in a pattern such that the warp predominates on one side of the fabric and the woof predominates on the other side of the fabric, and a synthetic resinous film adhered to at least that side of the fabric on which the natural fiber yarn predominates.

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