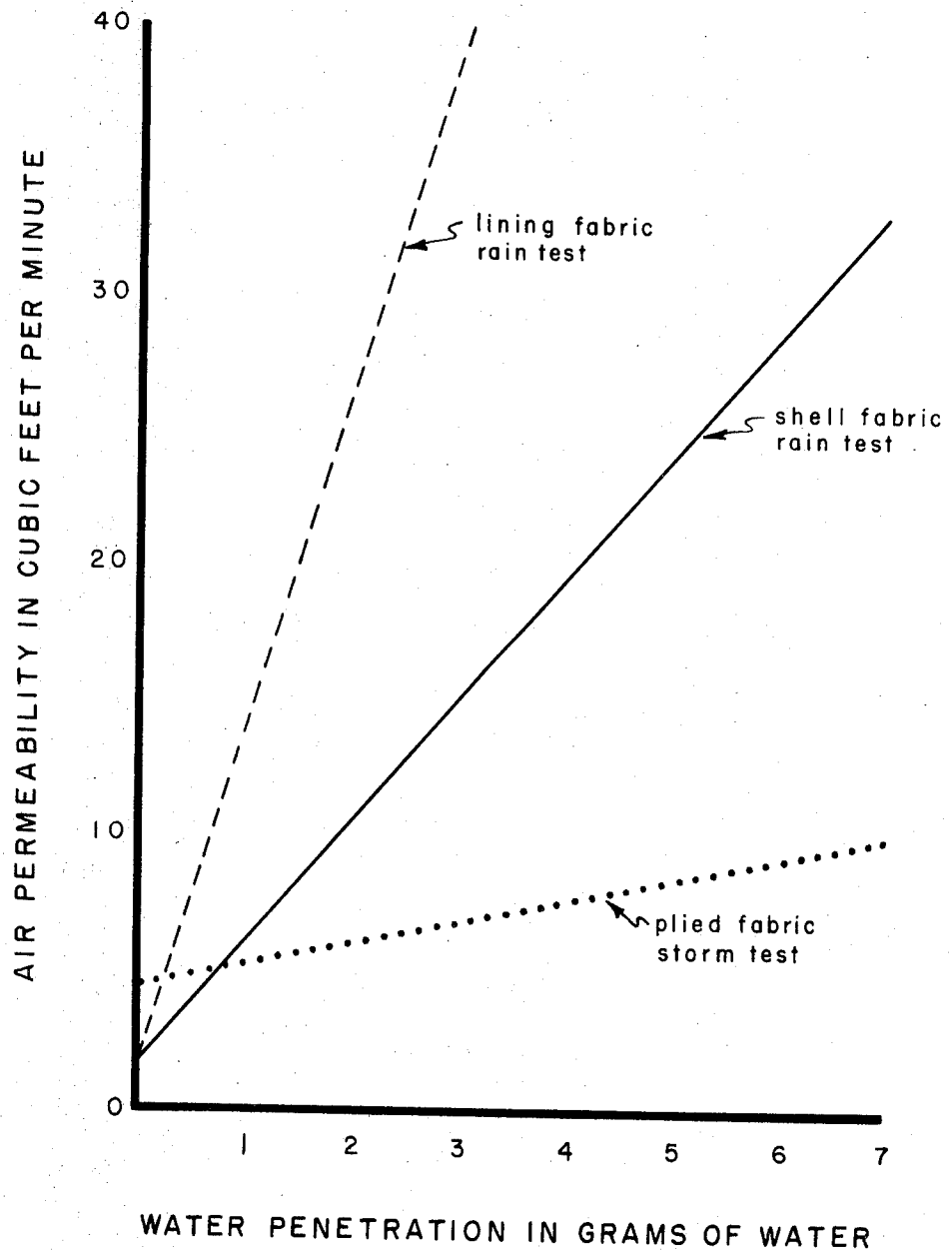
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TWO LAYERED WATER-REPELLANT FABRIC

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TWO LAYERED WATER-REPELLANT FABRIC

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ABSTRACT OF THE DISCLOSURE

A fabric comprising a plied system having at least two separate contiguous layers of fabric, both the inner and outer fabric layers being penetrable by rain and being resistant to standing water with the inner layer being of equal or tighter construction than the outer layer.

This application is a continuation-in-part of application Ser. No. 361,816, filed Apr. 22, 1964, now abandoned.

This invention relates to a rainproof fabric and more specifically to a multilayered breathable, rainproof fabric.

Rainwear garments are commonly prepared from fabrics which have been rendered completely air and vapor impermeable, such as for instance by sealing all pore spaces with rubber, oils or various resinous impregnants. Such fabrics, when made into rainwear garments, provide absolute protection from rain but are unattractive and due to the lack of air and vapor permeability, are uncomfortable to the wearer. As rainwear garments are now marketed to consumers who have a greater interest in appearance and comfort factor and more specifically in a comfort factor as related to air and vapor permeability of the fabric making up the rainwear garment, efforts have been made to provide attractive fabrics which are air and vapor permeable as well as water repellent.

While single layer fabrics and primarily single layer fabrics which have been given a water repellent treatment have provided important advances in the art of air and vapor permeable rainwear fabrics, it is found that a greater degree of air and vapor permeability coupled with maximum rain repellency is provided by a 2-ply fabric system such as that set forth in U.S. Pat. 2,556,621. The "breathable" 2-ply fabric system as represented by the aforementioned patent is prepared by combining two separate contiguous layers of fabric, the outer layer of which is penetrable by rain and by standing water and the inner layer of which is penetrable by rain but not penetrable by standing water. The 2-ply fabric system of the type represented by the patent will allow for the usage of materials which will greatly enhance the aesthetic value of the rainwear garment, that is to say the outer fabric may be an outer fabric having a construction other than simple close weave and may be fluffy fabric or a pile or raised cloth fabric or have a worsted "look" or "hand." The 2-ply fabric systems as represented by U.S. Pat. 2,556,621 do not, however, have that degree of durability which is desirable for a rainwear fabric, that is to say these "breathable" fabrics are unsuitable for use in a rainwear garment after the garment has ben subjected to a plurality of dry cleanings and washings. Soaps and detergents employed in normal dry cleaning and washing operations have the tendency to be absorbed by and/or coat the individual fibers making up the outer and/or lining fabric and thereby render these fibers hydrophilic. It is therefore important to employ an outer fabric in a plied rainwear fabric which has a construction such that repeated launderings will not substantially diminish the rainwear functionality of the garment.

In accordance with this invention it has now been discovered that a multilayered fabric system suitable for use in the preparation of rainwear and having durability to repeated dry cleaning and washing may be prepared by employing as an outer fabric a fabric which is penetrable by rain, but impenetrable by standing water and as an inner fabric a fabric which is equal to or of a substantially tighter construction than the outer fabric and which is penetrable by rain and impenetrable by standing water. It should be understood that the phrase "multilayered fabric system" as used herein defines those fabrics having two or more layers and that any number of additional layers of sheet material may be employed with the prerequisite two layered system. The additional layers must not, however, affect those physical characteristics specifically required of the two layer system. The additional sheet material may be woven or nonwoven fabrics, perforated resinous sheets and the like.

The standing water test as called for herein is carried out substantially as follows:

A circular piece of the fabric to be tested, 3 inches in diameter, is layered between two vertical cylinders (2⅛ inches inside diameter) and the cylinders clamped tightly together with the use of gaskets. The cylinders must be open at both ends in order to equalize atmospheric pressure. The fabric sample exposed to the column of water is 2⅛ inches in diameter. 250 cc. of tap water at 86° F. is gently poured over the fabric by means of a funnel and long tube. The column of water is allowed to stand against the fabric for 3 minutes. A fabric is considered acceptable if there is no water penetration.

The rainwear fabric is preferably a fabric composed of at least two separate contiguous layers of fabric, the outer layer being penetrable by rain and resistant to standing water and having an air permeability of from about 0.5 to about 150.0 and preferably from about 5.0 to about 70.0 and a rain penetration of from about 0.0 to about 9.0, and preferably from about 0.0 to about 5.0 and the inner fabric being penetrable by rain and resistant to standing water and having an air permeability of from about 0.5 to about 50.0 and preferably from about 5.0 to about 30 and a rain penetration of from about 0.0 to about 6.0 and preferably from about 0.0 to about 3.0, said inner and said outer layers being selected such that the two layers together have an air permeability of from about 0.5 to about 50 and preferably from about 5.0 to about 25 and a storm proof test of from about 0.0 to about 6.0, and preferably from about 0.0 to about 5.0.

The air permeability as called for herein is an air permeability determined according to ASTM Designation D 737–46 which is carried out substantially as follows:

A 10-inch by 10-inch fabric sample is mounted over a circular orifice with sufficient tension to draw the fabric smooth. Air is drawn through the known area of the fabric and through a calibrated flow meter. The pressure drop across the fabric is adjusted to 0.5 inch of water and the reading of the flow meter recorded. The volume of air passing through the fabric is then calculated and expressed as the air permeability of the fabric in cubic feet of air per minute per square foot of fabric at a 0.5 inch of water drop in pressure. The test is carried out under standard atmospheric conditions at 70° F. and a relative humidity of 65 percent.

The term "rain test" as employed herein is defined by the raintest as set forth in ASTM Designation D 583–58 and AATTCC method 35–1952 carried out substantially as follows:

An 8-inch x 8-inch fabric test speciment backed by a 6-inch x 6-inch piece of blotting paper weighed to the nearest gram is placed in a standard rain tester and the fabric sample is subjected to a 2-foot head of water for a period of one minute. At the end of the one-minute

period, the increase in weight of the blotting paper is determined to the nearest 0.1 gram.

The term "storm test" is defined as above but using a 3-foot head of water for five minutes.

A better understanding of the invention may be had from a description of the drawing.

In the drawing, three curves plotting air permeability in cubic feet per minute against water penetration in grams of water are set forth. The broken line is illustrative of lining fabrics given a rain test while the solid line is illustrative of shell fabrics which have also been given a rain test. The dotted line is illustrative of certain of the plied fabrics of this invention which have been given a storm test, the storm test being far more rigorous than the rain test. While the innumerable variables present in the various types of textile fabrics prevent an exact correlation from being drawn from the curves, the relationship existing between the shell fabrics and the lining fabrics and the plied fabric structure is readily apparent.

The fabrics employed in the plied fabric system of this invention are either composed of fibers which are hydrophobic in themselves or are composed of fibers which are subsequently rendered hydrophobic by suitable coating operations, the latter category including blends of hydrophilic and hydrophobic fibers which are subsequently rendered hydrophobic in their entirety by suitable coating operations. Coating operations employed herein must be coating operations such as will not render the interstices of the fabric impermeable to air and must also be a coating operation which is resistant to repeated laundering and dry cleaning operations. One type of coating composition which has been found to be especially suitable for purposes of this invention is the fluoro chemical type textile finish which is marketed under the trademark "Scotchgard" by Minnesota Mining & Manufacturing Company. The coating composition may be applied by any of those well-known methods of the coating art such as for instance padding, spraying, immersion and the like.

The fabrics employed in the plied rainproof fabric of this invention may be made of any fibrous material which is hydrophobic or capable of being rendered hydrophobic. Fabrics which have been found to be especially suitable for purposes of this invention are cotton, rayon, polyester and blends thereof.

The plied structure consisting of two or more separate contiguous layers of fabric may be unified by simply stitching the layers together or by laminating by means of a suitable discontinuous adhesive coating. The adhesive coating is preferably of the flexible cross-linking type such as for instance certain of the acrylic adhesives.

The following specific examples of the preparation of the plied fabrics of this invention are given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention.

In each of the following examples, a shell fabric designated as (a) is plied with a liner fabric designated as (b).

EXAMPLE I

(a) A prepared 65%/35% polyester/cotton poplin shell fabric, consisting of 110 ends and 52 picks of approximately 26's and 27's yarn count respectively is impregnated in aqueous medium with a water repellent composition, dried at 250° F., cured at 320° F. for 1½ minutes and washed. The deposited solids based on the dry weight of fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.75
Cationic softener	0.07

(b) A prepared cotton filling, rayon warp tackle twill lining fabric, consisting of 158 ends and 70 picks of approximately 36's and 25's yarn count respectively is impregnated with a water repellent composition as in (a) above. The solids deposited based on the dry weight of fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.75
Cationic softener	0.07

The air permeability of the plied fabric consisting of (a) and (b) is 17.5.

EXAMPLE II

(a) A prepared 50%/50% polyester/Avril (textile rayon marketed by American Viscose Corp.) poplin shell fabric consisting of 121 ends and 56 picks of approximately 25's and 25's yarn count respectively is impregnated with a water repellent composition, dried at 250° F., cured at 320° F. for 1½ minutes and washed. The solids deposited based on the dry weight of fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.75
Cationic softener	0.07

(b) A prepared cotton filling, rayon warp tackle twill lining fabric consisting of 110 ends and 70 picks of approximately 36's and 25's yarn count respectively is impregnated with a water repellent solution as in (a) above. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.75
Cationic softener	0.07

The air permeability of the plied fabric consisting of (a) and (b) is 12.5

EXAMPLE III

(a) A prepared 100% cotton poplin shell fabric consisting of 104 ends and 49 picks of approximately 22's and 18's yarn count respectively, is impregnated with a water repellent solution, dried at 250° F., cured at 320° F. for 1½ minutes and washed. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.50
Cationic softener	0.07

(b) A prepared cotton filling, rayon warp tackle twill lining fabric consisting of 158 ends and 70 picks of approximately 36's and 25's yarn count respectively, is impregnated with a water repellent solution as in (a) above. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.75
Cationic softener	0.07

The air permeability of the plied fabric consisting of (a) and (b) is 9.4.

EXAMPLE IV

(a) A prepared 65%/35% polyester/cotton poplin shell fabric described in Example I(a) is impregnated with a water repellent composition of a slightly different formulation than Examples I, II and III, dried at 250° F., cured at 350° F. for 1½ minutes and washed. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
Argus DWR (reactive methylol urea type water repellent marketed by Argus Chemical Co.)	0.70
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.50

(b) A prepared cotton/rayon tackle twill lining fabric described in Example I(b) is impregnated with a water repellent composition as in (a) above. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
Argus DWR (reactive methylol urea type water repellent marketed by Argus Chemical Co.)	0.70
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.50

EXAMPLE V

(a) A prepared 65%/35% polyester/cotton poplin shell fabric described in Example I(a) is impregnated with a water repellent composition of a slight different formulation than Examples I, II and III, cured at 350° F. for 1½ minutes and washed. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
Phototex FTC Paste (waxy thermosetting resin textile finishing agent marketed by Ciba Co.)	0.70
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.75

(b) A prepared cotton/rayon tackle twill lining fabric described in Example I(b) is impregnated with a water repellent composition as in (a) above. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
Phototex FTC Paste (waxy thermosetting resin textile finishing agent marketed by Ciba Co.)	0.70
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.75

EXAMPLE VI

(a) A prepared 65%/35% polyester/cotton poplin shell fabric consisting of 110 ends and 52 picks of approximately 26's and 27's yarn count respectively is impregnated with a water repellent solution, dried at 250° F., cured at 320° F. for 1½ minutes and washed. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.75
Cationic softener	0.07

(b) A prepared cotton/rayon tackle twill lining fabric consisting of 158 ends and 70 picks of approximately 36's and 25's yarn count respectively, was impregnated with a water repellent solution as in (a) above. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	2.75
Cationic softener	0.07

(c) A prepared cotton muslin fabric consisting of 75 ends and 68 picks is impregnated with a water repellent solution, dried at 250° F., cured at 320° F. for 1½ minutes and washed. The solids deposited based on the dry weight of the fabric are as follows:

	Percent
Aerotex 23 Special (Triazine resin marketed by American Cyanamid Co.)	5.00
FC 208 (polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.)	1.50
Cationic softener	0.07

Fabric (c) was plied between fabric (a) and (b) to give a 3-ply fabric system.

The air permeability of the plied fabric consisting of (a), (b) and (c) is 15.0.

The shell and lining fabrics forming the 2-ply system of Examples I, II, III and VI, all of which have a shell which passes the standing water test, were subjected to a series of 9 dry cleanings. A 2-ply fabric system having a shell which is penetrable by standing water which is designated as Example A and which is representative of the fabrics of U.S. Pat. 2,556,621 was also subjected to a series of 9 dry cleanings. All of the aforementioned plied fabrics were subjected to an initial storm test and to additional storm tests after each dry cleaning operation, the results of which are given in the following table.

	Water penetration in grams—storm test [1]—after 0–9 commercial dry cleanings									
	0	1	2	3	4	5	6	7	8	9
Example:										
A [2]	0.0	8.3	12.9	15.0	16.9	15.4	15.0	18.5	15.0	17.2
I	0.0	0.0	0.5	0.0+	0.0+	0.0+	2.5	1.5	0.6	5.8
II	0.0	0.0	0.0	0.0	0.0+	0.0	0.2	4.0	2.1	3.7
III	0.0	0.3	1.0	0.0	1.0	0.0+	5.9	2.2	7.9	12.5
VI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8

[1] ASTM standard D583-58 with 3 ft. head for 5 minutes.

[2] Plied fabric employing as a shell a 82 x 76 cotton poplin having 35's warp and 44's filling and an air permeability of 150 and as a lining a 113 x 76, 65%/35% polyester/cotton having 21's warp and 33's filling and an air permeability of 2.9. The air permeability of the two layer plied fabric is 2.0.

As may be seen from the table, Example A, which is representative of the 2-ply fabric system which has a shell fabric which is penetrable by standing water exhibits a satisfactory storm test before dry cleaning operations but fails the storm test subsequent to the first dry cleaning operation. Those plied fabrics of Examples I, II, III and VI which are illustrative of the rainwater fabrics of this invention exhibit a satisfactory rain test both before and after a plurality of dry cleaning operations. It is generally considered that a rainwear fabric must not pass in excess of 1–5 grams after 3 dry cleanings in order to be a commercial product. The former figure is permissibleunder J. C. Penney and Company standards and the latter figure is permissible under Sears Roebuck Company standards.

EXAMPLE VII

The procedure of this example is the same as that of Example I except that the FC 208 is replaced with FC 210 (a 28% active polymeric fluorocarbon marketed by Minnesota Mining & Manufacturing Co.) at the same solids level in the treatment of the shell and lining fabrics. The air permeability of the plied fabric is substantially the same as that of Example I as are the water penetration and storm test ratings after multiple commercial dry cleanings.

EXAMPLE VIII

The procedure of this example is the same as that of Example II except that the FC 208 is replaced with Zepel B (a 13% cationic polymeric fluorocarbon marketed by Du Pont) at the same solids level in the treatment of the shell and lining fabrics. The results of the tests on the plied fabric are similar to those of Example II.

EXAMPLE IX

The procedure of this example is the same as that of Example III except that the Aerotex 23 Special is replaced with Rhonite D–12 (a 42%) stabilized heterocyclic nitrogenous resins marketed by Rohm and Haas). Superior results similar to those of Example III are achieved with the plied fabric.

EXAMPLE X

The procedure of this example is the same as that of Example IV except that the Aerotex 23 Special is replaced with Rhonite R–1 (a 50% active dimethylol ethylene urea resin marketed by Rohm and Haas). The test results of the plied fabric are similar to those of Example IV.

EXAMPLE XI

The procedure of this example is the same as that of Example V except that the Aerotex 23 Special is replaced with Perma Fresh 183 (a 50% dihydroxy dimethylol ethylene urea resin marketed by Sun Chemical). The resin is employed at the same solids level. The resulting plied fabric exhibits the superiority of the fabric of Example V.

That which is claimed is:

1. A rainproof fabric comprising a plied system having at least two separate contiguous joined or bonded layers of fabric coated or impregnated with a polymeric fluorocarbon water repellent composition, both the inner and outer fabric layers being penetrable by rain and resistant to standing water, said inner layer being of an equal or tighter construction than said outer layer.

2. The rainproof fabric of claim 1 wherein said outer fabric is a polyester-cotton blend fabric.

3. The rainproof fabric of claim 1 wherein said layers are laminated by means of a discontinuous adhesive coating.

4. A rainwear garment prepared from the rainproof fabric of claim 1.

5. A rainproof fabric comprising a plied system having at least two separate contiguous joined or bonded layers of fabric coated or impregnated with a polymeric fluorocarbon water repellent composition, the outer fabric layer being penetrable by rain and resistant to standing water and having an air permeability of from about 0.5 to about 150 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 9.0 grams of water, and the inner fabric being penetrable by rain and resistant to standing water and having an air permeability of from about 0.5 to about 50 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 6.0 grams of water, said inner and said outer layers being selected such that the two layer fabric system has an air permeability of from about 0.5 to about 50 cubic feet of air per minute and a storm test penetration of from about 0.0 to about 6.0 grams of water.

6. The rainproof fabric of claim 5 wherein said outer fabric is a polyester-cotton blend fabric.

7. The rainproof fabric of claim 5 wherein said layers are laminated by means of a discontinuous adhesive coating.

8. A rainproof fabric comprising a plied system having at least two separate contiguous joined or bonded layers of fabric coated or impregnated with a polymeric fluorocarbon water repellent composition, the outer fabric layer being penetrable by rain and resistant to standing water and having an air permeability of from about 5.0 to about 70 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 5.0 grams of water, and the inner fabric being penetrable by rain and resistant to standing water and having an air permeability of from about 5.0 to about 30 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 3.0 grams of water, said inner and said outer layers being selected such that the two layer fabric system has an air permeability of from about 5.0 to about 25 cubic feet of air per minute and a storm test penetration of from about 0.0 to about 5.0 grams of water.

9. The rainproof fabric of claim 8 wherein said outer fabric is a polyester-cotton blend fabric.

10. The fabric of claim 8 wherein the two layers are laminated by means of a discontinuous adhesive coating.

11. A rainproof plied fabric comprising as an outer layer, a fabric coated or impregnated with a polymeric fluorocarbon water repellent composition which is penetrable by rain and resistant to standing water and which has an air permeability of from about 5.0 to about 70 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 5.0 grams of water, as an inner layer, joined or bonded to the outer layer a fabric coated or impregnated with a polymeric fluorocarbon water repellent composition which is penetrable by rain and resistant to standing water and having an air permeability of from about 5.0 to about 30 cubic feet of air per minute and a rain test penetration of from about 0.0 to about 3.0 grams of water, and an intermediate insulating layer, the three layers being selected such that the plied system has an air permeability of from about 5.0 to about 25 cubic feet of air per minute and a storm test penetration of from about 0.0 to about 5.0 grams of water.

12. The rainproof fabric of claim 11 wherein said outer and said inner layers are polyester-cotton blend fabrics.

13. The rainproof fabric of claim 11 wherein the layers are laminated by means of a discontinuous adhesive coating.

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