Nov. 27, 1956 B. H. FOSTER 2,771,661

RAINPROOF FABRIC

Filed Oct. 15, 1953

Fig. 1

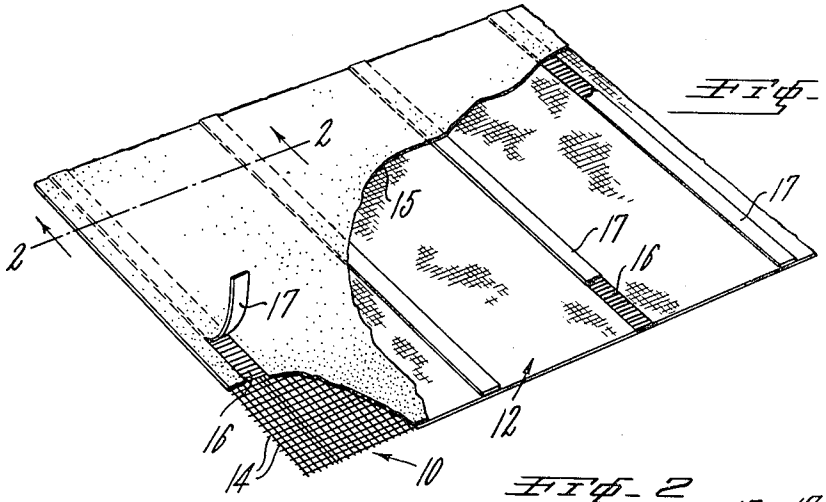


Fig. 2

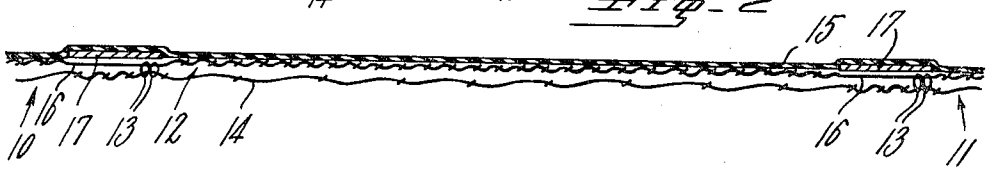
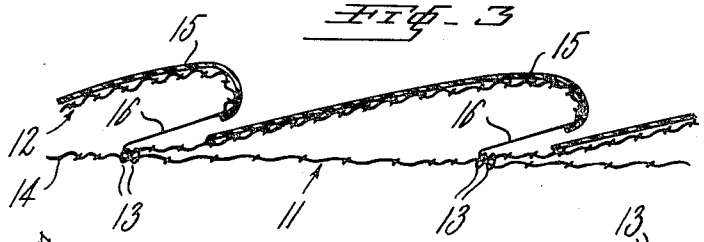


Fig. 3



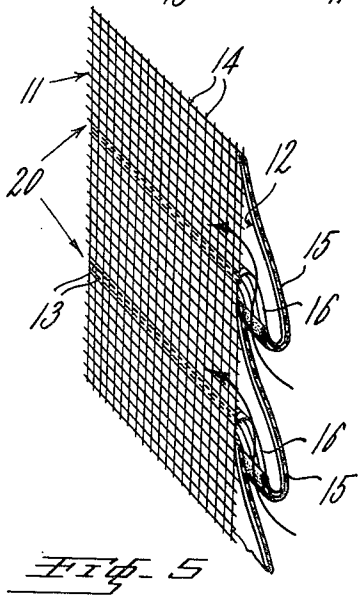


Fig. 5

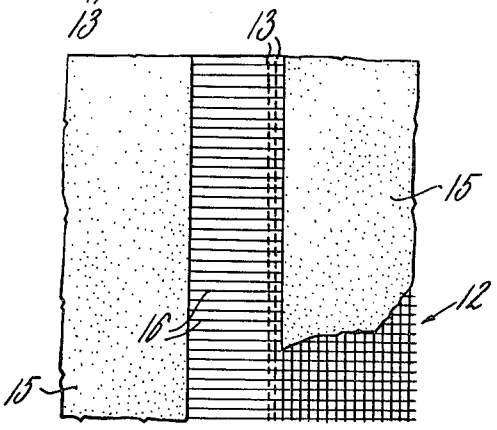


Fig. 4

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RAINPROOF FABRIC

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10 Claims. (Cl. 28—80)

This invention relates to a breathable rainproof fabric and to a method of making the same.

It is not difficult to produce fabrics which will resist penetration by water in the form of rain etc., for it is a comparatively simple matter to coat a fabric with a water impervious coating. However, it is extremely difficult to produce a rain resistant fabric which will be suitable for rain wear. This difficulty is caused by the fact that if a fabric is to be used in rain wear, that fabric must be such that the garment made thereof can be worn with some degree of comfort. Chiefly this comfort requirement dictates that some means be provided which will permit the escape of moisture vapor from inside the garment and the passage of air through the fabric to ventilate the garment when it is worn, so that the atmosphere within the garment will not become unduly hot and humid. Great effort has been exerted heretofore in an attempt to devise a rainproof fabric which can be used to produce rain wear that is truly comfortable.

These efforts have generally followed one of two procedures. In one method, a woven fabric has been treated to render it water repellent, but this treatment has an adverse effect upon the breathability of the fabric, and therefore upon the wearer's comfort. Furthermore fabrics which have been treated in this way are not truly water resistant and will soon become saturated in a heavy rain, so they will not maintain their wearers dry. In the second method, efforts have been directed toward devising a fabric coating which, although water resistant, is provided with myriad microscopic holes therethrough to permit the passage of air and moisture vapor through a fabric having this coating applied thereto. Although these materials will prevent the passage of water and will permit the passage of air therethrough, their air permeability is so low that garments made of fabrics coated therewith are really quite uncomfortable.

It is an object of this invention to provide an improved rainproof fabric which is so constructed that air and moisture vapor may readily pass therethrough yet which is constructed such that when fashioned into rain wear it will resist penetration by rain during normal usage of the garment.

More specifically, this invention contemplates a rainproof fabric and a method of making the same in which a water impervious coating is applied to a fabric over its entire surface excepting for selected areas of this surface which remain uncoated. These uncoated areas of the fabric are disposed therein to underlie the coated areas of the fabric, so rain may not impinge on these uncoated surfaces of the fabric. The coated areas of the fabric are made to overlie the uncoated areas in a manner such that air may pass freely under the overlying coated fabric and thence through the uncoated areas of the fabric, yet rain will impinge on only the coated areas of the fabric and will run off the fabric over these coated areas.

In one embodiment of the invention, a double fabric is constructed in which the face and backing fabrics are

tied together only along spaced apart lines. This double fabric is constructed so that one of the fabrics may be made to have a greater lineal dimension between the spaced apart lines in the direction at right angles to these spaced apart lines than the other fabric. A suitable water impervious coating, such as rubber or the like, is applied to the surface of that fabric which has the greater lineal dimension in the direction at right angles to the spaced apart lines. This coating is applied throughout the surface of this fabric excepting for a narrow band adjacent these spaced apart lines which bands remain uncoated. These uncoated bands are held under loops of the coated areas of the fabric, which loops have a somewhat clapboard-like appearance, by the other fabric which has the lesser dimension between the spaced apart lines where the two fabrics are joined together.

When fashioned into rain wear, this double fabric is disposed so that the loops depend downwardly to overhang the uncoated portions of the surface fabric. When the fabric is so disposed, rain will impinge on the coated areas of the fabric and will run off the fabric over these coated areas. Yet air may enter under these loops to pass into the garment freely through the uncoated areas of the fabric.

The fabric of this invention may be made conveniently by the following method. A double fabric is constructed in which the two fabrics are tied together along spaced apart lines in any suitable manner. Thus the fabrics may be sewed together by spaced lines of stitching, etc., but it is preferred to weave a double fabric in which spaced apart weft yarns are interwoven with both the face and backing fabric. One of the fabrics has extending at right angles to these tying weft yarns further yarns which have a greater shrinking power than the yarns that extend in the corresponding direction in the other fabric.

A water impervious coating is then applied to the fabric having the lesser shrinking power throughout its surface excepting for narrow bands adjacent the spaced apart tying yarns. This may be done in a number of convenient ways; for example the fabric may be coated while these areas extend over a vacuum box. But it is preferred to mask these areas of the fabric, then coat the fabric and then remove the masking means.

The double fabric is then subjected to a shrinking treatment. During this shrinking treatment, the uncoated fabric, having the greater shrinking power, will contract to draw the spaced apart lines where the two fabrics are joined more closely together to decrease the spacing between these lines. The coated fabric, which possesses the lesser shrinking power, will therefore have an excess of material between these lines, so a bend or loop will form in this fabric, and the coated fabric will assume a shingled or clapboard appearance in which the coated portions of the fabric overhang the uncoated areas adjacent the spaced apart lines. If necessary this fabric may be rolled so the bends or loops in the fabric overhang the uncoated portions of the fabric in the same manner throughout the fabric, but this has generally been found to be unnecessary.

This material having the clapboard appearance may then be fashioned into rain wear with the folds in the coated fabric depending downwardly over the uncoated portions of this fabric. The fabric, hence the garment fashioned therefrom, is not waterproof in the sense of preventing the passage of water through a piece of the fabric, for parts of the fabric are uncoated. But it is rainproof because the parts of the fabric which are normally exposed to the rain are coated with a water impervious coating, and these coated portions of the fabric normally overlie the uncoated portions of the fabric to protect the latter from penetration by rain. The coated fabric has a high air permeability, for air and moisture

vapor may pass readily through the uncoated parts of the fabric, hence a garment fashioned of the fabric has a high comfort factor.

For a better understanding of the nature of this invention, reference should be had to the following detailed description when read in conjunction with the accompanying drawing, wherein:

Fig. 1 is a perspective view of a double coated fabric in accordance with this invention having masking tape applied over the areas which are to remain uncoated;

Fig. 2 is a sectional view of the fabric of Fig. 1 taken substantially along the line 2—2 of Fig. 1 showing the fabric before it has been shrunk;

Fig. 3 is a sectional view of the rainproof fabric of this invention after it has been shunk;

Fig. 4 is a plan view of the fabric of Figs. 1 and 2 showing the coated fabric after the masking tape has been removed; and

Fig. 5 is a perspective view of the rainproof fabric of this invention showing its disposition when fashioned into a garment.

Referring now to the drawings, there is shown a breathable rainproof fabric **10** embodying this invention. The fabric shown is a double fabric formed of the under fabric **11** and outer fabric **12**. These fabrics **11**, **12** are tied together along spaced apart parallel lines by the tying yarns **13**. Two or three of these tying yarns are provided to form each spaced apart line **20** along which the under and outer fabrics **11**, **12** are tied together, and preferably these lines **20** are uniformly spaced in the fabric. The under fabric **11** is provided with yarns **14** extending substantially at right angles to the spaced apart tying yarns and having a greater shrinking power than the corresponding yarns in the outer fabric **12**.

The outer fabric **12** is provided with a water impervious layer **15** of rubber or other suitable material which covers this fabric excepting for the narrow bands **16** adjacent each line **20** where the tying yarns **13** tie the under fabric **11** to the outer fabric **12**. It will therefore be seen that the outer fabric has areas thereof which are coated to prevent the passage of water therethrough, and other areas thereof adjacent the tying yarns **13** which are uncoated and which therefore will permit the passage of air, moisture vapor, and water.

To render this fabric rainproof and therefore suitable for fashioning into rain wear, the shrinkable yarns **14** are shrunk to contract the under fabric **11** and therefore to cause the outer fabric **12** to bend or loop adjacent each line **20** in the manner shown in Figs. 3 and 5. When the yarns **14** are shrunk, the spaced lines **20** will be pulled more closely together, and the outer fabric **12**, which has a lesser shrinking power than the under fabric having the yarns **14**, will be caused to buckle. When this outer fabric **12** buckles, the uncoated portion **16** adjacent the tying yarns **13** are pulled up under the coated portions of the fabric **12** so that the areas **16** are disposed under the coated portions of the fabric **12** by the doubling of the fabric **12** upon itself. The resulting fabric is not waterproof in the sense of entirely resisting the penetration of water therethrough, but it may be fashioned into rain wear which will be rain resistant.

Thus if Fig. 5 is referred to, it will be seen that when this fabric is hung vertically the coated portions **15** of the fabric **12** will overlie the uncoated portions **16** of this fabric to produce a clapboard-like or shingled effect, so the falling rain will strike only the coated portions **15** of the fabric and will run off of the fabric from one coated portion to the other without entering the garment through the uncoated portions **16** of the fabric. Although the garment is therefore rainproof, it will permit the free passage of air and moisture vapor under the overhanging loops in the coated portions **15** of the fabric **12** and through the uncoated portions **16** of this fabric into the interior of the garment as indicated by the arrows in Fig. 5. Therefore the garment is freely breathable and it is rainproof.

To further illustrate the invention, the following specific constructions of two fabrics are given:

	Off Loom	Shrunk Coated
Fabric A:		
Width (in.)	9.25	8.145
Wt. (oz./sq. yd.)	9.14	22.2
Warps/in. (outer)	40	46
Warps/in. (under)	20	23
Wefts/in. (outer)	44	44
Wefts/in. (under)	22	44
Spacing of tying threads, outer (in.)	1.55	
Spacing of tying threads, under (in.)	1.55	.875
Width of uncoated band (in.)	.25	
Air permeability (cu. ft./sq. ft./min.)	158	34
Fabric B:		
Width (in.)	9.31	
Wt. (oz./sq. yd.)	6.43	19.4
Warps/in. (outer)	54	55
Warps/in. (under)	18	19
Wefts/in. (outer)	50	52
Wefts/in. (under)	18	33
Spacing of tying threads, outer (in.)	1.50	
Spacing of tying threads, under (in.)	1.50	.82
Width of uncoated band (in.)	.25	
Air permeability (cu. ft./sq. ft./min.)	352	34

It will be noted from the foregoing that these coated fabrics constructed in accordance with this invention will pass 34 cubic feet of air per square foot of fabric per minute. However, when these fabrics were subjected to a spray test there was no penetration of the fabrics by water. If desired, the air permeability of the rain wear fashioned from this fabric may be increased by omitting the weft yarns in the areas **16** of the outer fabric **12** where the coating **15** is not applied to this outer fabric. Such a construction has been illustrated in the drawings.

The fabrics **11**, **12** may be constructed in any suitable manner so long as these fabrics are tied to each other at spaced apart lines throughout the fabric, e. g. they may be sewed together. However, the simplest construction, and the one which is preferred, is to weave the fabric **11**, **12** as a double fabric and to provide spaced apart weft yarns **13** which are interwoven with both of the fabrics to tie them together. So also the fabrics may be constructed of any suitable materials so long as the fabric **11** has a greater shrinking power in a direction at right angles to the tying yarns **13** than does the fabric **12** in this direction. However, it is preferred to achieve this result in a double fabric having weft yarns **13** tying the fabrics together by weaving the fabric **11** with heat shrinkable thermoplastic warp yarns **14**. Such yarns are freely available in the textile industry, and yarns such as "Vinyon," a copolymer of vinyl chloride (90%) and vinyl acetate (10%); shrinkable saran, vinylidene chloride; "Dynel," a copolymer of vinyl chloride (60%) and acrylonitrile (40%); etc. would be satisfactory. These yarns are heat shrinkable, so that if the fabric having yarns of this character therein is immersed in hot water, the under fabric **11** will shrink.

After the double fabric having the heat shrinkable yarns **14** therein is woven, a water impervious coating **15** is applied to the surface of the fabric **12** to cover its surface excepting in the limited areas **16** adjacent the tying yarns **13**. Preferably this is achieved by masking the areas **16** by applying narrow masking tapes **17** to the fabric **12** over the areas which are to remain uncoated. The masked fabric is then coated as shown in Fig. 2, after which the masking tape **17** is removed as indicated in Fig. 1 to remove the coating of water impervious material applied thereover. The coated fabric is then heated to shrink the yarns **14**. It may be heated in any suitable manner, but preferably it is heated by immersing the fabric in hot water such as by running it through a bath of boiling water.

As pointed out above, I have found that the coated double fabric heretofore described, and shown in Fig. 4, will when heated shrink up to the configurations shown in Figs. 3 and 5, without the need for any pressing of the outer fabric **12**, when the fabric is passed through a hot

water bath. However, although not absolutely necessary, a better looking fabric is produced if the coated fabric is passed through the bath in a manner such that the tying yarns 13 follow the open area 16 as the fabric enters the boiling water.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A rainproof fabric comprising a fabric having a water resistant coating applied to only a portion of its surface area to leave other portions thereof uncoated, said fabric being arranged so the uncoated portions thereof underlie the coated portions thereof so air may enter under said coated portions, and yarns interwoven with said fabric at spaced apart points along the length of said yarns, said yarns being shorter than said fabric whereby the yarns hold said uncoated areas underlying said coated portions.

2. A rainproof fabric comprising an under and outer fabric, means joining said fabrics at spaced apart points, a water impervious coating covering a portion only of said outer fabric to leave portions thereof uncoated adjacent said spaced apart points, said under fabric having a lesser dimension between said spaced apart points than said outer fabric, whereby the coated portions of said outer fabric overlie said uncoated portion adjacent said spaced apart points to protect the uncoated portions from penetration by rain while permitting free entrance of air therethrough.

3. A rainproof fabric comprising an under and an outer fabric, yarns joining said fabrics along spaced apart substantially parallel lines, a rainproof coating applied to said outer fabric covering a portion only of said outer fabric to leave narrow bands along said spaced apart lines of said outer fabric uncoated, said under fabric having a lesser dimension between said spaced apart lines than said outer fabric, and loops in said outer fabric having the rainproof coating thereon overhanging said narrow bands, whereby said outer fabric in its uncoated areas is protected from penetration by rain while permitting entrance of air therethrough.

4. A rainproof fabric comprising a double fabric having spaced apart yarns interwoven with both of said fabrics to join said fabrics along spaced apart substantially parallel lines, a rainproof coating applied to the surface of one of said fabrics covering said fabric excepting for narrow bands extending along said spaced apart lines, the other of said fabrics having interwoven therein shrunken heat-shrinkable yarns extending at substantially right angles to said spaced apart lines, said shrunken yarns having a lesser dimension between said spaced apart lines than the corresponding yarns in the coated fabric, and loops in said coated fabric having the rainproof coating thereon overhanging said narrow bands, the fabric having the shrunken yarns therein holding said coated fabric in the looped configuration, whereby said coated fabric in its uncoated areas is protected from penetration by rain while permitting free entrance of air therethrough.

5. A rainproof fabric comprising a double fabric having spaced apart weft yarns joining said fabrics along substantially parallel lines, a rainproof coating applied to one of said fabrics covering its surface excepting at narrow bands extending along said spaced apart lines, the other fabric having heat shrunken thermoplastic warp yarns therein, loops in said coated fabric having the rainproof coating thereon overhanging said narrow bands, said heat shrunken thermoplastic warp yarns holding said coated fabric in the looped configuration, whereby said coated fabric in its uncoated areas is protected from penetration by rain while permitting free entrance of air therethrough.

6. The method of making a rainproof fabric which comprises joining a fabric having a greater shrinking power in one direction to a fabric having a lesser shrinking power in one direction at spaced apart points so the fabrics have different shrinking powers in the dimension between the points, shrinking said rainproof fabric to cause the fabric having the lesser shrinking power to loop upon itself between said points, and at some point in the process applying a rainproof coating to said fabric having the lesser shrinking power over its surface area except adjacent said points.

7. The method of making a rainproof fabric which comprises joining a fabric having a greater shrinking power in one dimension to a fabric having a lesser shrinking power in one direction by yarns to form spaced apart lines where the fabric are joined together so the fabrics have different shrinking powers in the dimension between said lines, shrinking said rainproof fabric to cause the fabric having the lesser shrinking power to loop upon itself between said lines, and at some point in the process applying a rainproof coating to said fabric having the lesser shrinking power over its surface area except for narrow bands adjacent said spaced apart lines.

8. The method of making a rainproof fabric which comprises stitching a fabric having a greater shrinking power in one direction to a fabric having a lesser shrinking power in one direction along spaced apart lines so the fabrics have different shrinking powers in the dimension between said lines, shrinking said rainproof fabric to cause the fabric having the lesser shrinking power to loop upon itself between said lines, and at some point in the process applying a rainproof coating to said fabric having the lesser shrinking power over its surface except for narrow bands adjacent said spaced apart lines.

9. The method of making a rainproof fabric which comprises weaving a double fabric one of which fabrics has heat shrinkable thermoplastic yarns therein having a greater shrinking power than the corresponding yarns in the other fabric extending in one direction thereof, joining said fabrics along spaced apart lines by interweaving yarns through both of said fabrics, applying a rainproof coating to said fabric having the lesser shrinking power over its surface area except for a narrow band adjacent said spaced apart lines, and heating said fabric to cause the thermoplastic yarns in said fabric having the greater shrinking power to shrink to cause the other fabric to buckle to form loops of coated fabric therein which overhang the uncoated portions of the other fabric.

10. The method of making a rainproof fabric which comprises weaving a double fabric wherein the two fabrics are joined together along spaced apart lines by weft threads interwoven with both of the fabrics, disposing heat shrinkable thermoplastic yarns in the warp of one of said fabrics, applying a rainproof coating to the other fabric over its surface excepting for narrow bands extending along said spaced apart lines, and heating said double fabric to cause said thermoplastic yarns to shrink to form loops in the coated fabric wherein the coated portions of said fabric overlie the uncoated portions thereof.

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