

Sept. 9, 1958

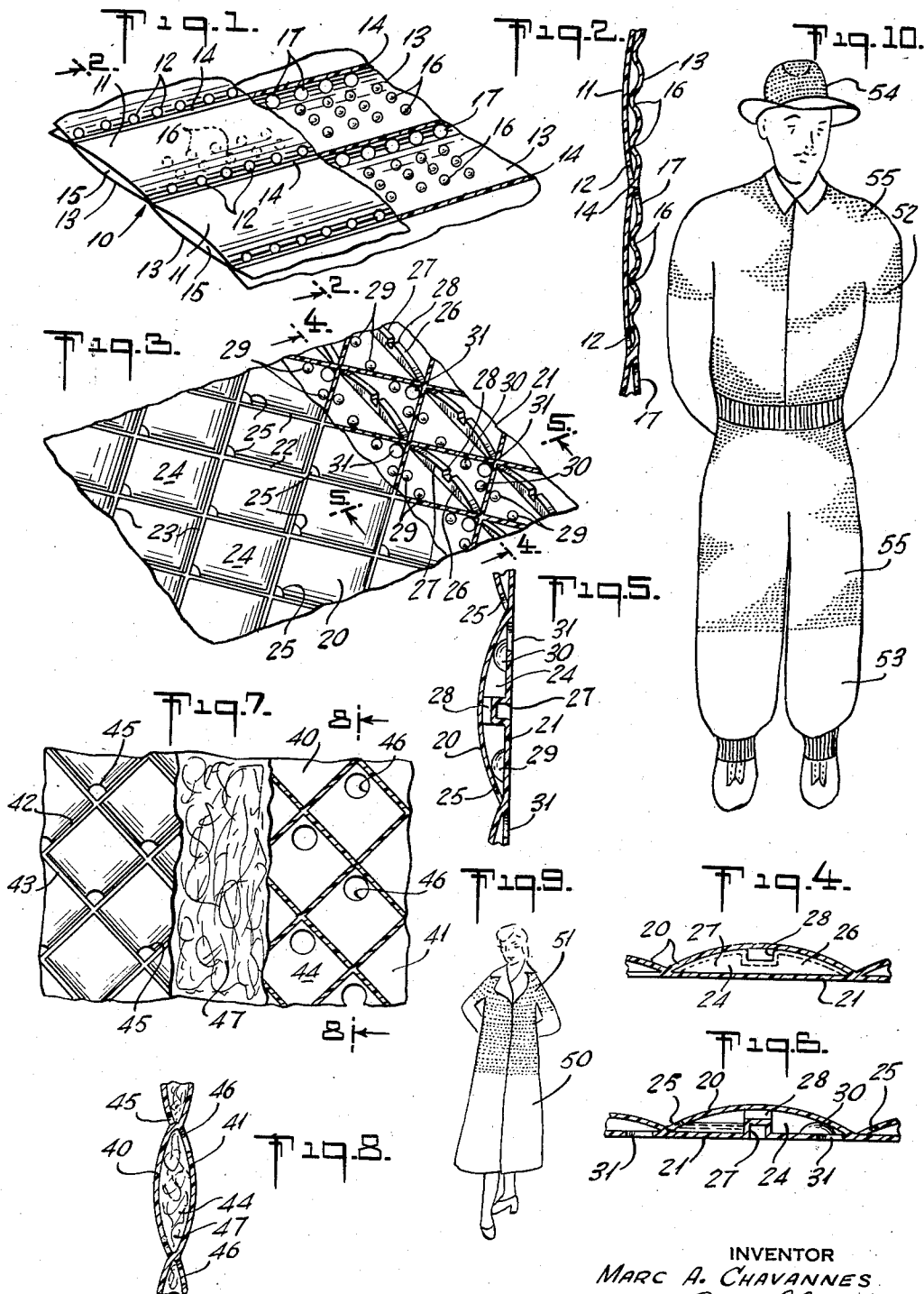
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2,851,390

FABRIC AND METHOD OF MANUFACTURE

Filed June 30, 1955

2 Sheets-Sheet 1



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Fig. 11.

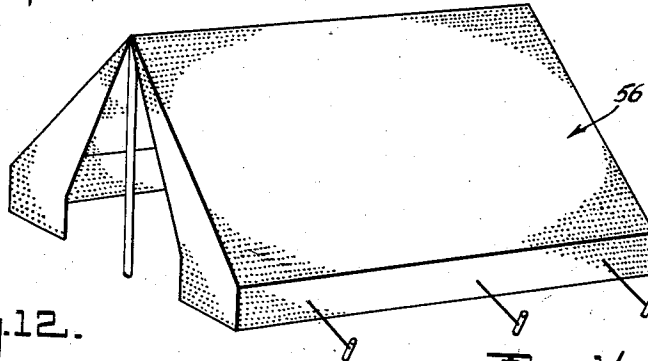


Fig. 12.

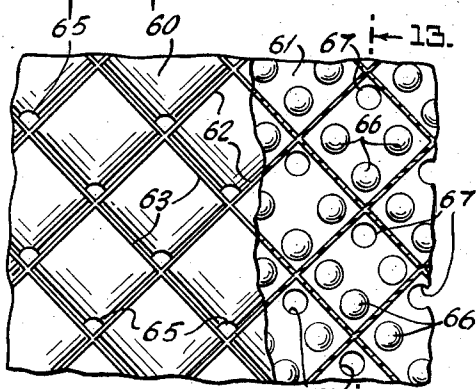


Fig. 14.

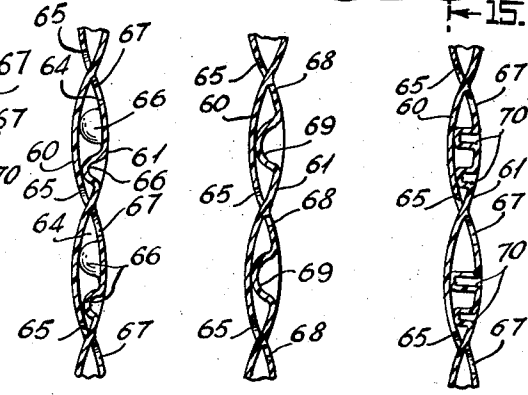
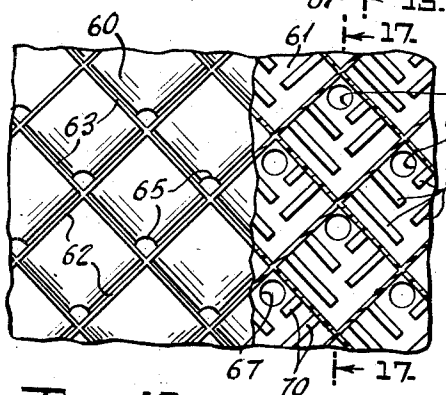
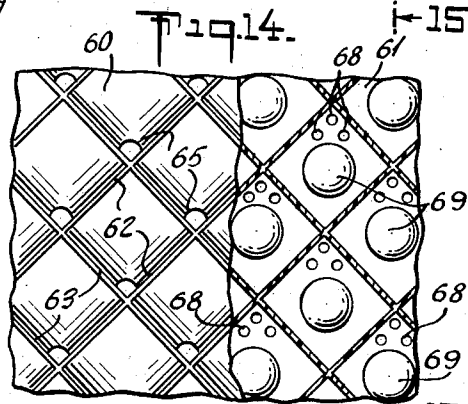


Fig. 16.

Fig. 13.

Fig. 15.

Fig. 17.

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FABRIC AND METHOD OF MANUFACTURE

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Application June 30, 1955, Serial No. 519,157

17 Claims. (Cl. 154—125)

This invention relates to fabrics formed of plastics and other waterproof and water resistant materials and more specifically to a ventilated waterproof fabric useful for rainwear, protective clothing, protective enclosures and other similar purposes, and to the manufacture thereof.

With the advent of plastics and treated woven materials impervious to liquids and gases numerous unsuccessful attempts have been made to provide them with porosity sufficient to provide for the free flow of gases therethrough while at the same time retaining their liquid proof characteristics. The attainment of this end is particularly important in the base of wearing apparel since plastic rainwear and other garments cause excess perspiration, particularly when used in warm weather. The same disadvantage is present when plastics and other fluid impervious materials are used as protective garments in industries and other activities for the protection against fluids, dust particles and the like.

Accordingly one object of the invention resides in the provision of a ventilated fabric suitable among other things for clothing, rainwear and the like that will shed liquids and at the same time provide a degree of comfort at least equivalent to that obtainable with woven materials. The importance of this feature of the invention is particularly evident in the case of protective clothing used in industry. Previous unventilated garments caused profuse perspiration of individuals and severely limited both the degree and duration of their activity. With ventilated garments in accordance with the invention the length of time a man may work under protected conditions in materially extended with no adverse affect on his health.

Still another object of the invention resides in the provision of an improved fabric structure for protective garments, enclosures and the like for the protection of individuals and equipment against moisture, dust and other foreign matter and at the same time permit the ready flow of air into and out of the garment or enclosure.

A further object of the invention resides in a new and improved ventilated fabric formed of materials impervious to water and other liquids that is characterized by its relatively low cost, ease of manufacture, durability and excellent appearance. By reason of the improved structural characteristics of fabrics in accordance with the invention, a variety of designs may be employed that will provide colorful and well appearing rainwear for men and women as well as highly durable protective garments for industrial and other purposes.

A still further object of the invention is an improved method for making a ventilated waterproof fabric useful for garments, enclosures and other similar purposes that is characterized by its relatively low cost and simplicity.

A still further object of the invention is the provision of an improved ventilated, waterproof fabric.

The above and other objects of the invention will become more apparent from the following description

and accompanying drawings forming part of this application.

In the drawings:

Fig. 1 is a perspective view in partial section of a fabric in accordance with one form of the invention;

Fig. 2 is a cross-sectional view of Fig. 1 taken along the line 2—2 thereof;

Fig. 3 is a perspective view in partial section of a modified form of the invention;

Figs. 4 and 5 are cross-sectional views of Fig. 3 taken along the lines 4—4 and 5—5 thereof;

Fig. 6 is a cross sectional view of the embodiment of the invention shown in Figs. 3 to 5 illustrating one of the advantages thereof;

Fig. 7 is a plan view in partial section of another embodiment of the invention;

Fig. 8 is a cross sectional view of Fig. 7 taken along the line 8—8 thereof;

Fig. 9 is a perspective view of a garment embodying a fabric in accordance with the invention;

Fig. 10 illustrates the application of a fabric in accordance with the invention to protective garments such as a hat, jacket and trousers;

Fig. 11 is a perspective view of an enclosure formed of a fabric in accordance with the invention;

Fig. 12 is a plan view in partial section of still another embodiment of the invention;

Fig. 13 is a cross sectional view of Fig. 12 taken along the line 12—12 thereof;

Fig. 14 is a plan view in partial section of still another embodiment of the invention;

Fig. 15 is a cross sectional view of Fig. 14 taken along the line 15—15 thereof;

Fig. 16 is a plan view in partial section of a further embodiment of the invention; and

Fig. 17 is a cross sectional view of Fig. 16 taken along the line 17—17 thereof.

Plastic materials such as vinyl, nylon, polyethylene, and woven and knitted materials coated or impregnated with plastic materials have the highly important advantage of being completely impervious to liquids and gases that are not solvents for the material. In many applications, such as garments and enclosures, it is desirable to provide a fabric having waterproof or water resistant characteristics but at the same time permit the ready flow of air into and out of the garment or enclosure.

The fabric in accordance with the invention overcomes the problems heretofore encountered with the use of waterproof materials in cases requiring ventilation or perviousness to gases as for instance protective garments and rainwear for men and women. This is broadly attained by the utilization of overlying layers of material adhered one to the other with the layers being individually perforated in a manner that provides for the flow of air through the layers and prevents the transmission of liquids therethrough. While the invention is particularly useful for garments and enclosures, it will become apparent that it is also useful for other applications requiring the separation of fluids and gases. Many efforts have been made to attain this end but have not been entirely satisfactory either because insufficient ventilation was attained or the structures devised either were too expensive and impractical or were ineffective in guarding against the transmission of liquids through the sheet material.

Referring to the embodiment of the invention illustrated in Figs. 1 and 2, the outer layer of the composite fabric structure 10 is denoted by the numeral 11 and includes a plurality of spaced openings 12 aligned in spaced rows. A second layer of material 13 is placed against the back side of the front layer 11 and the two

are secured together along spaced parallel lines 14 which provide water tight seals between the two layers and thus form a plurality of water tight compartments 15. It will be observed that the lines 14 along which the front and rear layers of fabric 11 and 13 are secured one to the other are disposed to one side of the openings 12 so that these openings are not blocked or otherwise closed by the seal and will provide for the free flow of air into and out of the compartments 15.

The rear layer 13 is formed with a plurality of small indentations 16 functioning as spacers to separate the front and rear layers of material and prevent them from adhering one to the other. This feature may be more clearly observed in Fig. 2. In addition to the indentations 16 the rear layer 13 also includes a series of spaced openings 17 disposed along the edge of each chamber opposite and generally parallel to the lines of openings 12. The openings 17 are preferably made somewhat larger than the openings 12 so that the impedance to the flow of air through each chamber 15 will be determined by openings 12.

The composite fabric material as described above may be employed in any position provided in each row of openings 17 in each chamber 15 is elevated at least slightly above the row of openings 12 communicating with the same chamber or compartment so that any fluid entering a compartment will drain out through the openings 12 under the influence of gravity. The openings 12 are preferably arranged so that the lower edge of each opening is substantially contiguous with the adjoining seal 14 securing both layers of the fabric together. With this construction, together with the outwardly curved walls of each compartment, water or other liquid that may fall on the outer layer 11 of the fabric will not normally enter the openings 12. In the event water does enter one or more of the openings, its momentum will be expended by contact with the inner surfaces of the compartments 15 and will be discharged through the openings 12. In addition the embossed indents 16 also act to retard the flow of water upwardly from the openings 12 to the openings 17. While this fabric effectively prevents water or other liquids from penetrating it, it will nevertheless provide for relatively free unimpeded flow of air through each chamber 15 by virtue of the two sets of openings 12 and 17 therein.

The fabric as illustrated in Figs. 1 and 2 may be formed of any suitable plastic material such as vinyl or polyethylene of the desired thickness and the overlying layers can be joined along with lines 14 by heat sealing them one to the other in the manner well-known in the art. If desired one or both layers of the composite structure may be formed of a woven material impregnated with a waterproofing compound of plastic or other similar substance and appropriate means may be employed for securing them one to the other. Similarly the formation of the indents 16 may be accomplished in any suitable manner as by heat embossing processes presently used in connection with plastics and other similar materials.

This improved composite structure for providing free ventilation and at the same time preventing the flow of liquids may be made of any weight material and plastics as thin as .003" or .004" have been employed successfully. This is particularly important in the case of rainwear and other garments since little weight is added by use of the composite structure and in the case of rainwear only the upper portion of the garment need employ the ventilated plastic in order to provide adequate ventilation about the body and upper portion of the arms.

In many occupations workers frequently must be protected against acids, bases and other strong chemicals or contaminated liquids. At the present time impervious materials such as plastics and plastic treated fabrics must be employed to provide the necessary protection. However, the living body must be ventilated constantly for

both comfort as well as health and workers required to wear plastic suits can therefore function only for limited intervals of time under such circumstances. With this invention, however, protective garments may be fabricated at least in part of the composite structure as described above and thus provide complete and adequate ventilation for the wearer and at the same time provide substantially complete protection against liquids that may be dangerous or poisonous to the human body.

A modified form of the invention is shown in Figs. 3 to 6 inclusive. In this embodiment the front and rear layers of fabric, denoted by the numerals 20 and 21 respectively, are sealed one to the other along sets of diagonal lines 22 and 23 disposed at substantially right angles one to the other to form a plurality of individual compartments 24. Each compartment 24 is provided with a lower opening 25 formed in the front layer 20 adjoining the lower intersection of the heat sealing lines 22 and 23 forming the bottom corner of the compartment. In actual practice it is preferred to form a circular opening 25 in the material 20 before being sealed to the backing material 21 and then position the heat seals 22 and 23 so that a portion of each opening 25 intersects the heat seals to form an opening having a curved top portion 25' and a triangular bottom portion defined by the heat seals 22 and 23. In this way any water or other liquid finding its way into any one or more of the compartments 24 will be drained completely and there will be no danger of the accumulation of liquids within the body of the fabric. A somewhat similar structure may of course be employed with the embodiment shown in Figs. 1 and 2.

The front and rear layers 20 and 21 of each compartment are held in spaced relationship by a transverse baffle 26 embossed in the layer 21 and having a curved outer surface 27. This curved surface is provided with a shallow channel 28 and provides for communication between the two sections of each compartment thus formed. In addition to the baffle 26, a pair of spaced indents 29 is positioned near one corner of each compartment adjoining the opening 25 in the front layer 20 and a second pair of spaced indents 30 is placed near the opposing corner which further includes an opening 31 in the rear layer 21.

When the layers 20 and 21 are secured one to the other in the manner illustrated, the front layer 20 lies firmly against the curved surfaces 27 of the baffles 26 so that the only communication between the openings 25 and 31 of each chamber is through the shallow channel 28 of the baffle 26. An important feature of this embodiment of the invention is illustrated in Fig. 6. It will be observed that with the fabric in the horizontal position with the layer 21 underlying the layer 20, that liquid entering one or more of the top openings 25 will be blocked by the baffles 26. In the preferred embodiment, the base of each channel 28 is above the associated opening 25 as shown so that the water or liquid level within a compartment will never exceed the level of the channel 28 and thus cannot run into the other portion of the compartment and be discharged through the opening 31.

In many instances it is also desirable to protect an individual from contaminated dust and dirt particles in certain industrial occupations as well as to provide a substantially waterproof garment for protection against liquids. This end is attained by means of the embodiment of the invention shown in Figs. 7 and 8. In this embodiment the front layer of fabric is denoted by the numeral 40 and includes a plurality of diagonally disposed heat seals 42 and 43 substantially identical to the heat seals described in connection with Figs. 3 through 6. These heat seals form a plurality of individual compartments 44 with each compartment having an opening 45 at the lower corner thereof formed in substantially the same manner as the opening 25 of the previous figures. The rear layer 41 of the composite structure has a single open-

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ing 46 disposed at the upper corner of each compartment 44 so that the flow of air will be established through each pair of openings 45 and 46. Within each compartment 44 there is included filter material 47 of cotton, glass fiber and the like to trap dust particles that may be carried into the opening 45 by reason of the flow of air through the openings 45 and 46. In addition this filter material 47 serves to separate the front and rear portions of the fabric layers 40 and 41 forming each compartment to insure good ventilating characteristics and guard against admission of liquids through openings 45.

In making a fabric of this nature it is preferable to utilize a filter material 47 of a nature that can be interposed between the front and rear layers prior to formation of the heat seals 42 and 43. One such material may be cotton impregnated with a heat sealable plastic material of vinyl or other plastic so that when a sheet of the filter material 47 is interposed between the front and rear layers 40 and 41 the layers can be heat sealed along the lines 42 and 43 to form a plurality of substantially water tight compartments.

In the fabrication of the embodiments of the invention as described above, the front and rear layers are perforated in the desired manner and at least one layer may be embossed to provide the spacing means between the layers. While it is usually desirable to emboss only the rear layer, the same ends can be achieved by embossing the front layer or even both layers. The prepared layers are then placed one upon the other and are sealed one to the other by heat sealing or other means. The sealing or bonding means is coordinated with the disposition of the openings in each layer to achieve the end products as described. In the case of the embodiment of Fig. 7, the embossing is omitted and a suitable filter material is disposed between the layers before the final sealing process. While heat sealable plastic and plastic impregnated material are preferred for convenience, any other type of waterproof material and appropriate sealing processes may be employed.

Fig. 9 to 11 inclusive illustrate several of the many applications for fabrics in accordance with the invention. In Fig. 9 there is shown a rain coat having a plurality of minute openings 51 about the upper section of the coat and sleeves. The openings 51 correspond to the openings 12, 25 and 45 of Figs. 1, 3 and 7 respectively, depending on the type of fabric employed. With a coat constructed in this manner, the body and arms of the wearer are adequately ventilated and the waterproof characteristics remain substantially unaffected. Moreover important features of the invention may be incorporated in attractive designs to enhance the appearance of rain-wear for both men and women.

Another form of protective garment is shown in Fig. 10. In this case the jacket 52, trousers 53 and side walls of the hat 54 are formed of ventilated fabric having outer openings 55 in accordance with the invention. Thus the wearer is afforded substantially complete protection from liquids and at the same time provides adequate ventilation for the head and entire body. This is particularly important in industrial plants wherein men work with strong acids or other contaminated liquids. In cases where protection against dust particles as well as liquids is required the embodiment of the invention shown in Fig. 7 may be used.

With enclosures such as the tent 56 in Fig. 11, the use of fabrics in accordance with the invention provides complete protection against rain and dust while at the same time affording good ventilation. This is particularly important in warm, humid climates whether the enclosure is used for either personnel or equipment. The enclosure may of course be fabricated entirely of ventilated fabrics as illustrated or only certain portions may be made of such fabrics.

A further embodiment of the invention is shown in Figs. 12 and 13 and includes two overlying layers of ma-

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terial 60 and 61 secured one to the other by heat seals along two sets of inclined lines 62 and 63 to form a plurality of rectangular compartments 64. As illustrated in the figures, the lower corner of each compartment 64 is provided with an opening 65 formed in the same manner described in connection with Figs. 3 and 7.

The rear layer of material 61 in this embodiment of the invention is provided with three indents 66 for each compartment 64 with the lower indent 66 being somewhat smaller than the upper ones. All three indents serve to hold the two layers apart as may be observed in Fig. 13. In addition to the indents 66 the rear layer 61 is provided with an opening 67 at the upper corner of each compartment and is preferably larger than the openings 65. With this construction the lower indent 66 of each compartment 64 serves as a deflector to intercept any liquid that may enter one of the openings 65. If liquid should enter an opening 65 in such a manner that it is able to proceed between the lower indent 66 and one of the lower edges of compartment it will ultimately strike one of the upper sloping edges of the compartment whereupon it will be deflected backwardly and be discharged through the opening it entered. Moreover with the disposition of the three indents 66 in the manner illustrated it will be observed that there is no direct path that the liquid can pursue between each opening 65 and its associated opening 67 while at the same time the free flow of air or other gas through the fabric is maintained.

Under certain conditions it may be desirable to utilize the form of the invention shown in Figs. 14 and 15. This form of the invention is similar in certain respects to the form shown in Figs. 12 and 13 and like numerals before used to denote like elements. In Figs. 14 and 15 the layers of material 60 and 61 are secured together in the same manner as shown in Fig. 12 by means of two sets of diagonal seals 62 and 63 and the front layer 60 is provided with an opening 65 at the lower corner of each chamber. The rear layer of material 61 is formed in a somewhat different manner than the rear layer 61 of Fig. 12 in that the opening 67 is eliminated and in place thereof three somewhat smaller openings 68 are provided. The combined area of these openings, however, is preferably greater than each opening 65 in order that the resistance to the flow of air through any given chamber 64 be determined by the front opening 65. The two layers of material forming each chamber are held in spaced relationship by a single relatively large indented portion 69 centrally spaced within the chamber. The use of a single indented portion shown in this embodiment of the invention may be desirable in cases where the rear layer of material 61 is of relatively heavy stock so that a single indent 69 will provide sufficient rigidity to hold the front and rear layers apart. In cases of rain-wear it may be desirable to modify the configuration and arrangement of the indented portions 66 and 69 of Figs. 12 and 14 to provide different designs when the front layer of material is of a transparent or translucent material.

The embodiment of the invention shown in Figs. 16 and 17 differs from the embodiment shown in Figs. 12 and 14 in that the rear layer of material 61 is provided with an embossed labyrinth of elongated baffles in order to further guard against the transmission of water through the composite structure. The rear layer of each chamber 64 is provided with sets of embossed channels 70 extending into the chamber and positioned in generally parallel relationship to the sealing lines 62 and 63. With this arrangement water or other liquid entering an opening 65 is virtually completely blocked from opening 67 while at the same time the embossed channels 70 are spaced so that air will flow freely through the openings between the channels to establish the free flow of air through the openings 65 and 67.

From the foregoing description of the invention it is evident that this improved fabric is useful for a variety

of applications in addition to garments and protective enclosures. For example, it may be used for window coverings to block the transmission of light while at the same time providing substantial flow of air there-through and for applications requiring the separation of fluids and gases. In the case of clothing it is significant to note that the separation of the two layers in the manner illustrated protects the openings in the outer layers from the direct impingement of falling liquids and prevents blocking of the inner holes through contact with the body.

In certain instances it may be desirable to secure added protection by using multiple layers of fabric bonded together in accordance with the teachings of the invention.

In certain cases it may be desirable to utilize coated or impregnated materials that are woven or knitted as one or both layers of this improved fabric structure. While the layer that is embossed should preferably be formed of a coated or impregnated knitted material, the overlying layer may be made either of a woven or knitted material. The use of coated or impregnated materials in this way not only provide a stronger fabric but the surface texture afforded thereby may be desired for ornamental purposes.

While only certain embodiments of the invention have been shown and described, it is apparent that modifications, changes and alterations may be made without departing from the true scope and spirit thereof.

What is claimed is:

1. A liquid proof flexible fabric for garments and protective enclosures comprising inner and outer layers of liquid impervious material secured one to the other to form a plurality of completely isolated chambers having inner and outer walls, the walls of each chamber each including at least one opening therein with the openings in opposing walls of each chamber being vertically offset with the fabric in sloping and inclined positions to prevent the passage of liquid through the fabric while permitting the flow of gas therethrough.

2. A composite fabric for use in vertical and inclined positions comprising inner and outer portions of liquid impervious material secured in overlying relationship to form completely isolated compartments having inner and outer walls, the inner and outer walls of said compartments each having at least one opening, with the opening on the inner wall of each compartment being above a horizontal plane intersecting that compartment and the opening on the outer wall of the last said compartment being below said horizontal plane.

3. A composite fabric according to claim 2 wherein the opening in the outer wall is at the lowermost edge of said compartment.

4. A composite fabric according to claim 2 wherein each compartment is filled with a filter material.

5. A composite fabric according to claim 2 wherein each compartment includes means in at least one wall for holding the walls in spaced relationship.

6. A composite fabric according to claim 5 wherein the last said means is an elongated baffle.

7. A composite fabric for use in vertical and inclined positions comprising inner and outer layers of liquid proof material secured together to form a plurality of elongated substantially horizontal compartments completely isolated one from the other, said compartments each having inner and outer walls including openings therein with the opening in one wall all being above the associated openings in the other wall whereby a liquid falling on said one wall will not penetrate the fabric and gases will flow freely through the fabric.

8. A composite fabric for use in vertical and inclined positions comprising a sheet of liquid impervious material having a plurality of individual compartments isolated one from the other, and having inner and outer walls, each compartment including upper and lower apices the lower apex of each compartment having at least one opening

on one side of the material and the upper apex having an opening on the other side of the material, all of the openings in said other wall of each compartment being above all of the openings in said one wall of the same compartment whereby liquid falling on said one wall of the material will be shed and gases will pass freely through each compartment.

9. A composite fabric for use in vertical and sloping positions comprising inner and outer elements of liquid proof material secured together to form completely isolated compartments each having an inner wall and an outer wall, said walls including openings therein for the flow of gases therethrough and all of the openings in the inner walls of said compartments being above all of the openings in the outer walls of the associated compartments to prevent liquid falling on the outer wall from penetrating the inner wall of said fabric.

10. A fabric for rain garments and protective enclosures comprising inner and outer fabric elements secured in overlying relationship to form a plurality of completely isolated compartments, and said fabric elements including openings communicating with said compartments to permit the flow of air through said fabric and with the openings associated with each compartment being offset to prevent liquid falling on the outer layer from penetrating the inner layer.

11. A garment formed at least in part of a ventilated waterproof fabric comprising inner and outer overlying layers of a waterproof material sealed one to the other to form a plurality of completely isolated compartments, means in each compartment for holding the walls thereof in spaced relationship, the outer wall of said fabric having at least one opening at the lower edge of each compartment and the inner layer having at least one opening near the upper edge of each compartment, all of said openings on the inner layer communicating with one compartment being above all of the openings in the outer layer communicating with the same compartment.

12. A garment according to claim 11 wherein said inner and outer layers are sealed one to the other to form a plurality of elongated horizontally disposed compartments with the outer layer of each compartment having a series of spaced openings along the lower edge thereof and the inner layer having a series of spaced openings along the upper edge thereof.

13. A garment according to claim 11 wherein said inner and outer layers are sealed one to the other to form a plurality of individual rectangular compartments with a pair of opposing corners of each compartment in substantially vertical alignment, said outer layer having an opening therein at the lower corner of said compartment with the edges of said opening being contiguous with said corner of the compartment and the inner layer having at least one opening adjoining the upper corner of said compartment.

14. The method of making a ventilated fabric of waterproof material comprising the steps of perforating at least two layers of material and sealing said layers one to the other in overlying relationship to form a plurality of completely isolated compartments with the perforations in said layers being offset and at least one perforation of each layer communicating with one of said compartments.

15. A fabric comprising at least two overlying layers of material secured one to the other to form a plurality of individual compartments and a baffle in each compartment embossed in one of said layers and having a curved edge part in contact with said other layer to divide said compartment in two parts, said baffle having a shallow channel in said curved edge part for communication between said compartment parts, one of said layers each having at least one opening communicating with one of said compartment parts and the other layer at least one opening communicating with the other of said compartment parts, both of said openings common to an

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individual compartment being substantially in the plane of the inner surface of said one layer and offset from a parallel plane defined by said shallow channel.

16. A fabric according to claim 15 wherein said compartments are essentially rectangular with the baffle extending between one set of opposing corners and the openings being disposed in proximity to the other set of opposing corners and one of said layers further includes indents in the vicinity of said openings to cooperate with the baffle in holding the layers of each compartment in spaced relationship.

17. A liquid proof flexible fabric for garments and protective enclosures comprising inner and outer layers of liquid impervious material secured one to the other to form a plurality of chambers having inner and outer walls, each chamber including at least two vertically offset openings with the fabric in inclined and vertical posi-

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tions, one of said openings opening in one surface of the fabric and the other of said openings opening in the other surface of the fabric, whereby said fabric when in said vertical and inclined positions prevents the passage of liquid through the fabric while permitting the flow of gas therethrough.

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