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(54) Protective Garment Augmented with patches of Closed-Cell Foam Material

(57) A protective garment 10 including an outer shell 26 of woven, abrasion resistant fibrous material, an inner layer of a thermal insulating material, and a moisture barrier portion, includes a portion of closed cell foam material 37 located on selected portions of said protective garment to provide additional areas of thermal protection or compression resistance.

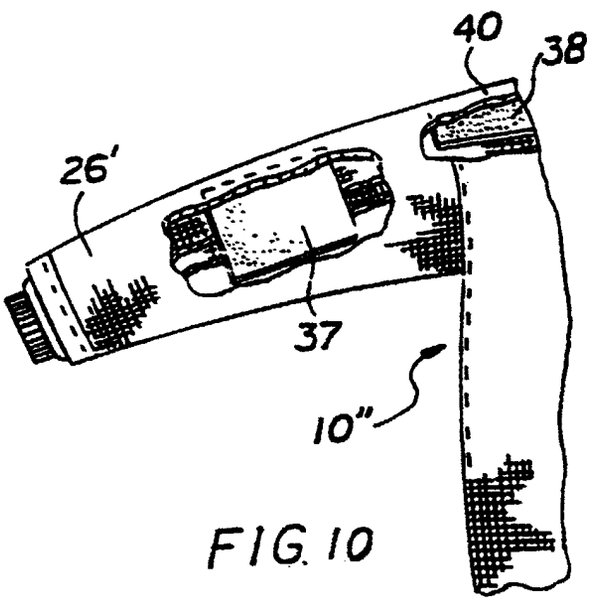

FIG. 10

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Description

Background of the Invention

[0001] The present invention relates to garments which protect the wearer from hazardous environmental conditions and, more particularly, to garments which provide the wearer with protection from external heat and moisture.

[0002] Firefighter garments are representative of protective garments designed to protect the wearer from a variety of environmental hazards. Typically, a firefighter garment includes an outer shell of an aramid fiber such as NOMEX or KEVLAR (both ' registered trademarks of E.I. DuPont de Nemours & Co:, Inc.), or PBI (a registered trademark of Celanese Corporation), which provides resistance to abrasion and some thermal protection. Such garments also include a thermal barrier, which may comprise a layer of NOMEX and KEVLAR fibers, or a batting of such fibers, often quilted to a lightweight NOMEX face cloth. The batting of the thermal barrier traps air and possesses sufficient loft to provide the necessary thermal resistance, and the face cloth provides resistance to abrasion of the thermal liner by the wearer.

[0003] Moisture resistance may be provided by a layer of a poly/cotton fabric having a neoprene coating, positioned between the thermal liner and the outer shell. In the alternative, the thermal liner may comprise NOMEX fabric coated with fire-retardant neoprene, thereby functioning as a combined moisture barrier and thermal liner. Such garments typically do not breathe in the sense that perspiration moisture vapor generated by the wearer cannot escape from the garment through the thermal liner and moisture barrier.

[0004] Moisture resistance is provided by a membrane of GORE-TEX (a registered trademark of W.L. Gore & Associates, Inc.) material bonded adhesively to a substrate of a NOMEX and KEVLAR blend. The GORE-TEX material has microscopic openings which permit the transport of moisture vapor, thereby allowing perspiration moisture vapor of the wearer to escape outwardly, but are sufficiently small to prevent liquid moisture from passing through to the wearer.

[0005] The aforementioned ensemble possesses acceptable abrasion, thermal and moisture resistance properties, but there exist inherent disadvantages with such a garment.

[0006] The typical arrangement of the components within the garment is such that the moisture barrier layer is positioned between the thermal liner and the outer shell. This is necessary to prevent the batting material of the thermal liner from absorbing moisture from the ambient, which would add to the overall weight of the garment and possibly reduce its loft and thermal resistance characteristics.

[0007] The disadvantage with such an arrangement is that the presence of the thermal liner between the moisture barrier and the wearer acts as a barrier which inhibits the free flow of perspiration moisture vapor from the wearer to and through the moisture barrier layer. Consequently, in high activity or stress situations, perspiration moisture vapor generated by the wearer may becomes trapped within the thermal liner, thus wetting the thermal liner, which adds weight to the garment and lowers the TPP (Thermal Protection Property) of the thermal liner.

[0008] Another disadvantage with such prior art garments is that the additional bulk and loft provided by such fabric thermal liners inhibits the freedom of movement of the wearer, producing. a "hobbling effect," and requires the use of a face cloth, which increases the cost of the garment. The former disadvantage increases the stress imposed on the wearer in a situation requiring high activity, and accelerates the onset of fatigue.

[0009] Another type of firefighter garment, disclosed in Aldridge et al. U. S. Patent No. 5,136,723, utilizes a thermal liner consisting essentially of a layer or layers of open mesh fabric. In addition to trapping a layer of air between the wearer and the shell of that garment, the open apertures promote heat and perspiration vapor transfer from the wearer's body. However, since such mesh fabric absorbs liquid moisture, it is preferable to place such a thermal liner inside of the moisture barrier; that is, between the wearer and the moisture barrier. Consequently, such a mesh barrier still impedes the transport of moisture vapor somewhat.

[0010] Further, since the batting of such prior art garments is somewhat uneven in thickness, it is necessary to provide a thermal liner which is nominally thicker than required to meet required TPP ratings, in order to ensure that the thermal liner meets such TPP ratings at all points on a garment, including at the thinner spots on the garment. Consequently, such constraints subject the wearer to stress and hasten the onset of fatigue in situations requiring high physical activity by the wearer.

[0011] Furthermore, the additional bulk of the garment resulting from the added thickness of the thermal liner requires additional shell material to cover it, thereby adding to the overall cost of the garment.

[0012] Accordingly, there is a need for a protective garment in which the loft or thickness of the thermal and moisture barriers is minimized in order that the overall weight of the garment is reduced, the amount of material required and hence the cost of the garment is minimized, and the freedom of movement afforded by the garment is enhanced.

[0013] Accordingly, there is also a need for a protective garment in which the transport of moisture vapor generated by the perspiration of the wearer is permitted to flow freely to and through the moisture barrier, which is relatively light in weight, yet provides adequate thermal protection, and which minimizes the restriction of movement and hobbling effect characteristic of insulated garments.

Summary of the Invention

[0014] The present invention is a protective garment having an outer shell, and a thermal liner and moisture barrier which consists of a layer of fire-retardant, closed-cell foam material. The closed-cell foam possesses the beneficial characteristics of moisture resistance and thermal insulation.

[0015] Consequently, in accordance with a first embodiment of the present invention, the closed-cell foam material acts as a combined thermal liner and moisture barrier to provide a protective garment in which a separate, discrete moisture barrier and thermal liner is eliminated, so that the entire garment consists essentially of an outer shell, a layer of closed-cell foam material and, preferably, an inner liner of lightweight face cloth material to prevent abrasion of the foam layer by the clothing of the wearer.

[0016] In a preferred embodiment of the invention, the closed-cell foam thermal liner/moisture barrier is bonded to a lightweight NOMEX face cloth and is placed loosely within the shell. The lamination of the face cloth to the foam layer would provide the foam layer with the necessary tear strength resistance to meet N.F.P.A. (National Fire Protection Association) requirements. In another embodiment of the invention, the combined thermal liner/moisture barrier is bonded to the outer shell by a suitable adhesive and the seams are sealed, forming a unitary component of the garment. With such a design, the face cloth preferably is attached adhesively directly to the combined outer shell and liner to make an entirely unitary garment.

[0017] While such a construction could be used in many applications, such as high or low temperature environments, when used as part of a firefighter ensemble, other qualities must be present. For example, in the preferred embodiment, the foam liner is made of a fire-retardant material, which enables the garment to meet N.F.P.A. requirements. Further, by bonding the foam layer directly to the outer shell, the combined thermal/moisture barrier meets the tear strength requirements of the N.F.P.A.

[0018] Consequently, the invention possesses many advantages over prior art garments. For example, the layer of closed-cell foam is lighter in weight and can be made thinner than prior art quilted battings of aramid fibers having comparable insulating properties. This reduction in thickness results not only from the superior insulating qualities of closed-cell foam, but the uniformity in thickness of the foam layer, which is superior to the uniformity in thickness of the prior art fiber insulation. This reduction in thickness reduces the amount of material required for the outer shell and therefore reduces the overall cost of the garment.

[0019] The reduction in thickness of the combined thermal liner and moisture barrier also minimizes the hobbling effect imposed by the garment on the wearer. This delays the onset of fatigue and reduces the stress on the wearer in high-activity situations.

[0020] Another advantage of the closed-cell foam liner over conventional fiber thermal liners is its resistance to absorption of water. This inherent property of the garment minimizes the weight gain of the garment when it becomes saturated with water, and facilitates drying of the garment. In addition, since the closed-cell foam does not become thoroughly soaked with moisture, it cannot create localized "hot spots" which occur when prior art fiber thermal liners become saturated with moisture in spots which absorb heat from the ambient and scald the wearer.

[0021] In accordance with a second embodiment, the present invention provides relatively high resistance to water absorption and relatively high moisture vapor transport characteristics when compared to conventional firefighter garments. This garment of the present invention comprises an outer shell, a thermal liner and a moisture barrier, in which the thermal liner includes a layer of apertured closed-cell foam material.

[0022] Two characteristics of the closed-cell foam provide these advantages. First, the closed-cell structure of the foam provides superior insulating properties when compared to air permeable fibers of prior art garment insulation on weight and thickness bases. Second, a sheet of the closed-cell foam of the present invention is more dimensionally stable and uniform in thickness than a comparable sheet of prior art fiber insulation, so that a sheet of the closed-cell foam can be made thinner and still meet the minimum overall N.F.P.A. requirements for a garment. Since the insulation layer can be made thinner, the overall size and bulk of the garment is reduced significantly, which reduces the amount of material required for the garment, thereby reducing the overall cost of the garment; and minimizes the hobbling effect of such insulation, which reduces stress and fatigue and facilitates donning and doffing the garment.

[0023] In prior art protective garments, it is necessary to position the thermal barrier between the moisture barrier and the wearer so that the moisture barrier protects the thermal barrier from becoming saturated with liquid moisture seeping through the outer shell. However, in that position, the thermal barrier hinders the flow of moisture vapor from the wearer through the moisture barrier membrane, and often becomes saturated with perspiration moisture from the wearer itself.

[0024] In contrast, the closed-cell foam thermal liner of the present invention does not absorb water and can be placed outside the moisture barrier, between the moisture barrier and the outer shell. With this arrangement of the layers, the moisture barrier membrane is positioned as close as possible to the wearer to maximize the flow of moisture vapor from the wearer through the moisture barrier. Since the thermal liner is on the opposite side of the moisture barrier from the wearer, the chance of the wearer being scalded by a heated thermal liner saturated with moisture is significantly reduced. Such an occurrence is further reduced since the closed-

cell foam layer of the thermal liner of the present invention does not readily absorb water.

[0025] Further, the moisture barrier substrate, typically a woven blend of NOMEX and KEVLAR, is against the wearer and thereby eliminates the need for a separate face cloth, which is needed to protect the thermal liner with prior art garments in which the thermal liner is inside the moisture barrier. This further reduces the overall weight and cost of the garment.

[0026] Consequently, the thermal liner of the garment of the present invention functions similarly to the mesh thermal liner of Aldridge et al. U. S. Patent No. 5,136,723 in that the apertures of the closed-cell foam liner of the present invention promote the transport of perspiration moisture vapor outwardly from the wearer. Furthermore, like the mesh apertures of the garment of the Aldridge et al. patent, the apertures in the closed-cell foam can perform an insulating function, provided that the apertures are sized sufficiently small. However, the use of closed-cell foam as the matrix for the apertures of the thermal liner of the present invention not only provides improved insulation values, but enables the liner to be positioned outside of the moisture barrier.

[0027] In a preferred embodiment of the invention, the foam thermal liner is bonded to the outer shell by an adhesive, and the moisture barrier is separate from the laminate formed by the outer shell and the foam thermal liner. Accordingly, the outer shell acts as a supportive substrate for the foam liner so that the combination of the shell and liner meet the N.F.P.A. requirements for tear strength.

[0028] In an alternate embodiment of the invention, the foam thermal liner is separate from both the moisture barrier and shell and is bonded by an adhesive to a fabric substrate. With this embodiment, all the layers of the ensemble can be separated to facilitate repair or maintenance.

[0029] In another embodiment, a garment having an apertured closed-cell foam liner or any other approved liner system, is augmented with patches of closed-cell foam material, which can be either apertured or non-apertured, positioned between the outer shell and the liner in strategic locations, such as the elbow or shoulder yoke, or the knee of the garment. Such pads or patches increase the thermal resistance in such areas in response to external pressure, as well as add resiliency to those areas in response to increased loading, as from the pads and straps of SCBA Equipment. Alternately, such padding can be applied externally of the outer shell by pads covered with a patch of leather or aramid shell material.

[0030] Accordingly, it is an object of the present invention to provide a protective or firefighter garment with a thermal liner consisting of closed-cell foam material which provides thermal resistance and moisture resistance; a firefighter garment in which the liner is relatively lightweight and resilient, yet possesses the necessary thermal protection property (TPP) ratings to meet N.F.P.A. standards; a firefighter garment having a closed-cell foam liner which is relatively easy to construct, launder and maintain; and a firefighter garment having a combined thermal liner and moisture barrier in which weight is reduced and freedom of movement is enhanced, resulting in reduced wearer stress and fatigue.

[0031] Accordingly, it is a further object of the present invention to provide a protective garment with a thermal liner including a layer of apertured closed-cell foam material which provides thermal resistance and moisture resistance; a protective garment in which the liner is relatively lightweight and resilient, yet possesses the necessary TPP ratings to meet N.F.P.A. standards; a protective garment having an apertured closed-cell foam liner which is relatively simple to construct, launder and maintain; a protective garment in which the thermal liner is relatively thin and uniform, thereby minimizing the bulk such a layer adds to a garment, which reduces the hobbling effect of such a garment and the cost of additional material; and a protective garment having a thermal liner and moisture barrier in which the apertured foam thermal barrier can be placed outside of the moisture barrier, thereby enhancing the transport of moisture vapor from the wearer outwardly to the outer shell and eliminating the need for a layer of face cloth material.

[0032] Other objects and advantages of the present invention will be apparent from the following description, the accompanying drawings and the appended claims.

Brief Description of the Drawings

[0033]

Fig. 1 is a somewhat schematic, perspective view of a firefighter garment incorporating a preferred embodiment of the present invention;

Fig. 2 is an exploded, perspective detail of the garment of Fig. 1 showing the layers of material comprising the ensemble;

Fig. 2A is an exploded, prospective view of the garment of Fig. 2, but showing taped seam;

Fig. 3 is an exploded, perspective detail similar to Fig. 2, but of an alternate embodiment of the invention;

Fig. 4 is a detail of the garment of Fig.1, but modified to include additional padding in strategic areas internally of the outer shell;

Fig. 5 is a detail of the garment of Fig. 1, but modified to include additional padding in strategic areas externally of the outer shell; and

Fig. 6 is a schematic, perspective view of a firefighter pant having reinforcing pads according to the present invention.

Fig. 7 is a somewhat schematic, perspective view of a firefighter garment incorporating a second preferred embodiment of the present invention;

Fig. 8 is an exploded, perspective detail of the garment of Fig. 7 showing the layers of material com-

prising the ensemble;

Fig. 9 is an exploded, perspective detail similar to Fig. 8, but of an alternate embodiment of the invention;

Fig. 10 is a detail of the garment of Fig. 7, but modified to include additional padding in strategic areas;

Fig. 11 is a detail of a garment similar to that in Fig. 7, but modified to include padding externally of the outer shell; and

Fig. 12 is a schematic, perspective view of a firefighter pant having reinforcing pads according to the present invention.

Detailed Description

[0034] As shown in Fig. 1, the present invention is embodied in a firefighter garment, generally designated 10, which is a firefighter coat having a body portion 12, sleeves 14, 16, a neck opening 18, a collar 20 surrounding the neck opening, and a front closure, generally designated 22. The front closure 22 is of conventional design and comprises snaps or a slide fastener (not shown) in combination with mechanical locking means such as hook and "D" combinations 24.

[0035] As shown in Figs 1 and 2, the garment 10 includes an outer shell, generally designated 26, of an aramid material such as NOMEX, which covers the entire garment. Extending throughout the garment 10 is an inner liner of a combined moisture barrier and thermal barrier 28, consisting of a layer of fire-retardant, closed-cell foam 29. The foam layer 29 is preferably about 3/32 inch (2.38 mm) thick, but should be at least 1/16 inch (1.59 mm) thick. A preferred fire-retardant material is ENSOLITE styles IV1, IV2, IV3, IV4, IV5, GIC, or IVC, all manufactured by Ensolite, Inc. of Mishawaka, Indiana.

[0036] The foam layer 29 is adhesively bonded to a layer of lightweight face cloth 30, preferably made of NOMEX, by dots 31 of a suitable adhesive, such as the adhesive used to bond the membrane to the substrate of conventional moisture barriers. Consequently, the combined moisture barrier/thermal barrier 28 is comprised of the lamination of the foam layer 29 and face cloth 30. The barrier 28 is waterproof, and therefore prevents moisture from reaching the wearer, and possesses sufficient thermal insulation characteristics to protect the wearer from external heat sources. As shown in Fig. 2A, the combined moisture barrier/thermal barrier 28 of the garment 10 is sealed by suitable tape 35 at seams 36. Consequently, the liner 28 may be made up of patterns out to form the desired garment 10.

[0037] In another embodiment, shown in Fig. 3, the combination moisture barrier/thermal barrier 28 is bonded to the inner surface of the outer shell 26 by dots 32 of a suitable adhesive. Seams are sealed conventionally, as by strips of tape (not shown), preferably about 3/4 inches (1.9 mm) wide. Consequently, the garment 10' is unitary in construction in that the outer shell 26' and barrier 28 are one piece. With either embodiment, the ensemble allows more freedom of movement and is lighter in weight than prior art garments.

[0038] The method of manufacture of the garment 10 is somewhat conventional in nature. With the embodiment of Fig. 2, the outer shell is constructed along conventional lines, in which patterns are cut from a roll of shell material and stitched together. The combined thermal liner and moisture barrier is first made in roll form as a laminate of closed-cell foam material and a fabric face cloth substrate, then cut in patterns which are stitched together to form the liner. The seams of the combined thermal liner and moisture barrier are sealed with tape 35 (see Fig. 2A) in a conventional manner. The combined thermal liner and moisture barrier is then inserted within the outer shell, and is attached by snaps, strips of hook and loop material or by stitching.

[0039] As shown in Fig. 4, pads 37, 38 are positioned on a garment 10" in strategic locations, such as the elbow for pad 37 and the shoulder yoke area for pad 38. Pad 37 is positioned between the outer shell 26 and the liner 28 of the garment. In the preferred embodiment, the pad 37 would be held in position by stitching to the outer shell, or by strips of hook and loop material (not shown) between the pad and the outer shell. Pad 38 is similar to pad 37 in that it is made of closed-cell foam material, but it also includes apertures 40 to reduce weight.

[0040] As shown in Fig. 5, a pad of closed-cell foam material 42 is mounted on the elbow portion of a sleeve 16"' of a garment 10"' and retained in position by a covering patch 44 of leather or an aramid material, such as NOMEX, which is stitched to the outer shell. Such a pad 42, similar to pads 37 and 38, would provide increased thermal protection in these areas, as well as distribution of loads applied externally to these areas.

[0041] As shown in Fig. 6, similar construction can be applied to a pant 46, which would have the same ensemble construction as either of Figs. 2 or 3. Furthermore, the knee portions of the pant 46 preferably would include pads 48, 50 of closed-cell foam material covered by leather patches 52, 54. Such pads 48, 50 could be either of the apertured of non-apertured variety. Again, such padding would provide increased thermal and compression resistance in the knee area.

[0042] Figure 7 shows a second preferred embodiment. The moisture barrier layer preferably consists of a membrane 56 of GORE-TEX material attached adhesively to a fabric substrate 58 of NOMEX and KEVLAR.

[0043] A thermal liner, generally designated 60, extends throughout the garment and consists of a layer 62 of closed-cell foam material which is provided with a multiplicity of apertures 63. The apertures 63 preferably are about 1mm in diameter and are arranged in a pattern of about 84 apertures per square inch (13.02 apertures per square centimeter). However, other hole sizes and hole densities may be employed without departing from that scope and intent of the invention. The foam layer 62 of the thermal liner 60 preferably is between 3/32

inches (2.38 mm) and 1/8 inches (3.18 mm) thick and is made of a fire-retardant material, such as ENSOLITE styles IV1, IV2, IV3, IV4, IV5, GIC or IVC, manufactured by Ensolite, Inc. of Mishawaka, Indiana.

[0044] The foam liner 60 is positioned between the moisture barrier layer 64 and the shell 26, and is bonded by a suitable adhesive to the shell, preferably by a pattern of "dots" 34 of adhesive so that the apertures 63 generally are not blocked. The dots 34 are shown larger than actual size in the figures for clarity, and are actually about 1mm in diameter.

[0045] An alternative embodiment of the invention is shown in Fig. 9. With the garment 10', the thermal liner 60' is positioned between shell 26' and moisture barrier 64, but is unattached to the shell. With this embodiment, the thermal liner 60' consists of an apertured foam layer 62' bonded by dots 34 of a suitable adhesive to a substrate 66 of a woven NOMEX material to provide dimensional stability and to meet the tear strength requirements of N.F.P.A. regulations. A preferred adhesive consists of the same adhesive used to bond the membrane 56 to the substrate 58 of the moisture barrier 64. Consequently, the thermal liner 60' is separable from the outer shell 26' and moisture barrier 64 for replacement, maintenance or laundering.

[0046] With the garments 10, 10' of Figs. 8 and 9, respectively, by positioning the thermal liners 60, 60' in between the moisture barriers 64 and outer shells 26, 26', the thermal liners no longer obstruct the free flow of perspiration moisture vapor, generated by a wearer during strenuous activity, through the moisture barrier 64. Consequently, the build-up of perspiration moisture within the garment is significantly reduced. This arrangement is made possible by the inherent properties of the closed-cell foam liner 58, 62'. Such a garment will possess advantages over traditional firefighter garments in that the closed-cell foam material is lighter in weight than a traditional thermal liner of similar TPP ratings.

[0047] Another advantage with such an arrangement is that the closed-cell form material does not absorb water, so that the overall ensemble does not get as heavy in conditions of high water saturation, and therefore reduces stress on the wearer since the weight is reduced. Furthermore, the TPP rating will remain more constant than prior art thermal liners, regardless of the amount of water saturation of the garment, since the thermal liner resists absorbing water.

[0048] The method of manufacturing the garment 10 of the present invention is similar to conventional methods. However, the outer shell is made of a laminate of outer shell material and closed-cell, apertured foam which is prepared in roll form, and the patterns are cut and sewn together to make the combination outer shell and thermal liner. The moisture barrier is separately made by laminating a semi-permeable membrane to a fabric substrate, and is inserted into the outer shell and secured at the peripheries of the outer shell and moisture-barrier by snaps, strips of hook and loop material, or permanently by stitching.

[0049] In the embodiment of Fig. 9, the closed-cell foam layer is first bonded to a fabric substrate and supplied in roll form, and the patterns of liner are cut from the roll, stitched into the desired garment shape and inserted into a conventional outer shell. The moisture barrier laminate of membrane and substrate is then inserted into the garment. The separate layers are attached to each other by snaps, strips of hook and loop material or permanently by stitching.

[0050] As shown in Fig. 10, pads 37, 38 are positioned on a garment 10" (which is constructed in accordance with the structure of Fig. 9) in strategic locations, such as the elbow for pad 37 (and knee as shown in Fig. 12) and the shoulder yoke area for pad 38. Pads 37 and 38 are positioned between the outer shell 26' and the thermal liner 60 of the garment 10". Pad 38 is similar to pad 37 in that it is made of closed-cell foam material, but it also includes apertures 40 to provide for moisture vapor transport from the wearer.

[0051] As shown in Fig. 11, with a garment 10"' constructed in accordance with Figs. 7 and 8, in which the foam layer 62 is bonded to the outer shell 26, a pad 42 is placed on the exterior surface of the shell at the elbow on a sleeve 16"' and held in position by a leather patch 44. Such a pad 42, similar to pads 37 and 38, would provide increased thermal protection in these areas, as well as distribution of loads applied externally to these areas.

[0052] As shown in Fig. 12, similar construction can be applied to a pant 46, which would have the same ensemble construction as either of Figs. 8 and 9. Furthermore, the knee portions of the pant 46 preferably would include pads 48, 50 of closed-cell foam material. Such pads 48, 50 could be either of the apertured or non-apertured variety. As shown in Fig. 12, the pads 48, 50 are mounted beneath patches 52, 54, respectively in the case where the pant 46 is constructed in accordance with Fig. 8. If the pant 46 is constructed in accordance. with Fig. 9, it may be preferable to mount the pads 48, 50 beneath the exterior surface of the shell 26' beneath a leather patch as in Fig. 10. Again, such padding would provide increased thermal and compression resistance in the knee area.

[0053] While the forms of apparatus herein described constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention.

Claims

1. A protective garment including an outer shell of woven, abrasion resistant fibrous material, an inner layer of a thermal insulating material, and a mois-

ture barrier portion, **characterised in that** the protective garment includes a portion of closed cell foam material located on selected portions of said protective garment to provide additional areas of thermal protection or compression resistance.

2. The protective garment of claim 1 wherein said portion of said closed cell foam material is located at at least one of the elbow, shoulder yoke, or knee of the garment.

3. The protective garment of claim 1 wherein said portion of closed cell foam material is coupled to an outer surface of said outer shell.

4. The protective garment of claim 3 further including a protective portion located over said portion of closed cell foam material.

5. The protective garment of claim 1 wherein said portion of closed cell foam material is located inside said outer shell.

6. The protective garment of claim 5 wherein said portion of closed cell foam is located between said outer shell and said layer of thermal insulating material.

7. The protective garment of claim 6 wherein said portion of closed cell foam is coupled to an inner surface of said outer shell.

8. The protective garment of claim 1 wherein said layer of thermal insulating material is located inside said outer shell and wherein said moisture barrier portion includes a moisture barrier layer located inside said layer of thermal insulating material, and wherein said portion of closed cell foam is located between said outer shell and said layer of thermal insulating material.

9. The protective garment of claim 1 wherein said portion of closed cell foam is either apertured or non-apertured.

10. The protective garment of claim 1 further comprising a face cloth located to be the inner-most layer of the protective garment and to be located adjacent to a wearer of the protective garment.

11. The protective garment of claim 1 wherein said outer shell is made of an aramid material.

12. The protective garment of claim 1 wherein said portion of closed cell foam includes at least two separate spaced apart portions.

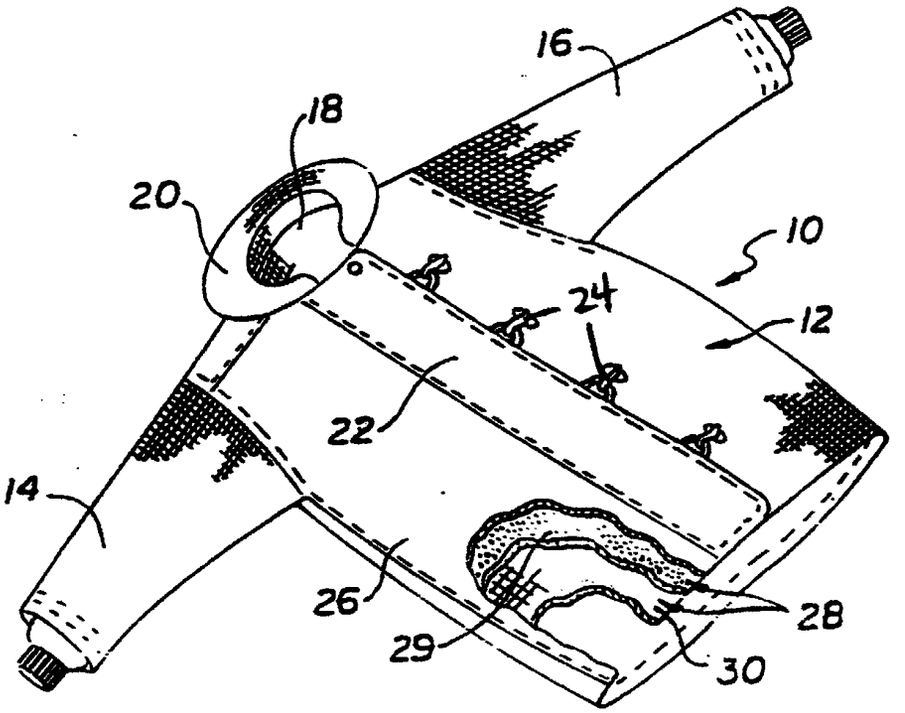

FIG. 1

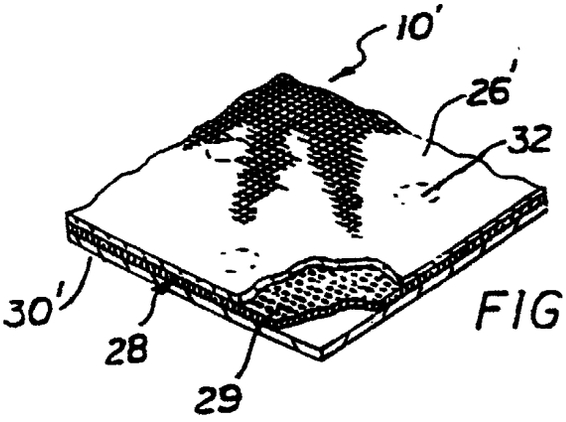

FIG. 3

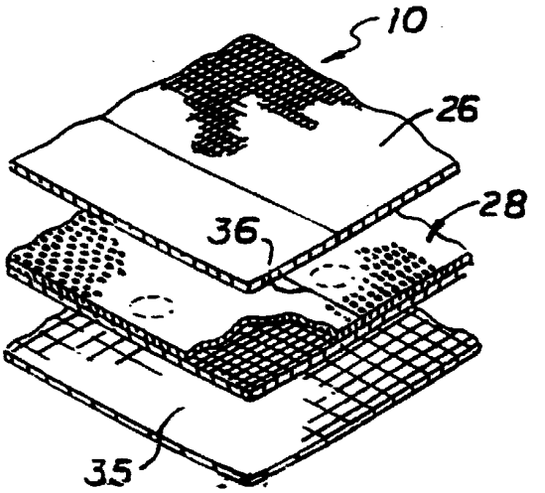

FIG. 2A

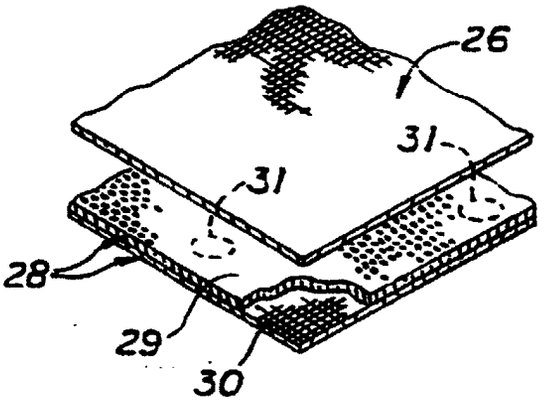

FIG. 2

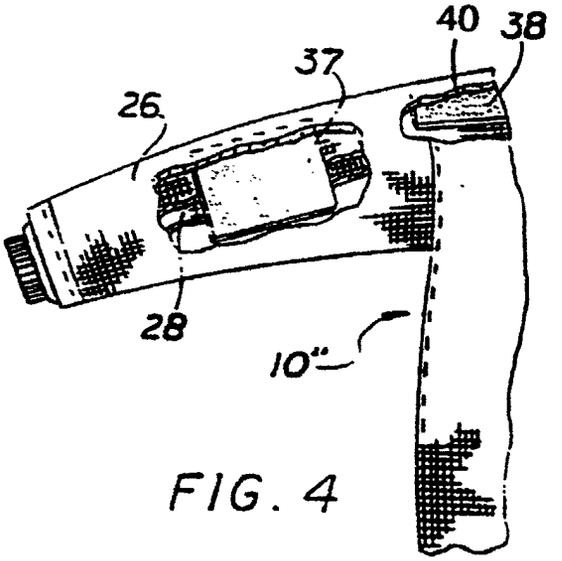

FIG. 4

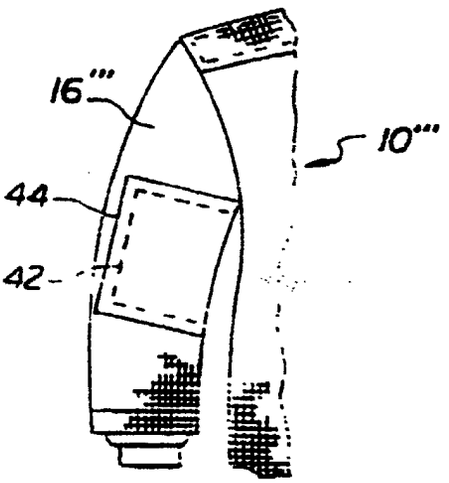

FIG. 5

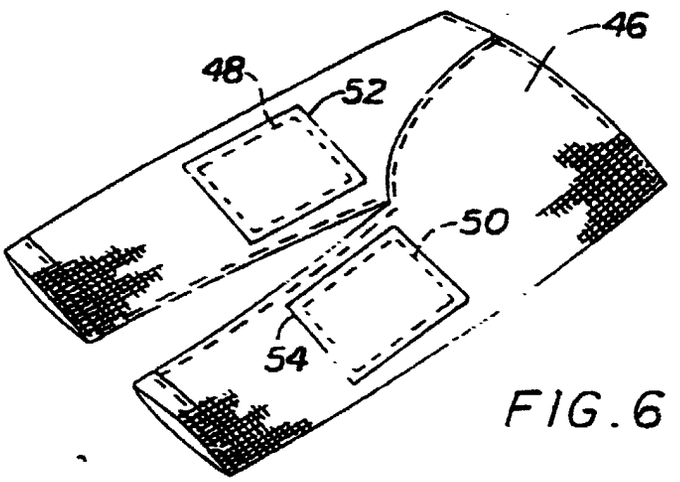

FIG. 6

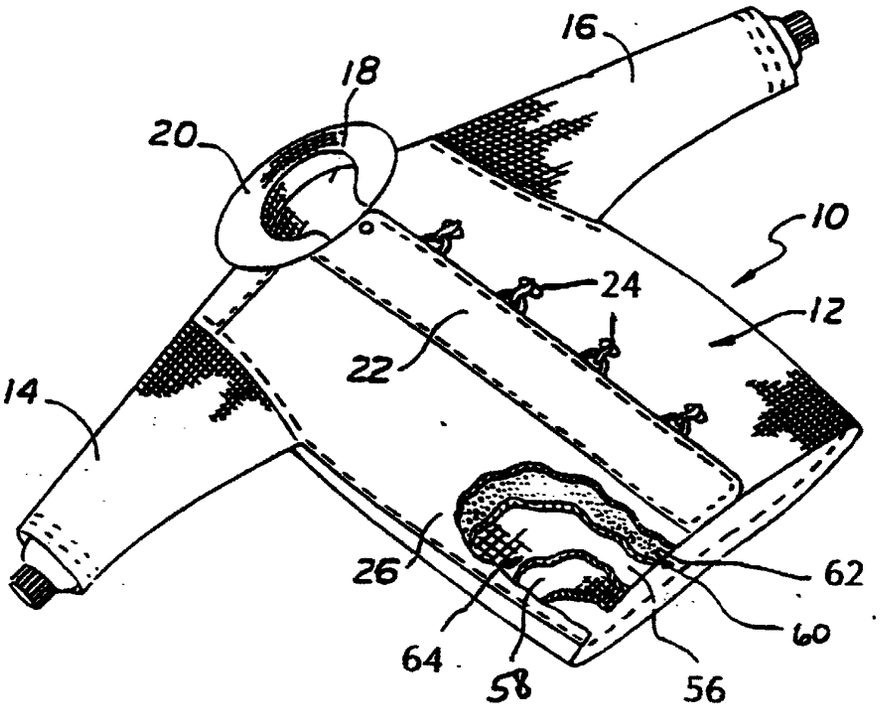

FIG. 7

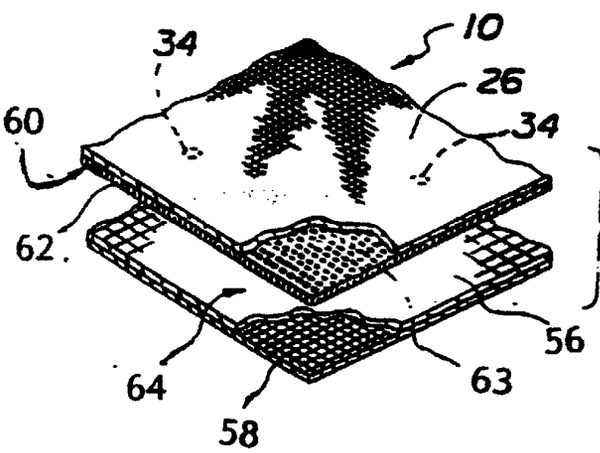

FIG. 8

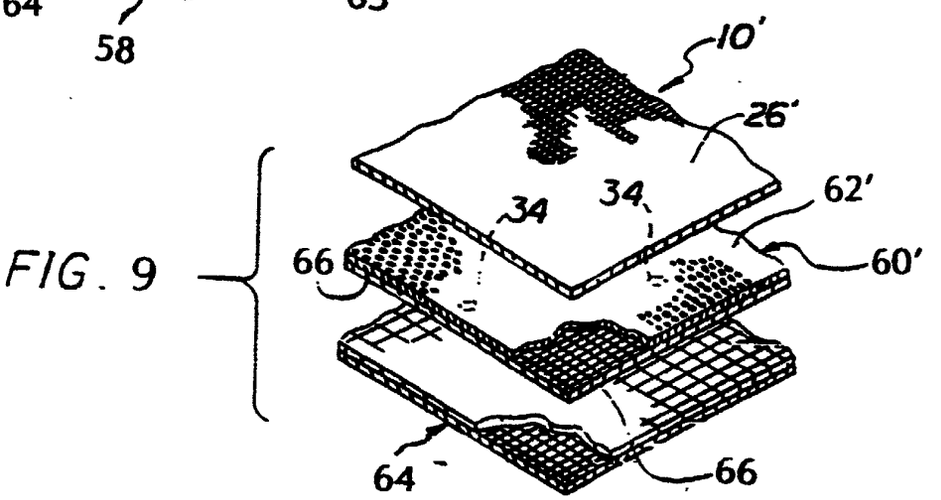

FIG. 9

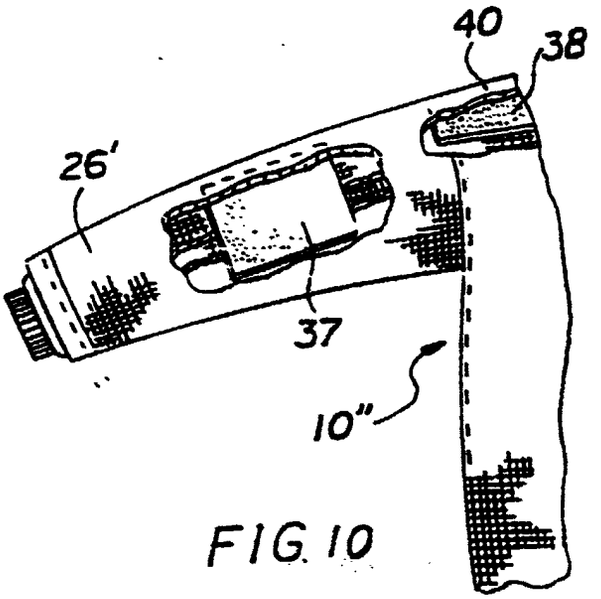

FIG. 10

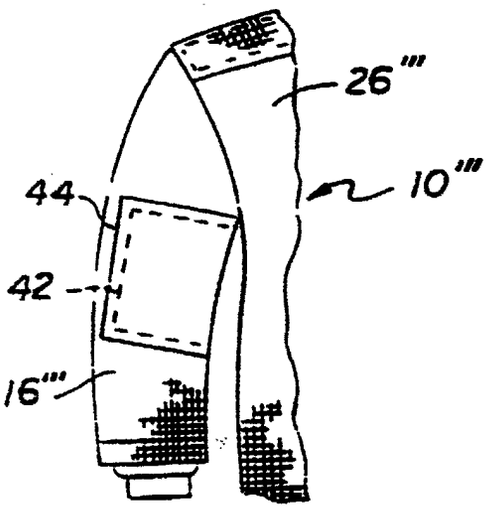

FIG. 11

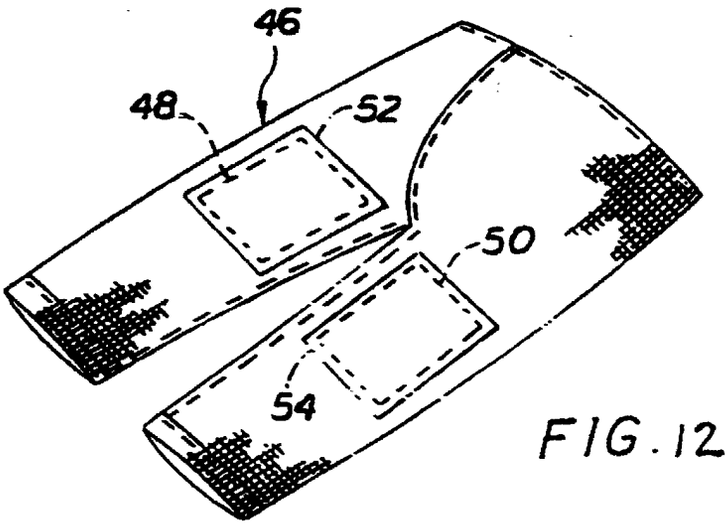

FIG. 12