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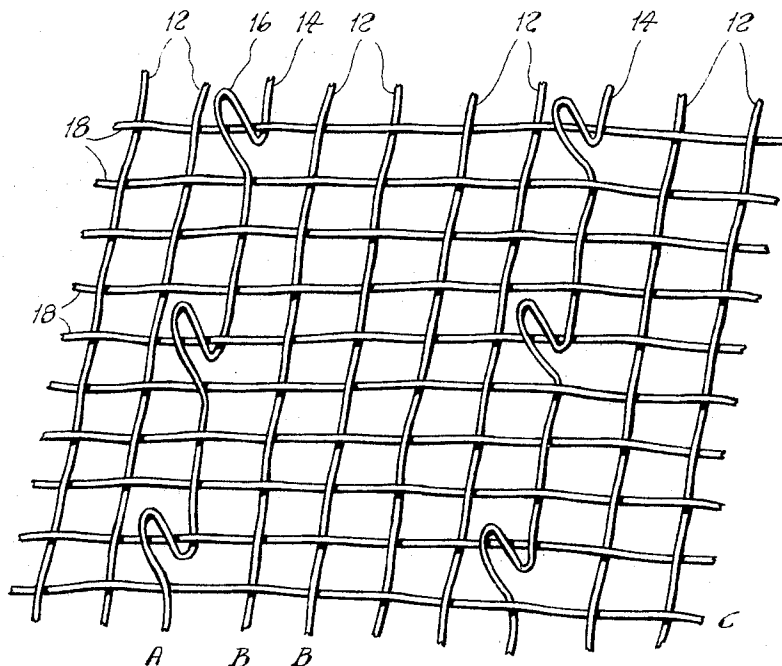
J. J. PRESS ET AL

3,441,063

PROTECTIVE FABRIC

Filed July 12, 1967

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A-MONOFILAMENT LOOP PILE YARNS
B-MULTIFILAMENT GROUND WARP YARNS
C-MULTIFILAMENT FILLING YARNS

Fig. 1

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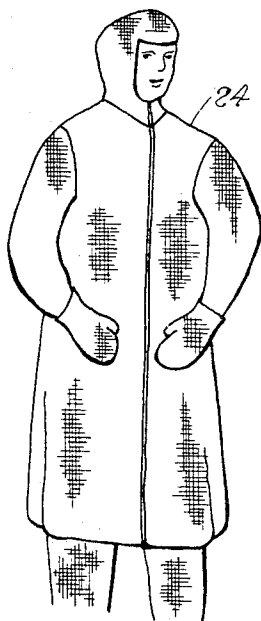


Fig. 2

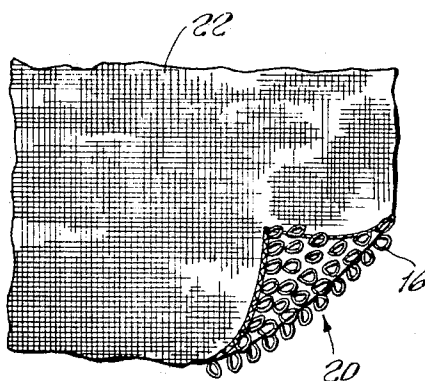


Fig. 3

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5 Claims

ABSTRACT OF THE DISCLOSURE

An air-permeable protective garment for shielding the wearer against intercepted droplets of hazardous chemical agents and for affording shielding to the wearer against high intensity thermal energy pulse. The garment does not subject the wearer to excessive heat stress when it is worn under high ambient temperature conditions. The garment is formed from a tightly-woven fabric of nylon and rayon including monofilament loop pile back; the warp yarns are nylon-rayon long staple blend in approximately equal parts by weight, and the pick yarns are either nylon-rayon long staple blend in approximately equal parts by weight or tightly twisted continuous filament rayon plied with tightly twisted continuous filament nylon.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

Background of the invention

At present, the military services use conventional cotton twill fabrics which are impregnated with detoxifying agents for protection against hazardous chemical agents. However, these fabrics will not prevent the penetration of surface deposited droplets particularly when local pressure is applied such as in the act of sitting or leaning. Impermeable rubberized suits for this purpose have not been satisfactory.

Summary of the invention

This invention relates to a double-textured fabric for protective garments including as the warp 30/1 cotton count single-ply long staple blend of approximately equal parts by weight nylon and high wet tenacity rayon. Following every four way yarns there is a 40 denier monofilament nylon pile yarn. The pick yarns forming a tight facing with the warp yarns are either 20/1 cotton count single-ply long staple blend of approximately equal parts by weight nylon and high tenacity rayon or an 150 denier, 40 filament, 2.5 turns per inch dull rayon plied with 100 denier, 34 filament, and 0.5 turns per inch nylon. At every fourth pick yarn, a loop is formed in every monofilament yarn. The nylon-rayon tightly-woven fabric face is a wicking medium that distributes any intercepted droplet by capillary action over a relatively large surface area minimizing the quantity available at any given point on the surface for transfer to a substrate, i.e., clothing worn beneath. The loop pile backing does not have wicking character and thus does not transmit liquid from face to substrate. Also the loop pile backing functions as a spacer which enhances the thermal protection afforded by the nylon-rayon blend face and with the air permeability of the fabric limits the heat stress on the wearer in high ambient temperature conditions.

An object of this invention is to provide a garment for use by those that handle containers of hazardous chemical agents.

A further object is to provide an air-permeable protec-

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tive garment effective for shielding the wearer against intercepted droplets of hazardous chemical agents.

A further object is to provide a garment as above and which affords shielding to the wearer against high intensity thermal energy pulses without subjecting the wearer to excessive heat stress.

Other objects and advantages will appear from the following description of an example of the invention, and the novel features will be particularly pointed out in the appended claims.

In the accompanying drawings:

FIG. 1 illustrates as an open weave, for explanatory purposes only, the fabric construction in accordance with the teachings of this invention;

FIG. 2 shows a protective garment embodying the invention; and

FIG. 3 shows the fabric's smooth face and loop pile back.

Description of the preferred embodiments

In FIG. 1, there is shown a weave pattern comprising in succession four warp yarns 12, one pile yarn 14, four warp yarns, one pile yarn, etc. The pile yarns are monofilaments and are each formed with a comparatively large loop 16 at every fourth pick yarn 18 on one surface only of the fabric. The loop pile was obtained by the warp wire method of weaving. This conventional type of weaving is used to produce frieze fabrics and loop pile upholstery materials. The loop is formed by the use of waste picks of a thickness selected according to the desired loop size and which picks are subsequently removed from the fabric. This method produces a positive uniform pile height on the fabric back 20 and permits the fabric face 22 to be tightly woven as shown in FIG. 3. The monofilament loops are securely anchored by this method; results were unsatisfactory with the terry method of weaving. A special reed with 65 percent air space was necessary to the success of the warp wire method to compensate for the space occupied by the warp wires in the dents of the reed and to allow sufficient room for the yarns to cross each other in the reed.

The pile yarn 14 is monofilament nylon on the order of 40 denier and the warp yarn 12 is 30/1 cotton count single-ply yarn which is a blend of approximately equal parts by weight nylon and high wet tenacity rayon long staple fibers. In one preferred embodiment, the face filling or pick yarn 18 is 20/1 cotton count single-ply yarn which is a blend of approximately equal parts by weight nylon and high wet tenacity rayon long staple fibers. In another preferred embodiment, the face filling or pick yarn is continuous multifilament viscose plied with continuous multifilament nylon where the rayon is approximately 150 denier and the nylon is approximately 100 denier; the rayon includes on the order of 40 filaments with approximately 2.5 turn twist per inch and the nylon includes on the order of 34 filaments with approximately 0.5 turn twist per inch. The fabric includes 136 warp yarns 12 and 34 pile yarns 14 per inch in one direction and approximate 46 face filling or pick yarns 18 in the other direction. The number of loops per square inch are on the order of 391 and the thickness of the fabric under 0.1 pound per square inch pressure is on the order of 0.053 and under 1.1 pounds per square inch pressure is on the order of 0.043 pound per square inch. The embodiment with the staple yarn picks weighs approximately 5.6 ounces per square yard and the embodiment with the continuous multifilament yarn picks weighs approximately 5.8 ounces per square yard. The fabric is impregnated with detoxifying agents in the form of chloramides suspended in chlorinated paraffin binders, e.g., standard XXCC3.

Liquid penetration tests on these materials were carried

out with a dye containing liquid of proper viscosity and wetting characteristics to simulate the surface tension and viscosity of chemical agents of concern. A .20 milligram drop of the simulant was placed on the fabric and immediately subjected to a dead weight pressure of 1 pound per square inch. There was no penetration through either embodiment to a blotter substrate. In a second test fabric samples were prestressed by dead weight over a cylindrical mandrel to provide a pressure of 1 pound per square inch. A 20 milligram drop of the simulant was placed on the sample. There was no penetration through either embodiment to a blotter substrate. Both embodiments were tested for resistance to thermal radiation. In each test a sample was subjected to a 5 second simulated weapons pulse equivalent to a 500 kiloton bomb. Samples of the embodiment with the staple yarn picks suffered no damage when exposed to 13.6 calories per square centimeter, slight melt when exposed to 15.3 calories per square centimeter and hard melt when subjected to 17.8 calories per square centimeter. Samples of the embodiment with the continuous multifilament picks suffered no damage when exposed to 13.6 and 15.3 calories per square centimeter and hard melt when exposed to 17.8 calories per square centimeter.

Similar results obtained with a fabric employing the same warp yarns and pile yarns but with a somewhat different staple blend for the picks as follows: 30/1 50/50 nylon-high wet tenacity rayon plied with 100/34 nylon wherein the fabric includes 136 warp yarns per inch, 34 pile yarns per inch, 43 pick yarns per inch, 366 loops per inch, with a weight of 6 ounces per square yard. Under the same conditions, there was no penetration through this fabric, and the thermal resistance of the fabric was relatively good.

Good results also were obtained with a fabric employing the same warp yarns and pile yarns but with all rayon (Cordura Viscose) picks 300/125/2.5S, wherein the fabric includes 128 warp yarns per inch, 32 pile yarns per inch, 43 pick yarns per inch, 344 loops per square inch, with a weight of 5.8 ounces per square yard. Under the same conditions there was no penetration though this fabric and its thermal resistance was better than the embodiments previously described but penetration resistance to droplets intercepted at substantial relative velocity was poor.

The garment 24 shown in FIG. 2 made from the fabric described for use by personnel handling quantities of hazardous chemical agents and for use as a garment for shielding against air-borne droplets effectively resists penetration by chemical warfare agents and in addition is capable of affording a measure of protection to thermal pulses. Droplets of a chemical warfare agent deposited on the fabric spreads out over a large area along the parallel yarns of the tightly woven face by capillary action. The back pile is not absorbent and resists liquid transfer through the fabric and by serving as a spacer enhances thermal protection and taken with the air permeability of the fabric contributes to minimizing heat

stress on the wearer under high ambient temperature conditions.

It will be understood that various changes in the details, materials, and arrangements of parts (and steps), which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

We claim:

1. A tightly-woven, air-permeable, double-textured fabric for a garment for shielding the wearer against droplets of hazardous chemical agents and for shielding the wearer against a high intensity thermal energy pulse, without subjecting the wearer to excessive heat stress under high ambient temperature conditions, comprising:

a facing of tightly-woven warp and pick long staple yarns and single-ply nylon monofilament pile yarns, wherein a nylon monofilament pile yarn alternates with four warp yarns, the warp yarns and pick yarns being a blend of equal parts by weight of nylon and rayon,

said nylon monofilament pile yarns forming a loop at every fourth pick yarn, all loops extending from one surface only of said facing.

2. A fabric as defined in claim 1, wherein said nylon monofilament yarn is 40 denier.

3. A fabric as defined in claim 2, wherein there are 300-400 loops per square inch.

4. A fabric as defined in claim 1, wherein:

said facing includes approximately 136 warp yarns per inch and 46 pick yarns per inch,

said warp yarn being 30/1 cotton count yarn, single ply, equal parts by weight nylon and high wet tenacity rayon, and

said pile yarn being 40 denier monofilament nylon.

5. A fabric as defined in claim 4, wherein the pick yarns are 20/1 cotton count yarn, single ply, approximately equal parts by weight nylon-high wet tenacity rayon long stable fiber blend.

References Cited

UNITED STATES PATENTS

2,238,098	4/1941	Bradshaw	139-391
2,362,299	11/1944	Nutter	139-402 X
2,642,571	6/1953	Brown	139-391 X
2,713,167	7/1955	Cowie et al.	2-2

FOREIGN PATENTS

821,447	10/1959	Great Britain.
893,766	4/1962	Great Britain.
1,030,147	5/1966	Great Britain.

OTHER REFERENCES

German printed application 1,161,482 (1964).

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U.S. Cl. X.R.