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FLAME RESISTANT AND WATER REPELLENT FABRICS AND METHOD OF MAKING THE SAME

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This invention relates to a method of treating fabrics that are constructed predominantly but not entirely of asbestos fibers to make the fabrics flame resistant and water repellent, and also to the resulting fabrics.

There is a substantial demand for a relatively thin, light weight and flexible fabric that is flame resistant. A flame resistant fabric may be produced by forming it entirely of asbestos fibers, but such a fabric will be relatively thick and heavy unless constructed of the rare and expensive long staple asbestos fibers. It has therefore been customary heretofore to make relatively thin lightweight fabrics by using asbestos fibers the average staple length of which does not exceed about ¾ of an inch and by mixing with such asbestos fibers approximately 25% of cotton fibers. This greatly improves the strength, flexibility and wearing properties of the resulting fabric, and permits the construction of a fabric that is lighter in weight than one made entirely of asbestos fibers.

It is found, however, that an asbestos fabric containing anywhere near 25% of inflammable fibers, such as cotton, will burn actively when ignited due to the presence of such inflammable fibers.

The present invention contemplates an asbestos fabric containing an appreciable quantity of inflammable fibers but which is flame resistant and water repellent. It also contemplates a method of treating an asbestos fabric that contains strengthening combustible fibers so as to make the fabric flame resistant and water repellent without rendering it impervious to the air, and capable of being repeatedly dry cleaned with the usual fabric cleansing solvents without serious loss of either its water repellent or its flame-resistant properties.

It has been proposed heretofore to treat fabrics with flame resistant material such for example as sodium silicate or inorganic oxides, but the sodium silicate tends to render the fabric objectionably stiff, and the oxides do not cling well to the fabric but become dislodged if the fabric is subjected to mechanical action or abrasion or to water. It has also been proposed heretofore to treat fabrics with a chlorinated compound applied from organic solvents to render them flame resistant and water repellent, but such fabrics cannot be dry cleansed as these materials are removed by the solvents used in dry cleaning.

The present invention resides in a novel method of treating fabrics which are constructed predominantly of asbestos fibers but contain sufficient inflammable reinforcing fibers to cause them to be flame supporting whereby such fabrics will be flame resistant and water repellent, but not appreciably stiffer, and may be repeatedly dry cleansed with the usual fabric cleansing solvents without injury. Such a fabric when treated as herein contemplated is well adapted for use in fire fighting suits, airplane engine covers, parachutes for flares and for other purposes where it may be exposed to a flame or high temperatures and to water, and if it becomes dirty or greasy it may be dry cleansed.

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The method of the present invention comprises precipitating on the fibers of an asbestos fabric containing a minor amount of inflammable fiber, a flame resistant water-insoluble inorganic oxide, depositing on the fibers a water-repellent metal soap, and heating the treated fabric to a temperature above the melting point of the deposited soap to fuse the same. After cooling, the treated fabric is found to be both water-repellent and flame-resistant, and to retain its flame resistance after washing. By means of the treatment described the deposited oxide is permanently fixed to the fabric, and the fused soap deposit performs the dual function of acting as a binding agent for the oxide particles, and of rendering the fabric water-repellent but not impervious to the air.

The invention herein contemplated in its preferred form consists in treating a fabric such as above described with a solution of a metal salt such as sodium stannate, sodium borate or the like, followed by a water solution of ammonium sulfate or aluminum sulfate, which causes a precipitation of one or more insoluble metal compounds on the fibers, and in forming on the fibers a water-repellent coating of a material such as the zinc soaps of cocoanut oil acids, known as "Laurex," and thereafter drying the fabric and heating it at a temperature above the fusion point of the deposited soap material. The soap may be applied from a solution or suspension thereof in ammonium hydroxide or from an aqueous suspension of the finely divided zinc soap, or from an aqueous solution or dispersion of the "Laurex" combined with an amine such as diethanol amine or morpholine. The soap suspension may also contain, in addition, aluminum acetate.

The treatments with these chemicals may be carried out in separate and distinct steps, or the precipitation of the metal oxide and the depositing of the water-proofing soap may be effected in a single step. That is, the second or precipitating bath may contain both the ammonium

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sulfate and the zinc soaps of cocoanut oil acids. If desired, aluminum soap may be used in place of zinc soap.

Since "Laurex" fuses at about 100° C., the final heating of the fabric to effect fusion of the deposited soaps should be carried out at a temperature of at least about 105° C. In practice temperatures in the range from 105° C. to 133° C. (about 220° F. to 270° F.) are satisfactory.

In order that the method may be more fully understood the following examples are given:

Example 1.—The above described fabric is passed through a 15% water-solution of sodium stannate then through squeeze rollers and into a bath containing 10% ammonium sulfate. It is then squeezed and dried over heating cans at 245° F. The second immersion precipitates stannic oxide in and on the fibers. The fabric is then washed with water, to remove the sodium sulfate which was formed during the reaction. The fabric is finally impregnated with a 4% solution or suspension of zinc soaps of cocoanut oil acids in ammonium hydroxide and water, then squeezed and dried at about 250–260° F.

Example 2.—Another method of treatment, and one which reduces cost and labor, consists of impregnating the fabric in a 15% solution of sodium stannate squeezing, then treating in a solution containing 15% of ammonium sulfate, 12% of zinc soaps of cocoanut oil acids, 12% of ammonium hydroxide (28%), and 61% of water. It is then squeezed and dried at 250–260° F. The second bath forms simultaneously on the fibers the deposit of stannic oxide and the deposit of zinc soaps.

Example 3.—Still another method comprises the impregnation of the fabric with 15% sodium borate solution, squeezing, then immersing in a solution comprising 15% ammonium sulfate, 12% of zinc soaps of cocoanut oil acids, 12% of ammonium hydroxide (28%), and 61% of water. The fabric is finally squeezed and dried at 250–260° F.

Example 4.—The fabric can also be treated by sodium stannate, ammonium sulfate baths and rendered water-repellent by impregnation with a solution of zinc soap of cocoanut oil acids combined with aluminum acetate or formate, followed by heating at 250–260° F.

Example 5.—Flame-proof properties can also be given to the fabric by treating with sodium stannate and using aluminum sulfate in place of ammonium sulfate to precipitate stannic oxide and alumina, then following with a treatment with the zinc soaps of cocoanut oil acids, and finally heating at 250–260° F.

The treatment described in each of these examples will make the fabric permanently flame resistant, and water-repellent rather than waterproof, since the oxide particles and metallic soap will be deposited on the fibers and yarns of the fabric without forming a continuous film upon either face of the fabric. This treated fabric can be repeatedly dry cleansed without seriously impairing its flame resistant or water-repellent properties. Furthermore such treatment does not change appreciably the softness or appearance of the fabric. The heating or drying temperature of 250–260° F. in each of the above examples serves to dry the fabric and also to fuse or melt the soap.

The total gain in weight of the fabric as a result of the entire treatment will generally be from about 10% to about 15%. For example, the treatment according to Examples 1 or 2 may give deposits consisting of about 3% of stannic oxide and about 12% of the zinc soaps or about 5% stannic oxide and about 5% of zinc soaps, according to the concentrations of the baths. A deposit of flame-proofing inorganic oxide equal to from 3% to 5% of the weight of the asbestos fabric is found to be sufficient for all practical purposes, and likewise a deposit of from 3% to 10% of insoluble metal soap is sufficient to render the fabric satisfactorily water-repellent and to prevent dislodging of the oxide deposit. After this small amount of metal soap is fused to the fibers it will not generate obnoxious fumes or gases even when exposed to relatively high temperatures.

The treatment of the present invention bonds the metallic oxide very firmly in place, and while it is not entirely clear why this treatment works so well upon asbestos fabric, it appears that both the oxide deposit and metallic soap adhere particularly well to asbestos fibers. This is most surprising in view of the fact that an all-cotton fabric will not retain the oxide deposit when subjected to the zinc soap treatment, so that the flame-resistance is largely lost as a result of carrying out the subsequent treatment.

It will be seen from the foregoing that I have provided a good, practical method of both flame-proofing and water-proofing an asbestos fabric that is reinforced with inflammable fibers, and that fabrics treated as herein contemplated may be repeatedly dry cleansed without impairing their water repellent or flame-resistant properties.

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

1. The method of treating a fabric that is formed predominately of asbestos fibers but contains some inflammable fibers, without changing appreciably its appearance, softness, or weight; which consists in precipitating on the fibers a flame-resistant water-insoluble inorganic oxide, depositing on the fibers over the oxide a compatible water-repellent zinc soap of cocoanut oil acids, and heating the fabric sufficiently to melt or fuse the deposited soap so as to fix this soap and the oxide upon the fibers and render the fabric non-flame supporting and water-repellent in such a way that the treated fabric is pervious to the air and the soap thereupon will not generate obnoxious fumes when exposed to relatively high temperatures.

2. The method of treating a fabric that is formed predominately of asbestos fibers but contains some inflammable fibers, without changing appreciably its appearance, softness, or weight; which consists in passing the fabric successively through a water solution of sodium stannate and through a water solution of ammonium sulfate to precipitate stannic oxide on the fibers, washing to remove the produced sodium sulfate, depositing on the fibers over the oxide a compatible water-repellent metal soap in aqueous ammonium hydroxide, and heating the fabric sufficiently to melt or fuse the deposited soap so as to fix this soap and the oxide upon the fibers in such a way that they will not generate obnoxious fumes when exposed to relatively high temperatures and serve to render the fabric non-flame supporting and repellent to water and also capable of being repeatedly dry cleaned without reducing appreciably its water repellent properties.

3. The method of treating a fabric that is formed predominately of asbestos fibers but contains some inflammable fibers, without changing

appreciably its appearance, softness, or weight; which consists in precipitating on the fibers a flame-resistant water-insoluble inorganic oxide, washing, depositing on the fibers over the oxide a solution containing zinc soap of cocoanut oil acids that is compatible with the oxide, and heating the fabric sufficiently to melt or fuse the deposited soap so as to fix the soap and the oxide upon the fibers in such a way that they will not generate obnoxious fumes when exposed to relatively high temperatures and serve to render the fabric non-flame supporting and repellent to water and also capable of being repeatedly dry cleaned without reducing appreciably its water repellent properties.

4. An asbestos fabric containing an appreciable quantity of inflammable fibers, and which is rendered flame resistant and water repellent but not impervious to the air and not appreciably heavier or stiffer by a flame-resistant, inorganic oxide deposited upon the fibers of the fabric and held in place by a compatible deposit of zinc soap of cocoanut oil acids fused to the fibers in such a way that the treated fabric will not generate obnoxious fumes under relatively high temperatures.

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