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## ARTICLE OF MANUFACTURE

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This invention relates to compositions of matter, and more particularly to yarns and plastic compositions having a basis of an organic derivative of cellulose and of improved fire-resistant properties.

An object of my invention is the production of yarns having a basis of an organic derivative of cellulose which are of increased fire-resistant properties and are substantially fire-proof.

Another object of my invention is the production of said improved yarns in an economical manner.

Still another object of my invention is the production of plastic compositions of improved fire-resistant properties and of appreciably low softening or melting point.

Other objects of my invention will appear from the following detailed description.

Many attempts have been made to treat ordinarily inflammable textile materials in such a manner as to reduce their tendency to burn freely when ignited or to inhibit their ignition altogether. Thus, fabrics made of various textile materials have been treated with aqueous solutions of inorganic agents such as ammonium chloride, ammonium phosphate, borax, boracic acid, ammonium sulphate and mixtures of these agents. While these agents impart a satisfactory degree of fire-resistance to the textile materials so treated, the hand of such treated materials is rather stiff and boardy and consequently the use of such fabrics has not been very great. In addition, the presence of these inorganic agents on the fabrics makes them highly sensitive to degradation by the action of light and on continued exposure these fabrics lose their strength to a substantial degree.

I have now discovered that fire-resistant yarns and plastic compositions may be obtained when such materials are prepared from solutions or other compositions of an organic derivative of cellulose which have been modified in such a manner as to have incorporated therein various amounts of tri-chlorethyl-phosphate. Not only are such yarns and plastic compositions fire-resistant, but the yarns are also soft and the hand and the draping qualities of fabrics woven from such yarns are satisfactory.

While my discovery is particularly applicable for imparting fire-resistant qualities to yarns and plastic compositions of cellulose acetate, yarns and plastic compositions having a basis of other organic derivatives of cellulose may likewise be treated and rendered highly resistant to fire. Examples of other organic derivatives of cellulose which may be treated in like manner are cellulose esters such as cellulose propionate, cellulose butyrate, mixed esters such as cellulose acetate-propionate and cellulose acetate-butyrate, and cellulose ethers such as ethyl cellulose and benzyl cellulose.

Preferably, I incorporate the tri-chlorethyl phosphate into the spinning solution from which the yarns are spun or into the press mass powder or plastic mass from which the plastic compositions may be prepared. In this way a more uniform distribution of tri-chlorethyl phosphate is obtained. This in turn results in yarns and plastic compositions which are uniformly fire-resistant. Thus, I have found that when from 5 to 50% of tri-chlorethyl-phosphate is incorporated into the spinning solution from which the yarns are spun or into the plastic compositions, said quantity being based on the weight of the organic derivative of cellulose material comprising the yarn or plastic composition, a product which is satisfactorily fire-resistant is obtained. I prefer, however, to incorporate the tri-chlorethyl-phosphate in such amounts that the finished yarns or plastic compositions contain about 5 to 15% of this compound. By preparing the yarns and plastic compositions in this way, highly beneficial results are obtained. As a result, the fire-resistant qualities imparted to the yarns, as well as the fabrics woven from said yarns, are outstanding.

The yarns may, however, be treated with the tri-chlorethyl-phosphate as they leave the spinning cabinet after the spinning operation. Thus, the yarn may be passed through a suitable bath containing the tri-chlorethyl-phosphate and a diluent or, alternatively, the tri-chlorethyl-phosphate may be applied to the running yarn by suitable furnishing devices, such as, for example, wicks or rollers. The yarn may also be treated as it is moving from bobbin to bobbin, as during a winding operation. If desired, the yarn may be treated in the form of hanks, the hanks being dipped into a bath containing the tri-chlorethyl-phosphate.

In another form of my invention, the tri-chlorethyl-phosphate may be applied to woven, knitted or netted fabric by dipping, spraying or the like. Thus, for example, the tri-chlorethyl-phosphate, in solution, may be applied to the fabric by employing a padding mangle by means of which the amount of the solution applied to the fabrics may be controlled by expressing the excess by means of rollers, the nip of which may be adjusted.

Continuous filament yarns which have been treated in accordance with my invention as to have incorporated therein various amounts of tri-chlorethyl-phosphate may be formed into staple fibers in any well known manner and these fibers may be spun into yarns on the woolen, cotton or worsted system of forming yarns from staple fibers. The staple fibers may likewise be mixed with cotton, silk, wool or regenerated cellulose staple fibers and mixed yarns of decreased flammability formed. Straw, bristles or plastic masses having a basis of an organic derivative of cellulose may also have their fire-resistant properties enhanced by incorporating tri-chlorethyl phosphate in such materials.

Fabrics which are woven in whole or in part of yarns which have been made highly resistant to fire are particularly useful as decorative materials in theaters where the use of fire-resistant fabrics is of utmost importance. Not only may they be used as decorative materials in the theater proper, for example, as draperies, but they may likewise be employed for costume and scenery purposes. The fire-proof character of the yarns also makes them particularly useful for electrical insulation purposes such as the formation of insulating covering for wires.

The incorporation of tri-chlorethyl-phosphate into materials having a basis of an organic derivative of cellulose yields products whose melting or softening point is appreciably lower than that of like materials in which the tri-chlorethyl-phosphate is absent. The extent to which the melting point is lowered depends to a substantial degree on the amount of the tri-chlorethyl-phosphate incorporated therein. Therefore, the amounts which may be used will, of course, be largely dependent upon the properties desired in the finished product. For ordinary yarns and plastic compositions, I preferably employ from 5 to 15% by weight, as indicated, but where a more plastic or coalescible yarn or plastic composition is desired amounts up to 50% by weight are used. This advantageous property, that is, lowered melting point, enables said treated materials to be employed for purposes for which they ordinarily would be wholly unsuitable. Thus, for example, in the preparation of cord fabric for pneumatic rubber tires, my treated yarn, say a yarn of treated cellulose acetate, may be employed to form a light weft in a cord fabric to control the heavy cord which forms the warp. When such fabric is incorporated into a rubber tire and the tire subjected to the vulcanization process, the heat present destroys the filamentary character of the cellulose acetate yarn, causing it to coalesce, and the cords are thus free to adjust themselves to any strain placed upon them during service. In addition, when formed into plastic masses, the treated organic derivatives of cellulose are temperature sensitive and thus, for example, may be used to form low-melting but non-inflammable caps for capping the nozzles of automatic sprinkler systems.

In order further to illustrate my invention, but without being limited thereto, the following examples are given:

*Example I*

2.5 parts by weight of tri-chlorethyl-phosphate are incorporated into 100 parts by weight of a 25% solution of cellulose acetate in acetone and the solution thereafter is spun into yarn by dry-spinning methods. These yarns are then woven into a fabric and when this fabric is tested by exposing it to the action of an open flame it is found to be highly resistant to burning.

*Example II*

6.5 parts by weight of tri-chlorethyl-phosphate are incorporated into 100 parts by weight of a 26% solution of cellulose acetate in acetone and the solution thereafter spun by dry-spinning methods into a yarn of 175 denier, and having 26 filaments therein. When this yarn is tested under a load of 0.1 gram per denier by stretching the yarn in a hot air oven the yarn softens and breaks at 132° C. This yarn is excellent as a light weft in cord tire fabrics and disintegrates during the vulcanization process.

It is to be understood that the foregoing detailed description is merely given by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention what I desire to secure by Letters Patent is:

1. Textile materials of improved hand and fire resistant properties, said materials having a basis of an organic derivatives of cellulose selected from the group consisting of cellulose esters and cellulose ethers and containing from 5 to 50% tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

2. Textile materials of improved hand and fire-resistant properties, said materials having a basis of an organic ester of cellulose and containing from 5 to 50% tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

3. Yarns of improved hand and fire-resistant properties, said yarns having a basis of an organic derivative of cellulose selected from the group consisting of cellulose esters and cellulose ethers and containing from 5 to 50% tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

4. Yarns of improved hand and fire-resistant properties, said yarns having a basis of cellulose acetate and containing from 5 to 50% tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

5. Fabrics containing yarns of improved hand and fire-resistant properties, said yarns having a basis of cellulose acetate and containing from 5 to 50% tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

6. Textile materials of improved hand and fire-resistant properties, said materials having a basis of cellulose acetate and containing from 5 to 15% of tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

7. Yarns of improved hand and fire-resistant properties, said yarns having a basis of cellulose acetate and containing from 5 to 15% of tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

8. Yarns of improved hand and fire-resistant properties, said yarns having a basis of cellulose acetate and containing 10% of tri-chlorethyl-phosphate as the sole plasticizing and fire-retarding agent.

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