Patented Aug. 15, 1939 2,169,757

UNITED STATES PATENT OFFICE

2,169,757

TEXTILE YARN

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No Drawing. Application March 20, 1937, Serial No. 132,119

2 Claims. (Cl. 28—1)

This invention relates to the sizing or similar treatment of yarns, fabrics or other textile materials and more particularly to a process of and composition for applying a protective coating to filaments, threads or yarns composed of or containing organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like.

As is well-known, it is necessary in the production of light weight fabrics and similar textile materials to apply a protective coating to the warp threads and in some cases a similar coating to the filling threads. In textile machinery, for example, a plain loom of the simplest construction, the warp filaments are contacted by a minimum of 10 metallic guides or reeds which travel in some cases at slow speed and others at high speed. Included among these guides are lease rods, electric warp stop motions, heddles and the reed. In the manufacture of any plain fabric such as taffeta having a construction of 200 warp threads per inch and 50 filling threads, the average shuttle will have a width of approximately one and one-half inches, and in creating a linear inch of fabric the shuttle has to travel the width of the fabric 50 times. This means that the shuttle contacts the warp threads at velocities of 30–40 feet per second at least twenty-five times before the finished fabric is produced and the warp yarn is subjected to no further abrasive action. Taking this as a typical example of the abrasive influences to which yarns are subjected in fabric manufacture, it will be readily understood that every warp thread should be surrounded with a protective coating which should be sufficiently flexible to permit bending around sharp angles. Such a protective coating should not be brittle or chip off during the fabric forming operation.

It has heretofore been the practice to apply various types of sizes to yarn for the purpose of reducing abrasion, such sizes consisting essentially of a material such as gelatin or a partially or completely water-soluble resinous material, dissolved or dispersed in water to which various other ingredients such as sulfonated oils or glycerine may be added. Such materials have several drawbacks in use, one of which is the fact that if the sizing material is not completely removed from the fabric in scouring and the fabric thereafter dyed, non-uniform dyeing is likely to result. This is particularly true with fabrics composed of or containing organic derivatives of cellulose such as cellulose acetate. When a thread containing traces of gelatin or other size which has not been completely removed in the scouring operation is dyed with a cellulose acetate dye, uneven dyeing or streaking of the fabric is likely to occur, due to the difference in ability of the gelatin to absorb the dye. In addition, it is often difficult to control the flexibility of the sized fabric, some materials after sizing being too stiff for ready handling. When attempts are made to employ softening agents in connection with such sizing compositions, a decrease in tensile strength is likely to take place which deleteriously affects the fabric.

This invention has as its principal object to overcome the above-mentioned deficiencies of known yarn sizing compositions and to provide a composition which may be applied as a protective coating to yarns, especially those composed of organic derivatives of cellulose such as cellulose acetate, cellulose propionate, cellulose acetate propionate, cellulose acetate butyrate and the like which will make possible uniform dyeing by means of dyes primarily adapted for the treatment of the particular material of which the yarn or fabric is composed. A further object is to provide a composition which, when applied to cellulose acetate and other yarns leaves thereon a hard, horny protective coating which is water-soluble and therefore removable by ordinary scour baths and is also susceptible of being dyed with the same dyes which are applied to the yarn material itself. A still further object is to provide a process for the treatment of yarns composed of or containing organic derivatives of cellulose to render them resistent to the abrasive influences met with in weaving and other textile operations. Another object is to provide a means of controlling the flexibility, stiffness, extensibility and tensile strength of yarn to which the sizing material is applied. Other objects will appear hereinafter.

These objects are accomplished by the following invention which comprises the provision of a sizing composition composed of an aqueous solution or dispersion of a water-soluble cellulose organic acid ester prepared from undegraded cellulose and containing a plasticizing or softening agent, and if desired, another agent adapted to give the film deposited from such composition the desired degree of stiffness and other properties. Such a composition may be composed, for example, of an aqueous solution of a water-soluble form of cellulose acetate and containing as a hygroscopic plasticizing agent a compound such as ethylene glycol, diethylene glycol, glycerine, triethanolamine and similar compounds and also containing a self-emulsifying oil as a stiffening agent. Typical examples of such oils are the sulfonated animal, vegetable or mineral oils or combinations of sulfonated oils with unsulfonated oils. The oil must be of a type which will emulsify spontaneously when poured into water.

The particular ingredients selected for compounding sizing compositions in accordance with my invention may vary rather widely, depending upon the particular characteristics of the protective layer or film it is desired to lay down upon the filaments or threads of the yarn undergoing

treatment. If it is desired to produce an exceptionally flexible coating, a plasticizing agent having a particularly drastic plasticizing action on the water-soluble cellulose acetate material may be selected. On the other hand, when less flexibility or plasticity of the coating is desired a plasticizing or softening agent of less drastic effect on the cellulose derivative material may be employed. The amount of the plasticizer also may vary within wide limits, depending both upon the particular cellulose acetate or other cellulose derivative employed in the composition, and upon the specific nature of the plasticizer itself.

As indicated above, to increase the stiffness of the protective layer or film a self-emulsifying oil is added to the composition. The amount of such agent may vary rather widely depending upon the particular agent selected and the particular effect desired. Suffice it to say that when one uses an oil of this nature as an ingredient of the sizing composition, the film deposited from such composition is considerably stiffer than cellulose derivative films normally formed by evaporation of solutions thereof. The film produced in accordance with the instant invention possesses a hard, horny texture, which gives the film its protective or abrasion-resisting properties.

Not only does the plasticizer present in my composition serve to plasticize the cellulose derivative protective film, but it also penetrates into the body of the yarn material underneath and acts as a plasticizing or softening agent for the yarn itself. This is one of the particularly advantageous features of my invention, inasmuch as it provides a means, not only of protecting the yarn, but also for maintaining the yarn in a pliable condition in which it may be readily employed for its intended uses. By a proper combination of a plasticizing agent such as diethylene glycol and a stiffening agent such as the above-mentioned sulfonated oils, or mixtures of sulfonated and unsulfonated oils, the properties of the deposited film may be varied through wide limits of flexibility, extensibility and tensile strength, a result not hitherto attainable by use of the commonly employed sizing compositions.

The following examples constitute typical compositions adapted for the sizing of cellulose acetate yarns in accordance with my invention:

	Parts by weight
Example I:	
Cellulose acetate (16–19% acetyl)	2.5
Sulfonated olive oil	0.5
Diethylene glycol	0.5
Water	30.0
Example II:	
Cellulose acetate sodium phthalate	2.5
Glycerine	0.3
Triethanolamine	0.2
Water	30.0
Example III:	
Cellulose acetate sodium phthalate	2.5
Glycerine	0.3
Sulfonated olive oil	0.1
Mineral oil	0.1
Water	30.0

The water-soluble cellulose acetate which I prefer to employ is preferably an acetate having an acetyl content of about 13–19%. Cellulose acetate having an acetyl content of 17.6% is especially satisfactory. The preparation of these water-soluble compounds forms no part of the instant invention, but is the invention of C. R. Fordyce, and is described and claimed in his copending application, Serial No. 62,333 filed February 4, 1936. Although I prefer to use the method outlined in that application for the preparation of the water-soluble cellulose esters, I may employ other methods, several of which are at present available.

While I have found it convenient to illustrate my invention by reference to water-soluble cellulose acetate, I am not limited thereto and may employ other cellulose esters capable of solution or dispersion in water, preferably those prepared from comparatively undegraded cellulose. Included among such compounds are the water-soluble salts of dicarboxylic acid esters of cellulose, such as the sodium, potassium or ammonium salts of cellulose acetate phthalate, cellulose acetate succinate, celulose acetate diglycolate and esters of the type represented by cellulose acetate lactate. I may also employ water-soluble ethers, such as methyl cellulose or an ethyl cellulose with low ethoxy content, and similar compounds. The selection of the particular water-soluble compound for use in making up the sizing compositions will, of course, depend largely upon the type of yarn to which the material is eventually to be applied.

The sizing compositions prepared in accordance with my invention may be applied to the yarn by any of the conventional methods used for this purpose. For example, cellulose acetate or other yarn may be sized as the filaments emerge from the spinning cabinet. They may be sized before, during or after twisting, and/or winding. Application may be by means of roll, spray, immersion or equivalent means and may be carried out while the yarn is being conveyed from bobbin to bobbin or in any other convenient manner. While my sizing compositions are primarily designed for the formation of a protective coating on warp yarns prior to weaving into fabric, they may in some cases be applied to the sizing of the filling threads where the formation of a protective coating on such threads is desirable for any purpose. My compositions are also susceptible of application to woven fabric in those cases where the sizing of such fabrics is required.

While I have found it convenient to illustrate my invention by reference to the treatment of yarns composed of or containing cellulose acetate, they may be applied to the sizing of many other types of cellulose derivative yarns, such as those composed of or containing cellulose propionate, cellulose butyrate, cellulose acetate propionate, cellulose acetate butyrate, the cellulose ethers such as ethyl cellulose, methyl cellulose, benzyl cellulose, and others as well as to the silk, wool, cotton, viscose and other natural or artificial materials.

The yarn sizing compositions of my invention have many advantages over previously known materials. One of the outstanding results obtained by use of such compositions is the fact that when a cellulose acetate size is applied for example, to a cellulose acetate yarn to form a protective coating thereon, one can be assured that the dyeing properties of the yarn will not be adversely affected because of the fact that the size coating has the same affinity for the dye as does the yarn itself. This is particularly advantageous in those instances where the scour bath employed to remove the size from the woven fabric does not completely remove all traces of the size. One of the most serious disadvantages

of the use of ordinary sizes is the fact that when the scour bath incompletely removes the size, uneven dyeing or streaking of the fabric will result, due to the difference in affinity for the dyestuff of the unremoved particles of size and the material of which the yarn itself is composed. This is entirely eliminated by the use of the sizing compositions herein described.

Another outstanding advantage of my invention is that it makes possible a control of the physical characteristics of the sized yarn such as flexibility, extensibility and tensile strength. In other words, by adjusting the amount of plasticizing agent in the composition, and the amount of the stiffening agent, one may attain any desired degree of stiffness, flexibility or plasticity of the size coating and therefore of the sized yarn itself. The use of a plasticizing agent in connection with the sized composition is also extremely important, due to the fact that the plasticizing agent penetrates into the body of the yarn material itself and renders it sufficiently soft and pliable to be readily passed through the various textile operations involved in manufacture of the finished fabric. A still further advantage of the use of the plasticizing agents above referred to is the property of reducing static in the materials to which they are applied. Their presence in the size compositions herein described, therefore, is exceptionally advantageous from the standpoint of reducing static in yarns to which they are applied.

What I claim and desire to secure by Letters Patent of the United States is:

1. A highly flexible yarn which is resistant to abrasion and especially adapted for use as warp in the manufacture of light fabrics and for other textile purposes, comprising filaments each composed of a cellulose organic acid ester core and a size coating thereon composed of a water-soluble cellulose organic acid ester having the same dyeing characteristics as the material of the core and containing a plasticizer which penetrates into and is permanently occluded by the material of the core, thereby to render the yarn highly flexible and to give it anti-static properties.

2. A highly flexible yarn which is resistant to abrasion and especially adapted for use as warp in the manufacture of light fabrics and for other textile purposes, comprising filaments each composed of a cellulose acetate core and a size coating thereon composed of water-soluble cellulose acetate having the same dyeing characteristics as the material of the core and containing a plasticizer which penetrates into and is permanently occluded by the material of the core, thereby to render the yarn highly flexible and to give it anti-static properties.

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