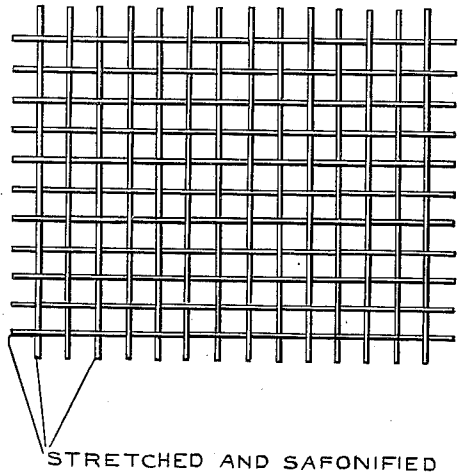
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SCREEN

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STRETCHED AND SAPONIFIED CELLULOSE ESTER THREADS.

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## SCREEN

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8 Claims. (Cl. 28—80)

This invention relates to window screens and relates more particularly to window screens woven of regenerated cellulose yarns, threads, filaments and the like of high tenacity prepared from stretched, saponified organic ester of cellulose materials.

An object of my invention is to provide a window screen which is strong, weather-resistant, inexpensive and efficient in operation.

Another object of my invention is the provision of a window screen which is designed to prevent the entrance of insects while permitting an ample degree of air circulation.

A further object of my invention is to provide a window screen of relatively translucent material whereby a substantial proportion of the external light may pass through.

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

The figure of the accompanying drawing shows diagrammatically a screen of the present invention.

Window screens designed to prevent the entrance of insects have heretofore been made of woven wire cloth fixed to a frame which is inserted in the windows of homes, automobiles and the like. The screen permits air to circulate but prevents the entrance of insects such as flies, moths, mosquitoes and the like. Wire cloth, however, suffers from disadvantages not only in that it is subject to rusting and like weathering, but it is easily bent or deformed and, as a consequence, the appearance of the screen may be easily marred. Materials from which window screens may be made and which do not suffer from the foregoing disadvantages have been long sought.

In accordance with my invention, I make window screens from open texture fabrics formed by weaving or netting high tenacity heavy denier yarns, threads, filaments and the like of regenerated cellulose. The yarns, threads, filaments and the like employed in practicing my invention are those which are obtained by the saponification of stretched yarns having a basis of cellulose acetate or other organic ester of cellulose.

The fabrics may be woven or netted in any desired pattern but the opening must, of course, be small enough to prevent the passage of insects therethrough. The open texture fabric may be fixed in any convenient manner to a frame of suitable size to fit the opening which is to be screened. It may be held in place on the frame after being stretched taut by suitable wooden or metallic strips affixed thereto by nails, tacks or staples, or the fabric may be held in place on the frame by a suitable adhesive. The fabric may, if desired, be reinforced along the edges by cloth strips or tapes of any suitable material sewn or otherwise fixed thereto and the reinforced edge attached to the frame. The fabric may also be woven in standard width with a closely woven selvedge which will serve to reinforce the fabric edge, thus obviating the necessity of employing a separate tape or cloth binding.

The fabric may be woven or netted on suitable textile devices. Multi-filament yarns or threads may be employed, as well as mono-filaments, or single filaments of heavy denier. Such yarns, threads or filaments may have a denier of 250 to 500 to 1000. When yarns or threads are employed they may contain relatively few filaments, or yarns containing 10 to 50 or more filaments may be employed. In the latter instance, the yarns or filaments are preferably given a relatively high twist of 10 to 50 or more turns per inch, since the high twist enables the yarns to retain their shape through considerable use.

The yarns may be treated before weaving or netting, or preferably, after their formation into fabrics, in order to render them water-resistant. If desired, they may be made entirely water-proof. For this purpose, the yarns may be coated with a clear lacquer so that a water-proof film is deposited thereon. The yarns or fabrics may also be treated with aluminum salts, wax emulsions or other compounds which are capable of imparting to said materials the capacity of repelling water and preventing the water from soaking into the body of the yarns and filaments forming the open-texture fabric.

The yarns, threads, filaments and the like may be prepared by extruding a solution of cellulose acetate or other organic ester of cellulose, dissolved in a suitable volatile solvent, through an orifice into an evaporative medium as in the dry method of spinning, or into a coagulating or precipitating liquid medium, as in the wet method of spinning. The orifice through which the solution is extruded may be of large diameter so that but a single filament of relatively large denier is formed. A number of filaments may also be extruded through a plurality of orifices and the filaments associated to form a multi-filament yarn or thread of relatively high denier. The filaments of the multi-filament yarn or thread may, if desired, be caused to coalesce or adhere to each other to form a single filament by treatment with a solvent, or by drawing the yarn or

thread, while in a softened condition, through a die or series of dies of the desired diameter.

After the yarn, thread or filament of relatively high denier is formed, it may then be stretched. This is usually done when the yarn is in a somewhat softened condition and the yarn may be increased in length to the extent of 200, 300, 500 or even 1000 to 2000% of its original length. The stretching causes the cellulose acetate or other cellulose ester yarns, threads or filaments to acquire a relatively high tenacity. This increased tenacity is retained and frequently enhanced upon saponification. After the yarns, threads, or filaments have been saponified and the regenerated cellulose yarns, threads or filaments obtained, the latter may then be employed in forming the woven or netted fabrics employed in forming the novel window screens of my invention.

The cellulose acetate or other organic ester of cellulose yarns, threads or filaments which are saponified in the preparation of the regenerated cellulose yarns, threads or filaments may be of any degree of esterification. For example, in the case of cellulose acetate materials they may have an acetyl value of 53 to 55%, calculated as acetic acid, which is the acetyl value of the cellulose acetate usually employed commercially due to its favorable solubility characteristics. Preferably, however, I employ yarns, threads or filaments and the like or an organic ester of cellulose of a degree of esterification equivalent to a cellulose acetate of an acetyl value of 40 to 45%, calculated as acetic acid, in preparing the strong yarns employed in forming the novel window screens of my invention. Optimum results are obtained when cellulose acetate yarns. threads or filaments of an acetyl value of 40 to 45%, calculated as acetic acid, are employed.

In stretching yarns, threads and filaments having a basis of cellulose of an acetyl value of 53 to 55%, the softened condition necessary during the stretching operation is obtained by treating the cellulose acetate materials with organic solvents, latent solvents or swelling agents therefor. This treatment is usually carried out by bath or padding methods or by exposing the cellulose acetate materials to vapors of said organic solvents, latent solvents or swelling agents during, or just prior to, the stretching operation.

Yarns, threads or filaments of cellulose acetate of an acetyl value of 40 to 45%, calculated as acetic acid, may, however, be stretched while subjected to the action of a hot aqueous medium, such as steam or hot water without the necessity of employing organic solvents, latent solvents or swelling agents for the cellulose acetate. The hot aqueous medium serves to soften said low acetyl yarns and the softened yarns may then be stretched to a substantial degree. The use of organic solvents, latent solvents or swelling agents as stretching aids may be entirely dispensed with. The term "organic solvents" as employed hereinafter in the appended claims is to be construed as including within its scope not only organic solvents for cellulose acetate or other organic esters of cellulose of a relatively low degree of esterification, but organic latent solvents, swelling agents and softening agents for said materials, as well.

The cellulose acetate, or other organic ester of cellulose, of a relatively low degree of esterification may be prepared by esterifying cellulose with an esterifying agent such as acetic or other organic acid anhydride in the presence of a catalyst, for example, sulfuric acid, and a diluent such as acetic acid. The cellulose acetate may then be ripened or hydrolyzed to the desired acetyl value in the manner well known in the art. The cellulose acetate may be ripened directly or ripening may be interrupted at some convenient point, the cellulose acetate precipitated and, after washing and stabilizing, the ripening may then be continued in the presence of the same or a different ripening agent. The most desirable results are obtained, however, if the cellulose acetate, or other cellulose ester from which the yarns employed in practicing my invention are prepared, is ripened or hydrolyzed to the desired solubility characteristics and acetyl value in a plurality of stages in the manner more particularly described in co-pending application S. No. 452,788, filed July 29, 1942.

The softening of the cellulose acetate, or other cellulose ester yarns of a relatively low degree of esterification may be softened by passing it through a trough or bath of water at or near the boiling point, i. e., at 98 to 100° C., or the yarn may be passed through a chamber containing steam. The latter may be at atmospheric pressure or at a pressure slightly above atmospheric, for example at a pressure of 1 to 3.5 or 10 lbs. sq. in. gauge. The time required to soften the yarn so that it may be stretched will vary depending upon the temperature of the aqueous medium and the degree of esterification of the yarn. Usually, the lower the degree of esterification the lower will be the temperature necessary to soften it. Or, for a particular temperature, the lower the degree of esterification the less will be the time necessary for reaching the desired degree of softness prior to stretching. Yarns of heavy denier will naturally require a somewhat longer period of time to soften. Usually the yarns may be softened sufficiently when exposed to the action of hot water or steam for from 0.2 to 2.0 seconds. After softening, the yarns may be stretched in a continuous manner by being passed from a roll which rotates at a low speed to one rotating at a higher speed, the roller rotating at the higher speed serving to give the yarn the desired stretch. The degree of stretch may be varied by increasing or decreasing the differential in the roller speeds. The yarn may likewise be stretched in a plurality of stages. For example, part of the stretch may be imparted to the yarn by softening and stretching in one stage and the remainder of the stretch may be imparted by a second softening and stretching operation. More than two stages of stretch may, of course, be employed. After stretching, the yarns may be taken up on bobbins or may be collected in a centrifugal spinning box or Topham box. The stretch imparted to said yarns by this process may be 200, 500 or even 1000 to 2000% or more of their original length.

After being collected on bobbins or the like, the yarns may be saponified while in package form by batch processes. In lieu of employing a batch process for saponification, however, the yarns may be saponified in a continuous manner. This may be done conveniently by leading the stretched yarns directly into a saponifying bath, the path through the saponifying bath being of sufficient length so that the yarn is completely saponified before leaving the bath. After saponification the yarn is washed free of the saponifying agent, dried and wound into packages of convenient size.

The saponification may be carried out by means of any suitable basic agent. The saponifying

agent may be inorganic in nature such as, for example, sodium hydroxide, potassium hydroxide, sodium silicate, ammonium hydroxide, sodium carbonate, or other inorganic basic agent. Organic saponifying agents may also be employed such as, for example, methyl amine, ethylene diamine, triethanolamine or other organic bases. The saponifying agents may be employed in varying concentrations in aqueous, alcoholic or aqueous-alcoholic solutions. The saponifying bath may be at a temperature of 20 to 100° C. For example, when aqueous solutions of sodium hydroxide are employed, they may be of a concentration of 0.1 to 5% by weight and saponification may be effected in from 30 to 180 minutes with the solution at 30 to 90° C. When employing aqueous solutions of sodium hydroxide as the saponifying medium, it is preferable to include a buffer salt such as sodium chloride or sodium acetate in said solution. Suitable methods which may be employed for saponification of the stretched yarns are more particularly described in U. S. Patent No. 2,053,766.

If colored screens are desired, the yarns, threads or filaments may be dyed by applying thereto suitable coloring matter. The coloring matter employed may be applied by batch dyeing processes whereby the yarns, threads or filaments in the form of hanks, bobbins or other yarn packages are immersed in a dyebath of suitable composition until the desired effect is achieved. The yarns, threads or filaments may be dyed in a continuous manner by causing the same to pass through a dyebath during the course of a winding operation. The length of the path through said dyebath may be so adjusted that the yarns, threads or filaments are properly dyed. In lieu of employing continuous or batch dyeing processes, dyestuffs or pigments may be incorporated in the spinning solution from which said yarn, threads or filaments are spun and yarns, threads or filaments of any desired color obtained.

It is to be understood that the foregoing detailed description is given merely 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. A window screen comprising an open mesh fabric containing yarns, filaments or threads of heavy denier regenerated cellulose prepared by stretching yarns, filaments or threads having a basis of an organic ester of cellulose, and saponifying said stretched materials.

2. A window screen comprising an open mesh fabric containing yarns, filaments or threads of heavy denier regenerated cellulose prepared by stretching yarns, filaments or threads having a basis of cellulose acetate, and saponifying said stretched materials.

3. A window screen comprising an open mesh fabric containing yarns, filaments or threads of heavy denier regenerated cellulose prepared by stretching yarns, filaments or threads having a basis of an organic ester of cellulose, and saponifying said stretched materials, said fabric having a water-proof coating thereon.

4. A window screen comprising an open mesh fabric containing yarns, filaments or threads of heavy denier regenerated cellulose prepared by stretching yarns, filaments or threads having a basis of cellulose acetate, and saponifying said stretched materials, said fabric having a water-proof coating thereon.

5. A window screen comprising an open mesh fabric containing yarns, filaments or threads of regenerated cellulose of a denier of 250 to 1000, prepared by stretching yarns, filaments or threads having a basis of an organic ester of cellulose, and saponifying said stretched materials.

6. A window screen comprising an open mesh fabric containing yarns, filaments or threads of regenerated cellulose of a denier of 250 to 1000, prepared by stretching yarns, filaments or threads having a basis of cellulose acetate, and saponifying said stretched materials.

7. A window screen comprising an open mesh fabric containing yarns, filaments or threads of regenerated cellulose of a denier of 250 to 1000, prepared by stretching yarns, filaments or threads having a basis of an organic ester of cellulose, and saponifying said stretched materials, said fabric having a water-proof coating thereon.

8. A window screen comprising an open mesh fabric containing yarns, filaments or threads of regenerated cellulose of a denier of 250 to 1000, prepared by stretching yarns, filaments or threads having a basis of cellulose acetate, and saponifying said stretched materials, said fabric having a water-proof coating thereon.

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