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MANUFACTURE OF ARTIFICIAL YARNS OR OTHER MATERIALS

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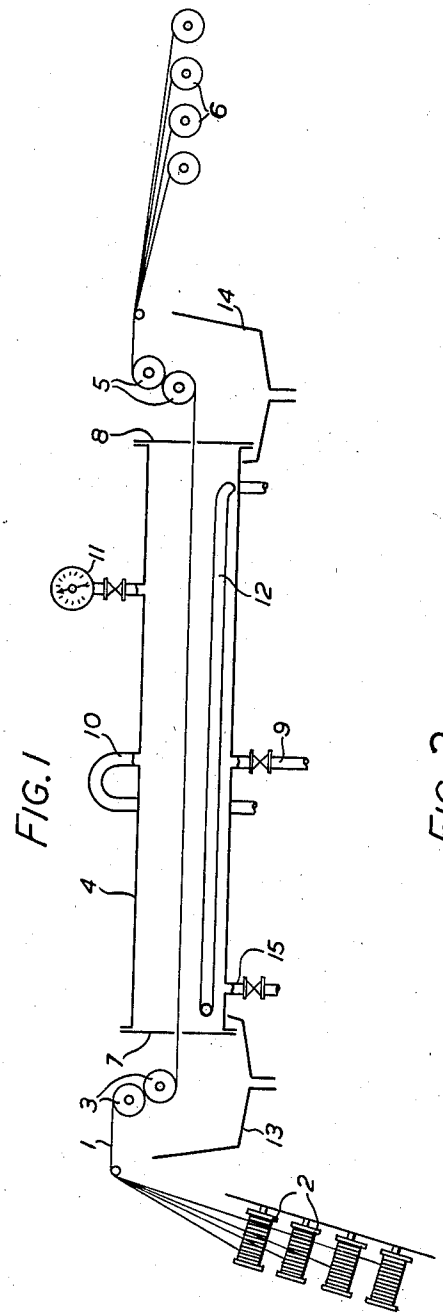


FIG. 1

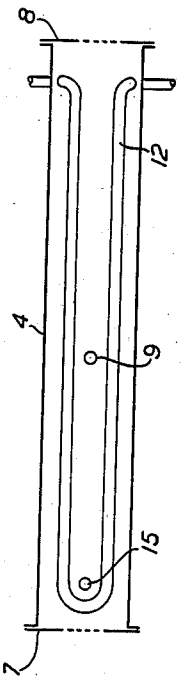


FIG. 2

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MANUFACTURE OF ARTIFICIAL YARNS OR OTHER MATERIALS

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Original application February 1, 1935, Serial No. 4,511. Divided and this application November 1, 1935, Serial No. 47,798. Renewed October 20, 1938. In Great Britain February 2, 1934

7 Claims. (Cl. 28—59)

This application is a division of our application S. No. 4,511 filed February 1, 1935, and relates to new apparatus for the production of artificial filaments, threads, yarns, ribbons, foils, films, and other materials having a basis of cellulose acetate or other cellulose ester or ether and having improved properties, particularly improved tensile strength.

The production of materials of the above character, and particularly filaments and similar textile materials, having an increased tensile strength is of considerable importance from the commercial point of view. The processes which have been hitherto proposed with this object have involved subjecting the threads or other materials to a stretching operation, and in order to obtain substantial increases in tensile strength it has been considered necessary to subject the materials to the action of liquids which are solvents or swelling agents for the materials, for example dioxane, acetone, acetic acid, and diacetone alcohol, all applied for example in aqueous solution. It has also been suggested to use such liquids in the vapour state.

It has now been discovered that materials having a basis of cellulose acetate or other cellulose ester or ether may have their tensile strength increased in a very simple manner by subjecting them to a stretching operation in hot water.

By the new process high degrees of stretch may be obtained, particularly when the water is employed at a temperature above 125° C., for example stretches of many hundreds per cent. Lower temperatures may be employed, for example down to 95° C. or even 85° C., but it is to be noted that temperatures above 98° C., for example temperatures of 100°, 110°, 120°, 130° C. or higher, give much better results. Temperatures above 100° C. may be obtained, while maintaining the water in the liquid state, by employing the appropriate super-atmospheric pressure, for instance pressures of 10, 20, 30 pounds or more per square inch above atmospheric pressure. The best conditions for treatment are dependent upon the degree of stretch required and the rate of stretching and upon a number of factors to be referred to hereinafter. For relatively low degrees of stretch the pressure may be substantially atmospheric pressure or only a few pounds above atmospheric pressure.

By employing appropriate temperatures for giving high degrees of stretch, filaments and threads of very fine denier and similarly thin foils, films and the like may be obtained.

Textile materials to be treated in accordance with the invention may be threads or other materials composed of continuous filaments, or may be spun yarns made of short or more or less long lengths of filament, and may be obtained by cutting up or by any other suitable process, for example the process of U. S. application S. No. 726,264 filed May 18, 1934. The materials may initially have any desired lustre from a high lustre to medium lustre or approximately the lustre of natural silk or even a dull lustre or no lustre at all. Thus, the materials may have a low lustre due to the presence therein of titanium dioxide or other pigments. Preferably the materials on entering the hot water are substantially free from volatile solvents.

The operation may be carried out on the materials in any suitable form; for example threads may be stretched in hank form, for instance between rollers positioned in a vessel containing the hot water. Preferably, however, stretching of the materials is effected during the course of their travel from one point to another. The treatment may be applied to a single thread, e. g. during winding from a cake or cheese or bobbin on to a bobbin, or it may be applied to a number of threads simultaneously. Thus, artificial threads may be stretched while running from one creel of bobbins to another creel. When simultaneously stretching a number of threads, it is advantageous to arrange the threads in parallel alignment in the form of a sheet or, if desired, in the form of two parallel sheets.

The stretching operation may be carried out so that the desired degree of stretch is obtained in a single stage of stretching or, if desired, intermediate rollers or other stretching devices may be provided so as to carry out the stretch in more than one stage.

Broadly the apparatus according to the present invention comprises a vessel for the water, heating means for maintaining the temperature of the water, means for guiding the materials through water in the vessel, and means for stretching the materials while in the vessel. For the treatment of running threads or other materials with hot water under pressure, the new apparatus comprises a substantially closed chamber for the hot water provided with heating means for water in the chamber and with one or more inlet and outlet orifices for the materials, associated with means for stretching the materials while in the chamber. The chamber may be provided with a source of supply of water under pressure and means for removing the water continuously. The water chamber may fur-

ther be provided with a pressure-relief valve, a water drain-off and a pressure gauge. For carrying out the operation in its preferred form, namely under pressure, the water chamber will be constructed to resist the required pressure and the inlet and outlet orifices for the materials will be as fine as possible.

The accompanying drawing illustrates diagrammatically a suitable apparatus for carrying out the stretching with hot water under pressure.

Figure 1 shows a longitudinal view of the apparatus, largely in section, while Figure 2 shows a horizontal cross-section of the hot water chamber.

The threads 1 from a creel of bobbins 2 are carried through nip rollers 3 into the hot water chamber 4, are drawn therethrough by nip rollers 5 and taken up on a creel of bobbins 6. To the hot water chamber 4 are secured closure plates 7 and 8 suitably perforated for the passage of the threads as illustrated in Figure 2. Water enters the chamber 4 by a pipe 9 from a suitable reservoir (not shown) maintained under pressure, for example by means of compressed air, and leaves the chamber by a pipe 10. The chamber 4 is further provided with a pressure gauge 11 and with a steam heating coil 12 for maintaining the desired temperature. Suitable catch trays, illustrated diagrammatically at 13 and 14, provided with drains, serve to catch the water exuded through the orifices in the closure plates 7 and 8. A drain 15 is provided for draining the hot water chamber 4, for example for threading up the apparatus.

The length of thread subjected to the action of the hot water may be quite short and good stretching may be obtained with a length of less than one foot. However, it is preferable to extend the length of the hot water chamber to some feet, for example 3–6 feet or more, the precise length depending upon the temperature and the amount and rate of stretching.

For any particular degree of stretch and rate of stretching, a range of temperatures is available. The best temperature at which to work depends upon a number of factors, including the twist on the initial thread, which for quick stretching should be as small as possible, and the nature of the cellulose derivative under treatment, materials made of high viscosity cellulose derivatives requiring in general rather higher temperatures than materials made of low viscosity cellulose derivatives. Furthermore when working under pressure in a substantially closed chamber, the size of the inlet and outlet orifices may have an influence upon the optimum temperature for any particular degree and rate of stretching. As previously indicated, the inlet and outlet orifices should be made as small as possible. Their size will naturally vary with the denier of the threads undergoing stretching. In general, the temperature is preferably adjusted to enable as low a stretching tension as possible to be used.

The stretched materials may be subjected to any desired after-treatment processes. Thus, the filaments, threads and other materials may be treated with shrinking agents to improve their extensibility. Suitable proceses for this purpose are described in U. S. application S. No. 611,240 filed May 13, 1932. In particular reference is made to the latent solvents referred to in that specification, for example a mixture of methylene chloride and benzene.

Again, stretched cellulose ester materials may be subjected to processes of saponification. The saponification may be such as to lead to a relatively small loss in weight, for example sufficient to give the materials an affinity for cotton dyestuffs, or may be complete or substantially complete, i. e. so as to eliminate all or substantially all of the ester content. The saponification may be effected under such conditions of tension that shrinkage takes place during or immediately after the saponification, this being advantageous from the point of view of the extensibility of the products.

Such further treatments may be carried out as operations separate from the stretching or may be carried out continuously with stretching. Thus, for example, the invention includes a continuous operation which involves first stretching and then shrinking, for example a stretching to several hundreds per cent. of the original length of the material followed by a shrinking by 7–12% of the length of the stretched material; a continuous operation involving stretching followed by saponification; and a continuous operation involving stretching, shrinking, and finally saponification.

While the invention has been described above more particularly with reference to cellulose acetate, it may also be applied to materials containing other cellulose esters or ethers, for example cellulose formate, cellulose propionate, cellulose butyrate, methyl, ethyl, or benzyl cellulose, or mixtures of esters and/or ethers or of mixed esters, ethers, or ether-esters. Furthermore, ribbons, foils, films, sheets and the like may be stretched by the processes described, and in the case of foils, films and the like the stretching may be either longitudinally and/or lateral or a lateral tension may be applied sufficient to prevent lateral shrinkage during the application of a longitudinal stretch.

What we claim and desire to secure by Letters Patent is:—

1. Apparatus for stretching running filaments, threads, foils and similar materials comprising a substantially closed pressure chamber, heating means associated with said chamber for heating water therein, inlet and outlet orifices in said chamber for passage of the materials and positively driven means for stretching the materials while in said chamber.

2. Apparatus for stretching running filaments, threads, foils and similar materials comprising a substantially closed pressure chamber, heating means associated with said chamber for heating water therein, inlet and outlet orifices in said chamber for passage of the materials and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

3. Apparatus for stretching running filaments, threads, foils and similar materials comprising a substantially closed pressure chamber, heating means associated therewith for heating water therein, inlet and outlet orifices in said chamber for passage of the materials, means associated with said chamber for supplying water thereto under pressure and for withdrawing water therefrom and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

4. Apparatus for stretching running filaments, threads foils and similar materials comprising a substantially closed pressure chamber, heating means associated with said chamber for heating water therein, inlet and outlet orifices in said chamber for passage of the materials, said orifices being of such size as to prevent substantial escape of water, and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

5. Apparatus for stretching running filaments, threads, foils and similar materials comprising a substantially closed pressure chamber, heating means associated therewith for heating water therein, inlet and outlet orifices in said chamber for passage of the materials, said orifices being of such size as to prevent substantial escape of water, means associated with said chamber for supplying water thereto under pressure and for withdrawing water therefrom and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

6. Apparatus for stretching running filaments, threads, foils and similar materials comprising, in combination with a creel of bobbins or other source of supply and with means for winding the materials after stretching, a substantially closed pressure chamber, heating means associated with said chamber for heating water therein, inlet and outlet orifices in said chamber for passage of the materials, and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

7. Apparatus for stretching running filaments, threads, foils and similar materials comprising, in combination with a creel of bobbins or other source of supply and with means for winding the materials after stretching, a substantially closed pressure chamber, heating means associated with said chamber for heating water therein, inlet and outlet orifices in said chamber for passage of the materials, said orifices being of such size as to prevent substantial escape of water, and positively driven means located outside said chamber for feeding the materials into and withdrawing them from said chamber, said means being adapted to stretch the materials during their passage through said chamber.

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