Feb. 16, 1937. H. DREYFUS 2,070,716

TREATMENT OF ARTIFICIAL FIBROUS MATERIALS

Filed Oct. 18, 1932

FIG. 1.

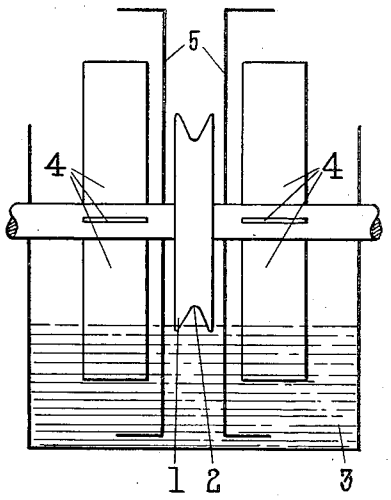


FIG. 2.

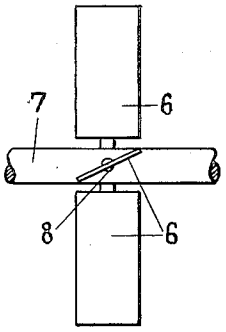


FIG. 3.

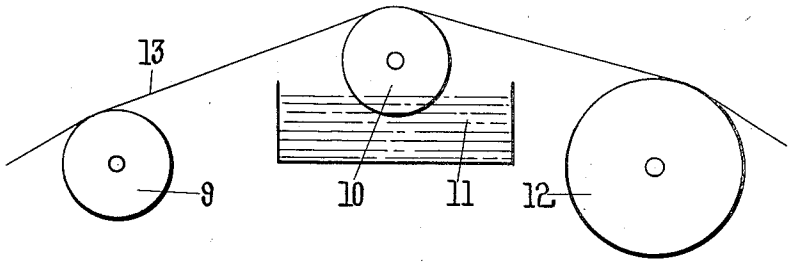
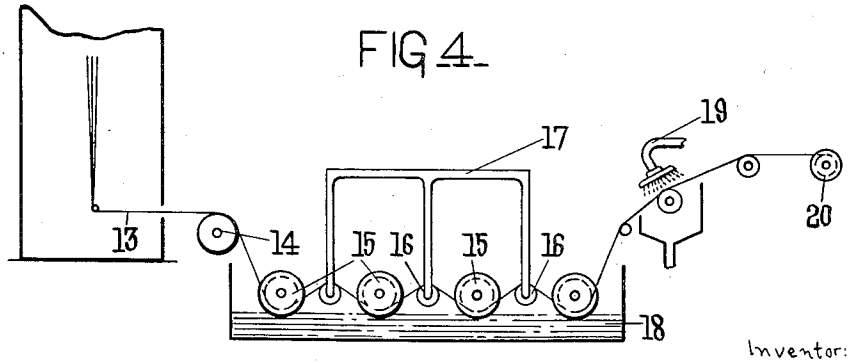


FIG. 4.



Inventor:
HENRY DREYFUS
by
I. Seltzer and D. Wiseman
Attorneys

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TREATMENT OF ARTIFICIAL FIBROUS MATERIALS

Henry Dreyfus, London, England

Application October 18, 1932, Serial No. 638,267
In Great Britain November 2, 1931

2 Claims. (Cl. 8—20)

This invention, which is a continuation in part of the invention described in application S. No. 378,684 filed July 16, 1929, relates to improvements in the treatment of artificial fibrous material and is more especially directed to improved processes for effecting the stretching of artificial filaments, yarns, threads, and the like made of or containing cellulose acetate or other cellulose esters or ethers, or other varieties of artificial fibres, for example those prepared from viscose, cuprammonium and nitro-cellulose spinning solutions.

The stretching of cellulose acetate filaments with resultant increase of tenacity, resistance to hot aqueous media and reduction in denier is first described in U. S. Patent No. 1,709,470. In U. S. application S. No. 378,684 filed 16th July, 1929, I have described the stretching of artificial filaments, threads, yarns and the like of cellulose acetate or other cellulose esters or ethers while the filaments are travelling from point to point, for example from bobbin to bobbin, from beam to beam or from a spinning machine, e. g. a dry spinning apparatus, to a winding device, the stretching being facilitated by means of suitable assisting agents, and particularly solvents or swelling agents for the cellulose derivative. The said specification describes achieving the stretch by a series of rollers rotated at different peripheral speeds. In this manner the stretch may be inserted in a series of stages. The importance of stretching in stages is also described in relation to the invention of U. S. application S. No. 573,424 filed 6th November, 1931, which describes the advantages which accrue from allowing a rest period between two or more of the stretching stages. Further, U. S. application S. No. 602,844 filed 2nd April, 1932, describes a process for stretching artificial filaments whilst they are in warp formation.

I have now found that considerable advantages may be obtained by employing freely mounted rollers or like devices in conjunction with such stretching operations. The rollers may for example be employed as the means of applying the assisting agents to the filaments, threads or the like or they may be employed to bring the filaments or other products into contact with a bath of assisting agent or the rollers may be the means of inserting the stretch in stages and especially in a very gradual manner.

The freely mounted rollers may be constructed of any suitable light material, as for example aluminium or other light metal or phenol aldehyde synthetic resin or other resistant plastic material. If desired the rollers may be provided with grooves in order to guide the filaments round the periphery of the roller. Such grooves have a further advantage as will be hereinafter described.

In employing the freely mounted rollers as the means of applying the assisting agents to the filaments, threads or the like, the latter may be passed over the rollers which dip into suitable vessels containing the assisting agent. By employing grooved rollers and by suitable adjustment of the size of the grooves, not only may the filaments or other products be maintained in position, but in addition the amount of assisting agent supplied to the filaments etc. may be very easily controlled, a matter of considerable importance in the stretching of travelling filaments, since the amount and uniformity of the stretch obtained depend very largely upon controlling the supply and rate of supply of the assisting agent. In addition by applying the assisting agent by means of rollers as described, the rate of travel of the filaments may be very high, for example 100 to 200 metres per minute or more, which is of advantage from the economic standpoint and is essential when the stretching is conducted continuously with the production of the filaments especially in the case of dry spinning. With such high speeds it is desirable that the rollers be of comparatively small diameter.

As a further modification, the filaments, threads or the like may be passed under the freely mounted roller or rollers and the latter may then be lowered so as to dip into baths containing the assisting agent. By this means relatively sharp angles in the path of the filaments or other products through the softening bath and to and from the same may be avoided and consequently the speed of travel of the filaments or other products may be considerably increased without risk of breakage. Preferably as before, grooved rollers are used and these may be arranged so that the outer periphery only of the roller or rollers dips into the softening bath and the softening liquid is drawn up into the groove. The filaments or the like are led under the rollers and in the grooves thereof so that they do not actually contact with the main softening bath and thus take up an amount of softening liquid controlled in accordance with the dimensions of the grooves.

The invention further includes inserting the stretch by means of a series of the freely mounted rollers or similar devices into which the filaments, threads, yarns etc. are brought into sub-

stantially non-slipping contact, the resistance to rotation of which gives rise to the tension necessary to stretch the filaments or other products. The advantages attaching to stretching in stages are thus obtained to an enhanced degree. The process of stretching, which makes use of the resistance to rotation of the rollers may be applied continuously with the production of artificial filaments, and by this means the stretch may be wholly or partially prevented from running back to the jet from which the filaments are extruded.

The amount of stretch inserted between any two rollers is dependent upon their resistance to rotation and such resistance may be controlled in a variety of manners, for example the weight of the rollers may be adjusted, or means may be provided whereby the natural resistance to rotation of the rollers is increased. Thus for example the rollers may be caused to run in contact with a liquid which may be more or less viscous, or a vane or similar device may be attached to each roller and this vane exposed to the fluid drag exerted by a gaseous or liquid medium. A jet of air or other gas may be caused to play upon a vane or like device in such a manner as to tend to set up a rotation in the reverse direction to that brought about by the filaments themselves, or the vane may be disposed in a substantially closed compartment so that the air or gaseous medium tends to retard the rate of rotation. The retardation may be controlled in these cases by the use of jets of air or other gas of varying intensity or by the use of liquids having varying viscosities. Instead of the vane rotating wholly in a liquid, it may be so disposed that it dips only partially into the liquid. The retardation of the roller may then easily be controlled by varying the depth to which the vanes are immersed in the liquid. The rotation of the roller may also be retarded by an electro-magnetic device or by any other suitable device. In that form of the apparatus in which vanes attached to the rollers rotate in a liquid medium, the bath of assisting agent may be used as the liquid medium. If desired the vanes may be provided in this process with a covering shield. Such a shield will serve to increase the drag on the roller and will localize in the bath the disturbance caused by the rotating vanes.

Where the freely mounted rollers assist in the stretching operation the filaments, yarns, threads and the like should be carried into substantially non-slipping contact with the series of freely mounted rollers or like devices, for example by carrying the filaments completely round the rollers. By applying a tension to the filaments after contact with the series of rollers the stretch is imparted thereto. For example at the end of a series of rollers a driven feed roller or like device may be employed, or alternatively feed rollers may be inserted at intervals along a series of the freely mounted rollers characteristic of the invention. Where the freely mounted rollers offer only a comparatively small resistance to rotation a very long series of such rollers may be employed with the result that the stretch is imparted to the filaments very gradually indeed. Alternatively if the resistance to rotation of the freely mounted rollers is substantial a relatively limited number of rollers may be used, but still the advantages accuring from stretching in stages are obtained.

For treating filaments of cellulose acetate or other organic esters or ethers of cellulose, suitable assisting agents are acetic acid, formic acid, lactic acid, diacetone alcohol, acetone and the like; the ethers, esters and ether-esters of olefine and polyolefine glycols, for instance the mono- and di-methyl and ethyl ethers of ethylene glycol, and of propylene glycol, dioxane and the mono-ethyl ether of di-ethylene glycol, glycol mono- and di-acetates, methyl glycol acetate and mono-, di- and tri-acetins; phenols, dichlorethylene, methylene chloride, ethylene chloride, methyl acetate and ethyl acetate. Such solvents or swelling agents may be diluted with water or with organic non-solvents, for instance hydrocarbons, alcohols or ethers.

The solvents or swelling agents may be applied before or during the stretching operation of the invention.

Where the solvent or swelling agent is applied during the stretching operation, the tension applied to bring about the stretch may be restricted to the softened portion of the thread, and wholly or partially be prevented from running back to that portion of the thread which has not reached the optimum condition for stretching.

After stretching in accordance with the present invention the solvent or swelling agent may either be allowed to dry in the filaments or threads or it may be washed off before drying. When as is most effective the solvent or swelling agent is applied in relatively high concentration, it is desirable to take precautions in the removal, since a too rapid removal tends to impair the lustre of the filaments or other products. For this purpose the filaments, instead of being washed directly with water to remove the solvent, may be treated with salt solutions or preferably with a solution of the solvent or swelling agent used in the stretching in relatively small concentration. Successive baths of such solvent or swelling agent in gradually diminishing concentration have the effect of gradually removing the solvent or swelling agent from the filament without deleteriously affecting its lustre. The filaments may finally be washed with water. The drying of the filaments may afterwards be carried out while maintaining the filments or threads under tension or in the absence of tension.

If desired the filaments, threads, yarns and the like treated according to the present invention may be submitted to a shrinking operation in order to modify their properties, e. g. their extension, as described for example in U. S. application S. No. 611,240 filed 13th May, 1932.

Suitable apparatus for use in this invention is shown in the drawing, but it is not to be considered as limiting the invention in any way.

Figure 1 shows an elevation of a suitably grooved roller provided with vanes dipping into a bath of assisting agent.

Figure 2 shows a method of attaching vanes to the roller so that they may be adjusted.

Figure 3 shows a suitable form of apparatus for stretching the filaments or threads whilst they are travelling from bobbin to bobbin or between other packages.

Figure 4 shows a suitable form of apparatus for stretching continuously with the spinning of filaments by the dry spinning process.

In Figure 1 the roller 1 provided with the groove 2 which may be of any desired depth is arranged so that only the outer periphery of the roller is immersed in the bath of assisting agent 3. The roller is provided with vanes 4

which are partially immersed in the liquid of the bath. Shields 5 serve to prevent the rotating vanes causing turbulence in the liquid near the grooved roller.

In the method of attaching vanes so that they may be adjusted shown in Figure 2, the vanes 6 are pivotally mounted on the roller 7. The pivot 8 is of such construction that the vanes may be disposed in a plane parallel to the axis of the roller, or in a plane making any suitable angle with the axis.

In Figure 3 filaments, threads or the like 13 are led from a bobbin or other package to a feed roller 9 and thence to a freely mounted roller 10 dipping into a bath of assisting agent 11. A third roller 12 rotating at a greater peripheral speed than the feed roller 9 exerts a stretching action on the filaments or the like, and the filaments are then washed, dried, and wound, or twisted and wound.

In Figure 4 the filaments 13 issuing from a dry-spinning cell are led round a feed roller 14 and under the freely mounted grooved rollers 15. Other freely mounted rollers 16 are arranged alternately with the rollers 15, and these are connected together by a structure 17 which may be adjusted to any height by any suitable raising or lowering mechanism (not shown). By adjusting the height of the rollers 16 the tension on the filaments or threads may be controlled. Alternatively, the freely mounted rollers 16 may be arranged to be adjusted independently, and thus by raising them by different amounts the amount of lap on individual grooved rollers may be varied. Thus little or no stretch may be effected while passing over certain of the rollers, e. g. the earlier ones, while with others, e. g. later ones, stretching may be carried out. The mounted rollers 15 are so disposed that only their outer peripheries are immersed in the liquid contained in the bath 18. The rollers 15 may also be provided with means opposing their tendency to rotate under the action of the filaments, such as the vanes shown in Figures 1 or 2. The filaments, after leaving the bath 18 are led to a spray washing device 19 and then to a winding device 20. The distance between the washing device 19 and the winding device 20 may be sufficiently great for the filaments to dry, or a drying device may be interposed between these two devices, or the filaments or threads may be wound in the wet condition.

The present invention may also be adapted to produce effect filaments or threads. Thus for example by using rollers which are grooved axially instead of circumferentially softening agent may be applied in a non-uniform manner, and filaments thus treated will exhibit after stretching, a variable denier along their length.

As already indicated the invention is of the greatest value in its application to the stretching of filaments, threads and the like of cellulose acetate or other organic derivatives of cellulose, for example cellulose formate, cellulose propionate, cellulose butyrate, cellulose nitroacetate or other organic esters of cellulose, cellulose nitrate, or cellulose ethers, or mixed ethers, e. g. ethyl, butyl or benzyl cellulose, and mixed ether-esters, e. g. ethyl cellulose acetate and oxyethyl cellulose acetate. However, the invention may also be applied to the stretching of other filaments, for example those produced by the cuprammonium, viscose and nitro cellulose processes, and consisting substantially of cellulose. Swelling agents for use with such materials comprise, for example, thiocyanates, caustic alkalies, and Schweitzer's reagent.

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

1. In a process wherein filaments, threads, yarns and like material having an organic derivative of cellulose base are softened, the steps of causing said materials to run below and in nearly tangential contact with the root of a peripheral groove in a cylindrical surface adapted to be rotated about its longitudinal axis by said materials, and maintaining a body of softening liquid for the base of said materials in such a position that its surface is below the lowest point of the root of said groove but above the lowest point of the peripheral edges of said groove, whereby said groove is kept supplied with softening liquid, the main body of softening liquid being kept out of contact with the materials.

2. In a process wherein filaments, threads, yarns and like materials having an organic derivative of cellulose base are softened, and stretched while in the softened condition, the steps of causing said materials to run below and in contact with the root of a peripheral groove in a cylindrical surface adapted to be rotated about its longitudinal axis by said materials, maintaining a body of softening liquid for the base of said materials in such a position that its surface is below the lowest point of the root of said groove but above the lowest point of the peripheral edges of said groove, whereby said groove is kept supplied with softening liquid, the main body of softening liquid being kept out of contact with the materials, and retarding the rotation of said cylindrical surface.

HENRY DREYFUS.