

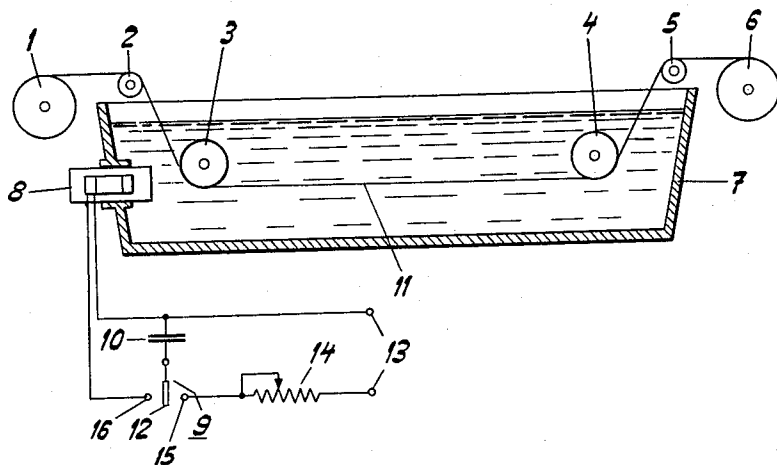
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H. LOOSLI

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METHOD OF TREATING KNITTED SUPERPOLYAMIDE TEXTILE FABRIC
WITH AN AQUEOUS PHENOL BATH SUBJECTED TO ULTRA-SONIC
WAVES AND FABRIC PRODUCED THEREBY

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METHOD OF TREATING KNITTED SUPERPOLY-AMIDE TEXTILE FABRIC WITH AN AQUEOUS PHENOL BATH SUBJECTED TO ULTRA-SONIC WAVES AND FABRIC PRODUCED THEREBY

Hermann Loosli, Zurich, Switzerland, assignor, by mesne assignments, to Rene Ruegg, Zurich, Switzerland

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9 Claims. (Cl. 8—130.1)

This application is a continuation-in-part of my co-pending application Serial No. 662,096, filed May 28, 1957, now abandoned.

My invention relates to a method of improving synthetic fibers of organic compounds, for instance synthetic fibers of straight molecular chain substances such as viscose fibers, acetate rayon fibers, nylon or condensation products of terephthalic acid with glycol (Terylene), and polyvinyl chloride products. Such substances, in form of fibrous staple as well as in yarn form, are generally less elastic and not so soft as natural vegetable or animal fibers. Besides, synthetic fibers have at best an only slightly developed surface texture. Their smooth surface is disadvantageous particularly in the manufacture of textile material because of the absence of the desired fiber-friction resistance or gripping ability peculiar to other fibers such as cotton, flax or sheep's wool. It is also known that the threads in textiles produced from fibers of smooth surface may tend to become displaced within the web structure, thus impairing its utility.

Attempts have therefore been made to artificially impart to such fibrous substances the desired adhesion or gripping ability together with the necessary flaccidity and softness. For instance, it has been proposed to treat the synthetic spun fibers with chemicals such as saponification products or oxidation products obtained from paraffin hydrocarbons; or by treating such fibers with a liquid dispersion of aerosol particles containing a wetting agent, in which the aerosol is obtained by thermal decomposition of volatile compounds in gaseous condition. Another known method involves producing bubbles and hollow spaces in the interior of the viscose bodies for increasing their heat-insulating ability and volume while giving them a softer and fuller feel, a curled and scarred surface, a reduced sheen and better permeability for dyes. Such hollow spaces are produced by decomposing concentrated hydrogen peroxide by means of catalysers within the interior of the viscose bodies. Esterification of cellulose and cellulose hydrate material, such as rayon and cellulose wool, by applying a fatty acid hydride at elevated temperature and simultaneously applying alkali salts of weak acids to act as catalysers, also have the effect of somewhat modifying the properties of the original fibers in the desired sense. Such esterified products, however, are not resistant to soap and caustic soda because of pronounced swelling, so that subsequent processing is necessary for minimizing this disadvantage.

Brief mention may be made of a known mechanical method attempting to artificially roughen and curl the synthetic fibers, for instance by passing them between a pair of rippled rollers.

The prior art methods for roughening and curling the fibers have been found to have the considerable disadvantage that the fibers so processed may in some cases become weakened, and that components of the chemical reagents may deposit themselves within the fibers or in the spun threads with the effect of impairing their properties, for instance the desired porosity. The mechanical curling methods produce fibers which are wavy in only one plane, which is wholly insufficient for most purposes.

It has also been proposed to treat spun thread by

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ultrasonics either by imparting ultrasonic oscillations to the spinning liquid or into the precipitation bath or into the bath of cleaning water subsequently used in the spinning of synthetic material. Such treatment also results in a loosening of the spun material. However, this method has not been used in actual practice because the ultrasonic effect must be maintained for too long a period of time until a visible loosening of the yarn texture can be observed, thus making the method uneconomical.

It is an object of my invention to provide a novel method which improves synthetic fibers of all kinds, or spun threads, yarn or fabrics made from such material, but which avoids the above-mentioned deficiencies of the methods heretofore available for such purposes.

According to my invention, the synthetic fibers or the spun products or fabrics made therefrom are processed within a bath which contains chemical additions for loosening and curling the texture of individual fibers and which is also subjected to ultrasonic oscillations. This has the effect that the ultrasonic oscillations augment and accelerate the chemical curling action of the additions upon the fibers so that the loosening in fiber texture is completed within much shorter time than when ultrasonics alone or only the chemical additions alone are employed. The ultrasonic oscillations may have a frequency of 20,000 to 40,000 cycles per second, although oscillations of higher frequencies, such as up to about 60,000 cycles per second, are likewise applicable.

The ultrasonic oscillations may be applied continuously. However, according to another feature of the invention, it is preferable to apply the ultrasonic oscillations intermittently, particularly in form of individual pulses or pulse trains. With such an intermittent operation, the oscillation generating and issuing ultrasonic oscillator can be loaded by impulse generating power to a much larger extent than is possible with a continuous application of the oscillations. Damped or undamped oscillation pulses or pulse trains can thus be applied. The ultrasonic oscillations are generated, in the manner known as such, for instance by excitation of a magnetostrictive body such as a nickel-iron rod, or by discharge of electric capacitors.

Particularly when employing damped impulses produced by discharge of capacitors with the aid of a commutator or the like, a simple and reliable impulse generator of low cost can be provided.

The process according to the invention will be further explained with reference to the examples described presently.

EXAMPLE 1

Ladies' Hose of Superpolyamides

The leg portion of the hose is produced from a yarn of 30 den./10 (times) with a twist of 320 per meter. The edge and the reinforcement consist of a yarn 40 den./13 with a twist likewise of 320 per meter. The weight of a single hose is approximately 10 g. A number of hose, for example six, are pulled sequentially through three baths, one behind the other. The first bath serves for opening the yarn, the second for neutralizing the chemical products of the first bath, and the third bath serves for washing the residue out of the material. The first two baths are subjected to ultrasonic oscillations.

The first aqueous bath contains as the curling agent a solution of 50 to 60 g./l., i.e. in the order of about 5% to 6%, of one of the crystallized phenols such as monohydroxybenzene and has a temperature of about 40° C. The second aqueous bath contains a solution of 3 g./l. caustic soda and has a temperature of 65° C. The third bath contains a solution of 1 g./l. of a penetration agent, for example triethanolamine and has a temperature of 65° C. The hose are successively drawn or conveyed

from one bath to the other, the processing treatment in the first bath being no longer than fifteen seconds. The duration of the subsequent processing in the other baths is less critical and hence may be permitted to be less uniform. Such further processing is preferably of longer duration than in the first bath, for example twenty to thirty seconds in each subsequent bath.

EXAMPLE 2

Material: Charmeuse (tricot cloth) of superpolyamide nylon 40 den., 70 g. per m.². The material to be processed is passed on an endless belt through three different baths. The first bath is the processing bath for opening i.e. curling the fibers. The second bath is the neutralizing bath. The third bath serves as a rinsing bath. The first bath is an aqueous solution of phenol as the roughening and curling agent, namely 40 g. per 1 liter of water, i.e., in the order of about 47, and has a temperature of 45° C. The second bath is an aqueous solution containing 3 grams caustic soda per liter of water, the solution having a temperature of 65° C. The third bath is an aqueous solution containing 1 gram of penetrating agent, namely triethanolamine, at a temperature of 65° C.

Duration of processing:

In the first bath about fifteen seconds,

In the second bath about thirty seconds,

In the third bath about thirty seconds.

EXAMPLE 3

A web of nylon (superpolyamide) made of 30 den./600 T/10 fibers, is conveyed through three baths by means of an endless belt as in Example 2 above. The composition, concentration and temperature of the respective baths are the same in Example 2. The web is subsequently dried under slight tension. The processing treatment in the respective baths is the same as in Example 2.

An apparatus for performing the above-described method, is schematically illustrated on the drawing which, for simplicity, shows only one bath instead of the two or three preferably used in accordance with the above-described examples.

The processing tank 7 shown on the drawing may consist of wood, for example. It may have a length of 1.5 m., a width of 60 cm. and a height of 60 cm. The tank is partly filled with the above-mentioned respective processing liquid. For the first bath, for example, it is filled with an aqueous solution of phenol as the curling agent. The temperature of the first bath is approximately 45° C. The web 11 to be processed (Example 2) is carried in a net from the supply roller 1 through guide rollers 2, 3, 4, 5 into the second bath and then into the third bath where the processed web is washed. Mounted in a wall of tank 7 is an ultrasonic oscillator 8 in such a position that it radiates its ultrasonic power output into the interior of the tank 7. The ultrasonic oscillator may consist of a magnetostrictive device having a nickel-iron rod excited by a magnetic field coil to oscillate at a frequency of approximately 38,000 cycles per second and to provide a radiating output power capacity of about 120 watts. Instead of a magnetostrictive oscillator, a piezo-electric oscillator may also be used.

The oscillator 8 is excited by the discharging current of a capacitor 10 whose charging and discharging is controlled by a switching device 9. The switching device 9 is shown to have an oscillator contact which may be operated mechanically or electromagnetically and makes alternate contact with stationary contact pieces 15 and 16 respectively. When contact 12 engages contact 15, the capacitor 10 is charged from a direct-current source 13 through a calibrating resistor 14. When contact 12 engages contact 16, the capacitor 10 discharges through the magnet coil of the oscillator 8 and excites the oscillator in accordance with the natural frequency of the oscillatory circuit formed by the capacitor 10 and the oscillator. The oscillations then decay in accordance with the damping of

the oscillatory circuit. The voltage at the capacitor 10, in the processing example here considered, is approximately 1,000 volts and the peak current intensity of the discharging current is approximately 200 amps. It will be understood that the oscillations may also be excited by other devices such as electronic tube circuits operating, for instance, with thyatrons instead of the mechanical switch 12.

Depending upon the intensity of the ultrasonic pressure field within the bath through which the web material 11 is being passed, the necessary duration of the treatment may vary. For instance, in the above-described Example 2, the processing period with a sonic power of 120 watts, a bath temperature of 45° C. and the above-specified chemical additions, is approximately fifteen seconds. With a smaller ultrasonic power and other bath composition and temperatures, the processing period may amount up to about one minute. Bath temperature, ultrasonic power output and the chemical bath composition can be so chosen relative to each other that the processing period is best adapted to the kind of web material, its traveling speed and other operating conditions.

Depending upon the particular operating conditions and the properties of the material to be processed, the method can be modified in various ways. For instance, the frequency of the ultrasonic oscillations can be increased or reduced; that is, the most favorable frequency can be determined by sample testing for each particular type of synthetic fiber. Tests have shown that these frequencies, in general, are within 20,000 to 60,000 cycles per second.

The duration of the individual impulses in the above-described example was approximately six cycle periods, that is about 0.00016 second, and the interval of interruption between consecutive pulse trains was approximately 0.5 second. In accordance with the example just given, it is preferable to operate the device 9 so that the individual ultrasonic pulse trains are spaced from each other an interval of time much longer than the duration of an individual pulse train. In this manner, the ultrasonic oscillator 8 may be given a very great instantaneous power output during the intervals of pulse duration, while the over-all power supply for rated power of the equipment is kept within reasonable limits.

Due to the damping in the discharging circuit, which, if necessary, may be increased by inserting series resistance between the capacitor 10 and the oscillator 8, any desired damping of the impulse trains can be obtained, for instance so that the decay to negligible amplitudes takes place within an interval of several cycles.

The ultrasonic oscillator 8 may also consist of mutually spaced capacitors electrodes which pass an electric discharge directly through the liquid.

The method according to the invention can be applicable simultaneously to any desired number of webs, threads or individual filaments of synthetic material. In such cases, a single bath, in a tank or vessel of proper size, can be used for a multiplicity of webs or threads or filaments, for instance 20 or more, without necessarily increasing the power output of the ultrasonic oscillator.

As a result of the described process, the web or other fibrous material exhibits increased elasticity and becomes generally more similar to natural fibers or webs made of natural fibers.

I claim:

1. The method of treating a knitted textile fabric comprised of superpolyamide multi-filament yarn of which the individual filaments are continuous, which comprises subjecting said fabric to an aqueous bath containing a solution of the order of four to six percent, based on the weight of the solution, of a chemical fiber-curling agent for superpolyamides, said agent consisting essentially of a crystallized phenol, and simultaneously imparting pulse trains of ultra-sonic acoustic wave oscillations to the bath, the frequencies of said oscillations being within the range of 20,000 to 60,000 cycles per second, the duration of

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such treatment in said aqueous bath being not longer than 15 seconds, whereby respective individual ones of said continuous filaments become curled and spread apart at portions thereof between crossing points of the knitted filaments, the effect over the fabric being uniform.

2. The method of treating a knitted textile fabric comprised of superpolyamide multi-filament yarn of which the individual filaments are continuous, which comprises subjecting said fabric to an aqueous bath containing a solution of the order of four to six percent, based on the weight of the solution, of a chemical fiber-curling agent for superpolyamides, said agent consisting essentially of a crystallized phenol, and simultaneously imparting pulse trains of ultra-sonic acoustic wave oscillations to the bath, the frequencies of said oscillations being within the range of 20,000 to 60,000 cycles per second, the duration of such treatment in said aqueous bath being not longer than 15 seconds, and the interval of the interruption between consecutive trains being longer than the period between interruptions, whereby respective individual ones of said continuous filaments become curled and spread apart at portions thereof between crossing points of the knitted filaments, the effect over the fabric being uniform.

3. In the method according to claim 2, said ultra-sonic oscillations being damped.

4. The method of treating a knitted textile fabric comprised of superpolyamide multi-filament yarn of which the individual filaments are continuous, which comprises subjecting said fabric to an aqueous bath containing a solution of the order of four to six percent of a crystallized phenol, and simultaneously imparting pulse trains of ultra-sonic acoustic wave oscillations to the bath, the frequencies of said oscillations being within the range of 20,000 to 60,000 cycles per second, the duration of such treatment being not longer than 15 seconds, and the interval of the interruption between consecutive trains

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being longer than the period between interruption, whereby respective individual ones of said filaments become curled and spread apart.

5. The method of treating a knitted textile fabric according to claim 4, said phenol being monohydroxybenzene.

6. The method of treating a knitted textile fabric according to claim 4, said superpolyamide yarn being nylon.

7. The method of treating a knitted textile fabric according to claim 4, said fabric comprising nylon yarn and being in stocking-fabric form.

8. The method of treating a knitted textile fabric according to claim 7, the duration of the individual impulses of said pulse train being approximately six cycle periods, and the interval of the interruption between consecutive pulse trains being approximately 0.5 second.

9. A fabric produced by the method of claim 1.

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