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METHODS FOR RELAXING SYNTHETIC FIBER FILAMENTS

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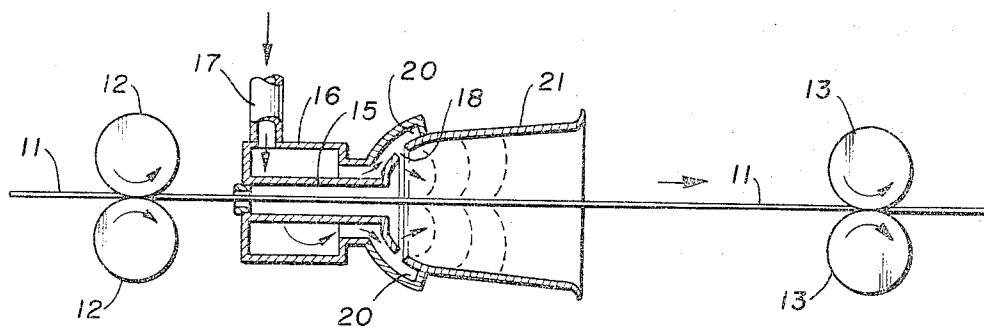


FIG. 1.

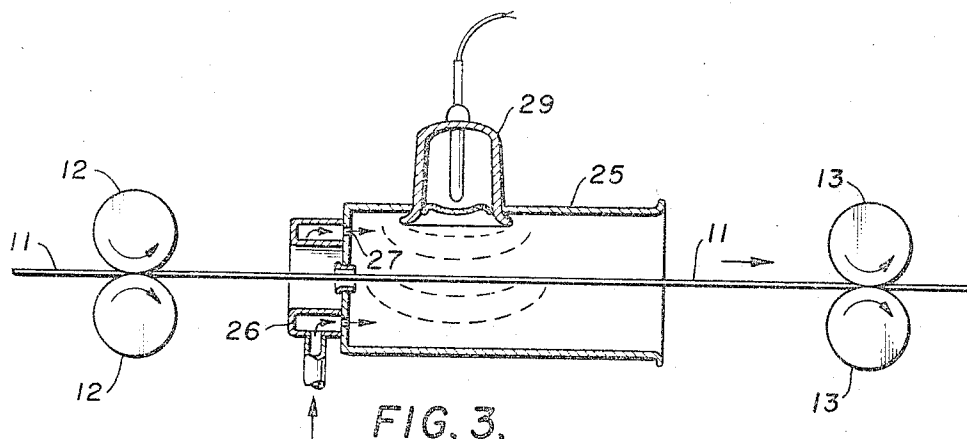


FIG. 3.

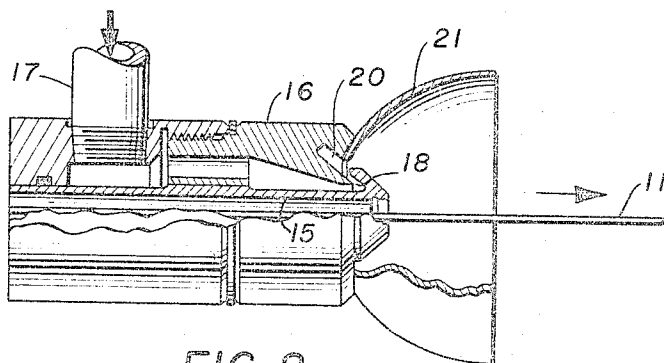


FIG. 2.

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METHODS FOR RELAXING SYNTHETIC FIBER FILAMENTS

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1 Claim. (Cl. 28—72)

ABSTRACT OF THE DISCLOSURE

The method of this invention comprises relaxing a bundle of synthetic filaments by advancing the filaments along a path, applying a heated gas to the filaments at some point in the path and agitating the heated gas by creating sonic vibrations therein.

This invention relates to methods for relaxing synthetic fiber filaments and more particularly to methods for continuously relaxing continuous synthetic fiber filaments.

It is well known in the art that acrylonitrile filaments which have been highly oriented by stretching must be relaxed to improve their physical properties and dyeability before being converted to textile goods. Unrelaxed fibers are characterized by poor dyeability, poor abrasion resistance and high fibrillation. Relaxation of synthetic fibers is generally accomplished by heating the fiber while it is in an untensioned state to cause shrinkage and the desired improvement in textile properties. Shrinkage in the order of 20 to 40 percent is commonly associated with the relaxation of the fiber.

One method of relaxing synthetic fibers consists of placing the fibers as a loose bundle or package into a steam autoclave and subjecting the fiber to saturated steam. This method yields a satisfactory fiber product, but has the disadvantage of being a batch process which interrupts the otherwise continuous process of spinning and packaging the fiber. This batch relaxation process therefore results in increased handling of the fiber and increased manufacturing costs.

Many designs for continuous relaxation chambers have been proposed. Most of these involve a steam pressure vessel with elaborate sealing means for feeding the synthetic fiber into and out of the chamber. Because of the fragile nature of the synthetic fiber tow or yarn bundle, which must not be abraded or entangled during relaxation, and because of the difficulty of sealing the chamber, continuous relaxation pressure chambers have not found wide acceptance in the synthetic fiber industry.

More recently it has been found that the synthetic fiber can be continuously relaxed by treating with a heated gas such as steam or hot air. Since this treatment is carried out essentially at atmospheric pressure, it is not necessary to seal the treating zone. The relaxation of small tows in the order of 300 filaments and 4500 total denier has been successfully accomplished by simply passing the tow with a concurrent flow of hot gas through a tube. To enhance the heat transfer to the fibers, baffles may be placed in the tube to direct the gas flow repeatedly through the fiber bundle. Unfortunately this technique has not been very effective when attempting to relax larger tow bundles having in excess of 500 filaments or 6500 total denier. This difficulty arises due to insufficient heat transfer to the filaments and due to the tension applied to the filaments as a result of the increased gas flows required. With this in mind, one of the objects of this invention is therefore to provide a method for continuously relaxing synthetic fiber filaments.

Another object of this invention is to provide a method for continuously relaxing continuous lengths of synthetic fiber tows or yarns in hot gas.

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A further object of this invention is to provide a method for hot gas relaxation of continuous lengths of synthetic tows or yarns having a large number of filaments or a large total denier.

The objects of this invention are generally accomplished by subjecting the synthetic filaments while in a relaxed state to heated gas and sonic vibrations. More specifically, bundles of fibers as a tow or yarn in continuous filament form are passed through an apparatus into which the heated gas is introduced. The gas under low velocity conditions contacts the fiber in a field of sonic vibrations. The sonic vibrations enhance the transfer of heat from the gas to the fiber to effect greater relaxation of the fiber. By a gas under "low velocity," it is meant any velocity which is low enough that tension applied to the filaments by the moving gas will not prevent relaxation of the filaments. Actual acceptable gas velocities are dependent upon the number of filaments, and the temperature of the heated gas. The sonic waves may be generated by gas flow across a resonating cavity. Since heated gas is required in the practice of this invention, it is convenient to use this same gas as the sound generating means.

Other objects and advantages of the invention will become apparent when the following detailed description is read in conjunction with the drawing, in which:

FIGURES 1-3 show different types of apparatus which may be utilized for applying an agitated and heated gas to the bundle of filaments to thereby carry out the process of the present invention.

Referring now in detail to the drawing, a synthetic fiber bundle 11 is fed from a first set of rolls 12 through the relaxing zone onto a second set of rolls 13, the peripheral speed of the rolls 13 being 20 to 40 percent less than the peripheral speed of the rolls 12 to allow for the relaxation and shrinkage of the filaments. In the relaxation zone between the rolls 12 and 13 the bundle 11 of synthetic filaments is subjected to a heated gas which is agitated by sonic vibrations.

In the apparatus shown in FIGURES 1 and 2 movement of the heated gas is utilized to create sonic vibrations which agitate the gas. The apparatus is provided with a central tube 15 through which the bundle 11 of filaments passes. The tube 15 is surrounded by a manifold 16 having an inlet line 17 and an exhaust opening 18 positioned near the end of the tube 15. A heated gas such as hot air or steam is passed from the inlet line 17 through the manifold 16 and out the exhaust opening 18 into the vicinity of the bundle 11 of filaments. The heated gas, in leaving the manifold 16, passes over a resonating cavity 20 built into the end of the manifold 16. Both the exhaust opening 18 and the resonating cavity 20 extend completely around the manifold 16. A bell 21 secured to the end of the manifold 16 extends along the path of the bundle 11 so as to confine the heated gas to the area surrounding the bundle 11 and to focus the vibrations generated by the resonating cavity 20 on the bundle of filaments.

The depth of the resonating cavity 20 will determine the frequency of sonic vibration. The sonic frequency range may be from 1 to 30 kc. but it is preferably from 10 to 20 kc. It will readily be seen that the bell 21 confines the sonic vibrations and the heated gas to an area surrounding the bundle of filaments.

FIGURE 3 shows another type of apparatus which may be utilized to perform the process of the present invention. In this apparatus the bundle 11 of filaments passes through a bell 25 having at one end thereof a manifold 26 which communicates with the interior of the bell 25 by way of an opening 27 for the admission of a heated gas to the interior of the bell 25. An electrically operated sonic generator 29 is mounted on the bell 25 for generating sonic vibrations in the heated gas passing through the bell 25.

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The sound waves serve to increase the heat transfer between the filaments and the surrounding hot gases by dissipating the air film surrounding the individual filaments and by agitating the stagnant air trapped between filaments in the fiber bundle. The sonic effect is enhanced by focusing the sound waves on the fiber travel path by means of the bell 21.

The method of this invention is useful in the heat treating of any continuous length of synthetic fiber material, such as the polyamides, polyesters, polyurethanes, and polyacrylonitrile based fibers. The method is effective to continuously relax or shrink these filamentary materials to improve their physical or chemical properties. It is also useful for bulking or crimping heat crimpable multi-components of conjugate spun yarns.

It is to be understood that the embodiment disclosed herein may be altered or amended and that other embodiments can be contemplated without departing from the spirit and scope of the invention.

What is claimed is:

The method of relaxing a bundle of synthetic fiber filaments, comprising advancing the bundle of filaments along a predetermined path, passing a heated gas over the bundle of filaments, creating sonic vibrations in the heated gas to agitate said gas and thereby better dissipate stagnant

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air inside said bundle, said sonic vibrations being created at points positioned along a circular line concentric with said path so that the bundle of filaments is subjected to sonic vibrations from all sides, and focusing said vibrations onto said path.

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