United States Patent Office 2,888,733 Patented June 2, 1959

2,888,733

PROCESS FOR THE FIXATION OF PRESSURE CRIMPED SYNTHETIC FIBERS

Harry Wegener, Chur, Switzerland, assignor to Inventa A.G., Lucerne, Switzerland

No Drawing. Application June 18, 1954 Serial No. 437,863

Claims priority, application Switzerland June 27, 1953

2 Claims. (Cl. 28—72)

The present invention relates to a process for the fixation of pressure crimped synthetic fibers, especially polycaprolactam fibers, more particularly to a process of fixation carried out in the crimping device.

For crimping fiber ropes made from synthetic threads obtained by spinning from the melt, it has become the conventional process to subject the fibers to pressure crimping.

According to the known methods, a pair of take-in rollers is provided for feeding into a chamber a rope to be crimped; said chamber is filled with the fiber rope and the fibers are constantly held under crimping pressure. This chamber is, however, not filled completely; there is a small free space below the point of contact of the rollers, which has an approximately triangular cross-section and is formed by the rollers and the upper surface of the chamber contents.

The height of the triangle and the length of the base line formed by the chamber contents depends on the pressure prevailing in the chamber.

As the fiber is fed in by the rollers, it strikes the base of the triangle, bends back and tends, by continued folding, to fill the empty space, narrow-angled arcs alternating with straight parts, so that a wave-like form of the fiber is obtained.

In order to fix the so accomplished crimping against the stress which the fiber is undergoing during the subsequent weaving or knitting processes, it has to be brought into a state which is resistant to deformation.

The shape of completely synthetic fibers can be fixed by treatment with dry heat or moist steam in special devices at certain pressures, and at temperatures of about 120 to 130° C.

It has also been attempted to carry out the fixing process in the crimping chamber proper, in order to avoid additional apparatuses, by introducing moist steam of a certain pressure and temperature into the chamber. However, the process of direct fixation with moist steam in the crimping chamber has the disadvantage that due to the low heat-conductivity of the synthetic material, the fiber cannot be properly heated in the short time available with the conventional operational speeds. Furthermore, the process requires a complicated mechanism within the crimping chamber. In case a heat fixation is carried out after the pressure crimping, the method of production is rendered more expensive due to a further processing step.

It is the object of the process according to the invention to overcome the above-mentioned drawbacks and to provide a simple method for the fixation of a pressure-crimped polycaprolactam fiber in the crimping chamber proper.

The present invention is based on the discovery that the temperature in the chamber can be so raised by the folding of the fibrils and the heat generated in their bending that the polycaprolactam fibers become moldable and may even be melted. This can be done by making the take-in speed in the crimping device about twice as high as practiced heretofore and maintaining the moisture content of the fiber entering the crimping chamber above a certain limit.

With the feed-in speeds of polycaprolactam fibers applied up to now, i.e. less than 100 m./min., this result cannot be achieved; however, by raising the speed to more than 100 m./min., and at the same time maintaining the degree of moisture in the fed-in rope at a minimum of 5%, the crimped material exhibits practically the same resistance to deformation as the ropes which underwent a special fixation treatment according to known methods. The high temperature mostly affects the points of folding, which is again due to the low heat conductivity of the material.

Since with a speed of, for instance, 170 m./min., and an arc number of 20/cm., each folding takes about 0.0002 second, the number of folds formed per minute is several billions with the conventional rope sizes. In this procedure, the material is heated to such an extent, that the water contained therein evaporates, so that a better heat distribution is obtained. The temperatures are of the magnitude of the usual temperatures of fixation, namely 120° C. to 130° C. The crimped and fixed material is tested for crimping fastness as follows: The ends of a single polycaprolactam fiber are secured, under a low pretension of 10 mgs. and a free length of 20 mm., in the clamps of a single-fiber test apparatus with pendulum balance or torsion balance. The crimped fiber is then stretched until it is completely de-crimped or straight. The de-crimping tension should not be of such magnitude as to effect a stress on the cross-section of the fiber.

A polycaprolactam fiber iss ubjected to 10 stretchings for 1 minute each, with 2 minutes for recovery between stretchings. The clamp distance during the recovery periods is the original 20 mm.

After the 10th recovery period, the fiber is stretched within the clamp with another 10 mgs. or at the highest 20 mgs.

The crimping fastness of the polycaprolactam fiber may be computed in percent according to the formula:

$$C.F.=\frac{(l_1-l_n)}{l_1}100$$

l_1 being the extension which the crimped fiber exhibits after de-crimping, and l_n the change in length remaining after de-crimping 10 times, as compared to the length of a crimped single polycaprolactam fiber before the test.

The invention will now be described in a number of examples, but it should be understood that these are given by way of illustration and not of limitation and that many changes in the details may be made without departing from the spirit of the invention.

Example 1

A rope of about 100,000 den. with about 28,000 single fibrils of 3.75 den. and a moisture content of about 5% are crimped at a feeding speed of about 80 m./min. According to the measuring method described above, the crimping fastness has been determined at about 30%.

The same rope with a moisture content of 10% and a feeding speed of about 160 m./min. shows, after crimping, a crimping fastness of about 55%.

Example 2

A rope as specified in Example 1 with a moisture content of 5% and 80 m./min. feeding speed, is subjected to a fixing process in boiling water for some time and yields a crimping fastness of about 53%.

When the same rope is fed into the crimping device with a moisture content of about 10% at a feeding speed of 170 m./min., and is fixed in the crimping device proper, it exhibits a crimping fastness of about 56%, which is

practically identical with the one above. No separate operation has, however, to be performed to obtain this crimping fastness.

If desired, the rope which is fed into the crimping chamber may contain some added wetting agent.

What I claim is:

1. A process for the fixation of pressure crimped synthetic polycaprolactam fibers by heat-setting in a crimping chamber without injection of setting agents into said chamber, which comprises feeding a rope of polycaprolactam fibers having a moisture content of 5 to 10 percent into a crimping chamber at a speed of 100 to 250 meters per minute, generating a hot, moist, setting atmosphere by virtue of the folding of the fibers, the heat generated by the folding of the fibers maintaining the crimping chamber at a temperature of approximately 120–130° C.

2. A process according to claim 1, wherein the speed is about 160–170 meters per minute.

References Cited in the file of this patent

UNITED STATES PATENTS

2,311,174	Hitt	Feb. 16, 1943
2,514,557	Pfau	July 11, 1950
2,575,781	Barach	Nov. 20, 1951
2,747,233	Hitt	May 29, 1956