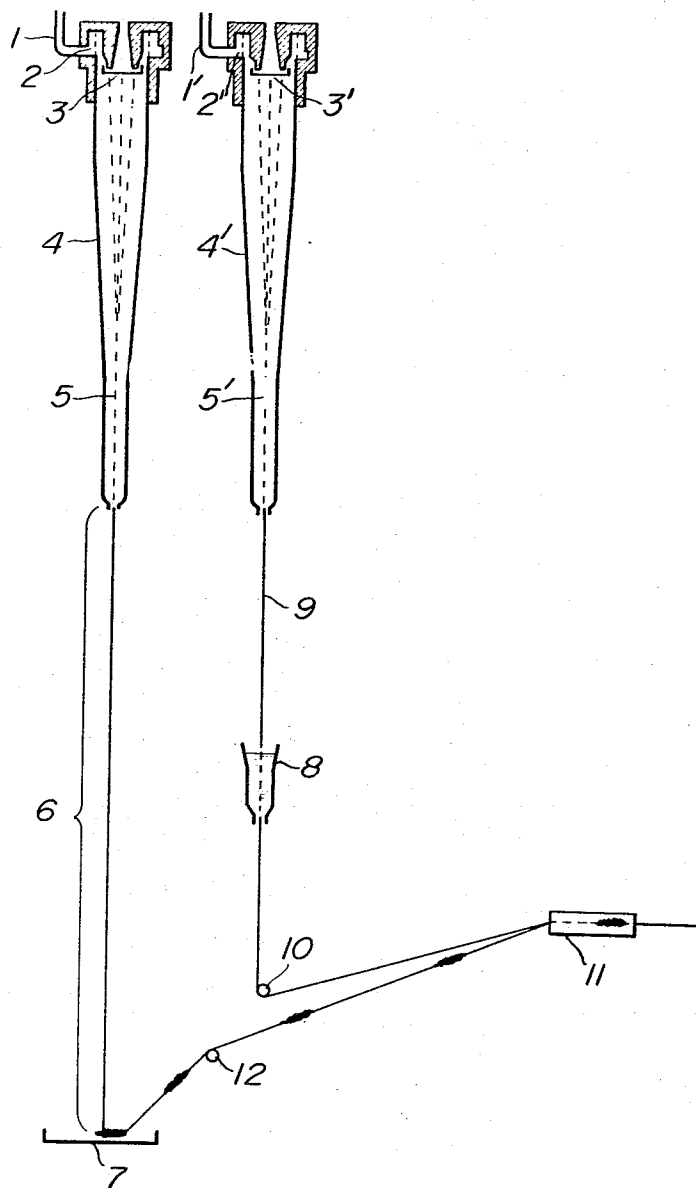


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APPARATUS ASSOCIATED THEREWITH
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METHOD OF PRODUCING NOVELTY YARN AND APPARATUS ASSOCIATED THEREWITH

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This invention relates to the manufacture of novelty yarn, and in particular to a method for the manufacture of novelty yarn comprising continuous filaments, which yarn can be made into fabric having a novel effect such as knotty shantung fabric. There is known a method for producing fancy yarns by spinning, which method uses running water as a stretching medium, such as the spinning of rayon and the like, which is disclosed in U.S.P. 2,251,247. It is a stretch spinning method for producing yarn with irregular knots and is characterized by sufficiently coagulating one of two separated spinning yarns of filaments by normal condition (this filament yarn is referred to as strength yarn hereinafter), coagulating the other yarn in a bath containing an increased amount of coagulation liquid or in a bath maintained at a low temperature and combining these two filaments into one yarn in a regenerating bath while causing the latter yarn to strike a receiver installed under a funnel (this filament yarn is referred to as slouched yarn hereinafter). However in this method, the differences in the spinning conditions of the strength yarn and the slouched yarn (an amount and temperature of coagulation liquid), requires that the difference in the coagulation state of the two yarns in the spinning process be made fairly large. The filament produced by such a method frequently causes problems in the weaving process, and in the handling of fabrics made from said filament. There is no doubt that spinning yarn by one set of apparatus having two different spinning conditions is commercially unfavorable.

If, in this instance, the spinning conditions between the strength yarn and the slouched yarn could be made equal, there would be provided a commercially advantageous spinning method. Moreover, since filament yarns of almost the same coagulation state are combined in this method, it would produce knotty yarns of superior properties.

After an extensive and careful study of the spinning process which uses running water as a stretching medium, I have now solved the above-described drawback.

Observing the spinning process which utilizes running water as a stretching medium, it is seen that the coagulation liquid delivered into a coagulation funnel flows from the outlet of said funnel while promoting coagulation of the spinning solution and stretching it to shape filaments by means of the friction between the filament yarn and the liquid. At the ordinary spinning, or at the spinning of the strength yarn, the speed of the filament yarn given by the drawing and the stretching of this coagulation liquid before being taken up by the winder must be equal to or slower than the take-up speed.

The first point which should be noted is that the speed of the coagulation bath from the outlet of the funnel can be increased by the acceleration of gravity to such an extent as to cause the speed of the yarns before being taken up to be greater than take-up speed under normal spinning conditions as described above. In other words, if the length of the free fall of the coagulation liquid is increased sufficiently, the falling speed of the coagulation liquid due to gravitational acceleration becomes so large, that the filament yarn is sufficiently stretched, as a result of which the speed of the filament yarn before being taken up can be made greater than the take-up

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speed. Therefore it becomes possible to take-up the yarn while forming irregular knots. In other words, it is possible to form the slouched yarn by making the filament yarn together with coagulation liquid strike a receiver installed beneath the spinning funnel, permitting it to remain there momentarily, thereby forming entanglements or loops while in a state of insufficient coagulation.

The second point which should be noted is that the speed of the coagulation liquid which is being accelerated by free fall is interrupted or reduced half way, thereby controlling the falling speed of the filament. It is preferable to install a lower step funnel, i.e. a small sized coagulation bath as hereinafter described, and promote the ultimate coagulation by which the speed-increase of the filament yarn due to drawing can be controlled at a moderate value and thus a strength yarn can be spun.

For example, when a small sized funnel having a broad opening on the top is inserted as the lower step funnel in the path of the falling filament yarn, the coagulation liquid fills this low step funnel and falls down from the bottom hole of this funnel together with filament yarn, by which the speed of coagulation liquid in the free falling part is interrupted and reduced.

This invention is based upon the above-described findings. The details of the present method will be more fully described by reference to the accompanying schematic drawing.

In the drawing, coagulation liquid is delivered from inlet pipes 1 and 1' through stream regulators 2 and 2' and, simultaneously, spinning solution is extruded from spinnerets 3 and 3' and formed into filament yarns while undergoing drawing and coagulation in spinning funnels 4 and 4'. Both spinning funnels are the same, and the spinning conditions within funnels 4 and 4' are also the same. The coagulation liquid discharged from spinning funnel 4 increases its falling speed by gravitational acceleration during its sufficiently long free falling distance 6 while stretching the spun filament yarn and strikes at receiver 7 placed in the path of the falling filament yarn. This receiver can be either a dish, a flat plate, or an uneven plate. Its angle of inclination can be freely selected. In this instance, the distance between funnel 4 and receiver 7 (i.e. free falling length) can be determined according to the spinning condition. Accordingly when the filament speed is sufficiently larger than the take-up speed, the falling filament yarn strikes receiver 7, remains there momentarily and forms loops or entanglements in a premature state of coagulation. Thus it is taken up as slouched yarn.

The coagulation liquid discharged from the other spinning funnel 4' enters the small sized lower step funnel 8 located halfway through its free fall distance, its falling speed is interrupted, thereby drawing as well as stretching, and the falling speed of filament yarn 9 is suppressed. The filament yarn subsequently passes direction changing rod 10, and is combined as a strength yarn with the above described slouched yarn and regenerated in bath 11, by which novelty yarns having irregular knots can be produced.

It will be favorable to provide the lower step funnel with a suitable buffer bath which controls the free falling of the coagulation liquid and does not damage the filament yarn. Its location, length and shape may vary according to spinning conditions such as temperature and amount of spinning liquid, desired denier of yarn to be produced, diameter of the spinning nozzle, etc., but it will be favorable to arrange it so that the tension of the filament yarn before being taken up is at a maximum. It is also possible to use a multiple funnel, i.e. one in which two or more funnels are assembled into a set.

As is obvious from the above description, the present method is not only commercially advantageous in that it

enables one to spin knotty yarns by use of the same amount of spinning liquid, the same temperature of coagulation bath and the same spinning funnel, but also in that it produces novelty yarns having superior properties.

The invention will be better understood by describing it in connection with the following specific example of the practice of it, in which proportions are expressed as percent by weight.

Example

As is shown in the accompanying drawing, normal stretch spinning funnels, as used in the cuprammonium process, having 40 cm. length and 0.4 cm. outlet diameter are used. Under funnel 4', lower step funnel 8 as described above having 10 cm. length, and 0.25 cm. outlet diameter is placed at a distance of 15 cm. from the lower end of the funnel 4'. At a distance of 20 cm. from the top of lower step funnel 8 is placed direction changing rod 10. Under funnel 4, receiver 7 having 0.5 cm. depth and 7 cm. width is placed at a distance of 40 cm. from the lower end of funnel 4. A spinning solution containing 9 percent cellulose, 7.2 percent ammonia, and 3.7 percent copper is extruded from spinnerets 3 and 3' each having 54 holes of 0.8 mm. diameter, after which it is coagulated while stretching by use of 800 cc./min. of water at a temperature of 28° C., combined into one yarn in regenerating bath 11 of 6.5 percent sulfuric acid and taken up by hanks at a take-up speed of 65 m./min. as multifilament of mean 150 denier.

In this instance the filament yarn 9, spun by funnel 4' enters the lower step funnel 8 which is always kept filled with down pouring water and by its buffer action, stretching of the filament is suppressed, while promoting coagulation and the take-up of the filament yarn is performed as usual. On the other hand, the filament yarn, spun by funnel 4 is drawn and stretched by means of the great water speed produced by gravitation due to the long free falling distance (the falling speed of water at the time of its impact with receiver 7 is about 180 m./min.) and strikes receiver 7 with a speed faster than the take-up speed.

Although the knotty yarns thus produced have knots which are not greatly different from the knotty yarns obtained by a known method (U.S.P. 2,251,247), the former shows superior properties in weaving operations. When yarns made by the known method are rewound from reels to bobbins, there are counted 100 to 300 cuts per 100,000 meters of yarn, whereas the yarn made according to the method described in this specific example reveals only 3 to 4 cuts per 100,000 meters of yarn.

What I claim is:

1. A method for producing a novelty yarn having irregularly spaced knots, said method comprising simultaneously extruding two separate spaced filaments of the same size and composition at a common level such that the filaments freely fall in space vertically, combining the filaments after one has fallen a greater distance than the other and reducing the speed of fall of the filament which passes through the lesser distance.

2. A method as claimed in claim 1 wherein the speed is reduced by passing the filament through a buffer bath.

3. A method as claimed in claim 2 wherein the buffer bath is placed about midway through the distance through which the filament falls.

4. A method as claimed in claim 1 comprising interrupting the fall of the filament which has fallen the greater distance and causing the same to momentarily accumulate whereby knots are formed therein before combination with the other filament.

5. A method for producing a novelty yarn having ir-

regularly spaced knots, said method comprising the steps of simultaneously extruding at least two separate filaments from a coagulable solution through a corresponding number of spinning funnels, discharging said filaments in a partially coagulated state from said spinning funnels, allowing said partially coagulated filaments to freely fall and acquire free fall velocities, whereby said partially coagulated filaments form yarns, one of said partially coagulated filaments being allowed to fall a greater distance than the other of said partially coagulated filaments to stretch said one partially coagulated filament, interrupting the fall of the thusly stretched partially coagulated filament while momentarily causing the same to accumulate whereby a slouched yarn is formed; passing the other of said partially coagulated filaments through a lower step funnel containing a buffer bath during its free fall to cause said other partially coagulated filament to fall with reduced velocity, whereby a strength yarn is formed, combining the thusly formed strength yarn with the slouched yarn while advancing the two formed yarns together at a velocity which is less than the free fall velocity of the said one partially coagulated filament, and greater than the reduced velocity of said other partially coagulated filament, and subjecting the thusly combined yarn to the action of a regenerating bath.

6. A method as claimed in claim 5 wherein said coagulable solution comprises cellulose derivatives.

7. A method as claimed in claim 5 wherein said coagulable solution comprises cuprammonium.

8. A method as claimed in claim 5 wherein said regenerating bath comprises sulfuric acid.

9. Apparatus for producing novelty yarn comprising first and second vertical spinning funnels in horizontally spaced relation and having outlets at a common horizontal level, means for supplying separate streams of spinning solution to each funnel, a spinneret in each funnel for extruding the respective spinning solution supplied thereto, an inlet pipe for each funnel for the supply thereto of respective streams of coagulation liquids whereby a filament yarn is discharged from the outlet of each funnel, a receiver below the outlet of one funnel, means below the outlet of the other funnel for reducing the speed of free fall of the filament yarn discharged therefrom, and means for engaging the filament yarns and combining and transporting the same at a speed such that irregular knots are formed in the filament yarn which contacts said receiver while the other yarn is stretched.

10. An apparatus as claimed in claim 9 wherein the outlets are of equal diameter.

11. An apparatus as claimed in claim 9 wherein the spinnerets are each provided with an equal number of perforations of uniform diameter.

12. An apparatus as claimed in claim 9 wherein the receiver is a shallow dish.

13. An apparatus as claimed in claim 12 wherein the dish has an uneven surface.

14. An apparatus as claimed in claim 9 wherein the means for reducing the speed of free fall is a lower step funnel containing a buffer bath.

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