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ARTIFICIAL WOOL FILAMENT AND YARN

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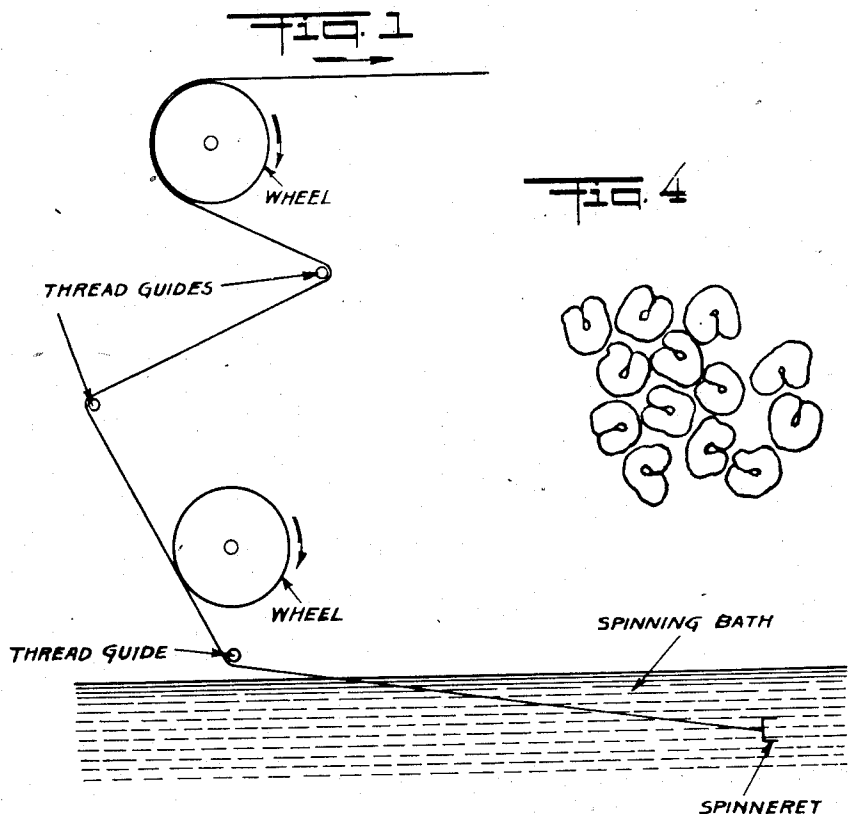


FIG. 4

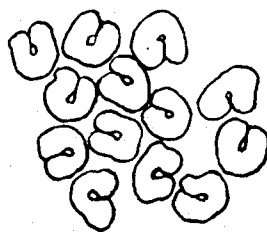


FIG. 2

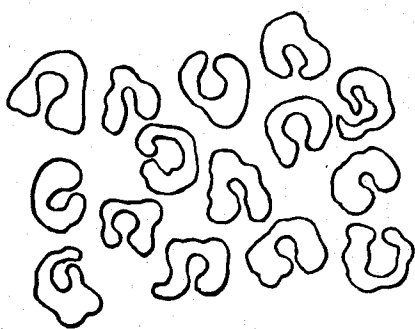
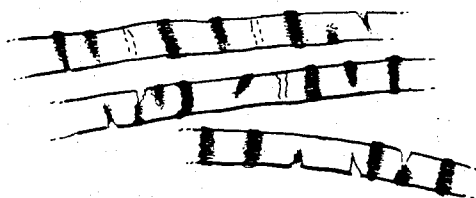


FIG. 3



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UNITED STATES PATENT OFFICE

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ARTIFICIAL WOOL FILAMENT AND YARN

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5 Claims. (Cl. 57—140)

This invention relates to the manufacture of filaments, threads, yarns, ribbons, staple or similar fibres and the products made therefrom, having the characteristics of natural wool in respect to appearance, feel, serimetric and physical properties. I produce such wool imitation filaments, etc. from cellulose containing vegetable sources according to the viscose method.

It is known that a temporary wool character can be obtained when producing filaments from viscose by spinning the viscose at a ripeness greatly deviating from the customary one. But such wool characteristics produced by extraordinary ripeness conditions are not permanent and disappear during the subsequent treatment of the filaments and/or their fabrics such as boiling, ironing, etc.

When hereinafter referring to ripeness degree, the so-called Hottenroth-ripeness is meant, which is determined according to the following method: 20 grams of viscose are diluted and mixed with 30 ccm. of water. Then a 10% ammonium chloride (NH_4Cl) solution is slowly added until the viscose reaches the coagulation point. The number of cubic centimeters of NH_4Cl solution necessary to reach this coagulation point is the ripeness or ripeness degree of the viscose.

In the drawing:

Fig. 1 is a diagrammatic view of a spinning device upon which the improved yarn is spun.

Fig. 2 is an end view of the finished yarn.

Fig. 3 is a side view of the same.

Fig. 4 is similar to Fig. 2 but showing a smaller air-enclosing canal.

The viscosity referred to hereinafter is determined according to the ball-fall method, carried out in the following manner: The viscose under examination is poured into a vertical glass tube of 300 mm. length and 25 mm. diameter. The viscose should have a temperature of about 18 degrees C. On the glass tube are provided two markings, 200 mm. apart. A steel ball of 3 mm. diameter and weighing 1.28 grams is dropped into the glass tube, and the time required by the steel ball to drop through the 200 mm. column of viscose between the upper and the lower mark, is measured. The number of seconds required by the steel ball to drop said 200 mm., is the viscosity of the viscose.

When spinning ordinary viscose rayon or staple fibre, the viscose is spun at a usual ripeness of 7 to 13 and a viscosity of 25 to 50. Approximately the same figures are meant when referring hereinafter to "ordinary or usual ripeness" and "ordinary or usual viscosity."

According to my invention, I obtain filaments, etc., with permanent wool characteristics by preparing a viscose of high viscosity and by spinning this viscose into a bath containing a comparatively large quantity of certain salts. A salt content of 4% zinc sulphate or more, besides the normal sodium sulphate content, was found very satisfactory for this purpose. But under certain circumstances aluminum sulphate, magnesium sulphate, ammonium sulphate, nickel sulphate and cobalt sulphate were also found suitable. It is also possible to use a combination of two or more of the above described salts, always over and above the normal sodium sulphate content. The reason I provide for these salts in my spinning bath is, that these salts not only improve the wool-like feel of the filaments produced according to this process, but I also find that the presence of these salts at the given high percentages counteract the drawbacks of spinning a highly viscous viscose. On the other hand, the high viscosity of the viscose counteracts the objectionable effects of the high percentage of zinc and other sulphates mentioned in the spinning bath, which occur, when using such high percentages in spinning a viscose of normal viscosity.

When referring in this specification to the "high salt content," a salt content of 4% zinc sulphate or more, over and above the normal sodium sulphate content of about 23%, or a combination of any two or more of the above mentioned salts, and having a similar effect as 4% or more zinc sulphate, is meant. The above mentioned "similar effect" is intended to refer to the wool characteristics of the filaments only.

As mentioned above, various attempts have been made to produce wool-like filaments by spinning a viscose with abnormal ripeness, both very high and very low. It is, however, known to people skilled in the art that it is very difficult to control the ripeness of viscose in either a very fresh (unripened) or in a very ripe condition. I have discovered the new and desirable effect of spinning a viscose with a high viscosity but at normal ripeness into a spinning bath containing a high percentage of zinc or similarly acting sulphates, in order to obtain filaments, etc., with a wool characteristic. I have also discovered that the disadvantage of spinning a viscose with a very high viscosity into a normal spinning bath, and the disadvantages of spinning a viscose of normal viscosity into a spinning bath containing a high percentage of zinc sulphate, can be avoided by spinning viscose with a high viscosity into a spin-

ning bath containing a high percentage of zinc or similarly acting sulphates. In this specification the term "spinning viscosity" is intended to refer to the viscosity of the viscose at the time of spinning.

Example 1.—Cellulose is treated in an 18% caustic soda solution at 20 degrees C. for about one hour and then pressed to retain caustic soda solution amounting to twice the quantity of cellulose used. This cellulose is then shredded into fine crumbs at a temperature of 22 degrees C. The shredded alkali cellulose is then immediately sulphidized with 33% carbonbisulphide at a temperature of 22 to 25 degrees C. for about 90 minutes. The xanthate obtained is dissolved in a dilute caustic soda solution, so as to form a viscose amounting to twice the quantity of cellulose used, and is stored in tanks. At this point the viscose has a viscosity of 900 and a ripeness of 13.

The viscose is then filtrated and evacuated immediately, within about 6 hours. During this time the viscosity drops to about 850 and the ripeness to 12.6. (According to the old method, viscose is stored for about 90 hours.)

The viscose is then spun (projected through spinnerets) into a spinning bath containing 11% sulphuric acid, 23% sodium sulphate and 4% zinc sulphate at a temperature of 45 degrees C.

The filaments obtained are either collected in one of the known devices and then washed, bleached, etc., in order to finish them or they can be finished in one continuous operation whilst continuously running.

Example 2.—Viscose prepared according to Example 1 is spun into filaments on a spinning machine provided with the following devices:

The viscose pump forces the viscose through the spinneret which contains the number of holes required for the purpose the filaments are provided for. There is, further, a glass wheel provided at a distance from the spinneret. The wheel is driven and runs outside the spinning bath. There is a second glass wheel provided above the first glass wheel.

The viscose projected through the spinneret forms filaments by coagulation and is withdrawn from the spinneret by the first glass wheel around which the filaments take up to one complete turn. From here, the thread passes on to and around the second glass wheel which is driven at a peripheral speed greater than that of the first wheel. The number of turns taken by the filaments around this second wheel depends on the position of the eventual collecting device. The filaments may be taken up by

(a) Bobbins, reels or any other winding-up mechanism,

(b) Pots or buckets,

(c) Rollers or other guiding or feeding devices on which the filaments, whilst continuously running, are subjected to washing and bleaching or that feed the filaments to be a cutting device.

The immersion length of the filaments in the spinning bath, the position of the glass wheels and the angles in the direction of the filaments or threads formed by these wheels must be determined according to the desired results and will vary with the types of viscose and spinning bath used.

Example 3.—Mode of operation as in Example 2 with the difference that there may be thread guides provided between the spinneret and the first glass wheel, between the first glass wheel and the second and between the second glass

wheel and the take-up arrangement, in order to increase the tension and stretch on the filaments.

Example 4.—Mode of operation as in Example 2 with the difference that one of the glass wheels is omitted and that tension is applied to the filaments between the remaining glass wheel and the spinneret or the take-up arrangement. There may be additional thread guides provided.

Example 5.—Mode of operation as in Example 2 with the difference that both glass wheels are omitted and that tension is applied to the filaments solely by means of thread guides between the spinneret and the collecting device.

In order to obtain a more wool-like feel and appearance of the filaments produced from viscose prepared according to above mentioned examples, it has been found advisable to coagulate these filaments in loose condition and to apply the necessary tension after the filaments have been formed but while they still partly are in a plastic condition.

To this end and as one embodiment of my invention, a spinning device as shown in Fig. 1 and explained in the examples may be used. After the viscose squirted through the spinneret has partly been precipitated so as to form tubes which still contain fluid viscose on the inside, they are given tension only sufficient to withdraw the filaments but not stretching them immediately after their formation.

After the filaments have thus been given time to take the required shape, they are stretched sufficiently by various methods to obtain sufficient strength. This can be done by thread guides, rollers, wheels, etc., as described in the examples.

The composition of the viscose and of the spinning bath cause the filaments produced to have a rough or cracked surface, similar to the scales of natural wool. Furthermore, the filaments twist in such a manner as to have a cross-section similar to a horse shoe, the ends of which touch or overlap, as illustrated in Fig. 2 and Fig. 4.

I have found that filaments, etc., obtain good wool-like qualities by spinning viscose as described under the following conditions:

I spin (project through a spinneret) viscose into a spinning bath of the composition as outlined. The distance between the spinneret and the (first) drawing-off mechanism is between 10 and 30 inches, all of which, or a portion of which may be the actual immersion length in the spinning bath.

There may be one or two drawing-off mechanisms provided anterior to the eventual collected device. According to the present invention, I withdraw the filaments formed from the spinneret under as little tension as possible so that the initial formation of the filaments which consists of the formation of a cellulose tube, (which is comparatively rigid, but which still contains fluid viscose on the inside), takes place in loose condition. After the filaments have thus been formed, under conditions which allow them to assume the required shape and structure caused by the effects of the viscose and the spinning bath upon each other, I apply tension or stretch the filaments by increasing the drawing-off speed. This increase in the drawing-off speed is such as to cause a cracking or breaking of the rigid outer cellulose layer of the filaments formed, which is not plastic enough to follow the stretch

applied to the filaments while the more plastic or fluid inner part of the filaments will be able to do so, as illustrated in Fig. 3.

I found that it is also possible to apply sufficient tension to the filaments to obtain the above described results by conducting filaments around thread guides instead of rollers, etc.

The cracked or ruptured surface of the filaments thus formed eventually, improves their wool feel and under proper conditions even resembles the scales of the natural wool fibre. Another consequence of this method of spinning is that the filaments take the shape of a horse-shoe (Fig. 2), the two ends of which almost touch or sometimes overlap, the filaments thus having an air-enclosing space in the center which increases the insulation power and thus the warmth of the filaments or yarn, fabrics, etc., made from them.

In order to be able to treat the filaments in the above described manner, it is important that the coagulation of the viscose and the complete regeneration of the cellulose does not take place too quickly. It is known to persons skilled in the

able conditions for each particular cellulose used or the type of wool imitation fiber, etc., to be imitated. There are a great many different types of wool ranging from Merino, which has a very soft feel, to a cross-bred, which is rather hard to the touch.

When using or referring in this specification to the term "filaments," this term is meant to include other viscose products, such as threads, ribbons, fibers and the like.

I am fully aware that neither a high zinc sulphate content in the spinning bath nor an abnormal viscosity of the viscose, nor a stretching of the filaments after formation are essentially new in themselves, but this invention concerns itself with their use and importance in the manufacture of wool imitation filaments, etc., and the new and desirable effect when used in combination.

Example 6.—Viscose prepared according to Example 1 and spun under conditions and on the devices according to Examples 2 to 4, is precipitated in a spinning bath having one of the following compositions:

	Sulphuric acid	Sodium sulphate	Zinc sulphate	Aluminum sulphate	Magnesium sulphate	Ammonium sulphate	Nickel sulphate	Cobalt sulphate	Remarks
	Grams per liter	Grams per liter	Grams per liter	Grams per liter	Grams per liter	Grams per liter			
1.....	135	285	50						Carpet wool.
2.....	150	285	45						
3.....	130	230	20		30				
4.....	130	230	30	15					
5.....	130	230	30				5		
6.....	135	180				70	5		
7.....	135	180			50		5	5	
8.....	150	200	20	10		20			Cross-bred.
9.....	120	150	60					5	
10.....	120	150	40		30				Merino.
11.....	160	200	50	10					Cross-bred.

art that zinc sulphate retards the complete regeneration of the cellulose by quickly forming a cellulose film or tube on the outside of the tiny stream of viscose projected through the spinneret. The still fluid viscose on the inside of the filament must then be coagulated by means of dialysis through this film membrane, thus retarding the complete regeneration of the cellulose.

The filaments obtained according to this method thus have the appearance and the feel of natural wool, and have at the same time a rough surface, and a hollow, air-enclosing space or canal in the center, as shown in Figs. 2, 3, and 4.

According to my invention, I apply to the filaments such a tension by conducting them around above mentioned thread guides or guide rollers placed at various distances and angles, so as to give the final filaments the same elongation as that of the natural wool fibres they are intended to be blended with, or which they are to replace.

By regulating the composition of the spinning bath, especially in regard to the quantity of sulphuric acid, I apply the required degree of hardness or softness to the fibres necessary in order to imitate the natural wool fibre, especially in regard to their behavior when spun into yarn. By increasing the quantity of sulphuric acid, it is, for instance, possible to increase the hardness of the fibres obtained up to the degree of hardness which certain kinds of wool, as for instance cross-bred, have.

It is impossible to indicate every condition necessary in order to obtain the desired properties of the filaments, threads, ribbons, etc., produced and it is to be understood that experiments cannot be avoided to find the most suit-

The dyeing properties of fibres or filaments obtained in the above described ways are excellent and of great uniformity. The reason is that the viscose prepared by my method has a very slow ripening tendency. In distinct contrast to the old method, the viscose prepared by my method changes its ripeness during the course of 2 hours, only about 0.1 to 0.15 degree.

It is known that fluctuation in the ripeness of viscose are the cause for uneven dyeing of the filaments or the fabric eventually produced. Ordinary viscose changes its ripeness during the two hour period, during which the contents of one spinning tank are being used up (which may form the thread of one continuous skein of rayon) by about 0.4 degree. While this fluctuation often causes uneven dyeing, the change in ripeness of the viscose prepared according to my invention of about 0.15 degree is negligible.

When producing filaments, etc., according to above described methods, the filaments have a subdued lustre which may range from a slight to a very distinct dullness. This property is very desirable in view of the fact that natural wool is also dull and that artificial filaments produced by this method can be blended with wool or used in the place of wool without changing the appearance of the product at all, compared with a 100% woollen product.

This dullness which in contrast to other delustering methods is obtained without the use of chemical additions or mechanical treatments, is permanent and will not be removed by any subsequent treatment of the product.

As it is intended to blend filaments produced according to my method with wool or to use them instead of wool, these filaments should therefore

resemble natural wool as closely as possible. For this purpose, the fibers, filaments, etc., produced are intentionally given the same physical properties as those of the woolen fibers they are to be blended with or they are to replace. Such mechanical and physical properties, of course, depend on and vary with the different kinds of natural wool, and include staple length, cross-section, crimp, surface character, elasticity, inter-fibre friction, color, luster, heat conductivity, feel and appearance.

It is obvious that when spinning a yarn which is to resemble wool, the percentage of artificial fibres used in this blended yarn can correspondingly be increased with an increasing wool-likeness of the artificial fibres. In some cases, even a 100% artificial fibre yarn can be spun, which has all the mechanical and physical properties of a pure woolen yarn.

After spinning filaments according to one of the above described methods, the filaments can either be (in the case of cut staple fibres)

- (a) Washed, cut and then dried
- (b) Washed, dried and then cut
- (c) Cut, washed and dried.

Without limiting myself to the below described method, I prefer to continuously wash, cut, and then dry the filaments. A suitable method and apparatus for carrying out my process are described in United States Patent No. 2,134,160. The term "washing" is meant to include such treatments as de-sulphurizing, bleaching, etc.

In order to give the filaments the same or better crimp than that of the natural wool fibre, which is very desirable to the spinner when spinning such cut filaments into yarn, I dry and treat the filaments as follows:

Prior to drying, I open the cut filaments as well as possible by floating them in a large volume of a suitable solution and/or mechanically by passing them through one of the known wet openers. I do this because it is known that a larger part of the crimp in artificial filaments appears during the drying operation and in order for the filaments to be able to follow this shrinking tendency as much as possible, it is necessary that the filaments be opened up well and be in a fluffy condition so as not to prevent them from shrinking, contracting, twisting and curling by inter-fiber friction.

I have found, however, that on account of the wet condition the filaments are in when first entering the dryer, it is impossible to complete the drying in as loose a condition as seems desirable for the purpose. I therefore have designed my dryer as follows:

The dryer is divided into two independent units or sections, each of which can be worked at different speeds, temperatures, humidities, etc. Intermediate these two sections, there is provided a second opener. The filaments passing through the first section of the dryer lose part of their moisture content and then pass through this second opener. The filaments which are now only in semi-wet condition are opened much more readily and are not as clogged together as when opened in wet condition. This second opener can also perform a much more thorough opening operation because the action on the filaments does not have to be as gentle as when opening completely wet fibers. It is known that viscose fibers are weaker in wet condition than in dry condition and while the first opener is to be designed in such a way as to avoid damage by stretching or tearing of the filaments, the second opener may

have a much more severe action. The fibres having passed through the second opener, enter the second section of the dryer in loose and fluffy condition and are capable of receiving a curl or crimp in the second section of the dryer.

By this method it is also possible to dry the filaments in the first section of the dryer at a much higher temperature because the filaments still have a high moisture content. In the second section of the dryer the temperature is correspondingly lower.

While it has been suggested to comb fibers during the drying operation in order to simplify the carding operation, I believe that I have discovered the new and desirable effect of an opening operation of semi-dry fibers on the crimp of the finished fibers.

The various wool-like properties of the fibres are important both from the standpoint of the spinner and the eventual consumer. The following properties, for instance, affect the making, i. e., the spinning of the yarn rather than the wearing or use of the fabric: staple length, cross-section, crimp, surface character and inter-fiber friction, all of which have a direct bearing on the spinnability and the cost of the yarn spun. On the other hand, color, lustre, heat conductivity, feel and appearance are properties of importance to the consumer rather than to the producer. One very important factor, equally important to both, is the elasticity, as this property affects the spinning as well as the wearing qualities of the fibres to a very large extent.

It is known that the spinning properties of fibres depend, to a large extent, on the surface structure (smoothness or roughness) of these fibres. It has always been considered a disadvantage of ordinary cut rayon staples that their surface was too smooth and did not result in the same good spinnability as that of cotton or of wool. As described above, I therefore, regulate the degree of roughness I apply to the filaments spun according to my process, by giving them a more or less cracked and rough surface, comparable to that of wool.

Through my process I am also able to give these artificial wool imitation filaments the same warmth (insulating power) as that of wool. I accomplish this by giving the filaments the described twisted shape resulting in the air-enclosing canal running in longitudinal direction through the whole length of the filaments.

I am able to blend artificial wool imitation filaments produced according to my process, amounting to at least 40% with natural wool to form either a composite yarn or a 100% artificial filament yarn. Such composite yarns may consist of a wool and cut staple fibre mixture, of a doubled wool yarn and staple fibre mixture, of a doubled woolen yarn and continuous filament rayon yarn. In each case the cut fibres, the staple fibre yarn and the continuous filament yarn have been given the above described wool characteristics.

This is a divisional application of my application Serial No. 258,498, filed February 25, 1939.

I claim:

1. As a new product, a composite yarn consisting of natural wool and artificial wool imitation fibers in which the artificial fibers have been made from unadulterated viscose by projecting said viscose through a spinneret into a spinning bath, drawing off the filaments under low tension so as to allow a comparatively rigid cellulose tube containing partly coagulated vis-

cose to form on the outside of the filaments, and then stretching the filaments so as to cause said cellulose tubes to crack and to thus form a rough surface, giving the fibers at least the same inter-fiber friction as that of natural wool and forming a stronger composite yarn with it.

2. As a new product, a composite yarn consisting of natural wool and artificial wool imitation fibers in which the artificial fibers have been made from unadulterated viscose by projecting said viscose through a spinneret into a spinning bath, containing sulphuric acid, sodium sulphate and at least 4% zinc sulphate, drawing off the filaments under low tension so as to allow a comparatively rigid cellulose tube containing partly coagulated viscose to form on the outside of the filaments, and then stretching the filaments so as to cause said cellulose tubes to crack and to thus form a rough surface, giving the fibers at least the same interfiber friction as that of natural wool and forming a stronger composite yarn with it.

3. As a new product, a composite yarn consisting of natural wool and artificial wool imitation fibers in which the artificial fibers have been made from an unadulterated viscose base and which have been given during the manufacture thereof the same properties and characteristics as natural wool including insulating power and curliness, such characteristics being permanently incorporated in the artificial fibers to withstand all future treatments of the fibers in their normal uses, in order to increase the percentage of artificial fibers in the composite yarn to over 40% without materially changing the properties of the composite yarn as compared to a pure woolen yarn, said artificial fibers having a rough surface formed by stretching the fibers during the spinning operation to cause a cracking of the outer surface thereof.

4. As a new product, a composite yarn consisting of natural wool and artificial wool imitation fibers in which the artificial fibers have been made from unadulterated viscose by projecting the viscose through a spinneret into a spinning bath, drawing off the filaments under low tension so as to allow a rigid cellulose tube to form on the outside of the filaments, stretching the filaments so as to cause said cellulose tubes to crack and thus form a rough surface, after-treating the filaments, cutting the filaments to form staples, subjecting the filaments to an opening operation, partially drying the filaments, subjecting the partially dried filaments to a second opening operation, and then completing the drying of the filaments to produce a fiber having a permanent crimp or curl substantially corresponding to that of natural wool so that the composite yarn will have the characteristics of natural yarn.

5. As a new product, a composite yarn consisting of natural wool and artificial wool imitation fibers in which the artificial fibers have been made from unadulterated viscose by projecting the viscose through a spinneret into a spinning bath, drawing off the filaments under low tension so as to allow a rigid cellulose tube to form on the outside of the filaments, stretching the filaments so as to cause said cellulose tubes to crack and thus form a rough surface, aftertreating the filaments and drying the filaments to produce fibers having a permanent crimp or curl substantially corresponding to that of natural wool so that the composite yarn will have the characteristics of natural yarn.

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