Dec. 27, 1938. A. H. ROSENBERG 2,141,253

FIBROUS SILK AND THE MANNER OF ITS PRODUCTION

Filed Feb. 12, 1935

Fig. 1

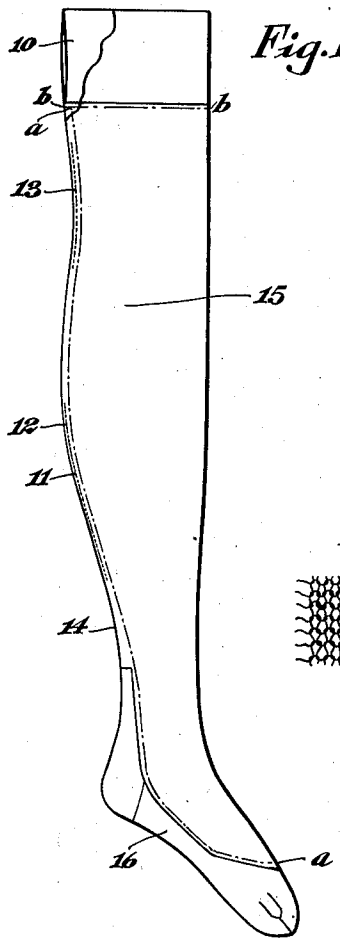


Fig. 2

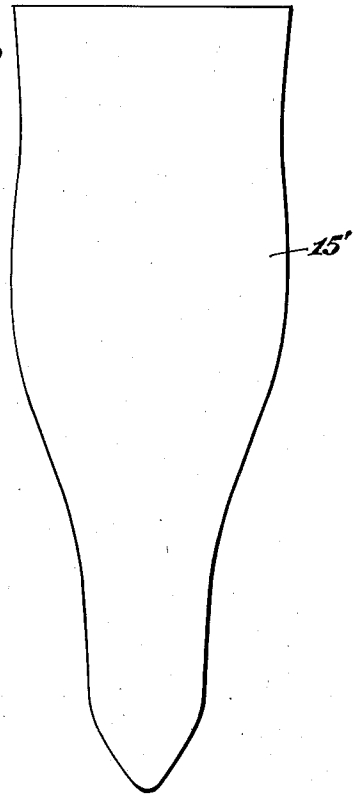


Fig. 3

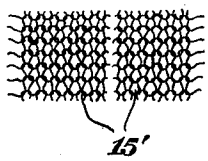


Fig. 4

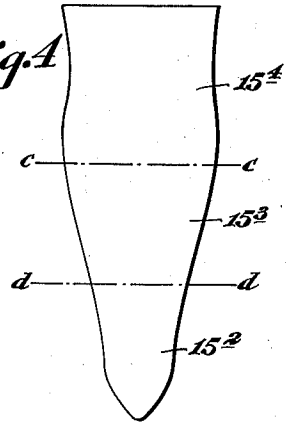
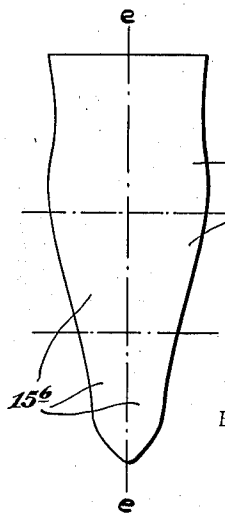


Fig. 5



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Patented Dec. 27, 1938 2,141,253

UNITED STATES PATENT OFFICE

2,141,253

FIBROUS SILK AND THE MANNER OF ITS PRODUCTION

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Application February 12, 1935, Serial No. 6,197

4 Claims. (Cl. 28—1)

This invention relates generally to the production of a material constituted of elementary filaments or fibres of silk or the like.

The invention contemplates a novel product, namely, a mass of such fibres in an elementary, filamentary or fibrous state and in the form of short lengths and free from nubs, entanglements and other impurities and free especially from the presence of threads as contra-distinguished from elementary fibres or filaments. My invention further contemplates a method by which material of the character mentioned can be reduced to a filamentary or fibrous state.

In the specification, I will describe my invention as employed for the production of such a material constituted, however, of real silk of the type which is obtained from the cocoon of the silk worm, and the employment for that purpose of a fabric constituted of such silk such as a stocking. It will, however, be understood that this is done primarily for convenience of disclosure and that my process is equally applicable to fabrics constituted of the artificial products known as "rayon" and the like, and to end products obtained therefrom.

It will therefore be understood that where I employ the word "silk" anywhere in the specification or claims that word shall be interpreted as including not only the product known as real silk, but also similar products such as rayon and the like.

Where I have attempted to employ such a method in connection with cocoon waste, that is those portions which are unsuited for spinning because of irregularities, coarseness or the presence of foreign matter, or in connection with pierced cocoon and "gum-waste", etc., I have discovered that the resulting fibrous silk mass will invariably contain nubs and other irregularities, and also that the filament lengths will vary widely so as to effect the homogeneity of the mass.

Where on the other hand I have attempted to apply this process to silk in threaded form, such as is produced by unravelling knitted fabrics, I have found that the product, besides presenting the same objectionable features mentioned in connection with the utilization of cocoon waste, is contaminated with threads which have escaped the reduction process.

I have discovered that (*a*) the contemplated method, if applied to silk fabrics of prescribed characteristics rather than to the silk threads or fibers, produces a homogeneous mass of pure silk fibres entirely free from the objections above mentioned and (*b*) a fabric knitted as is a silk stocking, possesses the prescribed characteristics for the proper application of my method to produce the desired end product.

Favorable for the attainment of my objective is the fact that a stocking is knitted of one or more threads which are continuous into parallel courses interlocked with each other by looping. The integrity of the stcoking fabric is maintained by the continuity of the thread or threads and the interlocking of the loops.

From another aspect my invention contemplates the reduction of the silk constituent of discarded stockings to a homogeneous mass of silk fibres or filaments, free of threads, nubs, and other irregularities.

Among the more important objects of my invention are: the production of a pure silk product constituted of elementary fibres or filaments; the attainment of such a product in which the mass is free of nubs, entanglements, and other impurities, the attainment of such a product which is free of threads as contra-distinguished from the elementary fibres or filaments; the manufacture of such a product which shall be suitable in all respects for further processing, for example, as spinning; the production of a silk mass in which the fibres or filaments are of uniform length throughout and for the attainment, in addition to such uniformity of fibre length, of a regulated control of the said lengths; the employment of a knitted fabric for the attainment of the aforementioned products and of a process whereby such products are obtained from such knitted fabrics; the utilization of discarded silk stockings as a main source of such fabric or such other knitted fabrics as may be available; a process whereby the useable silk portions of a stocking can be readily segregated from the rest for the practice of my process; the process whereby the useable silk portions so segregated are subject to other preparatory treatment, and generally the production of a new and improved silk product and a process for cheaply obtaining the maximum percentage of such product from available sources of waste material.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the product and of preferred methods of producing it. It is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of my invention is best defined by the appended claims.

For the attainment of these objectives, and such other objectives as may be herein pointed out, I

have illustrated the practice of my invention with one type of stocking, wherein:

Figure 1 is intended to show a conventional full-fashioned stocking;

Figure 2 is the intermediate product attained by my process;

Figure 3 is a broken away view of a transverse section of the fabric of Figure 2 on an enlarged scale;

Figure 4 shows the manner of cutting the fabric section of Figure 2 into smaller sections; and

Figure 5 is a view similar to Figure 4 showing the cutting of the fabric to still smaller sections.

Before describing my method and the product produced thereby, I will state that my method contemplates using discarded stockings as the source of raw material, and the selection therefrom, for my purposes, of stockings which in the main are constituted of silk.

I will further state that an important feature of my invention calls for (1) the substantial elimination therefrom of all portions or threads which are not of silk or are so constituted or have been so treated as to resist decoloration as they inhibit or interfere with the attainment of my objective and (2) the transformation quickly and inexpensively of the fabric from one knitted into courses from a single continuous thread into a fabric made of parallel interlooped but entirely disconnected courses.

Upon viewing Figure 1 of the drawing, it will be observed that I have here illustrated the selection of a discarded silk full fashioned stocking made on the flat bed machine. The numeral 10 is applied to the doubled over welt, 11 to the thread closing the rear seem, 12 to the rear seam (including the thread 11), 13 to the narrowings below the welt, 14 to the narrowings at the ankle, 15 to the calf or body of the stocking and 16 to the foot portion. The thread 11 will be assumed to be of cotton and the foot portion as variably reinforced and therefore not as adaptable as is the remainder of the stocking for purposes of practicing my invention. It will further be assumed that otherwise the stocking is made of silk and plain knitted.

The first step of my process on this specific type of stocking of Figure 1 is to cut away the entire rear seam 12 (including the seam thread 11) and in accordance with a preferred although not a necessary practice, to remove simultaneously therewith the foot portion 16, which removed portion is not employed in my process and is entirely discarded or otherwise employed. This can be performed by cutting through with an instrument such as a knife, scissors or razor blade, as shown by the heavy dotted lines *a*—*a*. In accordance with a still more desirable practice, the cut *a*—*a* can be extended to separate the welt 10 from the calf 15 by extending the cut as shown at *b*—*b*.

In Figure 2 I show the calf portion 15 as opened up and flattened out and in Figure 3 I show an end section on a very much enlarged scale, and in connection with this showing I wish to emphasize the following: (*a*) this fabric section 15' is plain knitted entirely of silk, and may be freely subjected to complete decoloration, (*b*) while the fabric 15' as to certain aspects is a knitted fabric, the successive interlooped courses are entirely disconnected from each other as will be seen upon viewing Figure 3 of the drawing.

The fabric section 15' of Figure 2 is an example of an intermediate product derived from a discarded silk stocking to serve as an attainment of that end product which I have in mind. Before proceeding to describe further desirable or preferred steps, of my process I will here premise that sections of this character are to be subjected to the treatment of a garnetting or carding machine for the purpose and in the manner to be hereinafter shortly set forth.

I will now describe the treatment by which the fabric section such as that shown in Figures 2, 4, and 5 of the drawing may be converted directly into its elementary, filamentary state, free from all defects such as presence of traces of threads and for this purpose I employ a silk garnetting machine or a wool card, modified slightly for the particular purposes herein set forth. Such a machine has two sets of wire brushes, or teeth which are spaced closely to each other with the wire brushes facing each other. The raw stock, such as the fabric sections of Figure 3 is presented between the two sets of opposed teeth; by giving the two sets of brushes a relative motion, the wire brushes or teeth will comb the raw stock and loosen it into a disintegrated mass constituted primarily of the elementary silk, i. e. silk filaments. Of course, the actual machines have series of such sets of opposed wires arranged in various ways and embodying many improved features; the relative motion of the opposed cards may be reciprocative, rotary or otherwise; one or both sets may be in movement, etc. The modus operandi remains the same in all cases, namely, a brushing, combing, pulling, tearing-apart operation which disintegrates or separates the mass into a soft wad of minute filaments of greatly reduced lengths.

Where silk in the form of threads is fed to the garnetting machine, I have found it practically impossible, except by several reruns, to convert the threads entirely into filaments. That is, there would always be present in the garnetted material, free threads. The presence of such threads limits the utility of the resulting product and therefore its value. Unsuccessful efforts have been made to eliminate this defect by modifying the garnetting machine, as by using various types of teeth of closer spaced wire brushes or by bringing the brushes closer together or by running the machine at lower speeds, etc.

The persistent and unavoidable presence of threads in the final product of fibrous silk using unravelled threads as the raw stock is accounted for at least in part by the fact that, as the intermingled and dishevelled batch of threads is presented to the Garnett machine, the threads will be offered to the wires of the Garnett brushes at various angles with the result that the first series of wires will attach themselves to a large number of different threads or at different, separated portions of the thread. The wire brush will thus pull a number of loops of threads and arrange them in lines parallel to the flow-direction through the machine. A percentage of the threads thus started in this direction will continue to be pulled in that direction past the ensuing series of brushes, with the unavoidable result that some of such threads, or at least portions thereof, will entirely escape the ripping action of the wires and will appear as thread traces in the final product.

Fabric sections such as shown in Figure 2, will not present this difficulty. Such sections will present four edges, two opposite edges being lengths of "courses" and the other two opposite edges being lengths of "wales". The lengths of "courses" are the parallel lengths of short threads

interlooped with ensuring courses; the lengths of "wales" are the ends of such parallel threads. It should be here again pointed out that an important effect of cutting off the rear seam, besides the other effects already explained, is that a continuous thread of great length is changed into thousands of short-length threads in parallel courses, held together by interloops; it is the loose ends of these parallel short thread lengths which constitute the two "wale" edges of the fabric.

Where the piece of fabric presents itself to the wires of the first series of brushes along its length of wales (or loose ends), the wires will not grip the threads but will idly unloop a few of the first lengths of wales, the piece of fabric itself not being engaged. It is only when the piece of fabric presents its length of "courses" that the wires will engage it and grip and shred the individual threads making up the courses. In this position of the fabric the course-threads are arrayed in parallelism to the wires, so that as the wires grip the first few courses, they immediately proceed to rip the threads into the elementary filaments or fibers. As the engagement of the parallel courses of threads by the Garnett wires, and the resulting ripping or disintegration of the individual threads, proceeds, the fabric itself is automatically pulled further into the range of the wire brushes by the wires themselves, and at the required rate of feed so that the machine does not become clogged or overloaded.

Eventually all the pieces will be presented along their length of courses and will be engaged by the Garnett teeth and gradually, orderly, and automatically fed through the machine, as the disintegration of the parallel courses of short-length threads into elementary fibres or filaments progresses. This method of treatment and of preparation, besides resulting in the automatic selection and feed of the prepared fabric and the orderly and automatic disintegration of the parallel courses of short threads, greatly reduces the load on the Garnett machine for the reason that the presentation of parallel courses of short-length threads held together only by inter-loopings offers practically no resistance to the extraction of separate threads, as would be the case, for example, where a batch of unravelled thread or pieces of woven fabric are attempted to be utilized.

In the practical operation of this step, a large number of prepared pieces of fabric are fed to the garnett. Where some of these pieces present their wale edges, i. e. loose ends of the many parallel threads of short length, garnetting or disintegration is not effected for the reasons above explained.

In this connection I further discovered that the lengths of the filaments or staples into which the threads are reduced by this operation will more or less depend upon the length of the threads which in turn depends on the width of the fabric section such as shown in Figure 2.

It is therefore a further feature of my invention to control the lengths of the staples or filaments to which threads are reduced and this I do by predetermining the lengths of the thread in the fabric i. e. the width of the fabric. Therefore, by feeding to the garnetting machine, fabric sections generally of the same width, I attain the further result of an end product made up of staples or filaments of substantially the same lengths.

Upon viewing Figure 2 of the drawing, it will be observed that the fabric section 15' is widest on the top and narrowest at its bottom and therefore, for the attainment of the phase of my invention referred to in the paragraphs preceding, it is within the contemplation of my invention to cut the fabric section 15' of Figure 2 along lines generally parallel to the courses, two such lines *c*—*c* and *d*—*d* being shown. This then provides three fabric sections 15^2, 15^3, 15^4, each of a different width and therefore made of threads of different lengths. Therefore, by assembling sections of the same width such as sections 15^2, and subjecting a mass of such selected sections to the thread tearing operation, the end product will be one in which the lengths of the staples or filaments will be uniform. This will be true also of the filamentary mass product from a group of sections of the width of 15^3 except that the filaments or staples will be somewhat longer. In this way the mass of each product can be controlled both as to the length as well as the uniformity of the length of its filaments or staples.

Cutting the fabric 15' of Figure 2 into the sections 15^2, 15^3, 15^4 as shown in Figure 4 gives the further result that they can be more readily and more quickly handled by a garnetting machine in that they reduce the load and therefore increase the speed of the output and for purposes of carrying this objective still further in Figure 5 I have cut the section 15' beyond that shown in Figure 4, by the vertical cut *e*—*e* so as to provide six sections 15^6 instead of three as in Figure 4.

In this manner, the effective portions, i. e. the edges of courses, have been increased in proportion to the extent of the horizontal lines of severance, without at the same time increasing the ineffective portions presented by the side edges of loose ends.

In this manner I obtain an end product which is in the form of a filamentary mass free of irregularities of any character whatsoever such as loose threads, nubs and thickened portions and in which in accordance with the further phases of my invention, the staple lengths may be controlled as referred to.

The process thus far described was limited entirely to the treatment of the fabric section or sections formed by the calf portion 15 and by referring again to the specification relating to Figure 1 of the drawing it will be noted that the welt 10 was also to be subjected to a reduction operation such as is herein disclosed. The welt must be understood as being merely a section of fabric except that it is doubled-over and as such will be treated merely as a fabric section in a manner already set forth. For example, if it answers dimensionally to the size which is desired to feed to the garnetting machine, then it can be severed as an entirety and fed to the machine as an entirety. On the other hand, if the welt should be an extremely narrow one, (i. e. from top to bottom) and therefore smaller dimensionally than sections to be treated, then in forming the severed welt section a sufficient length of the fabric therebelow can be severed with it to form a section of the desired dimensions.

In other words, the severing of the welt in the manner set forth in connection with the description of Figure 1 is on the assumption that the welt was of the required depth for garnetting treatment. If it is less, the severing cut can be well below the welt.

The treatment of the welt can be dismissed by the general statement that the welt will be reduced either to one or more fabric sections, or even may include in the one section part of the calf fabric all depending upon the predetermina-

tion of the dimensions which it is desired that the fabric sections shall have.

No reference has thus far been made to the treatment of tubularly knit stockings. Where such stockings are provided with what is known as a false seam by the use of a seaming thread to give the effect of the real seam of a full fashioned stocking, then such a stocking can be treated just as if it were a full fashioned stocking made on a flat bed machine, and all that has been said in reference to the treatment of said full fashioned stocking, applies equally to this other type. The false seam is treated as if it were a real seam, and removed as already above set forth.

Where on the other hand, the tubularly knit stocking, has no such imitation seam therein, then all that is necessary to do is merely to cut through the tubular knit stocking longitudinally so as to sever the continuity of the threads, and if desired, to do this cutting in a manner so as to remove the welt and the foot sections as already above set forth. The only difference between the treatment of this stocking and the full fashioned stocking would be that there would be no necessity for cutting away the seam.

Stockings as actually made present every variety of problem. Each, however, can be handled in accordance with the general principles herein outlined, namely, that the selection of such a stocking for treatment will depend upon (*a*) the percentage of the silk contained therein, and (*b*) the difficulties presented in the removal of those sections which will interfere with the treatment. For example, a stocking that has but a few rows of transferred loops for ornamental purposes might be adaptable for economic treatment in accordance with my process as it involves merely the removal of these rows of transferred loops. However, if such rows are repeated frequently and at short intervals, this might justify the rejection of such a stocking as not being sufficiently adaptable for my purposes.

It has previously been mentioned that the vegetable textile matter, such as cotton and rayon, may be removed from waste silk or silk-and-rayon or silk-and-cotton stockings by a suitable carbonization proces.

Where as an alternative to my process already above outlined, the stocking fabric is subjected to carbonization, cotton constituents such as the rear seam thread are eliminated. However, in order to attain my objectives, the further step will be required of destroying the continuity of the silk thread from which the stocking has been knitted by removing the side or end edges of the fabric.

The filamentary mass resulting from the process herein disclosed, is capable of a wide range of utility. For example, it can be employed for spinning purposes, to give a thread of uniform character throughout. Again it can be employed as the silk constituent of a composite mixture such as silk and wool, and where so employed, I have found that my end product is such that a much higher percentage of the silk can be employed than hitherto without adversely affecting the resulting fabric.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent, is:

1. The process of reducing a knitted fabric section to a filamentary mass, which comprises the step or steps of so treating the knitted fabric section as to cause each course to be severed from its adjacent courses, without, however, destroying the interlooping therebetween, and then subjecting the knitted section so treated to a reduction operation in which the courses are removed successively from the fabric, and the threads forming such courses, each reduced successively one at a time to a filamentary state.

2. The process of reducing a seamed stocking to a filamentary mass, which includes the step or steps of removing that section of a stocking which includes the seam thread, so as to produce a knitted section composed entirely of courses disconnected entirely from the adjacent courses, but, however, associated therewith by the interlooping resulting from the knitting, and then presenting said section to an operation in which the courses are removed one at a time, and reduced to a filamentary state.

3. The process of reclaiming silk fibres from full fashioned hosiery, that comprises cutting therefrom sections that are substantially homogeneous in texture and material, thereafter cutting said homogeneous sections into substantially rectangular pieces having two of their edges cut along the courses and their other two edges cut substantially at right angles to the courses, thereafter assorting said pieces into groups, each group being composed of pieces having approximately the same width as measured along the courses and, thereafter forming a mass of silk filaments of substantially uniform length by feeding the pieces of one of said groups, which pieces are approximately of the same width, into a disintegrating machine of the rotating comb type with the courses thereof positioned transversely across the combs of said machine.

4. In the process of forming a substantially uniform mass of silk filaments out of silken fabrics comprising nonhomogeneous portions, the steps of cutting said silken fabric into pieces of substantially homogeneous consistency by cutting along the courses thereof and transversely to said courses, and separating said pieces into filaments by feeding said pieces into a garnetting machine or the like, so that the courses thereof at all times lie transversely to the combs of said machine, so that all portions of each course are simultaneously engaged by said combs.

ARON HERSE ROSENBERG.