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RECOVERING SILK FROM KNIT GOODS

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The present invention relates to the recovery of silk thread from knit goods, and particularly those knit goods made of silk which also contain one or more seams made of cotton, rayon or other cellulosic fibre.

The present invention is a modification of and an improvement upon the disclosure of my copending application Ser. No. 520,445, filed March 5, 1931, and is in part a continuation of said prior application now abandoned. Examples of the materials to be treated include worn out silk stockings, knitted underwear, knitted caps, and in fact knitted silk goods generally having cotton seams or seams made of other cellulosic fibre.

As is well known, stockings are generally manufactured by producing on the stocking frame a flat piece of suitable form and connecting two opposed edges of the fabric thus obtained by a seam. For certain technical reasons in most cases, particularly when manufacturing silk stockings, it is necessary to use for making the seam a thread of a material which is different from the material of the body of the stocking, for instance a cotton thread. This fact is according to the present invention utilized for ravelling out discarded hosiery goods when operating on a large scale without manual work.

I have found that by the action of certain chemical agents, the resistance to breaking of the thread which had been used for making the seam becomes much quicker diminished or destroyed, than that of the material of the stocking made of silk. If for instance acid vapors are caused to act for a short time on the stockings, the cotton threads are rendered friable and rotten without the silk being in the least deteriorated. Moreover I have found it advantageous to bring about the action of the acid vapors within a rotating drum and while warm. Hydrochloric acid is particularly described herein as being the most suitable acid to employ, but it is not desired to limit the invention thereto.

I give the following example of my invention, this example being given for the purpose of illustrating the invention, which is of course not restricted to the specific example.

Women's silk stockings, more or less worn out and discarded constitute the starting material. These are washed if necessary and dried at a low temperature, preferably about 60 to 65° C., or not exceeding 80° C. The cotton heels, cotton tops, cotton toes or the like can be first removed by cutting if desired. Hydrochloric acid (aqueous solution in water) is then vaporized and introduced into a revolving drum in which has been placed a quantity of the stockings, or other knit goods, the quantity of hydrochloric acid so added being not in excess of 7% of the weight of the stockings. The air in the revolving drum has already been heated to about 60 to 65° C. or not above 80° C., and under these conditions there will be no condensation of the hydrochloric acid and water vapor upon the silk under treatment. These conditions are then maintained for about 30 to 45 minutes, during which time it will be found that the hydrochloric acid has so rotted or "tendered" the cotton or other cellulosic threads constituting the seams that this will readily break up and practically fall apart when the goods are pulled against the seam. It is advisable to withdraw samples from the drum, during the acid treating step, for the purpose of determining when this step has been sufficiently completed. During the time that the cotton is being rotted by the acid, said acid has substantially no effect upon the silk fibre or thread, and the silk will retain substantially all of its strength and lustre.

When the rotting operation has been sufficiently accomplished, the introduction of acid is stopped, and warm air is aspirated or blown through the drum, for the purpose of getting rid of all of the acid vapors. This step may require 15 minutes or so, and during the early part of the treatment the acid vapors can be led into another similar drum in which another batch of the stockings is being treated, and during the last portion of the air treatment a small amount of ammonia may be used along with the air to neutralize any absorbed acid still remaining in the stockings.

Thereafter the contents of the drum are washed thoroughly with water, in order to remove the last traces of acid remaining, and this water may carry small quantities of ammonia if desired, merely enough to make the same faintly alkaline.

The tumbling operation may in many cases be sufficient to entirely break up the cotton threads forming the seams, but where this does not happen this result can readily be accomplished by a slight pulling in the hands when the stockings are to be put onto the holding devices for raveling the same. After the washing in dilute ammonia the goods can be subjected to a bleaching operation, or a dyeing operation or both, and are then again dried and are ready to be raveled into silk thread.

At this stage the stocking will ordinarily represent a trapezoidal shaped piece of knitted fabric.

The same is then placed upon a holding device, which may be a table or bench carrying a row of closely spaced upstanding pins, upon which the part constituting the upper edge of the stocking is fastened, and by picking a thread at the bottom, it will be easy to ravel the entire stocking. The thread as raveled from the stocking may be wound upon rotating cones, bobbins, spools or the like or can be reeled and taken off in skein form.

It will be found that the silk thread thereby recovered is substantially as good as new silk thread for making knit goods, stockings and the like.

It may be called to attention that heretofore the great bulk of the worn out silk stockings have simply been discarded as of no value, and the material is available, in the large cities, in very large quantities.

The amount of hydrochloric acid used above is based upon the commercial hydrochloric acid solution of 22° Bé. (about 35.4% concentration). It will of course be understood that acid of other concentrations can be used, in an equivalent amount.

The temperature of the acid treating operation can vary more or less, a temperature of about 75° C. being preferred although temperatures from about 60° C. up to 80° C. being satisfactory to use.

I have above referred to using not over 7% of commercial acid of 22° Bé. This is given as the outside figure, and in most cases it will be found that much less of the acid, usually between 3% and about 4.5% (based on the weight of the stockings) will be found in most cases to be sufficient. When using below 7% of acid, there is no appreciable action or injury to the silk. It will be understood that 7% of 22° Bé. HClAq, (which contains about 35.4% actual HCl) is equivalent to 2.378% of actual HCl (or roughly 2.4% actual HCl) based on the weight of the goods treated. I always use less than 2.4% of actual HCl gas and preferably I use substantially less than this figure. I note that 3 to 4.5% of the hydrochloric acid solution is about 1 to 1.6% of actual HCl gas.

Hydrochloric acid is herein described as being the preferred acid material to employ. Other acids which are capable of being vaporized can be employed. Nitric acid is not suitable since it would have an injurious action on the silk, and I make no claim to the use of nitric acid.

At the end of the acid treatment, the cotton threads have been rotted to such a degree that they readily pull apart, but they are not blackened as in the usual "carbonizing process".

It will be seen that there are several variables, the most important of which can be listed as follows:—

1. The strength of the acid.
2. The quantity of the acid.
3. The temperature at which the acid vapor and material being treated, react.
4. The length of time during which the acid vapors are kept in contact with the material.
5. The dryness of the material to be treated before the acid vapor is admitted.

From the above description it will be seen that when any one of these factors is varied, the others (or some of them) will be varied to make up for same.

I have given the details of a preferred embodiment of the invention, but it is understood that variations, within the scope of the appended claims, are also covered.

In the above description I have referred to knitted silk stockings, etc., which have been worn and discarded. The invention is also applicable to stockings which are so imperfect that it is decided to discard the same, as where a batch of stockings are "not passed" by the factory inspector and the like, or are "shop-worn", faded or the like. I use the term "discarded" in the claims to include any such products as are to be raveled, whether from being worn or being imperfect or for any other cause.

I claim:—

1. A process of recovering silk thread from discarded silk knit goods having therein a seam of cellulosic fiber, which comprises subjecting the said knit goods in a substantially dry state, to warm vapor of hydrochloric acid in amount and concentration sufficient to rapidly rot the cellulosic fiber, but insufficient to substantially injure the silk, and thereafter raveling the silk portion of the knit goods.

2. A process of recovering silk thread from discarded silk knit goods which have therein a seam of cellulosic fiber, which comprises subjecting the knit goods, in a substantially dry state, to a heated vapor of hydrochloric acid in amount equivalent to about 3% to 7% of 22° Bé. HCl·Aq. based on the weight of the said knit goods, and thereafter raveling the silk portion of the knit goods.

3. A process of recovering silk thread from discarded silk knit goods in which the edges of said goods are joined by a seam of cellulosic fiber, which comprises subjecting the knit goods, in a substantially dry state, to vapor of hydrochloric acid at about 60 to 80° C., in amount sufficient to rapidly rot the cellulosic fiber seam, but insufficient to substantially injure the silk, and thereafter raveling the silk portion of the knit goods.

4. A process of recovering silk thread from discarded silk stockings containing a seam of cellulosic fiber, which comprises subjecting the stockings, in a substantially dry state, to vapor of hydrochloric acid in amount sufficient to rapidly rot the cellulosic fiber but insufficient to substantially injure the silk, while in a warm condition, and thereafter raveling the silk portion of the stockings.

5. A process for the recovery of silk thread from discarded silk stockings which consists in so weakening the thread of cellulosic material forming the seam by subjecting the stockings to the action of vapor of hydrochloric acid, but without any substantial damage to the silk thread forming the body of the stockings, that the thread forming the seam can thereafter be easily removed and the stocking left in such shape that the silk thread forming the body of the stocking can be easily recovered, breaking out the so weakened thread of cellulosic material and raveling the silk thread.

6. In the process for recovering the thread material of discarded knitted apparel made of animal fiber yarn, said apparel having seams made with a cellulosic thread, the improvement which comprises subjecting the goods to the action of a chemical having a preferential weakening action on the thread of the seams without during the same time substantially attacking the animal fiber material of the goods, pulling open said seam and thereafter raveling the animal yarn without reducing said yarn to the condition of fibers.

7. A process for the recovery of the silk thread material of discarded silk stockings having a stitching which joins opposed edges, said stitching comprising cotton thread, which process comprises treating the stockings with a chemical

capable of greatly weakening the cotton thread before it can exert any substantial deteriorating action on the silk, pulling open the said stitching and thereafter raveling the silk thread portion.

8. A process for recovering the thread material of discarded silk stockings with a connecting seam which includes cotton as a substantial portion thereof, which process comprises treating the stockings with vapors of an acid chemical capable of weakening the seam thread before it can exert any substantial deteriorating action on the silk of the stockings, pulling the seam open and thereafter raveling the silk portion.

9. A process for recovering the thread material of discarded hosiery goods made primarily of thread of animal fiber, and having a seam made of thread of another material than that of the goods themselves, which process comprises applying a low degree of heat to the goods sufficient for the purpose of drying them, and then treating them with vapors of chemicals for such time that the material of the thread used for making the seam will be greatly weakened, whilst the material of the fabric itself is not substantially attacked, after which the vapors are drawn off while maintaining an elevated temperature, pulling out said seam and raveling the knitted animal fiber portion.

10. A process for recovering the thread material of discarded hosiery goods made of an animal fiber thread, and having a seam made by means of thread of a cellulosic fiber thread, which process comprises treating the goods under continuous agitation with vapors of hydrochloric acid capable of destroying the seam thread before they can exert a deteriorating action on the material of the fabric itself, pulling to break the seam thread, and raveling the goods.

11. A process for recovering the thread material of discarded silk stockings having a connecting seam of cotton thread, which process comprises treating the goods with vapors of an acid reagent capable of rapidly rotting cotton, the actual weight of such acid amounting to less than 2.4 (calculated as HCl) per cent of the weight of the goods under treatment, and which destroys the thread used for making the seams prior to attacking the material of the goods themselves, whereby the seam can be readily pulled open and the stocking raveled.

12. Silk stockings having seam threads composed in major part at least of cellulosic fiber, said seam threads being in such a weakened and rotted condition by treatment with a chemical that rapidly deteriorates the said cellulosic fiber without substantially injuring the silk, that they have such a low degree of strength that the seams can be readily pulled open by pulling between the hands of an operator, whereby the stockings can readily be ravelled.

13. An article of apparel composed essentially of knitted animal fiber thread, and having seam threads composed in major part at least of cellulosic fiber, said seam threads being in such a rotted condition by treatment with a chemical that rapidly deteriorates the said cellulosic fiber without considerably injuring the said animal fiber, that they have such a low degree of strength that the seams can be readily pulled open by pulling between the hands of an operator, whereby the said articles can readily be ravelled.

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