

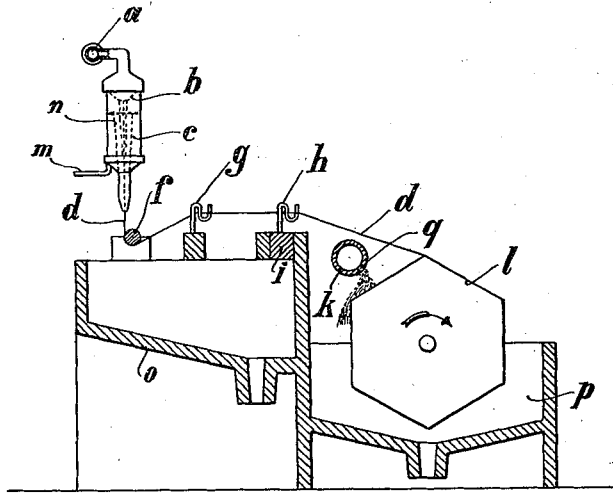
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MANUFACTURING ARTIFICIAL SILK THREADS

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UNITED STATES PATENT OFFICE.

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MANUFACTURING ARTIFICIAL SILK THREADS.

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To all whom it may concern:

Be it known that I, MARTIN HÖLKEN, Jr., a citizen of Germany, residing at Barmen, Germany, have invented certain new and useful Improvements in Manufacturing Artificial Silk Threads, of which the following is a specification.

My invention has reference to means for manufacturing artificial silk threads, and it refers in particular to those kinds of threads obtained from copper oxide-ammonia cellulose-solutions in accordance with the so-called stretching spinning process, and it provides means for the treatment of the comparatively thick threads discharged from the spinning nozzle or sprinkler which are only reduced to the desired degree of fineness by stretching. In the process referred to the threads escaping from the spinning outlet, in contradistinction to the spinning method proper in which the threads escape directly from the openings of the nozzle head in the desired degree of fineness, are not directly hardened, but they are exposed in the first place to the action of liquid serving merely for the washing out of the solvent, the so-called precipitation liquor, and in this stage they are stretched, that is to say, drawn out to the required degree of fineness by the pull exerted upon them by the thread winding device, and in addition thereto to some extent also by the tension produced by the precipitating liquor flowing in the direction of the drawing off of the threads. The required stretching is rather considerable, inasmuch as the thickness of the finished artificial silk threads amounts sometimes to about one hundredth of the thickness of the threads delivered from the spinning rose, nozzle or sprinkler. Only after the desired fineness of the threads has been arrived at, that is to say, after the stretching has been finished, the thread is congealed or solidified by the treatment with another liquid, the so-called hardening liquid. This well known process has been carried out heretofore by causing the bundle of threads squirted from the spinning outlet into the precipitating liquid to proceed downwardly

through a funnel together with the precipitating liquid, whereupon, after the discharge from the spinning device proper the threads are conducted around a glass rod, and are then made to pass through a horizontal or inclined gutter or channel in which the treatment with the hardening liquid is effected. Hitherto the path of the thread bundle outside of the liquids between the treatment with the precipitating liquid and the treatment with the hardening liquid, that is to say, the length of the passage through the air indispensable for the deflection of the bundle from the vertical to the inclined direction of movement is arranged to be as short as possible, so that the bundle of threads enters the hardening liquid almost directly after its discharge from the precipitating liquid. After its escape from the channel containing the hardening liquid the bundle of threads is in conclusion wound upon a spool or bobbin which, if required, may also be submerged in a container filled with hardening liquid. Ordinarily the transversely reciprocable channel or gutter may serve as a thread guide for producing the desired cross winding upon the bobbin. In view of the fact that the bobbin is revolved with a considerably greater peripheral speed than the velocity of discharge of the threads from the spinning rose amounts to, the individual threads of the bundle of threads are stretched that is to say they are drawn out to the required degree of fineness, which may be further assisted by the flowing of the precipitating liquid in the drawing-off direction of the bundle of threads. Inasmuch as the bundle of threads immediately after leaving the precipitating liquid is treated directly with the hardening liquid and is solidified within the same, the stretching procedure above referred to takes place almost exclusively during the treatment by the precipitating liquid, that is to say, along the practically not to be lengthened path of the threads in the said precipitating liquid.

The present invention is based upon the result of experiments from which it appears that the degree of fineness and uniformity,

and the other excellent qualities of the artificial silk obtained by the stretching spinning method from copper-oxid-ammonia or from similar solutions of cellulose are considerably improved by causing the length of thread to be submitted at the time being to the stretching operation to be as large as possible within the limits resulting from the consideration of strength of the unhardened threads, while on the other hand the stretching of the threads should not take place exclusively or chiefly within the precipitating liquid, but to a large extent in the open air, that is to say, provided the path through the air in the still plastic condition of the threads through which the bundle of threads travels after the treatment with the precipitating liquor, but before the treatment with the hardening liquid, and which, as mentioned above has been shortened heretofore as much as possible, is considerably lengthened. In view of these facts the passage through the air through which in the process according to this invention the still unhardened and therefore, extensible bundle of threads is to be conducted outside of the liquids between the treatment by the precipitating liquor and the treatment by the hardening liquor, is lengthened to an extent, so as to be greater than the length of path of the bundle of threads within the precipitating liquid, the invention, as in the previously known processes making provision for causing the comparatively thick threads delivered from the spinning nozzle to be first conducted through a precipitating liquid and then through a hardening liquid, and providing for the subsequent winding up of the threads with a simultaneous stretching of the threads by the pull of the winding device. By working in this manner, as has been shown by practical experiments, the thickness of the threads becomes very uniform, and, on the other hand, a more considerable stretching of the threads than heretofore is made possible without the occurrence of a tearing of the threads. The single threads of the bundle of threads, therefore, become much thinner and brighter, so that the total thread formed from the bundle likewise becomes more brilliant and more supple and therefore more silk-like than the threads of artificial silk manufactured according to the well known stretching spinning process.

In order to obtain a long passage of the threads through the open air the treatment of the bundle of threads with the hardening liquid is effected chiefly only during or after the delivery unto the winding device preferably consisting of a reel, so that the complicated and expensive system of channels or gutters heretofore required is dispensed with and may be replaced by a simple thread guide, while the hardening liquid may be de-

livered through a perforated pipe directly upon the layers of threads upon the reel or upon the bundle arriving thereupon. The mounting of this pipe may be preferably effected in such a manner that it is disposed underneath the strand being fed to the reel, so that the bundle of threads is acted upon by the hardening liquid discharged from the holes of the pipe only after it has been wound almost on the entire periphery of the reel.

On the accompanying drawing I have shown an arrangement of apparatus by way of example as an embodiment of the principles of my invention, and suitable for the carrying out of the new process hereinbefore referred to, the apparatus being shown diagrammatically in its essential parts.

In the drawing, the feeding pipe for the admission of the liquid to be submitted to the spinning operation, thus for instance, a solution of copper-oxide-ammonia, is shown at *a*, the pipe being connected to the spinning outlet rose head or sprinkler *b* provided in the well known manner with comparatively large delivery openings. The sprinkler is mounted at the upper end of a glass cylinder *c* closed on all sides, and into the bottom portion of which the precipitating liquid, clear water for example, is adapted to be introduced by a pipe *m*. Within the cylinder *c* and coaxially therewith a glass funnel *n* is arranged through which the bundle of threads delivered from the spinning rose head or sprinkler is downwardly led, and during this passage it is outwardly surrounded, bathed and guided by the precipitating liquid which enters into the funnel by overflowing over its edge, and is then likewise downwardly directed with constantly increasing velocity in consequence of the downwardly decreasing inner diameter of the funnel. While the precipitating liquor discharged from the lower end of the funnel *f* is delivered into a collecting basin *o*, the bundle of threads *d* is deflected, so as to assume a substantially horizontal feeding movement, by being guided around a glass rod *f* arranged below the funnel *n*, and is then led over two simple thread guides *g*, *h* and upon the reel *l* mounted in the trough *p*, and is wound upon said reel. In order to produce the desired cross winding the thread guide *h* next to the reel is arranged upon a bar *i* adapted for reciprocation in the axial direction of the reel. This reel is moved in the direction of the arrow with a peripheral speed considerably in excess of the speed of delivery of the thread bundle from the spinning sprinkler *b*, and by this means the threads of the bundle which have not yet come in contact with the hardening liquor, and are therefore still in the plastic condition, are stretched on their way from

the spinning rose head or sprinkler *b* to the reel *l*, and are thus drawn out to the desired degree of fineness. Finally the treatment of the threads by the hardening liquid is effected upon the reel *l*, and in such a manner that the layers of thread wound upon the reel are rinsed with hardening liquor. For this purpose an arrangement is made upon the side confronting the thread guides *g*, *h* and above the reel *l*, but below the bundle of threads delivered to the reel for mounting a pipe *k* having apertures *q* in the direction of the reel, and through which the hardening liquid, dilute sulphuric acid for example, is admitted which flows from the holes *q* of the tube upon the layers of thread wound upon the reel *l*, and is then conducted away through the trough *p* after having acted upon the threads.

As shown in the drawing the bundle of threads moves through the air upon its way from the glass rod *f* to the reel *l*, that is to say it is neither treated with the precipitating liquid nor with the hardening liquid upon this way through the air the length of which amounts to a multiple of the length of the path of the bundle of threads within the precipitating liquid. The stretching of the threads, therefore, is not affected as heretofore, merely within the precipitating liquid, but only partly in such precipitating liquid, and on the other hand, and for its greater portion upon its passage through the open air. At the same time, however, the unhardened length of thread which is submitted to the stretching tension is considerably increased, without it becoming necessary thereby to increase the size of the entire apparatus. By means of the increase of the unhardened length of thread submitted to the stretching tension, and on the other hand by the fact that the stretching of the threads takes place chiefly in the air, an artificial silk thread is obtained, as already mentioned, which is considerably finer, more supple and brighter than the threads of artificial silk obtained according to the process heretofore used. A very important advantage of the treatment of the bundle of threads with the hardening liquid upon the reel as compared with the treatment in a gutter or channel is presented by the fact that the threads are not suddenly brought into contact with the totality of the hardening liquid, but that on the contrary the hardening liquid is made to act gradually upon the threads by which means the sticking together of the single threads of the bundle of threads is less liable to occur. The threads manufactured according to the new process are therefore distinguished by their softer quality which is more resembling the properties of natural silk.

Of special importance with the new process is the use of the reel instead of the bobbin heretofore used for the winding up of the threads, and for producing the stretching tension. The reel has a diameter at least equal to the length of the way through the precipitating liquid, by which means on the one hand with a comparatively low number of rotations a high peripheral velocity of the reel, and consequently a considerable stretching of the threads and on the other hand in consequence of the great circumference of the reel an efficient treatment of the threads upon the reel is produced by the dropwise admission upon the same of the hardening liquid.

It is evident that the invention is susceptible of various alterations and modifications of the form of apparatus shown and described by way of example, and the process admits of other forms of construction of the apparatus within the scope of the invention as pointed out in the claims hereinafter appended. The treatment with the hardening liquor in particular, whenever this should be considered more advantageous for any reasons whatever, may also be effected entirely or in part before the winding of the bundle of threads upon the reel. If the pipe *k* is arranged for instance above the bundle of threads *d* delivered upon the reel, the solidification begins already before the winding of the bundle of threads upon the reel, that is to say, the threads are already partly solidified upon their being wound up on the reel.

I claim:—

1. The stretch spinning method for making artificial silk threads from cellulose solutions, comprising causing the comparatively thick extensible threads leaving the sprinkler to pass first through a precipitating bath, thereafter conducting them through the air a distance which is longer than the distance traversed in contact with the precipitating bath and stretching the same, causing the threads thus treated to be wound up on a reel, and then treating the threads on the reel with a hardening liquid.

2. The stretch spinning method for making artificial silk threads from cellulose solutions, comprising causing the comparatively thick extensible threads leaving the sprinkler to pass first through a precipitating bath, thereafter conducting them through the air a distance which is a multiple of the distance traversed in contact with the precipitating bath and stretching the same, causing the threads thus treated to be wound up on a reel, and then treating the threads on the reel with a hardening liquid.

3. In a device for the production of artificial silk from cellulose solutions, in combination, a spinning sprinkler with comparatively large delivery openings, a funnel be-

low said sprinkler for the guiding of said threads, and of a hardening liquid, thread guides for guiding the threads through the air, a reel adapted for stretching the threads during their passage through the precipitating liquid and the air, and disposed to the rear of the thread guides in the feeding direction of the threads, a perforated tube for bathing the stretched threads on the reel arranged upon the side confronting the thread guides, and adapted to allow the feeding of the threads to the reel above said tube.

In testimony whereof I affix my signature.

MARTIN HÖLKEN, JR.