Aug. 25, 1942. H. D. MULLER 2,293,995

MANUFACTURE OF ARTIFICIAL SILK

Filed March 18, 1940 2 Sheets-Sheet 1

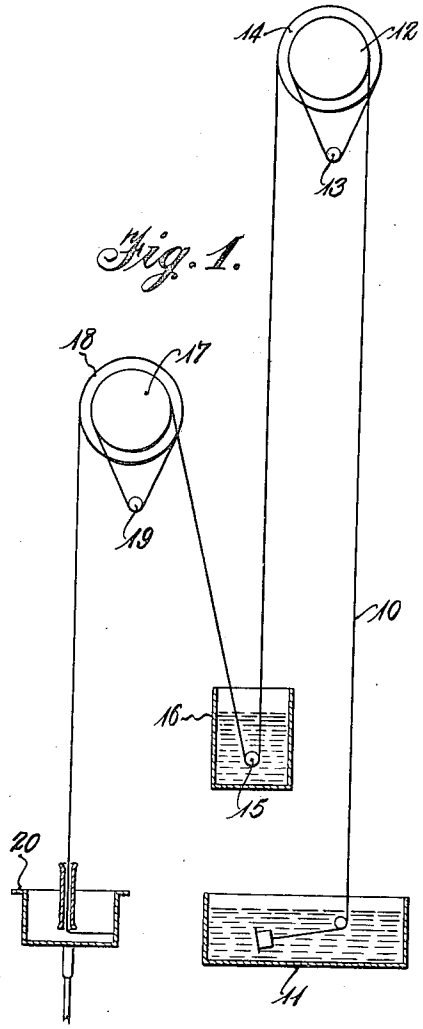


Fig. 1.

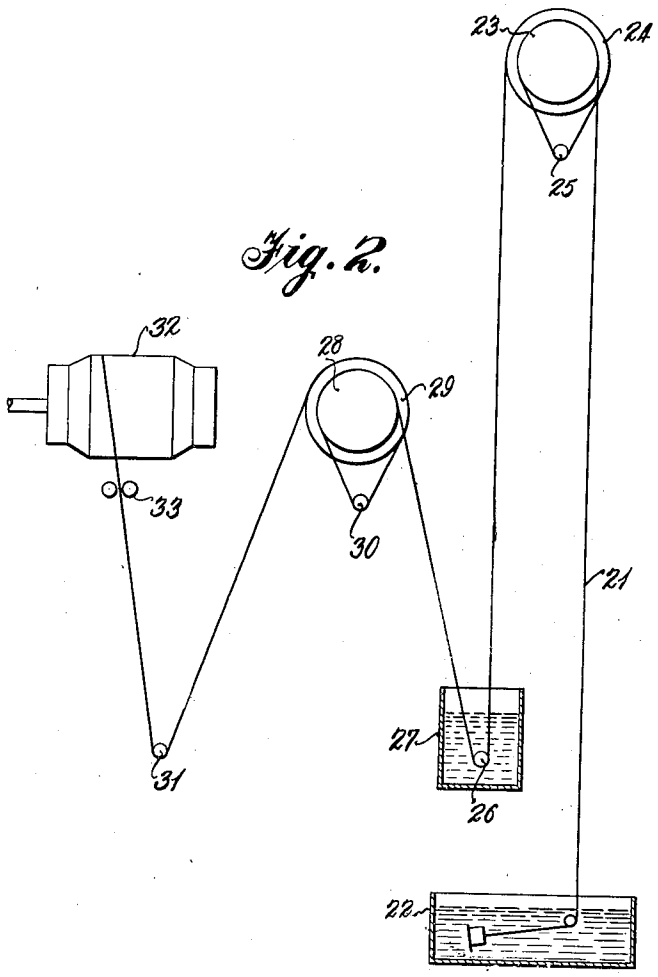


Fig. 2.

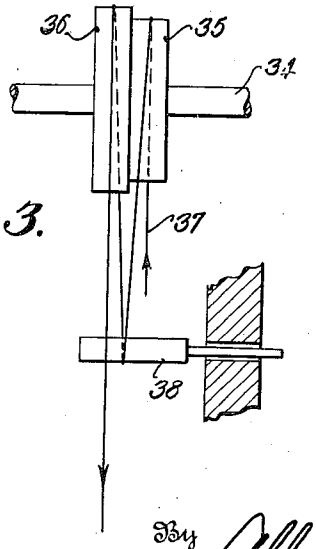


Fig. 3.

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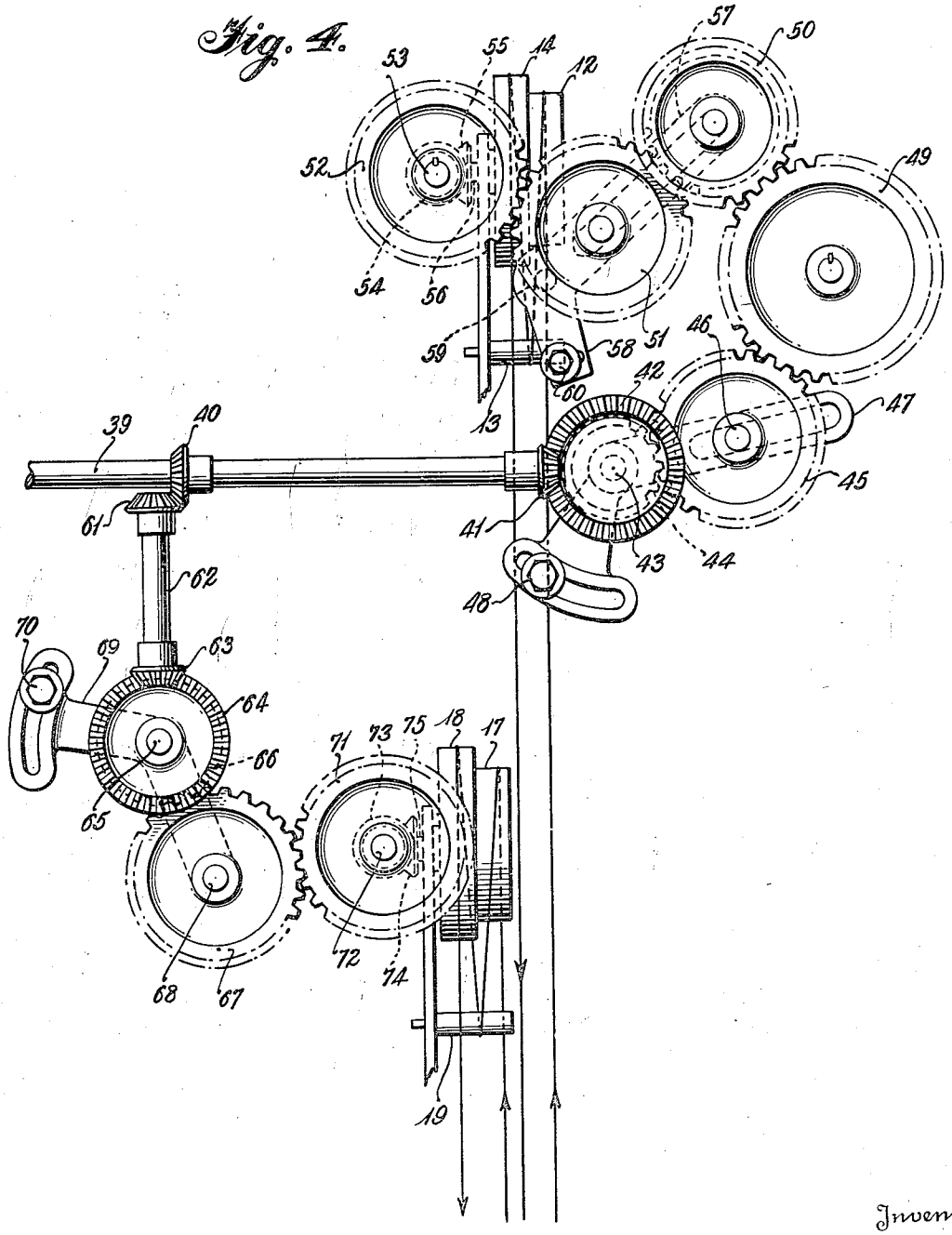
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Fig. 4.



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MANUFACTURE OF ARTIFICIAL SILK

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2 Claims. (Cl. 18—8)

This invention relates to improvements in the manufacture of viscose artificial silk. Threads of artificial viscose silk which are very strong both in the dry and wet state have hitherto been produced for example by passing the spinning solution into very strong acid baths or by subjecting the freshly spun threads to considerable stretching. The stretching operation has been assisted by passing the thread during stretching through a warm bath containing salt and acid, e. g. through a dilute spinning bath solution or through hot water. In either case a considerable stretching of the thread is essential in order to produce the desired result, but this high stretch may easily give rise to certain defects in the finished thread.

It is therefore the object of the present invention to provide a process which avoids these defects by carrying out the stretching of the thread in a particular manner.

It is a further object of the invention to provide a process for the production of threads of viscose artificial silk which is capable of being employed in conjunction with spinning centrifuges or with spinning bobbins.

According to the present invention there is provided a process for the manufacture of viscose artificial silk which includes the step of stretching the freshly spun thread before it is collected in at least three stages by means of rotary stretching devices and treating the thread with liquid at an elevated temperature during one of the stretching stages. The thread may be stretched while in the liquid by an amount not greater than 45% of its length.

The rotary stretching device may conveniently consist of two rollers rotating at increasing peripheral speeds and one form of such a device may consist of a stepped roller, the thread being passed first over that part of the roller of smaller diameter and thence around a guide pulley and over that part of the roller of larger diameter.

In one application of the invention the thread may be subjected to treatment with a liquid bath at an elevated temperature during the second stretching operation and in such a process the thread passing from the spinning nozzles into the precipitation bath may be subjected to initial stretching by means of two rollers rotating at increasing peripheral speeds and may thereafter be guided from the second roller in a downward direction around a guide roller in a bath containing liquid at an elevated temperature and thereafter in an upward direction to a second pair of stretching rollers. The peripheral speeds of the first and second pairs of rollers are so adjusted that the thread is also stretched while passing through the liquid bath between the pairs of rollers.

The bath in which the stretching takes place is maintained at a temperature between 40° and 90° C. Thus according to circumstances it may conveniently have a temperature of 40°, 50°, 70° or 90° C. The liquid may contain relatively small quantities of a salt and acid, for example sodium sulphate and sulphuric acid and may contain in addition smaller amounts of the sulphates of magnesium and zinc.

In order to simplify the apparatus, stepped rollers may conveniently take the place of rollers rotating at increasing peripheral speeds. The number of stretching operations may be increased to four, five or more and the individual stepped rollers themselves may be arranged so that each of the stretching operations takes place in a number of steps and the degree of stretching which takes place at any particular stage of the whole process may thus be regulated and predetermined according to the final stretch desired.

Instead of providing a single guide roller for the liquid bath a number of guide rollers around which the thread passes in series may be provided in order that the time of contact of the thread with the liquid may be increased.

By use of the present invention viscose artificial silk thread may be stretched to a high degree without danger of introducing defects into the thread.

The invention may be more readily understood and appreciated by reference to the following drawings wherein

Figure 1 is a diagrammatic view of a viscose spinning system showing the essential parts of an apparatus used in the centrifugal spinning process;

Figure 2 shows diagrammatically a viscose spinning system adapted for the bobbin spinning process;

Figure 3 is a diagrammatic view of a stepped roller construction that may be employed in either of the systems exemplified in Figures 1 or 2; and

Figure 4 is of a view in end elevation of a driving means suitable for the actuation of the stepped rollers.

Referring now to Figure 1, the thread 10 leaving the spinning bath 11 passes over the lower step 12 of the first stepped roller and thence around the guide roller 13 and over the larger step 14 of the roller whereby stretching of the thread takes place. The thread then passes in a

downward direction and is guided around a small guide pulley 15 in the bath 16 which contains liquid at elevated temperature. From this bath the thread passes to the stepped roller 17, 18 which is driven at such a speed that stretching of the thread takes place between the stepped rollers 12, 14 and 17, 18. Stretching of the thread also takes place in passing from the lower step 17 of the stepped roller around the guide roller 19 and over the step 18. After this stretching the thread is passed in the downward direction into the spinning pot 20.

The means for driving stepped rollers 17, 18 at a greater speed than stepped rollers 12, 14 so as to cause stretch between roller 14 and roller 17 is shown in Figure 4. The driving arrangement per se forms no part of this invention and is of the type described in the prior art.

Both stepped rollers may be driven from a common shaft 39 actuated by a source of power, not shown. Shaft 39 is provided with two bevel gears 40 and 41 which through intermediate gear trains drive stepped rollers 17, 18 and 12, 14 respectively. Bevel gear 41 meshes with bevel gear 42 mounted on a shaft 43 which likewise carries a gear 44. Gear 44 meshes with and drives a gear 45 mounted on a shaft 46 supported in the slot of an arm of a bell crank 47. Bell crank 47 is mounted for pivotal movement about shaft 43 and may be locked in any angular position by a nut 48 acting on its free arm. From gear 45 power is transmitted to a gear train comprised of gears 49, 50, 51 and 52, the last of which is keyed to a shaft 53 carrying a bevel gear 54 meshing with a bevel gear 55 carried on a stub shaft 56 which also carries stepped rollers 12, 14. Gear 50 is carried on the end of a slotted arm 57 of a bell crank 58 pivotally mounted at 59 and held in position by a lock nut 60. The shaft of gear 51 passes through the slot in arm 57 so that bell crank 58 may be moved to different positions to allow for easy replacement of gear 50 by a similar gear of different diameter. Thus the speed of stepped rollers 12, 14 may be varied by a change in the diameter of the gear 50 as well as by a change in the diameter of the gear 45.

Stepped rollers 17, 18 are driven through a gear train from bevel gear 40 on shaft 39, gear 40 meshing with a gear 61 which is attached to a shaft 62 having at its other end another bevel gear 63. Bevel gear 63 drives a gear 64 mounted on a shaft 65 which is additionally provided with a gear 66. Gear 66 meshes with a gear 67 mounted on a shaft 68 anchored to the end of an arm of a bell crank 69 which is mounted for pivotal movement about shaft 65, and may be held in adjusted angular position by a lock nut 70. Gear 67, because of its disposition on an arm of bell crank 69, may be replaced by a similar gear of different diameter and will thus serve to increase or decrease the speed of a gear 71 mounted on a shaft 72 which carries additionally a bevel gear 73 meshing with bevel gear 74 on stub shaft 75 to which stepped rollers 17 and 18 are attached.

As shown, it is contemplated that gear 67 be of a size to cause stepped rollers 17, 18 to rotate at a higher speed than rollers 12, 14.

It will be understood that slipping of the thread on the surfaces of the stepped rollers may be prevented by passing the thread more than once around each step of the roller.

Figure 2 shows the essential features of the apparatus when arranged for the spinning of viscose artificial silk by a bobbin spinning process. As in Figure 1 the thread 21 is spun in the spinning bath 22 and thence passes over the stepped rollers 23, 24 and the guide roller 25 and thence around the roller 26 in the liquid bath 27 to the stepped rollers 28, 29 and guide roller 30. From that stage the thread passes around the guide roller 31 and thence to the bobbin 32 via the winding device 33. The peripheral speed of the spinning bobbin may be smaller than, equal to or larger than that of the step 29 but it will be understood that in any case the speed at which the thread is wound on the bobbin 32 must be greater than the peripheral speed of the step 28.

Figure 3 shows a stepped roller which is mounted on a driving shaft 34 and comprises two integrally mounted steps 35 and 36. The thread 37 runs on to the lower step 35, thence over the guide roller 38 and from the guide roller over the higher step 36.

Although the thread is not in general stretched in the liquid by an amount in excess of 45% the present process permits of a high total degree of stretching and this ensures a very considerable strengthening of the thread. It has been found that the sub-division of the stretching into at least three operations makes it possible to manipulate the thread without risk of injuring it.

Example I

A viscose solution containing 7% cellulose and 6% alkali and having a degree of maturity corresponding to a Hottenroth number of 12 is spun in a centrifugal spinning machine of the general type shown in Figure 1. The artificial silk has a denier of 120 and is spun from spinning nozzles having 40 holes each 0.08 mm. in diameter. The spinning bath consists of an aqueous solution containing:

	Grams
Sulphuric acid per litre	125
Sodium sulphate per litre	250
Magnesium sulphate per litre	40
Zinc sulphate per litre	15

The thread 10 leaving the spinning bath 11 first passes over a stepped roller 12 which takes up the thread at the rate of 34.9 m. per minute and the step 14 of the roller passes it on at the rate of 38.2 m. per minute, thus effecting a stretching of 9.5%. The thread then passes around a small freely turning guide roller 15 mounted in a bath 16 which is maintained at a temperature of 70° C. and containing 10 gms. sulphuric acid and 20 gms. sodium sulphate per litre in addition to small quantities of magnesium sulphate and zinc sulphate and thence passes to a second stepped roller 17 which takes up the thread at the rate of 51.3 m. per minute. While the thread passes through the bath 16 it is thus subjected to a stretching of 34%. In passing from roller 17 to roller 18 the thread is stretched by a further 17% and it leaves the roller 18 at the rate of 60 m. per minute and passes to the spinning pot 20.

Example II

A viscose solution containing 7% cellulose and 7% alkali and having a degree of maturity equal to a Hottenroth number of 11 is spun in a spinning bath having the composition:

	Grams
Sulphuric acid per litre	135
Sodium sulphate per litre	230
Magnesium sulphate per litre	70
Zinc sulphate per litre	10

The spinning nozzle has a 100 holes each 0.07

mm. in diameter and the artificial silk thus formed has a denier of 250.

Referring to Figure 2 the thread **21** leaving the spinning bath **22** first passes over a stepped roller **23**, **24** which takes up the thread at 40 m. per minute and passes it on at 44.5 m. The thread then passes around the roller **26** in a bath **27**. This bath contains 10 gms. of sulphuric acid and 20 gms. sodium sulphate per litre in addition to small quantities of magnesium sulphate and zinc sulphate and is maintained at a temperature of 70° C. After leaving the bath the thread passes around a second stepped roller **28**, **29** which takes up the thread at the rate of 60.3 m. per minute, the step **29** of the roller having a peripheral speed of 72 m. The thread is wound on the spinning bobbin **32** at the rate of 70 m. per minute.

Example III

Viscose artificial silk is prepared from a solution having a composition similar to that described in Example I. After passing through the bath **16** which contains 20 gms. sulphuric acid and 40 gms. sodium sulphate per litre in addition to small quantities of magnesium sulphate and zinc sulphate and which is maintained at 75° C., the thread is finally taken up in a spinning pot **20** (Figure 1).

Example IV

Viscose artificial silk is prepared in the manner described in Example II, but the bath **27** is maintained at a temperature of 65° C. and contains 50 gms. of sulphuric acid and 80 gms. sodium sulphate per litre in addition to small quantities of magnesium sulphate and zinc sulphate.

What is claimed is:

1. A process for the manufacture of viscose artificial silk which comprises extruding a viscose solution through minute orifices into a coagulating bath to form filamentous thread therefrom, drawing the thread from the bath and stretching the same by passing the thread around surfaces driven at different peripheral speeds, passing the thread through a liquid bath maintained at a temperature in a range of about 40° C. to about 90° C. and again stretching the thread during said passage, effecting a third stretching operation by passing the thread around surfaces driven at different peripheral speeds and finally collecting the thread.

2. In an apparatus for the manufacture of viscose artificial silk thread, including a spinning nozzle, a coagulating bath and a collecting device, the combination which comprises a driven stepped roller located adjacent the coagulating bath for initially stretching the thread as it is propelled therearound from the step of smaller diameter to which the thread is delivered from the coagulating bath to the step of larger diameter, means for guiding the thread from the step of smaller diameter to that of greater diameter, a second driven stepped roller for stretching the thread as it is propelled therearound from the step of smaller diameter to the step of greater diameter, means for guiding the thread from the step of smaller diameter to the step of greater diameter on said second roller, means for guiding the thread from the step of greater diameter of the first roller to the step of smaller diameter of the second roller, means for driving the step of smaller diameter of said second roller at a higher rate of speed than the step of larger diameter of said first roller, a treating bath positioned between said stepped rollers and means located within said treating bath for guiding the thread therethrough, said means being the guide means by which the thread is led from the first stepped roller to the second stepped roller whereby a three-stage stretching operation may be performed by the use of two stepped godets.

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