Dec. 7, 1937. L. H. RYAN 2,101,720

MANUFACTURE OF ARTIFICIAL SILK

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Fig. 1.

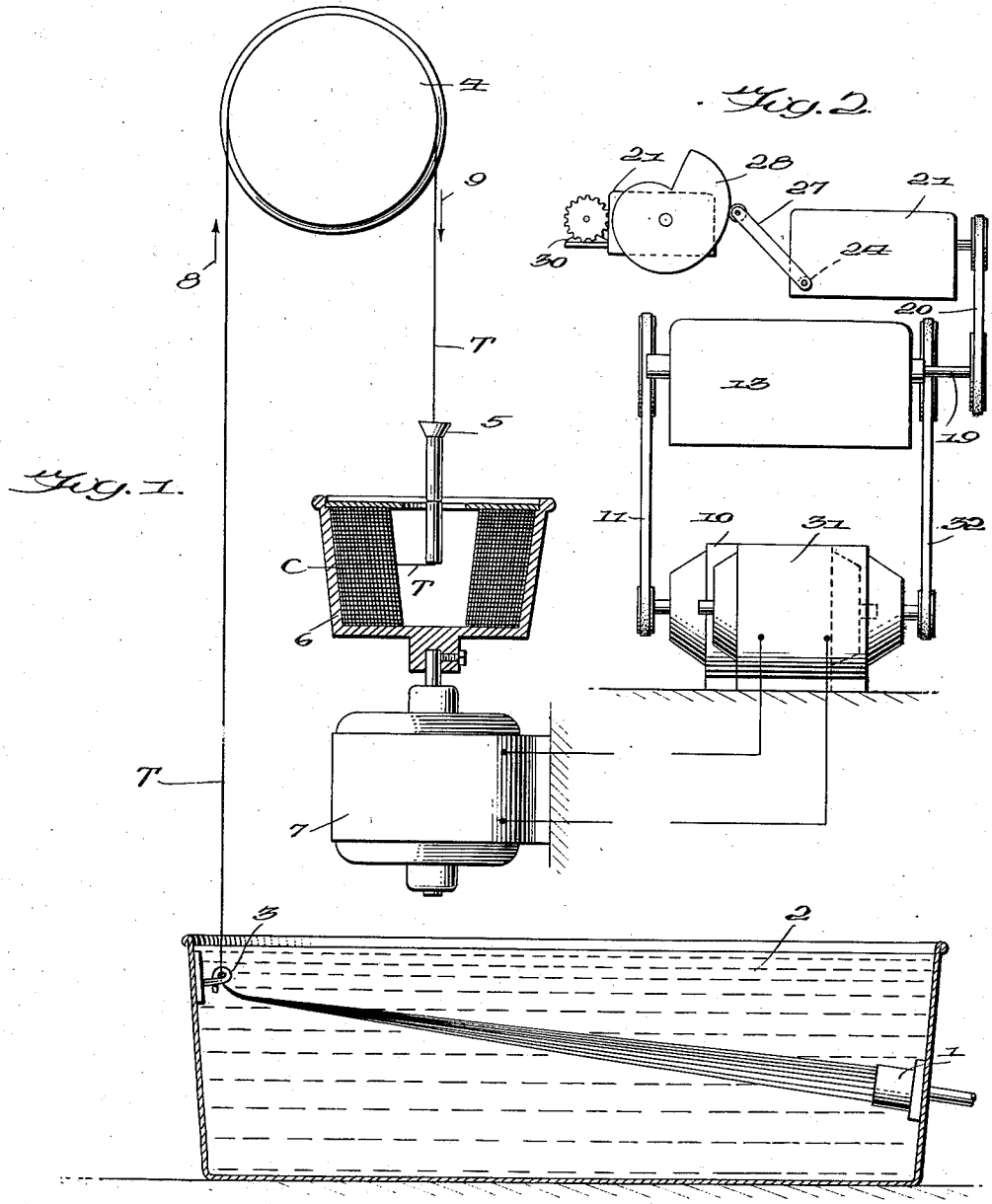


Fig. 2.

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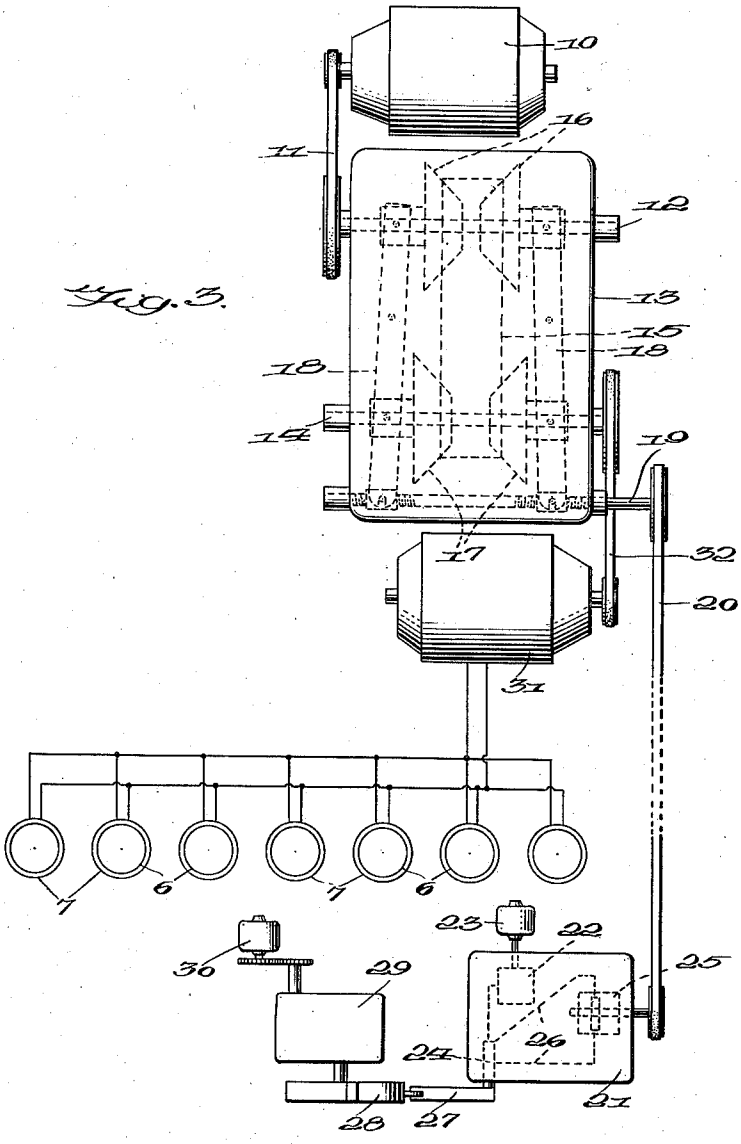
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Fig. 3.



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MANUFACTURE OF ARTIFICIAL SILK

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6 Claims. (Cl. 18—8)

This invention relates to the art of manufacturing artificial silk and the like and more particularly to a process and apparatus for forming freshly spun cakes or packages of artificial silk and the like which have improved qualities such as more uniform strength, stretch, denier, and dyeing properties.

Some progress has been made in the art in the matter of maintaining uniform conditions of spinning artificial silk and the like between different nozzles or spinnerettes on the same or other machines at the same time but these prior methods have not overcome the non-uniform characteristics found in a cake when comparing the yarn coming from different parts of the same cake. It is a known fact that by the ordinary methods of spinning, the cake will have non-uniform characteristics when comparing the yarn coming from the inner layers of the cake with that coming from the outer layers of the same cake.

It is an object of this invention to produce a cake which will be uniform in itself throughout its entire thickness in such properties as strength, denier, stretch, and dyeing characteristics.

In order to produce a package or cake of artificial silk and the like which will have uniform properties throughout its entire thickness, it is necessary to maintain uniform spinning conditions, such as degree of coagulation, tension, and godet wheel slippage. One method heretofore proposed to decrease the amount of slippage on the godet wheel is to increase the surface of contact between the thread and the godet wheel by using one complete wrap or two or three or more wraps around the godet wheel. Another proposed method was to use more than one godet wheel with any desired number of wraps around each.

While these proposed methods did produce some beneficial results in that they decreased the total amount of godet wheel slippage, they failed to overcome the real trouble, which is a variation in godet wheel slippage when comparing the slippage at the beginning of a doff with that at the end of a doff.

It is an object of this invention to maintain a uniform slippage, if any, on the godet wheel, at all times.

Another proposed method to overcome the uneven characteristics in a cake or package has been to increase the speed of the godet wheel gradually as the cake builds up in the bucket so that the denier will be the same on the inside and outside of the cake. By doing this the degree of coagulation is changed in that the thread travels through the coagulating bath at a different rate when comparing spinning at the beginning and end of a doff.

Still another proposed method has been to slowly and gradually decrease the quantity of viscose delivered from the jet during the spinning of a cake. This, likewise, introduces a change in degree of coagulation.

Another proposed method has been to introduce a change in tension on the thread before it reaches the godet wheel. This, likewise, introduces a variation in tension on the thread so that the cake, through its entire thickness, is spun with a variation in tension.

Thus, it can be seen that all prior methods have failed to produce a cake which will have uniform properties of strength, denier, stretch, and dyeing properties because they have not maintained uniform tension, degree of coagulation, or godet wheel slippage during the spinning of a cake throughout its thickness, but instead they have actually introduced a variation in the spinning conditions.

My invention will overcome the uneven characteristics found in a cake or package of artificial silk and the like without introducing any variation in tension, degree of coagulation or slippage during the entire time of spinning a cake.

I have found that one factor which produces a variation in tension and degree of coagulation is the continuous variation in godet wheel slippage from the beginning to the end of the doffing cycle. One of the reasons for this continuous variation in godet wheel slippage is the fact that the tension on the thread on the delivery side of the godet wheel is continuously decreasing during the doffing time.

Under certain conditions this variation of tension on the thread on the delivery side of the godet wheel will be transmitted to the thread on the take-up side of the godet wheel. I am fully aware of the reduction in total godet wheel slippage obtained by the use of two or more wraps around one or more godet wheels but I am also aware of the fact that there is a continuous difference in this total godet wheel slippage on the thread when comparing the beginning and end of the doff. By maintaining uniform tension on the delivery side of the godet wheel, I have found that the slippage will be uniform throughout the entire doffing time, thereby improving the uniformity of the characteristics of the yarn throughout the entire thickness of the cake.

The art is generally acquainted with methods

for maintaining uniform conditions of tension and coagulation up to the point where the thread is led onto the godet wheel. It was therefore, assumed that the yarn will have such uniform characteristics as are obtained from uniform spinning tensions and degree of coagulation. However, the assumption is incorrect in that we do find a difference in characteristics between the threads collected at the beginning and end of the doffing cycle.

All prior attempts to make a cake with uniform characteristics throughout its thickness have proven unsatisfactory in that they have actually introduced other variations in either tension or degree of coagulation. I have found the reason why a package of yarn will not have uniform characteristics throughout its thickness and have found a method and apparatus for correcting the trouble at its source without introducing any variation in tension and degree of coagulation at any point on the thread in its travel from the time it is formed at the spinnerette to the point where it is laid down in the pot or bucket.

An object of this invention is to equalize the tension on the thread at the point where it is laid down in the bucket by maintaining a uniform pull or tension or centrifugal force on the thread at this point at all times, irrespective of the thickness of the cake. In doing this, I have found a method and apparatus for producing a cake which will have uniform characteristics throughout its thickness.

As the cake steadily increases in thickness, I have found a corresponding decrease in centrifugal force in that this centrifugal force on the thread, where it is laid down in the bucket, varies with the square of its peripheral speed. I have found that the change in strength, denier, and dyeing characteristics will vary to the extent that this centrifugal force will vary. It is due to the gradual decrease in circumference on the inside of the cake that the peripheral speed changes as the cake builds up. Thus, it becomes obvious that with the usual methods of spinning, we are continuously spinning with uneven tensions, having the highest tension at the beginning of the cake, and the lowest at the inside or end of the cake.

It is an object of my invention to increase the speed of the bucket slowly and gradually during the spinning of the cake, to an extent required to maintain uniform tension on the thread at all times at the point where the thread is laid down in the bucket. By doing this I have found a method and apparatus for producing a cake which will have uniform characteristics of strength, denier, and dyeing properties throughout its entire thickness.

At the same time by maintaining the tension on the thread uniform at the point where the thread is laid down in the bucket, at all times and throughout the thickness of the cake, I have found a method of maintaining uniform godet wheel slippage at all times during the spinning of a cake.

It is a decided advantage in the art, from the point of view of cost and convenience of operation, to use as long a doffing time as possible; however, the limiting factor has been the introduction of uneven characteristics in the yarn due to the difference in centrifugal force or tension on the thread at the point where the thread is laid down in the bucket in the manner described above. With the present invention this variation in tension or centrifugal force is eliminated, thereby removing the limit in the time of doffing which existed heretofore.

Another object of this invention is to provide an apparatus with which it will be possible to maintain uniform tension on the thread throughout the entire doffing time, regardless of how thick the cake may be, by compensating for the usual and normal drop in tension caused by the continuously increasing thickness of the cake with the corresponding continuous drop in tension or centrifugal force on the thread at the point where the thread is laid down in the bucket. This apparatus increases the speed of the bucket while the cake is building up or increasing in thickness, to the extent required to maintain a uniform tension or force on the thread at the point where the thread is laid down in the bucket.

Prior to this invention the speed of the bucket has been operating at a uniform and constant speed during the entire doffing time. From the description given above, I have shown where it is necessary to change the bucket speed if a truly uniform product is desired. This invention provides an apparatus for accomplishing a change in bucket speed to any extent at any time for any length of time during the spinning of a cake, regardless of its thickness or size or shape of the bucket in which the cake is being formed.

I have shown an embodiment of my invention in the accompanying drawings, in which:

Fig. 1 is a diagrammatic view, partly in section, of the spinning apparatus;

Fig. 2 is a side elevation of the mechanism for controlling the speed of the spinning motors; and

Fig. 3 is a diagrammatic plan view of the controlling mechanism.

Referring to Fig. 1, I have shown a spinnerette 1 arranged to extrude the spinning solution in the form of filaments in a coagulating bath 2, through which the filaments pass to a guide 3, where the filaments are combined in the form of a thread or filament designated T. The thread T passes around a godet wheel 4 of the usual form and the thread may be wrapped entirely around the godet wheel or may extend over several godet wheels, if desired, in the usual way. The thread passes from the delivery side of the godet wheel into a funnel 5 which moves up and down in the usual manner to lead the thread into the bucket.

The spinning bucket is designated generally by the numeral 6 and is designed for collecting the thread and for forming a cake or package of the collected thread. The bucket 6 is rotated by means of an electric motor 7, so that as the thread leaves the lower end of the funnel 5, it is thrown out by centrifugal force to form the cake or package in the bucket. When the cake is started, the threads are laid down along the walls of the bucket, as shown in Fig. 1, until the cake of sufficient thickness is built up ready for doffing. The thread T is broken then and the cake, which is designated C, in Fig. 1, is removed from the spinning bucket 6.

This is one of the common methods for spinning artificial silk, but other methods are also common and the invention is not limited to the particular one shown.

It has been found that the cake C is not uniform, as has been pointed out above and the yarn does not have uniform characteristics.

By measuring the tension on the thread on the take-up side of the godet wheel, as repre-

sented by the arrow 8 in Fig. 1, when the thread is lead into an empty spinning bucket just at the beginning of the doff, I found the tension to be 20 grams. At the same time, the tension on the thread at the delivery side of the godet wheel, designated 9 in Fig. 1, was 8 grams. When the bucket was ready to be doffed, the tension at 9 dropped to 2 grams, and at the same time the tension on the take-up side 8 of the godet wheel, was 20 grams. This drop from 7 grams to 2 grams at the delivery side of the godet wheel was gradual and continued as the thickness of the cake increased. Under certain spinning conditions where provision was not made for reducing the amount of godet wheel slippage, I found that there was a drop also on the take-up side of the godet wheel at the end of the doff. The figures quoted were those taken on the thread while spinning a cake of 150 denier, 44 filament yarn by the usual method employed heretofore. Similar variations will be found for yarns of different denier or filament count. This drop in tension was found to be caused by a drop in the centrifugal force on the thread at the point where the thread is laid down in the bucket.

Prior to this invention, the spinning motors 7 have operated at constant and uniform speed during the entire doffing time, but I have found that it is necessary to change the bucket speed if a truly uniform product is to be obtained, and I have provided an apparatus for changing the bucket speed to any extent at any time and for any length of time during the spinning of a cake, regardless of its thickness or size or the shape of the bucket in which the cake is being formed.

I have shown in Figs. 2 and 3, one form of mechanism for accomplishing this change in the speed of the spinning motors, whereby the speed of the spinning bucket is varied during the spinning of a cake and as the thickness of the cake increases.

Referring to Fig. 3, an induction motor is shown at 10 which is connected by a chain 11 with a constant speed shaft 12 of a variable speed unit 13. The unit shown in Fig. 3 is of well-known mechanical construction in which the constant speed shaft 12 drives a variable speed shaft 14 through a belt 15 which passes around pairs of cone pulleys 16 and 17 mounted respectively on the shafts 12 and 14 to be shifted toward and from each other alternately by pivoted shifter arms 18 which are connected with the pulleys. The belt 15 drives the variable speed shaft 14 from the constant speed shaft 12 and the speed of the former may be changed in the usual way by shifting the cone pulleys 16 further apart while at the same time moving the cone pulleys 17 closer together, or vice-versa. In other words, the speed of the shaft 14 will depend upon the relative positions of the cone pulleys 16 and 17.

For moving the shifter arms 18 to change the relative speed of the shaft 14, the unit 13 has a screw shaft 19 rotated by a suitable belt or chain 20 from a control unit 21. This control unit is shown as of a character embodying a small oil pump 22, which is driven by a motor 23 and forces the oil through a valve 24 to a turbine 25 under pressure sufficient to operate the turbine and which in turn drives the belt or chain 20 to rotate the screw shaft 19. Pipe lines 26 connect the valve 24 with the turbine 25 to control the directions of rotation of the turbine.

The valve 24 is an ordinary sliding valve which opens and closes to direct the oil under pressure from the pump 22 into one or the other of the pipe lines 26; the extent to which the valve 24 is opened to either of the pipe lines, determines the amount of oil fed through the respective lines to the turbine, which in turn, operates the screw shaft 19 to the same extent for effecting a corresponding variation in the drive of the variable speed shaft 14.

The sliding valve 24 is opened or closed by means of a lever 27 which bears on a cam 28, the outline of which is shown in Fig. 2. The cam 28 is operated by a reduction gear unit 29 which in turn is driven by a motor 30.

Thus it can be seen that the variable speed shaft 14 may be controlled so as to revolve at any desired speed and for any given length of time, depending upon the shape of the cam 28.

The variable speed shaft 14 drives a frequency changer 31 through a chain 32 and the frequency changer 31 is electrically connected with the spinning motors 7 which drive the spinning buckets 6, so that by changing the frequency of the motors 7, the speed of rotation of the spinning buckets is changed accordingly and may be controlled so as to give any desired speed for any length of time during the spinning of cakes by shaping the cam 28 to obtain the desired results.

The particular constructions of the variable speed unit 13 and control unit 21, form no part of the present invention and other types of units may be substituted therefor. For instance, a control unit of the gear type may be used in place of the hydraulic unit designated 21. But in any event, the cam 28 of desired contour regulates the drive of the frequency changer 31, to vary the speed of the spinning motors.

The rate at which the thickness of a cake increases during the spinning of a complete cake does not vary directly with the time. The thread is led into the bucket at a constant rate but the rate of increase in thickness of the cake is continuously varying due to the continuous decrease in circumference of the cake. For example where the circumference of the cake at the beginning of a doffing cycle (using a 6 inch bucket) is compared with the circumference at the end of the doffing cycle when the thickness of the cake is one and one-half inches, the circumference at the beginning is twice as much as that at the end and although the thread is fed to the cake at a constant rate, the thickness will build up twice as fast at the end of the doff as it did at the beginning.

I have found that the uneven characteristics of the yarn, such as strength, denier, and dyeing properties will have to be corrected by increasing the bucket speed at a variable degree of increase, depending on the rate at which the thickness of the cake builds up. To accomplish this, the cam 28 of the control unit is designed to coincide with the rate at which the thickness of the cake builds up. This cam may be designed so that one complete revolution of the cam will correspond with the time required for building a complete cake so that there will be a minimum interruption for adjusting the cam at the time of doffing.

By controlling the rotation of the spinning bucket so as to provide uniform building up of the cake, a uniform tension is maintained at all times on the thread at the delivery side of the godet wheel, whereby uniform slippage of the thread on the godet wheel is likewise maintained.

I claim:

1. In a machine for forming artificial silk or the like, the combination of thread forming

means, a spinning bucket to receive the thread in the form of a cake, a motor for rotating said bucket, means for gradually increasing the speed of rotation of the bucket during the building of a cake therein, including change speed means comprising frequency changing means, and a cam connected with said change speed means for controlling the same, said cam being constructed for rotation through a complete revolution during the building of a complete cake in the spinning bucket.

2. In a machine for forming artificial silk or the like, the combination of thread-forming means, a spinning bucket to receive the thread to form a cake, a motor for driving said bucket, and means for changing the frequency of the electricity supplied to the motor whereby to change the speed thereof during the spinning of the cake.

3. In a machine for forming artificial silk or the like, the combination of thread-forming means, a spinning bucket to receive the thread to form a cake, a motor for driving said bucket, and means for changing the speed of the motor continuously at a uniform rate during the spinning of the cake by continuously and uniformly changing the frequency of the electricity supplied to the said motor.

4. In a machine for forming artificial silk or the like, the combination of thread-forming means, a spinning bucket to receive the thread to form a cake, a motor for driving said bucket, and means for changing the speed of the motor at a variable rate during the spinning of the cake by changing the frequency of the electricity supplied to the said motor at a variable rate.

5. In a machine for forming artificial silk or the like, the combination of thread-forming means, a spinning bucket to receive the thread to form a cake, a motor for driving said bucket, and means for changing the frequency of the electricity supplied to the motor whereby to change the speed of the motor during the spinning of the cake, said frequency changing means comprising a motor driving a constant speed shaft of a variable speed unit, a control unit connected with a variable speed shaft of the variable speed unit, a frequency changer driven by said variable speed shaft and electric connections between said frequency changer and the bucket motor.

6. In a machine for forming artificial silk or the like, the combination of thread-forming means, a spinning bucket to receive the thread in the form of a cake, a motor for rotating said bucket, and means for changing the speed of rotation of said bucket during the building of a cake therein, said means including a change speed unit comprising frequency changing means, and a cam connected with said change speed unit for controlling the same, said cam being constructed to rotate through one complete revolution during the building of a complete cake in the spinning bucket.

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