

July 13, 1937.

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2,086,651

METHOD AND APPARATUS FOR MAKING ARTIFICIAL SILK AND THE LIKE

Filed Oct. 31, 1935

3 Sheets-Sheet 1

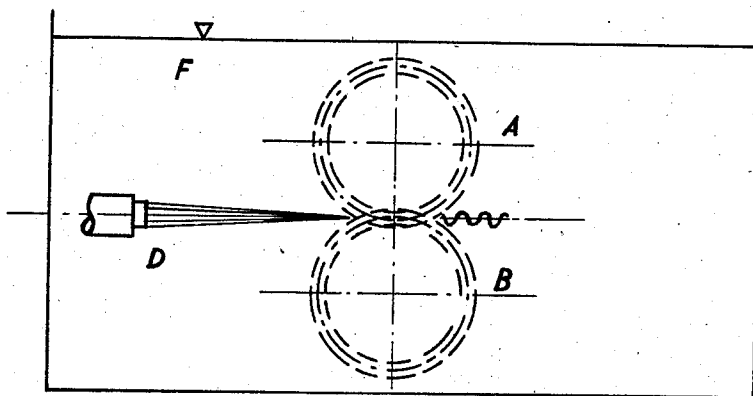


Fig 1

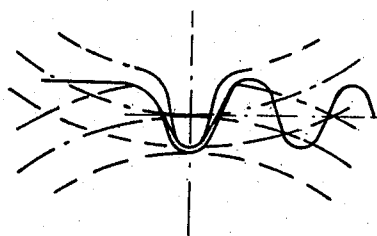


Fig 1a

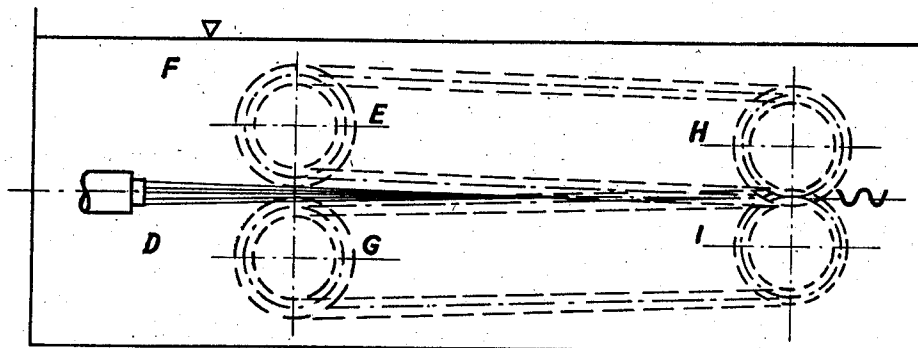


Fig 2

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3 Sheets-Sheet 2

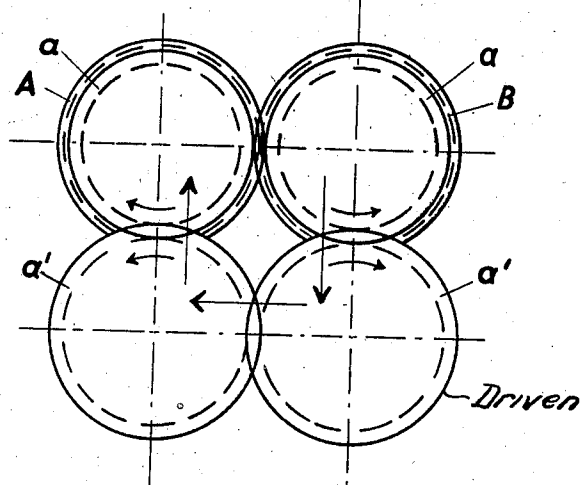


Fig 3

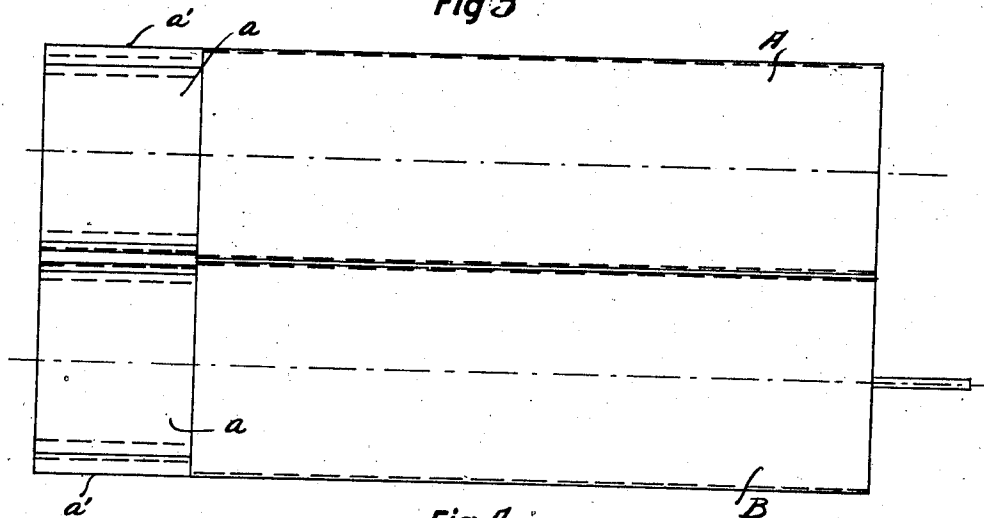


Fig 4

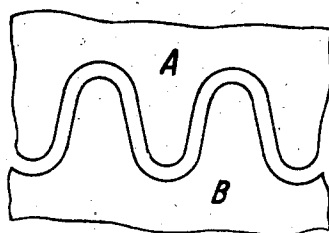


Fig 5

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3 Sheets-Sheet 3

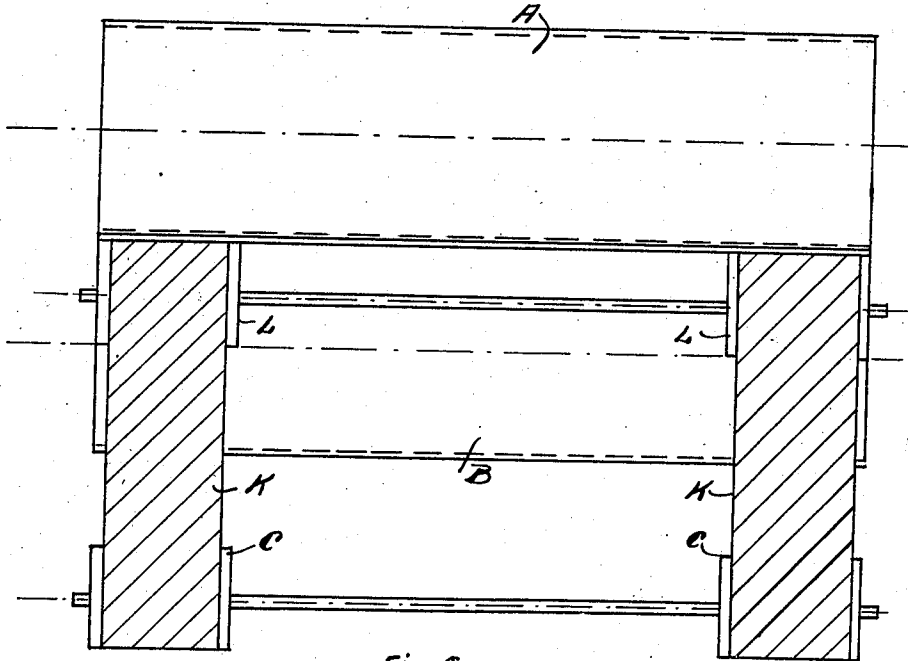


Fig 6

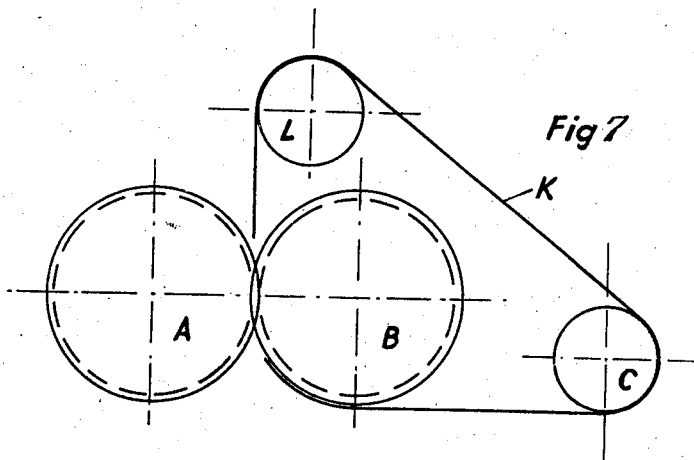


Fig 7

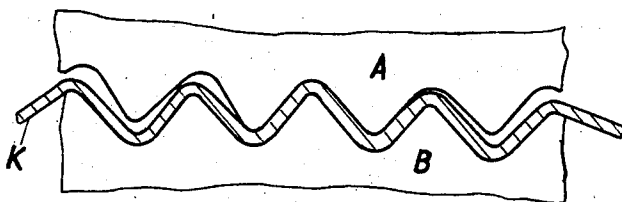


Fig 8

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UNITED STATES PATENT OFFICE

2,086,651

METHOD AND APPARATUS FOR MAKING
ARTIFICIAL SILK AND THE LIKE

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Application October 31, 1935, Serial No. 47,565
In Germany November 2, 1934

11 Claims. (Cl. 18—8)

The present invention concerns the production of artificial silk or fibres and apparatus therefore, more especially the production of curly and creasy silk or fibres which have a wool-like appearance and which when cut to short staple fibre may be worked up to tissues and the like in almost the same way and with almost the same effect as natural wool and other naturally curled natural fibres.

The invention is performed in using the well known processes for manufacturing artificial silk or fibres i. e. the dry spinning process or the wet spinning process in spinning solutions containing cellulose, as acetylcellulose, nitrocellulose, or any ethers or esters of cellulose or combinations of cellulose as for example xanthogenate or cuprammonium-cellulose. All these different solutions are thought of in the following when using the expression "solution containing cellulose".

Any method for rendering the filament curly and creasy may be used and the present invention consists in performing the curling process whilst the filament is still in a most plastic condition as it has been found that only in this condition it is possible to render the curly condition durable. Therefore the curly state must according to the present invention be forced on the filament so soon after the formation of the filament is performed that the formed thread is still in such a plastic state that it is able to take up the curly form. This will be the case according to the present invention when the coagulation of the interior parts of the filament has not yet been thoroughly finished and the filamentlike form is maintained only by an outside-tubelike structure which is filled with the spinning-solution not yet decomposed or coagulated. Therefore the curling-tool must be arranged so near to the spinning nozzle that the condition spoken of is fulfilled. This depends on the velocity of coagulation (i. e. the temperature and the chemical and physical nature of the coagulating medium and of the solution to be spun) the diameter of the filament spun and the velocity which with the filament is drawn off the nozzle. For example when spinning a so called ordinarily ripened viscose (7-11 chlorammonogrades) especially a ripened viscose made of ordinarily ripened alkalicellulose and containing for example 7-10% of cellulose when spinning by the wet spinning process the curling tool must be posed within about 3-10 or even to about 30 cm. from the spinning nozzle and the more the vis-

cose is unripened the more the curling tool may be removed away from the nozzle. Especially when using so-called unripened viscose (13-20 chlorammonogrades or even showing no chlorammonograde at all) made from unripened alkalicellulose and showing a high viscosity even when the content of cellulose is rather low (i. e. 4½-6½% of cellulose and about 4-6% NaOH) the curling tool may be removed one or 2 metres or even more from the spinning nozzle. A spinning bath may be used for these unripened viscoses containing about 11-15% of H₂SO₄ monohydrate and having a temperature of about -3 to +25° C. When using lower temperatures the speed of coagulation will be lower too. When using an ordinarily ripened viscose containing about 1% less alkali than cellulose the well known so-called "Müllerbad" may be used which has a temperature of about +40 — +50° C. containing a high percentage (15-35%) of one or more sulfates of alkali or earth-alkali especially magnesium or zinc. Other substances well known may besides be added to the spinning bath.

When passing the curling tool the filament may be stretched more or less whereby the curly state is rendered more durable. This may be performed in sending the filament between a pair of fluted rollers which will render the filament curly, the rollers being so constructed and mounted as not to damage the filament by squeezing it. The accompanying drawings show one way of curling the filament in using fluted rollers though other curling tools may be used too.

In the drawings:

Fig. 1 is a diagrammatic elevational view of one form of apparatus for carrying out my invention,

Fig. 1a is an enlarged view showing the manner in which the curling rollers cooperate to form undulations in the filaments,

Fig. 2 is a diagrammatic elevational view of another form of apparatus,

Fig. 3 is a diagrammatic end view of another form of apparatus, with means for synchronizing the rotation of the curling rollers,

Fig. 4 is a plan view of the apparatus shown in Fig. 3,

Fig. 5 is an enlarged view of a portion of the cooperating rollers of the apparatus shown in Figs. 3 and 4, showing the manner in which the ribs of the fluted rollers cooperate,

Fig. 6 is a diagrammatic plan view of a further modification of the invention,

Fig. 7 is an end view of Fig. 6, and

Fig. 8 is an enlarged diagrammatic view show-

ing how the curling rollers may be spaced by endless bands.

In Figure 1, D is the spinning nozzle through which the spinning solution is squeezed out and formed to a filament which will begin to coagulate from the outer surface to begin with either by evaporation of the dissolving liquid when using the dry spinning process or by a coagulation bath F in which the nozzle is dipped in when using the wet spinning process as described before. Before the coagulation has entirely gone through the whole filament the last passes between the two fluted rollers A B which will make the filament curly and creasy as shown in Figure 1 on the right side of the rollers A B. In Figure 1a one tooth of the roller A and a corresponding groove of the roller B is drawn on an enlarged scale, the filament passing between.

In Figure 2 another curling apparatus is described. The filament coming from the nozzle D and passing the coagulating medium F (for example hot air, when dry spinning or an acid bath when wet spinning) enters between two endless ribbons tightly fitting over two pairs of rollers E, H and G, I respectively, the ribbons carrying small parallel-lying bars so that a small groove is formed between two neighbored bars in which a bar fastened to the other ribbon will fit when the ribbons are moved with equal velocity by driving the pairs of rollers E, H and G, I with equal velocity.

Special care may be taken as to prevent any squeezing of the filament by the rollers A, B. One way and method for this purpose is shown in the Figures 3 and 4, the rollers A and B being adjustably approachable to each other or removable from each other within a certain room for moving.

To insure the synchronism between the fluted rollers A, B (Figure 3) whilst running, four cogwheels (a , a' , a') are used. The two fluted rollers A B are not directly combined with each other by cogwheels but only by means of a pair of two combing cogwheels (a' , a') mounted perpendicularly under the fluted rollers A, B and having a diameter only a little bigger (regarding the diameter of the filament spun) than the diameter of the cogwheels (a , a) rigidly attached to the fluted rollers A B. By this construction it is possible to approach or to remove the rollers A and B respectively without disturbing the synchronized running of them (Figure 5).

If the fluted rollers are changed but little their synchronism may be insured in a different manner, shown in the Figures 6-8: one or more (for example two) elastic endless ribbons K made from india rubber for example passing between the rollers A B are pressed closely between the cogging excluding in this way any synchronism between the two fluted rollers A B. Only one of the two rollers may be driven, which also is the case when using the apparatus described before and illustrated by the Figures 3-5. In choosing india-rubber-ribbons of different diameter, the rollers A B may be more or less approached to each other, the rubber-ribbons controlling the distance of the rollers. The driving of the fluted rollers may be accomplished by using the elastic ribbon as a driving band, the same running over strap wheels L and C or the like, one of which may be driven by a motor. It is not absolutely necessary to rest the fluted rollers A B on both ends; they may be rested only on one side or may be mounted in a hanging position dipping in a coagulating bath for example, without the bearing

or the guiding being exposed to the injurious influence of the coagulating bath. One of the rollers may be mounted in a way to give the possibility of swinging it or turning it off its working position from the other roller especially when the rollers are in a hanging position or rested only on one side so that the filament coming from the nozzle may easily be led between the rollers.

When producing staple fibres the filament spun and curled may be cut to staples in a known manner, preferably after the curling process is finished.

Having now described my invention and the way in which it may be performed that what I claim is:

1. The method of producing curly, wool-like filaments which comprises extruding a spinning solution into filament form, lineally distorting the filament before it has become thoroughly coagulated through and through and still is in a plastic condition, maintaining the original cross-sectional shape of the filament during the distortion thereof, and stretching said filament during the lineal distortion.

2. The method of producing curly, wool-like filaments which comprises extruding a spinning solution into filament form, stretching said extruded filament and lineally distorting the filament after the outside thereof has coagulated to form a tube-like, form-retaining casing but while the inner part of the filament still is in an uncoagulated plastic form, maintaining the original cross-sectional shape of the filament during the distortion thereof and stretching the filament during the lineal distortion.

3. The method of producing curly, wool-like filaments which comprises extruding a spinning solution consisting of unripened viscose of unripened alkali cellulose containing $4\frac{1}{2}$ to $6\frac{1}{2}$ percent of cellulose into filament form, stretching said extruded filament, lineally distorting the filament before it has become thoroughly coagulated through and through and still is sufficiently plastic to take up and retain a curly form, maintaining the original cross-sectional shape of the filament during the distortion thereof, and stretching the filament during the lineal distortion.

4. An apparatus for producing curly, wool-like filaments which comprises means for extruding a spinning solution into filament form, filament distortion means adapted to receive the filament extruded from said extrusion means and positioned sufficiently close to said extrusion means to receive the filament before it has become coagulated through and through, said filament-distortion means comprising a pair of rotatable rolls mounted on parallel axes and having inter-meshing teeth between which the filament passes, said rolls being spaced apart a distance such that during rotation the inter-meshing teeth will lineally distort the filament but substantially will not distort its cross-sectional shape, and means for driving said rolls independently of one another and in synchronism.

5. An apparatus for producing curly, wool-like filaments which comprises means for extruding a spinning solution into filament form, filament-distortion means adapted to receive the filament extruded from said extrusion means and positioned sufficiently close to said extrusion means to receive the filament before it has become coagulated through and through, said filament distortion means comprising a pair of rotatable rolls mounted on parallel axes and having inter-mesh-

ing teeth between which the filament passes, said rolls being spaced apart a distance such that during rotation the inter-meshing teeth will lineally distort the filament but substantially will not distort its cross-sectional shape, inter-meshing driving gears of substantially the same diameter as said toothed rolls carried by said rolls, and means interposed between the inter-meshing teeth of said driving gears as they rotate for spacing the gears and the toothed rolls from one another.

6. An apparatus for producing curly, wool-like filaments which comprises means for extruding a spinning solution into filament form, filament-distortion means adapted to receive the filament extruded from said extrusion means and positioned sufficiently close to said extrusion means to receive the filament before it has become coagulated through and through, said filament distortion means comprising a pair of rotatable rolls mounted on parallel axes and having inter-meshing teeth between which the filament passes, said rolls being spaced apart a distance such that during rotation the inter-meshing teeth will lineally distort the filament but substantially will not distort its cross-sectional shape, inter-meshing driving gears of substantially the same diameter as said toothed rolls carried by said rolls, and a driven, endless, flexible band interposed between the inter-meshing teeth of said driving gears as they rotate for spacing the gears and the toothed rolls from one another and for driving said rolls.

7. An apparatus as set forth in claim 5 in which the spacing means for the gears also is the driving means for the rolls.

8. An apparatus as set forth in claim 5 in which the gear spacing means is an endless flexible ribbon.

9. An apparatus for producing curly, wool-like filaments which comprises means for extruding a spinning solution into filament form, filament distortion means adapted to receive the filament extruded from said extrusion means and positioned sufficiently close to said extrusion means to receive the filament before it has become coagulated through and through, said filament distortion means comprising a pair of rotatable rolls

mounted on parallel axes and having inter-meshing teeth between which the filament passes, said rolls being spaced apart a distance such that during rotation the inter-meshing teeth will lineally distort the filament but substantially will not distort its cross-sectional shape, gears of the same diameter secured to the ends of said toothed wheels, and inter-meshing gears having a larger diameter than said first-mentioned gears with which said first-mentioned gears mesh, one of said larger gears being a driven gear.

10. An apparatus for producing curly, wool-like filaments which comprises means for extruding a spinning solution into filament form, filament distortion means adapted to receive the filament extruded from said extrusion and positioned sufficiently close to said extrusion means to receive the filament before it has become coagulated through and through, said filament distortion means comprising a pair of endless bands between which the filament passes, said endless bands having bars mounted parallel thereon and spaced apart to form grooves therebetween, said endless bands running over strap wheels, one endless band being mounted over the other, and the bars of one band meshing with the grooves of the other during the running of the bands and simultaneously lineally distorting and stretching the filament.

11. An apparatus for producing curly, wool-like filaments which comprises a nozzle for extruding a spinning solution into filament form, a pair of rollers having inter-engaging teeth for receiving the filament and lineally distorting the same between the teeth thereof as the rollers rotate, said rollers being positioned sufficiently close to the extrusion nozzle that the filament, when it enters the bight of said rollers, has not become coagulated through and through and still is in a plastic condition, the inter-engaging teeth of said rollers being spaced sufficiently as the rollers rotate to prevent destruction of the original cross-sectional shape of the filament, said interengaging teeth stretching said filament during the lineal distortion.

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