Jan. 19, 1943. A. H. BURKHOLDER 2,309,072

MANUFACTURE OF THREAD OR THE LIKE

Filed July 29, 1940 3 Sheets-Sheet 1

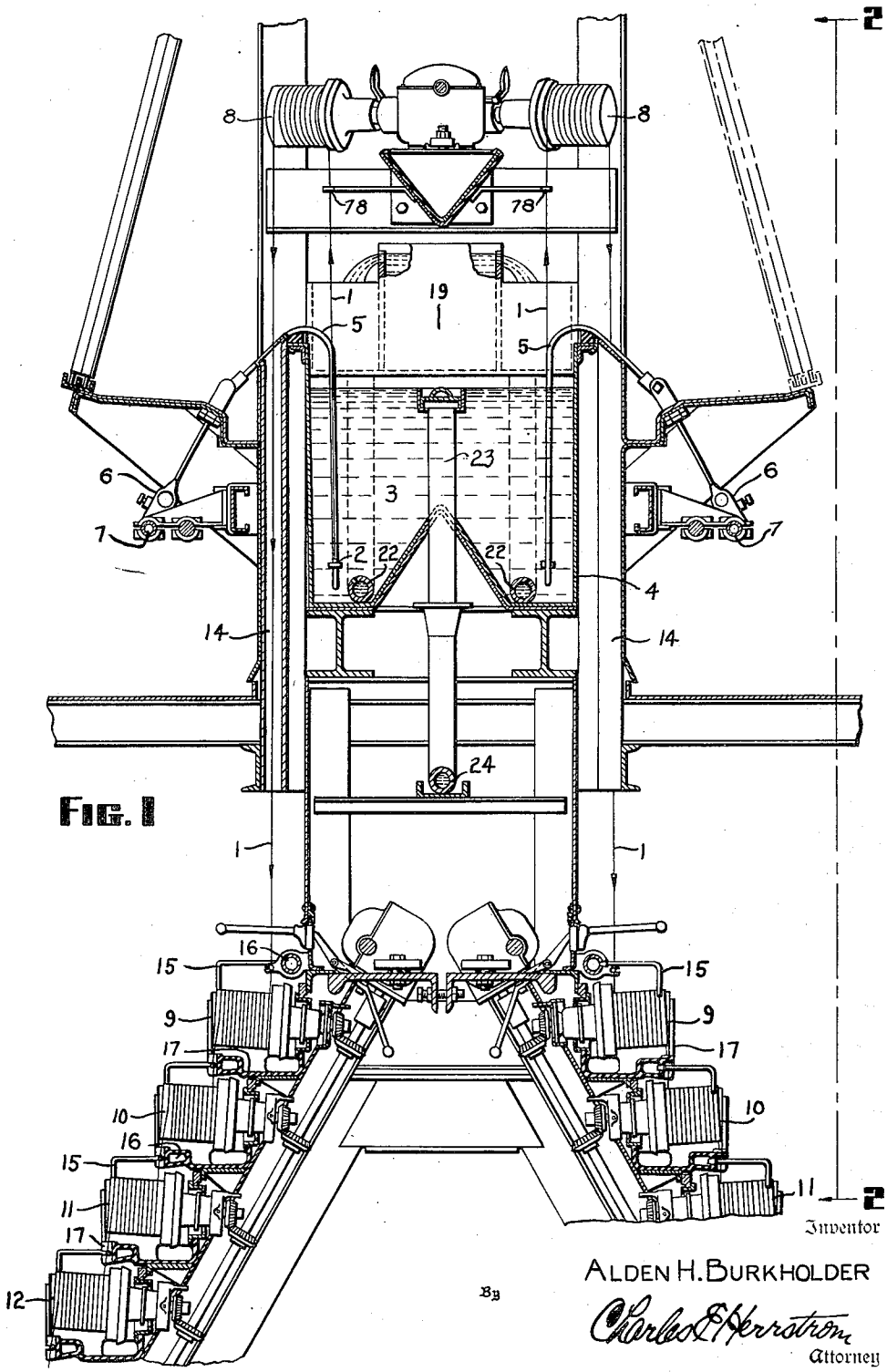


FIG. 1

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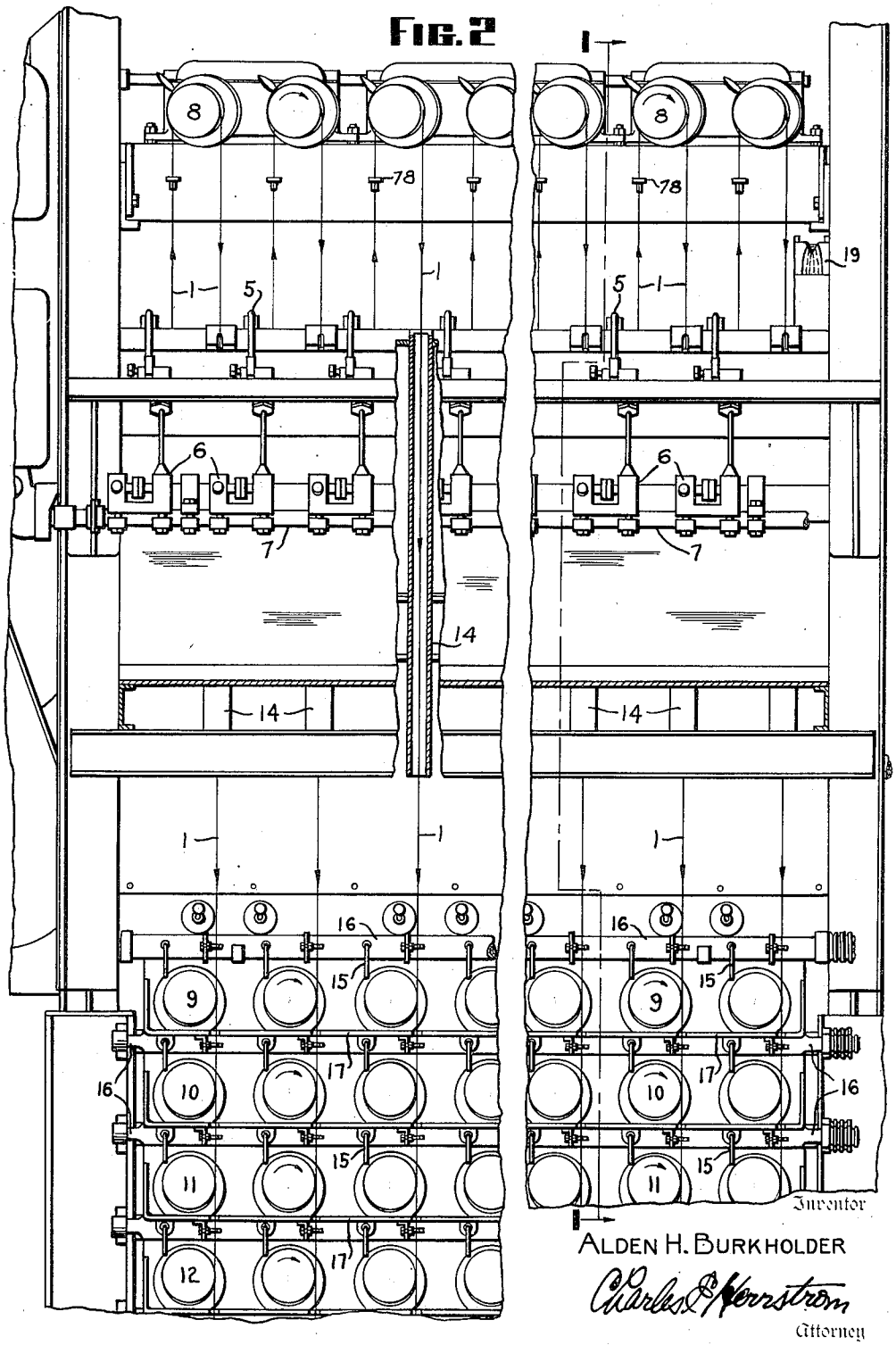
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MANUFACTURE OF THREAD OR THE LIKE

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FIG. 2



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MANUFACTURE OF THREAD OR THE LIKE

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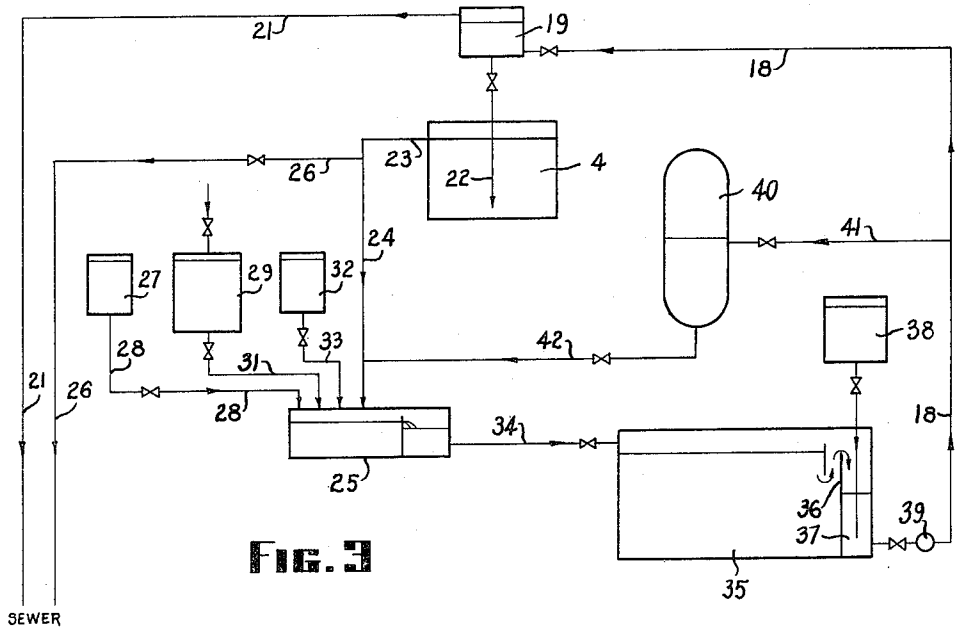


FIG. 3

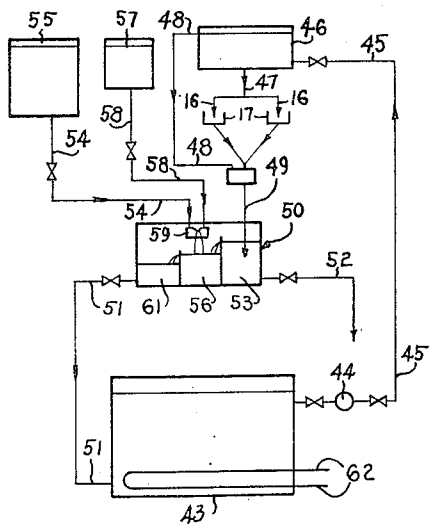


FIG. 4

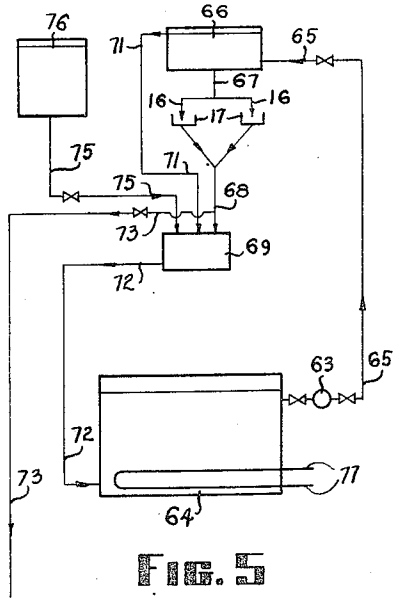


FIG. 5

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Patented Jan. 19, 1943 2,309,072

UNITED STATES PATENT OFFICE

2,309,072

MANUFACTURE OF THREAD OR THE LIKE

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Application July 29, 1940, Serial No. 348,106

4 Claims. (Cl. 18—54)

This invention relates to the manufacture of filaments, threads, cords, ribbons and other forms of strand material, all of which are referred to hereinafter by the generic term "thread."

The invention may be employed to especial advantage in the manufacture of artificial silk thread formed by the extrusion of a coagulable spinning mass into a suitable coagulating liquid. For purposes of illustration, but not in any sense of limitation, the features of novelty characterizing the invention will be described in connection with the manufacture of multiple filament viscose artificial silk thread on apparatus generally similar to that shown, described and claimed in copending application Serial No. 7,114 (Patent 2,225,642), filed February 18, 1935, by Walter F. Knebusch and Alden H. Burkholder. It will, however, be appreciated that the invention may be employed in the manufacture on other types of apparatus of sundry other kinds of thread, whether of natural or synthetic origin.

Briefly, the invention relates to the sequence of the operations performed upon the thread, to the conditions of processing, and to certain novel methods of maintaining the desired characteristics in the processing media.

In the drawings, Figure 1 represents a cross section from line 1—1 of Figure 2 of a portion of a machine for the manufacture of viscose artificial silk thread similar to that of said application. Figure 2 is a side elevation, from line 2—2 of Figure 1, of the portion of the machine illustrated in Figure 1. Figure 3 is a flow diagram of the circulation system for the coagulating liquid employed in said machine. Figure 4 is a flow diagram of the circulation system for the processing liquid applied to the thread shortly after its coagulation. Figure 5 is a similar flow diagram of the circulation system for the processing liquid next applied to the thread.

As indicated in Figures 1 and 2, each thread 1 is formed by the extrusion of viscose through a spinneret 2 into a coagulating bath 3 contained in trough 4. The viscose is supplied to each spinneret 2 by a mass tube 5 through which the viscose is forced by suitable means, such as a gear pump 6 associated with a viscose supply pipe 7 common to all pumps 6 on the same side of the machine. When the viscose comes into contact with the coagulating bath, a solidified thread 1 is formed which may be and preferably is drawn vertically upward by a first thread-advancing reel 8 of a descending series of several such reels. Five thread-advancing reels bearing reference numerals 8 to 12, inclusive, are shown in series, although more or less than five may be employed.

Each of said thread-advancing reels 8 to 12, inclusive, is adapted, during rotation, to store a long length of thread continuously but temporarily in a large number of closely spaced, generally helical turns which are advanced progressively from the supported to the unsupported end of the reel. The thread-supporting surface of each reel consists of a plurality of circumferentially spaced, axially extending bars which cooperate to advance the thread in the manner stated, the illustrated reel being in general of the type described in said application Serial No. 7,114. The reels shown in the drawings of the present application are in semi-diagrammatic representation, the indicated spacing of thread turns being considerably greater than the spacing of thread turns actually employed in the apparatus.

All of the reels in each descending series are disposed in stepped relation with their unsupported ends extending in the same direction; i. e., toward the operating face of the machine on the side thereof on which such reels are located. The thread-discharge end of each preceding reel is in opposite relation to the thread-receiving end of each succeeding reel; accordingly, the thread can pass downward from the unsupported end of each reel to the supported end of the succeeding reel. In such an arrangement, not only are the reels readily accessible for operating purposes but the thread can pass directly from reel to reel without undergoing detrimental bending or guide stresses.

In the apparatus illustrated, a plurality of such descending series of reels is disposed on each side of a common longitudinally extending coagulating trough 4. As shown in Figure 1, the banks of reels, when viewed in transverse cross section, resemble an inverted V. Corresponding reels of all downwardly extending series on each side of the machine are disposed in rows extending lengthwise of the machine, which makes possible the supply and removal of processing liquids by means of common longitudinally extending conduits on each side of the apparatus. It also provides various other practical advantages, such as construction economies.

After being withdrawn from the coagulating bath, each thread 1 is advanced from the supported to the unsupported end of one of the reels 8, being discharged from the reel beyond the lateral edge of trough 4. In the illustrated embodiment of the invention, no processing liquid

is applied to the thread on reel 8; instead, a period for furthering the coagulation of the thread is provided by storing a relatively long length of thread on said reel before the thread is subjected to processing liquid on succeeding reels 9 to 12, inclusive. As the thread 1 passes from reel 8 to the supported end of reel 9, it proceeds vertically downward through a channel 14 associated with the longitudinally extending side of coagulating trough 4.

On the reels subsequent to reel 8, liquid is applied to the thread by means of a reagent tube 15 communicating with a conduit 16 which extends longitudinally of the machine. Said conduit 16 supplies all corresponding processing reels on one side of the apparatus. A longitudinally extending collecting trough 17 which communicates with the sewer or with suitable recirculation means extends lengthwise of the machine beneath each such horizontal series of reels. In the embodiment of the invention illustrated, conduits 16 for reels 10 to 12, inclusive, are formed integrally with the collecting troughs 17 above such reels.

It is desirable that each of the reels on which liquid is applied to the thread shall be so operated that a film of processing liquid extending entirely around and for substantially the length of its thread-bearing periphery is formed upon the reel. In the illustrated apparatus, the turns of thread on each of reels 9 to 12, inclusive, are spaced sufficiently close together to permit the processing liquid which is applied to the thread to form such a film. The reel is preferably rotated at a speed such that the centrifugal force which is developed helps to maintain the film. Liquid is applied to the unsupported end of the reel, which is elevated slightly above the supported end so that countercurrent flow is obtained: Under such conditions, the formation upon the reel of the film of processing liquid is promoted.

As previously mentioned, each thread 1 is formed by extrusion of viscose into a bath containing dilute sulfuric acid, after which it is stored on reel 8 in order to permit coagulation of the thread to proceed. Thereafter, the thread is subjected on reel 9 to a somewhat more dilute sulfuric acid solution, preferably heated, and on reel 10 to a still more dilute sulfuric acid solution. The latter need not necessarily be heated, but can advantageously be heated to a temperature somewhat lower than that of the liquid applied on reel 9. Preferably, the acidity of the liquid applied on reel 10 is so low that it does not cause deleterious effects when the thread is subsequently subjected on reel 11 to an alkaline desulfurizing medium such as dilute sodium sulfide. The thread may be washed on reel 12, after which it may be subjected to other processing operations on subsequent reels.

In Figure 3 is shown the coagulating liquid circulation system employed in connection with the illustrated apparatus.

In such system, coagulating liquid is pumped through pipe 18 to a header box 19 disposed above the level of the coagulating liquid in trough 4. From header box 19, which is provided with an emergency overflow pipe 21, the coagulating liquid flows into the coagulating trough 4 through pipes 22 extending longitudinally of the trough (Figure 1). The coagulating liquid is drained from said trough 4 through a plurality of upright pipes 23 communicating with a common drain pipe 24 which pipes 23 are disposed at spaced intervals lengthwise of the trough: The inlets to such pipes 23 are disposed at a predetermined distance above the bottom of trough 4 in order to maintain the coagulating bath 3 at the desired level.

The coagulating liquid draining from trough 4 through pipes 23 and 24 passes to make-up tank 25, but only after a portion of the circulating coagulating liquid has been bled off from the system through pipe 26 in order to maintain the volume of liquid in the system constant.

The reagents needed to rejuvenate the coagulating liquid are added in make-up tank 25. Thus sulfuric acid from tank 27 may be added through pipe 28, water, if needed, from tank 29 through pipe 31, and zinc sulfate from tank 32 through pipe 33. Provision may also be made for adding sodium sulfate, if required. The replenished liquid is shown as passing through conduit 34 into a storage tank 35 in which a substantial part of the impurities present in the coagulating bath agglomerate to form a sludge readily separable from the coagulating liquid.

Coagulating liquid which is relatively free from sludge overflows a partition 36 in said tank into a compartment 37 in which an oleaginous material such as mineral oil emulsified in water by means of a suitable emulsifying agent, such as a sodium salt of a sulfonated higher hydrocarbon, is added to and mixed with the coagulating liquid. The purpose of adding the emulsified mineral oil, as from tank 38, is to render innocuous the relatively large quantity of insoluble impurities in the coagulating liquid; e. g., the sulfur formed in the regeneration reaction, and also to make possible the removal of such impurities from the coagulating liquid by forming the sludge to which reference has been made. The liquid in compartment 37 is forced by pump 39 through pipe 18 into coagulating trough 4, as indicated above.

In order to obviate the necessity of adding sodium sulfate to the system, some of the coagulating liquid is concentrated by passing it through an evaporator. To that end, a coagulating liquid evaporator 40 of the usual type is employed, its inlet being connected through pipe 41 with supply pipe 18. Its outlet is connected through pipe 42 with discharge pipe 24 from the coagulating trough 4. By means of such a system, a portion of the water in the coagulating liquid can be continuously removed; consequently, the concentration of acid, sodium sulfate, and other desired substances in the portion of the coagulating liquid returned to the system from the evaporator can be increased so as to maintain without additions the desired concentration of sodium sulfate in the circulating coagulating liquid.

The circulation system for the coagulated liquid itself forms no part of the present invention, being claimed in copending application Serial No. 348,232, filed July 29, 1940, by Hayden B. Kline et al.

The system for circulating the liquid to which the thread is subjected on reel 9 is shown diagrammatically in Figure 4. In said system, liquid is forced upward by means of pump 44 from storage tank 43 through pipe 45 to a header box 46. Said header box is so constructed that the liquid level therein is maintained at a predetermined distance above the discharge orifices of the reagent tubes 15 for the reels 9 disposed on both sides of the apparatus, thus insuring a predetermined uniform discharge of liquid

through each of reagent tubes 15. More liquid is supplied through pipe 45 than passes from header box 46 through pipe 47 and conduits 16: The excess passes out through overflow pipe 48. The overflow passed through pipe 48 and the liquid collected in troughs 17 beneath reels 9 and removed by means of pipe 49 are intermingled and passed to make-up tank 50, from which the mixture passes through pipe 51 to storage tank 43.

In the apparatus illustrated in the drawings, only chemicals not present in the coagulating bath need be added to the system. The amount of sulfuric acid, sodium sulfate and zinc sulfate carried over by the thread from the coagulating bath is more than sufficient to maintain the desired concentration of these substances in the processing liquid employed on reels 9. In time, they tend to build up to a concentration considerably greater than that desired; accordingly, a portion of the processing liquid is continuously bled from the system through pipe 52. For reasons of economy, the liquid so bled off is liquid to which no new additions have been made. To that end, pipe 52 communicates with a first compartment 53 in make-up tank 50 containing only contaminated liquid passing to it from reels 9.

In order to replace the volume of liquid so bled off from the system, fresh water is added to make-up tank 50 through pipe 54 from any suitable source, such as tank 55. Said pipe 54 discharges into a second compartment 56 in make-up tank 50 in such manner that it does not intermix with the liquid bled off from the system. In this manner, both the acid concentration and the quantity of liquid in the system are maintained at the desired amount. At the same time, the quantity of sodium sulfate in the liquid is maintained at the optimum value, which, as will appear hereinafter, is approximately 5%.

In the preferred embodiment of the invention, a soluble oil; e. g., a sodium or potassium salt of a sulfonated hydrocarbon, such as Twitchell oil, is added to the circulation system for reasons later to be indicated. Such oil is supplied from tank 57 through pipe 58, which also discharges into compartment 56. In order to obtain an efficient dissemination of the oil in the circulating liquid, means are provided for mixing the soluble oil and the water supplied to the system in a container 59 in make-up tank 50 from which the mixed liquid overflows into compartment 56. Preferably, the water added in container 59 is hot water.

Ordinarily, a thorough intermixing of the soluble oil and the added water occurs before and as the mixture passes from container 59 into compartment 56 of make-up tank 50. The liquid overflowing from compartment 56 into still a third compartment 61 of make-up tank 50, from which latter compartment the liquid passes through pipe 51 to storage tank 43, creates sufficient turbulence to complete, if necessary, the mixing of the oil with the processing liquid. In addition to the heat supplied by water added as above described, means may be provided to heat the liquid to maintain it at the desired elevated temperature. Thus steam or hot water pipes 62 are disposed in storage tank 43, but could, if desired, be located in compartment 56 or 61 of make-up tank 50.

The circulation system for the processing liquid applied to the thread on reels 10 is similarly arranged, as is evident from Figure 5. The liquid is supplied by means of a pump 63 from storage tank 64 through pipe 65 to a header box 66. From said header box, the processing liquid passes through pipe 67 to conduits 16 supplying reagent distributors 15 for reels 10. From collecting troughs 17 on opposite sides of the apparatus, the collected processing liquid passes through pipe 68 to a make-up tank 69. Overflow pipe 71 by means of which a predetermined level of liquid is maintained in header box 66 also communicates with make-up tank 69, from which the liquid passes through pipe 72 back to storage tank 64.

Apart from the materials carried by the thread from the preceding processing stage, no substance other than water is added to the circulation system for the processing liquid applied to the thread on reels 10. Because the amount of acid and other ingredients carried over by the thread would in time reach a concentration much greater than that desired, a portion of the liquid in the system is bled therefrom through pipe 73. In the arrangement illustrated in Figure 5, pipe 73 communicates with pipe 68 containing the contaminated liquid passing from the collecting troughs 17 beneath reels 10, wherefore only the contaminated liquid is withdrawn from the system. Fresh water, the only other substance added to the circulating liquid, is added to the system to dilute the acid and to replace the liquid removed, the water being supplied to make-up tank 69 through pipe 75 from a suitable source such as tank 76. The water added to the system may be preheated, but if desired the liquid in the system may be heated by hot water or steam coils 77 disposed in storage tank 64.

The desulfurizing liquid applied to the thread on the reel 11, as well as other processing liquids applied on succeeding reels, may be similarly recirculated by systems including means for bleeding off contaminated liquids and adding fresh reagents.

In the operation of the illustrative apparatus herein described, viscose is extruded into a coagulating bath containing by weight approximately 10.75% sulfuric acid, approximately 20% sodium sulfate, approximately 0.37% zinc in the form of zinc sulfate, and from 0.6 to 0.9% emulsified mineral oil, the bath in the vicinity of the spinnerets being maintained at a temperature of approximately 45° C. Threads of 150 denier, 40 filaments, are formed by extrusion of the viscose through the spinnerets, each such thread being drawn upward by a correspondingly disposed reel 8 located above the coagulating bath. Such reel, which is so constructed that it advances the thread lengthwise thereof for a distance of 4 inches in a helix 5 inches in diameter having 11 turns to the inch, rotates at a speed of 154 R. P. M.

From reel 8, the thread is passed downward to succeeding reel 9, which is 5 inches in diameter but which rotates at a speed of 169 R. P. M. This increase in peripheral speed imparts a stretch of approximately 10% to the thread between reels 8 and 9. The thread is stored on reel 9 in a helix about 4 inches long having 19 turns per inch. The liquid applied to the thread on the reel contains approximately 2.5% sulfuric acid, approximately 5% of sodium sulfate, approximately .07% of zinc as zinc sulfate, and about .5% of Twitchell oil, which is composed of about 10% to 15% sulfonated mineral oil mixed with plain mineral oil. The liquid is applied at a rate of 340 cc. per minute to the thread on each reel 9, being applied at a temperature of about 60° C.

The processing liquid for reels 9 is recirculated by the system shown in Figure 4. The

only liquids added to the circulation system are fresh hot water and Twitchell oil, which is added at the rate of 4 grams per thread per hour. The remainder of the ingredients in the liquid are supplied from the liquid carried by the thread passing from the coagulating bath into the treating stage comprising reel 9, wherefore they have substantially the same proportions with respect to each other as they have in the coagulating bath. The processing liquid applied to the thread in this manner serves to harden it preparatory to the performance of subsequent processing operations on it.

The thread then passes to reel 10, which is a 5-inch reel rotating at the same speed as preceding reel 9. The turns of thread on this reel are disposed in a helix the pitch of which is 23 turns per inch. Processing liquid containing from .015% to .025% of sulfuric acid, from .03% to .05% of sodium sulfate, traces of zinc in the form of zinc sulfate, and small quantities of Twitchell oil is applied to the thread on reels 10. The ingredients other than water are present in substantially the same ratio as in the liquid applied to the thread on reel 9, since such ingredients are carried over by the thread. On reels 10, the liquid is applied to the thread at the rate of 240 cc. per minute at a temperature of 30° C.

On reel 11, a desulfurizing medium consisting of a dilute alkaline solution of sodium sulfide is applied to the thread, the reel being of the same dimensions, rotating at the same speed, and advancing the thread in a helix of substantially the same pitch as in reel 10. The solution contains from .3% to .5% sodium sulfide and, for the purpose of stabilizing the solution, about .05% sodium hydroxide. It is applied to the thread on the reel at a temperature of approximately 50° C. at a rate of 240 cc. per minute.

The above-described system of processing possesses numerous unusual advantages, particularly in the manufacture of viscose artificial silk thread by a continuous process.

In the manufacture of such thread, regeneration of the cellulose content of viscose does not occur instantaneously. Apparently the viscose first solidifies without undergoing complete chemical reaction; that is, the material of which the thread is first constituted is in part a solidified form of cellulose xanthate. Thereafter the cellulose of which the thread is ultimately formed is regenerated, the sodium of the sodium cellulose xanthate of the viscose forming sodium sulfate by reaction with the sulfuric acid and the sulfur going into such by-products as carbon disulfide, hydrogen sulfide, and elemental sulfur. The entire reaction requires an appreciable time for its completion: Of the two effects, the solidification proceeds rapidly but regeneration more slowly, probably because it must proceed from the exterior to the interior of each filament.

In the illustrated embodiment of the invention, the indicated substantially vertical withdrawal of the thread from the coagulating bath by means of reel 8 causes a column of coagulating liquid to adhere to and to rise with the thread. In effect, this adds considerably to the immersion length of the thread in the coagulating bath, which length is approximately 15 inches. The liquid is largely, but not entirely, stripped from the thread by guide 18, sufficient liquid being carried beyond said guide so that the thread stored on reel 8 is thoroughly wet with coagulating liquid.

In the thread starting on reel 8, the cellulose content is apparently only incompletely regenerated, but because of the presence of the liquid carried up by the thread, regeneration proceeds on the reel. The thread is stored on the reel for a period long enough to permit further regeneration to take place; in addition, a decided change in the color of the thread from dark to light yellow occurs while the thread is stored on the reel. Regeneration of the thread, although occurring in considerable measure, is apparently not completed on reel 8: As a result, the thread by the time it leaves the reel is probably fully solidified but not completely regenerated.

As it passes downward to succeeding reel 9, the thread is stretched by any desired amount, within reasonable limits, while still in a more or less plastic condition. Conveniently, such stretch may be of the order of about 10 per cent. In the apparatus illustrated, such stretch is comparatively gradual in that it takes place in a length of thread passing through air for a distance of several feet. In the illustrated embodiment of the invention, this length of thread; viz., the distance from reel 8 to reel 9, is between six and seven feet. Gradual stretching of the thread in this manner; i. e., after it is substantially completely solidified, while it is at least partly and preferably more than one-half regenerated, but before it is regenerated completely and under conditions such that the stretch cannot carry back to the extremely soft thread issuing from the spinneret, has been found to be particularly advantageous.

Among other things, such stretching considerably increases the tensile strength of the thread without, however, substantially increasing the tendency of the thread to shrink upon drying. This is probably due to the fact that the stretching of the thread is performed a sufficient length of time after extrusion to permit the micellar structure of the cellulose to form but before a sufficient length of time has elapsed to permit the thread to harden to an extent such that permanent orientation of the micelles cannot be effected.

Although the thread starting on reel 9 is believed to be completely solidified, its cellulose content is, as indicated, but incompletely regenerated. Subjecting the incompletely regenerated thread to the action of a hot dilute acid on reel 9 results in substantial completion of the regeneration of the cellulose on this reel, permanently setting the stretch in the thread; that is, such thread will, upon being rewet after having been dried, shrink much less than thread which has been stretched after having been completely regenerated.

Because regeneration of the cellulose is substantially, if not entirely, completed on reel 9, sulfur and other substances formed as by-products of the regeneration reaction tend to deposit in the form of hard incrustations on said reel. Such incrustations have been found to damage the thread, principally by breaking the filaments thereof. The addition of a suitable oily material has been found to inhibit the deposition of such incrustations on the reel. Such oily material can advantageously be added in the treating liquid applied to the thread on reel 9.

For this reason, the liquid applied to the thread on reel 9 contains, as explained above, a suitable soluble oily material such as one of the metal salts of a sulfonated hydrocarbon; e. g., Twitchell oil.

Where such a material is used, the processing liquid applied to the thread on the reel washes away the by-products, such as sulfur, produced as a result of the regeneration reaction. Moreover, the added material serves to lubricate the thread and thereby reduce friction of the thread not only on reel 9 but also on succeeding reels.

A suitable soluble sulfonated hydrocarbon such as Twitchell oil serves to reduce the surface tension of the liquid in which it is dissolved, wherefore the formation of the previously mentioned film of processing liquid between adjacent turns of thread on reel 9 is facilitated. The thread turns may, therefore, be considerably more widely spaced on reel 9 than on other reels without concomitant disruption of the film. This is advantageous because a wider spacing of the thread turns is needed on reel 9 in consequence of the incomplete regeneration, and hence larger diameters, of the thread filaments. Moreover, reduction of the surface tension of the processing liquid reduces the surface tension of the film between the bars of the reel which are retracted during the thread advancing operation and the turns of thread on the reel, thus preventing breakage of the film and hence breakage of the thread filament.

The primary purpose of employing the acidic processing liquid applied to the thread on reel 10 is to wash the thread before it is desulfurized. However, maintenance in a mildly acid state of the liquid applied to the thread on reel 10 is advantageous in that it tends to prevent the formation of insoluble zinc deposits in such liquid and on the thread, doing so by maintaining the zinc in the form of relatively soluble salts which are readily removed by the washing operation. The degree of acidity is preferably so slight as not to cause difficulty in the succeeding alkaline desulfurizing stage.

The examples of thread processing conditions given above are purely illustrative and may be modified considerably, although the described conditions are preferred for the indicated kind and size of thread.

In the case of the liquid employed as the coagulant in coagulating bath 3, not only the concentration but also the temperature of the coagulating bath may vary considerably from that indicated, as from approximately 8% to approximately 14% in the concentration of the acid and from 30° C. to 50° C. in temperature. Under some circumstances, the coagulating bath need not be heated at all. With changes in acid concentration, appropriate changes should be made in the concentrations of the other ingredients in the coagulating bath; i. e., the sodium sulfate and zinc sulfate, all as well understood in the art.

In the case of the processing liquid applied to the thread on reel 9, the acid concentration may range from 1% to 5% and the temperature from 50° C. to 80° C., although these are not limitative. In general, it is found that the use of a high temperature will permit the use of lower acid concentrations. The concentrations of the other constituents of the liquid applied to the thread on this reel should be varied with the acid concentration. If, however, the liquid carried over by the thread supplies all of such constituents, the proportions will naturally be very nearly the same as those in the liquid carried over from the coagulating bath.

The amount of any 10–15% base Twitchell oil which it may be desired to add may vary from .3% to 1% or more, although a concentration of approximately .5% has been found to give efficient results with maximum economy.

The remarks made above in connection with the processing of the thread on reel 9 apply with equal force to the processing of the thread on the succeeding reel 10. Thus the temperature of the liquid applied on such reel may vary considerably, as from 20° C. to 60° C. The acid concentration in the liquid applied to the thread on this reel may vary from .015% to as high as .5% or more, the upper limit being in general determined by the possibility of formation of undesirable precipitates if the thread is subjected to an alkaline treatment in the succeeding stage.

Other modifications may be made in the processing conditions and sequence of processing operations, as well as in the apparatus illustrated, without departing from the spirit of the invention. For example, while a stretch of about 10% has been indicated as being imparted to the thread between reels 8 and 9, either a greater or lesser stretch or even none at all, may be imparted to the thread. Further, while the illustrated examples have been discussed in connection with the supplying of treating ingredients to later treating stages by a liquid carried by the thread from earlier treating stages, it is apparent that under suitable circumstances and in connection with certain aspects of the present invention, such treating ingredients may be supplied from other sources in addition to or in substitution for the treating ingredients supplied by carried-over liquid. The present invention may also be applied to the manufacture of other kinds of thread and even to the manufacture of thread by discontinuous methods.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What is claimed is:

1. A continuous process of manufacturing multiple filament viscose artificial silk thread comprising the sequentially performed steps of forming the thread by extruding viscose into a coagulating bath having an acid concentration substantially maintained at a predetermined value between 8% and 14%; stretching the incompletely regenerated thread by an amount of the order of 10%; subjecting the thread to the action of a first processing liquid characterized by an acid concentration substantially maintained at a predetermined value between 1% and 5%; subjecting the thread to the action of a second processing liquid characterized by an acid concentration substantially maintained at a predetermined value between 0.015% and 0.5%; and drying the thread.

2. A continuous process of manufacturing multiple filament viscose artificial silk thread comprising the sequentially performed steps of forming the thread by extruding viscose into a coagulating bath having an acid concentration substantially maintained at a predetermined value between 8% and 14%; stretching the incompletely regenerated thread; subjecting the thread to the action of a first processing liquid characterized by an acid concentration substantially maintained at a predetermined value between 1% and 5%; subjecting the thread to the action of a second processing liquid characterized by an acid concentration substantially maintained at a predetermined value between 0.015% and 0.5%; and drying the thread.

3. A continuous process of manufacturing mul-

tiple filament viscose artificial silk thread comprising the sequentially performed steps of forming the thread by extruding viscose into a coagulating bath at a temperature between 30° and 50° C. having an acid concentration substantially maintained at a predetermined value between 8% and 14%; subjecting the thread to the action of a first processing liquid at a temperature between 50° and 80° C. characterized by an acid concentration substantially maintained at a predetermined value between 1% and 5%; subjecting the thread to the action of a second processing liquid at a temperature between 20° and 60° C. characterized by an acid concentration substantially maintained at a predetermined value between 0.015% and 0.5%; and drying the thread.

4. A continuous process of manufacturing multiple filament viscose artificial silk thread comprising the sequentially performed steps of forming the thread by extruding viscose into a coagulating bath having an acid concentration substantially maintained at a predetermined value between 8% and 14%; stretching the incompletely regenerated thread by an amount of the order of 10%; subjecting the thread to the action of a first processing liquid at a temperature between 50° and 80° C. characterized by an acid concentration substantially maintained at a predetermined value between 1% and 5%; subjecting the thread to the action of a second processing liquid at a temperature between 20° and 60° C. characterized by an acid concentration substantially maintained at a predetermined value between 0.015% and 0.5%; and drying the thread.

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