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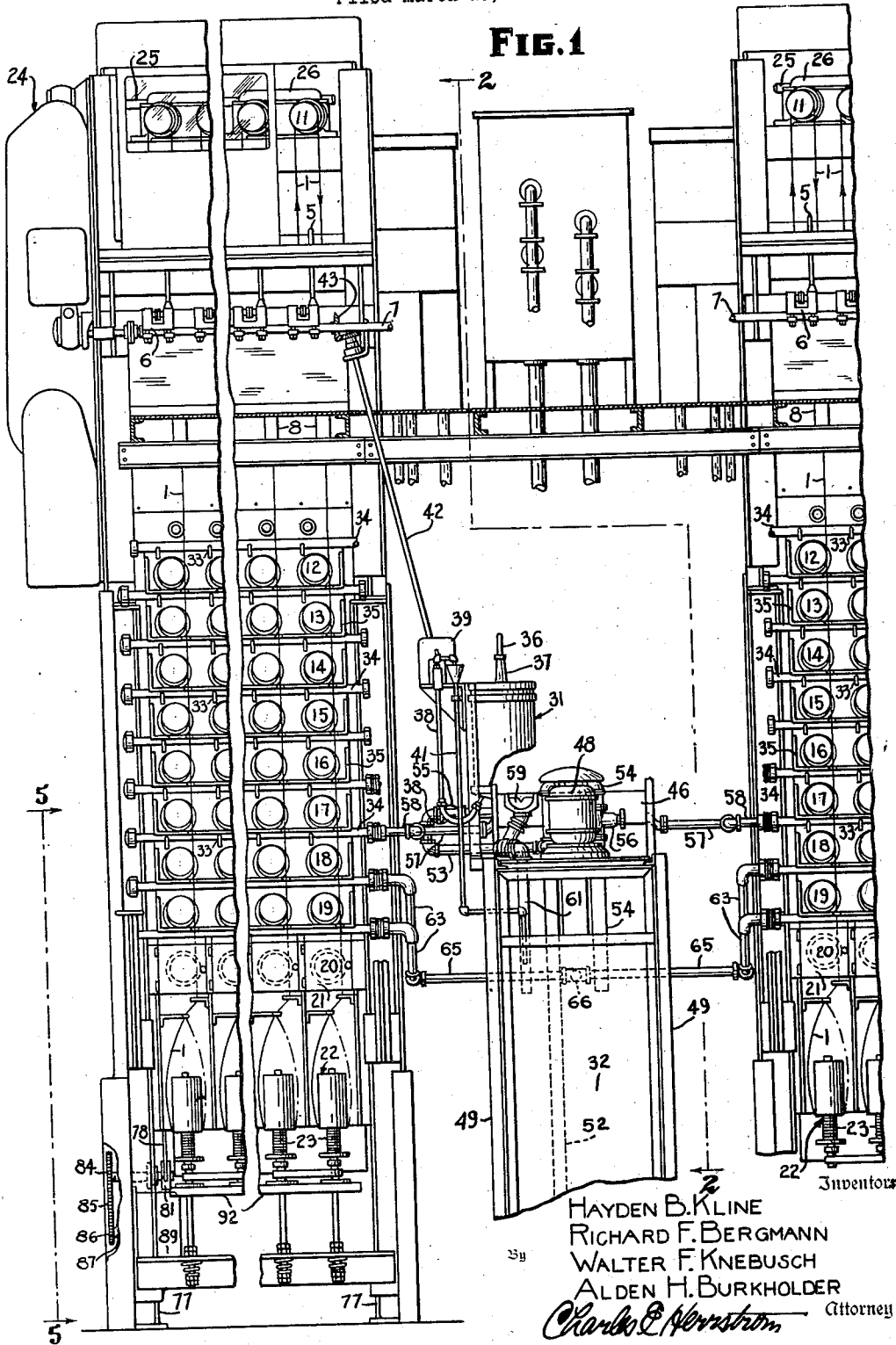
H. B. KLINE ET AL

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APPARATUS FOR CONTINUOUSLY CONDITIONING THREAD OR THE LIKE

Filed March 19, 1940

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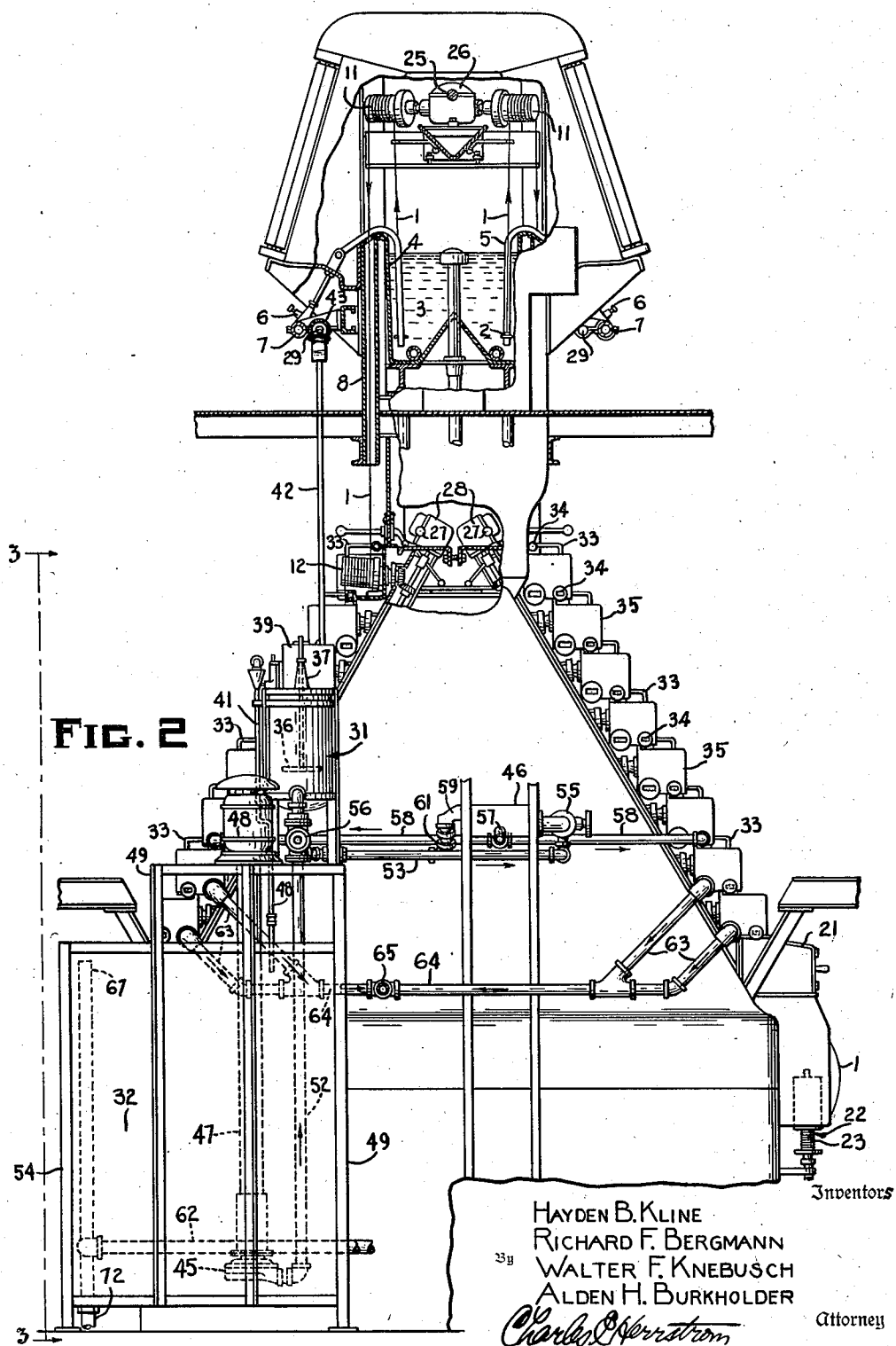
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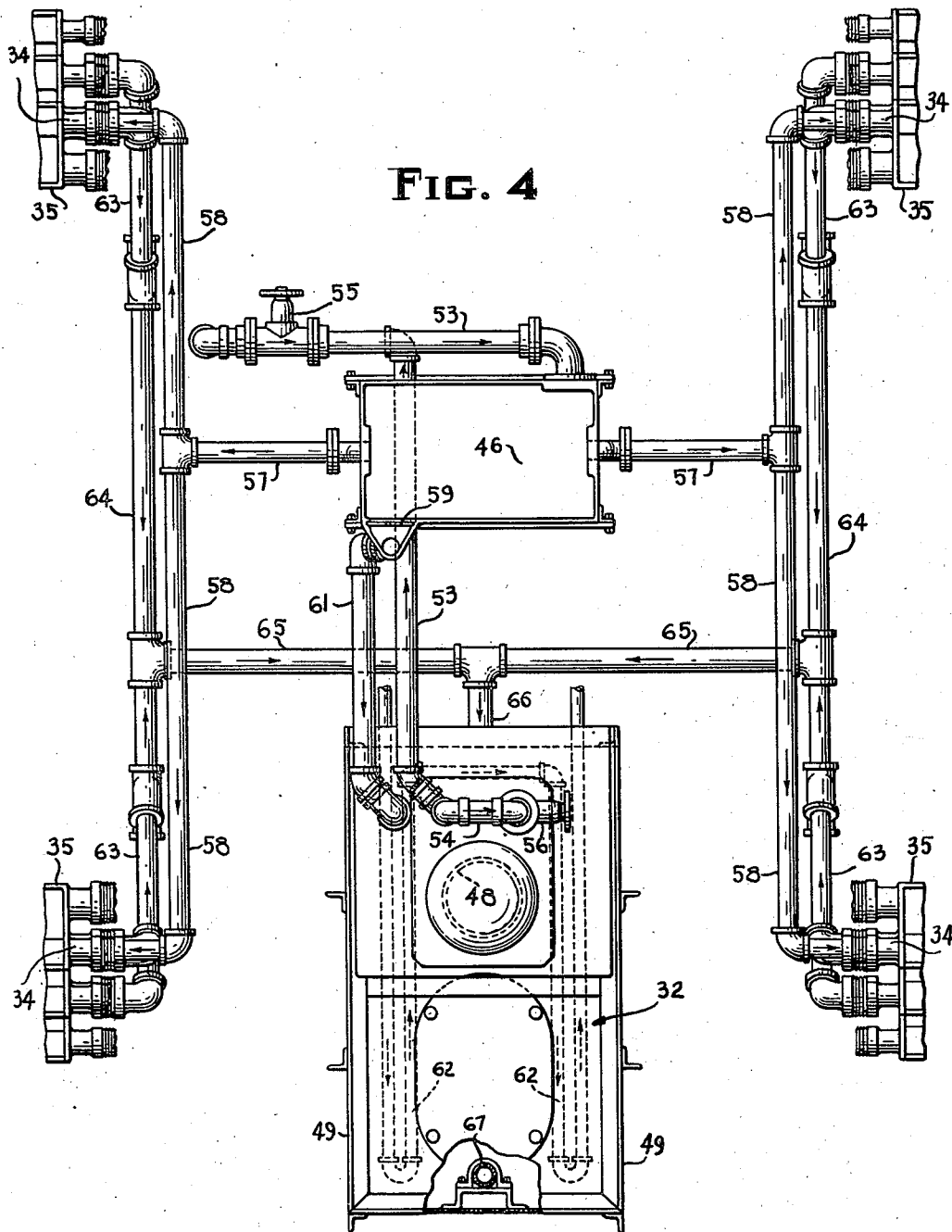
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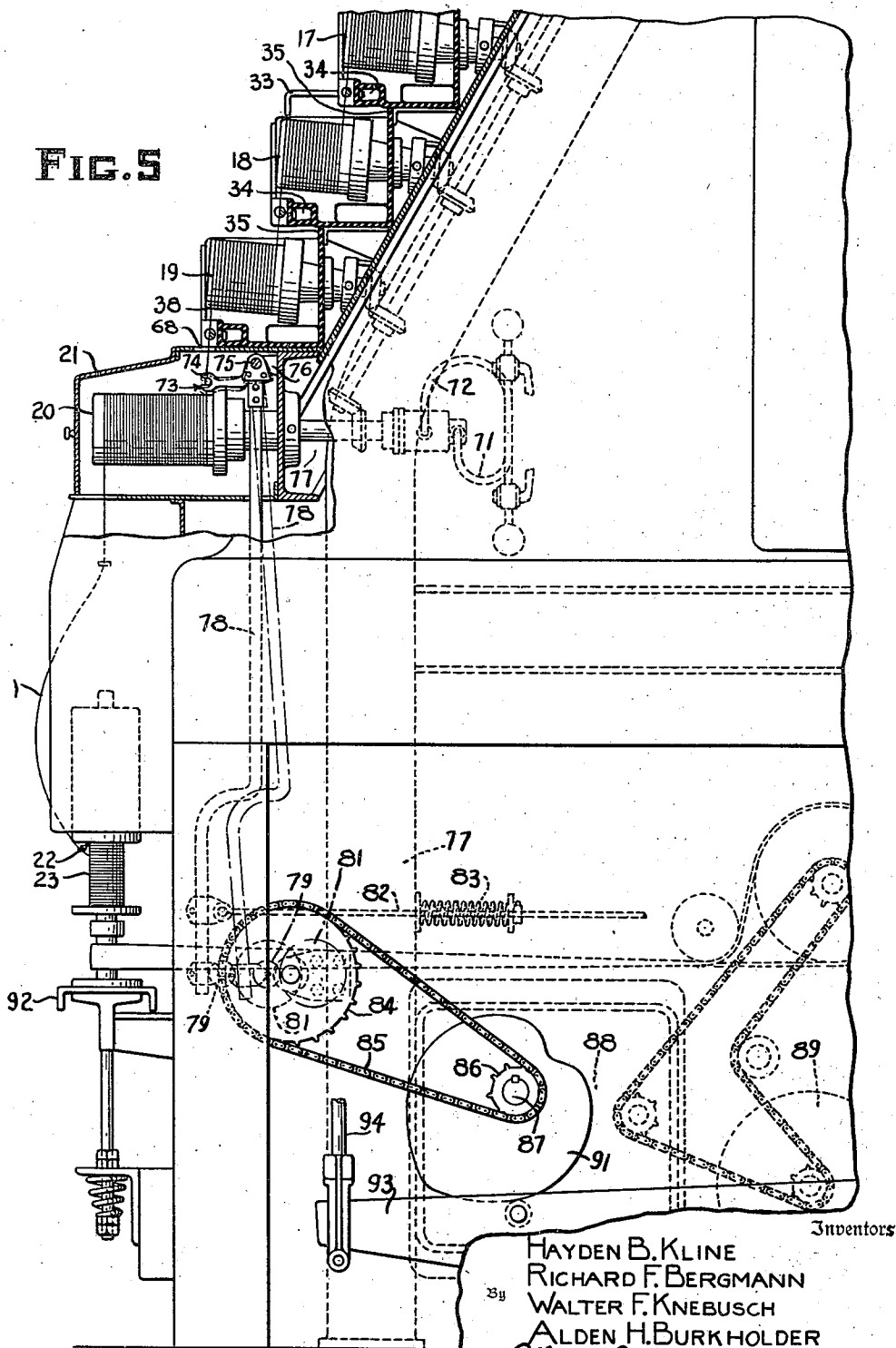
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FIG. 5



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2,294,870

APPARATUS FOR CONTINUOUSLY CONDITIONING THREAD OR THE LIKE

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6 Claims. (Cl. 18—8)

This invention relates to apparatus for continuously applying conditioning treatments to thread or the like, hereinafter referred to as "thread," for lubrication, sizing, tinting, etc.

It is often desirable to condition thread by applying a lubricating medium thereto to facilitate subsequent manipulation of the thread, as in winding, twisting, or forming the thread into fabrics: lubricants which may be employed for such purposes include mineral oils, vegetable oils, sulfonated mineral oils, sulphonated vegetable oils, fatty acid esters, water-in-oil emulsions, etc. At other times, it is desirable to condition thread by applying a sizing medium to stiffen it, bind its filaments together, protect it against scuffing during winding or fabric forming operations, or to set its twist: such a medium may take the form of a liquid vehicle in which are incorporated one or more materials such as resins, gums, gelatins, starches, etc., whether in suspension, solution or emulsion. For identification purposes, threads of different characteristics are often tinted different colors by means of fugitive dyestuffs, such dyestuffs being applied to the thread in much the same manner as the lubricants, sizes, etc. to which reference has been made.

Heretofore, it has been the usual practice to perform separately upon the thread treatments such as lubricating, sizing and dyeing; moreover, these treatments have ordinarily been performed discontinuously. That is, the thread has been subjected to one or more conditioning treatments while wound in the form of or as it is unwound from a bobbin or skein containing a thread of determinate length. Such procedures vary considerably among themselves; for example, where threads are treated while being unwound from packages, they may be passed over or under rolls immersed in treating liquids, or may be contacted by wicks or pads saturated with such liquids. All of these procedures, however, lack the desired degree of uniformity and economy of processing, the latter because they require so much handling of the thread.

The present invention provides, inter alia, apparatus for continuously conditioning thread, preferably concurrently with its production. Specifically, it provides apparatus for continuously applying any one or more, or all, of various lubricating, sizing, or fugitive tinting media before the thread has been initially dried; i. e., while it is still in the gel state. It further provides novel and useful apparatus for continuously conditioning thread by means of which it is possible to apply one or more conditioning media simulta-

neously to hundreds of threads in the same machine. The invention also includes means for facilitating the drying of the conditioned thread.

For convenience of illustration, but in no sense of limitation, the invention will be described hereinafter as employed in the manufacture, purification and conditioning of multiple filament viscose artificial silk thread. By way of example, reference will be made to a continuous process using apparatus of the type shown and described in Knebusch et al. application Serial No. 7,114, filed February 18, 1935 (Patent 2,225,642). The drawings illustrate how apparatus embodying the present invention may be employed in combination with apparatus of the type disclosed in said patent.

Figure 1 is a side elevation of two continuous thread-producing machines disposed in end-to-end relationship, corresponding ends thereof being adjacent each other so as to permit the apparatus of the present invention to be placed therebetween. Figure 2 is an end elevation, from line 2—2 of Figure 1, of one of the machines, including part of the conditioning system of the present invention. Figure 3, a view taken from line 3—3 of Figure 2, shows on a somewhat enlarged scale a side elevation of the portion of the conditioning system disposed between and adapted to serve the two adjacent machines illustrated in Figure 1. Figure 4 is a plan, corresponding generally to line 4—4 of Figure 3 and on the same scale as Figure 3, of the liquid distributing system. Figure 5, drawn on a considerably enlarged scale, represents an end elevation from line 5—5 of Figure 1 of a portion of the driven end of one of the machines; i. e., the end opposite that illustrated in Figure 2.

Each of the two machines shown in Figure 1 comprises a plurality, perhaps as many as a hundred or more, complete thread-producing units disposed in side-by-side relation lengthwise of the machine, each unit being adapted to produce one multiple filament viscose artificial silk thread. Each unit includes suitable means for extruding viscose into a coagulating bath; continuously but completely processing the resulting thread; and conditioning, drying and collecting the thread in finished form. In Figure 1, most of the thread-producing units intermediate the ends of the left-hand machine have been omitted for convenience in illustration.

As may be seen from Figures 1, 2 and 3, each thread 1 is formed by the extrusion of a suitable spinning solution; i. e., 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 mass tube the viscose is forced by suitable means, such as a gear pump 6 associated with a supply pipe 7 common to all pumps 6 on the same side of each machine. When the viscose comes into contact with the coagulating bath, the cellulose content of the viscose is regenerated, forming thread 1.

Thread 1, after issuing from spinneret 2, is drawn vertically upward to and by a first thread-advancing reel 11 of a series of like thread-advancing reels 11 to 20, inclusive. Thread-advancing reels 11 to 20, inclusive, are of cantilever construction, each being adapted, during rotation thereof, to store a long length of thread in a plurality of closely spaced, generally helical turns which are advanced from the supported to the unsupported end of the reel. The thread-supporting surfaces of such reels consist of circumferentially spaced, axially extending bars which cooperate to advance the thread in the manner stated. The reels, which are of the type described in Patent 2,225,642, are shown in the drawings in semi-diagrammatic representation, the indicated spacing of the thread turns being much greater than the spacing actually employed in such apparatus.

From the unsupported end of each reel, the thread passes downward to the supported end of the succeeding reel. To facilitate this, all of the reels in each downwardly extending series are disposed in stepped relation with their unsupported ends extending in the same direction; i. e., toward the operating face of the machine, but with the thread discharge end of each preceding reel in apposition to the thread-receiving end of each succeeding reel. In such an arrangement, all of the reels are readily accessible for operating purposes, the thread passing directly from reel to reel without detrimental bending or guide stresses.

In the illustrated apparatus, a plurality of such series of reels is disposed on each side of a common longitudinally extending coagulating trough 4. As shown in Figure 2, the banks of reels, viewed in cross section, thus resemble an inverted V. Corresponding reels of all downwardly extending series of each bank 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 and also provides various other advantages, such as construction economies.

Each thread 1 is advanced from the supported end to the unsupported end of the corresponding reel 11, being discharged from the reel beyond the lateral edge of trough 4. No processing liquid is applied to the thread on reel 11; instead, regeneration of the cellulose content of the viscose is permitted to continue thereon. As thread 1 passes from reel 11, it proceeds vertically downward through channel 8 to the supported end of reel 12, the second of the series of reels but the first reel to be employed in the liquid processing of the thread. Reels 12 to 17, inclusive, are adapted to store thread 1 continuously but temporarily while suitable processing media, such as desulfurizing, bleaching and washing liquids, are applied thereto in any predetermined sequence.

In the illustrated apparatus, reel 18 is adapted to store thread 1 while a conditioning operation is performed upon it. Reel 19 serves as a drip stage, no liquid being applied to the thread stored

thereon; instead, the reel stores the thread long enough to permit excess conditioning liquid to drip from thread 1. In consequence, the moisture content of the thread has an opportunity to equalize itself before the thread passes to reel 20, which is internally heated for the purpose of drying the thread. An enclosure 21 surrounds reel 20 to provide substantially constant drying conditions about the reel.

Upon completion of the drying operation, the thread 1 passes to a cap-twister 22, the collecting bobbin 23 of which is reciprocated and rotated by any suitable means.

As may be seen from Figures 1 and 2, reels 11 disposed in a horizontally extending series above collecting trough 4 are rotated through shafts 25 and gear boxes 26 by driving means 24. Reels 12 to 20, inclusive, are likewise rotated by common driving means 24 through the agency of horizontal shafts 27, which drive all of said reels 12 to 20, inclusive, in the several series of reels through gear boxes 28. Viscose pumps 6 are also actuated by driving means 24 through longitudinal shafts 29. Accordingly, these various parts are operated in timed relation by common driving means.

Figures 3, 4 and 5 illustrate in detail the apparatus by which the conditioning liquid is supplied to the reels employed in the operation of conditioning the thread. The apparatus illustrated in these several figures as embodying the invention includes an elevated reservoir 31 to which, from time to time, conditioning liquid may be added to replenish the supply in the system as a whole. Liquid added to said reservoir 31 passes in its course into recirculation tank 32, from which it is conducted to reels 18.

As shown more clearly in Figure 3, each of reels 18 is supplied with the conditioning liquid by means of a reagent distributor 33 communicating with a common conduit 34 which extends longitudinally of the machine and is connected to recirculating tank 32. A longitudinally extending collecting trough 35 extends beneath each horizontal series of reels 18. Collecting trough 35 beneath drip reels 19, communicates with recirculation tank 32 in a manner permitting the return of the used conditioning liquid.

Inasmuch as liquids of the type usually employed to condition thread require agitation to prevent them from settling out or congealing, each of containers 31 and 32 is provided with suitable agitating means. Preferably, a hand-operated dasher 36 the handle of which passes through a cover portion 37 is provided in reservoir 31. If desirable, dasher 36 may be mechanically actuated from driving means 24.

Liquid from reservoir 31 is withdrawn through a tube 38 connected thereto near the bottom of the reservoir, said tube 38 communicating with the intake of a proportional flow pump 39 disposed near the top of reservoir 31. A measured quantity of liquid passes from pump 39 through piping 41 to recirculation tank 32 to replenish the supply of the liquid stored therein. An inclined shaft 42, connected through bevel gears 43 to one end of viscose pump shaft 29 and through bevel gears 44 to pump 39, serves to drive said pump; in this manner, the amount of liquid passed to recirculation tank 32 is coordinated with the amount of viscose passed to the spinnerets by pumps 6.

The quantity of conditioning liquid added to recirculation tank 32 is determined, among other factors, by the amount of evaporation of the liquid being recirculated, the degree of dilution of the

recirculated liquid by diluents carried over from preceding stages, and the amount of liquid carried away by the thread from the conditioning stage itself. The liquid level in recirculation tank 32 may be checked from time to time, the output of the proportional flow pump 39 being correspondingly adjusted to supply more or less liquid to recirculation tank 32. To this end, pump 39 is preferably provided with output adjustment means.

From recirculating tank 32, the liquid is forced by a pump 45 to a header box 46, from which it passes under substantially constant hydrostatic pressure to the conduits 34 for reels 18. Centrifugal pump 45 is preferably disposed near the bottom of recirculation tank 32, being supported by tubular member 47 from an electric motor 48 mounted on frame members 49 above recirculation tank 32. Drive shaft 51, by means of which pump 45 is driven from motor 48, is disposed in tubular member 47.

The conditioning liquid to be applied to the thread is forced upward through conduit 52 by pump 45. Conduit 52 is divided into two branch conduits, as shown in Figures 1, 3 and 4. Branch conduit 53 conducts a portion of the liquid from conduit 52 to header box 46, while branch conduit 54 conducts the other portion of the liquid from conduit 52 back to recirculation tank 32. The relative proportions of the amounts of liquid flowing in the two branch conduits can be controlled by appropriate adjustment of the valves 55 and 56, respectively, in said branch conduits 53, 54. In the ordinary case, however, more liquid is supplied through conduit 52 than passes to header box 46: the remainder is returned through branch conduit 54 to tank 32 for the purpose of agitating the liquid therein.

Preferably, the lower end of conduit 54 is disposed vertically, as shown, for the downwardly discharged stream of liquid issuing therefrom agitates the liquid in tank 32 more efficiently.

Header box 46 communicates through a conduit 57 and cross conduit 58 with the longitudinally extending common conduits 34 on opposite sides of each machine, from which conduits 34 reels 18 of said machine are supplied with conditioning liquid. As shown in Figure 4, header box 46 supplies the two machines between the ends of which it is disposed. More liquid is supplied to the header box through branch conduit 53 than passes out of the box 46 to the reels 18: the excess overflows a weir 59 and passes through overflow conduit 61 back to tank 32, aiding in agitating the liquid therein. A constant level of liquid is maintained in header box 46 at a predetermined height above the outlets from the reagent supply conduits 34 for the reels 18. In this way, a predetermined amount of liquid can be supplied to each reel 18, making possible complete and uniform treatment of the thread.

In the apparatus illustrated in the drawings, heating tubes 62 are disposed in the lower portion of recirculating tank 32; so that, if desired, the conditioning liquid may be heated before applying it to the thread.

Preferably, troughs 35 beneath reels 18 and those beneath drip reels 19 are connected through return conduits 63 to a cross conduit 64 adapted to return the liquid through conduits 65 and 66 to recirculating tank 32. Recirculating tank 32 is provided with an overflow pipe 67 communicating with a sewer. The inlet end of said pipe 67 is disposed at any desired height above the usual level of the liquid in recirculating tank 32

and provides a means of removing excess liquid from the system should the amount in the system build up to more than the desired quantity.

The system hereinabove described is advantageous in that a large volume of liquid may be handled without the necessity of employing complicated apparatus. Furthermore, the apparatus of the invention permits the unused portion of the conditioning liquid to be reused so that no waste of materials is involved in the conditioning operation. The possibility of continuously reheating, refreshing and agitating the liquid makes for uniformity of composition of the liquid. All of a large number of threads may therefore be simultaneously conditioned concurrently with their production.

Among the problems encountered in the application of conditioning liquids to threads by a continuous method is the tendency of the conditioning liquid, particularly if it is a sizing medium, to cause the formation of objectionable deposits on reels subsequent to the reel upon which the conditioning operation itself is performed. This condition is most noticeable on reels adapted to dry conditioned threads. The deposits on such reels often damage the threads, for they frequently assume the form of rough ridge-like surfaces which tend to fray the thread or filaments thereof. The present invention provides means for preventing the formation of such deposits on the drying reels, thus eliminating this source of damage to the thread.

As hereinbefore explained, each reel 19 is adapted to store thread thereon without further application of any liquid, this reel operating to remove excess conditioning liquid from the thread as well as to equalize the moisture content of the thread before it is dried. Inasmuch as the thread is not dried on reel 19, there is no tendency for a dry deposit to form on such reel. This, however, is not true of drying reel 20, to which the thread passes from reel 19 by means of a slot 68 in enclosure 21 as shown in Figure 5. A heating medium, such as hot water, is circulated through reel 20 by means of inlet pipe 71 and outlet pipe 72.

In the operation of thread-advancing reel 20, the space between adjacent thread turns is of the order of $\frac{1}{16}$ inch. Under such circumstances, if the thread is moist with a sizing liquid and the thread in the helix formed by the thread turns passes in a fixed path over the reel, a deposit tends to form on each side of the thread path so that the thread turns in effect run in channels between ridges of solidified sizing compound. This occurs primarily at the portion of the reel on which the thread first starts, where the thread is wettest. As indicated above, such ridges tend to cause damage by fraying or snagging the wet, and therefore delicate, thread, particularly if it takes the form of viscose artificial silk thread.

According to the present invention, this is avoided by gradually changing the position of the helix formed by the thread on the reel 20. To this end, lead-on guide 73 is continuously moved back and forth during rotation of the reel in a direction substantially parallel to the axis of said reel for a distance at least equal to the pitch of the helix formed by the thread. Since all of the numerous turns of thread on the reel move lengthwise thereof in accordance with the movement of the first turn, no portion of the thread-bearing periphery of the reel can therefore be free of contact, at one time or another, with the thread. Therefore, no building-up of ridges can

occur; indeed, solids deposited on the reel are usually re-dissolved by subsequently applied liquid.

As shown in Figure 5, lead-on guide 73 for each reel 20 is carried by a guide arm 74 which extends toward the rear of the reel. Guide arm 74 is fixedly mounted on a longitudinally extending shaft 75 carrying one guide arm 74 for each reel 20. Shaft 75 is mounted for oscillation in supports 76 attached to the frame 77 of the machine. An actuating lever 78 is connected to shaft 75 at a point spaced lengthwise thereof from the guide arm 74 of the reel 20 nearest the drive end of the machine; i. e., the left-hand end of the machine shown to the left in Figure 1.

The lower end of lever 78 is provided with a cam follower roller 79 held against a cam 81 by a rod 82 attached at one end to lever 78, a compression spring 83 being disposed between a stop on said rod and the frame 77 of the machine. Cam 81 is rigidly associated with a sprocket 84 mounted on the frame 77 of the machine. Sprocket 84, and hence cam 81, is rotated by a chain 85 from a driving sprocket 86 mounted on shaft 87 of a speed reduction device 88 driven by motor 89. Shaft 87 supporting sprocket 86 also has mounted thereon a cam 91 which serves to move the lifting rails 92 up and down through the agency of lever 93 and tension member 94 as shown in Patent 2,203,665.

During rotation of cam 81 from sprocket 86, lever 78 is moved between the positions indicated by dotted and broken lines in Figure 5. Such movement causes shaft 75 to rock about its axis, producing in substantial timed relation to the rest of the apparatus, an arcuate movement of thread guide 73. The component of said arcuate movement lengthwise of the reel 20 is sufficient to produce the desired back and forth movement lengthwise of the reel of the first turn of thread. Similar mechanism is provided for the reels 20 on the opposite side of the machine, the motion of lever 78 being transmitted through rod 82 to a corresponding lever on the opposite side of the machine.

The apparatus of the hereinabove described invention makes possible economical treatment of the thread. Moreover, the thread is treated with the conditioning liquid before it has become dried, which means that it takes up such conditioning liquid more readily than would otherwise be the case. Despite the fact that the conditioning liquid may have a tendency to settle out, it can be continuously agitated and recirculated so that its composition is uniform. As a result, thread treated according to the present invention is characterized, among other things, by a high degree of uniformity.

Various modifications may be made in the apparatus disclosed as embodying the present invention; for example, other conditioning liquids than those indicated may be employed. Although the thread produced according to the invention may advantageously be sized for use in crepe fabrics, it is apparent that it may be differently treated preparatory to employment for a variety of other purposes. Moreover, although the invention has been described in connection with the manufacture of multiple filament viscose artificial silk thread, it is apparent that the invention is applicable to the treatment of other kinds of thread.

It is intended that the patent shall cover, by suitable expression in the appended claims, what-

ever features of patentable novelty reside in the invention.

What is claimed is:

1. Apparatus for treating thread comprising a thread store device which continuously but temporarily stores thread thereon in the form of a traveling helix characterized by a series of generally helical turns; means for continuously applying to the thread a processing liquid which on drying tends to form a hardened deposit and which, in the mass, has a tendency to settle on standing; a container accommodating a relatively large volume of such processing liquid; a conduit associated with said container for conducting liquid from said container to said liquid applying means; a pump for supplying liquid from said container to said conduit in excess of the amount applied to the thread; means for returning at least a part of the liquid from said conduit back to said container to agitate the liquid contained therein; means for drying the turns of thread stored on said thread store device; and means for changing the positions of the turns of thread on said thread store device to prevent the formation on said thread store device of hardened deposits of liquid.

2. Apparatus of the character described in claim 1 which includes a liquid supply source associated with said container and a power driven pump for delivering liquid from said liquid supply source to said container, the output of said power driven pump being adjustable to supply to said container from said liquid supply source an amount of liquid sufficient to replace that removed from the circulation system of which said container is a part.

3. Apparatus for treating thread comprising at least one thread store device which continuously but temporarily stores thread thereon in the form of a traveling helix characterized by a series of generally helical turns; means for changing the positions of the turns of thread on said thread store device; means for applying processing liquid to the thread stored on said thread store device; a container accommodating a relatively large volume of such processing liquid; a conduit associated with said container for conducting liquid from said container to said liquid applying means; a pump for supplying liquid from said container to said conduit in excess of the amount applied to the thread; and means for returning at least a part of the liquid from said conduit back to said container to agitate the liquid contained therein.

4. Apparatus for treating thread comprising at least one thread store device which continuously but temporarily stores thread thereon in the form of a traveling helix characterized by a series of generally helical turns; means for applying processing liquid to the thread stored on said thread store device; a container accommodating a relatively large volume of such processing liquid; a conduit associated with said container for conducting liquid from said container to said liquid applying means; a pump for supplying liquid from said container to said conduit in excess of the amount applied to the thread; means for conducting at least a part of the liquid from said conduit back to said container to agitate the liquid contained therein; means for returning to said container that portion of the liquid applied to the thread which is not carried away by the thread, thus forming a closed circulation system of which said container is a part; a liquid supply source associated with said

container; and a power driven pump for delivering liquid from said liquid supply source to said container, the output of said power driven pump being adjustable to supply to said container from said liquid supply source an amount of liquid sufficient to replace that removed from said circulation system.

5. Apparatus for treating thread comprising two thread store devices each of which continuously but temporarily stores thread thereon in a traveling helix characterized by a series of generally helical turns, the thread passing from the first of said devices to the second; means for applying to the thread stored on the first of said thread store devices a processing liquid which on drying forms a deposit; means for drying the thread while it is stored on the second of said thread store devices; a guide through which the thread passes before starting on the second of said thread store devices; and means for reciprocating said guide back and forth in a direction substantially parallel to the axis of said thread store device over a distance at least equal to the pitch of the helix formed by the thread, whereby the positions of the turns of thread on said device are changed.

6. Apparatus for continuously processing thread comprising a horizontal series of rotary thread-advancing thread store devices each of which continuously but temporarily stores a long length of thread in a traveling helix character-

ized by a series of generally helical turns; a plurality of devices for simultaneously twisting and collecting the thread each of which is characterized by a vertically reciprocable part, one of said devices being associated with one of said thread store devices; means including a cam at one end of said apparatus for actuating said vertically reciprocable parts; a second cam driven from said first cam; a lever bearing against said second cam, the other end of said lever being pivotally mounted at a point in close proximity to the endmost thread store device of said horizontal series; a rod extending lengthwise of said horizontal series of thread store devices adapted to be oscillated about its longitudinal axis by said lever; and a guide carried by said rod in proximity to each of said thread store devices serving to guide the thread passing to said thread store device, each of said guides serving to move the point at which the thread starts on the corresponding thread store device by making at least one complete reciprocation during a plurality of revolutions of said device so that the number of revolutions of said device per unit of time is greater than the number of reciprocations of the guide in the same unit of time.

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