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APPARATUS FOR TREATMENT OF FIBERS

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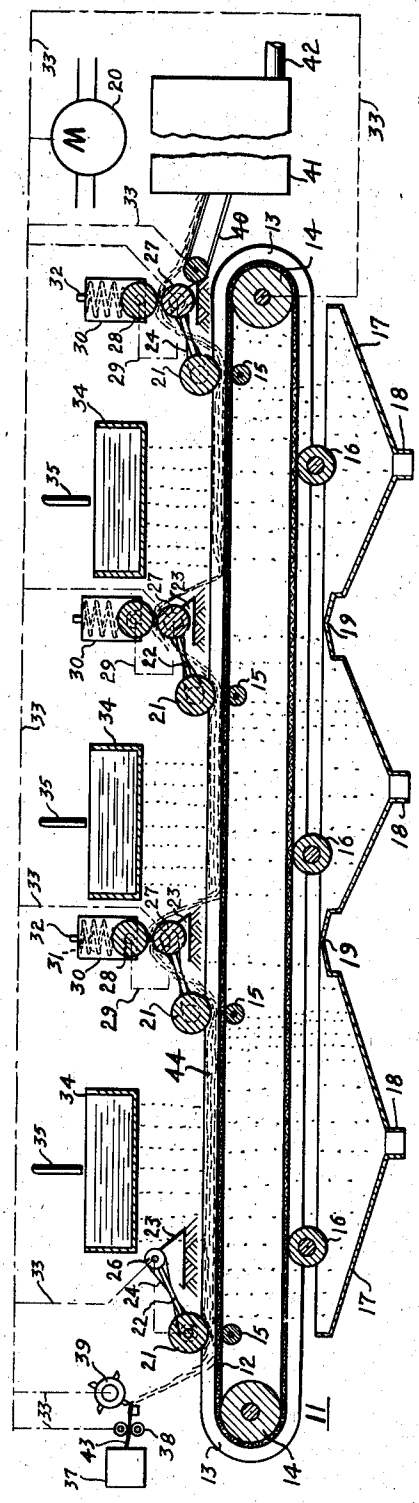

FIG. 1

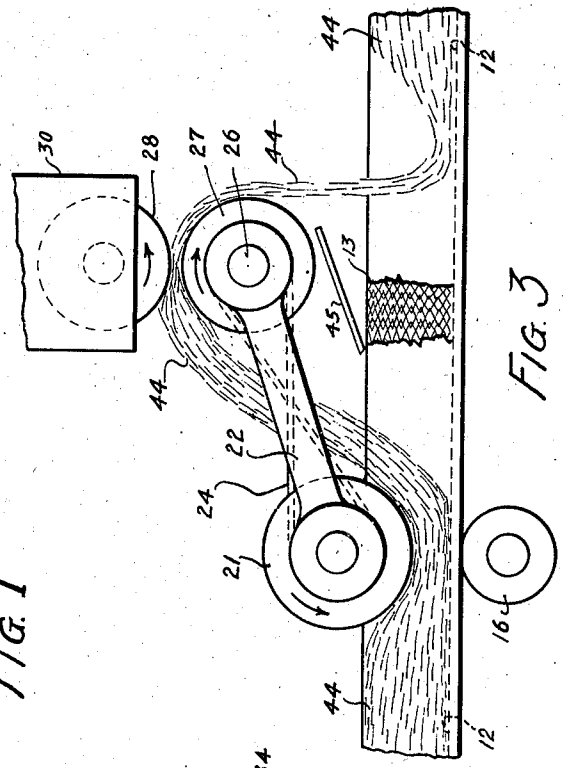

FIG. 3

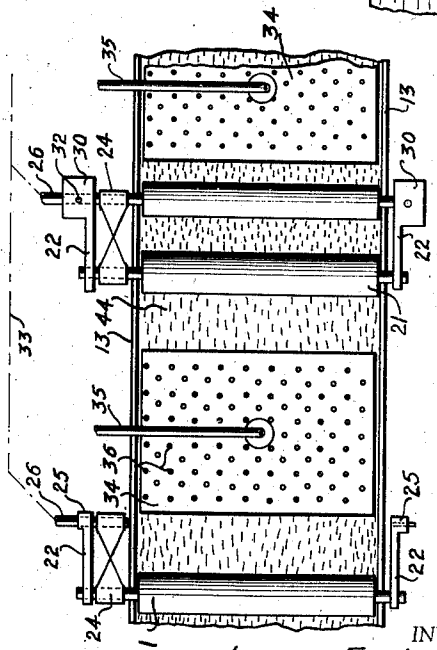

FIG. 2

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APPARATUS FOR TREATMENT OF FIBERS

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4 Claims. (Cl. 68—9)

My invention relates to the textile industry and more particularly to apparatus for the treatment of fibers with liquid in a continuous system of manufacture.

My invention will be described with reference to its use in the manufacture of staple fibers from artificial threads such as artificial threads produced from viscose or other cellulose derivatives. It is to be understood that my invention is not necessarily limited to the treatment of fibers artificially produced but may also be adapted for use in processing natural staple fibers.

In the manufacture of staple fibers from artificial threads or filaments it is necessary that the fiber be treated with certain liquids, for example with acids, water, and bleaching and desulphurizing agents. It may be necessary and desirable to subject the fiber to an acid bath and then to wash out the acid with water in another bath before the fiber is subjected to the treatment of another liquid used in processing the fiber. It may therefore be necessary to alternately treat the fiber with an acid, desulphurizing agent, or bleaching agent with water as a wash. It has been found that a thorough flooding of the fibers with the appropriate solution results in a better treatment of the fiber than the mere application of the solution to the surface of the fiber by spraying or otherwise.

It is an object of my invention to provide apparatus for the treatment of textile fibers with liquid in a continuous system of manufacture.

Another object is to provide apparatus for the treatment of a continuously moving bed of staple fibers with different liquids.

Another object is the provision of a system of separate compartments in which the several treating processes occur and through which the staple fibers progressively move in continuous train.

Another object is the provision of apparatus for the successive treatment of staple fibers and the like with several treating liquids without mutilating or degrading the fibers.

Another object is the provision of a system for the successive treatment of a bed of staple fibers by passing them through liquid baths on a continuous conveyor and in which the liquid baths are separated from each other.

Another object is the provision for the removal of liquid from a matted layer of staples moving along a conveyor without pressing the fibers against the conveyor to degrade the fibers.

Another object is the provision for the removal of liquid from staple fibers moving along a conveyor at a distance from the bottom of the conveyor.

Another object is the provision of a compartment system for the separate treatment by liquids of a continuously moving bed or band of loose staple fibers.

Another object is the provision of an improved apparatus for the separation of liquids used in successively treating a continuous flow or train of material.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 represents a cross-sectional view taken lengthwise of my apparatus and is largely diagrammatical in nature;

Figure 2 is a plan view of the left hand half of the apparatus shown in Figure 1, and

Figure 3 is an enlarged view, partially diagrammatical in nature, of a portion of my apparatus and illustrates the action of the floating roller on the bed of staples and the squeeze rollers between which the staples pass at an elevation above the conveyor.

Referring to Figure 1, I show a continuous conveyor, denoted generally by the reference character 11, which is of the endless belt type. The conveyor belt is constructed of woven wire so woven as to support a bed of staple fibers and at the same time to permit liquid to drain through the conveyor belt. The conveyor belt may also be constructed of solid sheets of material perforated with a plurality of openings to permit liquid to drain therethrough and at the same time supporting the bed of staple fibers on the conveyor. The conveyor belt has a bottom portion 12 with raised sides 13 extending longitudinally along the longitudinal edges of the bottom portion 12. The side portions 13 are preferably woven as a part of the belt and are flexible so as to bend around the end pulleys as the belt moves in its travel. The conveyor belt is adapted to support and convey a relatively thick bed of loose staple fibers deposited upon the bottom portion 12 intermediate the side portions 13. There is thus afforded, in effect, a supporting pan without end walls which can support the fibers during processing and which permits liquid to drain through the bottom of the pan. Suitable end pulleys 14 support the conveyor belt and upon rotation move the upper level of the conveyor belt in continuous travel from the left hand end of the view of Figure 1 toward the right hand

end. Travel of the upper level of the conveyor belt toward the right of Figure 1 is referred to herein as forward travel and movement of fibers upon the top of the conveyor toward the right in Figure 1 is referred to as a conveying of the fibers forward. Either or both of the pulleys 14 may be connected to a source of power. In the diagrammatical view of figure 1 I have illustrated the pulley 14 on the right end being driven by the driving means shown diagrammatically by the dot and dash line 33.

Four spaced supporting rolls 15 are used for supporting the upper level of the conveyor belt and maintaining it in alignment. Three spaced supporting rollers 16 are positioned under the lower level of the conveyor belt as a means of support. The rollers 15 and 16 are not driven but merely rotate with movement of the conveyor belt. A catch basin 17 is positioned under the conveyor for receiving liquids dripping through the perforate conveyor belt. The catch basin 17 is divided up into portions for catching different types of liquid which drain through different portions of the conveyor. The peaked portions 19 are disposed to mark the division between the portions of the catch basin and the respective liquids flow into the said portions of the catch basin 17. An outlet 18 is positioned at the bottom of the sump of each portion of the catch basin 17. Liquid flowing out the outlets 18 is conducted to the respective fluid system for each type of liquid and after being replenished or regenerated may be used again for treatment.

An elongated bed 44 of staple fibers is deposited upon the upper portion of the conveyor belt intermediate the raised sides 13 and this elongated bed 44 is continuously moved forward upon operation of the conveyor. A filament spinning apparatus shown diagrammatically by the reference character 37 produces a bundle of filaments 43 which are moved forward by the rolls 38 driven by the common power source 33. A suitable cutting mechanism 39, driven by the common power source 33, cuts the filaments 43 into suitable staple length, for example one and one-quarter to six inches long, and distributes the cut staples upon the conveyor in the form of a loose bed of staple fibers indicated as the bed 44. The raised sides confine the bed 44 to the conveyor belt and permit a relatively thick bed, for example three or four inches deep, of staple fibers to be formed and moved upon the conveyor.

The bed of staples 44 is treated by several liquids during its course of travel along the conveyor. In the illustration of the drawing, the application of three different liquids is shown by way of example. Three pans or liquid containers 34 are positioned above the conveyor belt at three different locations along the length of the conveyor. The respective liquid for each container 34 is fed into the top of the conveyor by means of the respective inlet pipes 35. The inlet pipes 35 are in communication with a source of the appropriate liquid, including the liquid drained out through the outlets 18 of the catch basin 17. A plurality of small openings 36 in the bottom of the containers 34 sprinkle the liquid over an extended area above the conveyor belt. The liquid falls down upon the bed of staples 44 and floods the staples so that the staples are completely immersed in the liquid or solution and thereby become thoroughly saturated with the liquid. The staples upon being flooded in the bath of liquid and partially floating therein form a relatively thick, expanded and puffed-up layer of staples. The swollen mass of staples holds a considerable amount of the liquid and excess liquid passing through the bed 44 is drained off through the openings in the conveyor belt. This excess liquid seeping down through the conveyor belt falls down into the catch basin 17.

It is seen that in the use of three liquid containers 34 subjecting three different locations along the conveyor to baths of different liquid it is necessary to divide the course of the conveyor and to confine each liquid to its respective local position along the conveyor. It is desirable to separate each bath so that the liquids are not confused but rather are distinctly separated in treating the bed of staples. In the use of three different baths the course of the conveyor is divided into three compartments in which each liquid bath is confined but through which the elongated bed of staples moves in a continuous manner.

Four rollers 21 are disposed transversely of the conveyor and intermediate the raised sides 13 of the conveyor belt. By reason of the fact that external force is not applied to these rollers they are termed floating rollers. The four floating rollers 21 are spaced from each other to define three separate divisions or compartments along the length of the conveyor. Each floating roller 21 is journaled upon the ends of arms 22 which in turn are journaled upon shafts 26, the arms 22 having bearings 25 which freely ride upon a shaft 26. A suitable driving belt 24 rotates the floating rollers 21 with the shafts 26. The arrangement of the floating rollers 21 upon the arms 22 is such that the rollers freely ride upon the top of the bed 44 of staple fibers and merely the weight of the rollers 21 is effective in compressing the bed of staples moving under the rollers 21. For example, the weight of each roller may be five or six pounds and it may be said that the downward force of the floating rollers is relatively slight. The belt 24 driven by the shafts 26 and in turn powered by the common power source 33 is ratioed to rotate the floating rollers 21 at a speed relative to the speed of the conveyor. The counter-clockwise rotation of the rollers 21 permits the fibers to pass freely under the rollers on the conveyor bottom 12.

By reason of the free riding arrangement of the floating rollers 21 and the slight pressure exerted by their own weight the rollers 21 in cooperation with the bed of fibers 44 act as a dam to prevent longitudinal flow of liquid along the conveyor. Therefore, the rollers 21 act as a limit to flow of liquid longitudinally of the conveyor beyond the limits of the local liquid bath. At the same time, however, the floating rollers 21 permit the bed of staples 44 to pass between the rollers 21 and the conveyor bottom 12. Since the conveyor belt is of woven wire or of a perforated sheet it is important that the bed 44 is not pressed with any appreciable force against the bottom of the conveyor belt as this tends to mutilate or degrade the staples. By the very nature of the conveyor belt having openings for drainage it cannot have a smooth continuous surface. If considerable pressure were exerted upon the bed 44 to force the staples down upon the bottom of the conveyor belt the staples would be forced into the openings of the perforate conveyor belt and consequently torn or injured during movement of the apparatus. By having the floating rollers merely ride upon the top of the bed 44 without application of additional force the rollers 21 act as an effective dam against longitu-

dinal flow of liquid but do not exert such a pressure as to mutilate or degrade the staple fibers. The slight compression of the rollers 21 does, however, partially mat the bed of staples. This partially matted bed of staples has sufficient body that it may be handled as a continuous strip in the further steps of processing. Roughly, the partially matted bed may be described as having similar characteristics to a wetted band or strip of cotton batting.

At the terminus of each liquid bath compartment there is positioned a pair of mating squeeze rolls 27 and 28. The lower squeeze roll 27 is suitably supported and journaled upon a support 23 and it is driven by the shaft 26 powered by the common driving source 33. The upper squeeze roll 28 is geared to the lower roll 27 by the gear drive shown diagrammatically by the reference character 29. The squeeze rolls 27 and 28 are therefore arranged to move and squeeze material interposed therebetween. The upper squeeze roll 28 is suitably supported by a bearing housing 30 containing a coil spring 31 adapted to exert a downward force upon the squeeze roll 28. A suitable adjustment mechanism 32 is provided for adjusting the compression of the coil spring 31 and thereby the force of the roll 28 upon the roll 27. The external arcuate surfaces of the mating rolls 27 and 28 are smooth and continuous. Considerable force may be applied upon the staples to compress the same without mutilating or degrading the staples as there is no tearing action as would result from staples catching on a rough or perforated surface.

The elongated bed of staple fibers moving along the conveyor upon being partially matted under the floating rollers 21 is carried upwardly at a distance from the bottom of the conveyor and passes between the squeeze rolls 27 and 28. Since the squeezing is not done upon the relatively rough bottom of the conveyor belt the excess liquid may be squeezed from the bed of staples without a mutilation or degradation of the staples being squeezed. The slightly matted bed of staples upon passing through the squeeze rolls 27 and 28 is almost completely extracted and then again moves downwardly and resumes its place at a forward position upon the continuous conveyor to move forward through the next successive steps of the manufacturing process. It is to be seen in the large view of Figure 3 that the bed 44, while flooded with liquid in one of the compartments of the apparatus is relatively thick. Upon passing under the floating roll 21 the bed is partially matted and reduced in thickness and a restriction is placed upon longitudinal flow of the liquid along the conveyor. The bed of staples 44 then moves upwardly away from the conveyor and is there squeezed between the rolls 27 and 28 where the excess liquid is squeezed out and the bed is matted more completely and still further reduced in thickness. The matted bed then moves down to its place upon the conveyor at a longitudinal distance from where it left the conveyor and moves forward into the next liquid bath where it again becomes thick and expanded upon being wetted by the liquid of the next successive bath. The leaving of a longitudinal space on the conveyor unoccupied by fibers at each set of squeeze rolls aids in preventing longitudinal flow of liquid between the flooded compartments. A shield 45, shown in Figure 3, may be used to keep liquid dripping from the squeeze rolls from flowing forward into the next successive compartment. It is therefore to be seen that the apparatus which I have invented incorporates all of the advantages of wet treatments in separate compartments with all the advantages of a continuous conveyor system, the same being accomplished in a manner to avoid injury to the staples being processed. Utilization of the apparatus greatly increases efficiency of the treatment given to staple fibers and gives a result heretofore impossible with the previous apparatus known.

All of the driven parts of the apparatus are driven in unison to give a smooth and regulated flow of material through the apparatus. I have illustrated in the drawing the several parts being driven by a common source of power 33 connected to the motor 20. A suitable secondary conveyor 40 conveys the matted bed of staples from the last set of squeeze rolls 27 and 28 and delivers it continuously into a drying unit shown diagrammatically by the reference character 41 from whence it is delivered out through the outlet 42 to the place of storage, shipment, or further processing.

Although I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. In an apparatus for the treatment of continuously conveyed fiber by the successive subjection of the fiber to different baths of liquid, the combination of a continuous conveyor for conveying said fiber along a course, said conveyor having a bottom and integral sides to support and to confine the fiber in its movement upon the conveyor, a plurality of liquid feed means for flooding a plurality of portions, respectively, of said conveyor to treat the fiber thereon, a plurality of spaced rotatable rollers disposed transversely of said conveyor and positioned at a terminus of each of said portions of the conveyor, positioning means for maintaining said rollers in spaced relationship, said positioning means being adapted to permit said rollers to freely ride on said fibers moving along the conveyor, said portions of the conveyor intermediate of the rollers being open to hold the fiber without compression, and driving means for rotating said rollers to aid the movement of said fibers under the rollers on the conveyor, the relationship of the conveyor, rollers, liquid feed means, positioning means, and driving means, being such that the said portions of the conveyor intermediate said sides form separate flooded compartments, the liquid therein being dammed against flow longitudinal of the conveyor and the fiber moving therethrough is conveyed by said bottom and sides of the conveyor from one compartment to another undisturbed by movement of the conveyor sides relative to the conveyor bottom and moved between the conveyor and rollers without mutilation or degradation of the fibers.

2. In an apparatus for the treatment of staples with liquid, the combination of a continuous conveyor having a bottom portion and raised side wall portions integrally formed therewith to form a three-walled compartment for said staples and liquid, said conveyor being formed to

permit seepage of liquid therethrough and to permit said side wall portions to flex with said bottom in its continuous course, a pair of spaced rollers positioned intermediate of said side wall portions and above said bottom portion, said rollers being adapted to ride upon, and to compress, said staples on the conveyor, the said rollers in cooperation with said staples limiting the flow of liquid lengthwise of the conveyor to constitute end walls for said three-walled compartment.

3. In an apparatus for the treatment of a bed of staples with liquid, the combination of a woven conveyor having a bottom portion and integrally formed side portions constituting a continuous channel in which said staples and liquid are contained and moved in a forward direction, a roller positioned forwardly in said channel of the conveyor intermediate of the said side portions, said roller being positioned over said bottom portion of the conveyor and adapted to compress the bed of staples and to limit the forward movement of liquid beyond said roller, and driving means for moving said conveyor and rotating said roller in unison to forwardly advance the bed of staples therebetween.

4. In an apparatus for the treatment of staples with liquid, the combination of a foraminate conveyor belt having a bottom wall and side walls integrally formed therein to form an elongated container, said conveyor belt being adapted to continuously convey and to contain said staples in a layer through said treatment, liquid supply means for flooding a portion of said conveyor belt intermediate of said side walls to treat the fibers thereon, the foraminate conveyor belt permitting excess liquid to seep therethrough, two spaced rollers positioned between said side walls at opposite ends of said flooded portion to form end walls for said flooded portion of the conveyor, freely swingable arms having journal bearings provided at the free ends thereof for said rollers, said swingable arms securing said rollers in said spaced relationship longitudinally of the conveyor belt and permitting said rollers to freely ride on said layer of staples, the said rollers partially compressing said layer, the said rollers and the partially compressed layer limiting the longitudinal flow of liquid beyond said flooded portion of the conveyor belt, and driving means for moving said conveyor belt and rotating said rollers in unison to move said layer between the conveyor and the rollers at substantially the same speed.

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