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STAPLE PROCESSING DEVICE

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Fig. 1.

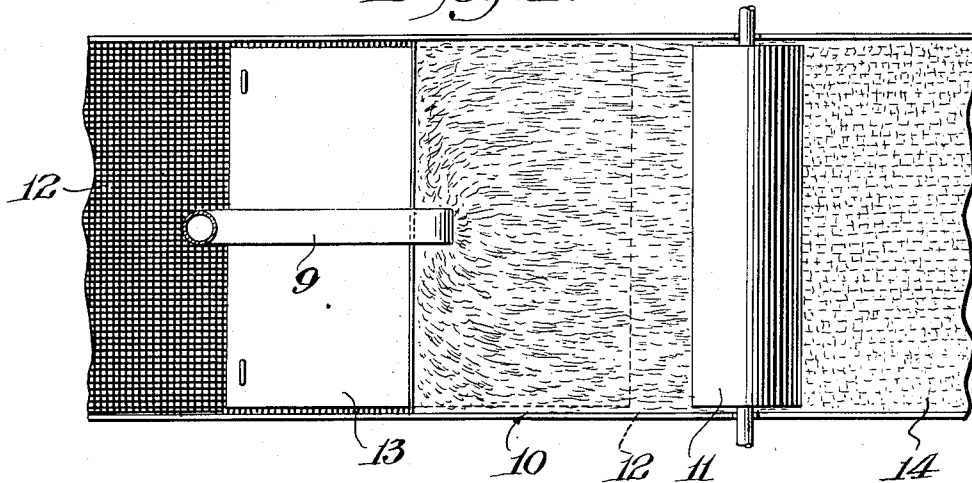
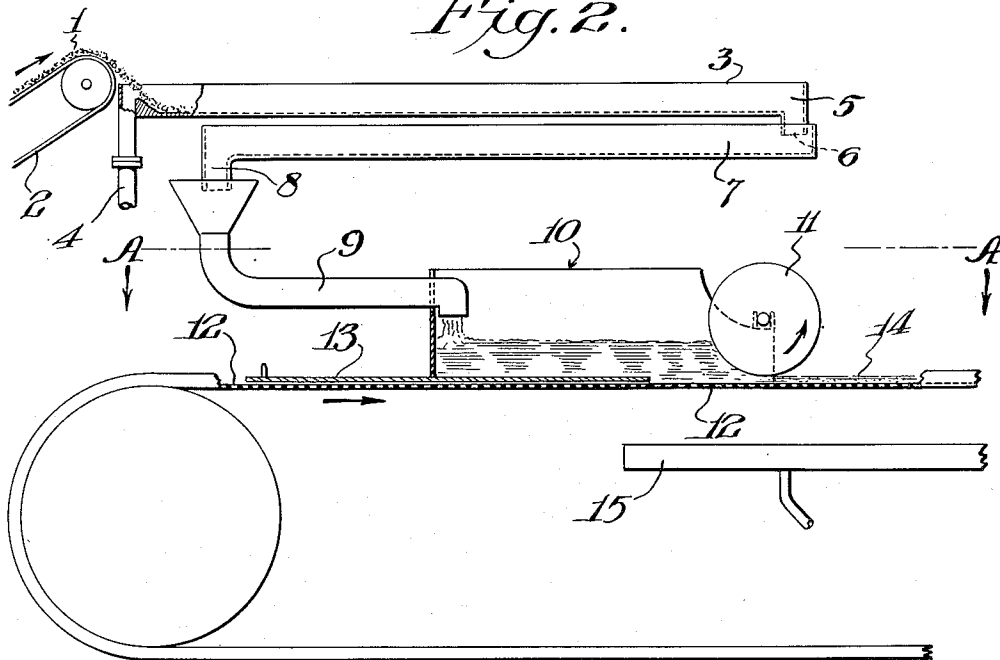


Fig. 2.



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2,696,147

STAPLE PROCESSING DEVICE

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1 Claim. (Cl. 92—44)

This invention relates to the treatment of fibrous material with liquids. It relates to the purification of staple rayon and, more particularly, to an improved method and apparatus for opening the wet "chips" and presenting all the staple fibers to uniform liquid purification.

Rayon staple is commonly produced by extruding viscose through large spinnerets, each having several thousand holes, and quite a few of the filament bundles thus formed are collected together as a tow composed of 100,000 filaments, more or less, which may be processed as such and then cut into staple lengths before drying. Alternatively the tow may be cut in either the acid state before any washing or purification treatment or after a preliminary wash to remove the coagulating bath ingredients and some of the by-products formed in spinning. There are certain inherent advantages in cutting the filaments into staple lengths before substantial purification but there is difficulty in uniformly and efficiently purifying the fibers in this form. Probably the most important advantage of staple fiber purification rather than tow purification is getting retentive crimp in the fibers which naturally arises from the individual fibers being in a relaxed state during purification. On the other hand, difficulty in completely opening the dense chips and presenting the fibers therefrom uniformly to processing liquids whereby to obtain satisfactorily purified fiber has been a baffling problem over many years.

Numerous methods and means have been proposed and some of these have been partially effective in overcoming the inherent difficulty of staple fiber processing. The known prior art methods and equipment fail to reduce the compact chips completely to individual loosened fibers and require exceptionally long purification cycles and result in a non-uniform processed product. Then too, if the fibers released from the chips are too violently worked, they may and have frequently become tangled and form "neps" and "rat tails" or "strings" which militate against satisfactory subsequent processing.

It is important that the chips of cut staple be quickly and completely eliminated but without tangling of the fibers. The free fibers should then be formed into a uniform blanket which will allow slow uniform passage of processing liquid without channeling. The change from dense chips to a satisfactory blanket of individual fibers should take place quickly with a minimum of space and equipment if the process is to be operated economically and efficiently for until this blanket of released fibers is formed, satisfactory purification cannot continue.

An object of this invention is to provide an improved process and apparatus for treating a fibrous material with liquid. Another object is the provision of apparatus and process for converting wet staple rayon chips to individual fibers and immediately forming the free fibers into a uniform blanket which can be effectively treated with processing liquid. Other objects will be apparent from the description that follows.

The objects of this invention are accomplished by feeding the fibrous material to be treated to a sluice containing the liquid and passing it from there, preferably through a conduit having an oscillating outlet end, into a slurry box which has an open bottom section and which is situated over an endless perforated conveyor belt. The liquid is drained out of the fibrous material by passing the wet mass in the box onto the perforated conveyor belt and then between a roller, which closes one end of the box, and the conveyor belt thereunder. The bottom opening in the box may be adjustable by means

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of a retractable bottom the adjustment of which permits the volume of fibrous material/liquid mixture to be varied so that uniform treatment is assured. This opening, for a given operation, may be set or fixed and maintained at the desired setting during continuous operation. The setting of the open section and the clearance between the roller and belt will, of course, depend upon the blanket thickness desired. In the case of staple rayon chips, the chips are softened and opened in the sluice and also in the slurry box. The oscillating tail pipe permits uniform distribution of slurry in the box and the opening in the slurry box bottom permits necessary drainage for suitable blanket formation.

In the figures below, which are given for illustrative purposes only,

Figure 1 is a plan view on line A—A of Figure 2 and Figure 2 is a side elevation partly in section.

As shown, wet, preliminary washed chips 1 of staple lengths are supplied from a wet cutter (not shown) by means of a conveyor 2 to one end of the sluice box 3. At about the same point, through conduit 4 a dilute aqueous solution of caustic soda is brought into the box at a sufficient rate of flow to carry the chips to the other end of the upper section 5 of the box and the softened chips and liquid are discharged through opening 6 to the lower section 7 of the sluice box through which they flow in the reverse direction. This reversal of flow and the turbulence that accompanies it causes the chips to loosen up and by the time the staple has reached the discharge end 8 of the lower run they are partially opened. Again, the passage of this slurry through the oscillating tail pipe 9 with its attendant bends substantially completes the job of breaking up the chips and delivers substantially separated fibers to the slurry box 10. The oscillating tail pipe 9 may be operated by a motor or any convenient manner (not shown). Actually, oscillation is not necessary and a stationary tail pipe can be used.

Slurry box 10 is built with two side boards and a board across the inlet end, while a driven roller 11 is provided to close the exit end of the box. This roller may be independently driven or, preferably, it may be driven by a drive interlocked either mechanically or electrically with the conveyor belt drive. The box 10 is supported over the perforated or screen conveyor 12 and is also provided with a bottom plate 13 partially covering the screen under the box. The slurry box clears the conveyor by about 1/8 of an inch. The bottom plate may be adjustable or not. The box lies very close to the belt but preferably does not ride on the belt. Due to the oscillations of the tail pipe 9 the slurry is uniformly fed across the full width of the slurry box 10. Due to the closed bottom near the entrance end and the open portion further along, the fibers have a chance to complete separation and to settle down in an evenly distributed form by the time the conveyor screen 12 carries the soaking wet mass of fibers to the vicinity of the roll 11. This roll squeezes and condenses the fiber mass to form a blanket 14 of quite uniform texture, which may subsequently pass under desulfuring, washing, bleaching, and/or finishing showers before final squeezing, fluffing and drying. The uniform flow over the draining section results in a blanket of uniform thickness. The liquid draining from the fibers may be recovered by using a tank 15 or standard sumps and recirculating pumps.

The slurry box 10 is designed in accordance with slurry consistency. With a slurry formed using 105 gal./min. of 0.5% sodium hydroxide at 85° C. and 17 lbs./min. of 1.5 denier/filament chips (or 20.1 lbs./min. of 3.0 d./f. chips or 20.8 lbs./min. of 5.5 d./f. chips, all on 11% regain basis), the slurry box is designed and set so that a retention of the slurry in the box for about one minute is accomplished. Under the above conditions retention for 0.5 minute is insufficient. With thinner slurries less retention is necessary. Of course, the length of the sluice, the number of spinneret holes on the spinning machine, etc., each have their effect on the retention time required in the slurry box for optimum opening. Such factors are, of course, considered in the design of the apparatus.

The use of dilute caustic solution in forming the chip slurry serves a dual purpose of a liquid vehicle to swell

the fibers and soften the chips as well as to initiate desulfuring action on the washed staple fibers. This solution could be substituted by plain water or by a sodium carbonate, sodium sulfide or other desulfuring solutions as desired. Obviously, this early use of a desulfuring reagent speeds up the process and is an economic expedient.

Because the conveyor screen runs under the slurry box, which is provided at the entrance zone of the fiber slurry with a bottom plate, there is a space where the fibers can finally turn and work apart and recombine themselves into a well distributed voluminous mass while provided with the necessary liquid vehicle. Subsequently, when the liquid drains from the slurry through the screen of the conveyor after the bottom plate no longer covers the screen, the fibers become rematted in a random arrangement and when compacted by the roll 11 from a uniformly pervious blanket.

By having the side boards of this box relatively high and the end roll of proportionally large diameter a rather deep bed of slurry is held in the box. This better insures the formation of a good processible blanket. The roll is preferably positively driven in the direction shown, although it may be frictionally driven or held stationary. If stationary, much more power will be required to drive the conveyor.

In U. S. Patent 2,337,068 there is disclosed a trough through which a screen conveyor carrying a blanket of fibers passes. The trough retains the liquid in an effort to soak to a greater extent the fibers making up the blanket. In this case the treatment liquid is retained in the trough by the sides and bottom of the trough and by the rollers at either end. It is necessary to retain the liquid in this manner in order to get uniformity throughout the blanket. This means of handling might well be necessary if the blanket of fibers is poorly formed, non-uniform in porosity or, in general, too impervious. With the improved blanket obtained by the method above described, such a treating trough used in combination with a conveyor belt carrying the blanket is not only unnecessary in subsequent purification steps but would be an actual process hindrance. This is because the stock in the improved blanket in accordance with this invention is so well opened that it soaks up the treatment liquid bodily and allows it to drain through the blanket effectively, when it is applied either by means of a spray or shower pan, instead of shedding the liquid from the surface and allowing it to escape ineffectively through the side walls of the conveyor. Thus, the porous nature of the improved blanket of this invention serves to hold the treatment liquids long enough for adequate, uniform processing without any liquid-confining apparatus.

This invention permits the shower pan to be replaced by spray pipes and the use of one-third less solution per pound of production with greatly improved uniformity of purification, finish application, etc. The invention allows increases in capacity for each conveyor amounting to as much as 50% and the dryer capacity is increased by at least 10% because the blanket contains fewer unopened chips. Quality is improved as shown by a 10% increase (on 1.5 d./f. stock) in cohesion as measured by the draw sliver tenacity.

By the use of the apparatus and process of this invention the quantity and quality of cut stock processed are appreciably increased. Thick spots, which are bypassed by purification solution, and thin spots, which drain excessive amounts of solution, are avoided. By adjusting the drainage space between the retractable bottom 13 and the forming roll 11, the height of the slurry in the box 10 is regulated to cause a uniform flow over the draining section. This results in a blanket of uni-

form thickness. The decrease in "rat-tails" and "strings" makes the blanket very easy to pull apart.

While this invention has been described with particular reference to staple rayon chips, it is not limited thereto. Various fibrous materials may be treated in the apparatus of this invention, including those of synthetic polymers such as polyamides, polyacrylonitriles, etc. or other products such as wool, silk, cellulose acetate, cotton, asbestos, etc.

Similarly, the invention is not limited to the particular form shown. For example, the bottom of the slurry box may be made stationary and the roller adjustable to permit a greater or lesser amount of screening to occur. The roller may also be adjustable in the vertical direction to permit variation in blanket thickness. Further, the end of the box opposite the roller may be oblique or inclined to the belt, and adjustable so that the distance between its bottom edge and the roller could be varied. Still further, the path to the slurry box may be longer or more tortuous, if desired.

By the process and apparatus of this invention the number of unopened chips is markedly reduced and the occurrence of hard, compact unopened chips is eliminated. In standard blankets about 60% by weight of the stock can be segregated as chips many of which are hard and compact. In the improved blanket obtained by this invention, only about 40% by weight can be identified as chips and all of these are soft, fluffy chips, the structure of which permits ready and adequate penetration of process liquids and the attainment of crimped form. The hard, compact unopened chip characteristic of standard blankets is advantageously eliminated.

Any departure from the procedure described herein which conforms to the principles of the invention is intended to be included within the scope of the claim below.

I claim:

Apparatus for converting staple chips of regenerated cellulose fibers into individual fibers laid down in blanket form without appreciable entanglement of the individual fibers which comprises a sluice box having upper and lower sections in substantially horizontal position; at the entrance end of said upper section for said chips, an inlet for an aqueous liquid; means for reversing the direction of flow of liquid at the opposite end of said upper section comprising a conduit to discharge said liquid and said fibers substantially vertically downward into said lower section and means directing the flow in said lower section in a direction opposite to the direction of flow in said upper section; a slurry box mounted above a perforated conveyor belt; an oscillating conduit for discharging said liquid and fibers from said lower section uniformly into said slurry box, said box having a roller at its discharge end and said box having a bottom plate above and partially covering said belt, said roller and said belt providing means to press the fibers into said blanket on said belt as said belt passes out from beneath said box.

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