APPLARATUS FOR TREATING AND PROCESSING OF ELONGATED FLEXIBLE ELEMENTS

Heinz Fleissner, Egelseich, Germany, assignor to Fleissner u. Co., G.m.b.H., Egelseich, Germany

Original application June 3, 1959, Ser. No. 817,949. Divided and this application July 12, 1960, Ser. No. 42,560

Claims priority, application Germany June 4, 1958 6 Claims. (Cl. 68 — 19)

The present invention relates to an apparatus for treating and processing elongated flexible elements, and more particularly for washing, rinsing, bleaching, dyeing, impregnating or sizing of cables, textile bands, belts, threads or the like regardless of whether the materials are made of natural or synthetic substances.

This application is a division of my co-pending application Serial No. 817,949, filed June 3, 1959, entitled “Process and Apparatus for Treatment of Elongated Flexible Elements.”

It is already known to wash or otherwise treat cables or bands made of flexible material by leading the material in parallel strands over a series of guide rollers immersed in a liquid treating substance. The disadvantage of such systems is that the apparatus occupies too much space, and especially in that it is very difficult to allow for shrinkage of and to subsequently outshrink the treated material.

An important object of the invention is to provide an improved process of treating and processing flexible material which may be practiced in a compact apparatus occupying comparatively little space and which takes into full consideration the shrinkage of processed material due to the latter’s contact with a liquid treating agent.

A further object of the invention is to provide an improved apparatus which is capable of folding the treated material at least once without interruptions in the continuous or stepwise advance of the material toward and beyond the liquid treating station.

A still further object of the instant invention is to provide an apparatus of the above outlined characteristics which is so constructed that it may continuously process a single or simultaneously a large number of elongated flexible elements.

A concomitant object of the invention is to provide an apparatus of the type above set forth which is comparatively short, compact and cheap in manufacture, which is capable of folding the conveyed material into layers of many different configurations, and which is constructed with a view to maintain the material in folded condition during certain stages of, or during the entire treating and processing cycle.

With the above objects in view, the invention consists essentially in the provision of an apparatus for treating and processing at least one flexible element which comprises various structural features in combination. Means are provided in the apparatus for bending the element at spaced intervals in substantially opposite directions so as to form a third or bent structure located in a predetermined plane as well as means for advancing each bent flexible element. Also provided are means containing a supply of liquid treating medium in the path of each bent flexible element and at least one hollow drum having a perforated mantle and means for withdrawing the treating medium from the interior of each drum so that the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum, and means for withdrawing the treating medium from the interior of each drum. Other features of the combination are means for advancing each bent flexible element from the treating medium and means comprising a rotary roller means for at least partially expelling the treating medium from each flexible element. Finally, there are provided in combination with the foregoing, means comprising a drying compartment, at least one drying drum in the compartment, the drying drum having a perforated mantle, means for rotating the drying drum, and means for withdrawing air from the drying drum so that the flexible element is caused to adhere to at least a portion of the mantle of the drying drum while advancing through the drying compartment.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of certain specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a schematic side elevational view of an apparatus for the treatment of elongated flexible elements which embodies the invention, certain parts being shown in vertical section taken substantially along the line 1—1 of FIG. 2, as seen in the direction of arrows;

FIG. 2 is top plan view of the apparatus partly broken away;

FIG. 3 is a schematic side elevational view of a modified apparatus with certain parts shown in vertical section;

FIGS. 4a—4f are schematic diagrams showing different manners of laying one or more flexible elements onto various conveying components of the apparatus;

FIG. 5 is a schematic view of one form of a cable or band laying or folding device; and

FIG. 6 is a diagrammatic enlarged view of part of the apparatus shown in FIG. 1.

Referring now in greater detail to the illustrated embodiments, and first to that shown in FIGS. 1 and 2, the apparatus for the treatment of flexible elements comprises essentially a receptacle 21 for a liquid treating medium, 22, a drum 5 in the receptacle 21 about which the flexible element or elements 1 may be led during one stage of the treatment, a drying compartment 11, means 3, for folding the flexible element or elements 1 into a plurality of folds, layers or coils 1a at a point in advance of the treating medium 22, and conveying means 4, 4a and 7, 9 for advancing the layers 1a of flexible element or elements 1 into the treatment bath 23, and from the latter through a pressing or squeezing station 23 into the drying compartment 11, respectively.

The flexible element or elements 1, four of which are shown in FIG. 2, advance in the direction of arrow A over a deflecting roll 2 to be thereupon engaged by the folding, pleating or bending elements 3a of the folding device 3 whose swingable levers 3b are pivotally connected at 3d to an upright frame member or support 3c. Elements 3a, mounted in pairs on their respective levers 3b, fold the flexible elements 1 which pass therebetween, for example, in the form of zig-zag layers 1a onto the upper run of the first band of apron conveyor 4 which delivers the folded, coiled or pleated material onto the slightly inclined second conveyor 4a. The bands or aprons of conveyors 4, 4a preferably consist of a series of parallel strips or slats schematically indicated in FIG. 1 by the reference numeral 20. The flexible elements in the form of zig-zag layers 1a are thereupon led over a deflect-
ing roll 30 and are urged by the liquid treating medium 22 toward the perforated or apertured mantle of the drum 5 which is hollow and houses a portion of a vacuum pump 5a, the latter's function being to draw liquid 22 through the perforations or apertures formed in the mantle of e.g. washing drum 5 whereby the liquid treating medium 22 causes the layers 1a of flexible elements 1 to firmly adhere to the drum while the elements 1 are led thereabout.

Upon leaving the mantle of drum 5, the layers 1a pass onto a second deflecting roller 31 and onto the upper run of the aforementioned band or apron conveyor 7 to thereupon pass between the pressing or squeezing rollers 8, 8a of the pressing apparatus 23 before being led onto the upper run of the conveyor 9 whose righthand portion extends through an opening 24 into the interior of drying compartment 11 and into close proximity of the mantle of a first drying drum 12.

The transfer of layers 1a from conveyor 4a into the path about the mantle of drum 5 and from the latter onto the conveyor 7 is assisted by a skein-like belt 32 which travels in an endless path about the mantle of drum 5, between deflecting rollers 30, 33, and about a pair of deflecting rollers 33, 34. Thus, the layers 1a do not come into actual contact with the mantle of drum 5 but rather with the outer side of endless band 32. The liquid treating medium which is squeezed or pressed from the belt 32 by rollers 8, 8a is collected in an inclined chute or tray 10 to be returned into the receptacle 21. It will be readily understood that each flexible element may be caused to travel about more than one drum 5 while subjected to the action of liquid treating medium 22.

After passing about the lower half of drying drum 12, the layers 1a advance onto the mantle of a median drying drum 13, and finally about the mantle of a third drying drum 14 to be thereupon led by a non-represented conveyor means to one or more additional treating stations, not shown. While advancing through the compartment 11, the layers 1a of material 1 are subjected to the action of a suitable drying medium, e.g., hot air. The mantles of drums 12–14 are perforated or apertured (see FIG. 2.), and vacuum is generated in the interior of drying drums 12–14 by ventilators or fans 12a, 13a, 14a, respectively; therefore, the layers 1a are caused to adhere to the mantles of respective drums while passing through the drying compartment 11. The inner sides of the upper halves of drums 12 and 14 are covered by substantially semicylindrical covers 12b, 14b, respectively, of sheet metal or any other suitable material, and a similar cover 13b is provided adjacent to the inner side of the lower half of median drum 13. Covers 12b, 13b and 14b are stationary and thus prevent the layers 1a from passing about the upper half of drum 12, about the lower half of drum 13, and about the upper half of drum 14, respectively. Due to the provision of members 12b–14b, the radially oriented suctional force generated by ventilators 12a–14a is prevented from attracting the layers 1a except in the lower halves of drums 12, 14 and in the upper half of median drum 13. Thus, as soon as the layers 1a, while traveling about the first drum 12, reach the closest point between drums 12, 13, the suctional force generated at the aperture 12b is prevented by cover 12b from causing further adherence of layers 1a to the mantle of drum 12 while the force generated by fan 13a becomes effective at a point just beyond the adjacent axially parallel edge of cover 13b to cause transfer of the layers 1a onto the upper half of median drum 13. The transfer of layers 1a from the drum 13 onto the lower half of drum 14 is analogous.

Drums 12–14, conveyors 4, 4a, 7, 9, the drum 5 in bath 22, and the pressing rollers 8, 8a may all be rotated at predetermined or angular speeds, either intermittently or continuously, by a schematically represented adjustable drive 15 whose details of construction form no part of this invention.

Flexible elements 1 may consist of cables, bands, threads, belts or the like and may be made of a synthetic or natural textile material, e.g., cotton, wool, rayon or the like. It is assumed merely by way of example that the flexible elements 1 advancing toward the deflecting roll 2 at the left-hand end of FIG. 1, are woven or synthetic bands or threads coming from a suitable spinning apparatus, not shown. The liquid 22 in receptacle 21 may constitute a drying, size or simply a washing medium, depending upon the treatment which the flexible elements 1 should be subjected in the receptacle 21 while passing about the apertured mantle of drum 5.

The construction of the apparatus shown in FIG. 3 is slightly different from that of the assembly just described in connection with FIGS. 1 and 2. It is assumed in FIG. 3 that the pressing or squeezing rollers 8, 8a are driven at speeds sufficiently high to draw the flexible element or elements 1 from deflecting roller 31 under such tension that the layers or folds 1a formed by device 3 are destroyed and the treated material advances beyond the rollers 8, 8a in the form of straight bands 1b. This is desirable in certain instances, for example, when the treating liquid should be nearly completely removed from the bands 1b by the time they reach the drying compartment 11. Moreover, the rapidly rotating rollers 8, 8a, by generating tension in conveyed material, may also stretch and thus restore the original length of flexible elements 1 which might have shrunk while passing through the liquid bath 22.

The bands 1b advancing beyond the liquid-expressing or squeezing rollers 8, 8a are led along the inclined surface of a frame member 16 to pass over a deflecting roll 2 similar to member 2 and fixed to the drying compartment 11, to be thereupon deformed into zig-zag or otherwise shaped layers 1a' by a second folding device 3' comprising parts 3a', 3b' and 3c' analogous to similarly numbered components of the first cable or band folding device 3. It will be noted that the pivot means 3d' about which the lever or levers 3b' may be swung with elements 3a' are mounted directly on the outer side of drying compartment 11.

FIG. 4a illustrates portions of four straight cables or bands 1 or 1b as they are led toward the deflecting roll 2 (FIGS. 1 to 3) or toward the deflecting roll 2' (FIG. 3), respectively.

FIG. 4b illustrates layers 1a or 1a' of flexible elements 1 substantially as folded by the devices 3 and 3'. It will be noted that the layers 1a or 1a' in FIG. 4b are closely adjacent to each other while the layers formed by device 3, as best shown in FIG. 2, are formed with considerable interval therebetween. The closeness of layers 1a or 1a' and the length of their folds or plies depicted upon the length of oscillatory movements performed by levers 3b or 3b', as will be described in connection with FIG. 5.

FIG. 4c shows a modified arrangement of layers 1c whose portions are parallel and closely adjacent to each other. In addition, each layer 1c extends over more than one-half of the width of conveyor 4. It will be readily understood that such an arrangement requires slight modifications in the mounting of elements 3a, 3a' in FIG. 4b. FIG. 4d illustrates layers 1d of flexible elements whose individual portions are corrugated or puckered to fully utilize the surface of conveyor 4.

FIG. 4e shows a closely or densely coiled helical layers 1e.

FIG. 4f illustrates a single coiled layer 1f of very large diameter extending substantially over the entire width of conveyor 4; thus, it will be seen that the novel method and apparatus may be utilized for treating only one or simultaneously a large number of elongated flexible elements, as will be described in connection with FIG. 5. A single flexible element may be laid in parallel folds which extend over the entire width of a conveyor or other carrier, if desired.

The selection of the manner in which the flexible ele-
ment or elements 1 may be laid by devices 3, 3' often depends upon space considerations, it being desirable to process great quantities of material per unit of time. Moreover, such selection further depends upon the manner in which the material is removed from the last drying drum 14, and also upon the desired degree of crimping, curling or curling of the processed material. For example, regenerated cellulose fibers should often be treated to assume the desirable elastic characteristics of wool. To that end, the synthetic material is formed by the device 3 or 3' into a number of curls or layers and led into the bath 22 which may then consist of an impregnating agent. The thoroughly wetted material is then upon squeezed or pressed by passage between rollers 8, 8z to be dried in the compartment 11 and to be thereupon fixed in any known manner. It has been found that, upon storing for a period of, say 14 days, a synthetic material processed in the just described way assumes desirable elastic characteristics and a curly or curled shape to be ready for use as a substitute for wool in pillows or the like.

FIG. 5 shows merely by way of example a suitable folding device 3' which, for the sake of simplicity, has been illustrated with a single pendulum 34" lever 34" pivotable about a pivot axle 34" which is mounted on the frame member or support 3c'. The lower end of lever 34" carries a pair of shafts 40 each rotatably mounting a fusing element or roller 3a'. Each roller 3a" is connected for rotation with a gear 41; these gears are in mesh and are rotated in the directions indicated by arrows over a pulley mounted at the rear end of the right-hand roller 3a". The pulley is driven by a belt 42 which also passes over a second pulley 43 rotatably mounted on support 3c'. Member 43, in turn, is driven by a belt 44 which travels over a further pulley 45 operatively connected to the output shaft 47 of a motor 46. Output shaft 47 also drives a third belt 48 passing over a pulley 49 which is rotatably mounted on a shaft 50 fixed to the frame member or support 3c'. Pulley 49 is connected for rotation with a cam 51 whose peripheral cam surface is in contact with two followers 52, 53 both fixed to a rod 54 which is reciprocably mounted in two aligned bearings 55, 56 carried by the support 3c'. Rod 54 is formed with a downwardly extending bracket 57 which carries a pin 58 received in an elongated closed cam 59 formed in the lever 3b'.

The flexible element 1 passing from the non-represented deflecting roll, e.g., the member 2 shown in FIGS. 1 and 2, is entrained by the mantles of rollers 3a" which rotate in opposing directions so as to be fed in parallel layers 1g onto the upper run of conveyor 4 to 1c, and is advanced in stepwise fashion by the non-represented drive, e.g., by the assembly 15 shown in FIG. 2. The movements of lever 3b" transversely of the conveyor 4 are brought about by a cam 51 which reciprocates the rod 54 by means of followers 52, 53, and by the pin 58 which engages with the walls of member 3b" surrounding the latter's cam slot 59.

It will be readily understood that the layers 1g may be arranged in zig-zag fashion, as shown in FIGS. 4b and 4c, if the intermittent movement of conveyor 4 is changed to a continuous movement at a predetermined speed. The types of layers shown in FIGS. 4d, 4e and 4f may be arrived at by imparting to the lever 3b" a second movement over a non-represented system of cams or the like. As before stated, the type of folding device 3' shown in FIG. 5 is but one of many known assemblies which may be utilized for the purposes of FIGS. 3 and is intended to the specific construction of this folding device.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others that can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should be intended to be comprehended within the meaning and range of equivalence of the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed, are defined as follows:

1. An apparatus for treating and processing at least one flexible element which comprises, in combination, means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; means for advancing each bent flexible element; means for containing a supply of liquid treating medium from the path of the path of each bent flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum; means for advancing each bent flexible element from the treating medium to the interior of the respective drum; means for advancing each bent flexible element from the treating medium; pressing means comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for drying each flexible element.

2. An apparatus for treating and processing at least one flexible element which comprises, in combination; means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; means for advancing each bent flexible element; means containing a supply of liquid treating medium in the path of each flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum; means for advancing each bent flexible element from the treating medium to the interior of the respective drum; means for advancing each bent flexible element from the treating medium; comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for rotating said roller means at such speeds that the roller means produce tension in each bent flexible element whereby to destory the layers; second bending means for again forming a to and fro bent structure of each flexible element; and means for drying each bent flexible element.

3. An apparatus for treating and processing at least one flexible element which comprises, in combination; means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; at least one conveyor means for advancing each bent flexible element; means containing a supply of liquid treating medium in the path of each bent flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to ad-
here to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum; means for advancing each bent flexible element from the treating medium; pressing means comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for drying each flexible element.

4. An apparatus for treating and processing at least one flexible element which comprises, in combination; means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; means for advancing each bent flexible element; means containing a supply of liquid treating medium in the path of each bent flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium for the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum; conveyor means for advancing each bent flexible element from the treating medium; pressing means comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for drying each flexible element.

5. An apparatus for treating and processing at least one flexible element which comprises, in combination; separate means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; means for advancing each bent flexible element; means containing a supply of liquid treating medium in the path of each bent flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum; means for advancing each bent flexible element from the treating medium; pressing means comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for drying each flexible element.

6. An apparatus for treating and processing at least one flexible element which comprises, in combination; means for bending said element at spaced intervals in substantially opposite directions so as to form a to and fro bent structure located in a predetermined plane; means for advancing each bent flexible element; means containing a supply of liquid treating medium in the path of each bent flexible element; at least one hollow drum having a perforated mantle and rotatably installed in the treating medium so as to advance the bent flexible element in a curved path having its axis of curvature extending substantially parallel to the plane of said bent structure and transversal to the longitudinal extension thereof along the periphery of said mantle; means for rotating each drum; means for withdrawing the treating medium from the interior of each drum whereby the treating medium causes each bent flexible element to adhere to at least a portion of the mantle of each drum by penetrating through each mantle into the interior of the respective drum; means for advancing each bent flexible element from the treating medium; pressing means comprising rotatable roller means for at least partially expelling the treating medium from each flexible element; and means for drying each flexible element.

References Cited in the file of this patent

UNITED STATES PATENTS

313,306 Farmer Mar. 3, 1885
1,220,268 Payet Mar. 27, 1917
1,432,319 Brandwood Oct. 17, 1922
1,794,403 Hanhart Mar. 3, 1931
2,293,154 Lovett Aug. 18, 1942
2,520,594 Costa Aug. 29, 1950
2,552,078 Williams May 8, 1951
2,637,659 Miller May 5, 1953
2,847,227 Eriksson Dec. 24, 1957
2,835,047 Fleissner May 20, 1958
2,922,229 Kiefer Jan. 26, 1960

FOREIGN PATENTS

213,709 Australia Mar. 6, 1958