TENSION CONTROL FOR TEXTILE FABRIC FINISHING MACHINES

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The present invention relates generally to textile fabric finishing and more particularly to a method and apparatus for controlling fabric tension in machines effecting such finishing. The invention has special application to "wet" finishing machines or those which utilize gaseous and vaporous media such as steam, acids, or other more or less aerosol or volatile fluid fabric treating agents, in that it provides for sealing off from contact therewith those elements of the tension control system which are subject to damage by wetting or corrosive action.

The invention will be more fully understood by reference to the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a top plan of a finishing machine equipped with a preferred form of my novel control;

Fig. 2 is a side view of the machine of Fig. 1 further illustrating the operation of a control according to the invention;

Fig. 3 is a top plan on a larger scale of certain elements of the control apparatus; and

Fig. 4 is a side view on a smaller scale of corresponding elements of a modified form of the apparatus.

In the finishing of textile fabrics it has been the practice for some time to control cloth tension by mounting drive speed regulating devices or compensators between the several successive fabric processing machines of a given installation. According to the known practice, the motor driving each machine has been accelerated or decelerated by these compensators as required for synchronization with a selected controller or lead motor.

One class of these machines of relatively recent development is that providing chambers, chests, or boxes enclosing rolls about which the cloth is conducted for processing. Where such machines have been employed in "wet" finishing operations, such as dyeing, fulling, washing, or aging, the chests thereof generally have been vapor-tight to confine the steam, and/or other vaporous, gaseous or volatile wetting and treating agent required. Such chests initially were designed to contain a traveling cloth length of possibly twenty yards, that is, the total length of cloth between the entry and exit points and subject to the processing at any given moment.

Subsequent increases in production standards resulting in part from improved chemicals and processing techniques, making possible a higher speed of travel for the fabrics, have required modification of the finisher chests to accommodate greater fabric lengths in the enclosed run, up to sixty or more yards, and have permitted the processing of much more delicate fabrics, such as acetate rayons and the like, than could formerly be handled. Wet finishing machines such as the ailer herein illustrated are now provided with as many as forty or more rolls, arranged in sets of upper and lower or top and bottom rolls over and under which the fabric is alternately and successively passed. The increased number of rolls and/or speed of cloth travel in such more modern finishing apparatus have been found to create conditions under which the cloth may stretch or shrink to a substantial degree within a single machine, resulting immediately or directly in excessive tension or looseness in the fabric, and ultimately in cloth wrinkling, selvedge doubling, and the like injurious effects.

It is a primary object of this invention, therefore, to provide a new and improved roll drive control for regulating and adjusting the tension of the fabric as it passes about the multiple rolls of a single finisher, and more particularly for compensating tension changes at several selected locations therein, thereby preventing injury to the fabric otherwise likely to result from such changes.

An important consideration in the design and construction of compensators for such application within fabric processing machines, at least those for wet finishing operations, is the presence in the finisher of the wetting agent hereinbefore mentioned, under continued exposure to which some controller units deteriorate and others break down altogether. Accordingly, another object of the invention is the provision of compensator means wherein control elements susceptible to damage or malfunctioning by wetting or corrosive action are once sealed off from exposure to the interior of the finisher and made readily accessible for repair and adjustment from the exterior thereof.

Referring now more particularly to Figs. 1 and 2, a length of cloth A is shown being advanced around the upper and lower rolls at the entry end of a large capacity finisher of the class described. The machine selected for purposes of illustration is that known commercially as an ager or steam box, the special features and functions of which are, of course, immaterial excepting as it comprises a chamber, chest or box B housing sets of upper and lower rolls UR and LR respectively. The elongated rectangular box B, of which only an initial portion is shown, is seen to have top, bottom and opposite side walls 10, 11, 12 and 13; and an entry end wall 14, a similar exit wall being provided at the outgoing end, not shown. The box or chamber may have any suitable supporting structure 15, and includes along the sides longitudinal supporting and bearing frames 16 for the upper and lower rolls UR and LR in the known or preferred manner.

In accordance with the present invention, the multiple upper and lower rolls are divided into varying numbers of independently or separately driven groups or stages, each comprised of opposed or vertically spaced sets of driver and follower or idler rolls, as bracketed at I, II in Fig. 2. It will be understood that the groups may have differing numbers of rolls, as may variously be required or convenient for the numerous finisher types and designs, five-roller sets of drivers and followers being shown herein merely by way of example. It is noted further that while roll group I of Fig. 2 is shown with its motor drive connected to bottom rolls, it is immaterial to the present invention whether the top or bottom rolls be made the drivers in any given finisher.

As best shown in Fig. 3, the motive power for the several stages is conveniently applied directly to a single roll from an electric motor or other power source 20, the remaining lower rolls of the set thereof in the particular group or stage being drivingly connected to the first as by sprocket and chain means 21, 22. Thus in the illustrated embodiment the lower or bottom roll UR are the drivers and the upper or top rolls UR are the non-driven followers. It will be understood that the indicated drive and couple is repeated or duplicated at each roll stage, and that the several motors 20 are separately and severally powered or energized in any desired or preferred manner.

It is hereby noted also that the present invention contemplates compensation of tension changes
by identical installations regulating the motors of every such group, and is therefore readily adapted to machines of any size and type.

The several elements of a tension control unit constructed and arranged in accordance with the invention are shown in greater detail and on a larger scale in Fig. 3. The control is initiated at a tension sensing and signaling means or movable support 30 for one of the followers of the plt 31, the particular roll selected being further designated as D on Figs. 1 and 2. A controller drive assembly 40 is associated with this support or sensor and communicates with control devices at the exterior of the finisher chamber. A counterbalance unit 50 is also mechanically coupled to the drive 40 and arranged yieldably to position the movable roll D in a calculated manner. A conventional motor speed controller 60 is mounted in association with the drive 40 outside the chamber and is connected to regulate the speed of the drive motor 20 conformant to the adjustment of the controller by the drive 40.

The tension sensing or movable support element 30 is seen to comprise in the preferred embodiment of Figs. 1 to 3 a pair of bell cranks or lever arms 31, 31 mounting at their free ends inwardly projecting studs or stub shafts 32, 32, on which the movable or dancer roll D is freely rotatable, as shown. The crank arms 31, 31 have the ends away from the roll D angularly fixed at 31x, 31x to the rotary drive assembly 40. The latter comprises an elongated shaft 41 journalled in bearings 41a, 41a on the side frames 16, 16, and predeterminately extending through and outwardly of the opposite side walls 12, 13 of the finisher chamber B. As indicated in Fig. 2, shaft 41 is conveniently employed also as the support for that upper or follower roll UR adjacent to and next preceding the dancer roll D, which follower roll being freely rotatable on said shaft 41.

Further in accordance with the invention, the rotary drive assembly 40 carries the mentioned counterbalance unit 50, which may have any desired or preferred form or construction. In the embodiment of Figs. 1 to 3 it comprises a pair of masses or weights 51, 51 at the respective sides of and external to the chamber B (one weight omitted for clarity on Fig. 1), said weights being adjustably positioned on lever arms 52, 52 fixed as at 53, 53 on the shaft 41 so as to be angularly displaced from roll supporting arms 31, 31. It will be readily understood that the weights 51 are adjustably positioned radially and circumferentially of the shaft 41 to cancel or counteract the torque applied thereto by the support 30, roll D, and cloth A when the cloth is moving over said roll D under the desired degree of tension.

The motor speed controller 60 or speed-change signaling device is indicated in dotted line in Fig. 2, and comprises such motor drive speed adjusting and regulating device as may be appropriate or suitable for the type or form of drive motor in use. Where the drive is the conventional D. C. gear motor illustrated in Fig. 1, the controller 60 will take the form of a field rheostat, as represented in Fig. 2. It is seen to be mounted on the finisher side frame 16 adjacent the exteriorly projecting portion of shaft 41, and is drivingly coupled thereto in any convenient manner, as by sprockets 42, 44 on the shaft and the controller respectively and connected by chain 43 in the arrangement illustrated. Controller 60 is electrically connected for regulation of the speed of drive motor 20 in a well known manner not here requiring illustration.

It will be readily understood from the foregoing that the design and construction of a controller according to the present invention makes possible the location of the control and the counterbalance means and the driving connections between shaft 41 and the controller 60 wholly outside the finisher chamber B. The several moving and otherwise vulnerable parts of a controller are thus not only insulated from exposure to the deleterious wetting agents in the chamber but also made readily accessible for adjustment or repair from the exterior thereof.

I have illustrated another one of the various constructional forms which the apparatus of the invention may take in Fig. 4, wherein the dancer roll D is supported at opposite end portions by hangers 33, suspended on lines 34 carried over pulleys fast to the drive shaft 41, and having at the other depending ends variable counterbalancing weights 55. The roll D and its hangers are seen to be guided for vertical movement between guides 36, 37, those at one or both ends of the roll presenting a vertical rack 37a engaging a pinion 33a on the hanger, as shown, to eliminate any cramping which might hinder free vertical movement of the roll. Vertical movements of the roll D under tension variations in the traveling material A effect movement of the lines 34 in one and the opposite directions thereby to turn the shaft 41 and have it rotatably adjust the speed controller 60 conformantly. It will be understood that the remaining elements and units of the tension regulating apparatus of Fig. 4, such as the shaft 41, driving connections 42, 43, 44, and controller 60, may be generally similar to those of the preferred form of Figs. 1 to 3.

The operation of my novel tension control method and apparatus will be readily understood by those skilled in the art. A continuous run of textile fabric is advanced through the finisher by the several motors 20, the cloth passing successively through the several groups and reversely over and under their top and bottom rolls, as shown. The cloth tension is continuously detected or sensed at each finisher, and particularly at the follower roll intervening between the last and first driver rolls of adjacent successive stages, by mounting such follower roll, herein shown and described as dancer roll D, for movement toward and away from said final and initial driving rolls, in a manner to lengthen or shorten the cloth loop or span thereof. It will be readily apparent that by this arrangement the controller sensor detects undesired or excessive tension changes at the points where they are most likely to occur, that is, at the followers intermediate and connecting the general set of drivers, or in other words, at the cross over from one roll stage to the next.

In accordance with the present invention, the tension changes are initially absorbed or compensated at the several stages by upward or downward movement of the dancer rolls D, which is seen proportionally to vary the distance of fabric travel length of cloth in each stage. Assume, for example, that shrinkage of the cloth, from whatever cause, occurs in stage II, causing it in effect to run faster than stage I. Such acceleration will effect an increase in the tension of the cloth passing over the dancer D shown, which will upset the described balance of the support element 30 and the counterbalance unit 50 across the pivot 41 and thus be cancelled or compensated momentarily in this instance by a responsive downward movement of the support-carried roll D toward the lower dotted line position of Fig. 2. Similarly, relative stretching or looseness of the cloth in stage II will be reflected as a decrease in tension at the dancer D, and the now overbalancing weights 51 will urge it oppositely toward an equilibrium position approaching the higher dotted line position of Fig. 2, at which the slack is taken up and the desired level or degree of tension is restored.

The degree and direction of movement of the dancers D is seen to be measured by the drive units 40, which carry the measured quantity outside the finisher chamber and order or signal appropriate adjustment of the controllers 60. The difference in effective cloth speed of adjacent or successive stages, momentarily compensated by proportional variation in the cloth span of the first or forwardmost thereof, is thus ultimately cor-
rected by adjustment of the drive speed of said forwardmost stage. The net effect of the interaction of the several simultaneous and continuous stage speed adjustments in any given finisher is therefore a motor of establishing the final drive motor 20 (the one for the rolls nearest the exit) as the lead motor, in that it is governed by no other, and of cancelling out or summarizing the degrees and quantities of relative tautness and looseness arising in the several stages by appropriate drive speed adjustment with respect to a base or standard speed established by said final or lead motor.

Further in accordance with the invention, the interaction of the dancers D, controllers 60, and motors 20 is in the nature of a closed or endless cycle. It will be readily appreciated that the described acceleration or deceleration of the motors of the several stages ordered by their respective controllers as signaled and adjusted by the drivers 40, effects a second unbalancing of the dancer rolls D, whereby they are returned to their normal or intermediate position. Such return and rebalancing of the dancers is, of course, accompanied by a further like repositioning and adjustment of the drivers 40 and controllers 60, and therefore reflected in a second adjustment of the speed of the motors 20. It will be obvious that such second adjustment would, without more, be followed by an indefinite succession of successively smaller changes and adjustments, the inherent nature and tendency of the described speed governing device being one of controlling the several roll stage devices continually and ever more closely to approximate the speed yielding the exact degree of tension which balances the dancer D in the intermediate, non-signalling position. However, and as hereinbefore described, the indicated governing process is subject and subordinate to constant change or variation of fabric tension experienced at the dancer rolls, and is thus found to proceed in a manner the exact form of which is unpredictable, and which only very generally follows the indicated pattern. Whatever the nature and extent and variation of the tension changes arising in the several stages of a fabric finisher, the operation of my novel controller is, then, to control automatically and continuously the fabric tension and more particularly to cancel or compensate in a sensitive and accurate manner incipient and actual changes in such tension, especially those occurring at the cross over between roll stages. From the foregoing it will be appreciated that I have provided a new and improved tension control method and apparatus for textile finishers of the type having a plurality of independently driven roll stages. More particularly my novel control has been shown automatically and continuously to compensate changes in fabric tension at each stage of such machines, while providing for mounting the several vulnerable and adjustable units thereof in a safe and unexposed but readily accessible position.

It will be understood that my invention, either as to means or method is not limited to the exemplary embodiments or steps herein illustrated or described, and I set forth its scope in my following claims.

I claim:
1. Textile apparatus for advancing long fabrics through an enclosure generally in the confined presence of moisture as in treating, washing, aging and wet-finishing operations, said apparatus comprising, a frame and housing defining such enclosure, a plurality of groups of rolls journaled on the frame and disposed in the housing, each roll group comprising a set of driver rolls and a set of follower rolls, mounting means for said rolls disposed for supporting and traveling the fabric alternately about a driver and a follower roll in succession through the roll sets and groups, a drive motor for each roll group external to the housing and connected to drive the entire set of driver rolls of its group, one follower roll in the last portion of each set thereof having within the housing rotary bearing means itself movable to provide for bodily movement of said roll toward and from the next roll in the fabric path and thereby constituting said bearing means movable as an element to sense and measure tension variation in the fabric local thereto, a translating shaft for each roll group rotatively supported on the frame and extending out through the housing and having means connecting it for rotation by said tension sensing and measuring element of the corresponding roll group, and for the drive motor of each roll group a speed control means operatively subject to the translating shaft of the same roll group to effect tension compensating adjustment of the drive of that roll group wherein the tension variation is sensed and measured.

2. Textile apparatus according to claim 1 wherein the roll sets and groups are so positioned and arranged that the tension-sensing rolls are last in the follower sets in the direction of fabric advance and pass the fabric directly to the first driver roll of the set thereof in the next roll group.

3. Textile apparatus for advancing long fabrics through an enclosure generally in the confined presence of moisture as in treating, washing, aging and wet-finishing operations, said apparatus comprising, a frame and walls defining such enclosure and having restricted entrance and exit passages for the fabric, a plurality of groups of spaced alternate driver and follower rolls mounted for rotation in the enclosure for advance of the fabric about them, one follower roll of each group having a movable counterbalanced support element itself shiftable toward and from the next roll in the fabric path and thereby affording said movable supported roll capacity also for tension-sensing bodily movement by and proportionate to variation in tension of the fabric thereat, each such movable support element having a translating shaft journaled on and projecting externally of the enclosure and having means connecting it with the support element for turning thereby in the direction and to the extent determined by said bodily movement of the tension sensing roll, an individual variable speed electric drive for each roll group connected to drive all the driver rolls thereof, a speed control device for each such drive, and means operatively connecting the translating shaft of each roll group with the speed control device for the drive of the same roll group.

4. Textile apparatus according to claim 3 wherein the movable roll support element for each roll group comprises arms having the tension sensing roll journaled at the outer ends and being angularly fixed on the corresponding translating shaft at the inner ends, together with counterbalance arms angularly adjustable fixed on said shaft and carrying adjustable weights settable along said arms in accordance with desired normal tension for the fabric.

5. Textile apparatus according to claim 3 wherein the movable roll support element for each roll group comprises a vertically movable carriage, guiding and counter-balancing means therefor, and means mechanically coupling the carriage and the translating shaft of the same roll group for translation of the vertical movement of the carriage into axial turning of the shaft.

References Cited in the file of this patent

UNITED STATES PATENTS

1,594,395 Weston Aug. 3, 1926
1,706,165 Hull Mar. 19, 1929
1,796,832 Cottrel Mar. 17, 1931
2,029,854 Canning Feb. 4, 1936
2,084,367 Woodhead June 22, 1937
2,200,328 Cohn et al. May 14, 1940
2,234,991 Converse May 25, 1941
2,247,717 Belcher June 28, 1941
2,544,467 Michel Mar. 6, 1951