United States Patent

Barnes

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[54] METHOD FOR TREATING TEXTILE MATERIALS

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[21] Appl. No.: **842,640**

Related U.S. Application Data

[62] Division of Ser. No. 549,894, May 13, 1966, Pat. No. 3,465,716.

[52] **U.S. Cl.** .....**117/115,** 117/102 L, 117/102 A, 117/DIG. 8, 8/159, 28/74, 28/76, 68/3 SS, 68/18 F, 68/22 B, 118/405

[51] **Int. Cl.** **B65g 49/04,** B05c 3/12

[58] **Field of Search** .....117/102, 111, 113, 115, 102 L, 117/103, DIG. 8; 118/424, 425, 501, 405, 612, 416, 57, 64, 124, 216, 223, 224, 246, 428; 68/22, 3 SS, 18.1; 28/74, 76, 75; 26/18.5, 19; 8/159, 158, 151

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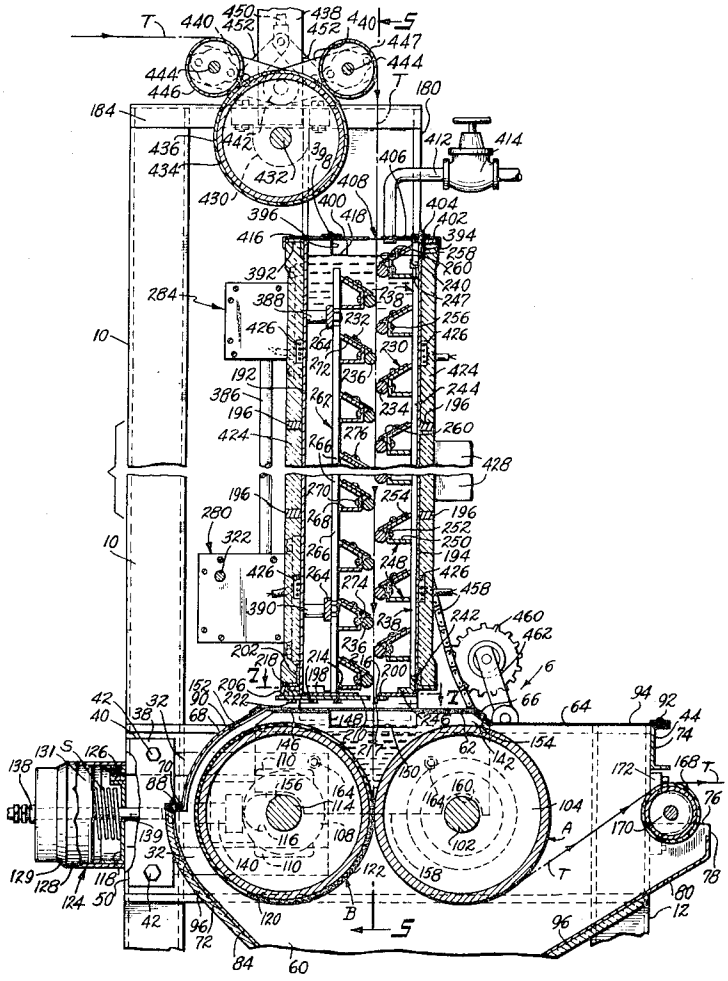
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[57] **ABSTRACT**

The method of treating textile material by passing the same under tension through a body of treating liquid in a treating zone while applying rubbing contact to the textile material at staggered points on opposite sides thereof and while subjecting the treating liquid and points of rubbing contact to vibration. A constant head of the treating liquid is maintained in the treating zone by adding treating liquid to the zone at a rate faster than it is being absorbed by the textile material. The excess treating liquid is collected, filtered and returned to the treating zone so that continuous circulation thereof occurs.

12 Claims, 9 Drawing Figures

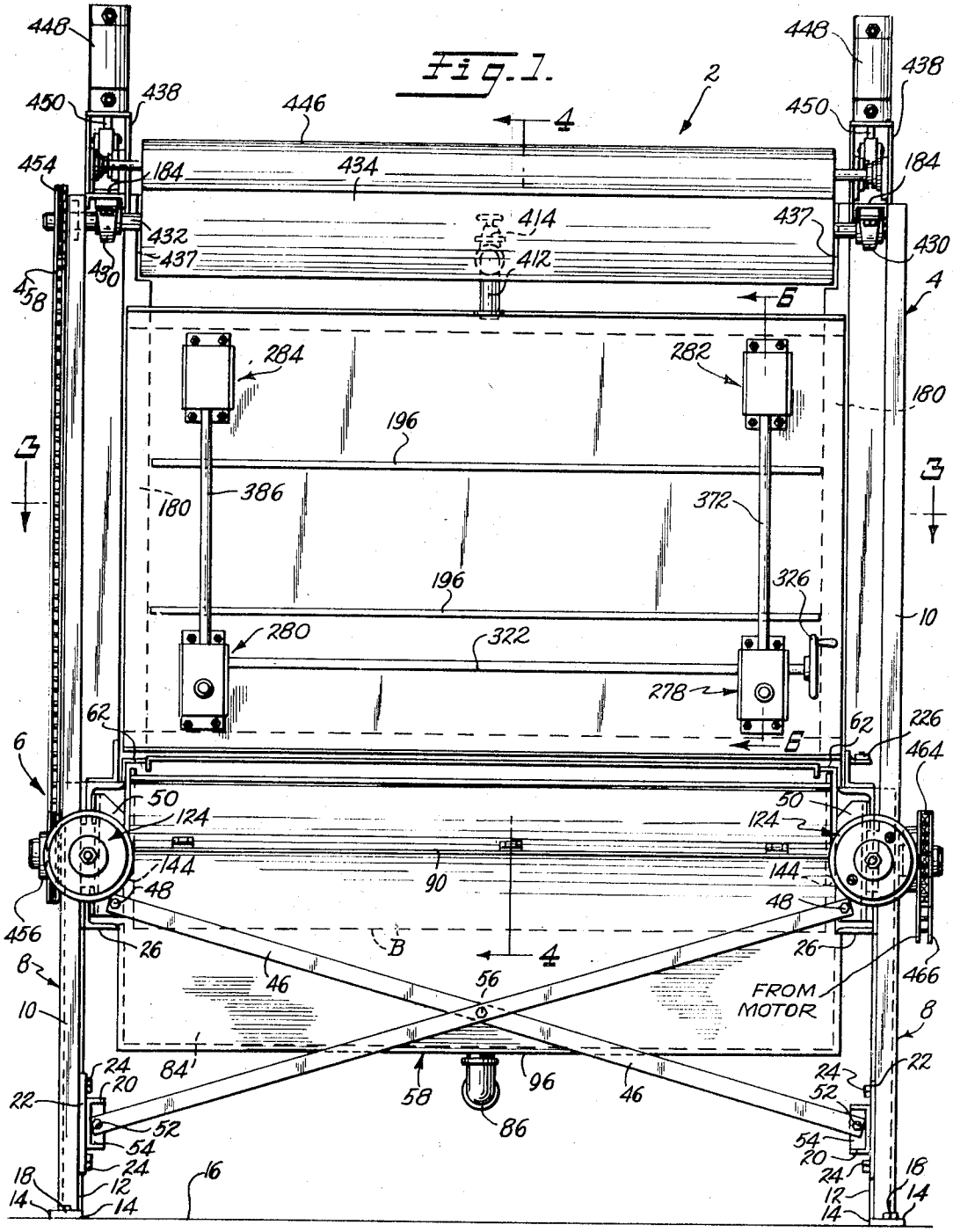


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SHEET 1 OF 6

Fig. 1.



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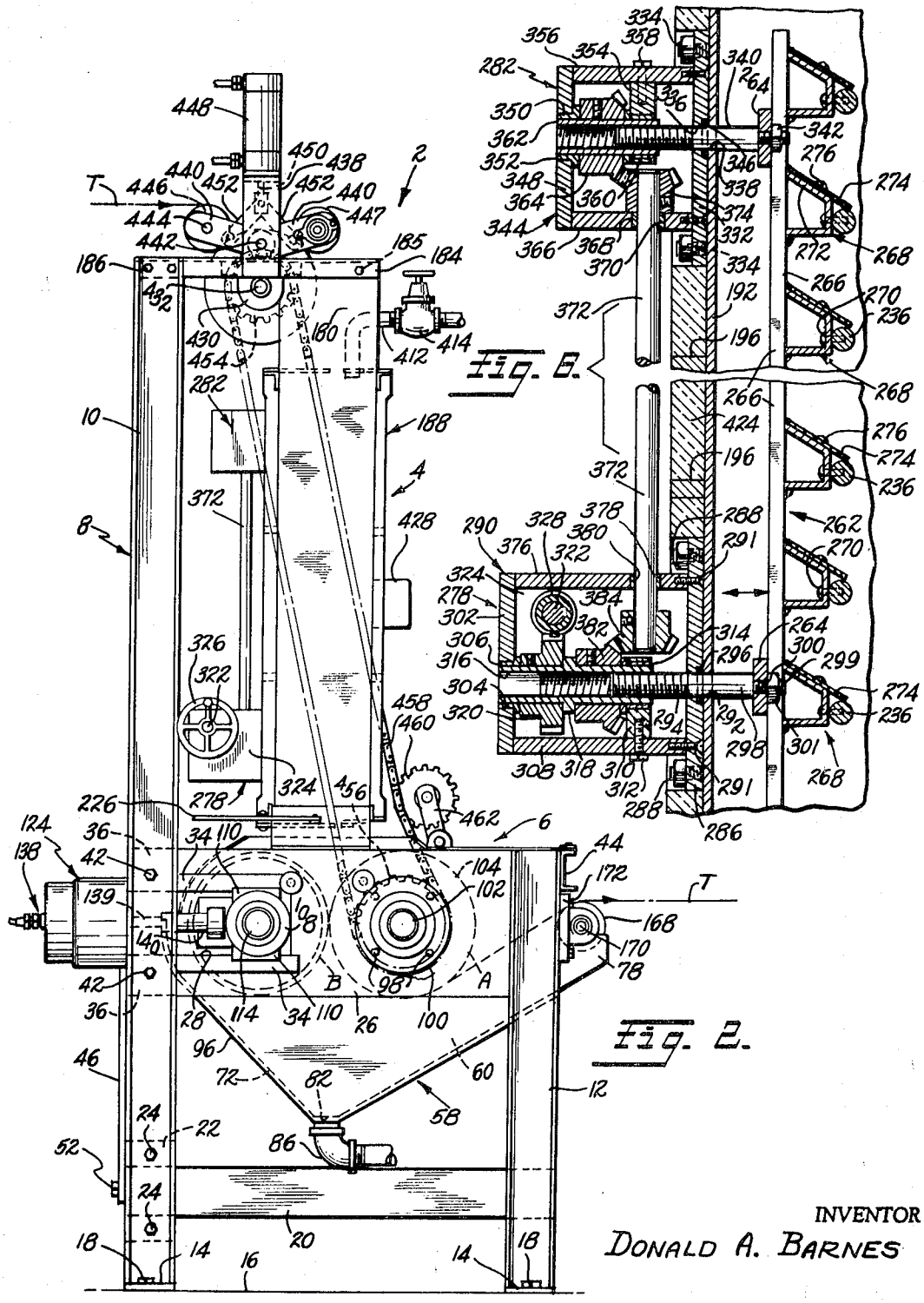


Fig. 6.

Fig. 2.

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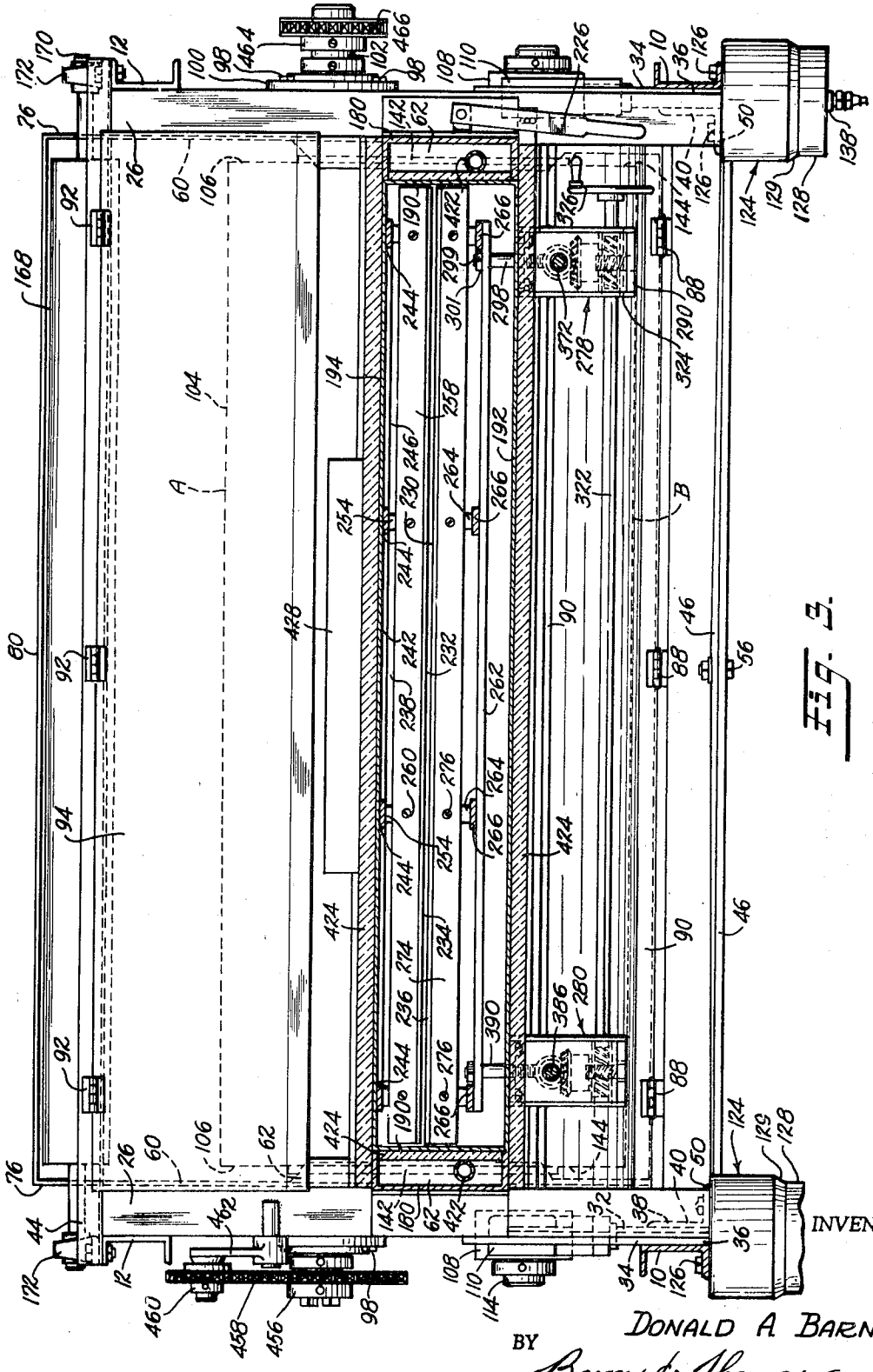


FIG. 3.

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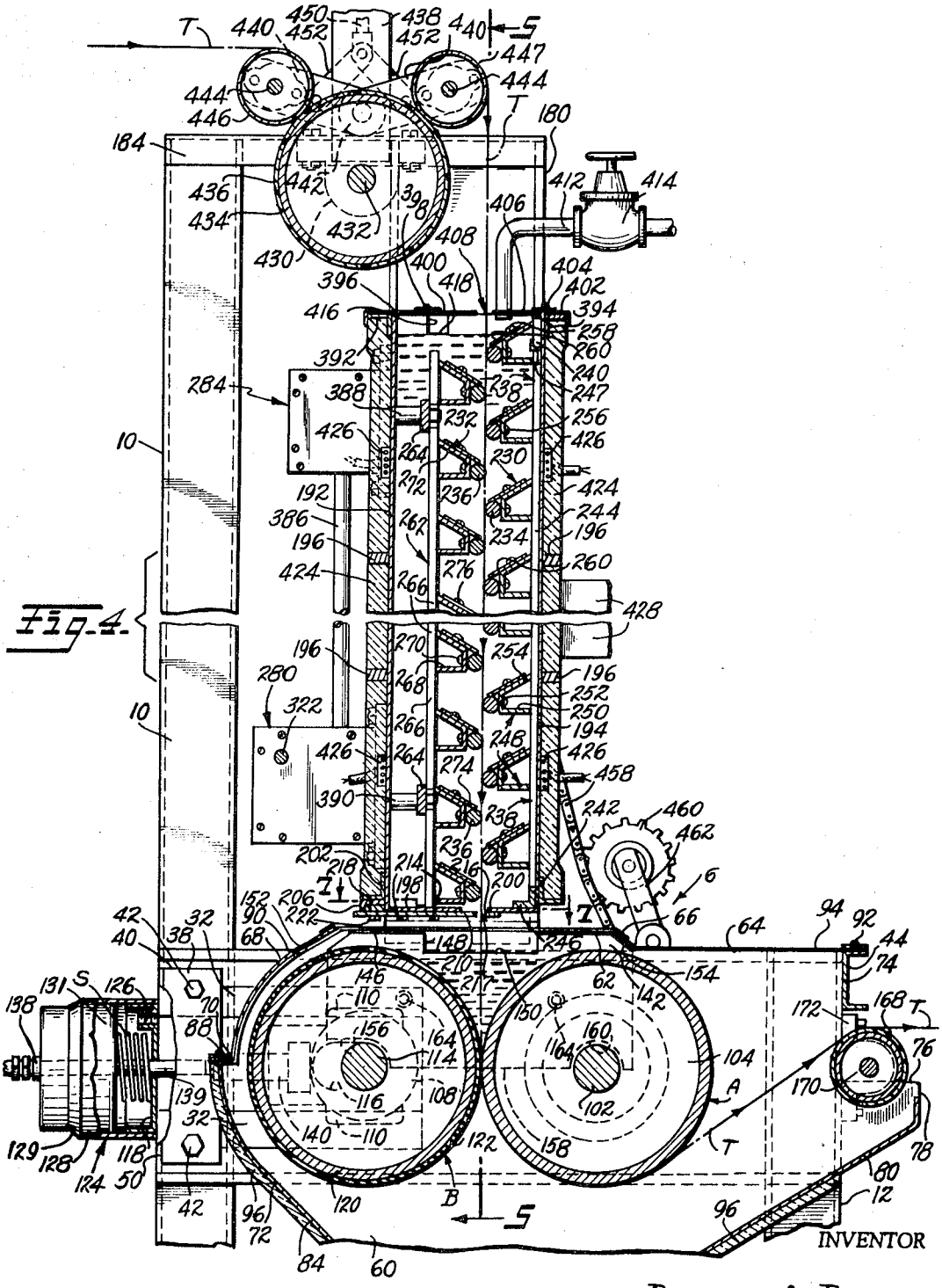


Fig. 4.

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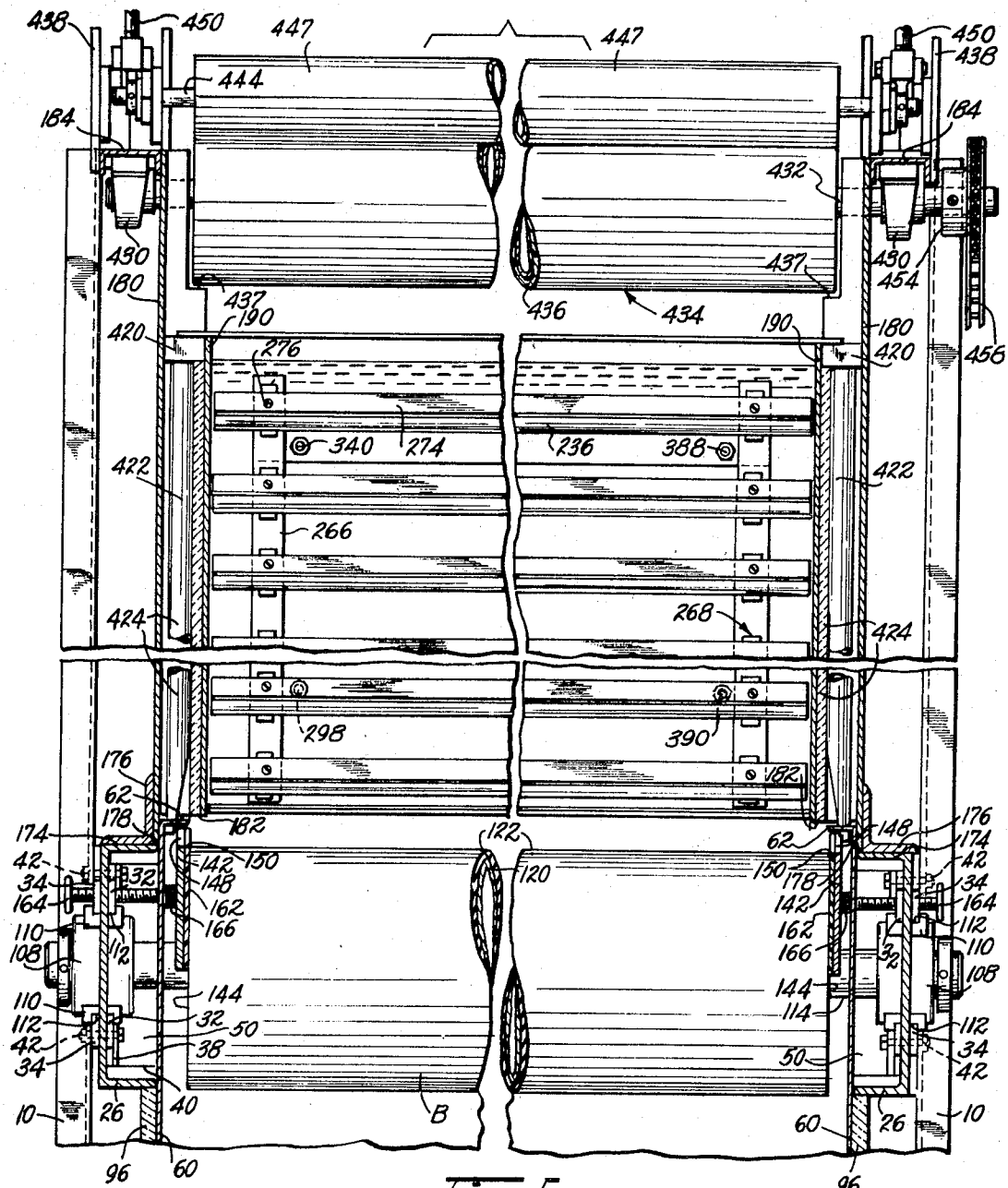
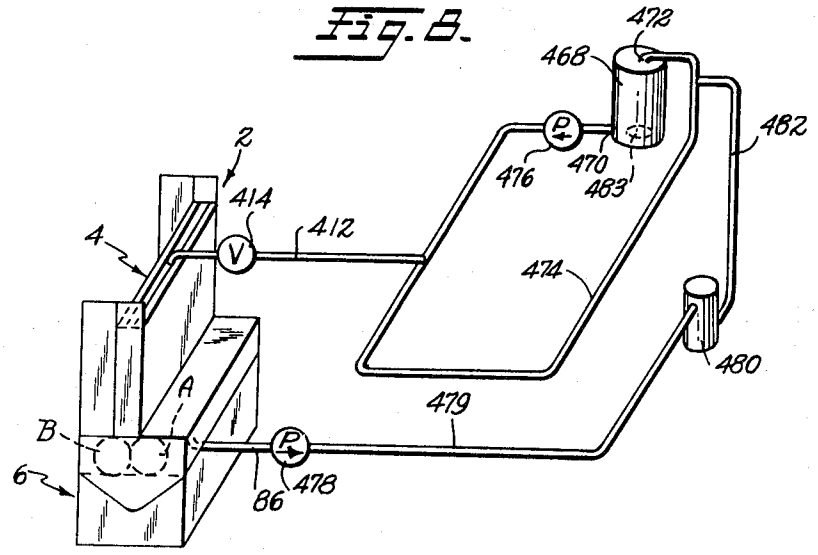


Fig. 5.

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Fig. 8.



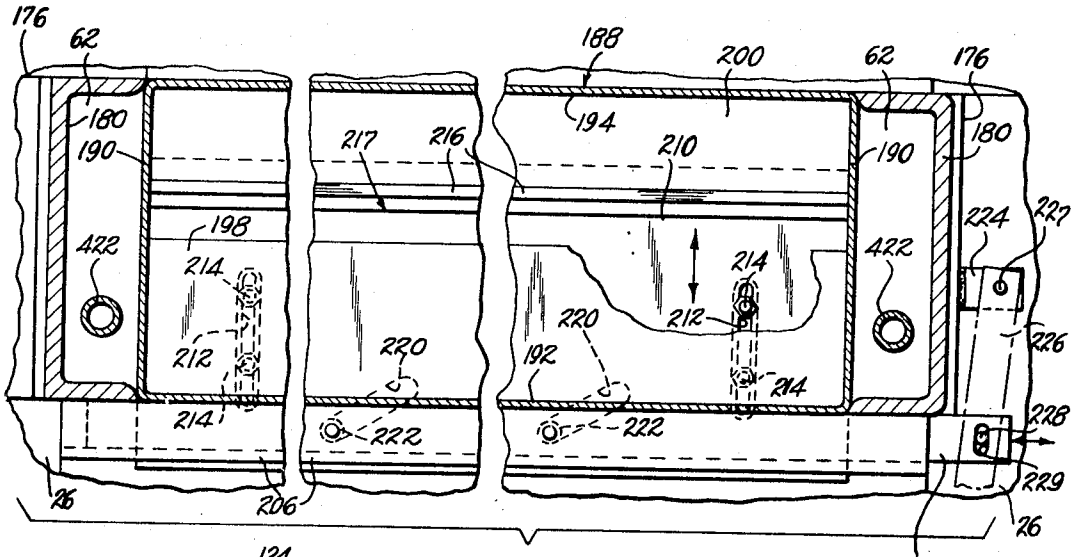


Fig. 7.

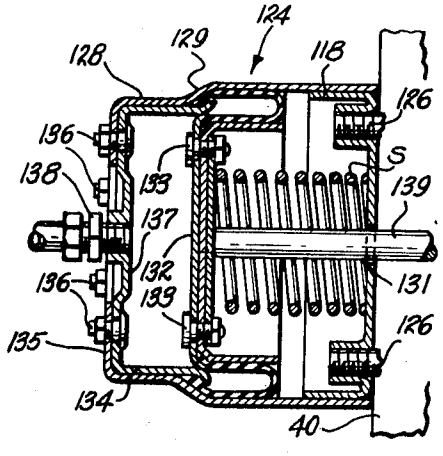


Fig. 9.

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METHOD FOR TREATING TEXTILE MATERIALS

CROSS-REFERENCE

This application is a division of my copending application Ser. No. 549,894, filed May 13, 1966 now U.S. Pat. No. 3,465,716.

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This application is a division of my copending application Ser. No 549,894, filed May 13, 1966 now U.S. Pat. No. 3,465,716.

This invention relates generally to a method for coating or treating textile material with a selected liquid solution. More particularly, it relates to a method for uniformly and rapidly applying size to textile material of either single or multiple end yarn, or "open-width" woven or felted fabric, and which can also be utilized to treat such textile materials with color and other liquids.

During the working of single-end and open-width textile materials the need frequently arises to apply either hot or cold size thereto. The composition of particular size solutions employed will vary, but typical solutions include starch, carboxymethyl cellulose, polyvinyl alcohol, and polyvinyl acetate. When properly applied, the size should form an even and uniform film on the textile material. After drying, such a film will protect the textile material during weaving and other processes, and will impart a desired finish to the final product.

There has long existed a need for apparatus which can apply any desired size solution, either hot or cold, rapidly and uniformly to textile materials, and which can accommodate a wide variety of textile materials, both single-end and open-width in form. It is the principal object of the present invention to provide such an apparatus.

Another object is to provide an apparatus for applying liquid size to textile materials rapidly and in a uniform manner, without damaging the material and without substantial waste of either the material or the size solution.

Another object is to provide apparatus for applying size to textile materials, constructed so that the movement of textile material therethrough can be halted for an indefinite period and then be restarted without interferring with the uniform application of size and without resulting in improper sizing.

A further object is to provide a textile size applicator incorporating a saturator unit that can be easily threaded with textile material; that incorporates no moving elements; and which will uniformly apply size solution to the entire surface of textile material passing therethrough.

Still another object is to provide a textile size applicator which can apply either a hot or cold size solution, and which is designed to avoid dilution and pollution of the size solution.

A still further object is to provide a textile size applicator for applying a hot size solution, designed to maintain the temperature of the solution substantially constant at all times.

Still another object is to provide a textile size applicator which can be easily threaded with textile material, and which, in threading, requires a minimum amount of lead on the textile material to thereby reduce waste to a minimum.

A further object is to provide a textile size applicator incorporating a pressurator unit constructed to operate uniformly upon a wide flow of textile material, and which includes means for maintaining a uniform reservoir of size solution in the region immediately above the rolls of the unit.

Another object is to provide textile size applicator apparatus for handling a hot size solution designed to recirculate the heated size solution with a minimum heat loss for economical use thereof.

Other objects and many of the attendant advantages of the invention will become readily apparent from the following detailed description, when taken in connection with the accompanying drawings, wherein:

FIG. 1 is a front elevational view of the textile size applicator of the invention;

FIG. 2 is a right end elevational view of the applicator of FIG. 1;

FIG. 3 is an enlarged horizontal sectional view, taken on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged fragmentary vertical sectional view, taken on the line 4—4 of FIG. 1, showing details of the saturator unit and of the pressurator unit;

FIG. 5 is a fragmentary, transverse vertical sectional view, taken on the line 5—5 of FIG. 4;

FIG. 6 is an enlarged fragmentary vertical sectional view, taken on the line 6—6 of FIG. 1, showing the details of one pair of the actuators for moving one set of parallel contact rods of the saturator unit toward and away from the other set of contact rods;

FIG. 7 is an enlarged fragmentary horizontal sectional view, taken along the line 7—7 of FIG. 4, showing the construction of a movable plate on the bottom of the tank of the saturator for adjusting the width of the saturator tank outlet;

FIG. 8 is a schematic diagram showing the system for circulating liquid size through the present textile size applicator; and

FIG. 9 is an enlarged longitudinal sectional view through one of the actuators for moving the sliding pillow block bearings which rotatably support one of the rolls.

Referring now to the drawings, the textile size applicator of the invention is indicated generally at 2 and includes a saturator unit 4 for impregnating textile material passing therethrough with a size solution, and a pressurator 6 incorporating a pair of rolls A and B for controlling by squeeze pressure the amount of size remaining on textile material passing therebetween. The applicator 2 is supported by a main frame including a pair of identical side frames 8, each side frame having front and rear vertical channel members 10 and 12, respectively, the flanges of which face outwardly. The front channel members 10 are substantially longer than the rear channel members 12, and all of the channel members 10 and 12 terminate at their lower ends in foot plates 14 secured to a supporting floor 16 by bolts 18.

A cross brace channel member 20 extends between each set of front and rear channel members 10 and 12, the rear end of each member 20 being welded to its associated rear channel member 12. A vertically extending spacer plate 22 is welded to the front end of each channel member 20, the plates 22 extending above and below their associated channel members 20 and being secured to the front channel members 10 by bolts 24.

A pair of wide confronting channel members 26 is secured to the inner side of the side frames 8 and support the pressurator unit 6, the rear end of each member 26 being welded to the upper end portion of its related rear channel member 12. The front end of each channel member 26 has a rectangular slot 28 therein, and inner and outer rectangular bars 32 and 34, respectively, are welded to the opposite faces of the central web of each channel member 26 along the edges of the slot 28, the outer ends of the bars 34 terminating in rectangular spacer plates 36. The base flange 38 of a vertical angle member 40 is engaged with the front end of each set of inner bars 32, and each angle member 40 and the front end of its channel member 26 are secured to their associated front vertical channel member 10 by bolts 42.

The upper end of the rear channel member 12 are interconnected by a channel member 44 welded thereto, and the front of the applicator frame is braced by a pair of diagonally extending braces 46. One end of each brace 46 is connected by a bolt 48 to the upstanding flange 50 on one of the angle members 40, and the other end thereof is connected by a bolt 52 to a plate 54 welded to the front end of the opposite channel member 20. Diagonally extending braces 46 are connected where they cross by a bolt 56.

The pressurator unit 6, FIGS. 2, 4 and 5, includes a drain pan 58, which comprises a pair of stainless steel sideplates 60 welded to the flanges of the channel members 26. The upper end of the sideplates 60 extend a short distance above their adjacent channel members 26, and terminate in centrally disposed horizontal flanges 62 that extend for about one-third the width of the plate, there being a rear top edge portion 64

on each plate that lies flush with the top of the channel member **26**, and which is connected to its associated inturned flange **62** by an inclined top edge portion **66**, FIG. **4**.

The front edge of each sideplate **60** includes an arcuate upper portion **68** extending downwardly from the inturned flange **62** and terminates in a horizontal ledge **70**, and a lower edge portion **72** that initially curves downwardly from the ledge **70** and terminates in a straight edge inclined at about 45°. The rear edge of each plate **60** includes an upper vertical portion **74** extending for a little over one-half the height of the channel member **26** and terminates in a horizontal ledge **76**, a short vertical edge portion **78**, and an inwardly inclined lower edge portion **80**. The edge portions **72** and **80** terminate at their lower end in a short horizontal bottom edge **82**.

Welded to the edges **72**, **78**, **80** and **82** of the sideplates **60**, to complete the drain pan **58**, is a stainless steel bottom plate **84**, the pan **58** having a drain conduit **86** connected to the bottom thereof. Hinges **88** are secured to the upper, front edge of the bottom plate **84**, and are connected to a front arcuate cover **90** shaped to rest when closed on the ledges **70** and the arcuate edges **68**. Another set of hinges **92** is secured to the top surface of the cross channel member **44**, and mounts a rear hinged cover **94** shaped to rest on the edges **64** and **66** when closed. Thus, when the covers **90** and **94** are closed, the drain pan **58** is open only in the region at the upper end thereof defined between the inturned flanges **62**.

The outer exposed surfaces of the bottom plate **84** and the sideplates **60** of the drain pan **58** have insulation **96** secured thereto, to help maintain a constant temperature in the liquid contained within the drain pan.

Secured to the central web of the channel members **26** by bolts **98**, FIG. **3**, is a pair of pillow block bearings **100** for mounting the opposite end portions of a drive shaft **102**, the webs of the channel members **26** and the sideplates **60** having circular holes therein through which the drive shaft **102** passes. Mounted on the drive shaft **102** to rotate therewith is the roll A, the outer surface **104** of which is preferably made of stainless steel. The roll A is about **12** inches in diameter and has a length greater than the distance measured between the confronting inturned flanges **62**. The radial end faces **106** of the roll A are spaced inwardly a substantial distance from their associated sideplates **60**.

Slidably mounted within the rectangular slots **28** in the front end of the channel members **26** are pillow block bearings **108**, FIG. **2** and **4**, each of which has top and bottom bosses **110** thereon provided with rectangular grooves **112** that receive guides defined by the side edges of the slots **28** and the bars **32** and **34**. The opposite end portions of a shaft **114** are received through the sliding pillow block bearings **108**, the sideplates **60** of the drain pan **58** having horizontally elongated openings **116** therein through which said shaft extends. The longitudinal axes of the shafts **102** and **114** lie in a common horizontal plane, and the sliding pillow block bearings **108** allow the shaft **114** to be moved horizontally toward and away from the fixed shaft **102**. The roll B is mounted on the shaft **114**, and is of the same diameter and length as the roll A. The roll B includes a steel core **120**, covered with yarn or rubber **122** to provide a relatively soft surface.

The pillow block bearings **108** are shifted horizontally to move the roll B toward and away from the roll A by a pair of pneumatic actuators **124**, FIGS. **2**, **3** and **9**, secured by bolts **126** to the upstanding flanges **50** of the angle members **40** and to the front flanges of the channel members **10**. Each actuator **124**, as is best shown in FIG. **9**, comprises a flanged base **118** having a cup-shaped housing **128** secured thereto, the cylindrical wall of said housing having an inclined shoulder **129** formed thereon. A piston **130** is received within the housing **128**, and the central portion of a rolling diaphragm **131** is clamped to said piston **130** by a retainer **132** secured to the piston by bolts **133**. The outer periphery of the diaphragm **131** is held against the shoulder **129** by a cup-shaped clamping member **134**, which is secured to the annular end wall **135** of the housing **128** by bolts **136**. The end wall **137** of the member **134** has an inlet fitting **138** thereon for admitting air under pressure to the chamber defined by the member **134** and the rolling diaphragm **131**. A coil spring S is positioned between the actuator base **118** and the rear face of the piston **130**. Thus, when sufficient air pressure is supplied through the fitting **138**, the piston **130** is moved to compress the coil spring S, and when such air pressure is relieved, the coil spring will move the piston **130** toward the end wall **137**.

A piston rod **139** is connected at its inner end to the piston **130** and extends through an opening **131** in the base **118** and between the angle iron **40** and the channel **10** toward the associated sliding pillow block **108**. The angle iron **40** is spaced from the channel **10** by the inner rectangular bars **32**, and by the spacer plates **36**. The outer end of each piston rod **139** is connected to a shaft **140** mounted on the associated bearing **108**. Thus, when sufficient air pressure is supplied through the fittings **138**, the bearings **108** will be slid toward the roll A. The coil springs S are of sufficient strength so that when air pressure is relieved within the actuators **124** said springs will be effective to slide the bearings **108** away from the roll A. Thus, the position of the bearings **108**, and hence the pressure of the roll B against the roll A, can be controlled by controlling the air pressure supplied to the actuators **124**. If such air pressure is entirely relieved, the coil springs S will move the roll B away from the roll A, thereby providing a space between the rolls and making possible easy threading of textile material between said rolls.

The rolls A and B engage saturated textile material issuing from the lower end of the saturator unit **4**, which material also passes through a reservoir of the size solution and is then pressed under a desired pressure between the oppositely rotating rolls to squeeze excess solution from the textile material. A constant volume of size solution is maintained in the reservoir between and above the rolls A and B during the pressing operation, the reservoir for containing the solution being defined by the upper confronting surfaces of the rolls A and B and by a pair of reservoir plates **142**, FIG. **5**, at the ends of said rolls.

The radial end faces **144** of the roll B lie in the same plane as the radial end faces **106** of the roll A, and all of said end faces are spaced inwardly from the drain pan sideplates **60**. The reservoir plates **142** are received between the roll end faces **106** and **144** and the sideplates **60**. The plates **142** are generally rectangular, the vertical height thereof being slightly less than the distance measured vertically between the lower surfaces of the inturned flanges **62** and the common horizontal plane within which the axes of the shafts **102** and **114** lie. The top edge **146** of each plate **142** has a centrally positioned rectangular notch **148** therein, FIG. **4**, the horizontal bottom edge **150** of which defines a weir that preferably lies on a horizontal line extending tangentially to the top crest of the rolls A and B. The upper front and rear corners **152** and **154** of the plates **142** are cut at an angle to fit within the drain pan **58**, and the lower front corner of each plate **142** is cut out at **156** to clear the shaft **114** and to allow for horizontal movement of said shaft. The bottom edge **158** of each plate **142** has an arcuate notch **160** therein shaped to fit about the drive shaft **102**.

The reservoir plates **142** are preferably made from stainless steel, and the inner surfaces thereof are completely covered with a sheet of Teflon **162** bonded thereto, or some other suitable self-lubricating material. The Teflon sheets **162** of the reservoir plates **142** are held in tight sealing engagement with the opposite radial end faces **106** and **144** of the rolls A and B, respectively, by a pair of adjusting screws **164** threadably received within bores provided in the vertical webs of the channels **26**, the inner ends of the screws **164** being fitted with coil springs **166** that engage the outer surface of their associated plates **142** to resiliently urge the Teflon surface **162** of said plates into sealing engagement with the roll end faces. Thus, the inner surface of the reservoir plates **142** and the confronting upper surfaces of the oppositely rotating rolls A and B define a reservoir for receiving liquid size flowing thereinto from the saturator unit **4**.

The flow of size solution into the reservoir is caused to be of a volume substantially greater than the amount of size that is removed from the reservoir by the textile material passing between the rolls A and B, and the excess solution flows over the two weir edges **150** and downwardly into the drain pan **58** for removal through the drain **86**. Thus, a constant level of size solution is maintained within the reservoir above the rolls A and B, the depth of said solution being determined by the height of the weir edges **150**.

Mounted on the rear end of the pressurator unit **6** is a roll **168**, FIG. **2**, coated with Teflon or the like, which roll is supported on a shaft **170** mounted in bearings **172** bolted to the rear channels **12**. Textile material is thus fed from the saturator unit **4** downwardly between the rolls A and B, beneath the roll A, and then outwardly over the Teflon-coated roll **168** through the space between it and the channels **44**.

The saturator unit **4** is so positioned above the pressurator unit **6**, that textile material passing therefrom will move directly downwardly into the bight between the rolls A and B. Welded centrally on the upper flange **174** of each channel **26** is an angle iron **176**, positioned so that the vertical flange thereof is set back slightly from the outer edge of the flange **174** to define a ledge **178**. A pair of confronting channels **180** extends upwardly from the channels **26**, the lower end of each channel **180** resting on one of the ledges **178** and being welded to the vertical flange of the associated angle iron **176**. The lower end of the flanges of the channels **180** are cut away at **182** to provide clearance for the inturned flanges **62**, and the upper end of each channel member **180** is secured to the rear end of a channel brace **184** by bolts **185**, the front end of each brace **184** being secured by bolts **186** to the upper end of the front vertical frame member **10**.

Supported between the confronting channels **180**, FIGS. **3** and **4**, is a tank **188**, comprising a pair of end walls **190** welded to the edges of the flanges of said channels, and front and rear walls **192** and **194**, respectively, welded between the end walls **190**. The walls **190**, **192** and **194** are preferably made from stainless steel, and the front and rear walls **192** and **194** are braced by parallel, horizontally disposed reinforcing bars **196**, FIG. **4**, welded to the exterior thereof.

The bottom of the tank **188** is partially closed by front and rear bottom wall portions **198** and **200**, FIGS. **4** and **7**, respectively. The bottom wall **198** is welded to the walls **190** and **192**, and the bottom wall **200** is welded to the walls **190** and **194** in spaced apart relation. Welded a short distance above the bottom edge of the front wall **192** is an angle iron **202**, and secured to the upstanding flange thereof is a guide bar **206** having a downturned lip on its outer edge, the lower edge of said lip lying flush with the bottom surface of the bottom wall **198**.

A rectangular plate **210** is engaged with the lower surface of the bottom wall **198**, and has a plurality of spaced, parallel, countersunk transverse slots **212** therein, FIG. **7**. A plurality of bolts **214** is secured to the bottom wall portion **198**, and extends downwardly through the slots **212** to mount the plate **210** for sliding movement toward and away from the bottom wall **200**, there being a pair of spaced apart bolts **214** passing through each slot **212** to maintain proper alignment of the plate **210**. A narrow bar **216** is welded to the bottom, forward edge of the bottom wall **200** to project partially across the space between the bottom walls **198** and **200**. The bar **216** and the plate **210** thus define therebetween a rectangular outlet opening or slot **217** extending the full length of the tank **188**, the area of which can be varied by sliding the plate **210** toward or away from the bar **216**, as will be explained more fully hereinafter.

Received in a rectangular space between the guide bar **206** and the plate **210** is a longitudinally slidable bar **218**. The plate **210** has a plurality of spaced, parallel, angled cam slots **220** therethrough in the region beneath the guide bar **206** (FIG. **7**); and the slide bar **218** carries a plurality of cam followers **222**, which extend into said cam slots. Thus, if the slide bar **218** is reciprocated longitudinally, the plate **210** will be moved toward or away from the bar **216** by the cooperating angled slots **220** and cam followers **222**.

A bracket **224**, FIG. **7**, is welded to the upstanding flange of the angle iron **176** on the right end of the size applicator **2**, as viewed in FIG. **1**, and one end of a handle **226** is pivotally connected by a pin **227** to said bracket. The handle **226** has a longitudinal slot **227** through which a pin **228** mounted on the outer end of the slide bar **218** passes to pivotally connect said handle to said slide bar. Thus, the slide bar **218** can be readily moved longitudinally by swinging the handle **226**, whereby the width of the rectangular outlet opening **217** in the bottom of the tank **188** can be adjusted as desired. Mounted within the size solution tank **188**, FIG. **4**, are rear and front sets **230** and **232**, respectively, of horizontally extending, evenly spaced, parallel, cylindrical contact rods **234** and **236**, respectively, each set consisting of several rods. The rear set **230** of rods is carried by a rectangular frame **238**, comprising upper and lower horizontal members **240** and **242**, respectively, connected by four vertically extending parallel members **244**, FIG. **3**. The lower horizontal frame member **242** is received behind a stop **246**, FIG. **4**, welded to the upper face of the bottom wall **200**, and the frame **238** is fixedly but demountably further secured to the rear tank wall **194** by brackets **247** engaged with the upper frame member **240**.

Mounted on each of the vertical frame members **244** is a plurality of identical, equally spaced support brackets **248**, each including a horizontally disposed lower arm **250**, a vertical outer arm **252**, and an upwardly inclined top arm **254** that extends at about 30° to the horizontal. The brackets **248** on adjacent vertical frame members **244** are horizontally aligned, and the rods **234** are secured to the vertical outer arms **252** of each aligned set of brackets by screws **256**. Secured to the upper arm **254** of each set of horizontally aligned brackets **248** by screws **258** is a baffle plate **260**, arranged so that the leading edge thereof tangently engages the associated rod **234**.

The front set **232** of rods is carried on a frame **262**, which includes a pair of horizontally disposed members **264** having a plurality of vertically disposed, parallel members **266** welded thereto. Mounted on member **266** is a plurality of equally spaced brackets **268**, identical to the brackets **248**. The contact rods **236** are secured to the brackets **268** by screws **270**, and the upper inclined arm portion **272** of the brackets **268** has baffle plates **274** secured thereto by screws **276**.

The front set **232** of rods is mounted for movement toward and away from the rear set **230** of rods, such movement being effected by a pair of lower gear box assemblies **278** and **280** and a pair of upper gear box assemblies **282** and **284**, all mounted on the tank front wall **192** and arranged so that all four are simultaneously operated. Referring in particular to FIG. **6**, the lower gear box assembly **278** includes a baseplate **286** secured to the tank wall **192** by stud bolts **288**, and to which a housing **290** is secured by bolts **291**. The tank wall **192** has an opening **292** aligned with an opening **294** in the baseplate **286** containing a groove in which a resilient sealing ring **296** is received. The inner end of a threaded, frame-supporting rod **298** extends through the openings **292** and **924** into the housing **290**. The outer end of the rod **298** has a reduced threaded portion **299**, which passes through a bore **300** in the frame member **264** and is nonrotatably secured to said frame member by a nut **301**.

The front wall **302** of the housing **209** has an opening **304** aligned with the opening **294** in which is fitted a flanged bushing **306**. The bottom wall **308** of the housing **290** has a bearing mount **310** secured thereto by bolts **312**, and carries a flanged bushing **314** aligned with the bushing **306**. The opposite ends of an internally threaded collar **316** are rotatably mounted in the bushings **306** and **314**, and the threaded inner end of the rod **298** is received within said threaded collar.

The collar **316** has an external radial shoulder **318**, one side of which is engaged by a worm gear **320** secured to said collar. A transverse operating shaft **322**, FIG. **3**, extends through the sidewalls **324** of the housing **290**, and has a crank handle **326** secured thereon. The shaft **322** has a worm **328** mounted thereon, within the housing **290** meshing with the worm gear **320**. Thus, when the handle **326** is turned to rotate the shaft **322**, the collar **316** will be rotated by interaction between the

worm 328 and the worm gear 320. When the collar 316 is rotated, the rod 298 will be moved axially, the direction of movement depending upon the direction in which the handle 326 is turned.

The upper gear box assembly 282, FIG. 6, is positioned directly above the lower gear box assembly 278, and includes a baseplate 332 secured to the tank wall 192 by stud bolts 334, the baseplate 332 and said tank wall 192 having aligned openings 336 and 338, respectively. A threaded frame supporting rod 340 is nonrotatably secured at its outer end to the upper frame member 264 by a nut 342 and the inner end of said shaft extends through the aligned openings 336 and 338 into the interior of a housing 344. A sealing ring 346 is mounted in a recess at the outer end of the opening 336 to prevent leakage of size solution along the rod 340.

The front wall 348 of the housing 344 has an opening 350 aligned with the openings 336 and 338 in which a flanged bushing 352 is mounted. A bearing mount 354 is secured to the top wall 356 of the housing 344 by bolts 358, and carries a flanged bushing 360 aligned with the bushing 352. The opposite ends of an internally threaded collar 362 are rotatably mounted in the bushings 352 and 360, and the threaded inner end of the rod 340 is received within said collar.

Secured to the collar 362, between the bushings 352 and 360, is a bevel gear 364. The bottom wall 366 of the housing 344 has a bore 368 in which a bushing 370 is seated. The upper end of a vertical shaft 372 extends through the bushing 370 and has a bevel gear 374 secured thereto and meshing with the bevel gear 364. Thus, when the shaft 372 is rotated, the collar 362 will be caused to rotate, thereby effecting axial movement of the rod 340.

The top wall 376 of the housing 290 has an opening 378 containing a bushing 380 through which the lower end of the vertical shaft 372 extends. Secured to the collar 316 between the shoulder 318 and the bushing 314 is a bevel gear 382, which meshes with a bevel gear 384 secured to the lower end of the shaft 372. Thus, the gears in the gear box assemblies 278 and 282 are interconnected, so that when the handle 326 is turned to rotate the operating shaft 322, the rods 298 and 340 will be simultaneously moved axially in the same direction and at the same rate.

The gear arrangement in the gear box assembly 280, FIG. 1, is identical to that of the gear box assembly 278, and is operated by the shaft 322. The gear box assembly 284 is identical to the gear box assembly 282, and is connected to the gear box assembly 280 by a vertical shaft 386. The assemblies 280 and 284 function to operate frame supporting rods 388 and 390, respectively, which are connected to the frame 262 in the same manner as the rods 298 and 340 with the result that said frame is mounted for movement toward and away from the stationary frame 238, on the four supporting rods 298, 340, 388 and 390. Thus, the frame 262, and the rods 236 mounted thereon, can be precisely moved toward or away from the rods 234 by merely turning the handle 326 in the desired direction.

The rods 234 and 236 lie on opposite sides of the path followed by textile material moving downwardly through the saturator unit 4, the rods of each set being vertically spaced apart a distance of about 4 inches, and the rods 236 being positioned vertically about midway between the rods 234. Typically, 16 rods will be employed, eight for the front set 232 and eight for the rear set 234. All of the rods 236 lie in a vertical plane parallel thereto, and when the saturator unit 4 is in use, the front set 232 of rods is moved toward the rear set 230 of rods until the textile material moving through the saturator is engaged by the rounded front surfaces of all of the rods, the pressure of engagement being easily adjusted to any desired value by turning the handle 326. The sliding contact of the textile material with the rounded surface of the several rods 234 and 236 produces a rubbing or wicking action on the moving material, resulting in highly effective and uniform saturation thereof by the liquid size in the tank 188.

Referring to FIG. 4, the upper end of the front and rear walls 192 and 194 of the tank 188 have angle irons 392 and 394, respectively, secured to the exterior thereof and a plate 396 is welded to the horizontal flange of the angle iron 392 and to the underlying top edges of the tank 188. The plate 396 extends rearwardly across the top of the tank 188 for a little less than one-fourth the width of said tank, and has a plurality of hinges 398 secured thereto along its rear edge. A front hinged cover 400 is secured to the hinges 398, and the opposite ends thereof extend beyond and rest upon the top edge of the end walls 190 when said cover is closed.

A plate 402 is welded to the horizontal flange of the angle iron 394, and a plurality of hinges 404 secure a rear cover 406 thereto. The opposite ends of the cover 406 extend beyond and lie upon the top edge of the end walls 190 when closed. When the hinged covers 400 and 406 are fully closed they define therebetween a rectangular inlet opening 408 that extends the full length of the tank 188, and through which textile material passes to the saturator unit 4. The inlet opening 408 is positioned vertically aligned with the tank outlet opening 217.

The saturator unit 4 is supplied with size solution through a conduit 412 containing a flow control valve 414. The lower end of the conduit 412 extends through an opening in the cover 406 to discharge within the tank 188. The tank 188 is intended to have a constant depth of liquid size therein when in operation. For this purpose, the end walls 190 of the tank 188 have rectangular notches 416 in their upper edge, the horizontal edge 418 of said notches 416 defining weirs. Rectangular drain pans 420, FIG. 5, lie within the channels 180 and are welded to the outer face of the tank and walls 190 to receive overflow from the weirs 418. Vertical drain pipes 422 are connected to the drain pans 420 and extend downwardly therefrom within the channels 180 and through the inturned flanges 62 of the drain pan 58 to discharge between the reservoir plates 142 and the drain pan sideplates 60.

In operation, liquid size supplied to the tank 188 through the conduit 412 will drain through the tank outlet opening 217 into the reservoir above the rolls A and B, the rate of flow from said tank being determined by the setting of the plate 210. In addition, a certain amount of size will be carried out of the saturator unit 4 by the textile material passing therethrough. To ensure a constant depth of liquid size within the tank 188, the valve 414 is adjusted so that size is supplied through the conduit 412 at a rate substantially greater than the rate at which it is removed from the tank 188 by the textile material, and by the flow through the outlet opening 217. The excess supply causes the size to rise within the tank 188 to the level of the weir edges 418, and thereafter the excess flows over said weir edges and downwardly into the drain pan 58 through the drain pipes 422.

The textile size applicator 2 is designed for use with so-called "hot" size solution and the like, which must be maintained at a substantially constant, high-operating temperature. For this purpose, the end, front and rear walls of the tank 188 have insulation 424 thereon, and a plurality of spaced electrical heating units 426 is secured to the outer surface of the front and rear walls 192 and 194. The combination of the heating units 426 and the insulation 424 makes it possible to maintain liquid in the tank at a constant, preselected temperature.

A vibrator unit 428 is mounted on the rear wall 194 of the tank 188, and can be of any suitable commercial type capable of selectively imparting vibrations to the tank over an amplitude range from near zero to about one-half inch. The vibrator 428 preferably has a variable frequency to adapt it for use with size solutions over a wide range of viscosities, and experience will dictate the optimum frequency for a given viscosity. The vibrator 428 functions to enhance the ability of the saturator unit 4 to coat textile material passing therethrough with liquid size, as will be explained later.

The circulating system for the size applicator 2 is illustrated in FIG. 8, wherein is shown a supply tank 468 having an outlet

470 and an inlet 472. A bypass loop 474 is connected between the outlet 470 and the inlet 472, and a circulating and supply pump 476 is connected in said loop downstream of the outlet 470. The conduit 412 is connected to the bypass loop 474 downstream of the pump 476 to receive size solution. The drain pan conduit 86 is connected with the inlet of a drain pump 478. The outlet of pump 478 is connected by a conduit 479 to a strainer unit 480, the outlet of which is connected by a conduit 482 to the bypass loop 474 ahead of the tank inlet 472. The supply pump 476 has a capacity greater than the maximum demand of the saturator unit 4, and thus excess size solution is continuously circulating in the bypass loop 474. The supply tank 468 contains suitable means 483 for heating a size solution when a hot solution is required.

The textile size applicator 2 is equipped with feed means for moving textile material therethrough at a uniform rate and under uniform tension. Bolted to the channels 184 above the saturator unit 4 are bearings 430, FIGS. 1, 2 and 4, which support a shaft 432 to which is secured a feed roll 434 having a diameter of about 9 inches, the outer surface 436 of said feed roll being comprised of cork or the like. The upper end of the flanges on the channels 180 are cut back at 437 to accommodate the feed roll 434. Mounted to extend upwardly from the channel 184 directly over the shaft 432 are brackets 438, each having a pair of arms 440 mounted thereon to pivot about a shaft 442. The outer end of the arms 440 support a pair of shafts 444 that extend parallel to the shaft 432, and which have front and rear steel rolls 446 and 447, respectively, mounted thereon. The rolls 446 and 447 are arranged to swing toward the outer surface of the feed roll 434. A two-way pneumatic cylinder 448 is mounted on each bracket 438, and includes a piston rod 450 pivotally connected to the upper end of a pair of links 452. The lower end of the links 452 is pivotally connected to the midpoints of the arms 440. The rolls 446 and 447 can thus be raised or lowered by operating the pneumatic cylinders 448 to advance or retract the piston rods 450.

One end of the shaft 432 has a sprocket 454, FIGS. 1 and 2, secured thereon. A sprocket 456 is mounted on the corresponding end of the drive shaft 102, which carries the drive roll A. A drive chain 458 is engaged with the sprockets 454 and 456 to provide a positive drive connection therebetween, tension in the drive chain 458 being maintained by an idler sprocket 460 rotatably mounted on an adjustable arm 462 secured to the channel 26. The other end of the drive shaft 102 has a sprocket 464 mounted thereon with which is engaged a drive chain 466 leading from a suitable prime mover or other power source (not shown).

The rolls A and B and the feed roll 434 are arranged to feed textile material through the saturator unit 4 and the pressure unit 6. To thread textile material T through the size applicator 2, the pneumatic cylinders 448 are operated to move the rolls 446 and 447 away from the feed roll 434; the handle 326 is turned to rotate the shaft 322 to back the front rods 236 away from the rear rods 234; and the handle 226 is operated to move the plate 210 to its fully open position. Since no super atmospheric air pressure is acting on the diaphragms 131, the springs S now hold the pressure roll B away from the drive roll A. The textile material T is then manually threaded over the front roll 446, around the lower portion of the feed roll 434, over the rear roll 447. The cover 400 is raised to give access to the interior of the saturator unit 4, and the textile material T is then passed downwardly between the bars 234 and 236 to emerge through the tank outlet opening 217. The textile material T is then passed between the rolls A and B, under the roll A, and then over the roll 168, and from thence to suitable drying equipment or other axillary apparatus (not shown).

When threading of the textile material T through the apparatus has been completed, the pneumatic cylinders 448 are operated to move the rolls 446 and 447 downwardly to firmly engage the textile material T between said rolls and the soft, outer cork surface 436 of the feed roll 434. The actuator units 124 are then supplied with air pressure to move the squeeze roll B toward the steel roll A, to exert the desired pressure on the textile material T passing between said rolls. The handle 326 is then rotated to move the rods 236 toward the rods 234 until opposite portions of the textile material T are in rubbing engagement with the rounded surface of said rods, and until said rods place the textile material T under the desired tension. The handle 226 is operated to position the plate 210 to provide the desired width of tank outlet opening 217.

Threading of the applicator 2 then being complete, size solution is run into the tank 188 of the saturator unit 4 through the conduit 412.

Liquid size is supplied to the tank 188 at a rate sufficient to establish the desired constant depth therein, the plate 210 being adjusted to supply size solution to the reservoir area above the rolls A and B at a rate sufficient to establish a constant level of size within said reservoir. After the flow of size to the saturator unit 4 and the roll unit 6 is stabilized, the applicator 2 is placed in operation by activating the vibrator unit 428 and applying power to rotate the drive shaft 102. When the shaft 102 is rotated, the drive chain 458 effects simultaneous rotation of the drive roll 434, the sprockets 454 and 456 being designed so that the textile material T will be supplied by the feed roll 434 and taken up between the rolls A and B at exactly the same rate.

As the textile material T moves downwardly through the saturator unit 4, the opposite portions thereof rub against the parallel rods 234 and 236, which action helps to saturate or apply a thin film coating of size on the material. The vibrations set up by the vibrator unit 428 cause a high rate of agitation and cavitation in the size where the textile material rubs against the rods 234 and 236, resulting in thorough application of size. Further, vibrations set up by the vibrator unit 428 tend to ease the movement of the textile material across the rods 234 and 236, reducing friction. The angularly disposed baffle plates 260 and 274 aid the vibrator 428 in keeping the size solution in a state of constant agitation.

The textile material T, after passing through the saturator tank outlet 217, moves downwardly through the size solution maintained in the reservoir above the rolls A and B, and then is squeezed by the covered roll B against the steel roll A to ensure a uniform film coating of size thereon. The value of the squeeze pressure is easily set with the actuators 124, and the constant volume of size in the reservoir ensures very uniform extraction or application of size. The combined operations of the saturator unit 4 and the pressure unit 6 ensure that when the textile material T leaves the rolls A and B it will be uniformly and evenly coated with size solution and to an extent unattainable by previously known size applicator equipment. The sized textile material T then moves over the roll 168, and onward to other processing equipment.

The size applicator 2 provides several novel and significant advantages. First, textile material can be processed at a very rapid rate of 300 to 500 yards per minute, with no overthrow of liquid size and without agitation of the size to the point where it is caused to froth or foam, an advantage derived in part because there are no moving elements, such as high-speed rolls, within the saturator unit 4, other than the textile material itself, and in part because the size is at all times nearly completely enclosed from the air, is filtered to remove lint, etc.

Second, the multiple rods 234 and 236, coupled with the vibrator 428, and pressure rolls A and B with their associated constant level reservoir of size thereabove, make it possible to obtain a most thorough application of liquid size to textile material within a minimum distance of travel of the material, resulting in a minimal amount of textile material being required to initially thread the applicator. This greatly reduces waste of textile material, since the unsized lead length of usually 20 to 70 yards, depending upon the slashing setup, is normally useless and must be discarded. The present applicator reduces such waste by approximately 95 percent.

Third, another unique advantage derived from the present invention is the conservation of size solution resulting from

the manner in which the applicator is constructed. The hinged covers **400** and **406** on the tank **188**, and the hinged covers **90** and **94** on the pressure unit **6**, function to nearly completely enclose the regions within which the size solution is disposed, thereby preventing splashing of size solution out of the apparatus, and also preventing contamination of the solution by foreign matter. Further, the insulation **96** and **424** function to help maintain a constant operating temperature for the size solution, and the electrical heating units **426** heat the solution without the conventional use of live steam, thereby eliminating objectionable dilution of the size by steam.

Fourth, the constant circulation of size solution through both the tank **188** and the reservoir above the rolls A and B ensures that the solution will not coagulate, settle or stagnate, and that the composition thereof will remain stable. With this constant circulation and refreshment of the size solution, it is possible to halt the movement of textile material through the applicator **2** for an indefinite period, without causing "roll marks" or otherwise affecting the quality of the size coating obtained when operation is resumed.

Fifth, the continuous agitation of the size solution by the vibrator unit **428** also prevents the constituents of said solution from separating out, and hence contributes to maintaining a constant size solution composition.

Sixth, conservation of size solution is a maximum because, upon shutdown of the units **4** and **6**, the valve **414** is manually closed and the solution then in the tank **188** can drain therefrom by gravity, release of pressure on the roll B will cause it to be moved away from the roll A to drain the roll reservoir into the drain pan **58**, and the pump **478** will return the size from the said pan to the storage tank **468**.

The applicator **2** obviously can also be utilized to carry out operations on textile material other than applying size thereto. For example, the apparatus can be used to great advantage with liquid color dye solutions for dyeing fabric and yarn, with the result that the dye solution will be more uniformly applied to the material. Regardless of the liquid employed, the saturator **4** and the pressure unit **6** will function to thoroughly coat and/or treat textile material moved through the applicator **2**.

The applicator **2** is uniquely constructed to handle any form of textile material, single-end, multiple end, or "open-width" woven or felted fabric, and simulate "single-end" sizing operating from a warper creel. The elongated rolls **434**, **446** and **447** of the feed mechanism and the elongated rolls A and B of the pressure unit **6** make it possible to process 700 to 900 ends of yarn supplied from a warper creel spread over a width of 54 to 74 inches, without requiring lease rods, combs, or other auxiliary equipment to maintain separation of the single-end fibers, and will provide a uniform and even coating on such fibers. Moreover, the foregoing is accomplished with a single unit, as against at least two units in conventional systems.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically shown and described.

I claim:

1. The method of treating textile material, comprising: moving textile material under tension vertically downwardly through the full height of a body of treating liquid; and simultaneously with such downward movement applying an adjustable pressure of a predetermined value to the textile material against one side thereof by rubbing contact with said material at several vertically spaced points and simultaneously applying rubbing contact pressure several relatively vertically staggered points on the opposite side of said textile material.

2. The method of treating textile material as defined in claim **1**, including the step of: vibrating the body of treating liquid and vibrating the rubbing points of contact on said opposite side of said textile material during the application of the rubbing contact pressure to the textile material.

3. The method of treating textile material as defined in claim **1**, including the step of: continually draining off a portion of the treating liquid from said body; adding treating liquid to said body at a rate faster than it is being drained; and removing the excess treating liquid after being added in order to maintain a constant volume of treating liquid in said body.

4. The method of treating textile material as defined in claim **3**, including the step of: continuously collecting together the excess treating liquid removed from said body, and the treating liquid drained from said body; filtering the same; and returning it to said body.

5. The method of treating textile material as defined in claim **1**, including the step of: maintaining the liquid body at a constant level by simultaneously and continuously draining treating liquid from a lower portion of said body, replenishing said body with treating liquid at a rate faster than it is being drained therefrom; withdrawing the excess treating liquid from the upper portion of said body after it has been added to said body; collecting together the excess treating liquid supplied to said body and the treating liquid drained from said body; filtering the same; and returning it to said liquid body.

6. The method of treating textile material as defined in claim **1**, wherein the body of treating liquid is maintained under a constant gravity head in a treating zone.

7. The method of treating textile material as defined in claim **6**, including the step of squeezing excess treating liquid from the textile material after it has passed through the body of treating liquid in the treating zone.

8. The method of treating textile material as defined in claim **1**, wherein the treating liquid is a dye solution.

9. The method of treating textile material as defined in claim **1**, in which the treating liquid is a sizing material.

10. The method of treating textile material as defined in claim **1**, wherein the textile material is moved through the body of treating liquid at a rate of 300 to 500 yards per minute.

11. The method of treating textile material as defined in claim **2**, including the step of electrically heating the treating liquid to maintain the same at a substantially uniform temperature.

12. The method of treating textile material as defined in claim **2**, wherein the points of rubbing contact in the body of treating liquid are vibrated at an amplitude of from next to zero to one-half inch and at a frequency that is optimum for the viscosity of the particular treating liquid employed.

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