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Hiatt

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[54] **PROCESS AND APPARATUS FOR LIQUID TREATING OF TEXTILE FABRIC**

[75] Inventor: **Sammy G. Hiatt,** Greensboro, N.C.

[73] Assignee: **Burlington Industries, Inc.,** Greensboro, N.C.

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[52] **U.S. Cl.** **8/151.1,** 68/176

[51] **Int. Cl.** **B05c 1/134**

[58] **Field of Search** ..... 68/176, 177; 8/151, 151.1, 8/152; 29/121 H

[56] **References Cited**

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Primary Examiner—Harvey C. Hornsby
Assistant Examiner—Philip R. Coe
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

An apparatus and process for the liquid treatment of textile fabric, preferably in rope form, the textile fabric having its leading end attached to means which cause the same to travel in a confined endless path into and out of a treating liquid bath with the reaming portion of the textile fabric formed in successive spiral loops and moving into and out of the treating liquid, the trailing end of the textile fabric following loosely in an unconfined path into and out of the treating liquid.

66 Claims, 12 Drawing Figures

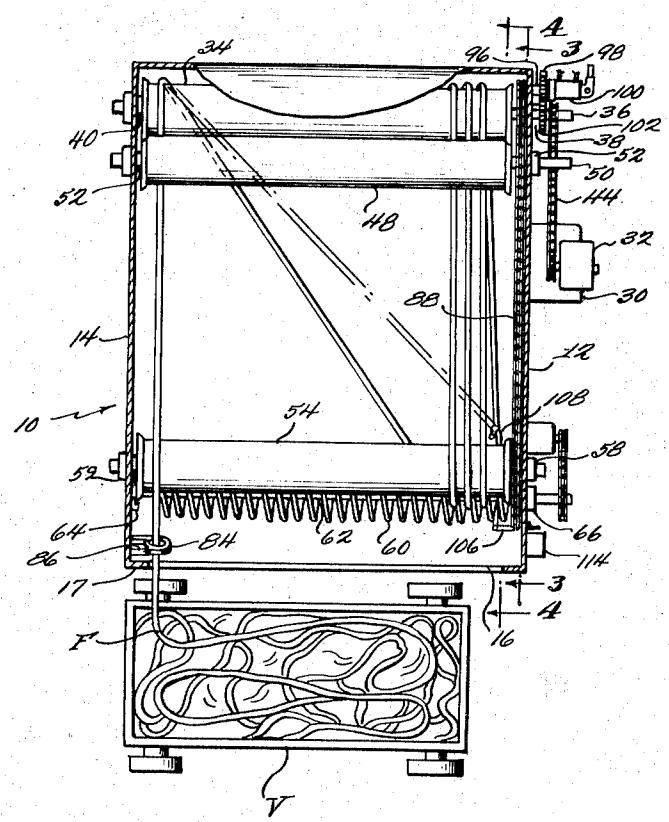
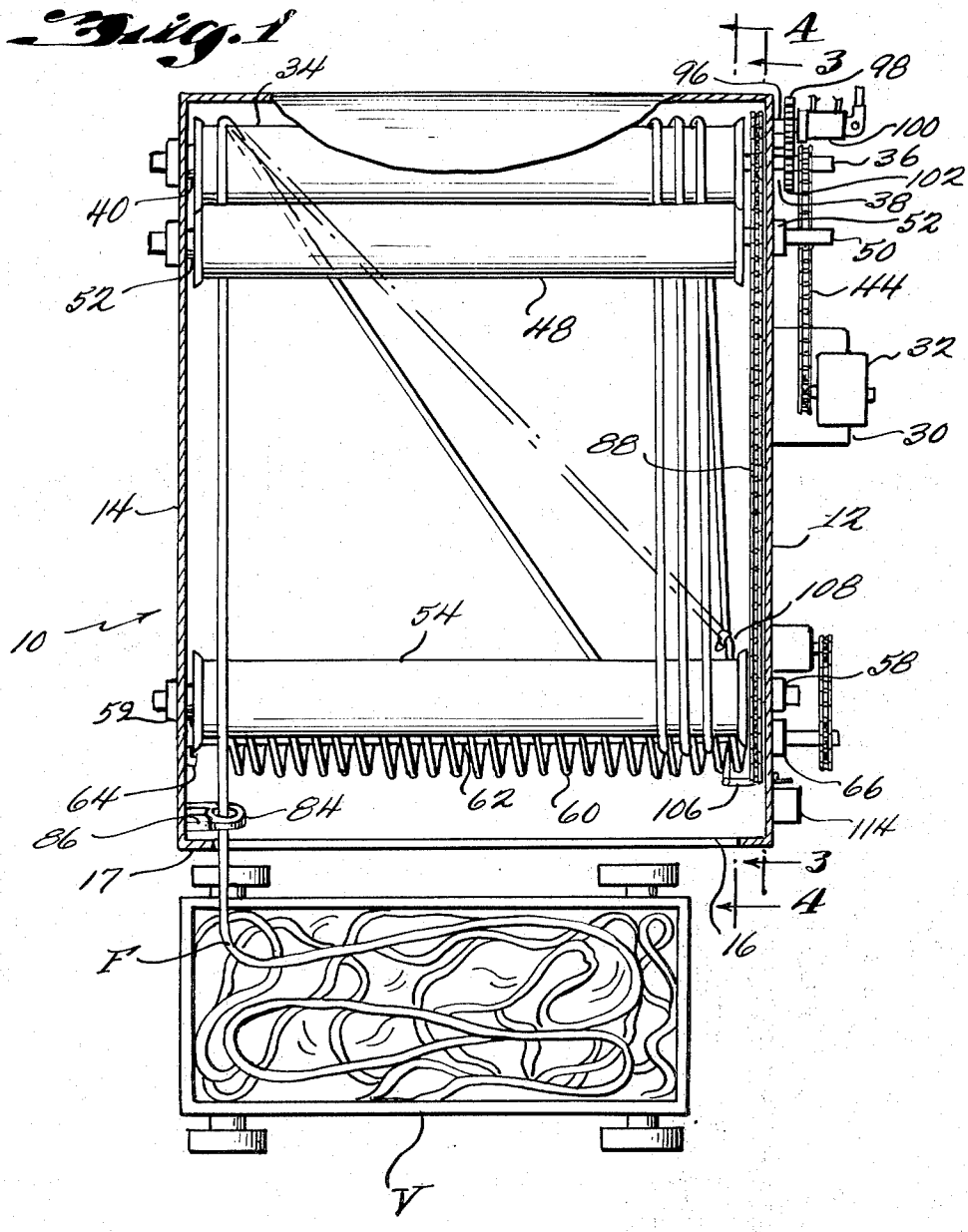


Fig. 1



INVENTORS
SAMMY G. HIATT

BY Cushman, Darby & Cushman
ATTORNEYS

Fig. 2

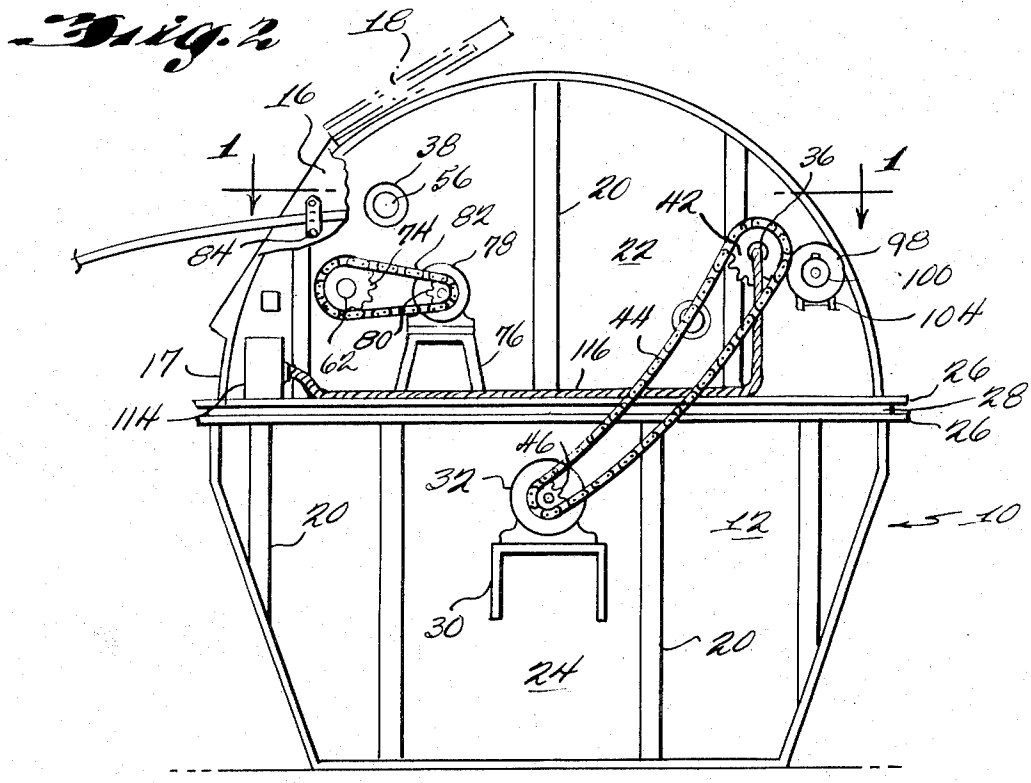
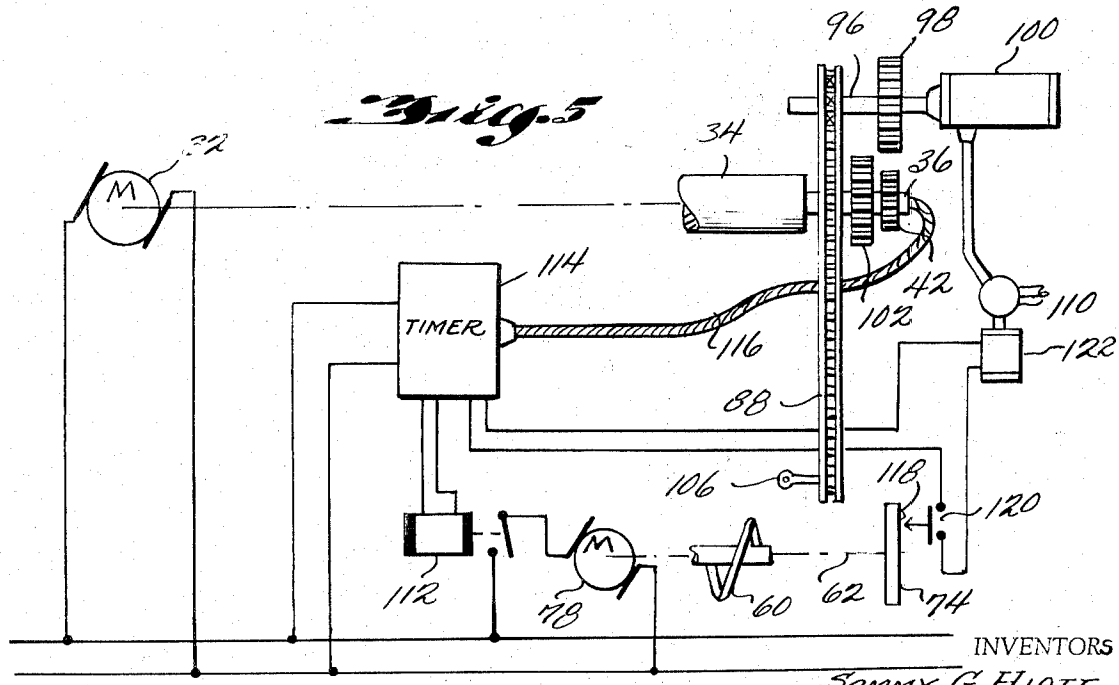


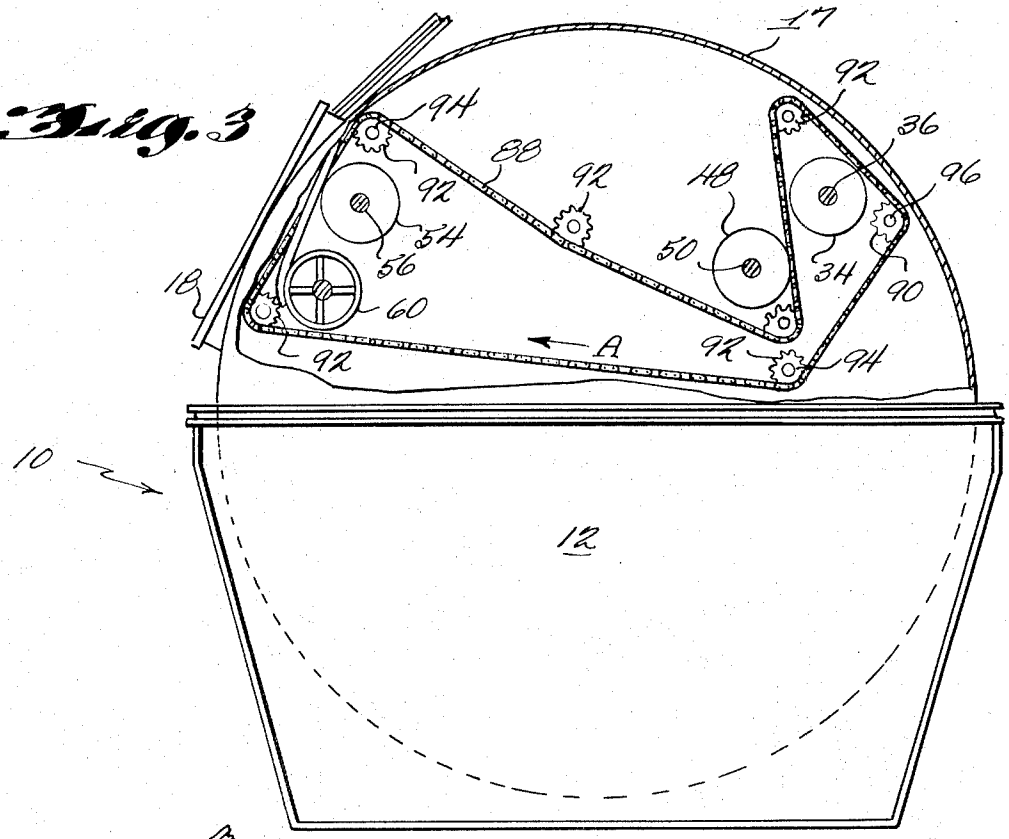
Fig. 5



INVENTORS
SAMMY G. HIATT
WILLIAM A. SQUIRES
EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY

BY Cushman, Darby & Cushman
ATTORNEYS

Fig. 3



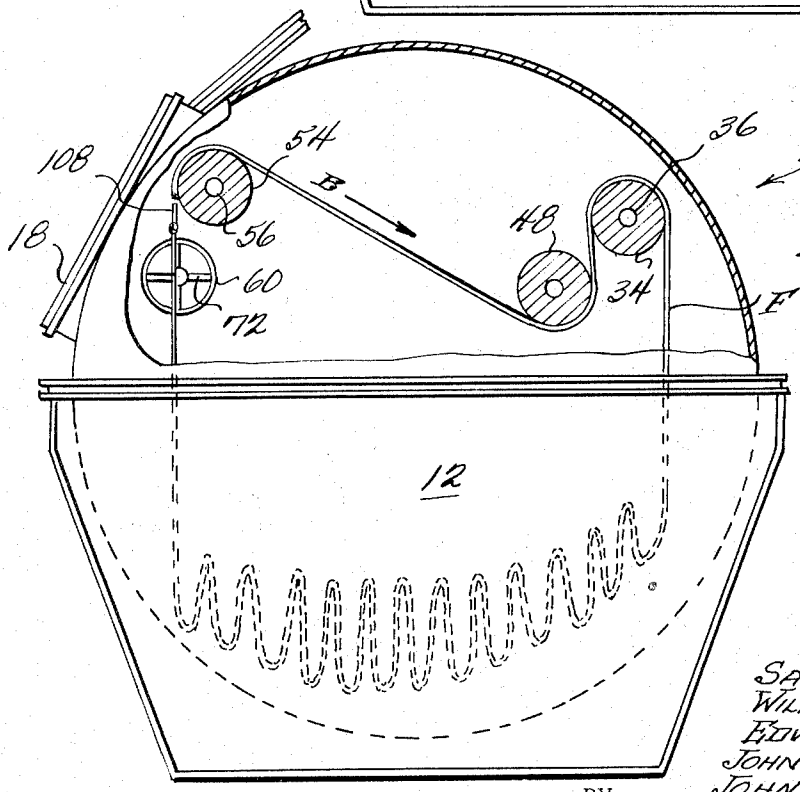


Fig. 4

INVENTORS
SAMMY G. HIATT
WILLIAM A. SQUIRES
EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY
BY
Cushman, Darby & Cushman
ATTORNEYS

Fig. 6

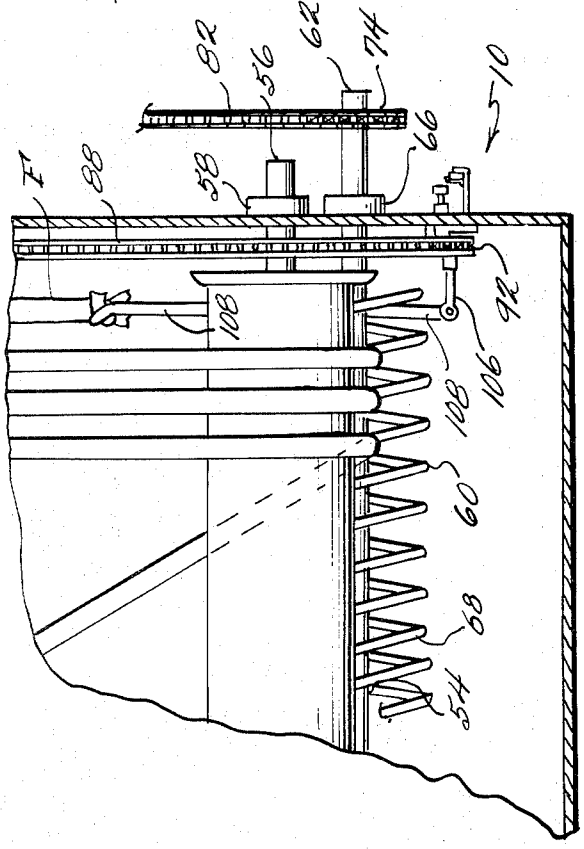
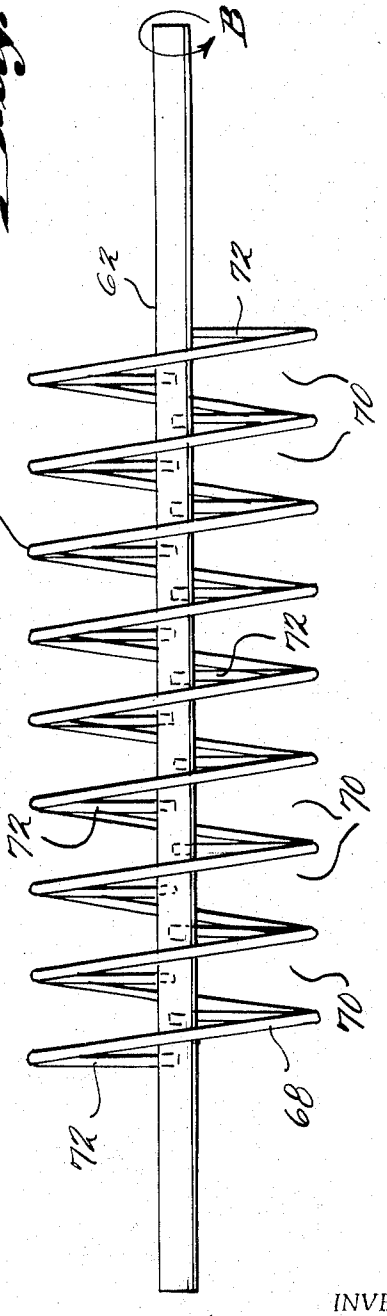


Fig. 7



INVENTORS
SAMMY G. HIATT
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EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY
BY
Cushman, Darby & Cushman
ATTORNEYS

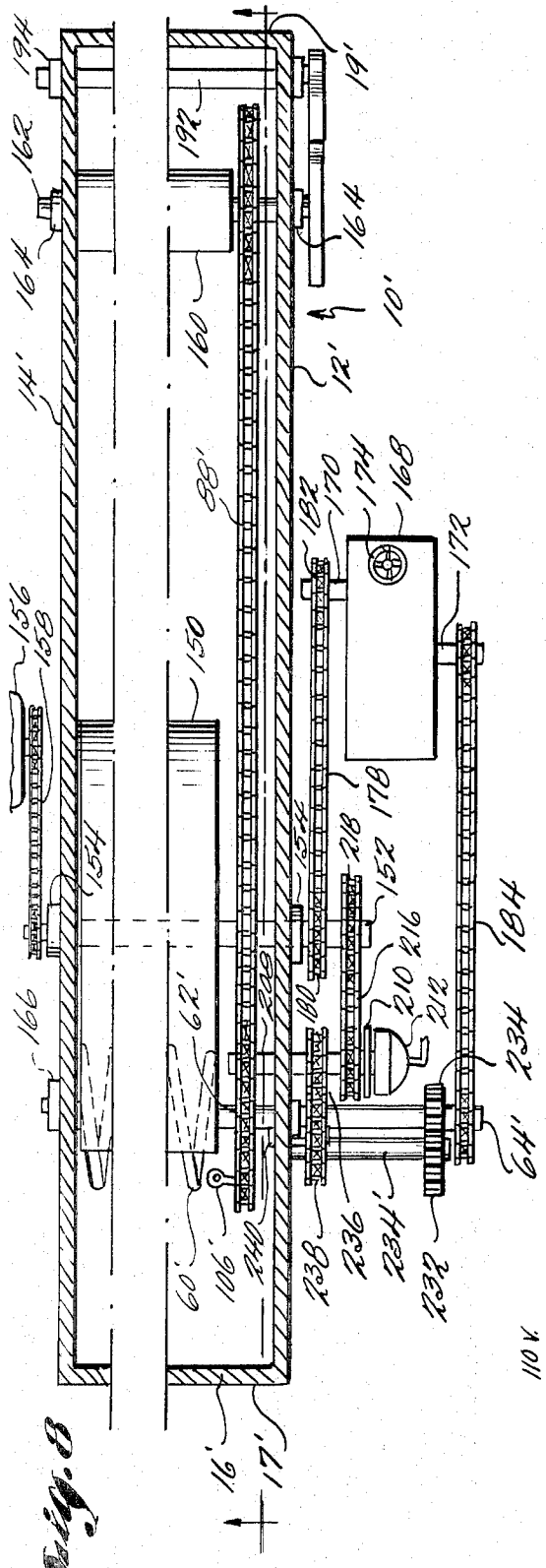


Fig. 8

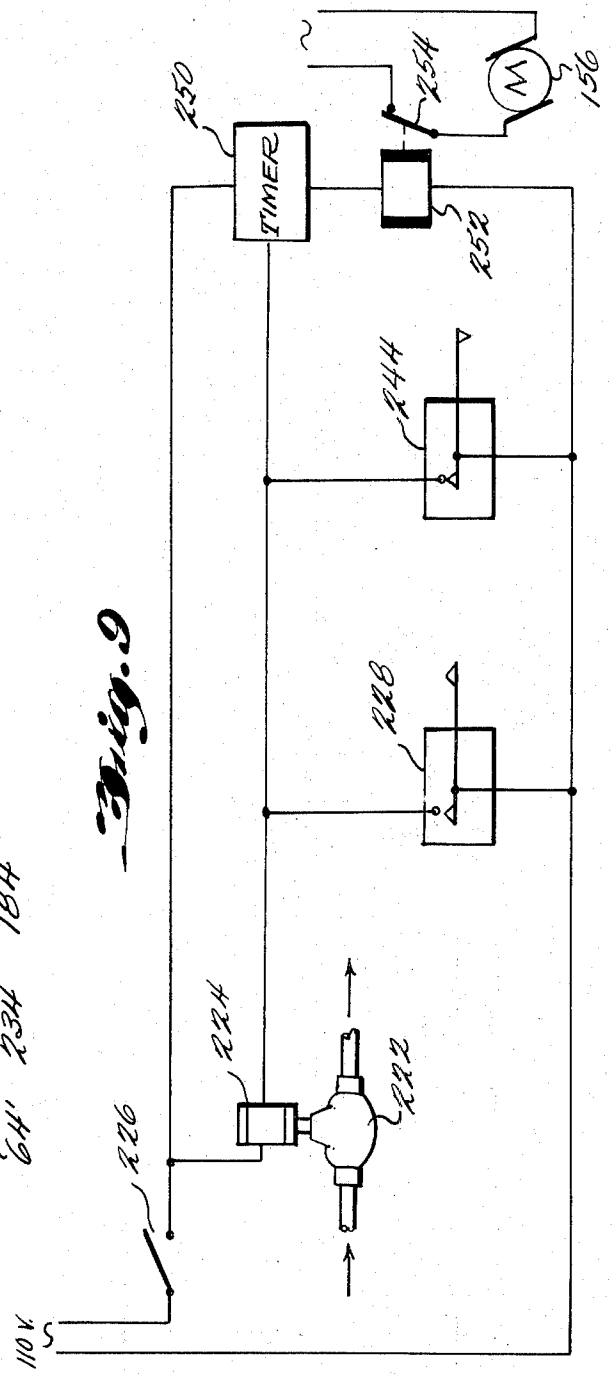
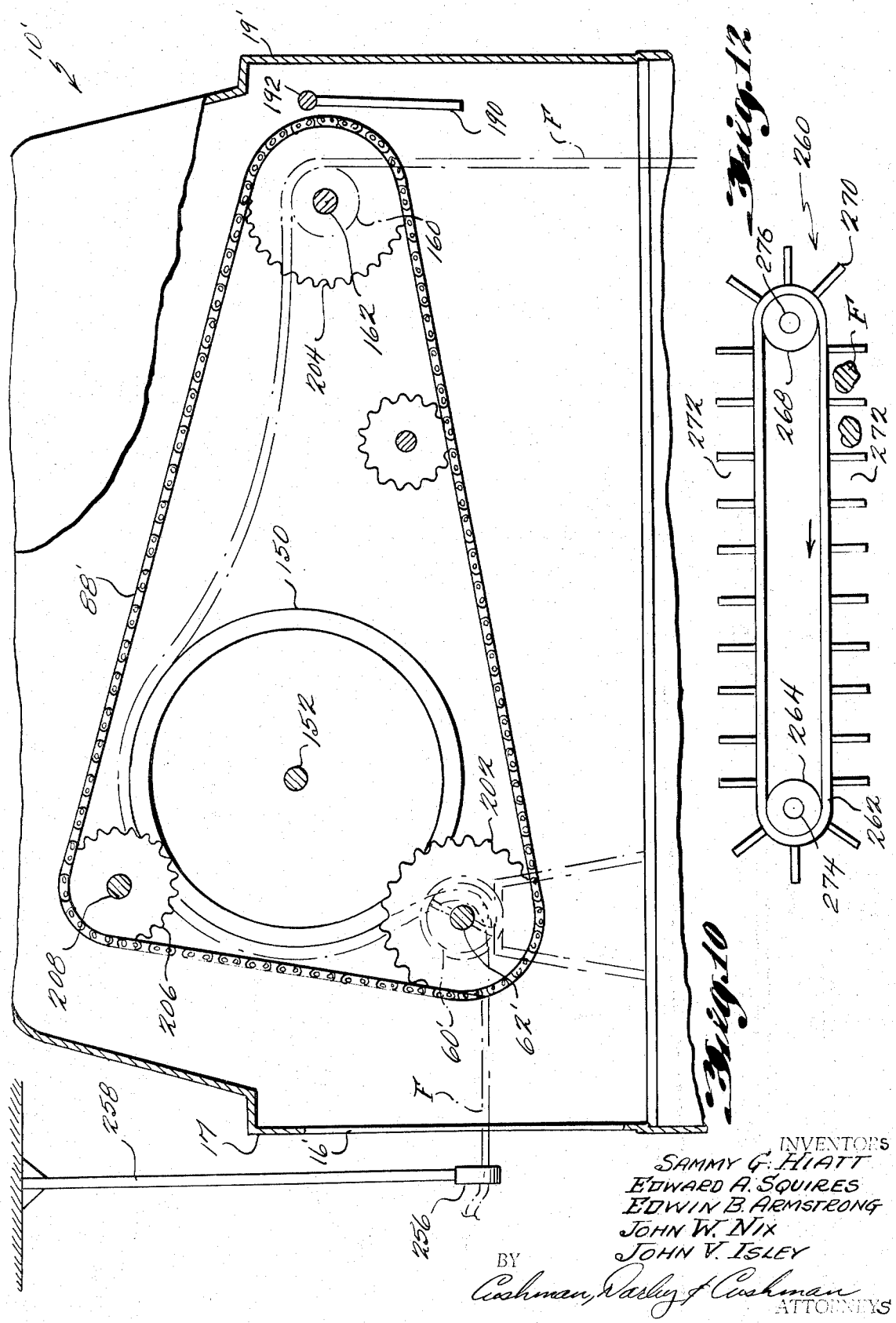


Fig. 9

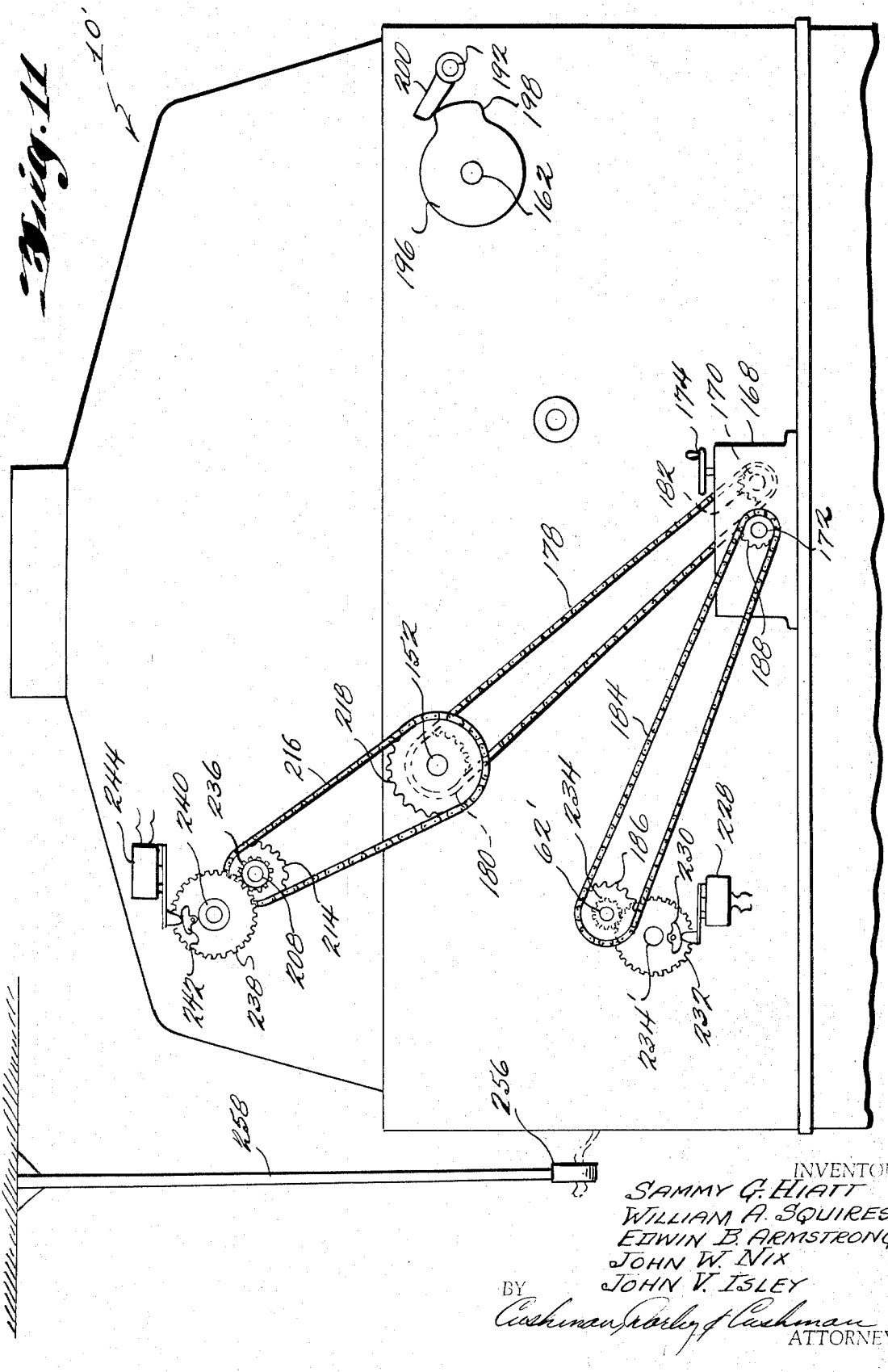
INVENTORS
SAMMY G. HIATT
WILLIAM A. SQUIRES
EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY
BY Cushman, Darby & Cushman
ATTORNEYS



INVENTORS
SAMMY G. HIATT
EDWARD A. SQUIRES
EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY

BY
Cushman, Darby & Cushman
ATTORNEYS

Fig. 11



INVENTORS
SAMMY G. HIATT
WILLIAM A. SQUIRES
EDWIN B. ARMSTRONG
JOHN W. NIX
JOHN V. ISLEY
BY
Cushman, Darby & Cushman
ATTORNEYS

PROCESS AND APPARATUS FOR LIQUID TREATING OF TEXTILE FABRIC

The present invention relates to an improved apparatus used in the liquid treatment of textile fabrics, preferably in rope form. More particularly, the present invention relates to an improved liquid treating apparatus for textile material capable of treating the material in a single length or strand, the invention also contemplating a method or process of loading a single length of textile fabric in rope form into a liquid treating tank and then continuously treating the same within the tank.

While the present invention will be described in connection with liquid treating apparatus such as a dye beck wherein the fabric is continuously fed into and out of a dye bath of dye liquor, it will be understood that the novel apparatus and method is capable of use in other textile liquid treating apparatus such as scouring machines, washing machines or the like.

Dye becks which have heretofore been used for dyeing fabric in rope form have utilized a plurality of draw rolls, plaitor rolls and the like positioned above the dye bath and about which separate individual endless strands of fabric in rope form pass continuously into and from the dye liquor. Such apparatus utilizes a peg rack that maintains each of the individual endless strands of textile fabric in rope form separate from one another. The capacity of these dye becks is in the order of fifteen hundred yards of material, there being anywhere from 15 to 20 or more separate endless strands. In the operation of such a dye beck it is necessary to take lengths of fabric, for example, 100 yards of fabric and feed the same into the dye beck about the draw rolls or reels and then sew the two ends of the fabric together. For each endless strand, the above procedure is repeated until the beck is filled with the desired number of endless strands of fabric. The dyeing operation can then be started by loading the beck with the dye liquor and operating the beck until the desired shade is obtained. The unloading of the beck requires the reverse procedure in that each of the individual endless strands must be cut and the fabric removed. If subsequent textile operations require treatment of a continuous length of fabric, the pieces must then be sewn to each other to make up such a length.

More recently, efforts have been made to utilize a single endless strand in the dye beck in order to obviate the necessity of sewing together the relatively short individual endless strands within the beck, then cutting and resewing into one long strand or length for subsequent processing. However, such apparatus required much labor in loading the same as a single long length, for example, fifteen hundred yards must be moved through the various feeding devices to properly hand coil into loops and then have the two ends sewn together. Additionally, such dye becks required rather complex mechanisms for moving the long endless strand continuously through the beck into and out of the dye liquor, the mechanisms placing undue strain on the fabric.

A third type of apparatus in the liquid treatment of fabric, involves apparatus capable of feeding a continuous running length or strand into and out of the apparatus having the treating liquid therein. In this type of aparauts difficulties have been encountered in obtaining a proper and uniform liquid treatment as oftentimes it

was difficult to obtain a stability in the treatment of the fabric especially in cases where the fabric is being dyed. For example, if a continuous running length of material is fed from outside of the apparatus into the treating liquid in the apparatus and then out of the apparatus to be rolled therein or to be further processed, such fabric would have different shades due to the exhaustion of the dyestuffs from the dye liquor unless constant vigilance is maintained throughout the cycle of operation. In other words, the maintaining of a quality control for a particular length of goods was nearly impossible as the operator was continually having to check the color of the fabric coming from the apparatus and then adding dyestuffs to the dye liquor so as to compensate for exhaustion. It was difficult to try and match and obtain the same shade throughout the entire length of fabric.

An object of the present invention is to provide an improved and efficient apparatus particularly suited for the liquid processing of fabric in rope form in a single length, the fabric being uniformly treated throughout its entire length.

Another object of the present invention is to provide an improved apparatus capable of liquid treating of textile fabrics in rope form, the apparatus being easily loaded by a single operator attaching one end of the fabric within the apparatus, the remaining length being automatically fed into the apparatus.

Still another object of the present invention is to provide an improved method of automatically loading a liquid treating apparatus with a single long strand or length of fabric and of treating the fabric strand or length continuously in the apparatus without the necessity of the ends of the strand being sewn together to form an endless strand.

A still further and important object of the present invention is to provide a liquid treatment apparatus capable of liquid treating a long length of fabric, the apparatus having an improved automatic feeding means for feeding the length of fabric from externally thereof into the same and means for continuously immersing the length of fabric in the liquid and removing the length therefrom.

Ancillary to the immediately preceding object, it is a further object to provide a feeding and treating mechanism capable of use with an open apparatus or a pressurized apparatus.

A still further object of the present invention is to provide an improved dyeing apparatus for dyeing a single long length of textile fabric material in rope form, the apparatus providing for smooth, fast uninterrupted movement in the feeding of the textile material to apparatus from externally thereof and then through the dye bath with little or no slippage of the material passing over the draw rolls, the material further being in a completely relaxed or tensionless position when in the dye bath. By having the material in a completely relaxed or tensionless condition, the shrinkage or elongation of the material does not affect the dyeing of the same and, thus, resulting quality defects in the material are eliminated.

Another object of the present invention is to provide an improved dyeing apparatus for dyeing a single long length of textile material in rope form, the apparatus having improved means for advancing the material into and out of the dye liquor with additional means for adjusting the length of the loops of material therein either

initially or during treatment so as to provide for miscalculation of length of loops or shrinkage of material.

These and other objects and advantages of the present invention will appear more fully in the following specification, claims and drawings, in which:

FIG. 1 is a horizontal sectional view through a liquid treating apparatus such as a dye beck for textile fabrics made according to the present invention, the view being taken substantially on the line 1—1 of FIG. 2 and with the structure for the door or closure being omitted;

FIG. 2 is an end elevational view of the apparatus of the present invention looking from the right of FIG. 1, parts of the apparatus being broken away for clarity;

FIG. 3 is a view similar to FIG. 2 but having an upper portion thereof broken away, the broken away portion being taken substantially on the line 3—3 of FIG. 1;

FIG. 4 is a view similar to FIGS. 2 and 3 but showing the upper broken away portion of the apparatus taken substantially on the line 4—4 of FIG. 1;

FIG. 5 is a diagrammatic view of the controls for the present invention;

FIG. 6 is an enlarged fragmentary view of the lower right-hand corner of FIG. 1;

FIG. 7 is an enlarged elevational view of the spiral-shaped fabric feed or cloth guide element or peg rack;

FIG. 8 is a generally diagrammatic horizontal sectional view, partly broken away, of a modified form of the apparatus of the present invention;

FIG. 9 is a simplified wiring diagram for the apparatus of FIG. 8;

FIG. 10 is a diagrammatic vertical sectional view of the upper portion of the apparatus of FIG. 8, the view being taken substantially on the line 10—10 of FIG. 8;

FIG. 11 is a view similar to FIG. 10, but being in elevation and illustrating the various drive elements for the apparatus; and

FIG. 12 is a diagrammatic plan view of a modified form of movable peg rack or cloth guide usable with either the apparatus of FIG. 1 or FIG. 8.

Referring now to the drawings wherein like character and reference numerals represent like or similar parts, the method of the present invention is brought out best by first giving a description of the improved liquid treating apparatus for the textile material.

The apparatus will be described in its preferred form as a dye beck but, as mentioned above, both the apparatus and the method involved are capable of use in any textile treating process involving the use of liquids such as scouring or washing machines or the like. The dye beck of the present invention is generally designated by the numeral 10 and is preferably a cylindrical tank disposed on a horizontal axis and having end walls 12 and 14. All of the interior parts of the dye beck 10 or the parts of the system which come into contact with corrosive water, chemicals or dyestuffs are desirably constructed of stainless steel or other corrosive resistant metals or corrosive resistant plastics. It will be understood that the tank of the dye beck 10 is of liquid tight construction and is provided with an opening 16 in its side wall 17 through which the textile material to be treated is inserted and removed and through which the interior of the beck may be serviced by the operator or maintenance personnel. The opening 16 may be provided with a closure 18, the closure 18 having the usual seals thereon if the dye beck is to be used as a pressure beck rather than an open beck.

The end walls 12 and 13 for the dye beck 10 are provided with the usual vertical stiffening members 20 on both the upper and lower semi-cylindrical sections 22 and 24 respectively. The sections 22 and 24 are bolted together through the flanges 26, there being a gasket 28 placed therebetween for providing a seal and air-tight relationship if the dye beck is to be pressurized.

The interior of the dye beck in the lower portion thereof where the dye bath is heated may be similar to that disclosed in the copending United States application of Robert A. Gilliam and John V. Isley Ser. No. 301,437 and filed Aug. 12, 1963. Additionally, the dye bath may be heated by suitable closed steam coils (not shown) provided between a false bottom and the side wall 17 of the beck, the controls for the steam coils and the steam coils themselves being of the type shown in either of the U.S. patents of John V. Isley and Robert A. Gilliam numbered 3,094,858 and 3,094,859 and both issued June 25, 1963.

A bracket 30 mounted exteriorly of the end wall 12 supports an electric motor 32 or other suitable source of power. The electric motor 32 provides the prime source of power for a driven draw roll 34 which extends horizontally within the tank or beck 10 between the end walls 12 and 13. In more detail, the driven roll 34 is mounted on a shaft 36 extending through a liquid tight bearing 38 on the end wall 12, the other end of the shaft being supported on a similarly mounted bearing 40 carried on the opposite end wall 14. A driven sprocket 42 (FIG. 2) mounted on the exterior portion of shaft 36 extending from the wall 12 receives an endless drive chain 44 which extends about a drive sprocket 46 on the drive shaft 36 of the motor 32.

A second roll 48, which is also horizontally disposed within the dye beck 10 is mounted on a shaft 50 suitably supported in the end walls 12 and 14 by bearings 52. The roll 48 has its axis of rotation parallel to but slightly below the axis of rotation of the driven roll 34. While the roll 48 is shown as an idler roll, it will be appreciated by those skilled in the art that the roll 48 may be positively driven at the same surface speed as the roll 34 off of the roll 34 by suitable chain drive or the like. As best shown in FIGS. 1 and 4, both the rolls 34 and 48 are positioned adjacent the rear of the dye beck 10 above the level of liquid of the dye bath in the lower portion of the dye beck, the roll 34 being positioned slightly above the roll 48 and closer to the rear of the dye beck.

An idler roll 54 is mounted adjacent the front of the dye beck 10. The idler roll 54 which has an axis of rotation parallel to the axes of rotation of the driven roll 34 and roll 48 also extends horizontally between the side walls 12 and 14, the roll being mounted on a shaft 56 which has its ends suitably supported in the bearings 58 and 59. The bearings 58 and 59 which are positioned on the exterior of the end walls 12 and 14, respectively, are liquid tight bearings similar to the bearings 38 and 52. Roll 54 is preferably mounted at an elevation in the tank intermediate the elevation of the rolls 34 and 48 and as will now be understood, this roll is also positioned above the level of the dye bath within the dye beck 10. Further, roll 54 may be positively driven at the same surface speed as rolls 34 and 48, if so desired. While the guide rolls 34, 48, and 54 have been illustrated as mounted on shafts extending therethrough

and supported adjacent their ends, it is, of course, understood that the shafts for the respective rolls may be stub shafts supported in the respective end walls **12** and **14** of the dye beck **10**, the rolls being rotatably mounted on the stub shafts except for the driven roll or rolls which would have to be splined or keyed to the driven stub shaft or shafts.

As best shown in FIGS. **1, 4, 6,** and **7,** a spiral-shaped element or rotatable peg rack **60** is provided in the front portion of the dye beck **10** immediately below the idler roll **54** and slightly forward of the same. The spiral-shaped element **60** serves two functions in the operation of the dye beck. First, the spiral-shaped element **60** functions as a means to assist in the automatic feeding of textile fabric into the dye beck and the forming of successive loops therefrom prior to the liquid treatment of the fabric and the automatic removal of the fabric from the dye beck at the end of the liquid treatment of the same. Secondly, the spiral-shaped element **60** functions as a movable or rotatable peg rack during the liquid treatment of the fabric within the dye beck and spaces and prevents the loops of the fabric in rope form from becoming entangled. A more detailed description of the functions and operation of the spiral-shaped element **60** will follow later in the specification.

The spiral-shaped element **60** which is preferably made from stainless steel comprises an elongated shaft **62** which has one end supported in a bearing **64** on the interior surface of the end wall **14** and the other end extending through the end wall **12** and supported on a liquid tight bearing **66.** Mounted on the shaft **62** concentrically thereof is a spiral or helical shaped wire member **68** which defines a helix throughout the length of the same providing a plurality of movable spaces or pockets **70** for reception of the fabric in rope form. The wire member **68** is supported on the shaft by a plurality of radially extending braces or spokes **72.**

Referring now to FIGS. **2** and **6,** a driven sprocket **74** is mounted on the end of the shaft **62** which extends exteriorly of the end wall **12.** A bracket **76** suitably carried on the end wall **12** supports a gear head electric motor **78** having a drive sprocket **80** on its drive shaft. An endless chain **82** extending about the drive sprocket **80** and the driven sprocket **74** rotates the driven sprocket **74** one revolution each time the motor is energized as will be explained later in the specification.

Referring now to FIGS. **1** and **2,** a guide or threading eye **84** supported by a bracket **86** carried by the dye beck **10** or by frame structure adjacent the dye beck **10** is positioned adjacent the opening **16** at an elevation above the spiral-shaped element **60.** The guide or threading eye **84** is arranged to receive the textile fabric F in rope form from a cart or vehicle V and feed the same over the roll **54,** under the roll **48** and over the driven roll **34.** It will be understood that the fabric F on the cart V is the total yardage of fabric to be treated. Usually a loom will weave about 80 to 120 yards of fabric and since the dye beck will accommodate in the order of 1,500 yards, then the individual lengths of fabric F are sewn to each other to make up the total length to be treated. However, with modern replenishing looms, lengths of fabric 500 yards or more are being woven, the size of the roll on the beam being the determining factor of the individual lengths produced. With this in mind, the present dye beck **10** can accommodate these long lengths of fabric and thus there is material reduction in the amount of labor involved in preparing for the liquid treating process. A more detailed description of the loading operation of the fabric F and reason for having the pivotal guide eye **84** adjacent the beck opening will follow later in the specification.

Referring now to FIGS. **1, 3,** and **6,** a stainless steel endless chain **88** is suitably mounted for movement in a confined endless path adjacent the interior of the end wall **12.** The endless chain **88** passes about a driven sprocket **90** and a pluality of plurality sprockets **92** and is arranged to follow substantially the same path as a loop of the fabric F follows when above the liquid level of the dye bath and passing over, under and over the rolls **54, 48,** and **34,** respectively in the direction of the arrow B in FIG. **4.** Each of the idler sprockets **92** are suitably journaled for rotation on stub shafts **94** supported on the interior of the end wall **12** whereas the driven sprocket **90** is keyed to a driven shaft **96** extending through the end wall **12** and rotatably supported in a liquid tight bearing. The shaft **96** has splined thereon for movement longitudinally thereof a gear **98** movable by an air clutch **100.** When the gear **98** is in the position shown in FIG. **1,** it is in engagement with a gear **102** keyed to the driven shaft **36** of the driven roll **34** and thus will be rotated thereby so as to rotate the shaft **96** and move the chain **88** over the idler sprockets **92.** The air clutch **100** is suitably carried by a bracket **104** mounted on the end wall **12** of the dye beck **10.**

Referring to FIG. **6,** the chain **88** has extending from one of the links thereof a rigid member **106** which carries a flexible leader **108** (FIG. **1** and FIG. **6**). The leading end of the textile fabric F is suitably attached to the flexible leader **108** by sewing or tying the same thereto and, thus, the leading end of the fabric F substantially follows the path of the chain **88** when the chain is moving about its sprocket in its confined endless path. It will be noted that the confined endless path of movement of the leading end of the fabric F is in a plane extending transverse of the axes of the rolls **54, 48,** and **34** and the length of the leader **108** is sufficiently long to insure the leading end of the fabric F being immersed in the treating liquid during the travel of the leader along the lower portion of the apth of the chain.

Referring now to FIG. **5,** it will be noted that a pulse timer **114** is provided for controlling the rotation of the spiral-shaped element **60** and actuation of an air valve **110** for the air clutch **100** in a particular timed sequence. In more detail, a flexible cable **116** extending off of and driven by the continuously rotating shaft **36** of the driven roll **34** causes the timer **114,** upon a predetermined number of revolutions of the shaft **36,** to send a pulse to and energize a time delay relay **112** so that the motor **78** can be energized a sufficient period of time to permit the same to rotate the spiral-shaped element **60** one complete revolution. At the end of one complete revolution of the spiral-shaped element **60,** a lug **118** on the sprocket **74** of shaft **62** actuates a switch means **120** to close a circuit to a time delay relay **122** whereby the same may be energized by a pulse also from the timer **114** for a predetermined length of time. The time delay relay **122** operates the air valve **110** to its open position which in turn causes the air clutch to move its driven member **98** into engagement with the drive member or gear **102.** The time delay relay **122** actuates the air valve **110** for a sufficient length of time to permit the rethreading chain **88** to make one com-

plete revolution and thus thread the fabric or cloth through the empty pocket in the end of the spiral-shaped element **60.** The pulse timer **114** is so synchronized with the rotation of the loops of fabric through the dye beck **10** that it causes the spiral-shaped element **60** and the rethreading chain **88** to each make one complete revolution in the above-described timed sequence for each complete revolution of the loops of fabric through the dye beck **10.** Further, it will be noted that the gear **98** and the gear **102** are of a 1:1 ratio, and thus, the movement of the rethreading chain **88** is at the same velocity as the surface velocity of the positively driven roll **34** and the fabric traveling therewith.

The operation of the dye beck **10** may be described as follows: The dye bath with the proper amount of dyestuff is prepared in the dye beck **10** prior to the insertion of the fabric F in rope form therein as once the operator has attached the leading end of the fabric F in rope form to the flexible leader **108** and has started the continuously operating electric motor **32,** the fabric will be automatically fed into and threaded about the rolls **54, 48,** and **34** to form successive continuous spiral loops with the liquid treatment of the loops following as soon as all of the fabric has been fed from the cart or vehicle V without any other operations on the part of the operator.

The operator threads the leading end of the fabric through the pot eye **84** over the roll **54,** under the roll **48** and over the roll **34** and then directly to the leader **108** at the opposite end of the dye beck, as shown in FIG. **1** in broken lines. Then the operator attaches the leading end of the fabric to the leader **108** by sewing, tying or clipping. Once this has been completed, the operator then divides the total yardage of the single strand or length of fabric F on the cart by the number of loops that the dye beck **10** is capable of handling and thus determines the yardage for each loop. The length of the spiral-shaped peg rack **60** and the number of pockets along its length or the pitch of its helix determines the maximum number of loops the dye beck **10** will take. With the knowledge of the yardage for each loop of a particular length of fabric F, the pulse timer is adjusted by the operator to deliver one pulse for each rotation of a loop through the beck. Once the leading end of the fabric F is attached to the leader **108** carried on the chain **88,** the electric motor **32** is started and continuously drives the driven roll **34** throughout the automatic feeding and treating of the fabric. This will cause the fabric F to begin feeding over roll **54,** under roll **48** and over roll **34** into the bottom of the beck as the leading end of the fabric F is not moving during this initial feeding into the dye beck **10** as it is attached to the leader **108** and the chain **88** at this time is stationary.

However, after a predetermined amount of fabric F has been fed into the bottom of the beck, the pulse timer **114** operatively receives a signal through the flexible cable **116,** the pulse timer in turn starting the sequence of operation for first rotating the spiral-shaped element **60** one revolution and then rotating the rethreading chain **88** one revolution during a dwell of the spiral-shaped element **60.** In more detail, the pulse timer **114** supplies a signal to the time delay relay **112** to actuate the same for a predetermined amount of time, this in turn energizing the motor **78** which will rotate the spiral-shaped element one complete revolution. During this initial revolution of the spiral-shaped element **60,** there will be no effect on the fabric F as it has not as yet been threaded up through the first pocket **70** of the spiral-shaped element **60.**

After one complete revolution of the spiral-shaped element **60,** the lug **118** on the sprocket **74** of shaft **62** will have rotated to a position where it closes the switch means **120** to the time delay relay **122.** This permits the timer **114** to send a signal and energize the relay **122** for a predetermined length of time so that the air valve **110** is open long enough to cause the air clutch **100** to engage the gear **102** with the gear **98** whereby rotation of the gear **98** rotates the chain **88** a complete revolution in the direction of the arrow A. When the chain rotates a complete revolution, it will carry with it the fixed leading end of the fabric F up through the first pocket **70** in the spiral-shaped element **60** and will further carry the end over the roll **54** under the roll **48** and over the roll **34** back to the position shown in FIGS. **1** and **6** just beneath the spiral-shaped peg rack **60.** Since the chain is carrying the end of the fabric F at the same speed as the fabric is being moved by the draw roll **34,** a complete loop is formed as shown in FIG. **4** with a pleated portion being retained in the bottom of the dye beck **10,** the pleated portion being formed during the initial movement of the fabric into the beck when the chain is stationary. By having the fabric pleated when in the dye bath, the fabric is in an entirely relaxed and tensionless condition during its direct contact with the dyestuff.

After the first loop of fabric is formed, the second loop begins to be formed as the fabric is being continuously fed into the dye beck **10** by the continuously driven roll **34.** When sufficient additional fabric has been fed into the bottom of the dye beck **10,** the sequence of operation of the spiral-shaped element **60** and the rethreading chain **88** is repeated. In other words, the spiral-shaped element **60** makes a complete revolution and the fabric F of the first formed loop which is in the first pocket or space **70** of the spiral-shaped element **60** will move to the left of FIG. **6** or **7** leaving the first pocket empty for reception of the fabric F during the next cycle of movement of the rethreading chain **88.** While the above operation is going on it must be remembered that the draw roll **34** is continuously rotating and the second loop is beginning to form by pleating in the bottom of the dye beck. It will now be apparent that the loops of fabric are successively formed from right to left of FIG. **1** and are rethreaded in step-by-step increments toward the left of FIG. **1** upon formation of each loop by the cycle of operation of first moving the spiral-shaped element **60** through one complete revolution and then the chain **88** through one complete revolution until all of the fabric has been removed from the cart V or other source of supply and is in the beck.

Once the dye beck **10** is completely filled with the single length of fabric F in rope form, the trailing end of the length of fabric F merely follows around loosely in an unconfined path whereas the sequential operation referred to above is continuously repeated with the formed loops continuously moving in a path (arrow B FIG. **4**) into and out of the dye bath. This operation continues for as long as desired to obtain the liquid treatment of the fabric required.

After the liquid treatment of the fabric has been accomplished and it is desired to unload the dye beck **10,**

the motor **32** is stopped so that the leading end of the fabric F can be loosened from the rigid member **106** and directed back through the pot eye **84** into the truck or vehicle V. The motor **32** is again started so that the sequential operation described above continues as the fabric is fed through the eye **84** into the cart V. The loops of fabric will be taken out of the beck from the right to the left of FIG. **1.**

It will now be obvious to those skilled in the art that the improved dye beck and process heretofore described accomplishes the objects and advantages of the present invention. The labor involved in loading the dye beck and in operating the dye beck is materially reduced as the fabric to be treated is in a single uninterrupted length and does not have to be sewn into short endless loops, each loop being individually made up in the beck by the operator. Further, the dye beck results in more uniform dyeing of the total yardage of fabric as the fabric can be brought into the beck, the dye bath then being inserted and the temperature quickly raised. In other words, the present process and apparatus eliminates streaking and provides for uniformity of dyeing throughout the entire length.

Referring now to FIGS. **8–11** inclusive, there is disclosed another preferred modification of dye beck **10'** which is also a cylindrical tank disposed on a horizontal axis and having end walls **12'** and **14'**. As in the dye beck **10,** the interior parts of the dye beck **10'** which come in contact with corrosive water, chemicals or dyestuffs are desirably constructed of stainless steel or other corrosive resistant metals or corrosive resistant plastics. The dye beck **10'** is provided with an elongated opening **16'** in its side wall **17'**, the opening **16'** being provided with the usual pressure tight closure (not shown).

In the dye beck **10'** there is provided a large driven or draw roll **150** which extends on a horizontal axis. A shaft **152,** supporting the roll **150** extends through suitable liquid tight bearings **154** carried on the side walls **12'** and **14'**, respectively. The roll **150** is positioned adjacent the opening **16'** of the tank and is continuously driven by an electric motor **156** through a chain and sprocket arrangement **158.**

A second roll **160** is supported within the tank of dye beck **10'** adjacent the rear wall **19'**, the roll **160** being mounted on a shaft **162** extending through suitable bearings **164** carried on the end walls **12'** and **14'**, respectively. The roll **160** is disclosed as an idler roll but it will be appreciated that this roll may also be driven just as the roll **150,** it being understood that when the roll **160** is driven, it must be driven at the same surface speed as the roll **150.** Since the roll **150** is the driven or draw roll and must drive all of the successive depending loops of fabric as they are rotated into and out of the treating liquid in the tank, the diameter of this roll is quite large as compared to the diameter of the idler roll **160.**

A spiral-shaped element or rotatable peg rack **60',** substantially similar in construction to the spiral-shaped element **60** heretofore described, is provided within the dye beck **10'** and is adapted to continuously rotate on an axis parallel to the axes of the rolls **150** and **160.** The axis of the spiral-shaped peg rack **60'** is spaced forward of and below the axis of the roll **150** as best shown in FIG. **10.** The spiral-shaped element **60'** rotates on a shaft **62'** extending through bearings **166,** the shaft **62'** having an end portion **64'** which extends a substantial distance exteriorly of the side wall **12'.**

A speed reducer unit **168** which may be of the type such as a "Link Belt Company P.I.V. Speed Reducer Unit," has an input shaft **170** for positively driving at variable speeds an output shaft **172.** The input shaft **170** drives the output shaft through a positive chain drive (not shown) which may be adjusted by an adjustment wheel **174** whereby the speed of the shaft **172** may be selectively varied relative the speed of the input shaft **170.** Input shaft **170** is driven off of the shaft **152** of roll **150** by means of an endless chain **178** passing about a sprocket **180** on the shaft **152** and a sprocket **182** on the shaft **170.** Shaft **62'** is operatively connected to the speed reducer unit **168** for continuous rotation by means of an endless chain **184** passing about a sprocket **186** on the shaft **62'** and a sprocket **188** on the shaft **172.** The speed at which the spiral-shaped element **60'** continuously rotates is such that a pocket of the element moves one space during the time it takes the roll **150** to rotate the loops of textile fabric through one complete revolution in the tank. By utilizing the adjusting wheel **174** of the speed reducer unit **168,** the speed of rotation of the spiral-shaped element **60'** can be initially adjusted for the desired lengths of loop to be formed within the dye beck **10'** or it may be adjusted during operation of the dye beck to accommodate for a miscalculation in the original length of the loops or for shrinkage of the material which would necessarily decrease the length of the loops.

Adjacent the rear wall **19'** of dye beck **10'** is an oscillating plaitor member **190** mounted on a shaft **192** extending through bearings **194** carried on the side walls **12'** and **14'**. The plaitor member **190** is oscillated by a cam **196** carried on the shaft **162** of roll **160.** A lobe **198** on the cam engages an arm **200** on and extending radially of the shaft **192** to cause the same to rock back and forth on its axis, this causing the plaitor member to strike the loops of textile fabric F as they pass downwardly into the treating liquid so that pleats are formed in the same.

The dye beck **10'** is provided with an endless chain **88',** similar to the chain **88,** the chain **88'** being movable in a confined endless path adjacent the interior of the end wall **12'**. Chain **88'** has a slightly different path than the chain **88** since the dye beck **10'** of FIGS. **8-11** has only two rolls over which the cloth passes and consequently the endless path of the chain **88'** is arranged to follow substantially the same path as the path of a portion of a loop of fabric F follows when the same is above the liquid level of the dye bath. A rigid member **106'** is provided on the chain **88'** for attachment of the flexible leader of the leading end of textile fabric when the length of the same is being fed into the beck. For each revolution of a loop of textile material through the dye beck **10',** the rethreading chain **88'** rotates one complete revolution in its endless path at the same speed as the fabric is driven by the roll **150.** Since the chain is of considerable shorter length than the length of a loop of textile material, it will be obvious that the chain will be moving for only a short period of time during each revolution of the loops.

Chain **88'** extends about sprockets **202** and **204** which are mounted on the shafts **62'** and **162** respectively, the sprockets **202** and **204** being freely rotatable relative to the shafts. Additionally, the chain **88'** passes around a drive sprocket **206** carried on a stub shaft **208**

extending through the side wall 12' of the dye beck 10'. The shaft 208 carries a driven member 210 of an air clutch 212 which is normally disengaged from a drive member 214 in the form of a sprocket freely rotatable on the shaft 208. The drive member or sprocket 214 is continuously driven off of the shaft 152 by means of a chain 216 passing around a sprocket 218 keyed to the shaft 152. As is now apparent, when the clutch 212 is actuated the driven member 210 engages the drive member 214 and this causes the shaft 208 to rotate thus causing movement of the endless chain 88'.

Referring now to FIG. 9, a simplified wiring diagram for operating the rethreading chain 88' is disclosed. An air valve 222 for supplying air from a suitable source of supply to the air clutch 212 is actuated by a solenoid or relay 224. The relay 224 is in an electrical circuit having a master disconnect switch 226 which is closed when the dye beck 10' is started. As will be apparent from FIG. 9, the relay 224 is energized when a normally open switch 228 is momentarily closed. The switch 228, as shown in FIG. 11, is actuated by a lug 230 provided on a gear 232 carried on a stub shaft 234', the gear 232 meshing with a continuously rotating gear 234 carried on the extended portion 64' of shaft 62'. Upon energizing the relay 224, the clutch 212 is immediately actuated so that the shaft 208 starts to rotate carrying with it the chain 88'. Shaft 208 is provided with a gear 236 (FIG. 11) which meshes with a gear 238 carried on a stub shaft 240. The gear 238 is provided with a lug 242 that engages and opens a switch 244 which is in a holding circuit for the relay 224. As soon as the gear 238 starts to rotate the switch 244 closes the holding circuit and maintains the relay 224 energized for a sufficient length of time to cause the chain to make one complete revolution. In other words, one revolution of the gear 238 corresponds to one revolution of the chian 88' through its endless path and thus when the lug 242 comes back to the position shown in FIG. 11, it will open the switch 244 which immediately disengages the air clutch 212 to stop movement of the chain 88'.

As a safety measure, should the chain 88' be hung up for any reason before it has completed its movement, a timer 250 is provided for actuating a relay 252 which in turn opens a switch 254 in the circuit for the main motor 156 of the dye beck 10'. The timer is arranged to actuate the relay 252 30 seconds after the chain 88' stops for any reason prior to its complete revolution and thus the main motor 156 is stopped so that there can be no damage to the dye beck 10' or to the fabric being treated therein.

As shown in FIGS. 10 and 11, a pot eye or threading eye 256 is provided exteriorly of the dye beck and is fixedly attached relative to the dye beck 10' by a support 258. The pot eye is in front of the opening 16' of the dye beck 10' and arranged about half way between the end walls 12' and 14' of the same. The pot eye 256 is arranged to swivel on a vertical axis to accommodate the feeding of textile fabric to and from the dye beck 10'.

The dye beck 10' is operated in a substantially similar manner to the dye beck 10 although there are some slight changes with respect to loading and unloading the same. In either instance, the loading and unloading is completely automatic once the end of the fabric F has been attached to the rigid member 106' of chain 88'.

In FIG. 10 it will be noted that the fabric F which is threaded through the pot eye 256 is passed under the spiral-shaped element 60' and placed in the first pocket of the same adjacent the chain 88'. Then the fabric is fed upwardly over the draw roll 150 and downwardly over the idler roll 160 with the end of the fabric being attached to the rigid member 106' of the chain when a sufficient length of fabric has been placed in the beck to form one loop. The dye beck 10' is then started and the loading is then the same as the loading described with respect to the dye beck 10 with the only difference being that the spiral-shaped element 60' is continuously rotating rather than having an intermittent rotation as heretofore described. The swivel mounted pot eye 256 follows the fabric as the loops are being successively formed, the loops filling the pockets of the spiral-shaped element 60'.

The unloading of the dye beck 10' is the reverse of the above described method. The end of the fabric attached to the rigid member 106' of the chain 88' is released and threaded back through the eye 256 and as the fabric loops continue to rotate in the dye beck, the loops are successively fed out of the dye beck from the end 12' near the chain 88' toward the opposite end 14' of the dye beck 10'.

Referring to FIG. 12, there is disclosed a movable peg rack 260 which may be used in place of the spiral-shaped elements 60 or 60' of dye beck 10 and 10' respectively. The movable peg rack 260 includes an endless belt or chain 262 passing about sprockets 264 and 268 respectively. The belt or chain 262 has a plurality of outwardly extending fingers 270 which define pockets 272 therebetween for loops of textile fabric F. In the arrangement shown in FIG. 12, the movable peg rack 260 with its fingers 270 is arranged to move in a horizontal plane so that the pockets 272 also move in a direction away from the rethreading chain. Of course, the timing of the movment of the pockets 272 must be identical with the movement of the pockets of either of the spiral-shaped elements 60 or 60' so that there is always an empty pocket in which the leading end of the length of fabric is fed. It will now be apparent that to obtain the above movement of the rack 260, the shafts 274 and 276 upon which the sprockets 264 and 268, respectively, are mounted, must have their axes vertical.

The specific embodiments are processes described are merely for the purpose of illustrating the invention, it being understood that the specific embodiments and processes are susceptible to some modifications and changes without departing from the spirit and principles of the invention. Therefore, the terminology used throughout the specification is for the purpose of description and no limitation, the scope of the invention being defined in the claims.

What is claimed:

1. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending and axially spaced guide rolls in the upper portion of said tank about which a length of textile fabric having a leading and a trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls; a fabric guide element in the upper portion of said tank having movable pockets for receiving and spacing

the successive depending loops of the length of textile fabric; means in said tank adjacent one end thereof for fixedly attaching the leading end of the length of textile fabric thereto, said means being movable in an endless path having at last a portion thereof similar to the path of the fabric about said guide rolls; means to move the pockets of the fabric guide element one space and rotate the last mentioned means one revolution whereby the loops of the length of textile fabric advance with the pockets during every rotation of the loops through the tank.

2. The apparatus of claim **1** in which said plurality of guide rolls includes a pair of closely positioned guide rolls and a third guide roll spaced from the pair, said fabric guide element being positioned closely adjacent said third guide roll and said length of textile fabric passing over said third guide roll and under and over said pair of guide rolls and into the liquid in the successive depending loops.

3. The apparatus of claim **1** in which said plurality of guide rolls includes at least a pair of guide rolls spaced from each other above the liquid in the tank, one of said guide rolls being positioned closely adjacent and above said fabric guide element, and said length of textile fabric passing over said pair of guide rolls into the liquid in successive depending loops with each loop extending out of said liquid upwardly through one of the pockets of said fabric guide element.

4. The apparatus of claim **1** in which said means for fixedly attaching the leading end of the length of textile fabric threto travels at a speed equal to the surface speed of at least one of said guide rolls driven by said drive means.

5. An apparatus as claimed in claim **1** including a threading eye fixedly carried with respect to said tank for receiving the length of textile fabric from externally of said tank, said threading eye being positioned adjacent an opening of said tank.

6. An apparatus as claimed in claim **5** in which said threading eye is mounted on a swivel externally of said tank.

7. The apparatus of claim **1** in which said fabric guide element is a spiral-shaped element mounted for rotation on an axis parallel to the axes of said guide rolls, the spiral-shaped element defining the pockets.

8. The apparatus of claim **7** in which said spiral-shaped element includes an elongated shaft and a spiral-shaped wire member coaxial with and supported on said shaft.

9. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending and axially spaced guide rolls in the upper portion of said tank about which a length of textile fabric having a leading and trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls; a fabric guide element in the upper portion of said tank having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric, said fabric guide element being an endless belt movable in a plane parallel to the axes of the rolls and having a plurality of outwardly extending spaced fingers defining the pockets; means in said tank adjacent one end thereof for fixedly attaching the leading end of the length of textile fabric thereto, said means being movable in an endless path having at least a portion thereof similar to the path of the fabric about said guide rolls; means to move the pockets of the fabric guide element one space and rotate the last mentioned means one revolution whereby the loops of the length of textile fabric advance with the pockets during every rotation of the loops through the tank.

10. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending and axially spaced guide rolls in the upper portion of said tank about which a length of textile fabric having a leading and a trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls; a fabric guide element in the upper portion of said tank having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric; means in said tank adjacent one end thereof for fixedly attaching the leading end of the length of textile fabric thereto, said means being movable in an endless path having at least a portion thereof similar to the path of the fabric about said guide rolls; means to move the pockets of the fabric guide element one space and rotate the last mentioned means one revolution whereby the loops of the length of textile fabric advance with the pockets during every rotation of the loops through the tank, said means to move the pockets of the fabric guide element one space and rotate the means for fixedly attaching the leading end of the length of textile fabric thereto includes means to alternately move the pockets one space and rotate the means in said tank one revolution during a portion of each revolution of the loops of the length of textile fabric through the tank.

11. The apparatus of claim **1** in which said means to move the pockets of the fabric guide element one space and rotate the means for fixedly attaching the leading end of the length of textile fabric includes means to continuously move the pockets one space for each revolution of the loops within the tank while rotating the means for fixedly attaching the leading end of the length of textile fabric one complete revolution during a portion of each revolution of the loops of textile fabric within the tank.

12. The apparatus of claim **1** in which said means to drive at least one of said guide rolls operates to continuously drive the same.

13. The apparatus of claim **1** in which said tank is pressurized.

14. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending guide rolls in the upper portion of said tank about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls, a spiral-shaped guide element in the upper portion of said tank having a helix defining pockets for receiving and spacing the successive depending loops of the length of textile fabric; an endless chain at one end of said tank movable in a plane transverse to the axes of said guide rolls; said chain having an endless path with at least a portion thereof similar to the path of the fabric about

said guide rolls; means for attaching the leading end of the length of fabric to the chain; means to move the chain through complete revolutions with a dwell between each revolution; and means to rotate the spiral-shaped element one revolution during every revolution of the loops through said tank.

15. The apparatus of claim **14** in which said means for attaching the leading end of the length of fabric to the chain includes a flexible leader having a length sufficient to permit the leading end of the length of fabric to be immersed in the treating liquid during the travel of the chain along the lower portion of its path.

16. The apparatus of claim **14** including a threading eye carried adjacent an opening of said tank, said threading eye being arranged to receive the length of textile fabric from externally of said tank into said tank over said guide rolls and into and out of the liquid in said tank as the length of textile fabric is being threaded in the successive depending loops.

17. The apparatus of claim **14** in which said means to move the chain is operable by said drive means for said guide rolls, said chain being moved at a speed substantially equal to the surface speed of said guide rolls.

18. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending guide rolls in the upper portion of said tank about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls, a spiral-shaped guide element in the upper portion of said tank having a helix defining pockets for receiving and spacing the successive depending loops of the length of textile fabric; an endless chain at one end of said tank movable in a plane transverse to the axes of said guide rolls; said chain having an endless path with at least a portion thereof similar to the path of the fabric about said guide rolls; means for attaching the leading end of the length of fabric to the chain; means to move the chain through complete revolutions with a dwell between each revolution, said means to move the chain including a pulse timer and means operable by said pulse timer for driving said chain at a speed substantially equal to the surface speed of said guide rolls, said pulse timer being operable to move the chain one revolution for a movement of one complete loop over the guide rolls; and means to rotate the spiral-shaped element one revolution during every revolution of the loops through said tank.

19. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending guide rolls in the upper portion of said tank about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls, a spiral-shaped guide element in the upper portion of said tank having a helix defining pockets for receiving and spacing the successive depending loops of the length of textile fabric; an endless chain at one end of said tank movable in a plane transverse to the axes of said guide rolls; said chain having an endless path with at least a portion thereof similar to the path of the faric about said guide rolls; means for attaching the leading end of the length of fabric to the chain; means to move the chain through complete revolutions with a dwell between each revolution; and means to rotate the spiral-shaped element one revolution during every revolution of the loops through said tank, said means to rotate the spiral-shaped element one revolution during each revolution of the loops through the tank including a pulse timer operable during each revolution of the loops, a motor operatively connected to said spiral-shaped element for rotating the same, means responsive to a pulse from said pulse timer for operating said motor for a sufficient length of time to rotate said spiral-shaped element one revolution.

20. The apparatus of claim **19** in which said means to move the chain includes clutch means for operatively connecting the chain to said drive means for said guide roll, means operatively connected to said clutch means and responsive to rotation of said spiral-shaped element for causing said clutch means to engage and rotate said chain through a complete revolution for every revolution of the loops passing about said guide rolls.

21. The apparatus of claim **14** in which said means to rotate the spiral-shaped element one revolution during each revolution of the loops through the tank includes drive means for continuously rotating the spiral-shaped element in timed sequence with the movement of the loops through the tank.

22. The apparatus of claim **21** including adjustment means for said drive means of said spiral-shaped element whereby the speed of rotation of said spiral-shaped element may be varied to vary the length of the loops of fabric.

23. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank having a lower portion thereof for a treating liquid; a plurality of horizontally extending guide rolls in the upper portion of said tank about which a length of textile fabric having a leading end and a trailing end, each of the loops extending downwardly into the treating liquid; means to drive at least one of said guide rolls; a spiral-shaped guide element in the upper portion of the said tank having a helix defining pockets for receiving and spacing the successive depending loops of the length of textile fabric, means to rotate said spiral-shaped element one revolution during each revolution of the loops through the tank including drive means for continuously rotating the spiral-shaped element in timed sequence with the movement of the loops through the tank; adjustment means for said drive means of said spiral-shaped element whereby the speed of rotation of said spiral-shaped element may be varied to vary the length of the fabric; an endless chain at one end of said tank movable in a plane transverse to the axes of said guide rolls; said chain having an endless path with at least a portion thereof similar to the path of the fabric about said guide rolls; means for attaching the leading end of the length of fabric to the chain; means to move the chain through complete revolutions with a dwell between each revolution, said means to move the chain one revolution including clutch means for operatively connecting said chain to said drive means for said guide roll, and means responsive to each revolution of said spiral-shaped element for actuating said clutch means a sufficient length of time for said chain to make a complete revolution.

24. The apparatus of claim 23 in which said chain has a speed equal to surface speed of said drive roll.

25. The apparatus of claim 14 in which said tank is pressurized.

26. An apparatus for continuously treating a length of textile fabric in rope form and in successive depending loops with a liquid comprising: a generally elongated horizontally disposed tank having end walls and a lower portion thereof for a bath of treating liquid, said tank having an opening therein positioned above the normal level of liquid; a horizontally disposed driven roll extending between the end walls of said tank in the upper portion thereof above the liquid; a horizontally disposed spiral-shaped guide element in the upper portion of said tank having a helix defining pockets along the length thereof, said spiral-shaped guide element having an axis parallel to and spaced from the axis of said driven roll; an endless chain at one end of said tank movable in a plane transverse to the axes of the guide roll and the spiral-shaped guide element; means for attaching the leading end of the length of fabric to the chain for movement thereby; means to continuously drive said driven roll to move the loops of the length of fabric in contact over the same and downwardly into the liquid, a pulse timer actuated sequentially by the drive means for said driven roll; means responsive to each actuation of said pulse timer and operatively connected to said spiral-shaped element for moving the same through one complete revolution whereby the loop of fabric in the pocket next to said endless chain moves one pocket away so as to leave an empty pocket; drive means responsive to each revolution of said spiral-shaped element for rotating said endless chain one complete revolution of its endless path whereby the length of textile fabric fed over said drive roll down into the liquid in said tank and attached to said endless chain and passes through the empty pocket in said spiral-shaped guide element.

27. The apparatus of claim 26 in which said drive means for said endless chain includes an air operated clutch operatively connecting said endless chain to said drive means for said driven roll.

28. The apparatus of claim 26 in which said drive means for rotating said spiral-shaped guide element includes a motor and means for operating said motor a predetermined length of time, said last mentioned means being operable by said timer.

29. The apparatus of claim 26 including a threading eye mounted adjacent the opening of said tank, said threading eye being positioned to feed cloth directly to said driven roll.

30. The apparatus of claim 29 including a closure for the opening in said tank.

31. An apparatus for continuously treating a length of textile fabric in rope form and in successive depending loops with a liquid comprising: a generally elongated horizontally disposed tank having end walls and a lower portion thereof for a bath of treating liquid, said tank having an opening therein positioned above the normal level of liquid; a horizontally disposed driven roll extending between the end walls of said tank in the upper portion thereof above the liquid; a horizontally disposed spiral-shaped guide element in the upper portion of said tank having a helix defining individual loop receiving pockets along the length thereof, said spiral-shaped guide element having an axis parallel to and spaced below the axis of the driven roll; an endless chain at one end of said tank movable in a plane transverse to the axes of the guide roll and the spiral-shaped guide element; means for attaching the leading end of the length of fabric to the chain for movement thereby in an endless confined path; means to continuously drive said driven roll to move the loops of the length of fabric in contact over the same and downwardly into the liquid, means driven by said last-mentioned means for continuously rotating said spiral-shaped guide element in timed sequence with the rotation of said driven roll; means responsive to each revolution of said spiral-shaped element and operatively connected to said endless chain for rotating said endless chain one complete revolution of its endless path.

32. The apparatus of claim 31 in which said means to drive said spiral-shaped guide element includes means to vary the speed of the same relative to said driven roll.

33. The apparatus of claim 32 in which said means to drive said spiral-shaped guide element includes a speed reducer unit having a positive drive between an input shaft operatively connected to said drive roll and an output shaft operatively connected to said spiral-shaped guide element, said speed reducer unit including means to vary the speed of the output shaft relative to the speed of the input shaft.

34. An apparatus as claimed in claim 31 in which said drive means for said spiral-shaped guide element rotates the same one revolution for each revolution of the loops of fabric in said tank and in which said endless chain rotates one complete revolution for each revolution of the loops of fabric in said tank, said endless chain rotating at a speed equal to the speed of the loops of fabric.

35. The process of loading a length of textile fabric in rope form into a liquid treating tank and then continuously treating the same within the tank comprising the steps of: threading the rope into the tank over at least a first surface and a second surface with at least one of the surfaces being a traveling surface and all of the surfaces being above the liquid; attaching the leading end of the rope at one end of the tank for travel in a confined endless path, a portion of the endless path being the same as the path of the rope over the surfaces; arranging the rope to pass through one of a plurality of guide pockets; then causing successive spiral loops of rope to be sequentially formed by continuously moving the rope over the surfaces and as each loop is formed, advancing the pocket with the loop therein one pocket space away from the end of the rope attached for movement in the endless path, and then causing the attached end of the rope to move one complete revolution over the confined endless path for each revolution of the completed loops, and repeating the cycle of the travel of rope to form the successive loops so as to continuously treat the loops within the tank.

36. The process of claim 35 in which after all of the length of fabric is fed into the tank, the trailing end of the rope is allowed to follow loosely in an unconfined path within the tank.

37. The process of claim 35 in which the velocity of the leading end of the rope when moving in the confined endless path is the same velocity as the loops of rope passing over the moving surface.

38. The process of claim 35 in which the movement of the attached end of the rope in one revolution of the

confined endless path occurs during a portion of each passing of the completed loops about the moving surfaces.

39. The process of claim **35** in which the movement of the pockets is continuous with the pockets moving one pocket space for each revolution of the loops of textile fabric.

40. The process of claim **35** in which the movement of the pockets is in increments of one pocket space with a dwell therebetween for each revolution of the loops of textile fabric.

41. Winch apparatus comprising, in combination, a winch roller mounted for rotation, a convolution guide and feed member cooperating with the winch roller, a conveyor positioned near one end of the winch roller, means on the conveyor for securing thereto one end of the fabric in rope form, means for rotating the winch roller, means for driving the conveyor, and means for actuating the convolution guide and feed member to wind the fabric in rope from in helical convolutions in side-by-side relation over the winch roller and the convolution guide and feed member and to draw the fabric in rope form through the apparatus by unwinding the helix at its trailing end and compensatingly rewinding the helix at its leading end and simultaneously advance the successive convolutions in a direction toward said trailing end.

42. Winch apparatus comprising, in combination, a tank for a body of treating liquid, a winch roller mounted for rotation, a helical feed screw having its axis substantially parallel with the axis of said winch roller positioned below and to one side of said winch roller, a conveyor at one end of said winch roller and said helical feed screw, said conveyor being positioned for movement in an orbital path in a vertical plane substantially at right angles to the axis of said winch roller, means on said conveyor for fastening to said conveyor one end of the fabric to be treated in rope form, means for driving said conveyor, and means for rotating said winch roller and means for rotating said helical feed screw in timed relation with the movement of said conveyor.

43. Apparatus for treating textile fabrics in rope-like form, especially scouring and dyeing fabrics, comprising, in combination, a container for a treating medium, a driven winch roller, a guide arranged so that the fabric to be treated passes from the winch roller through the treating medium and over the guide substantially in the form of a helix, a carrier adjacent one end of the roller and attachable to and for revolving the leading end of the fabric around the adjacent ends of the winch roller and guide, drive means for driving the carrier and winch roller in the same direction to effect unwinding of the helix at its trailing end and compensatingly rewinding the helix at its leading end, and means on said guide for advancing the convolutions of the helix along the winch roller and in the direction of said trailing end whereby the position of said helix as it unwinds and rewinds remains substantially constant axially of the winch roller.

44. Apparatus for treating textile fabrics in rope-like form, especially scouring and dyeing fabrics, comprising, in combination, a container for a bath of treating medium, a winch roller, a helical feed screw spaced from said winch roller having its axis substantially parallel to the axis of said winch roller, and arranged so that the fabric to be treated extends over the winch roller, passes through the said bath of treating medium and around the helical feed screw in the form of a helix, a carrier adjacent one end of the winch roller and attachable to and for revolving the leading end of the fabric around the adjacent ends of the winch roller and the helical feed screw, means for driving the carrier and winch roller in the same direction, and means for driving said helical feed screw for advancing the convolutions of the helix along the winch roller in the direction of the trailing end of the fabric whereby the position of the helix as it unwinds and rewinds remains substantially constant axially of the winch roller.

45. The process of treating fabrics in rope form with a treating fluid which comprises winding the fabric in rope form in helical convolutions in side-by-side relation with the convolutions exposed to the treating fluid, and drawing the fabric in rope form through the treating fluid by unwinding the helix at its trailing end and compensatingly rewinding the helix at its leading end while advancing the successive convolutions in a direction towards the trailing end.

46. The process of treating fabrics in rope form with a treating fluid which comprises winding the fabric in rope form in helical convolutions in side-by-side relation with at least the lower portions of the convolutions exposed to the treating fluid, and drawing the fabric in rope form through the treating fluid by unwinding one end of the rope of fabric while moving the opposite end of the rope of fabric through an orbital path and moving the successive convolutions in the direction towards said end of the fabric being unwound in timed relationship with the unwinding and said movement in said orbital path.

47. The process of treating fabrics in rope form which process comprises establishing a bath of treating liquid, fastening one end of the fabric in rope form to a conveyor and moving said conveyor to move said fastened end in an orbital path at one end of the bath of liquid to wind the fabric in successive side-by-side convolutions extending in a direction away from the said fastened end of the fabric and toward the opposite free end of the fabric in rope form, the lower end of said convolutions being immersed in the bath of liquid and the upper portion of said convolutions being positioned in the space above the level of liquid in said bath, and drawing the loose end of the fabric through the bath by moving the free end of the fabric in rope form in a direction toward the fastened end while moving the fastened end of the rope fabric through a horizontal path and moving the successive convolutions in a direction toward said free end of the fabric in timed relation with the movement of said free end and the movement of said fastened end in said orbital path.

48. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank for a treating liquid; a guide roll about which a length of textile fabric having a leading and trailing end is treated in successive depending loops, at least a portion of the loops extending into the treating liquid; means to drive said guide roll; a fabric guide element having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric, said fabric guide element being an endless belt having a plurality of outwardly extending spaced fingers defining the pockets, said pockets being movable in a plane parallel to the axis of the guide roll; means in said tank for fixedly attaching the leading end of the length

of textile fabric thereto, said means being movable in an endless path in a plane transverse to the axis of said guide roll; means to move the pockets of the fabric guide element and means to rotate the last-mentioned means in timed relationship with rotation of the loops of fabric.

49. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank for a treating fluid; a guide roll about which a length of fabric having a leading and trailing end is treated in successive depending loops, each of the loops extending into the treating liquid; means to drive said guide roll; a fabric guide element having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric; means for fixedly attaching the leading end of the length of textile fabric thereto, said means being movable in an endless path and in a plane transverse to the axis of said guide roll; and means to alternately move the pockets one space and rotate said means to which the leading end of length of textile fabric is attached one revolution during a portion of each revolution of the loops of the length of textile fabric through the tank.

50. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank for a treating liquid; a guide roll about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, at least a portion of each of the loops extending into the treating liquid; means to drive said guide roll; a fabric guide element having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric; means for attaching the leading end of the length of fabric, said means being movable in an endless path and in a plane transverse to the axis of said guide roll; means to move said fabric attaching means through complete revolutions; means to move said pockets in timed relationship with the revolution of the loops; and said means to move said fabric attaching means including pulse timer and means operable by said pulse timer for driving said fabric attaching means at a speed substantially equal to the surface speed of said guide roll, said pulse timer being operable to move the fabric attaching means one revolution for the movement of one complete loop over the guide roll.

51. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank for a treating liquid; a guide roll about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, at least a portion of each of the loops extending into the treating liquid; means to drive said guide roll; a fabric guide element having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric; means for attaching the leading end of the length of fabric, said means being movable in an endless path and in a plane transverse to the axis of said guide roll; means to move said fabric attaching means through complete revolutions; means to move said pockets one space during every revolution of the loops; and said means to move said pockets during each revolution of the loops includes a pulse timer operable during each revolution of the loops; a motor operatively connected to said fabric guide element for moving the pockets thereof, means responsive to a pulse from said pulse timer for operating said motor for a sufficient length of time to move said pockets one space.

52. An apparatus for continuously treating a length of textile fabric in rope form with a liquid comprising: a tank for a treating liquid; a guide roll about which a length of textile fabric having a leading end and a trailing end is threaded in successive depending loops, at least a portion of each of the loops extending into the treating liquid; means to drive said guide roll; a fabric guide element having movable pockets for receiving and spacing the successive depending loops of the length of textile fabric; means for attaching the leading end of the length of fabric, said means being movable in an endless path and in a plane transverse to the axis of said guide roll; means to move the said fabric attaching means through complete revolutions; drive means for continuously moving said pockets in timed sequence with the revolutions of the loops; adjustment means for said pocket moving drive means whereby the speed of movement of the pockets may be varied to vary the length of the loops of fabric; clutch means operatively connecting the drive means for said fabric attaching means to said roll drive means; and means responsive to movement of the pockets a predetermined distance for actuating said clutch means a sufficient length of time for said fabric attaching means to move one revolution.

53. An apparatus for continuously treating a length of textile fabric in rope form and in successive depending loops with a liquid comprising: a tank for a bath fo treating liquid; a driven roll for receiving and moving the loops of textil fabric through the liquid in said tank; fabric guide means having movable pockets extending along a line parallel to the axis of said roll, said pockets receiving and spacing the loops of textile fabric; means movable in an endless path and in a plane transverse to the axis of said roll for attaching the leading end of the length of fabric thereto; means to continuously drive said driven roll; a pulse timer actuated sequentially by said drive means for said driven roll; means responsive to each actuation of said pulse timer and operatively connected to said fabric guide element for moving the pockets of the same through one space for each complete revolution of the loops of fabric so that the pocket next to the fabric attaching means moves one pocket away thereby leaving an empty pocket; drive means responsive to the movement of the pockets one space for causing said fabric attaching means to move one complete revolution of its endless path whereby the length of textile fabric fitted over said driven roll and through the liquid in said tank and attached to said fabric attachment means passes through the empty pocket in said fabric guide element.

54. An apparatus for continuously treating a length of textile fabric in rope form in successive depending loops with a liquid comprising: a tank for a bath of treating liquid; a driven roll for moving the loops of textile fabric through the liquid in said tank; a fabric guide element having movable pockets extending along a line parallel to the axis of said roll; means movable in an endless confined path and in a plane transverse to the axis of said drive roll for attaching the leading end of the length of fabric thereto; means to continuously drive said driven roll; means driven by said last-mentioned drive means for continuously moving the pockets of said fabric guide element in timed sequence with the rotation of said driven roll; means responsive

to the movements of said pockets a predetermined distance and operatively connected to said fabric attaching means for moving the latter one complete revolution of its endless path.

55. The process of treating fabrics in rope form, which process comprises establishing a bath of treating liquid, fastening one end of the fabric in rope form to a conveyor and moving said conveyor to move said fastened end in an orbital path at one end of the bath of liquid to wind the fabric rope on a support in successive side-by-side fabric convolutions, the lower portions of said convolutions being immersed in the bath of liquid and the upper portions of said convolutions being positioned in the space above the level of liquid in said bath, and drawing the fabric through the bath of liquid by rotating said support and simultaneously moving the successive fabric convolutions in a direction away from said fastened end of the fabric in timed relation with the movement of said fastened end in said orbital path.

56. A process for treating a fabric in rope form wherein said fabric is disposed on an elongated support as a helix composed of a series of fabric convolutions of fabric rope in spaced side-by-side relationship to each other along the support, and the support is rotated for treatment of the fabric, which comprises conveying an end of the fabric rope in an orbital path around said support and an adjacent elongated convoluted guide member to place said fabric rope within a convolution on said guide member, and, in timed relation with each orbit of said end, moving the convolution of said guide member away from said fastened end a distance sufficient to create and maintain said spaced side-by-side relationship.

57. A process according to claim **56** in which treatment of the fabric is accomplished by exposing at least the power portions of said fabric convolutions to a treating fluid.

58. A process according to claim **57** in which the lower portions of the fabric convolutions are immersed in a treating liquid and rotation of the support draws the fabric rope through the treating liquid.

59. The process of treating fabrics in rope form, which comprises:

A. forming said fabric rope into an essentially horizontally disposed helix having a plurality of spaced side-by-side convolutions by

1. fastening an end of said fabric rope to a conveyor at one end of a treating chamber;

2. moving said conveyor and said end in an orbital path which encloses the ends of an elongated rotatable support for said helix and an elongated screw parallel to and coextensive with said support;

3. rotating said support and said screw in timed relation with the orbital movement of said fastened end;

4. whereby a fabric convolution is engaged in a flight of said screw and draped over said support and the rotation of said screw moves its engaged fabric convolution away from said fastened end, leaving a flight without a fabric convolution near said fastened end to engage a fabric convolution successively formed by a successive orbit of said fastened end; and

5. continuing said rotation and movement until all of the fabric is formed into a helix;

B. a treating fluid contacting at least the lower portion of the thus formed convolutions,

C. continuing to convey said fastened end in an orbital path around said support and said screw to continually place fabric rope within a flight of said screw,

D. continuing said rotation of said screw to continually move each convolution away from said fastened end and provide an unengaged flight near said fastened end, and

E. continuing said rotation of said support to expose all portions of the fabric to the treating fluid.

60. Winch apparatus comprising, in combination, a tank for a body of treating liquid, a winch roller mounted for rotation, a helical feed screw having its axis substantially parallel with the axis of said winch roller positioned below and to one side of said winch roller, a conveyor at one end of said winch roller and said helical feed screw, said conveyor being positioned for movement in an orbital path in a vertical plane substantially at right angles to the axis of said winch roller, means on said conveyor for fastening to said conveyor one end of the fabric to be treated in rope form, means for driving said conveyor, and means for rotating said winch roller and said helical feed screw in timed relation with the movement of said conveyor.

61. Apparatus for treating textile fabrics in rope form comprising a tank having opposing end walls and a bottom liquid chamber, a drive main reel rotatably mounted in the tank horizontally above the chamber for drawing roped fabric into the tank in the formation of a cloth helix and revolving loops of the helix after formation thereof, a spiral guide member rotatably mounted in the tank horizontally above the chamber and in spaced parallel relation with the drive main main reel, said spiral guide member having movable pockets for guiding the fabric in spaced loops on the drive main reel, a carrier disposed at one end wall of the tank and movable in a vertical orbital path around the adjacent ends of the drive main reel and spiral guide member and having means whereby the leading end of the rope fabric is swivelly attached thereto and carried thereby around the ends of the drive main reel and the spiral guide member, said drive main reel and the spiral guide member being rotated and the carrier being revolved in timed relation with the spiral guide member so that the roped fabric helix is formed in spaced apart loops around the spiral guide member and the drive main reel with a loop being formed by the carrier in relation to the drive main reel and the spiral guide and with the laid-up loops being revolved by the drive main reel and being guided by the spiral guide member, and at least one roller disposed horizontally in the tank and positioned adjacent to and parallel with the spiral guide member and over which the formed loops are supportingly passed in their movement relative to the spiral guide member.

62. The apparatus of claim **61** wherein said roller is mounted for free rotation and is positioned above the spiral guide member so that the outer face is disposed in a vertical plane to receive the loops passing upwardly from the spiral guide member, said roller being driven solely by the traction of the loops passing thereon.

63. The apparatus of claim **61** wherein said spiral guide member is composed of a center supporting and stabilizing shaft and a helical wire member coiled around and attached to the shaft by supporting spoke

elements, the convolutions of the helical wire member defining the movable pockets, said roller being disposed above the spiral guide member and being driven so that the surface speeds of the roller and drive reel are substantially identical.

64. The apparatus of claim **61** wherein a stop control means is provided in association with the main reel for stopping operation of the apparatus.

65. The process of contacting with a liquid a continuous length of fabric in the form of a succession of loops extending around at least one roller and comprising a helix, portions of said loops being in contact with said liquid, said process comprising moving said loops in orbital paths around said roller and through said liquid whereby successive portions of said loops are contacted with said liquid, the orbital movement of the loops comprising said helix tending to accumulate said loops at one end of the helix, urging portions of said loops towards the other end of said helix and forming new loops at said first end by moving the end of said fabric at the first end of said helix through an orbital path around said roller.

66. An apparatus for contacting with a liquid a continuous length of fabric in the form of a succession of loops comprising a helix, said apparatus comprising

at least one roller around which said loops extend, means for rotating said roller and thereby moving said loops in orbital paths,

a receptacle for liquid to contact said fabric, the movement of the loops in said orbital path contacting with said liquid successive portions of said loops and tending to accumulate said loops at one end of said roller

means for engaging the respective loops and for urging said loops away from said one end,

and means for forming new loops in said helix comprising means at said one end for moving the end of said fabric at said one end in an orbital path around said roller.

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PRINTER'S TRIM LINE

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,820,950 Dated June 28, 1974

Inventor(s) Sammy G. Hiatt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Drawings:

Delete the names of William A. Squires, Edwin B. Armstrong, John W. Nix, and John V. Isley from sheet 2 to sheet 7 of the drawings.

In the front page format in the Abstract:

Lines 7 and 8, correct the spelling of "remaining"

In the Specification:

Column 1, lines 65 and 66, correct the spelling of "apparatus"

Column 6, line 10, delete "pluality of plurality" and insert --plurality of idler--

line 43, correct the spelling of "path"

Column 11, line 36, correct the spelling of "chain"

Column 12, line 38, correct the spelling of "movement"

line 47, delete "are" and insert --and--

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,820,950 Dated June 28, 1974

Inventor(s) Sammy G. Hiatt

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Claims:

Column 13, line 31, correct the spelling of "thereto"

Column 15, line 67, correct the spelling of "fabric"

Column 22, line 30, delete "fo" and insert --of--

line 32, delete "textil" and insert --textile--

Column 24, line 35, delete "main" (second occurrence)

Signed and sealed this 17th day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents