Sept. 3, 1963 C. E. NEALE 3,102,771

METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

Filed March 9, 1961 6 Sheets-Sheet 1

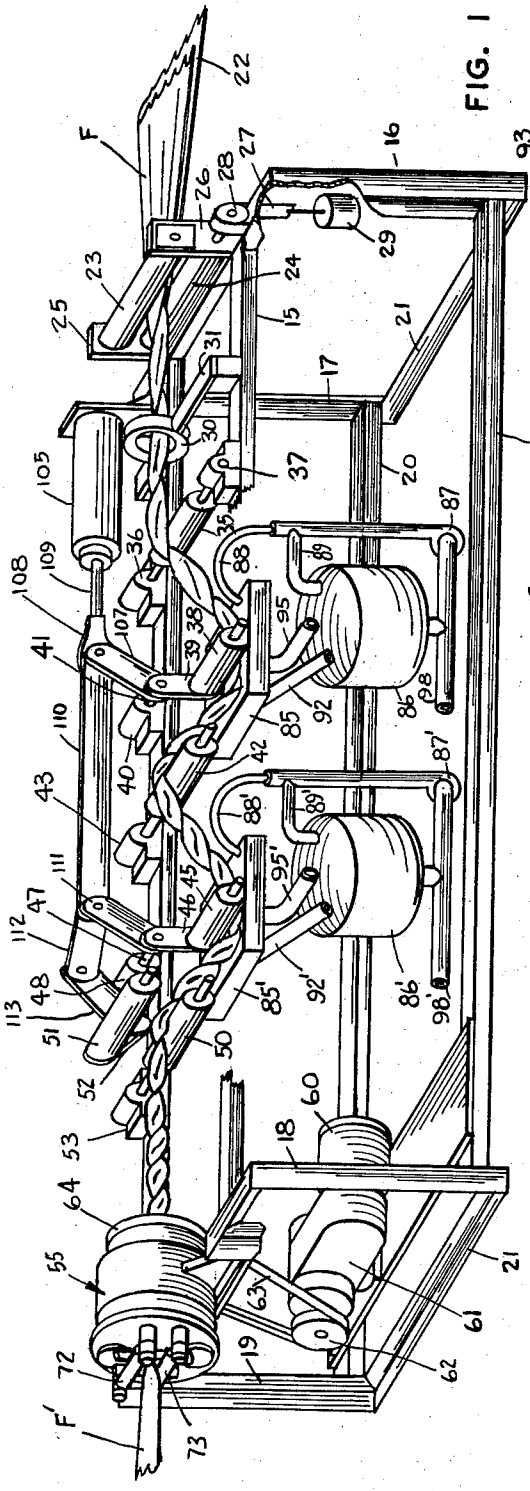


FIG. 1

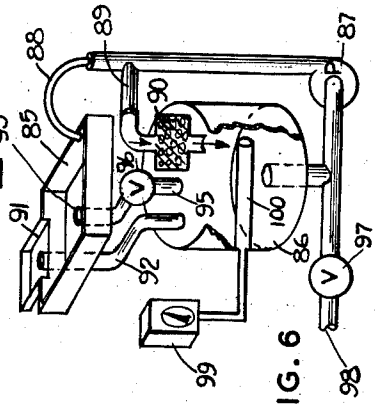


FIG. 6

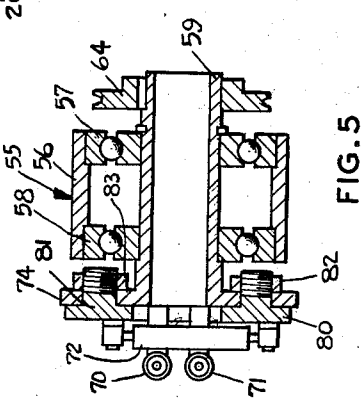


FIG. 5

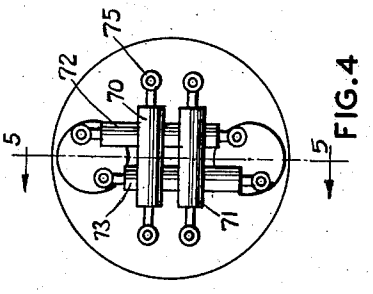


FIG. 4

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Sept. 3, 1963 C. E. NEALE 3,102,771

METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

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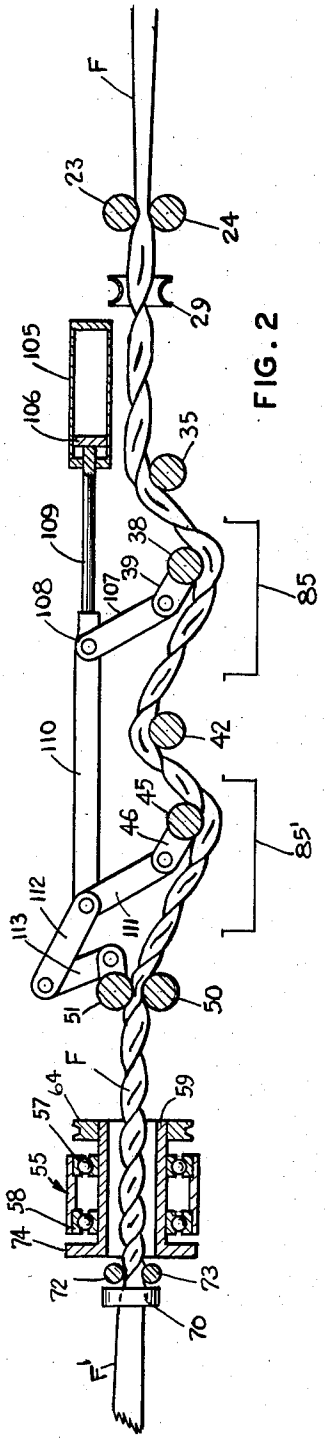


FIG. 2

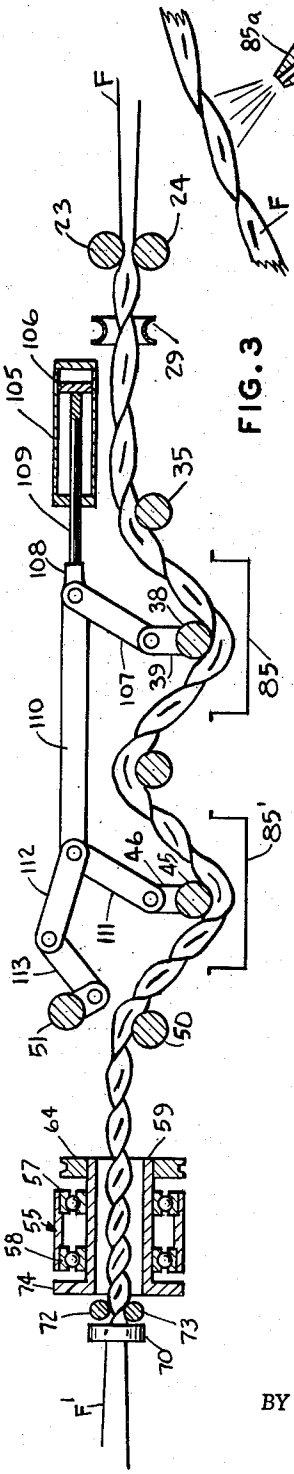


FIG. 3

FIG. 12

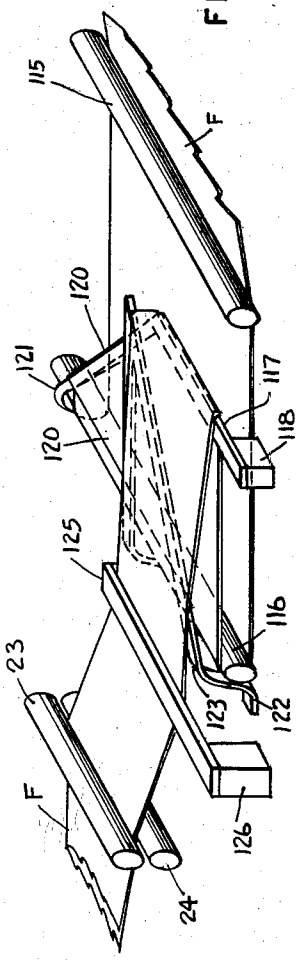


FIG. 7

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METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

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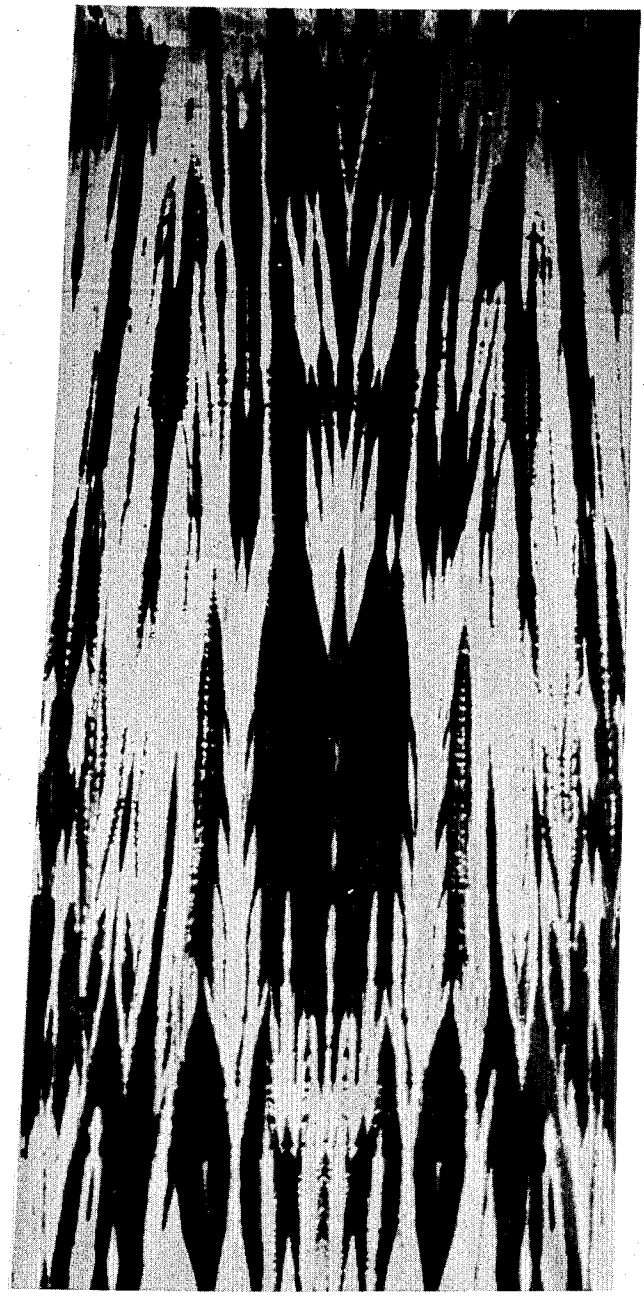


FIG. 8

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METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

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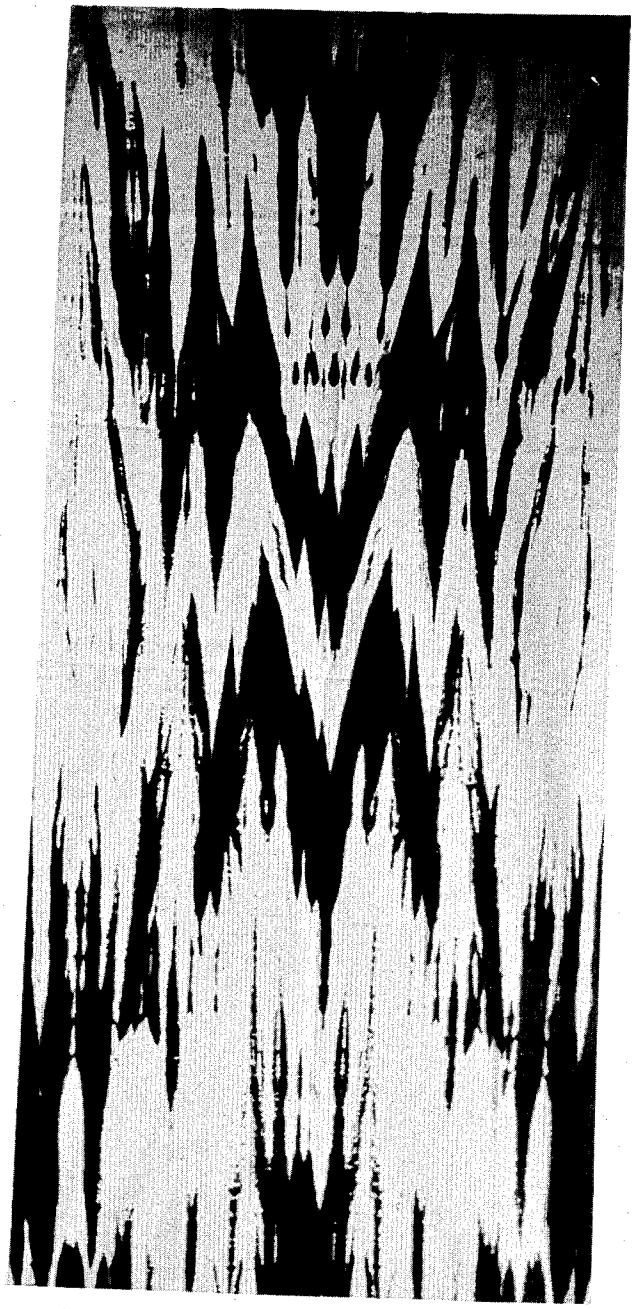


FIG. 9

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METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

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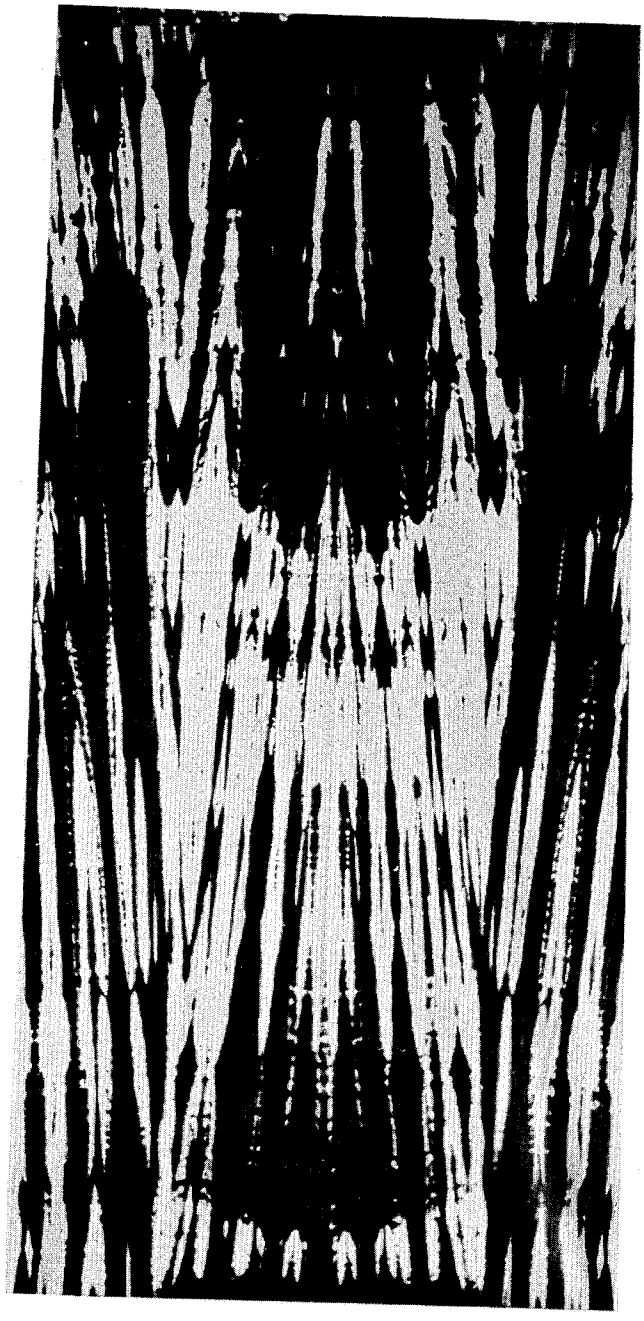


FIG. 10

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METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

Filed March 9, 1961 6 Sheets-Sheet 6



FIG. 11

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United States Patent Office 3,102,771 Patented Sept. 3, 1963

3,102,771
METHOD AND APPARATUS FOR DYEING RUNNING LENGTHS OF FABRIC

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Filed Mar. 9, 1961, Ser. No. 94,494
15 Claims. (Cl. 8—14)

This invention pertains to the continuous dyeing of running lengths of textile fabric and more particularly to the method and apparatus for achieving improved effects in the dyeing of all types of fabrics including cotton, natural, and synthetic fibers. Running lengths of textile fabric have in the past been printed by means of rather costly and expensive equipment but the ability to achieve multi-color design effects on a running length of fabric by means of a dye bath has proved to be a problem of considerable difficulty. The prior art shows several ways of producing multi-color effects in a dyed fabric. For the most part, however, these were batch or hand operations as described in Ross Patent 1,655,973. A continuous dyeing method is described in Spencer Patent 2,823,092 but the present invention carries forward the teaching of Spencer to provide far superior design effects and better apparatus from the standpoint of constant control.

The primary object of the present invention, therefore, is to provide an improved method for the continuous dyeing of running lengths of textile fabrics to provide both symmetrical and asymmetrical design effects.

A further object of the invention is to provide a method of dyeing a continuous running length of textile fabric in which the fabric is folded before running through the dye bath.

A further object of the invention is to provide a method for dyeing running lengths of continuous textile fabric in which the fabric is twisted at or before it is immersed in the dye bath.

A further object of the invention is to provide a method for dyeing a running length of continuous fabric in which the fabric is both folded and twisted at or prior to immersion in one or more dye baths.

A still further object of the invention is to provide an improved apparatus for imparting a twist to a running length of fabric as it is immersed continuously in a dye bath.

A further object of the invention is to provide an improved method for dyeing a running length of fabric in which a twist is imparted to a rope-like length of fabric in a color applying zone.

Further objects will be apparent from the specification and drawings in which:

FIGURE 1 is a perspective of my improved apparatus showing a running length of continuous fabric being immersed simultaneously in two dye baths,

FIGURE 2 is a schematic view showing the apparatus of FIGURE 1 but in a moved position in which the fabric is maintained in an elevated position without losing the twist,

FIGURE 3 is a schematic view similar to FIGURE 2 but with the fabric running through two dye baths,

FIGURE 4 is an end view of the twist imparting mechanism shown in FIGURE 1,

FIGURE 5 is a sectional detail as seen at 5—5 of FIGURE 4,

FIGURE 6 is a flow diagram showing the dye liquor circulating system,

FIGURE 7 is a schematic perspective showing the fabric folding device which controls the fabrics before it enters the dye mechanism,

FIGURES 8–11 are photographs showing lengths of fabrics dyed in accordance with the present invention, and

FIGURE 12 is a schematic view showing a modified form of device for applying color to the twisted fabric.

The invention comprise the steps of imparting a backtwist to a folded running length of fabric as it is continuously immersed and running through one or more dyeing zones. In the preferred form I utilize a dye bath or trough. However, it will be understood that the color application is made in a dye zone in which a spray or rollers or any other means may be employed to transfer the color to the goods. By the term "backtwist" I mean to indicate that the twist-imparting device is installed downstream from the dye zone and that the twist runs back along the fabric into and through the dye zone. The fabric before entering the dyeing mechanism is preferably folded one or more times to improve the unique dyeing characteristics. The apparatus also incorporates a suitable device for lowering and elevating the fabric into and out of the dye zone and simultaneously maintaining the twist in the running length of fabric when the color is not being applied.

Referring now more particularly to the drawings, the dyeing apparatus constructed in accordance with the present invention comprises a framework having an upper section 15 which is supported by four standards 16, 17, 18, and 19 which in turn are connected by ties 20, 20 and 21, 21. The fabric F to be dyed is delivered to the dyeing mechanism from a suitable source or supply, not shown, and then folded as shown at 22 once upon itself. Additional effects may be achieved if the fabric is folded more than a single time. The fabric then travels between a pair of undriven nip rollers 23 and 24 mounted in standards 25 and 26. The lower roller 24 is friction controlled by means of a brake comprising a strap 27 trained over a pulley 28 on an outboard end of the roller shaft. A suitable weight 29 is suspended from the free end of belt 27 to provide the desired braking effect which in turn prevents the roller from overrunning when the fabric stops. The fabric F is carried from nip rollers 23 and 24 through a pot-eye 30 which is mounted on frame member 31 connected to section 15. The function of pot-eye 30 is to maintain the generally central alignment of the fabric F but the pot-eye 30 does not compress nor twist the fabric.

After leaving pot-eye 30, the fabric travels over a fixed idler roller 35 journaled in bearings 36 and 37. From thence it passes under a pivoting roller 38 mounted on a pair of cranks 39, 39 one of which is broken away for purposes of clarity. Crank 39 is in turn journaled in bearing 40 through the agency of shaft 41. After passing under roller 38, the fabric F travels over a second fixed idler roller 42 which similarly is journaled in bearings 43, 43 only one of which is shown. In the event it is desired to use more than one dye treatment for the fabric, an additional dye application is provided by passing the running length of fabric F under roller 45 which like roller 38 pivots from a raised to a lowered position. Roller 45 is secured to cranks 46, 46 one of which is attached to shaft 47 and journaled in bearing 48 as was described in connection with roller 38. After passing under roller 45, the fabric travels between two normally open nip rolls 50 and 51, the latter of which is mounted in a bellcrank arm 52. Roller 50 is journaled in bearings 53, 53 in much the same manner as is the case with rollers 35 and 42.

The twist is imparted to the running length of fabric F by means of a rotating twister assembly 55 mounted on the upper framework 15 as shown in FIGURE 1. Such twister heads are known in the art, an example being shown in Jones Patent 2,695,653. The twister used in the present invention comprises a fixed housing 56 (FIGURE 5) which is securely mounted on upper framework section 15. Housing 56 carries two annular ball-bearing assemblies 57 and 58 which journal a hollow shaft 59.

Shaft 59 is rotated by means of a motor 60 driving through a variable speed unit 61, pulley 62, belt 63, and pulley 64 keyed to shaft 59. The fabric controlling and twist imparting element of the twister assembly which is mounted on the opposite end of shaft 59 comprises two pairs of parallel rollers 70, 71, and 72, 73. The individual rollers of each pair, specifically rollers 70 and 71, are parallel to each other and likewise the rollers of the other pair 72 and 73 are parallel to each other but the axes of the pairs of rollers are at 90° to each other. Rollers 70 and 71 are supported on the twisting head plate 74 by means of posts 75, 75. The second pair of rollers 72 and 73 are individually adjustable with regard to each other and this adjustability is achieved by means of a pair of rotatable segments 80 and 81 which may be turned in plate 74 to effect constant parallel positioning of rollers 72 and 73 but with variable radial spacing therebetween. A pair of lock nuts 82 and 83 shown in FIGURE 5 may be tightened to lock the rollers 72 and 73 in any desired adjusted position. It is important to appreciate the significance of the adjustment of the twist imparting rollers 70–73. The clamping effect of the rollers on the fabric produces a twist which runs back into the fabric F at least under the roller 38 or the first roller which immerses the running length of fabric into the dye. However, this clamping effect cannot be so great that more than the desired twist is imparted to the exit end of the fabric F', thereby preventing the proper rolling up on the dyed material. A predetermined reverse twist is inserted into the fabric before it is laced through the twister head 55 so that when leaving the head after twisting, the fabric will be substantially flat but still folded. It will be understood that a certain amount of hunting in the twist may be present and is desirable from the standpoint of permitting further but limited control of the appearance of the fabric. It has been observed that the twist imparted by the rollers builds up to a fixed amount at which point the fabric slips in the rollers. When slipping first takes place, the degree of twist backs off somewhat below the average, at which point the rollers securely clamp the fabric and run the twist up until slipping again occurs.

Referring now again to FIGURES 1 and 6, the dye baths and the means for supplying the dye liquor to the bath will be more fully described. The dye liquor is supplied to a trough 85 from a dye reservoir 86. A constant supply of dye bath is circulated to trough 85 through a pump 87. An orifice or restricted discharge line 88 limits the supply of dye liquor to trough 85 and a large diameter by-pass 89 insures circulation of a major portion of the dye liquor directly back into the reservoir 86 through filter 90. The depth of dye liquor in trough 85 is conveniently controlled by means of an offset overflow pan 91 having a return line 92 to reservoir 86. A drain line 95 having a suitable valve 96 permits trough 85 to be drained into reservoir 86 and complete draining of the entire system is achieved when valve 97 is opened to discharge all of the dye liquor from pipe 98. The temperature of the dye liquor in reservoir 86 is maintained at the desired level by means of an automatic temperature control system indicated at 99 and connected by suitable leads to a heater element 100 in the reservoir 86. It will be understood that any desired number of dye troughs 85 may be used in the system. FIGURE 1 shows two such dye troughs with identical reservoirs and circulating systems. The numbers used for the second dye circulating system are identical to the first system described above with the addition of primed characters.

The liquid dye application trough described above is the preferred means for applying the color to the fabric F. However, any suitable device for applying the color may be substituted. One alternative is illustrated in FIGURE 12 in which the running length of twisted fabric F is passed through a dyeing zone where the color in the form of a spray is applied to the fabric through a nozzle or an orifice 85a. Any other suitable color applying device may also be used.

FIGURE 3 shows the apparatus in normal operating or running position with the fabric F traveling under rollers 38 and 45 which in turn immerse the fabric first in dye trough 85 and subsequently in dye trough 85'. When the fabric travel is stopped for any reason during or at the end of an operating cycle, it is important to remove the fabric from the dye troughs and also to insure that the twist in the fabric does not run out in either direction. For this purpose, I utilize the initial nip rolls 23 and 24 to provide a twist block that prevents any twist in the fabric from running back beyond the rollers 23 and 24. The initial twist is held in the fabric by means of the pivoting rollers 50 and 51, which, in practice, are desirably located in close proximity to the entrance end of the twister head 55. Roller 51, as well as rollers 38 and 45, are actuated by means of a fluid pressure cylinder 105 having a piston 106 therein. Suitable fluid connections and control valves, not shown, are connected to cylinder 105 so that the piston may be reciprocated back and forth in the cylinder in a well known manner. A link 107 is pivoted to the crosshead 108 of piston rod 109 so that actuation of piston rod 109 pivots roller 38 and crank 39 from the lowered position of FIGURE 3 to an elevated position shown in FIGURE 2. A connecting link 110 actuates roller 45 in the same way since shaft 47 is connected to the crank 46 for roller 45 by means of a link 111. Another link 112 pivotally connects one arm 113 of bellcrank 52 to the end of link 110 so that upon actuation of piston 106 to the position shown in FIGURE 2 which in turn moves piston rod 109 to the left, rollers 38 and 45 are raised and roller 51 is lowered to clamp the fabric F against roller 50. This not only raises the fabric from the dye baths 85 and 85', but clamps the fabric securely between rollers 50 and 51 thus preventing the twist from running out.

The improved and unique fabric designs achieved with the present invention are chiefly accomplished by means of the backtwist in the dyeing zones described above. An additional important feature of the invention and one which permits a very unusual yet balanced effect to be achieved has to do with the pre-folding of the running length of fabric, either once or, if preferred, two or three times. This, of course, depends in some measure on the initial width of the running fabric F.

Referring now to FIGURE 7, a conventional folding device is shown used in conjunction with the improved dyeing equipment of the present invention. It is, of course, important to utilize a folding device capable of turning over a running length of fabric F at least once upon itself, but it will be understood that the fabric F may be folded any number of times depending upon the appearance results desired. The fabric F passes under a fixed or stationary guide bar 115 thence under and around a second fixed guide bar 116. From there it is laced over a flat plate or bar 117 mounted on a post 118. Plate 117 extends approximately halfway across the width of the fabric F. Edge 120 of the fabric, however, is trained around a 45° bar 121, and thence carried at right angles to the path of travel around a second 45° bar or folding element. Anchored at 122, this second flat element 123 directs edge 120 of fabric F into an underlying position under the opposite running edge. The folded fabric then passes under flat plate 125 mounted on a support 126 and from thence to and between rollers 23 and 24. It will be understood that this folding device is of a type generally well known in the art and does not, per se, form any part of the present invention. However, it does provide a satisfactory means in combination with the dyeing and twisting mechanism for continuously folding running lengths of fabric to enhance the design as is shown more clearly in the photographs of the fabrics.

In operation, the fabric F is folded back on itself at

least once as shown in FIGURES 1 and 7. The dye machine is then laced up with the fabric trained over and under the various rollers as explained above. After the fabric is laced through the twisting head **55** and rollers **70–73** a reverse twist is imparted to the fabric so that it may be rolled up in flat form. The reverse twist is equivalent to the amount of backtwist which is constantly imparted by means of twisting head **55**. It will be understood that there is slippage between the rollers **70–73** and the fabric after a pre-determined twist has been imparted. It is only sufficient that the turns per inch or per unit length in the fabric be sufficient to insure that the twist runs back at least into the first dye trough **85**.

The present invention permits a wide variation in the results achieved and at the same time with properly controlled conditions a reasonably good duplication in the same running length of fabric. If desired, a uniform pre-dye before folding may be employed. This, of course, produces a superimposed effect so that two different colors are produced but one color is added to the overall uniform background. Additional effects may be achieved by using a plurality of dye baths as shown in the present case. In this event, the superimposed unusual effects may be added to a fabric in the greige or to one that has also been previously dyed in the uniform manner. As in the case of the dye baths, additional effects and variations can be achieved by the number of folds that are initially applied to the fabric. In most cases I have found that it is preferable to fold the fabric at least once. This gives an allochiral effect which is clearly shown in FIGURES 8–11.

In order to achieve maximum control of the dyeing operation, it will, of course, be understood that variations in the type and construction of the fabric produces variable effects and will have definite bearing on the dye acceptability. Naturally any other well-known features of the fabric or the fibers having to do with dye acceptability should be maintained uniform if a maximum uniform result is to be achieved. Likewise, the tension in the fabric must be retained constant for any given run where repetition of the design is required. The number and depth of immersion is the dye troughs and consequently the dye liquor as well as the temperature and viscosity of the dye bath are all factors which may be individually or collectively varied if variation is desired. On the other hand, if uniformity is required, these conditions should be maintained as nearly constant as possible. A further important feature having a great deal of effect upon the design is, of course, the speed of fabric feed, as well as the rotational speed of the twister head **74**. Another mechanical condition which can be varied or maintained constant as desired is the torque or twisting moment applied to the fabric by the rollers **70–73** of each pair on the twisting head. This twisting moment is, of course, controlled by the lateral spacing of the rollers of each pair and is generally adjusted by means of the plugs **80** and **81**.

A very interesting and unexpected result achieved by the present invention is the ability to provide novel and unusual fabric coloring in which there are no precise repeats but in which nearly every unit length of the fabric is closely similar to every other unit length. This ability to maintain a close overall similarity in the fabric but to insure that no section is an exactly duplication of any other section is a highly desirable feature in the design and styling of such fabrics.

Referring now to FIGURES 8–11, it is to be particularly noted that the designs achieved with the present invention can be controlled to produce diverging "chevron" effects so that an entirely different visual appearance is achieved as distinguished from a mere bunching or lateral compression of the running length of fabric. In FIGURE 11 there is distinct V or chevron running down the center of the fabric with both converging and diverging lines in the same area. This, of course, is achieved

because the fabric is folded once and also because of the nonuniform twist throughout the length of the fabric, the reason being, of course, that maximum twist occurs immediately adjacent the twister plate **74** and the farther the fabric is removed from the head, the fewer turns per unit length are present. In FIGURE 10 there is even a more striking illustration of both converging and diverging pattern lines. This presents a most unusual and striking appearance and insofar as is known cannot be achieved by any other continuous machine or method. When the twist is increased or the fabric feed decreased, a sharper chevron effect can be accomplished as is clearly illustrated in FIGURE 9. FIGURE 11 shows a much more gradual divergence of the pattern marks which, of course, is accomplished by increasing the fabric feed or changing the degree of twist. The fabric shown in FIGURE 8 shows other interesting variations such as the diamond effect near the bottom of the figure, both converging and diverging striations, and the very close allochiral duplication that is achieved by means of the folding step. The permutations and combinations of effects that can be achieved by superimposing different dyes or colors by means of a plurality of dye baths and also by increasing the number of folds are almost limitless. The invention is characterized, however, by the fact that it is possible to achieve non-longitudinal designs in a fabric which can be controlled to provide almost exact duplication and which may in turn be varied to provide wide dissimilarity from one section of the fabric to another.

The operation of the device is extremely simple and lends itself to the production of a wide variety of design effects but at the same time the cost and difficulty involved are reduced to a minimum. Heretofore such effects have never been able to be achieved except by means of the very slow and more expensive printing with screens or similar techniques.

Having thus described by invention, I claim:

1. In apparatus for the continuous dyeing of a running length of textile fabric, a frame, a first pair of rollers mounted adjacent one end of said frame, a fabric guide mounted on the frame in spaced relation to said rollers, a dye bath on the frame, means for selectively immersing a running length of fabric into said dye bath, a second pair of rollers between which the running length of fabric is trained, means for releasing and clamping said second pair of rollers, and a twister head mounted at the opposite end of the frame for imparting a twist into the fabric as it runs through the dye bath.

2. Apparatus in accordance with claim 1 in which the first set of rollers is provided with a friction brake.

3. Apparatus in accordance with claim 1 having a variable speed drive for the twister head.

4. Apparatus in accordance with claim 1 in which the means for raising and lowering the fabric with respect to the dye bath comprises a pivoting roller under which the fabric travels and linkage means for raising and lowering said roller.

5. In apparatus for the dyeing of a running web of continuous fabric the combination which comprises a framework, a pair of nip rollers mounted at one end of said framework, a fabric folding device positioned in advance of said nip rollers for folding a running length of fabric on itself, at least one dye bath mounted on the framework, a roller pivotally mounted on the framework, means for moving the roller into and out of the dye bath to selectively immerse and elevate the length of running fabric passing under the roller, a pot-eye through which the fabric travels between the nip rollers and the dye roller, a pair of clampable nip rollers through which the fabric passes after leaving the dye bath, means for selectively clamping the fabric between said clamping rollers when the fabric is elevated from the dye bath, and a twister head adjacent said clamping rollers for backtwisting the fabric into and through the dye bath.

6. Apparatus in accordance with claim 5 having a plurality of dye baths.

7. Apparatus in accordance with claim 5 having unitary means for actuating the dye roller and the clamping rollers.

8. The method of continuously dyeing a running length of textile fabric which comprises the steps of flat folding the running length of fabric, immersing said folded fabric in a dye bath, removing the fabric from the dye bath, imparting a twist to the fabric, running the twist back into and through the dye bath, untwisting the fabric, and rerolling the fabric.

9. The method of claim 8 in which the fabric is immersed gradually in a plurality of dye baths and in which the number of turns of twist per unit length varies gradually from one dye bath to the next.

10. The method of continuously dyeing a running length of textile fabric which comprises the steps of twisting a leading end of said length of fabric in one direction, imparting a reverse twist to said length of fabric in the opposite direction in a twisting zone, running said reverse twist back in the direction of fabric feed, immersing said fabric in a dye bath in the area of said reverse twist, removing the fabric from the dye bath, and clamping the fabric between the twisting zone and the dye bath to prevent run-out of the twist.

11. The method of claim 10 including the step of clamping the fabric before it enters the dye bath.

12. The method of claim 10 including the steps of simultaneously immersing and removing the fabric from a plurality of dye baths.

13. The method of claim 10 including the step of folding the fabric at least once upon itself before immersing in the dye bath.

14. The method of continuously dyeing a running length of textile fabric which comprises the steps of immersing said fabric in a first dye bath, imparting a given number of turns of twist to the fabric as it passes through said first dye bath, removing the fabric from the first dye bath, immersing the fabric in a second dye bath, imparting a greater number of turns of twist to the fabric as it passes through said second dye bath, removing the fabric from the second dye bath, and removing the twist imparted in both of said dye baths.

15. The method of claim 14 including the step of folding the fabric at least once upon itself before immersing in the first dye bath.

References Cited in the file of this patent

UNITED STATES PATENTS

1,342,935	Bancroft	June 8, 1920
1,623,709	Smith	Apr. 5, 1927
1,655,973	Ross	Jan. 10, 1928
2,117,603	Dungler	May 17, 1938
2,741,893	Vandamme et al.	Apr. 17, 1956
2,823,092	Spencer	Feb. 11, 1958
2,960,963	Sheldon	Nov. 22, 1960

FOREIGN PATENTS

684,695	Great Britain	Dec. 24, 1952
794,503	Great Britain	May 7, 1958