April 16, 1968 A. J. PERRY 3,378,332

CONTINUOUSLY PASSING A FABRIC THROUGH A SCOURING BATH IN A PATH ADJACENT TO A SERIES OF PRESSURE STREAMS OF SCOURING LIQUID

Filed Dec. 23, 1963 2 Sheets-Sheet 1

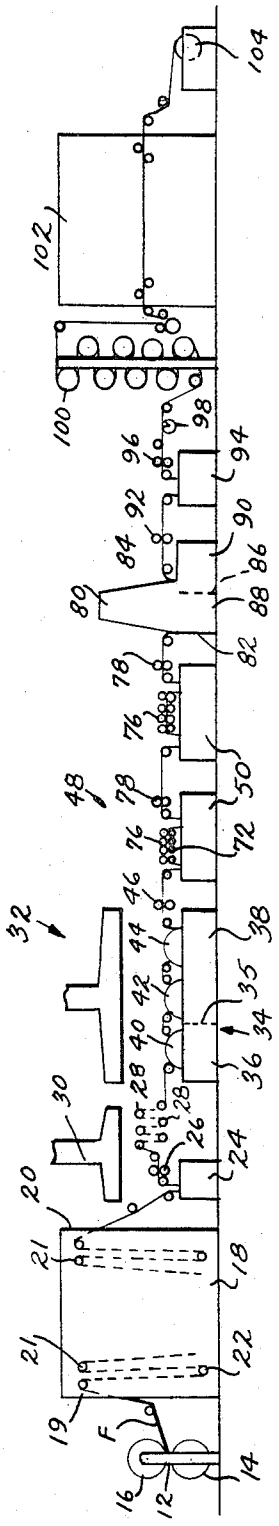

Fig. 1.

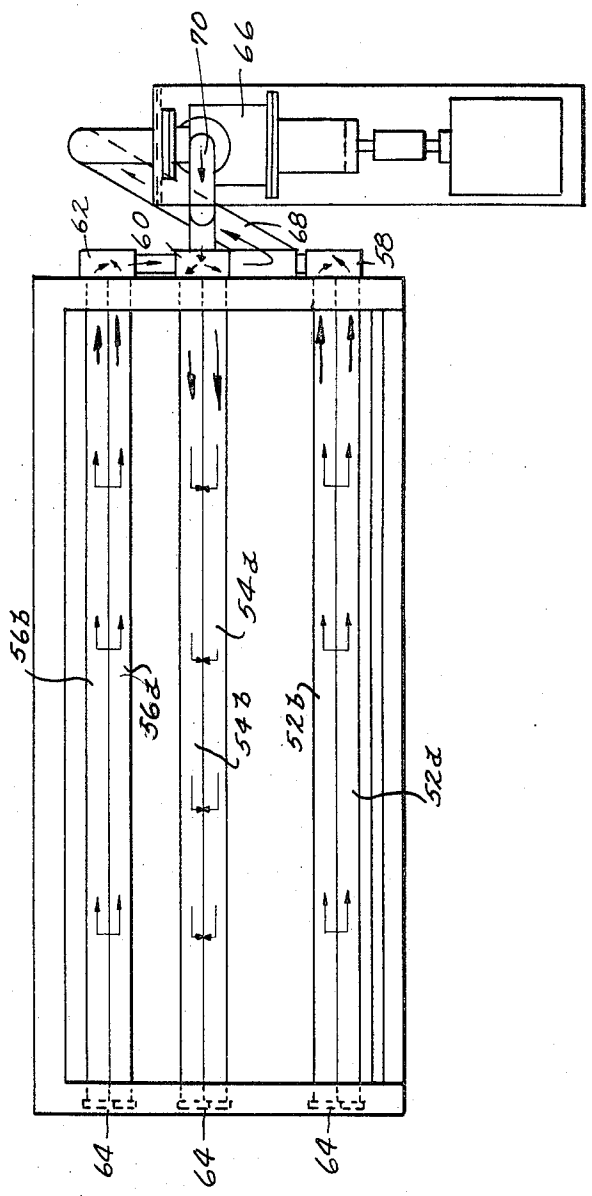

Fig. 4.

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Fig. 3.

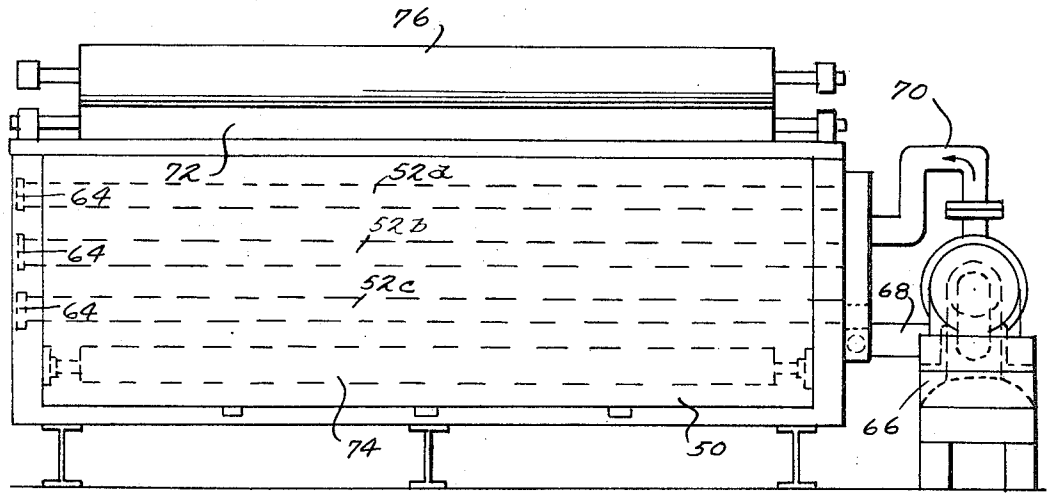
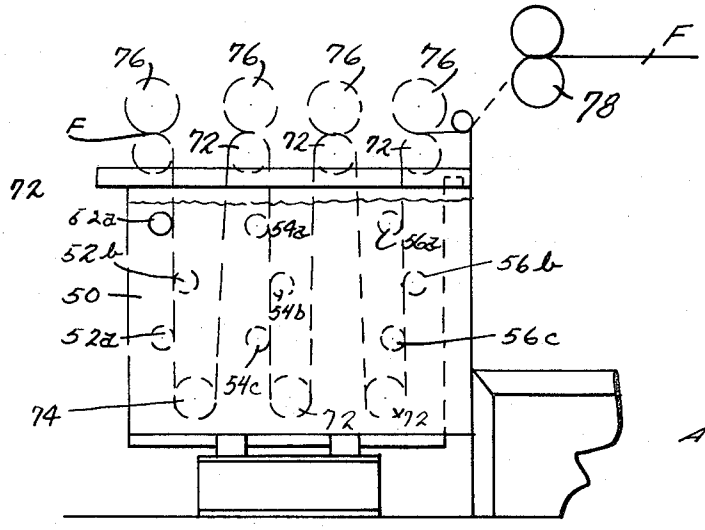


Fig. 2.



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ABSTRACT OF THE DISCLOSURE

There is provided a continuous process for treating a textile fabric whereby the fabric is efficiently washed and accomplishes removal of soil which is disposed within the fabric. The fabric is accumulated in a series of vertical, essentially wrinkle-free folds after which it is scoured by forcing scouring liquid alternately back and forth through the fabric by passing the fabric in a serpentine fashion adjacent to a series of pressure streams of scouring liquid.

The present invention relates to a novel method and apparatus for continuously processing textile fabric, especially fabric which is normally treated in open width. The invention is particularly concerned with the preparation of fabric which is to be subsequently dyed or otherwise processed on a jig, although the invention is not limited thereto, e.g. the processing of white fabrics is contemplated.

Textile materials which are generally processed on a jig have characteristic features requiring open width treatment. Typical of such materials are the filament yarn fabrics of specific weave constructions, e.g. taffetas comprising nylon, polyethylene terephthalate (such as Dacron) and/or cellulose acetate. Processing this type fabric in rope form or in other ways where the material is not in open width is unsatisfactory because creases, wrinkles, shifted yarn ends and uneven dyeing result.

Because of the above-mentioned problems in handling taffeta or the like, it has become standard practice in the art to prepare the fabric for dyeing right on the jig. It will be appreciated that such preparation requires a number of treatments such as desizing, degeasing, and cleaning, scouring, etc. in order to place the fabric in a condition which will give consistently uniform and otherwise satisfactory dyeing. Necessarily, these operations are carried out batchwise on the jig, and the preparation for dyeing is, therefore, very time-consuming. In fact, it is quite customary for the preparation to take twice as long, or even longer, than the actual jig dyeing itself. This, of course, means that dyeing production is substantially reduced due to the fact that the jig equipment is involved in the more time-consuming preparations for dyeing. Additionally, it is difficult to obtain a uniformly treated fabric by these methods with the result that dyeings may be uneven and blotchy. Despite these problems, however, processing on the jig has been considered, up to the present time, as the best way of preparing taffetas or other fabrics requiring open width treatment.

It will be apparent from the foregoing that the principal object of the present invention is to provide a method and apparatus for preparing fabric, particularly for jig dyeing or the like, which are free from the disadvantages encountered in prior treatments. A more specific object of the invention is to provide a jig-free method for effectively preparing fabric. An additional object is to provide a unique and highly effective method and means for scouring fabric. Still another object of the invention is the provision of method and apparatus for preparing fabric which give a product of optimum characteristics at substantially reduced cost and time. A further object of the

invention is the provision of a method and apparatus for continuously preparing the fabric whereby batch operations and the difficulties caused thereby are obviated. Other objects and advantages will also be apparent from the following detailed description of the invention and the accompanying drawings wherein:

FIGURE 1 is a diagrammatic view of a system for preparing fabric for jig dyeing or otherwise processing the same according to the invention;

FIGURE 2 is an end view of scouring means used in the invention;

FIGURE 3 is a front elevation of the scouring means; and

FIGURE 4 is a top plan view of these means.

Broadly stated, the method contemplated herein involves the following steps carried out continuously: providing a supply of fabric to be processed; withdrawing fabric from the supply and accumulating the thus-withdrawn fabric as a series of vertical, essentially wrinkle-free folds; passing the accumulated fabric through a liquid cleaning bath if desired; then control shrinking the fabric in the wrinkle-free condition; scouring the fabric by forcing scouring solution back and forth through the fabric and then washing, neutralizing, if necessary and drying.

The thus-processed product, if it is to be colored, may be jig dyed to give dyeings of consistent uniformity. Alternatively, if whites are involved, the product may be utilized directly without treatment on the jig.

A critical feature of the invention, as broadly described above, resides in the scouring operation. To this end, the invention contemplates a forced internal circulation system to provide the scouring action which, as indicated, is effected by forcing the scouring solution back and forth through the fabric construction as opposed to standard practice where the motion of the fabric is utilized to create the cleaning action. This feature is described in more detail below.

Referring more particularly to the drawings, the system of FIGURE 1 includes the fabric supply means which, as shown, comprises a two-roll let-off stand made up of an appropriate bracket or supporting assembly **12** for two rolls **14** and **16** of greige fabric or the like to be processed. This arrangement makes it possible to mount a new roll, for example roll **16**, to replace a previously exhausted one before roll **14** runs out of fabric thereby providing for continuous fabric supply. When, for example, roll **14** is nearly exhausted, the end of fabric thereon may be simply sewed to the beginning edge of the other roll **16** so that the fabric feed will continue. This method of supply also facilitates inspection and treatment for dirty knots, the latter being a problem which frequently occurs, especially in the case of fabric containing nylon yarns. Dirty spots of this type may be removed from the fabric before it is fed into the accumulator **18** by means of a solvent spray gun or the like.

From the appropriate supply roll, the fabric (F) is introduced into the accumulator **18** whose main function is to take up sufficient fabric to allow for continuous operations taking into account the relative times involved in previous and subsequent operations. The fabric is fed into the accumulator at inlet end **19** and withdrawn at the exit end **20**. Included within the accumulator is an upper horizontal row of rolls **21** spaced evenly across the top of the accumulator and a bottom horizontal row of rolls **22** spaced along the bottom of the accumulator. As shown, the fabric (F) is passed sequentially over a top roll **21** and under a bottom roll **22** through the accumulator. The vertical folds of fabric formed in the accumulator are essentially wrinkle-free and there is no significant fillingwise tension thereon.

Some lengthwise tension is exerted on the fabric but this is uniform across the width of the fabric.

It will be appreciated that any number of rolls **21** and **22** may be employed in the accumulator and the distance separating the top and bottom rows may be widely varied depending, for example, on the holding time desired. Typically, however, the accumulator may include something of the order of fourteen top rolls **21** and fifteen bottom rolls **22**, separated by a distance vertically of from 2–12 feet, advantageously four feet. Retention times of the order of 1–5 minutes are usually sufficient, although the time for any particular situation will vary depending on the fabric being treated and the nature of the treatments.

The fabric emerging from the accumulator **18** is then advantageously subjected to an overall cleaning treatment by immersion in an appropriate multi-dip solvent or chemical bath **24**, the fabric leaving the bath being passed through pressure nip rolls **26** to facilitate the cleaning action on the fabric. This phase of the system also includes a plurality of retention rolls **28**, six such rolls being shown in FIGURE 1, to prolong the chemical or solvent cleaning action on the fabric before it goes to the next operation.

The number of dips in bath **24** and the number of retention rolls **28** may be varied and will depend on a number of factors such as the type of fabric being processed, the surface condition of the fabric, the type and strength of the chemical bath used, the linear speed of the fabric passing through the unit, etc. It should also be understood that this cleaning treatment may not be necessary at all in certain cases although it is usually preferable to use this step especially in the case of whites and other light shades of fabrics. Thus, cleaning at this stage plus the other cleaning operations included in the system herein makes it possible to complete the processing of whites in the manner prescribed without any further treatment on the jig. This itself represents a substantial improvement over existing processing techniques where whites and light shade materials generally must be subjected to various treatments on the jig to insure satisfactory results.

Nip rolls **26** serve to pull the fabric from the supply rolls **14** or **16** through the accumulator **18** and bath **24**. This makes it possible to feed the fabric through the retention rolls and subsequent shrinking operation, as described below, without the lengthwise tension which would otherwise be required to pull the fabric through the prior operation. As a result, excessive warp tension is avoided and there is, therefore, no significant tension or pulling in on the fabric width.

Exhaust means, broadly shown at **30**, are provided for vapor removal during the cleaning treatment. This makes it posible to use a wide variety of solvents or cleaning agents in the bath **24**. The choice of any particular cleaning agent and the amounts thereof will depend on other operating conditions such as the nature of the fabric being treated although a typical illustration of one such bath is given elsewhere herein. Usually, the temperature of the bath **24** will be in the range of 100 to 160° F., although other temperatures may also be used. The time of treatment may be in the neighborhood of 1.5 to 2.0 minutes.

From the cleaning operation, if used, the fabric F is passed through a so-called creper drum boil-off phase broadly designated by the numeral **32** where uniform and controlled shrinkage of the fabric is effected while the fabric is subjected to appropriate chemical treatment. As noted above, the nip rolls **26** of the chemical pad or cleaning bath function to deliver the fabric to the creper drum boil-off operation with little, if any, tension in the filling or width direction. Thus allows a maximum amount of shrinkage (usually of the order of 3.0 to 3.5% from the original fabric width) with uniform width control and thus eliminates the high incidence of creases normally encountered in jig scouring the fabric. More particularly, when scouring on the jig according to conventional practice, shrinkage occurs in several progressive stages with each end or pass through the jig. The characteristic variations in jig speed, tension and roll build up retention time, result in uneven shrinkage. Uneven shrinkage causes uneven roll build up, creases and other physical defects on the fabric and dyeing defects such as dark selvedges, shade variation and corrugation streaks. All of these factors are eliminated or at least highly minimized by fabric pre-shrinkage according to the invention before loading onto the jig for dyeing.

The creper drum boil-off section **32** comprises an appropriate boil-off tub **34**, partitioned as shown by the broken lines **35**, into sections **36** and **38**. In the embodiment illustrated, the first section **36** is provided with a rotating creper drum **40** of stainless steel or the equivalent, while the second section **38** includes two such creper drums **42** and **44**. However, it is to be understood that the number of drums, as well as their diameter and rotational speed, can be varied depending on such factors as retention time desired, as will be understood by those in the art.

The passage of the fabric around the rotating drum surfaces in contact with the treating agent in sections **36** and **38** provides the necessary retention time for maximum shrinkage of the fabric while the fabric is in a relatively relaxed, yet smooth state on the drum surface. The use of a partitioned boil-off tub **34** is advantageous because it permits the use of different reagents or temperatures in the two sections **36** and **38** if desired.

After the indicated controlled shrinkage step, the fabric leaves the section **38** and drum **44** through a pair of nip rolls **46** which deliver the fabric to the next operation in an essentially tensionless state. These nip rolls **46** also serve to squeeze out any excess treating solution from the controlled shrinkage section **32** which might still remain in the fabric thus permitting a fuller penetration and more effective operation of the treating liquid of the next step, i.e. the forced circulation scouring operation referred to previously and identified generally by the numeral **48** in FIGURE 1.

The scouring operation includes at least one scouring tank **50** and advantageously two such tanks as shown in FIGURE 1. The construction of these tanks is shown in FIGURES 2–4 and with particular reference to FIGURE 2, it is to be noted that the tank is provided with three vertical sets **52**, **54** and **56** of conduits or pipes which are parallel and extend the length of the tank. Each set comprises three pipes, the top, middle and bottom pipes in each set being further identified by the letters *a*, *b* and *c*, respectively. As shown, the middle pipes *b* of each set are located somewhat off line with respect to the top and bottom pipes *a* and *c* so that the fabric (F) may be threaded therebetween in the manner shown in FIGURE 2.

Each of the pipes is provided with an elongated slot facing towards the fabric and in close proximity thereto as shown. Advantageously this slot is long enough to run the full width of the fabric although, if desired, a series of shorter slots spaced along the length of the pipe may also be used.

At one side of the tank **50**, there are provided manifolds **58**, **60** and **62** which communicate respectively with the adjacent ends for the three pipes in each set **52**, **54** and **56**. The opposite ends of these pipes are closed, as shown at **64**, while the manifolds **58**, **60** and **62** are connected to either the suction side or pumping side of a liquid circulating pump **66**. In the embodiment shown, manifolds **58** and **62** are connected through conduit **68** to the suction side of pump **66** while manifold **60** is connected through conduit **70** to the pumping side. As a result, scouring liquid in tank **50** is withdrawn by the pump through the fabric, the slots in the pipes of sets **52** and **56** and manifolds **58** and **62** into the suction side

of the pump. The pump then discharges scouring liquid through conduit **70**, manifold **60** and the slots in the pipes of the middle set **54** through both sides of the fabric within the tank. The directions of flow are shown by the arrows in FIGURE 4 and it will be seen that the system provided constitutes a closed scouring liquid circulating system whereby liquid is alternately sucked and blown through the fabric to completely penetrate the fabric and effect the desired scour.

It will be appreciated that the number and positioning of the pipes in tank **50** may be varied from that shown without deviating from the invention. Additionally, the operation of the various pipes may be reversed, e.g. the pipes of sets **52** and **56** may be connected to the discharge side of the pump while the pipes of set **54** connect to the suction side.

To accomplish the desired forced circulation of scouring liquid, i.e. the alternate sucking and blowing action, the fabric (F) may be fed through the tank **50** in the manner shown in FIGURE 2 using a top set of idler rolls **72** and a bottom set **74**. As noted, this gives an unusually effective scouring action but a further cleaning effect may also be obtained by mounting a soft bristle brush roll **76** above each of the top idler rolls **72**. These brush rolls are appropriately spaced or gapped with respect to rolls **72** in order to prevent any significant downward pressure against the fabric. The purpose of these brush rolls is to provide a brushing and cleaning action in the event of greasy knots as might be the case when treating nylon fabric. It is contemplated that the first brush roll **76** adjacent the inlet end of tank **50** will rotate in one direction, e.g. counter-current to the fabric travel, while the other brush rolls will rotate in the direction of fabric travel. In any case, the peripheral speed of the brush rolls **76** should be greater than the linear speed of the fabric in order to obtain the desired action although the speed used can be varied and will depend on other operating conditions.

The second tank **50** shown in FIGURE 1 may also be used for scouring or, if desired, this tank may be used for a water wash employing the forced circulation or reverse flow feature to improve the washing effect. For instance, when white and other light colored fabrics are processed, one or more scouring tanks **50** provided with flow or liquid circulating means substantially as described above may be employed. However, when darker shades are involved, a wash operation utilizing the forced circulation feature may be advantageously employed after one or more scours in the manner indicated.

Some further shrinkage may occur during the scouring operation depending on the extent of shrinkage in the boil-off step. In any case, however, the product leaving the forced circulation scour or scour and wash is dimensionally stabilized for subsequent jig dyeing if the latter is contemplated.

From the forced circulation scour, with or without wash, the fabric is passed through a pair of nip rolls **78** which squeeze excess scouring or washing agent out of the fabric, permit fuller penetration of subsequent treating agents and deliver the fabric to the next operations in an essentially tensionless state.

If additional rinsing action is desired, the fabric may be advantageously introduced into a spray tower **80** where the fabric is treated with hot water sprays. The inlet and outlet (or doff) ends of the tower designated by the numerals **82** and **84**, respectively, may each be provided with a set of pressure spray nozzles (not shown) positioned to spray both the face and back sides of the fabric with water. Conveniently, the spray tower tub **86** is partitioned into two parts **88** and **90**, the latter being referred to herein as the doff-side section. New make-up water is used in the doff-side section and control heated to, for example 120–140° F. Doff-section water is supplied to the spray nozzles from the entry section **88**.

After the pressure spray cleaning operation, if used, the fabric is again passed through a pair of nip rolls **92** which function in a manner substantially the same as described above for nip rolls **78**. From these rolls **92**, the fabric may be introduced into a neutralizing bath **94** which may comprise, for example, two dip immersion pans containing dilute acetic acid or the equivalent and a pair of nip rolls **96**. This operation serves to neutralize any alkaline agent that might yet be present on the fabric from the scouring operation. The pH of the acid solution is generally maintained at about 5.5 to 6.5, preferably at about 6.0 but this may be varied depending on other conditions.

Following the neutralizing treatment, if used, the fabric may then be passed over an air suction slit **98** which removes additional water and facilitates drying of the fabric. Drying is then completed by passing the fabric over a stack of drying cans **100** after which the fabric is taken up in a doff-end accumulator **102** generally similar to the inlet accumulator **18**. The doff-end accumulator permits continuous operations by providing time for doffing a full roll of treated fabric and mounting another. Spindle takeup drive means **104** are preferably used to build up the doff roll. The resulting combination with the accumulator **102** very effectively avoids creases and wrinkles and shifting of yarns. The doffed roll of fabric may then be used or treated as desired. As noted, whites which by-pass jig dyeing may be inspected at this stage prior to other uses while fabrics which are to be dyed may be stored indefinitely without damage pending jig dyeing.

The invention is further illustrated by the following example using a nylon taffeta fabric in greige form:

The fabric is taken off one of the supply rolls **14** or **16** and fed into the accumulator **18**. Residence time in the accumulator is about 1.5 minutes. The fabric is then fed into a cleaning bath **24** at a temperature of about 110° F. and having the following composition:

Sodium silicate	gals.	4.0
Hydrogen peroxide	gals.	1.0
Tetra sodium pyrophosphate	lbs.	2.0
Polyoxyethylene-thio ether	gals.	1.5
Varsol	gals.	25.0
Modified hydroxy polyamino carboxylic acid	lbs.	3.0
50% sodium hydroxide	lbs.	20.0
Water to make 100 gallons		Balance

From the cleaning bath (three dips being employed), the fabric is passed through the nip rolls **26** and retention rolls **28** into the boil-off tank **34**. The two sections **36** and **38** of the tank are filled with the same treating solution, namely, one of the following composition:

Modified hydroxy polyamino carboxylic acid	lbs.	6
Soda ash	lbs.	55
Long chain-alcohol-sulphate	lbs.	27
Varsol	gals.	80

Mixed with water to form 5 to 10% solution.

The temperature of this solution is kept at 140° F. in the first section **36** and at 200° F. in the second section **38**. Retention time (at 25 yards per minute) is about 0.2 minute in section **36** and about 0.50 minute in section **38**. An average of 25% of this solution is added as makeup per 6,000 yards of fabric treated.

After this controlled shrinkage treatment where the fabric shrinks on drums **40**, **42** and **44**, the fabric passes through the nip rolls **46** into the forced circulation scouring unit **50**. The scouring solution may comprise the following:

Modified hydroxy polyamino carboxylic acid	lbs.	3.0
Soap	lbs.	5.0
Soda ash	lbs.	46.0
Long chain-alcohol-sulphate	lbs.	35.0
Varsol	gals.	45.0

Mixed with water to form 5 to 10% solution.

Makeup scour solution may be provided at the rate of 25% (by volume) of the original amount after every 6,000 yards of fabric treated. The scouring agent is advantageously kept at a temperature of 200° F. and the fabric retention time (at 25 yards per minute) is about 0.20 to 0.25 minute. The second unit **50** in this case may be a water wash operating in the same manner as the scour, i.e. by repeated reverse flow of solution through the fabric due to the novel arrangement of slitted sets of conduits described above. Temperature of the water wash may be in the area of about 160° to 180° F.

From the scour and wash tanks **50** the fabric is then passed successively through spray tower **80** where it is rinsed; acetic acid pad **94** where the fabric is neutralized (the acetic acid solution being maintained at a pH of about 6.0); air suction slit **98** to remove additional water and facilitate drying; dry cans **100** where the fabric is dried and then rolled up by means of the doff-end accumulator **102** and the spindle drive takeup means **104.**

The above-described process and the product obtained thereby are characterized by a number of advantages over prior preparation procedures. Some of these advantages are:

(1) Superior scouring and washing of fabric which results in a higher degree of dyeing uniformity. This eliminates or minimizes dyeing defects such as dye blotches, streaky dyeing and shade variations;

(2) Uniform shrinkage control which eliminates or minimizes creases and dark selvedges;

(3) Continuous operation which eliminates defects such as boil-off marks, uneven shrinkage, etc. encountered normally with batch operations;

(4) Elimination of the necessity for using the jig for processing white fabrics or for preparation of fabric to be dyed thus providing increased availability of jigs for dyeing operations and also avoiding fabric defects characteristic of jig processing; and

(5) Substantially reduced costs with a radically improved fabric that can be jig dyed to give uniform dyeings of optimum overall characteristics.

Other advantages and possible modifications of the invention will be appreciated from the foregoing description which is given for illustrative purposes, the scope of the invention being defined in the following claims wherein:

What is claimed is:

1. In a continuous process for treating a textile fabric comprising the following steps: providing a supply of fabric to be treated; withdrawing fabric from said supply and accumulating the same in a series of vertical, essentially wrinkle-free folds; shrinking the fabric and scouring the fabric the improvement comprising scouring the said fabric by forcing scouring liquid alternately back and forth through the fabric by passing the fabric in a serpentine fashion adjacent to a series of pressure streams of scouring liquid.

2. The process of claim **1** wherein the fabric is subjected to a further cleaning treatment prior to shrinking.

3. The process of claim **1** wherein the fabric is in the essentially tensionless state widthwise during said shrinking and scouring.

4. The process of claim **1** wherein the scouring agent is alkaline and the fabric after scouring is spray washed, neutralized and then dried.

5. The process of claim **1** wherein the scouring solution is forced back and forth through the fabric by successively sucking and blowing the solution through both sides of the fabric.

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