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Chiba et al.

[11] **3,802,840**

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[54] **METHOD FOR TREATMENT OF A FABRIC**

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Related U.S. Application Data

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[30] **Foreign Application Priority Data**

Aug. 10, 1970 Japan 45-69270

[52] **U.S. Cl.** **8/152**

[51] **Int. Cl.** **B05c 3/08**

[58] **Field of Search** ..... 8/158, 152, 150; 68/175, 68/177, 178, 181 R, 184

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Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A method for liquid treatment of a fabric, in which the fabric to be treated in a rope form or web form is circulated in a predetermined direction within a treatment bath in a treatment tank, is disclosed. There is provided, of the treatment bath in the treatment tank, a treatment chamber consisting of a shower section provided with a fabric inlet, and a treatment section communicated with the shower section and having at least one constricted portion in the midway thereof, and surrounding the fabric so as to pass the fabric therethrough. A treatment conduit extends from the treatment chamber to within the treatment bath in the treatment tank. A treatment liquid is supplied to within the shower section of the treatment chamber to seal the fabric inlet with the liquid during the circulating process of the fabric. The treatment liquid is then jetted in the direction of travelling of the fabric within the treatment section to cause the treatment liquid to spout through the clearance between the fabric and the constricted portion when the fabric passes through the constricted portion, to thereby impart to the fabric a positive shaking motion. The fabric is then led from the outlet of the treatment chamber through the treatment conduit to within the treatment bath while maintaining the fabric to be immersed in the treatment liquid.

1 Claim, 6 Drawing Figures

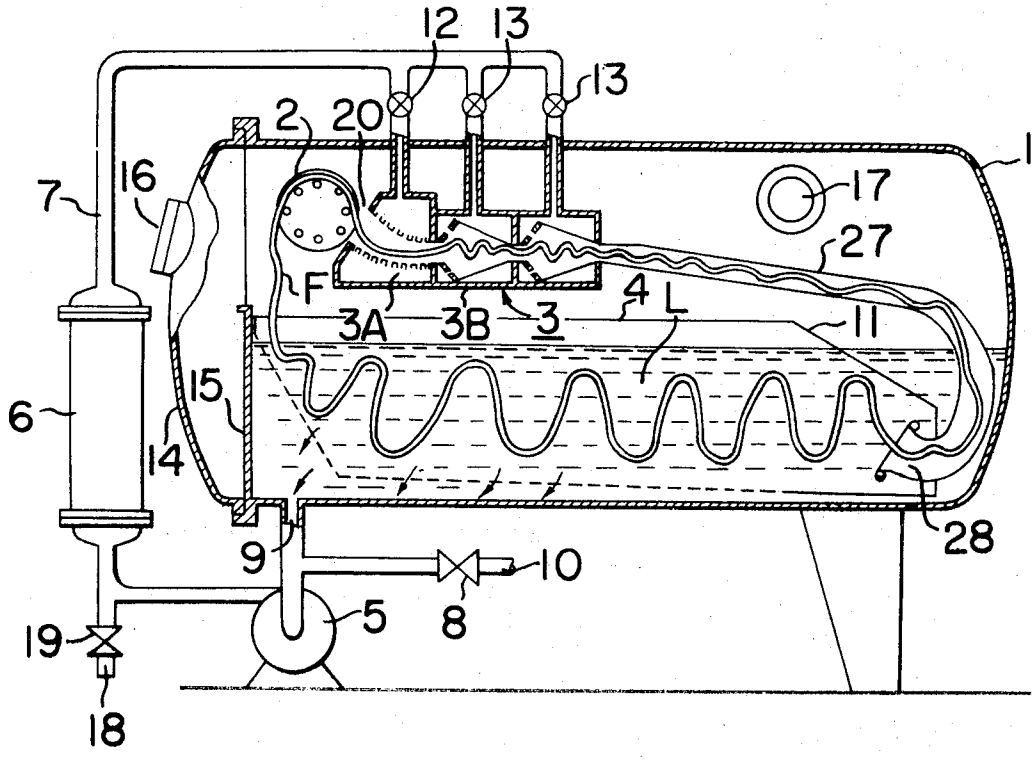


FIG. 1

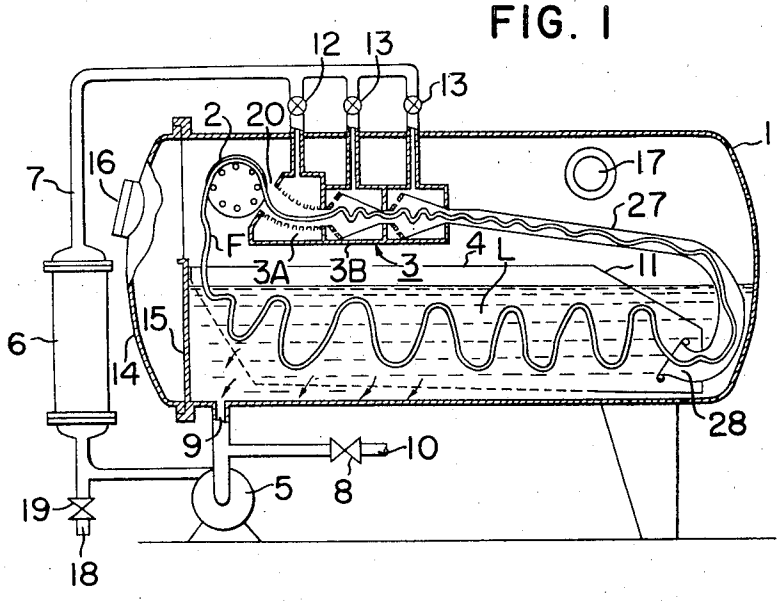

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FIG. 2

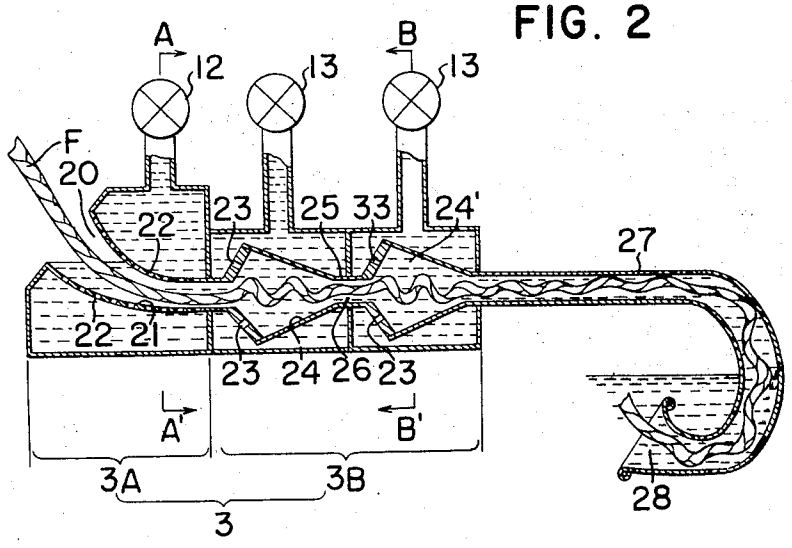

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FIG. 3

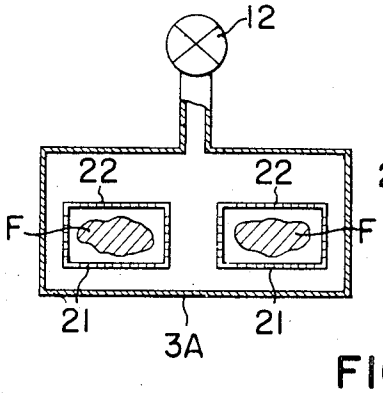


FIG. 4

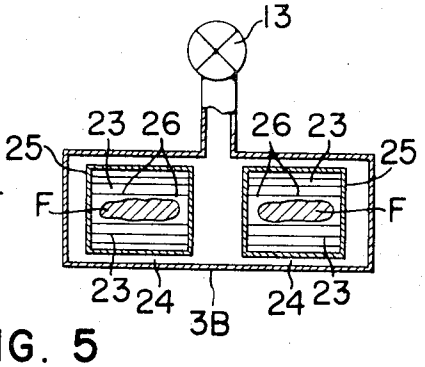


FIG. 5

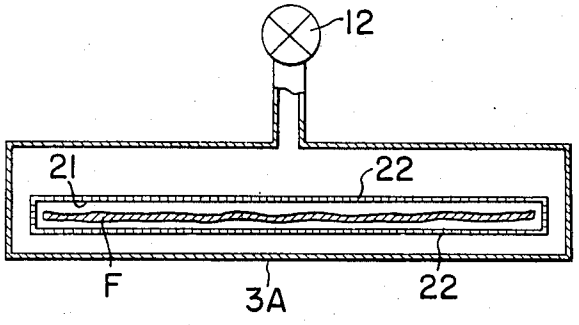
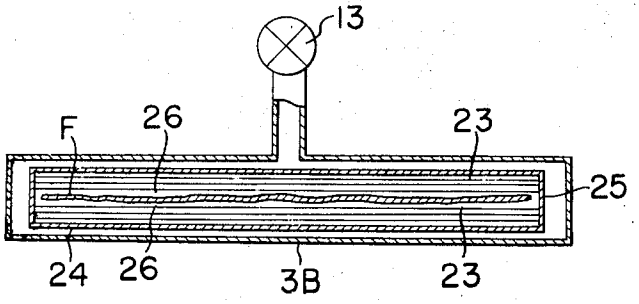


FIG. 6



METHOD FOR TREATMENT OF A FABRIC

This is a division of application Ser. No. 77,401 filed Oct. 2, 1970, now Pat. No. 3,659,438.

BACKGROUND OF THE INVENTION

The present invention relates in general to a novel useful method for treatment of a fabric with a treatment liquid, and more particularly to improvements over the prior art method which comprises forming a fabric into a rope, passing the fabric through a treatment pipe having its inlet and out let so formed that they are roughly in conformity with the rope in configuration and dimension, and at the same time circulating a dye liquor within the treatment pipe to forceably cause the rope form of fabric to be dyed while it is passing through the treatment pipe.

However, according to the prior art method, since the creases formed by making the fabric into a rope form are neither removed nor transferred during the passage of the rope form of fabric through the treatment pipe, there was a disadvantage that uneven dyeing of the fabric was brought about.

In order to eliminate such a disadvantage, a method has been proposed in which at least one constricted portion is formed between a dye liquor jetting port and an outlet of a dyeing treatment pipe to generate a pressure difference between the upper stream side and the lower stream side with respect to the constricted position. When the fabric is passed through the constricted portion an appropriate clearance is formed between the fabric and the constricted portion to cause a positive contact of the fabric with the dye liquor and a rubbing action thereof by making use of the shaking motion due to a turbulent flow produced upon spouting a dye liquor through the clearance, and thereby the dyeing effect is improved and also the creases formed in the fabric is transferred to remove the uneven dyeing due to fixing of the creases.

However, according to the aforementioned proposal, since a large amount of air is sucked at the inlet of the dyeing treatment pipe through which the fabric is transferred together with the liquor flow, and also since the terminal end of the dyeing treatment pipe is located above the dye liquor surface within the dyeing apparatus, the rope form of fabric and the liquor flow discharged from the outlet of the treatment pipe fall onto the liquor surface just like a waterfall to generate further more bubbles, resulting in a severely turbulent state of the dyeing bath. Thus, staying and transfer in good order of the rope form of fabric is so disturbed that the fabric is reversed in relative positions or becomes entangled and eventually the movement of the fabric may often become impossible.

SUMMARY OF THE INVENTION

The present invention has been proposed in order to obviate the above-mentioned disadvantages.

Therefore, one of the principal objects of the present invention is to provide an improved method for treatment of a fabric, in which the generation of bubbles within the treatment bath and the turbulence in the treatment bath during the treatment of the fabric are prevented, and smooth staying and transfer of the fabric is enabled, so that the treatment may be carried out efficiently.

Another principal object of the present invention is to provide an improved method for treatment of a fabric, in which the fabric can be treated efficiently so as not to cause uneven dyeing in the treatment pipe.

Still another principal object of the present invention is to provide an improved method for treatment of a fabric, the equipment of which is simple in structure and is adapted to prevent the generation of uneven dyeing by effectively removing or transferring the creases of the fabric within said treatment pipe.

In order to achieve the aforementioned various objects, according to the present invention, a method for liquid treatment of a fabric, in which the fabric to be treated in a rope form or web form is circulated in a predetermined direction within a treatment bath in a treatment tank, is characterized in that the method includes providing outside of the treatment bath in the treatment tank, a treatment chamber consisting of a shower section provided with a fabric inlet, and a treatment section communicated with the shower section and having at least one constricted portion in the midway thereof, and surrounding the fabric so as to pass the fabric therethrough. A treatment conduit extended from the treatment chamber to within the treatment bath in the treatment tank is provided. A treatment liquid is supplied to within the shower section of the treatment chamber to seal the fabric inlet within the liquid during the circulating process of the fabric. The treatment liquid is then jetted in the direction of travelling of the fabric within the treatment section to cause the treatment liquid to spout through the clearance between the fabric and the constricted portion when the fabric is passed through the constricted portion, to thereby impart to the fabric a positive shaking motion. The fabric is then led from the outlet of the treatment chamber through the treatment conduit to within the treatment bath while maintaining the fabric to be immersed in the treatment liquid.

Because the present invention is constituted as described above, the treatment liquid spouts to within the shower section of the treatment chamber provided outside of the treatment bath in the treatment tank, regardless of the direction of travelling of the fabric, to maintain a liquid-filled state in the hollow space of the section. This liquid filling serves as a liquid seal for preventing a large amount of air from being sucked through the fabric inlet of the shower section in accordance with the travelling of the fabric, to prevent the generation of bubbles due to the jetting of the treatment liquid within the treatment chamber, and also to prevent damage to the fabric such as abrasion, napping, etc due to direct rubbing of the fabric fed into the treatment chamber with the inner wall of the treatment chamber, and further to prevent the loss of the driving power of the treatment chamber due to the direct contact with the fabric.

The fabric is then led into the treatment section of the treatment chamber communicated with the shower section, and the driving power for the fabric is enhanced by jetting the treatment liquid in the direction of travelling of the fabric. Still further, upon passing through the constricted portion, between the upper and lower stream sides of which is produced a hydraulic pressure difference, the treatment liquid is caused to spout through the clearance between the constricted portion and the fabric. The spouting flow reaches a turbulent state accompanied with a severe vibration, so

that the rope form of fabric is subjected to a vibrative motion having its fulcrum at the contricted portion within the treatment chamber on the lower stream side, and this vibrative motion propagates in the forward and backward directions to cause the fabric to transfer while carrying out a shaking motion. Since the fabric is treated with the treatment liquid while the position of the creases formed on the rope form of fabric is being transferred owing to this shaking motion, not only the fixing of creases and the generation of uneven dyeing are obviated, the chance of contact and penetration of the treatment liquid with respect to the fabric is increased by the shaking motion, and furthermore, due to the accompanying rubbing action, the treatment effect is far more improved.

In addition, by making the travelling speed of the fabric and the speed of the treatment liquid passing through the treatment chamber not equal to each other at this time, it is possible to further increase the contact between the fabric and the treatment liquid to enhance the treatment effect.

Furthermore, since provision is made such that the fabric may be led by the treatment conduit extended from the treatment section of the treatment chamber to within the treatment bath in the treatment tank and discharged together with the liquid flow from the outlet of the treatment conduit into the treatment bath, the turbulence due to falling of the liquid flow onto the liquid surface of the treatment bath can be obviated, and by extending the treatment conduit the driving power for the fabric may be enhanced, and simultaneously therewith by gradually regulating the jet flow, regular staying and transfer of the fabric within the treatment tank may be carried out, resulting in a remarkable improvement in the treatment effect.

In addition, as described above, owing to the fact that the driving power for the fabric is enhanced by jetting the treatment liquid in the direction of travelling of the fabric within the treatment chamber and also by extending the treatment conduit led from the treatment chamber to within the treatment bath in the treatment tank, the fabric driving reel provided in front of the treatment chamber can be located at a lower position, so that even when the reel is in a horizontal type of tank having a relatively small size transverse cross-section, a high speed operation of the reel is possible.

In carrying out the method of the present invention it is possible to employ an apparatus including a high speed rotary reel for running the fabric, which reel is provided outside of the treatment bath in the treatment tank. A treatment chamber surrounds the fabric so as to pass the fabric therethrough which chamber is provided outside of the treatment bath in the treatment tank in the rear of said reel. The treatment chamber consists of a shower section having a fabric inlet and spouting a treatment liquid from its inner wall regardless of the direction of travelling of the fabric, a treatment section communicated with the shower section and having means for jetting the treatment liquid in the direction of travelling of the fabric, and at least one constricted portion in the midway thereof. A treatment conduit extends from the treatment chamber to within the treatment bath in the treatment chamber.

The aforementioned apparatus further may include a door member mounted at the front surface of the treatment tank so as to be freely opened or closed over the entire front surface; a treatment liquid inner tank casing detachably mounted in the treatment tank so that it can be pulled out forwardly from the treatment tank; and a treatment liquid dam plate covering the front surface of the treatment liquid inner tank casing. Owing to the fact that the entire front surface of the treatment apparatus can be opened or closed by means of the door member, the efficiency of operations such as loading, unloading, etc. of the fabric with respect to the treatment tank can be enhanced, and also the treatment liquid inner tank casing can be readily taken out of the apparatus by removing the treatment liquid dam plate to enable direct cleaning, inspection and repair of the inner wall of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will be come apparent from the perusual of the following description taken in conjunction with the preferred embodiments illustrated in the accompanying drawings, in which:

FIG. **1** is a side view partially in longitudinal cross-section of one preferred embodiment of an apparatus for dyeing a fabric to be used upon carrying out the method according to the present invention,

FIG. **2** is an enlarged longitudinal cross-section side view of the principal part of the apparatus in FIG. **1**,

FIGS. **3** and **4** show transverse cross-section views of a treatment chamber for a rope form of fabric taken along lines A — A′ and B — B′, respectively, as viewed in the direction of the arrows in FIG. **2**, and

FIGS. **5** and **6** show transverse cross-section views of another treatment chamber for a web form of fabric taken along lines A—A′ and B—B′, respectively as viewed in the direction of the arrows in FIG. **2**.

DETAILED DESCRIPTION OF THE INVENTION

Now the present nvention will be described with reference to the illustrated embodiments.

In FIG. **1**, reference numeral **1** designates a laterally elongated cylindrical dyeing tank, numerals **2** and **3**, respectively, designate a reel for running a fabric F and a dyeing treatment chamber provided in the rear of the reel, both of which are located above a dyeing bath, numeral **4** designates a dyeing inner tank casing disposed at the bottom of the dyeing tank and having a great many perforations for passing a liquor, numeral **5** designated a pump for circulating the dye liquor, numeral **6** designates a heat exchanger interposed in the discharging side conduit **7** of the pump, numeral **8** designates a water feed valve interposed in a water feed conduit **10** which is united with a dye liquor suction conduit **9** which communicates the suction port of pump **5** and the bottom of the tank, numeral **11** designates a guide plate, numerals **12** and **13** designate flow rate regulating valves interposed in branch pipes communicating from conduit **7** to a shower section **3A** and a treatment section **3B**, respectively, as described later, of the dyeing treatment chamber **3**, numeral **14** designates and end-plate-like door mounted at the foremost portion of dyeing tank **1** so as to open or close the entire surface freely, numeral **15** designates a dye liquor dam plate mounted at the front surface portion of the dyeing inner tank **4** to dam up the dye liquor L within dyeing tank **1**, numerals **16** and **17** designate peep windows provided in door **14** and dyeing tank **1**, respectively, and numeral **18** designates an exhaust valve interposed in an exhaust pipe **19**.

Dyeing treatment chamber 3 is of hollow rectangular tube shape, and its shower section 3A is penetrated with a conduit 21 including a fabric inlet 20 flared in cross-section and having a cross-section configuration corresponding to the cross-section of the rope form of fabric, the inner wall of conduit 21 being provided with jetting perforations 22 for jetting the dye liquor towards the fabric F regardless of the direction of travelling of the same and for liquid sealing the fabric inlet 20, as illustrated in FIGS. 2 through 4.

In the treatment section 3B communicated with shower section 3A, another conduit 24 provided with jetting ports 23 for jetting the dyeing liquor in the direction of travelling of the fabric F, communicates with conduit 21, and between the jetting ports 23 of conduit 24 and the outlet of the treatment chamber 3 is formed at least one constricted portion 25 in such manner that between the constricted portion and the fabric F passing therethrough is retained a clearance 26 for spouting the dye liquor.

To the outlet portion of the conduit 24 in treatment chamber 3 is connected a treatment conduit 27 which extends substantially in the horizontal direction up to the rear of the dyeing inner tank casing 4 and reverses in direction forwardly so as to terminate its outlet beneath the surface of the dye liquor L, the terminal end portion 28 of conduit (27) opening into the dye liquor being flared.

Upon operation of the illustrated apparatus, as shown in FIG. 1, the dyeing tank 1 is loaded with the dye liquor L to such an extend that the upper ends of the guide plate 11 and the dyeing inner tank casing 4 are not covered by the dye liquor to form a dyeing bath, the fabric F is passed through the respective conduits 21 and 24 in the treatment chamber 3 and the treatment conduit 27, and after loading the same on the reel 2 the opposite ends of the fabric F are sewed together to form a rope form of endless belt which circulates through the reel 2, the respective conduits 21 24 of the treatment chamber 3, the treatment conduit 27 and the dyeing bath L.

Then simultaneously with the operation of the dye liquor circulating pump 5, if the reel 2 is rotated at a circumferencial speed of, for example, 60 to 120 m/min. by the intermediary of appropriate driving means, the fabric F is circulated and transferred in a predetermined direction, and it is dyed in the dyeing treatment chamber 3, the treatment conduit 27 and the dyeing bath L. Now the dyeing process of fabric F will be described in more detail in the following.

When the flow rate regulator 12 is regulated in the shower section 3A of the dyeing treatment chamber 3, the dye liquor is jetted from the jetting perforations 22 of the conduit 21 regardless of the direction of travelling of the fabric F, to liquid seal the fabric inlet 20 of the conduit 20 so that a large amount of air may not be sucked into the conduit 21 together with the fabric F introduced through fabric inlet 20, and also to prevent the damage of the fabric and the loss of the driving power by obviating direct rubbing between the fabric F and the conduit 21. In this connection, while a part of the dye liquor in shower section 3A overflows out of the fabric inlet 20, most of the dye liquor flows towards the treatment section 3B in accordance with the travelling of the fabric F due to the suction action of the treatment section.

Then into the enlarged conduit portion 24 on the upper stream side is injected the dye liquor from pump 5 via the heat exchanger 6, conduit (7) and the flow rate regulator valve 13 and through the jetting ports 23 to maintain a certain extent of hydraulic pressure therein, this pressure being governed by the hydraulic pressure from the pump 5, and the liquid sealing state at the constricted portion 25 and at shower section 3A.

On the other hand, the dyeing treatment chamber 3 of the enlarged conduit portion 24' on the lower stream side is located at a predetermined height above the level of the dye liquor L and the dye liquor within conduit portion 24' is continuously discharged through the terminal end portion 28 of the treatment conduit 27 due to the difference in level of the dye liquor, so that the conduit portion 24' takes a certain extent of negative pressure, such negative pressure being governed by the conditions of the pump 5, the constricted portion 25, and the terminal end portion 28 of the conduit 27.

As described, the fabric F transferred from the shower section 3A to the treatment section 3B of the treatment chamber 3 passes through constricted portion 25 having a hydraulic pressure difference between the upper stream side and the lower stream side thereof, and simultaneously therewith the dye liquor spouts through the clearance 26 between constricted portion 25 and fabric F. Then this spouting flow becomes an entirely turbulent flow, so that the rope form of fabric F is subjected to a vibrative motion having a fulcrum at constricted portion 25 due to the turbulent flow, this vibrative motion being propagated in the forward and backward direction, and the fabric F is transferred while carrying out a shaking motion.

Owing to the above-mentioned shaking motion, the rope form of fabric F is made free from the fixing of creases formed therein and from the generation of uneven dyeing, while on the other hand, the chance of contact and penetration of the dye liquor with respect to the fabric is enhanced, and further the dyeing effect is enhanced due to the accompanying rubbing action.

The shaking motion in the treatment section 3B of treatment chamber 3 is also propagated into the liquor flow in the treatment conduit 27 communicated with the treatment section, resulting in enhancement of the shaking effect on the fabric. In addition, within the gradually enlarged treatment conduit 27 provided with a flared terminal end portion, the liquor flow gradually reduces its flow speed and is discharged into the dyeing bath L in the condition of regular flow, so that there occurs no turbulence of the dye liquor at the fabric outlet portion, and the rope form of fabric F is regularly fed into the dyeing bath together with the dye liquor and then transferred at a low speed towards the dye liquor suction conduit 9 which communicates with the suction side of the pump 5.

As described, the increase of the contact length between the rope form of fabric and the liquor flow results in enhancement of the driving power for the rope form of fabric due to the liquor flow, which makes unnecessary significant reliance upon the driving power due to the natural head between the treatment chamber 3 and the lower liquor surface, and consequently, the treatment chamber 3 can be located at a relatively low height with respect to the lower liquor surface,

which makes it possible to provide the subject apparatus even in an envelope having a relatively small transverse cross-section.

FIGS. **5** and **6** show a dyeing treatment chamber for a web form of fabric, in which the conduits **21** and **24** in the shower section **3A** and the treatment section **3B** respectively, are formed in a wide and flat shape, and the dye liquor jetting perforations **22** are formed in a honeycomb shape and the dye liquor jetting ports **23** are formed in a slit shape. In these figures, components equivalent to those of the preceding embodiment are given the same reference numerals.

The dyeing action for the web form of fabric is substantially the same as that for the rope form of fabric described above, and therefore, the description thereof will be omitted.

In addition, if necessary, the end-plate-like door **14** is opened to open the entire front surface of the tank **1**, and by removing the semi-circular shape of dye liquor dam plate **15** mounted at the lower half of the foremost portion within tank **1** the dyeing inner tank casing **4** is pulled out, whereby the contamination of the inner wall of the tank due to deposition of the dye may be easily removed and the welded portions on the inner surface of the tank body may be directly inspected and/or repaired.

Furthermore, the present invention is applicable not only to the dyeing of fabrics, but also to cleaning, desizing, degumming, bleaching, etc.

While the present invention has been described above with reference to its preferred embodiments, it is intended that the invention is, of course, not limited to these embodiments only, but various changes in design could be made without departing from the spirit of the invention.

What is claimed is:

1. A method for liquid treatment of a fabric, in which the fabric to be treated in a rope form or web form is circulated in a predetermined direction within a treatment bath in a treatment tank; characterized in that said method comprises the steps of providing outside of said treatment bath in said treatment tank, a treatment chamber consisting of a shower section provided with a fabric inlet, and a treatment section communicated with said shower section and having at least one constricted portion in the midway thereof, and surrounding said fabric so as to pass said fabric therethrough; providing a treatment conduit extended from said treatment chamber to within said treatment bath in said treatment tank; supplying a treatment liquid to within said shower section of said treatment chamber to seal said fabric inlet within said liquid during the circulating process of the fabric; then jetting said treatment liquid in the direction of travelling of the fabric within said treatment section to cause the treatment liquid to spout through the clearance between the fabric and said constricted portion when the fabric is passing through said constricted portion, and thereby to cause said fabric to carry out a shaking motion positively; and further leading said fabric from the outlet of said treatment chamber through said treatment conduit to within said treatment bath while maintaining said fabric to be immersed in said treatment liquid.

* * * * *