United States Patent

Arioli

[15] 3,646,785

[45] Mar. 7, 1972

[54] APPARATUS FOR FINAL IMMERSION WASHING OF CONTINUOUS PIECES OF FABRIC

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[22] Filed: **Aug. 10, 1970**

[21] Appl. No.: **62,290**

[30] **Foreign Application Priority Data**

Aug. 13, 1969 Italy 20882 A/69

[52] **U.S. Cl.** ..... **68/175**, 68/9, 68/22 R, 68/62

[51] **Int. Cl.** **B05c 3/132**

[58] **Field of Search** ..... 68/175, 176, 184, 43, 62, 22 R, 68/9; 8/151

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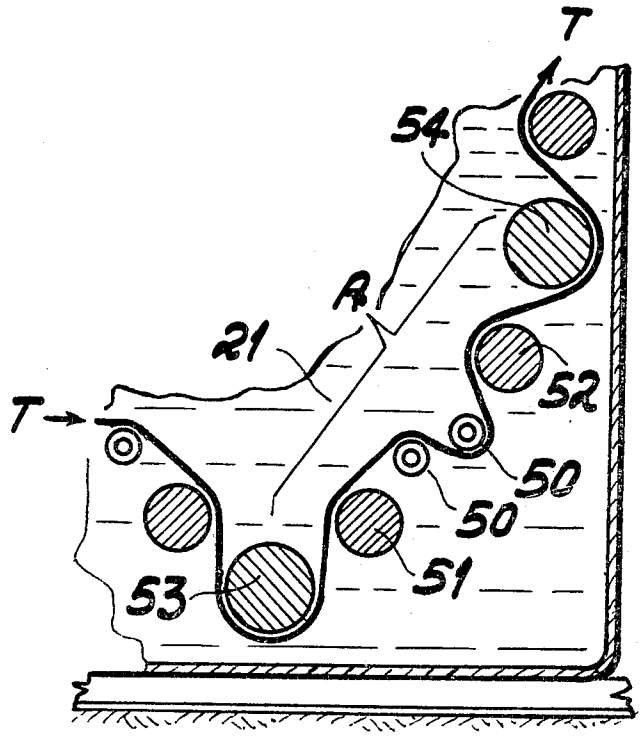
[57] **ABSTRACT**

The disclosure describes an apparatus for continuous immersion washing of pieces of fabric and more particularly of knitted fabric, which comprises a plurality of washing tanks provided with a sequence of groups of rollers, each group comprising closely spaced washing, widening and feed rollers which are arranged for guiding the progressing fabric through the liquid baths within said tanks, said rollers alternatively acting on said fabric to exert a gentle transversal and longitudinal pull to ensure complete maintenance of the fabric in its full width while being processed.

8 Claims, 5 Drawing Figures



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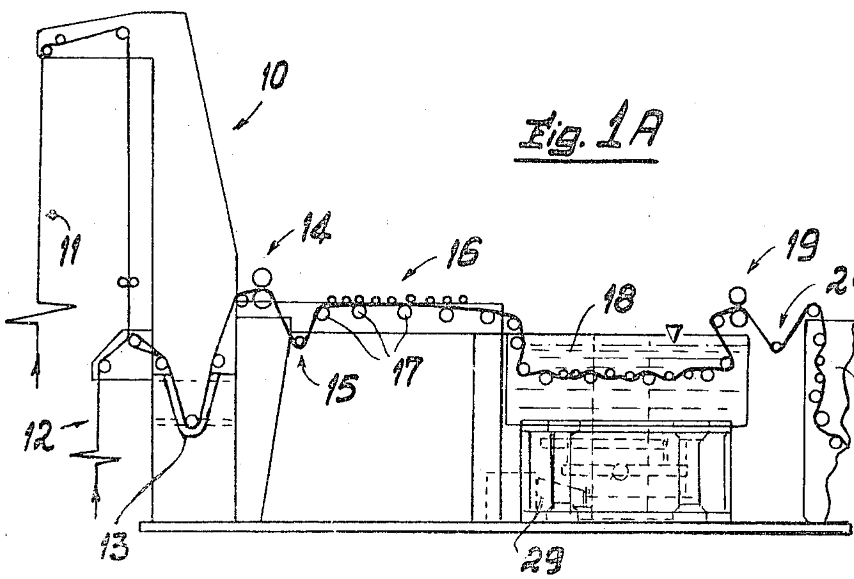

Fig. 1A

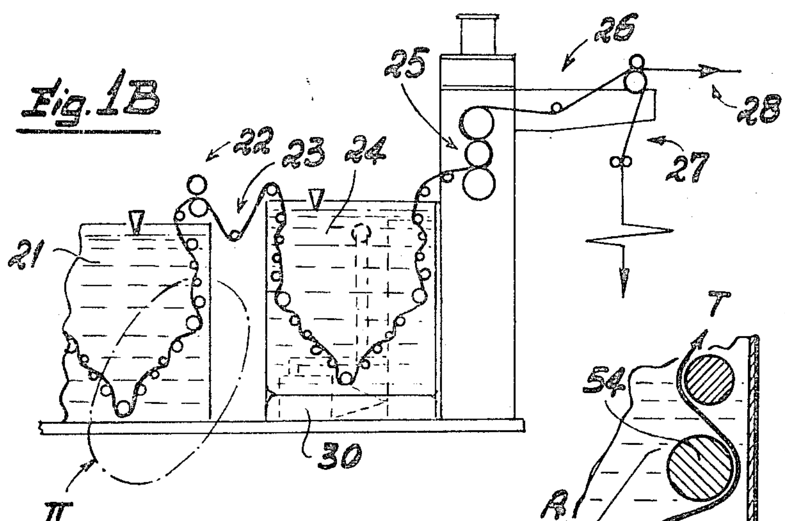

Fig. 1B

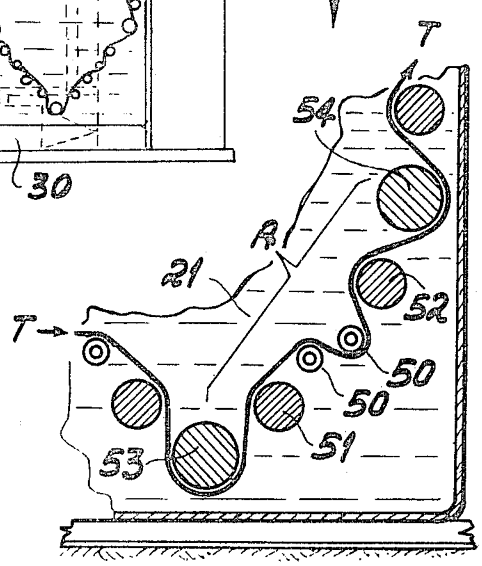

Fig. 2

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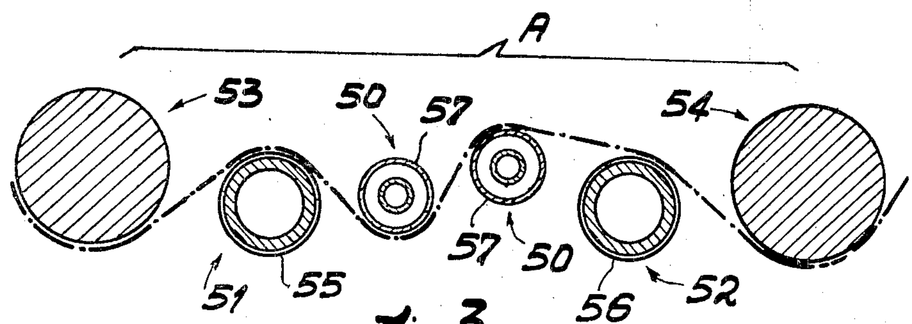

Fig. 3

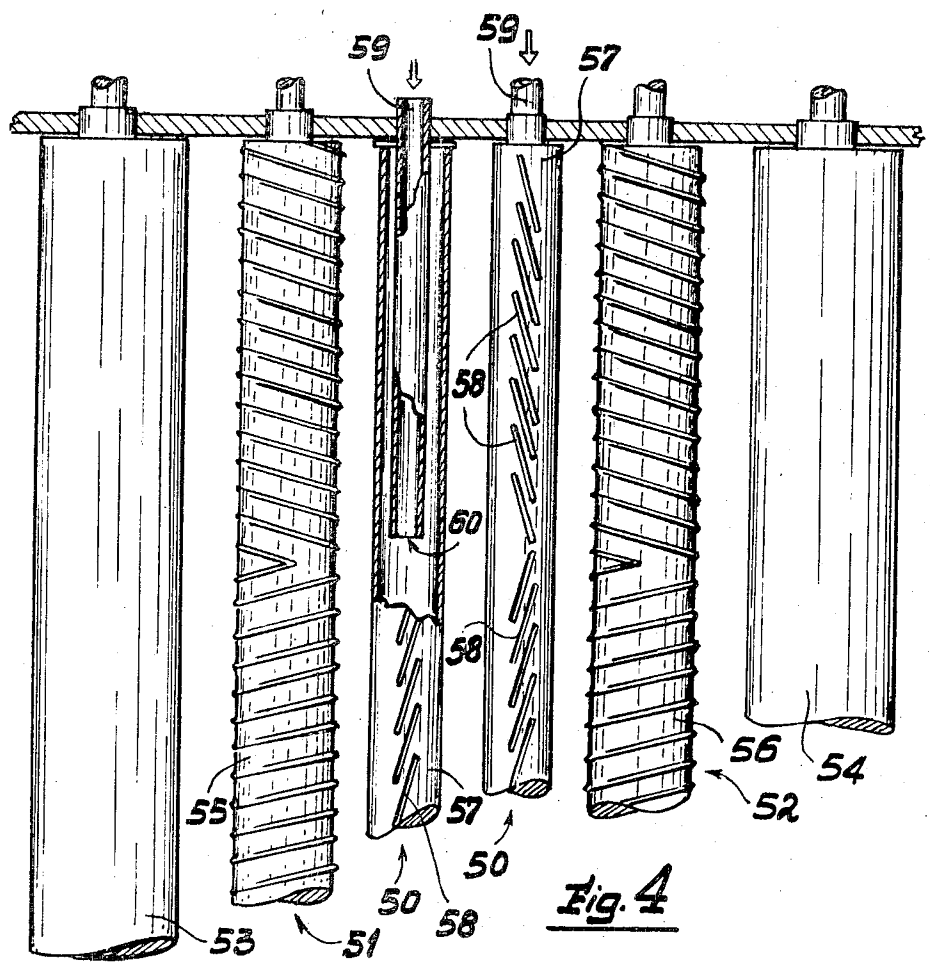

Fig. 4

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APPARATUS FOR FINAL IMMERSION WASHING OF CONTINUOUS PIECES OF FABRIC

BACKGROUND OF THE INVENTION

This invention is related to an apparatus for the wet treatment of fabrics and, more particularly, it is concerned with a new and improved apparatus designed for continuous immersion washing of pieces of fabric, which are lengthwise progressed into washing tanks while maintained fully open and planar in their width. The apparatus of the invention is particularly adapted for processing knitted fabrics and for performing the so-called "finishing" immersion treatments after printing of the fabric, said treatments including a plurality preliminary and of forced final immersion washing steps.

The manufacture of lightweight knitted fabric has heretofore been widely expanding. Such fabrics, which are mass produced by recently developed circular knitting machines, are, for example, widely made use of for ladies' garments. Such fabrics can be and are ornamented by printing processes and require a careful final treatment. It is known to those skilled in the art that serious problems are to be faced when such knitted fabrics are to be humidified and more particularly immersion washed. Such fabrics do not comprise the conventional weft-warp network of the loom-produced fabrics, that is a texture consisting of parallel and intercrossed threads arranged lengthwise and respectively crosswise of the fabric, and which can resist (within reasonable limits, of course) the tensions applied either longitudinally or transversally to the fabrics.

The characteristic texture of a knitted fabric is such that it is not adapted to resist tensions. It is subject to elongation in any direction in which a pull is exerted thereon. Additionally, such knitted fabrics are subject to curl or roll up, particularly when wet, from the edges towards the center portion of the piece of fabric.

In brief, while several attempts for providing and operating machines for continuous immersion washing of pieces of such fabric have been made, and in general of lightweight and rather extensible fabrics, by guidedly progressing the pieces along and about idle rollers, under the pull exerted by feed rollers, such attempts have been unsuccessful.

SUMMARY OF THE INVENTION

According to the invention, it has surprisingly been found that a proper and efficient finishing treatment, by continuous immersion washing of pieces of knitted fabric lengthwise progressed into and out of washing tanks, can be achieved by providing, within any one or more of the tanks and below the liquid level thereof, groups of closely spaced rollers, each group including at least one hollow washing roller having orifices in its cylindrical surface through which the washing liquid is forced to pass, two widener rollers having helically arranged ribs on their surfaces, respectively located upstream and downstream of said washing roller (or rollers), and two smooth surfaced feed rollers, one of which is located upstream of the upstream widener roller and the other is located downstream of the downstream widener roller.

Such groups of rollers are arranged along the path of the fabric, within the washing tank or tanks, to form feeding, widening and processing recurring units. The downstream feed roller of one unit can be made use of to act as the upstream feed roller of the adjacent subsequent unit. Preferably both feed and widener rollers are motor driven at a speed properly adjusted for progressing the fabric at a nearly tensionless condition. Such rollers are driven by variable speed DC motors (individually known in the art) supplied by supply means controlled by idle dancer rollers positioned along the path of the fabric, preferably upstream of each tank where an immersion washing treatment is performed.

According to a preferred feature of the invention, the washing rollers have their surface apertured by elongated openings each forming a helically arranged lot and are connected to a supply of pressurized washing liquid so that said liquid is forcedly issued from inside of said rollers through said slots. Said slots are arranged in helically opposed inclination at the symmetrical half-length of each roller and their inclination is such that, with relation to the direction at which the fabric progresses adjacently to the roller, the issuing liquid exerts a widening action on the fabric, that is contributes to maintain the fabric well open and planar in its width.

These and other features and advantages of the invention will be best apparent from the following detailed description of a presently preferred embodiment but is not limited to the details of said embodiment, said description being referred to the accompanying drawings, wherein the apparatus is shown in a simplified and diagrammatic manner and wherein all structural details and the various means and devices known in the art and individually not forming part of this invention have been omitted.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A and 1B are side elevational sectional views in diagrammatic form of adjacent portions of the apparatus, including a feed unit and a preliminary washing tank and respectively two forced washing tanks and a delivery unit according to the present invention;

FIG. 2 is a fragmentary and enlarged sectional view which illustrates the detail confined in the contour indicated at II in FIG. 1B, and comprising one of the roller groups or recurring operative units of the machine;

FIG. 3 is an enlarged sectional view of one of such units, which is included within bracket A in FIG. 2, and illustrates some details of the rollers; and

FIG. 4 is a fragmentary plan view from above the unit and rollers of FIG. 3, one of the washing rollers being shown partly in section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A machine constructed and operable according to the invention comprises a plurality of components arranged for being sequentially percurred by the piece of fabric. Preferably such apparatus comprises at least the components shown in FIGS. 1A and 1B. Such components will now be briefly described, in the order of the direction of progression of the piece of fabric, whose path is indicated by a continuous line in FIGS. 1A to 2.

A conventional feed unit is generally indicated at **10**. The fabric can be continuously fed at **11** or at **12**, according to the nature of the network, i.e., if it is of the regular type or if it is of the so-called crease-resisting type. The fabric is then passed into a first small basin tank **13** for a first wetting and, if necessary, for preliminary treatment, such as application of fixatives or the like, a first pair of squeezing rollers **14** being located downstream to tank **13**.

A first vertically displaceable dancer roller **15** is arranged upstream of a conventional preparatory unit generally indicated at **16**, wherein the fabric is progressed above a plurality of supporting rollers **17** and is wetted by a plurality of spray nozzles located above and/or below the fabric. Said unit is conventional and it will therefore not be further described. Likewise, the details of the dancer roller, its mounting and the manner by which the displacement of such dancer roller, as a function of the tension applied to the piece of fabric, is made use of for controlling and adjusting the speed of the drive motors of the downstream adjacent unit feed roller, are well known to those skilled in the art and will therefore not be further described.

A preliminary immersion washing is performed in a tank wherein a prewashing bath **18** is contained, the fabric issuing from said bath being then squeezed between a second pair of squeezing rollers, **19**, followed by a second tension-controlling dancer roller **20**.

The actual forced washing is preferably performed in at least two steps, the second one being more properly a rinsing

step. The first step is performed in a deep tank including a bath **21** wherein the fabric is immersion processed, followed by a pair of squeezing rollers **22**. The longitudinal tension is then controlled again by a dancer roller **23** and then the fabric is caused to be immersed into a final bath **24** for being finally squeezed by final squeezing rollers **25**, which preferably comprises three rollers, as shown.

A conventional delivery unit is generally indicated at **26**. The fabric can be delivered at **27** in delivered lap form or, if preferred, delivered at **28** towards a reel (not shown) to be wound thereabout.

The apparatus is further provided with suitable pumping, filtering, heating and otherwise treating means for circulating the liquids in the various baths. Such means are generally indicated at **29** and **30** and they will not be further described, as appertaining to current art and not forming part of the invention.

According to the principal feature of the invention, the path and the progression of the fabric, at least in each bath **21** and **24**, is ensured by a plurality of successively located groups of rollers, which form recurring fabric driving and washing units along such path, and which are provided below the liquid level in said baths. In each bath, at least two of such recurring units are arranged, preferably four units, as shown in FIGS. **1A** and **1B** (bath **21** being shown partly in FIG. **1A** and partly in FIG. **1B**).

Each unit spans over a portion A of the said path which is indicated at T—T in FIG. **2**. Apart from their individual actual arrangement (being more or less inclined and/or more upwardly or downwardly directed of the considered part of said path) said units are similar to each other and, therefore, the following description of the unit shown in FIG. **2** and of the unit shown in FIGS. **3** and **4** (in another relative arrangement of rollers) applies to all recurring units of the apparatus.

A recurring roller group unit, such as those shown in FIG. **2**, FIG. **3** and FIG. **4**, comprises at least one and preferably two washing rollers **50** (as shown). Such rollers **50** are arranged to contact the one face and respectively the other face of the travelling piece of fabric (the path of which is illustrated by a dash-and-dot line in FIG. **3**). Upstream and downstream to said washing rollers **50** (the direction of travel of the fabric is assumed to be rightward in FIG. **3**) there are located a widener roller **51** and a widener roller **52** respectively. Upstream to roller **51** and downstream of roller **52** there are located a feed roller **53** and a feed roller **54** respectively. The upstream feed roller **53** acts also as the downstream feed roller of an adjacent group (if any) and similarly the downstream feed roller **54** acts as the upstream feed roller of a subsequent group (if any).

The above rollers are closely spaced to each other, as shown. The interaxial distance between two adjacent rollers is preferably not greater than twice the diameter of the two smaller ones of the adjacent rollers.

Each feed roller **53** and **54** is provided with a smooth cylindrical surface and it is preferably made of stainless steel. Such feed rollers are driven to impart a gentle longitudinal pull to the fabric in the region where the latter is in contact with said feed rollers so that the said fabric is not subjected to tensional forces in the relatively short interval during which it progresses through each one of said recurring units.

As shown in particular in FIG. **4**, each widener roller has a cylindrical base surface provided with helically arranged ribs. The resulting surface **51** acts therefore in a manner which uniformly spreads the fabric along its width. Such ribs are arranged on opposite helical directions in the two opposite sides of the roller, the inversion of such direction occurring at the middle of the length of the roller. It has been surprisingly found that when a longitudinal pull is exerted by a feed roller having a widening roller acting adjacent thereto, the transverse pull exerted by such latter roller counteracts or opposes the tendency of the fabric, in particular of a knitted fabric, to roll up or curl, while the small overtension resulting by the spreading or widening of the fabric, where acted upon by the widening rollers, is counteracted or opposed by the longitudinal pull exerted by the adjacent feed roller.

Each washing roller **50** preferably consists of a tubular cylindrical roller having a smooth surface **57** which is apertured by slots **58**. Such slots **58** are arranged in opposite helical directions in the side portions of the roller, in a fashion similar to that of the ribs of the widening rollers. The washing liquid is pumped inside said rollers **50**, by suitable pumping means (not shown) wherein an axial duct **59** is axially extended so that its outlet **60** is located nearly at the middle of the roller, whereby the liquid is issued at essentially even pressure through each one of the slots **58**.

It has further surprisingly been found that such arrangement effectively contributes to maintain the fabric well opened transversally and planar. It is believed that by forcible issuing liquid through openings consisting of slots as above described and shown in FIG. **4**, a double action is provided. The direction of the issuing liquid contributes to laterally spreading the fabric by exerting a gentle sideward pull thereto, and such issuing liquid, as impinging on a nearly tensionless fabric, spaces the same fabric from the surface **57** of the roller, so that such fabric travels, where actually washed, in a liquid medium only.

It is evident that the invention might be subjected to several modifications as to its details, without departing from the spirit and scope thereof.

I claim:

1. An apparatus for continuous immersion washing of pieces of fabric tending to curl when subject to longitudinal pull, the washing being performed by causing the piece to longitudinally travel within a washing bath, while maintained transversally spread for its full width, along a path defined by a sequence of rollers, the said apparatus being characterized by the fact that within said bath there are arranged at least two groups of rollers, each group comprising at least one washing roller, one widening roller upstream and one widening roller downstream of said washing roller, a driven feed roller upstream of the upstream widening roller and a driven feed roller downstream of the downstream widening roller, the washing roller being hollow and apertured for passage of the washing liquid through its surface and the widening rollers having each a helically ribbed surface subjecting the fabric to a sideward pull when rotated adjacently to said fabric.

2. The apparatus of claim **1**, wherein said groups of rollers are arranged adjacently to each other and the downstream feed roller of the upstream group acts as the upstream feed roller of the downstream group of rollers.

3. The apparatus of claim **1**, wherein the spacing between the axes of adjacent rollers in each group is not greater than twice the diameter of the smaller one of said adjacent rollers.

4. The apparatus of claim **1**, wherein each group comprises two adjacent washing rollers arranged for rollingly engaging one and respectively the other face of the fabric.

5. The apparatus of claim **1**, wherein each washing roller comprises liquid inlet means for supplying pressurized washing liquid thereinto and causing said liquid to issue from openings provided on its surface to space the fabric from said surface where impinged by the issuing liquid.

6. The apparatus of claim **5**, wherein each washing roller is apertured by slots helically arranged on its surface in opposite directions in the two side portions of the roller, the helical inclination of said slots being such to cause the issuing liquid to exert a sideward pull on the said fabric where impinged by the liquid.

7. The apparatus of claim **5**, wherein the liquid inlet means in said washing rollers consists of a duct axially arranged within the roller hollow and having its outlet substantially at the middle of the length of the roller.

8. The apparatus of claim **1**, which comprises washing tanks wherein each one of which a sequence of at least four groups of roller is comprised.

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