United States Patent

Stanway

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[54] **METHOD AND MACHINES FOR DYEING TEXTILE PIECE GOODS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **68/62,** 68/177, 68/184

[51] **Int. Cl.** **B05c 3/134,** B05c 9/04

[58] **Field of Search**.....68/177, 178, 179, 176, 184, 68/62, 20; 26/20, 21, 55 R, 56

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Assistant Examiner—Philip R. Coe
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[57] **ABSTRACT**

A method and machine for the dyeing of fabrics in open width or rope form in a winch dyeing machine in which the fabric in a pleated state is assisted along an arcuate chute by liquor supplied at one end thereof and withdrawn at the other end thereof at a lower level than the supply.

2 Claims, 8 Drawing Figures

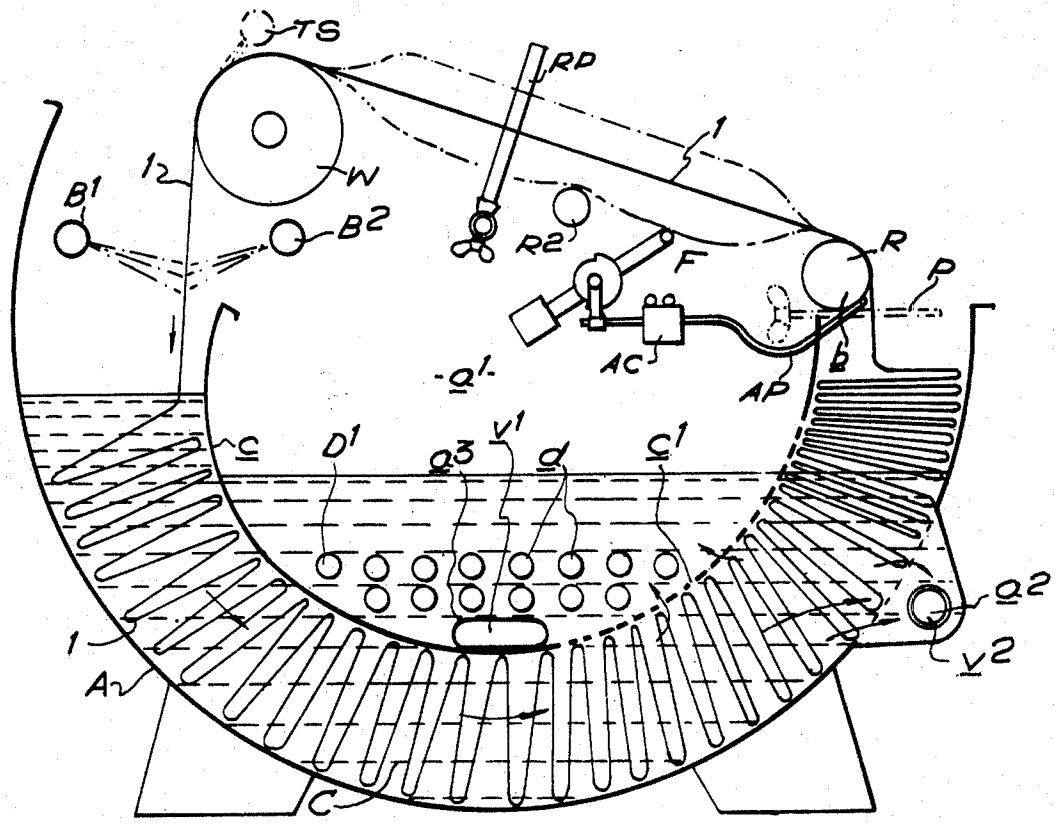

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FIG. 1

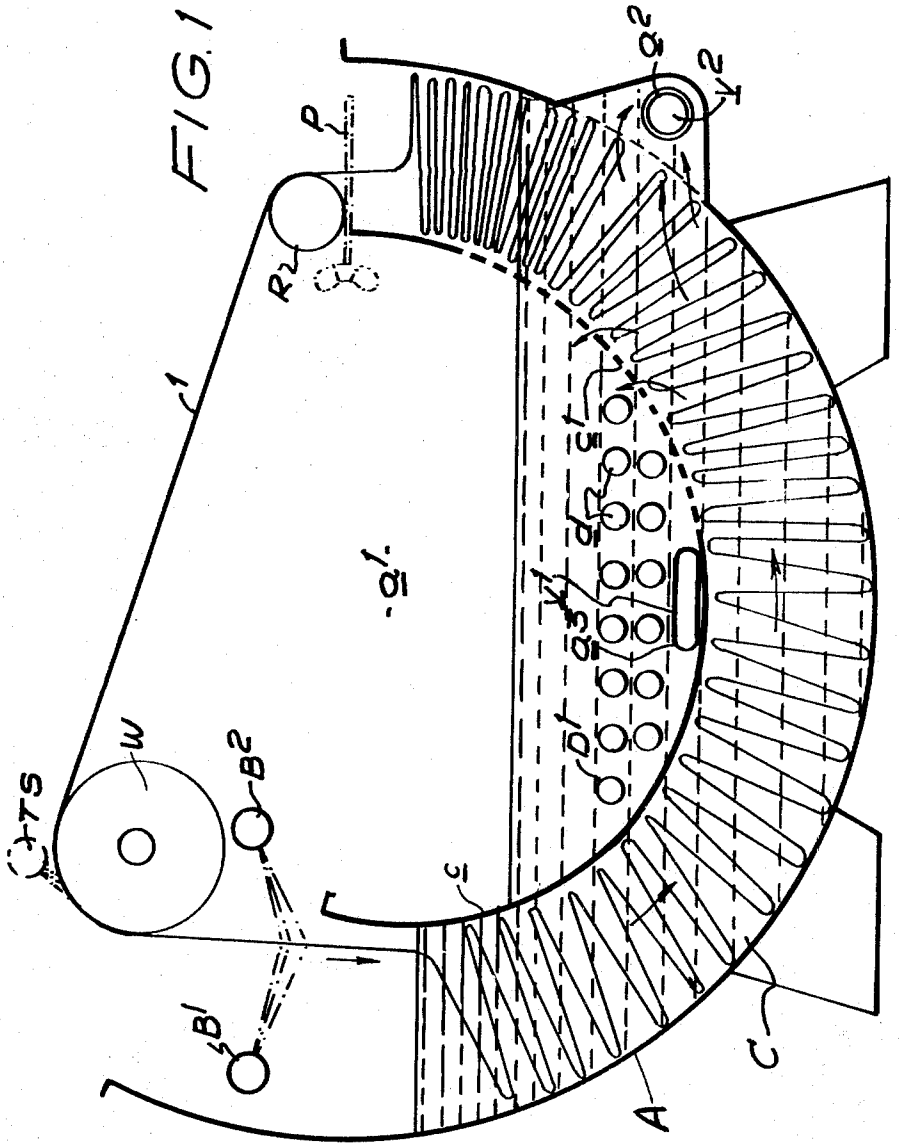
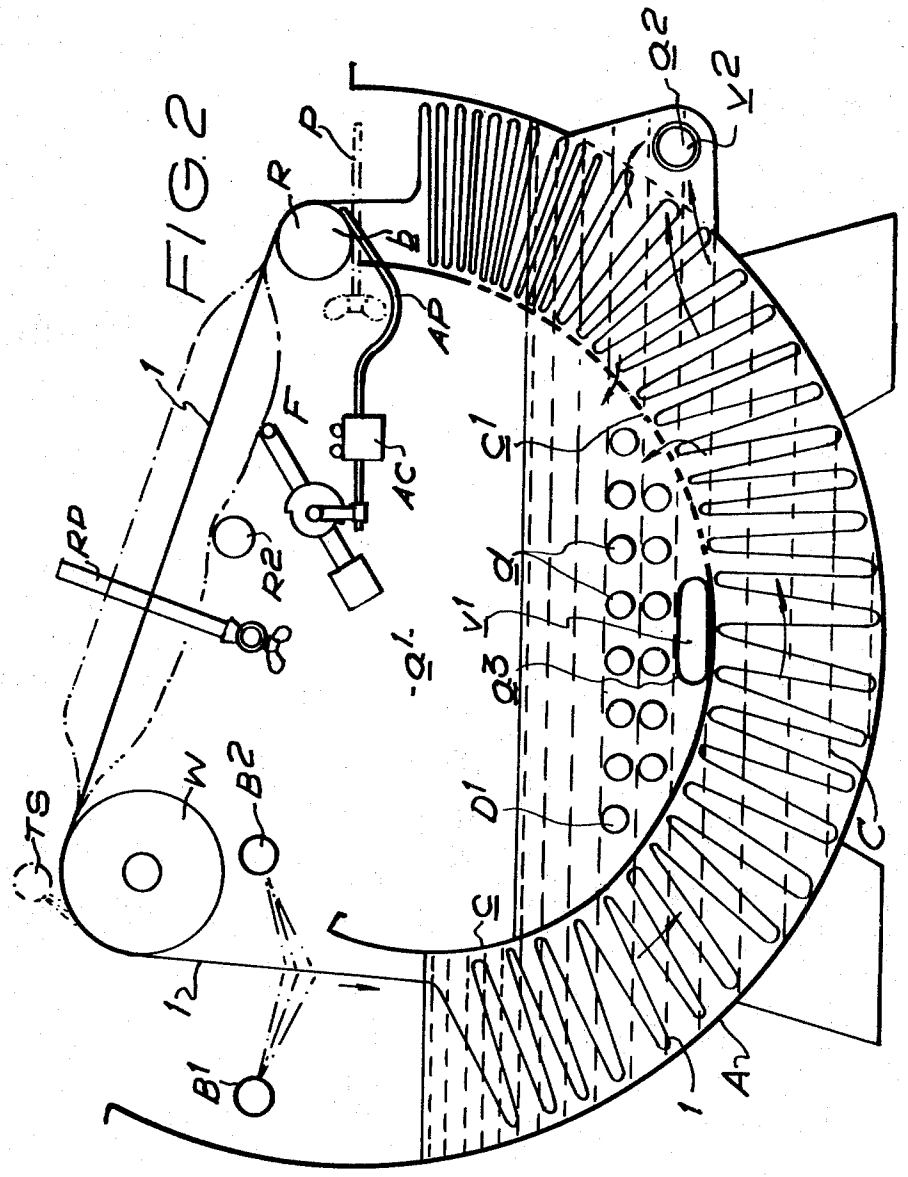


FIG 2



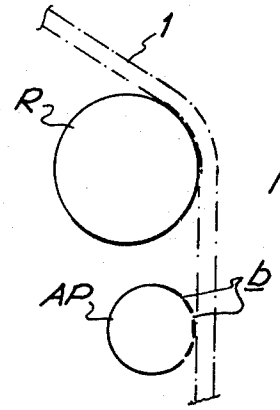


FIG. 3

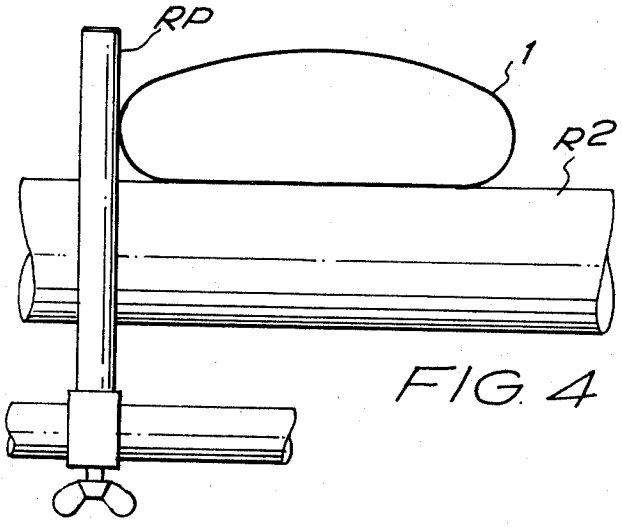


FIG. 4

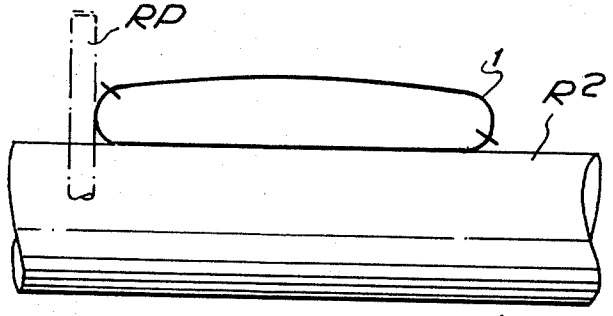


FIG. 5

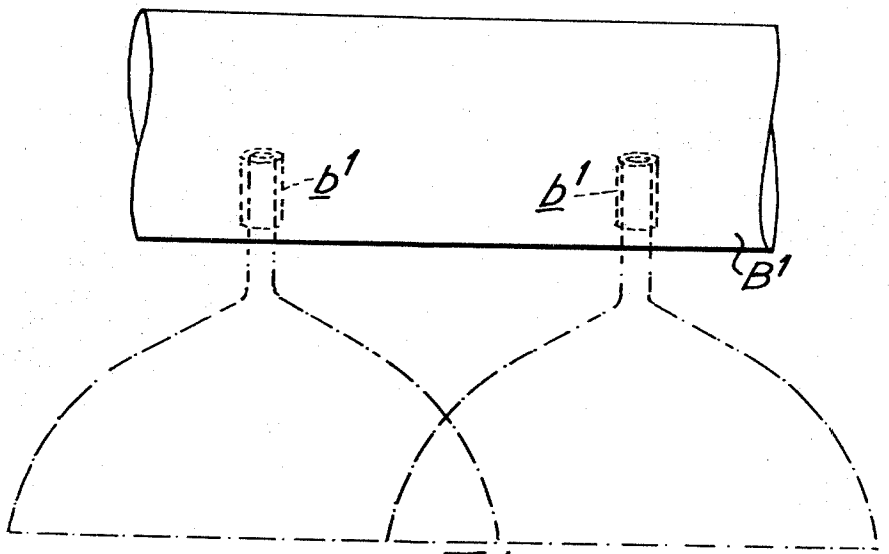


FIG. 6

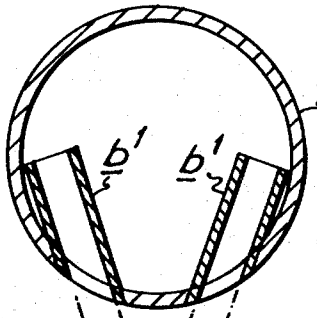


FIG. 7

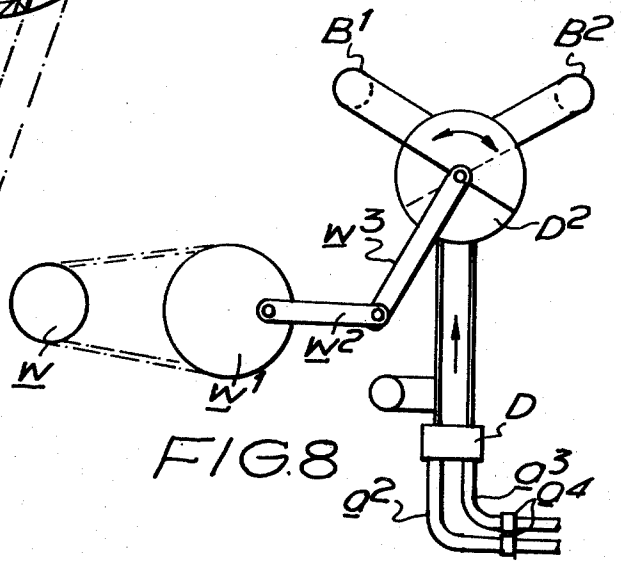


FIG. 8

METHOD AND MACHINES FOR DYEING TEXTILE PIECE GOODS

This invention relates to an improved method and apparatus for dyeing textile piece goods in rope or open width form.

Winch dyeing machines have been proposed in which the fabric is dyed in "rope form," that is to say the fabric is bunched together in its width in order to take less space. Winch dyeing machines are made to accommodate various numbers of these ropes, according to the capacity required. In all cases the principle is basically the same. Each rope of fabric is loaded into a bath in the machine containing the dyeing liquor so that it passes over a roller and a winch that can be either oval or round, and then returns to the bath from the winch, the two ends being secured together to form an endless rope. There are other methods of loading known in spiral dyeing devices, where basically the principle of the device is to use one length spirally loaded into the machine so that the same effect of individual ropes is achieved.

With the introduction of fabrics made partly or wholly of synthetic fibers, fabric temperatures have, in general, increased. Winch machines covered with hoods above the treating liquid have been proposed and when dyeing at temperatures above 100° C the winch roller and its ancillary equipment are mounted within a completely closed vessel which is pressurized.

The fabric is arranged in the machine in a plurality of convolutions with a portion of each convolution extending over the winch roller but the bulk of each convolution at any given instant is packed in pleated formation along the sloping back and also along the base of the bath with a relatively small proportion of the fabric situated above the surface level of the liquor forming the bath.

The force required to draw the fabric from the closely packed mass in the bath varies from one convolution to another and also varies with the physical form of the fabric, being less for smooth, fine fabrics than for rough coarse fabrics.

There are several problems associated with the winch dyeing machine. The fabric being pleated in the bath is lifted out of the liquor over the roller and transported by the winch back again into the bath, but in lifting the fabric out of the bath, a considerable amount of dye liquor is transported by the fabric, and in doing so imposes a downward pull on the fabric between the winch roller and liquor level in exactly the opposite direction from that of the fabric movement. With open weave and knitted fabrics the amount of dye liquor lifted up in this way is very considerable —undoubtedly several times the weight of the fabric rope itself — and this in one of the reasons why a winch machine tends to "extend" the fabric, and why it is difficult to design a winch which does not slip. The demand for high temperature dyeing is constantly increasing and this aggravates the problem, since the reason for high temperature dyeing is to swell the fabric in order to give better dyeing absorption and for this very reason the fabric becomes more extensible. To some extent, also, the amount of dye liquor lifted out by the rope is the most limiting factor on the speed at which a winch dyeing machine can be operated, since the higher the speed the greater the "pull out" of liquor and therefore

the greater the amount of drag imposed on the fabric in the wrong direction.

The transport of the fabric from one side of the vessel to the other may be facilitated by means for first removing the surplus liquor from the fabric to reduce the extension thereof. (But simply removing the liquor by any form of mangling device would have the effect of fixing any creases in the fabric particularly in thermoplastic fibers and may even contribute to further extension of the fabric).

In the winch dyeing of open width fabrics such as carpets or other heavy weight fabrics the usual liquor to fabric weight ratio is in the region of 40 or 45 : 1, and it is now found the liquor ratio can be reduced to 20 : 1 or even lower which gives a saving in the volume of water employed and in the quantity of effluent for disposal and a reduction in the size of the machine. This furthermore applies to high temperature dyeing or dyeing at atmospheric temperature. A reduction in the amount of chemicals added to the liquor is also obtained.

According to the invention a method for dyeing fabric in open or rope form prior to the passage of the fabric over a winch roller comprises traversing the fabric in pleated formation through the bath, extracting liquor from the bath at a level below that at which the fabric ceases to remain in pleated formation and returning the liquor to the opposite side of the machine for recirculation with the pleated fabric through the machine.

The invention further comprises a machine for carrying out the method in which the fabric in pleated formation passes through the both in an arcuate channel or passageway between retaining walls, liquor being supplied to the channel or passageway at an inlet end thereof, travelling therethrough with the fabric and being extracted from the channel or passageway at the opposite side of the machine at a lower level than the inlet.

The invention will be described with reference to the accompanying drawings:

FIG. 1 is a transverse section through a winch dyeing machine showing the passage of the fabric whether in open or rope form therethrough, and also showing dividing pegs and top spray pipes for fabrics in rope form;

FIG. 2 is a transverse section similar to FIG. 1 but fitted with an air pipe and means for controlling the air supplied therethrough;

FIG. 3 is a detail of the air pipe showing the position of holes or apertures therein;

FIG. 4 is a detail view of the arrangement of roller R^2 and peg RP for rope fabrics;

FIG. 5 is a detail view of arrangement of roller R^2 and rotary peg RP for varying the crease in a tubular fabric at each passage;

FIG. 6 is a detail side view of a spray pipe;

FIG. 7 is a transverse section of same;

FIG. 8 is a detail view of the drive for a reciprocating valve for controlling the flow of liquor to the sprays.

A winch dyeing machine A for dyeing an endless length of fabric 1 in either open or rope form is constructed with a substantially semicircular channel C through which the fabric in pleated form is passed. The channel C is of arcuate shape and extends the whole length of the machine. The inner surface *c* of the chan-

nel is perforated over a portion of the periphery on the trailing end thereof in the direction of travel of the fabric i.e. the perforations c^1 extend over substantially one half of the periphery of the surface *c*.

The fabric is transported over a winch W and falls into the channel C in pleated form and from which channel the fabric is withdrawn at the other end of the channel C over a roller R and then repasses over the winch.

Dye liquor is supplied to the channel C from pipes B^1, B^2 and is drawn off at a^1 and/or through a pipe a^2 by means of a pump D and is returned by the spray pipes B^1, B^2 to the channel C in order to create a "head" pressure in the channel C to push the pleats or folds of the fabric **1** through and out of the liquor at the other end of the channel before the fabric is taken over the roller R, thus draining off a large proportion of the liquor from the fabric before it starts on its journey over the roller R and winch W, and thereby reducing the weight of fabric and liquor which has to be lifted out of the channel and therefore reducing the pull.

FIG. **1** shows the liquor being returned through the two spray pipes B^1, B^2 impinging on each side of the fabric.

When the fabric is in rope form, dividing pegs P are provided across the width of the channel C beneath the roller R. The fabric **1** is pleated into channel C to fill the channel in order to prevent the liquor from by-passing the fabric instead of acting as a propellant for traversing the pleats along the channel.

The dye liquor flows along the channel C and passes into the interior a^1 of the machine through the perforations or holes c^1 to be heated by pipes d of a heat exchanger D^1 before being withdrawn by the pump through ports v^1 on a pipe a^3 and/or through ports v^2 into the pipe a^2. Each of the ports v^1, v^2 is connected to the external pump by means of stainless steel pipes a^2, a^3 and each pipe has an isolating valve a^4 incorporated so that the liquor can be drawn either from a^1, or from a^2, or from both, or regulated by means of the valves a^4 to give a proportional amount from each side. The heat exchanger D^1 is shown arranged in the space a^1 but may be in the pipe line to the pump D. A filter (not shown) is incorporated in the pipe lines or pump.

On leaving the pump D the dye liquor passes to a reciprocating valve D^2 (FIG. **8**) which delivers the dye liquor alternatively to the sprays B^1 and B^2 thus creating the pleating or plaiting of the fabric entering the channel C. The drive to the reciprocating valve D^2 is taken from the main shaft *w* through a variable speed drive w^1 and links w^2, w^3 which allows the reciprocating action of the valve to be varied, so that the plaiting action can be adjusted to fall down evenly in the channel C.

A top spray TS is shown in FIG. **1**, connected in the same pipeline from the pump but taken off the pipeline before it gets to the reciprocating valve D^2 so that it is not affected by this valve. A control valve (not shown) is arranged in the line to spray TS to vary the amount of liquor delivered to the top spray. Apart from giving additional liquor spray on the fabric the spray TS also acts as a fine control on the plaiting action by relieving or increasing pressure on sprays B^1 and B^2.

The volume of liquor being delivered into the channel C may be controlled by using a variable speed pump D, but a fixed speed pump with adjustable main valve can alternatively be used to control the flow of liquor.

A large volume of liquor is required for the action of the machine but a large number of small spray nozzles would be undesirable because they may block up easily with "lint," that is fine fibers which tend to become detached from the fabric to be dyed. On the other hand, large bore jets have the disadvantage of impinging too heavily onto the fabric. This was overcome by using a spray pipe arranged as shown in FIGS. **6** and **7**. The main spray pipes B^1, B^2 have a series of smaller pipes b^1 welded tangentially inside the main spray pipe B^1 or B^2 so that two jets of water impinge on each other and create an overlapping fish-tail effect, and thus the main energy of the spray jets is dissipated on each other before the liquor reaches the fabric **1** in the form of a wide spray. This is also applied to some knitted fabrics which are produced in tubular form and also to other flat fabrics which can be conveniently edge-sewn by stitching the selvedge together to produce a tubular fabric.

The conventional way of dyeing such fabrics is by rope dyeing, but the main problem is that creases created in the rope or fabric during dyeing are difficult to displace, and sometimes become set in the fabric even after finishing processes have been completed. The creases may be displaced by forming a balloon in a tubular fabric by directing jets of compressed air onto the fabric **1** as it is raised from the liquor by the roller R which causes the fabric to balloon.

As the fabric is taken up over the roller R in FIG. **2** it passes first across the air pipe AP which has a series of very small holes *b* in line with the direction in which the fabric is travelling. The air enters the tube of fabric **1** and blows it out into a balloon between the roller R and winch W (FIG. **2**) and it has been found that the use of the top spray TS is important to the successful operation of this principle. The action of the top spray is to seal the top of the tube and prevent the air escaping with the fabric over the winch W and into the channel C where it would otherwise cause difficulties with plaiting. Once the air has blown out the tube between roller R and winch W, the air injection from pipe AP can be discontinued for quite long periods and the balloon of fabric will maintain itself. In some cases the balloon will even create itself without any air injection provided the top spray is kept inuse.

If the fabric is allowed to run under the conditions described it will maintain its flatness over the whole length of the dyeing cycle without much difficulty, but the creases at the two edges of the tube would form and reform in more or less the same place each time and in some cases may set as permanent creases along the length of the fabric.

To overcome this defect, at a point approximately half way between roller R and winch W a second roller R^2 is mounted somewhat below the center line of the theoretical path of the fabric **1**. When ballooning occurs, the bottom half of the balloon comes into contact with the roller R^2, which may either be driven at the lineal speed of the fabric or may be left free to rotate of its own accord. By giving the balloon a slight lateral movement by means of a peg RP, the portion of the fabric in contact with the roller R^2 remains in line but the free part at the top of the balloon moves over in the

direction of the thrust exerted by the peg RP and therefore the edge which was flattened in the previous run through the machine is moved over slightly, in other words, the tube is constantly being spiralled on itself during the whole period of the dyeing cycle. In order to prevent the peg RP from pushing the balloon of fabric too far out of line, dividing and locating pegs P as illustrated below roller R are employed. The peg RP is a roller peg, that is to say it is free to rotate as the fabric passes over.

It was found that under certain circumstances, with an uncontrolled air pipe AP, the balloon became too pronounced and tended to create a slippage on the winch. This was overcome by means of an air control valve AC (FIG. 2) which is operated from a finger F, bearing lightly on the balloon of fabric. The air control valve is arranged so that, when the balloon has reached its correct dimensions the finger F shuts off the air through the valve and therefore controls the supply to the air pipe AP. The finger F may be common to all the runs of fabric in the machine, but experience has shown that it is preferable to have a separate control for each run of fabric.

There are fabrics which lend themselves to open width dyeing — carpets being a good example — but other stiff fabrics are also applicable. Since the machine lays the fabric in regular folds and contains it within the channel C, and since it assists its movement by the general liquor flow in the channel, the machine is extremely suitable for this type of production. The main mechanical problem with open width dyeing is to prevent the fabric wandering sideways and if it is not stiff enough it has a tendency to "bunch" and form itself into a rope. This tendency is overcome in this machine and, in the case of stiff carpets and the like, it is only necessary to use an arcuate guide bar or pate on each side of the fabric to contain it as it progresses through the channel, and to ensure that the fabric fills the width of the channel reasonably well so as to avoid excessive by-pass of the dye liquor. Otherwise, fabrics which may bunch or wander can be controlled in the conventional way by means of opening rollers, spiral rollers, edge guiders and the like.

In cases where the pile of a carpet is constructed from thermoplastic fabrics which may be flattened by the sprays a variable shape winch as described in British Pat. No. 1,092,927 may be employed, so that if desired the plaiting action can be performed by setting the winch to oval shape and re-directing the spray which would otherwise impinge on the pile.

Carpets are preferably loaded into the machine with the back lying on the winch, therefore the spray B^2 cannot harm the pile. The spray B^1 is then directed downwards on the back of the channel so that the liquor falls into the channel but the sprays B^1 cannot hit the pile. The reciprocating valve D^2 feeding the sprays B^1 and B^2 is then set so that the spray B^2 impinges on the back of the carpet when the oval of the winch is in a position to give maximum throw of the plait—thus the spray B^2 assists this throw and, by adjusting the angle of the jets of the spray B^2 in relation to the throw of the winch, the width of the plait can be set to fill the cavity adequately. The spray TS may be reduced to a very light spray or may be discontinued altogether.

The machine in all its forms shows in addition to the advantages already mentioned, low liquor ratios and therefore improved economy of heating, water, chemicals, and effluent, higher fabric speeds, and a virtually non-slip winch mainly because most of the dye liquor is drained from the fabric before its passage across the top of the channel. Also because of the rewetting action of the sprays before it falls into channel C, the same principles apply to machines designed to dye at temperatures above atmospheric boiling point — that is pressurized machines enclosing the winch W and channel C and other parts in a closed chamber. Such machines are substantially cylindrical in shape (for purposes of mechanical strength).

What we claim is:

1. A winch dyeing machine for the dyeing of a continuous length of fabric in open or rope form comprising a winch, means including retaining side walls defining an arcuate chute having an inlet end open upwardly to receive fabric from the winch and an outlet end open upwardly to discharge the fabric under pull from the winch, spray means for supplying dye liquor into the chute at said inlet end to provide and maintain a body of dye liquor within the chute and so directed as to assist passage of the fabric being dyed along the chute, said spray means being adapted to direct liquor onto opposite sides of the fabric before it enters the chute, means for alternately operating said spray means at opposite sides of the fabric for aiding in pleating the fabric entering the chute, and suction pump means connected to withdraw liquor from said chute at a region adjacent the position where the fabric rises out of the body of liquor toward said outlet end of the chute.

2. A machine for dyeing fabric in open or rope form comprising means including a winch and a chute for traversing the fabric in pleated formation through the machine, means for supplying dye liquor into the chute, means for extracting liquor from the chute at a level below that at which the liquor is supplied to the machine and returning the liquor to the supply means for recirculation with the pleated fabric through the machine, means for ballooning a tubular fabric after leaving the chute and before passing over the winch and means for traversing the fabric spirally to prevent creasing in the same place on a subsequent passage.

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