PATENT SPECIFICATION (11) 1 578 039

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(21) Application No. 6891/77 (22) Filed 18 Feb. 1977
(31) Convention Application No. 661 396
(32) Filed 25 Feb. 1976 in
(33) United States of America (US)
(44) Complete Specification published 29 Oct. 1980
(51) INT CL³ D06B 11/00, 1/04
(52) Index at acceptance B2L 101 110 122 126 135 A B

(54) METHOD AND APPARATUS FOR TEXTILE DYEING

(71) We, RCA CORPORATION, a corporation organized under the laws of the State of Delaware, United States of America, of 30 Rockefeller Plaza, City and State of New York, 10020, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is directed to an improved method and apparatus for dyeing textiles.

One apparatus for textile dyeing known in the industry is a TAK dyeing apparatus and process. This apparatus is described in detail in U.S. Patents 3,731,503; 3,683,649 and 3,800,568. This process disperses droplets of dyes onto a tufted carpet surface producing an irregular pattern having a uniform irregularity or randomness and not appearing as a repetitive or regulated pattern. This appearance is known in the art as "space dyeing."

Other apparatus for space dyeing include randomly applying dyes of different colors to a single yarn along the length thereof. Multiple spools of such colored yarns are then tufted into a carpet wherein the colors appear in random order in the finished product. This last-mentioned process is rather complicated and expensive and thus greatly increases the cost of the finished product. The former process while attempting to duplicate the effect produced by the multicolor yarn does in fact produce a somewhat harsher toning, that is, more contrasting than desirable. What these different processes attempt to achieve is a multi-tone finish in a textile material which while irregular and non-repetitive has a unified irregularity that is smooth, unbroken and pleasing to the eye with gradual shadings intermixed among the colors.

Other apparatus is known, such as that shown in British patent specification 1,363,129, in which an engraved printing roller is employed to apply a thickened resist to one surface of a dyeable substrate, and a plurality of feeding means are employed to apply dye to an inclined plate located beyond the resist applicator, at which plate the dyes mingle, and then drop onto the other surface of the substrate. The substrate then passes through a pair of rollers which cause the dyes further to intermingle and to be absorbed by those parts of the substrate not previously saturated by the resist composition.

According to the present invention there is provided, subject to the disclaimer set out hereinbelow, a method of dyeing a textile material in a continuous process in which both a resist and a dye are employed comprising the steps of:

continuously applying a sheet of viscous, liquid dye resist on a surface of the material;

transporting the textile material and during such transport and in a continuous process applying a dye to the liquid dye resist coated fibers of the material;

continuing to transport the material, and during such transport, fixing the dye to the fabric.

An embodiment method of dyeing a textile material comprises the steps of: applying a dye resist material to a surface of the textile material, applying a dye medium to a surface of the dye resist coated textile material, and fixing the dye medium to the textile material. The step of applying the dye resist material includes covering the textile material surface with a sheet of the dye resist material in viscous form, such that the sheet has substantially uniform thickness and has a substantially unblemished surface, and the step of applying the dye medium includes dropping the medium in liquid form, preferably as droplets, on the dye resist coated textile material surface, so that prior to the fixing step the liquid dye medium spreads with respect to the surface of the textile material prior to and during the fixing step.

An embodiment apparatus for dyeing the textile material includes means for applying the dye resist material to the surface of the textile material, means for applying the dye

medium in the form of droplets to a surface of the dye resist material, and means for fixing the dye medium to the textile material. The means for applying the dye resist material includes means for applying to the textile material surface a sheet of the dye resist material in viscous form having an unblemished surface and substantially uniform thickness, and the dye medium applying means includes means for dropping droplets of the medium in liquid form on the dye resist coated textile material surface.

In the following detailed description of the embodiments of the invention, reference is made to the attached drawings, in which:

FIGURE 1 is an elevational view of an apparatus constructed and operated in accordance with an embodiment of the present invention,

FIGURE 2 is an enlarged side sectional view of the dye resist applicator of Figure 1, and

FIGURE 3 is a front sectional view of the dye resist applicator of Figure 2 showing a distribution of the dye resist to the well portion thereof.

In Figure 1, textile material 10 to be dyed can be a tufted carpeting. The carpeting is initially processed through a suitable dyeing pad 12 which is a conventional dyeing apparatus for applying a uniform base color to the material 10. The use of the dyeing pad 12 for dyeing carpeting in accordance with the present invention is optional. As will become apparent later, the textile material 10 need not have a specially applied base color. However, the pad 12 provides an enhanced, pleasing uniform coloring to the carpeting for certain coloring effects. Textile material 10 is conveyed in the direction 14 by suitable drive roller 16 and other rollers (not shown) in the system. Means for conveying the carpeting through the system are conventional. Textile material 10 is passed through a printing head 18 which is also optional. Printing head 18 may optionally provide a preprinted pattern on the carpeting to achieve a multitude of coloring effects as may be desired. It is to be understood that both the printing head 18 and the pad 12 merely provide enhancement colorings to the special effects provided by the apparatus 20. In accordance with the present invention apparatus 20 provides a dye to the textile material 10 producing an effect that is comparable to space dyeing but less expensive than space dyeing of yarns with a much smoother, subtler toning than the prior art TAK dyeing.

Textile material 10 is in a substantially horizontal path beneath a dye resist applicator 22 and a TAK dyeing machine 26. Applicator 22 is shown in detail in Figures 2 and 3. Applicator 22 provides a continuous film or sheet of a suitable dye resist 24 such as a vegetable gum. The dye resist 24 has a syrupy viscosity preferably of 400 to 4000 centipoise. Dye resist 24 is applied to the upstanding tufted surface 25 of the textile material 10 which tufts face the dye resist. The sheet of dye resist 24 has a substantially unblemished surface and is unbroken when applied to the textile material 10 along the breadth of the textile material which breadth extends in and out of the drawing as viewed in Figure 1, as the material 10 progresses in direction 14.

The dye resist coated textile material 10 is moved forward in the direction 14 so that the textile material is in a substantially horizontal position before the resist 24 is applied and while the textile material 10 is passed through the TAK dyeing machine 26. TAK dyeing machine 26 is a conventional machine described in the aforementioned patents. In particular, machine 26 is a dye applicator for forming one or more dyes into a plurality of drops which form a uniform, but irregular pattern on the tufted material 10. Material 10 is then formed into a downwardly disposed loop 28 with respect to the roller 16 over which the textile material 10 is driven. Textile material 10 is then passed upwardly and thence into a conventional steamer 30. Steamer 30 fixes the dye on the textile material to the material, washing away the dye resist that has been coated on the material by the apparatus 22, in a conventional manner.

The TAK machine 26 as shown includes a plurality of dye applicators 32 and 32′ which apply dyes of the same or different colors in droplet form to the carpeting passing below. Droplets for the applicator 32 are shown at 34 and the droplets for the applicator 32′ are shown at 34′, respectively. The detailed construction of the machine 26 and steamer 30 are well known and need not be further described herein.

As provided in accordance with the apparatus constructed and operated with the present invention, the dye resistant applicator 22 provides the sheet of dye resist 24 in a unique arrangement with respect to the apparatus 26 to provide enhanced coloring effect on the material 10 not heretofore possible with prior art apparatus. In Figure 2, dye resist applicator 22 includes an elongate tub 36 (i.e. elongate perpendicular to the plane of the drawing) which extends along the breadth of the carpeting of textile material 10. The tub 36 has a first channel-like well 38 which forms a first storage well for the dye resist 40. Dye resist 40 is a suitable viscous vegetable gum having a long chemical chain and having such a syrupy consistency that it does not easily separate when caused to flow. This is an essential characteristic of the dye resist. While the viscosity of the gum (resist) is preferably in the range of 400 to 4000 centi-

poise, a particularly preferred value is about 1050 centipoise (CPS). The resist may be formed of a vegetable gum comprising any one of the conventional materials including borax, acid, ground beans or a grain material. In the preferred embodiment, the gum is provided at 2 grams per liter up to 15 grams per liter with the remaining portion being water. This gum is known as a manno-galactan vegetable gum. It will occur to those skilled in the art that other dye resist materials having the described viscosity and consistency may also be used. The resist 40 is applied to the well 38 via suitable inlet conduits 42. Well 38 and conduits 42 are best illustrated in Figure 3.

In Figure 3 suitable storage tank 44 stores a quantity of the vegetable gum dye resist. The resist is fed via a connecting pipe 46 through a valve 48 to a "Y" conduit 42 by which a conduit 50 is connected to pipe 46 to provide a uniform distribution of the resist as indicated by the arrows 52 and 54. Each of pipes 50 distributes the resist to an additional conduit 56 at two connections 58 and 60. The connections 58 and 60 are each uniformly spaced from opposite ends of the conduit 56. That is, the connections 58 and 60 are each respectively centrally disposed between the corresponding adjacent end of conduit 56 and the center of conduit 56. The purpose of these connections is to provide a substantially uniform distribution of the relatively thick viscous resist into the well 38. The conduit 56 has a centrally disposed exit aperture 62 and two end apertures 64 and 66. These three apertures 62, 64 and 66 uniformly distribute the resist 40 into the well 38 along the breadth thereof in the direction 68. This uniform distribution is an important goal in the present embodiment as will become apparent later. Should the thickness of gum dye resist 40 be applied merely at the one end of well 38 or some other single location, then the resist 40 will tend to overfill the well at that location while failing to flow completely to the other location in the well due to the relatively high viscosity of the material. This non-uniform fill is to be avoided in the apparatus 22 as will be explained. Uniform distribution of the resist via apertures 62, 64 and 66 permits the oozing resist 40 to flow together and form a relatively uniform level body of resist 40. The flow of the resist 40 from the storage 44 through valve 48 and conduit 46 is by gravity. Other means of applying resist to conduit 46 such as a pressurized supply may alternatively be utilized.

The well 38 of Figure 2 generally is an elongate U-shaped channel as shown. One upstanding wall 70 of the well 38 is topped or crowned with a longitudinally extending pipe 72 which extends between the sidewalls 74 and 76, Figure 3. Pipe 72 is horizontally disposed parallel with the horizontally disposed well 38 to permit a uniform overflow of the dye resist 40 over pipe 72 into a second well 78 via gravity. The rearmost upstanding wall 80 extends upward to the same height as walls 74 and 76 to contain the resist 40 therebetween.

Well 78 is formed by a pan having a flat, horizontally disposed bottom wall 84 connected to wall 70 and a pair of upstanding side walls formed by the continuation of walls 74 and 76 extending across the width of the tub 36 joined with a forward wall 88 which slopes upwardly and forwardly from bottom wall 84. Disposed between walls 76 and 74 and extending the breadth of the tub 36 parallel to pipe 72 is a baffle 90 which forms the tub 36 between wall 88 and wall 70 into two wells 78 and 92. Baffle 90 is L-shaped, having a lower flat horizontally extending leg 93 which extends forwardly in a direction toward wall 88 parallel to the bottom wall 84. Leg 93 is spaced from wall 84 to permit the flow of the gum or dye resist from well 78 to well 92. Baffle 90 has an upstanding wall 91 which extends about the same height as the walls 74 and 76 above the level of the resist overflowing pipe 72. Wall 91 is sufficiently high to prevent overflow over the uppermost edge thereof. As a result, the only means for flowing the resist 40 from well 78 to well 92 is between the leg 93 and bottom wall 84 as shown by arrows 94.

Disposed spaced from and adjacent each of the sidewalls 74 and 76 is a pair of overflow conduits 98 (one of which is shown in Figure 2) which cooperate with level control device 97 to maintain and control the level of the resist in well 92. Any excess resist that is flowing into well 92 overflows into the overflow tube 98 and is discarded. To prevent waste of the material and to maintain the level of the resist in well 92 substantially constant, level control device 97 is also provided. Device 97 includes a hollow conduit 99 having its open end terminating at the level at which resist 40′ is to be maintained in well 92. Pressurized air is forced through the conduit 99 in the direction 100. This action provides a backpressure in the conduit 99 in accordance with whether or not the end of the conduit 99 is blocked by the resist 40′.

It will be apparent that as the resist fills up the well 92 and covers the exposed end of tube 99 the pressure in the conduit 99 rises. As the resist flows out of the well 92 and uncovers the end of conduit 99, the pressure in the conduit falls. A suitable pressure switch 102 is sensitive to the pressure differential present in conduit 97 and as the pressure builds up, sends a signal to a conventional control device 104 indicating that the level of the resist 40′ has risen to a point where it

has blocked the end of conduit 99. Control device 104 then sends a signal to valve 48, shutting the valve in response to the signal received from switch 102. This cuts off the flow of additional resist into well 38 until once again the level of the resist in well 92 lowers to a point where the open end of conduit 99 is open to the atmosphere, reducing the pressure therein, activating switch 102 and causing the control 104 to again open the valve 48 to permit the flow of resist 40.

Disposed in the well 92 adjacent the sloping wall 88 is a resist pick-up roller 106. Roller 106 is a cylindrical, smooth surfaced roller which extends the breadth of the tub 36 between walls 74 and 76 as best seen in Figure 3. As the roller 106 rotates in the direction 108 the gum resist adheres to the surface of the roller due to the gluey consistency of the gum resist 40'. As provided in accordance with the present invention, the resist 40' at surface 110 is smooth and glassy in appearance which can easily be observed by eye. While the level control 97 and overflow tubes 98 may cause some bubbling in the resist 40, these bubbles are extremely minute, in the order of about 1/16th inch in diameter and are insubstantial in affecting the desired process results.

Secured to wall 88 outside well 92 is a doctor blade 112. Blade 112 slopes upwardly and rearwardly toward roller 106 and slideably engages the surface of roller 106 along the upper forward surface thereof. The doctor blade 112 picks off and separates the resist adhering to the surface of roller 106. Gravity causes the resist to slide down the sloping surface of the doctor blade, forming a continuous flowing sheet of resist 24. Doctor blade 112 is a conventional device and may be made of a suitable material such as fiberglass. Textile material 10 with its pile facing the sheet 24 is disposed horizontally when receiving the sheet 24. Textile material 10 is pulled past and over the idler roller 114. Textile material 10 with the dye resist coated on the tufted upstanding surface thereof is then passed through the TAK machine 26 of Figure 1 as explained above herein.

The purpose of the apparatus 22 is to provide a glassy-smooth and level surface 110 in the body of resist 40' while the resist 40' is removed from the tub by roller 106. The glassy-smooth surface is provided by first filling well 38 with the resist 40 and causing the resist to flow over pipe 72 uniformly along the length thereof. The resist flows into well 78. Because of its thick, gummy, gluey consistency, the resist has a tendency to have a greater level adjacent the pipe 72 and wall 70 than at baffle 90 which is spaced therefrom. In addition, the flow of the resist into well 78 causes ripples in the surface thereof and an unevenness which must be removed. The removal of the unevenness of the surface of the resist and the maintenance of the level thereof is achieved by the baffle 90, the overflow conduits 98 and the level control 97. The baffle 90 prevents the fluid in well 78 at the surface thereof from flowing directly into well 92 surface. As a result, all resist flowing into well 92 is flowing from the bottom of well 92 upwardly. This assures a minimum effect of the surface of the resist in well 78 on the surface 110 of resist 40' in well 92. As the resist flows upwardly in well 92 it is also distributed uniformly along the length thereof into the drawing as it flows beneath the leg 93. This flow is very gradual. The surface 110 of the resist in well 92 by means of the baffle 90, leg 93 and pipe 72 is made extremely smooth and has a glass-like finish.

Roller 106 is spaced remote from leg 93 and adjacent wall 88 to assure further levelling and smoothing of the surface 110 of the resist. By maintaining the level of the surface 110 substantially constant a substantially uniform thickness of resist is picked up by roller 106 as it rolls at a constant rate. Preferably, the film of resist adhered to roller 106 is about 1/4" thick. As an example, the flow rate of the resist on doctor blade 112 can be about 800 cubic centimeters (cc.) per square yard. By way of example only, the speed of the roller 106 can be about 28 RPM for a roller about 6 inches in diameter. The roller 106 preferably has a speed of about 20—31 RPM and rotates at that rate which corresponds to the rate of travel of the textile material 10. The surface 110 being smooth, glassy and level ensures that the film of the viscous resist that adheres to the roller 106 is smooth and uniform throughout. This smooth, uniform film is transferred to the doctor blade 112 and thence into sheet of resist 24 as a continuous sheet on a continuously moving material 10.

It is to be understood that it is prejudicial for the present embodiment if the thickness of the sheet 24 be not uniform throughout. Any change in thickness such as might be caused by large bubbles or differences of levels of the surface 110 during the process will result in a difference of thickness of the resist as it is applied to the textile material 10 and thus can cause a change in the coloring affect. This difference of thickness and coloring is undesirable. Carpeting usually is exposed to an observer's eye almost simultaneously over the entire area. Any slight changes of coloring to darker or to lighter hues are readily noticeable and are highly undesirable. While the coloring is random in shades, the randomness is uniform providing a uniform variation in shading and producing a heather effect. Minute changes in shading are readily noticeable even by an untrained observer.

Once the dye droplets at 34, 34' impinge upon the resist coated textile material 10, the resist spreads the dyes around and prevents them from soaking immediately into the textile material. As a result, the droplets are permitted to spread themselves thin and also form a concentrated dye effect where the dyes impinge upon the material. This reduces the contrastyness or harshness such as exhibited by the prior art dyeing processes. The amount of time permitted before the carpet or textile material is fixed in a steamer 30, Figure 1, depends on the overall effect desired. A multitude of dyeing effects may be achieved once the dye resist sheet 24 is applied to the textile material in the uniform consistent smooth surface film. In essence, three successive serially disposed wells 38, 78 and 92 are shown and described for forming a viscous slow moving material (resist 40) into a relatively quiet body of material having a controlled surface (resist 40').

Various modifications may be made to the apparatus of Figure 2 to achieve the desired effect, i.e., a glassy-smooth resist having a controlled level. These may include providing different devices for controlling the feed of the resist into the tub and the maintenance of the level thereof. For example, knowing the feed rate of the sheet of resist 24, a suitable resist supply mechanism can be provided which automatically feeds the resist into the well 38 so that a level control 97 and overflow tube 99 may not be necessary. However, such changes are more complex and costly. Nothing in the above description of embodiments and modifications should, however, be construed as including within the scope of the invention as defined in the appended claims, systems in which textile material is supported substantially horizontally during its transport between the applicator of the dye and the steamer, i.e. the zone where the dye is fixed.

Subject to the foregoing disclaimer, WHAT WE CLAIM IS:—

1. A method of dyeing a textile material in a continuous process in which both a resist and a dye are employed comprising the steps of:

continuously applying a sheet of viscous, liquid dye resist on a surface of the material;

transporting the textile material and during such transport and in a continuous process applying a dye to the liquid dye resist coated fibers of the material;

continuing to transport the material, and during such transport, fixing the dye to the fabric.

2. The method of claim 1 wherein the dye is applied in droplets to the dye resist coated fibers of the textile material.

3. The method of any of the preceding claims wherein the sheet of dye resist is of the same width as the material and covers the entire surface of the material.

4. The method of any of the preceding claims wherein the sheet of dye resist is of uniform thickness.

5. The method of any of the preceding claims wherein the viscosity of the dye resist is 400 to 4000 centipoise.

6. The method of any of the preceding claims wherein the viscosity of the dye resist is about 1050 centipoise.

7. The method of any of the preceding claims wherein the resist is a water soluble resist and wherein the fixing of the dye is accomplished by transporting the fabric through a steam bath.

8. The method of any of the preceding claims wherein the dye resist is a vegetable gum.

9. The method of any of the preceding claims wherein the fabric is a carpet and wherein the resist and dye are applied to the tufted surface of the carpet.

10. The method of any of the preceding claims wherein, during the applications of the dye resist, and the dye, the textile material is in a substantially horizontal path.

11. Apparatus for dyeing a textile material and including: means for applying a viscous liquid dye resist to a surface of the textile material, means for applying a dye in the form of droplets to a liquid dye resist coated surface of the tetxile material, and means for fixing the applied dye to the textile material, wherein the means for applying the liquid dye resist includes:

a roller located in a bath of the resist and a blade the edge of which is close to the surface of the roller for peeling from the roller surface a sheet of uniform thickness of the resist and directing that sheet onto the textile material.

12. Apparatus for dyeing a textile material and including: means for applying a viscous liquid dye resist to a surface of the textile material, means for applying a dye in the form of droplets to a liquid dye resist coated surface of the textile material, and means for fixing the applied dye to the textile material, wherein the means for fixing includes:

means for transporting the textile material to a steam bath in such manner that the material forms a downwardly extending loop and then the material moves upwardly and enters the steam bath at a point above the level it has when the dye is applied to it.

13. Apparatus for dyeing a textile material and including: means for applying a viscous liquid dye resist to a surface of the textile material, means for applying a dye in the form of droplets to a liquid dye resist coated surface of the textile material, and means for fixing the applied dye to the textile material, where-

in the means for applying the liquid dye resist to the textile material includes means whereby the resist is stored in a trough of a width sufficient to permit the entire width of the textile material to be covered with resist when the resist is transported from the trough onto the textile material, where the trough has a plurality of entrance apertures spaced from one another along the width of the trough located at the bottom portion of the trough through which the resist is concurrently supplied to the trough to insure that the viscous resist, as it enters the trough, will provide a substantially uniform depth of resist along the entire width of the trough, that is, to insure that the surface of the resist is relatively smooth and horizontal, and wherein means are provided for obtaining from this trough containing the resist a sheet of uniform thickness of the resist and applying the same to the surface of the textile material.

14. A dyeing apparatus or method substantially as hereinbefore described with reference to the drawings.

15. A textile material when dyed by the method or apparatus of any of claims 1—14.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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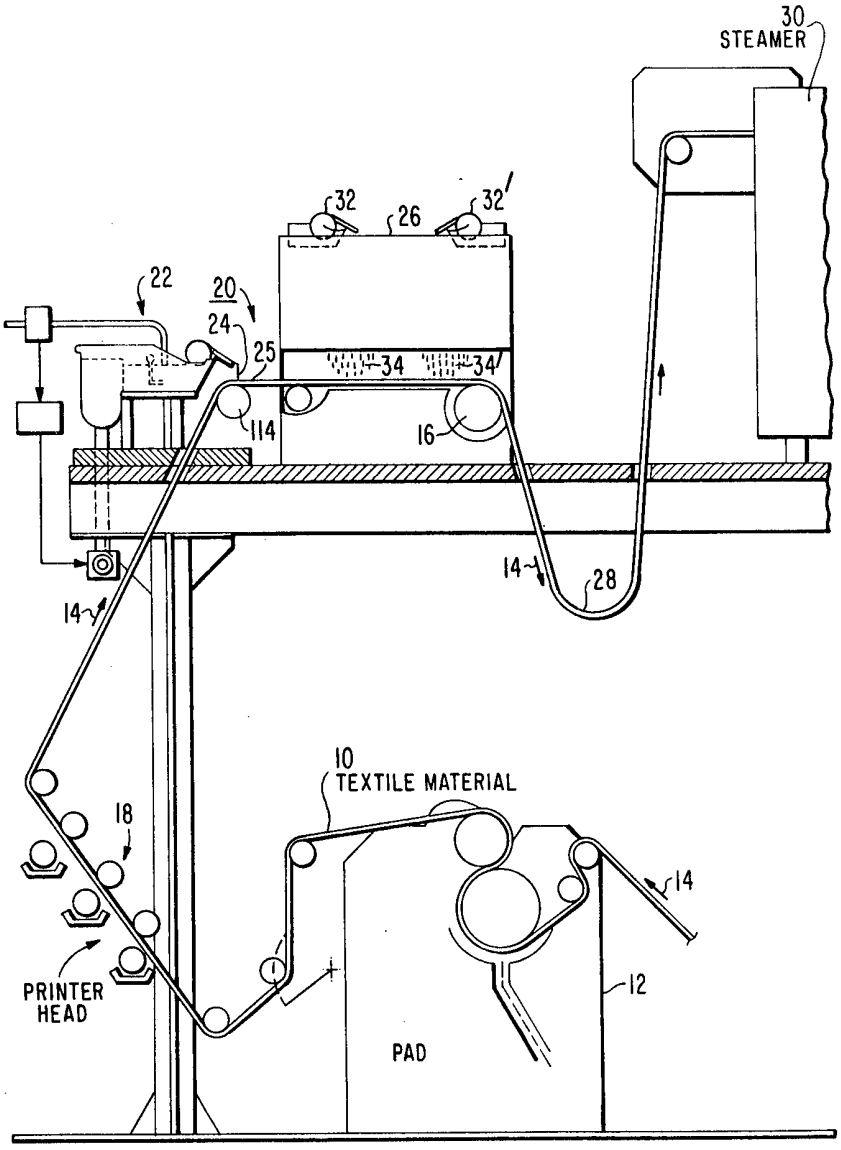

Fig. 1.

1578039 COMPLETE SPECIFICATION
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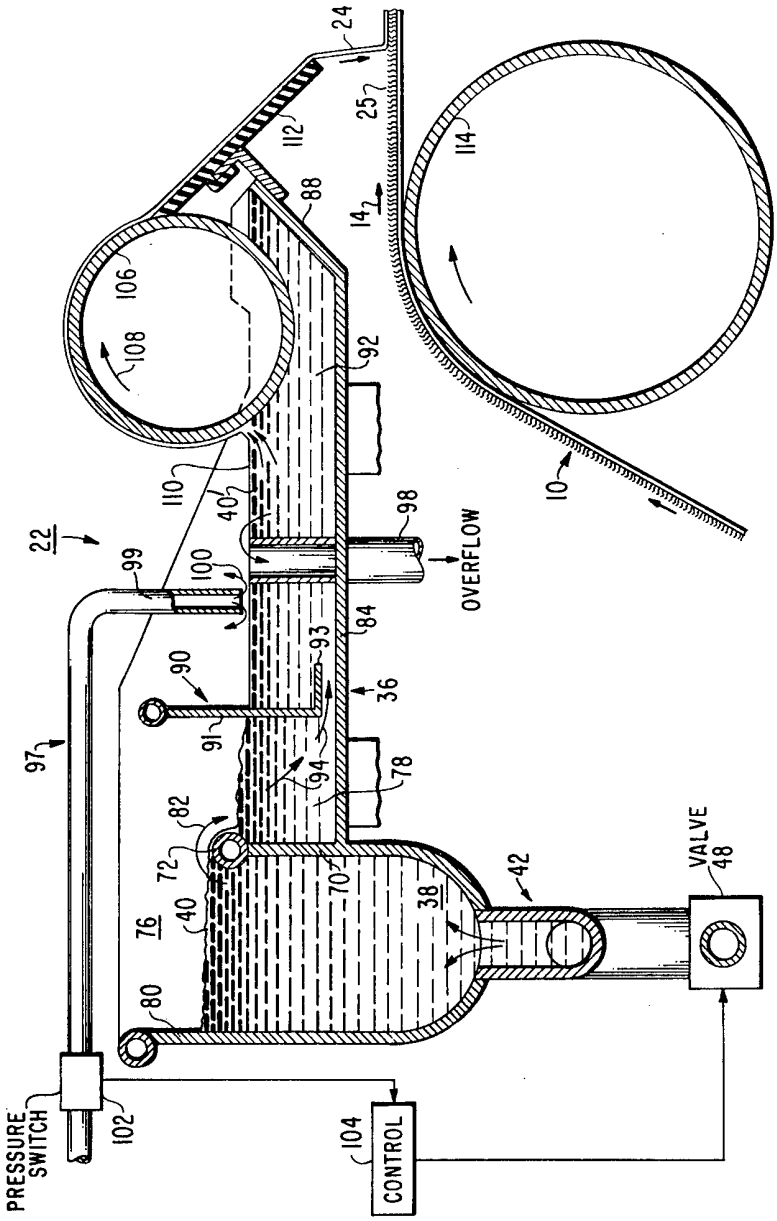

Fig. 2.

1578039 COMPLETE SPECIFICATION
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Sheet 3

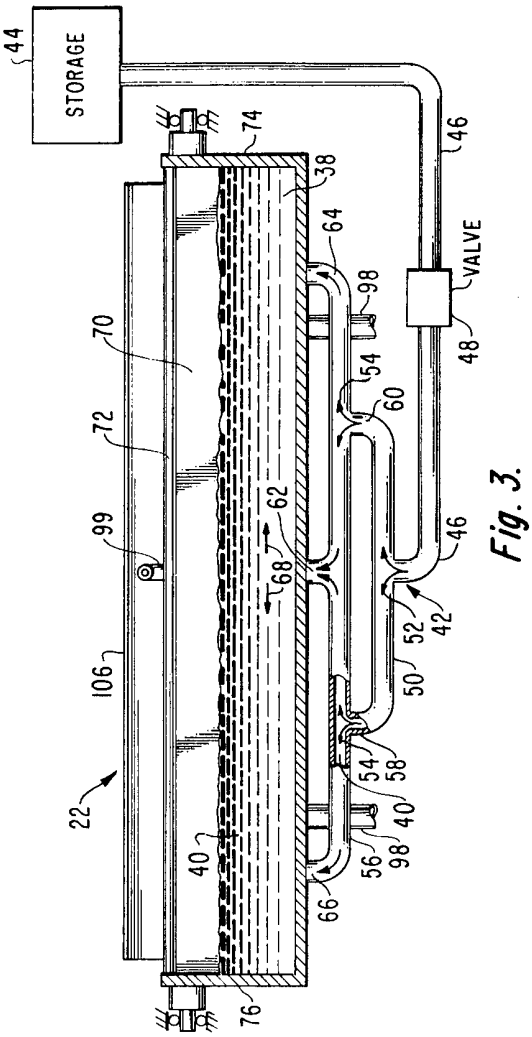

Fig. 3.