

[54] APPARATUS FOR LIQUID TREATMENT OF TEXTILE MATERIALS OF STRING FORM

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[58] Field of Search.....68/177, 178

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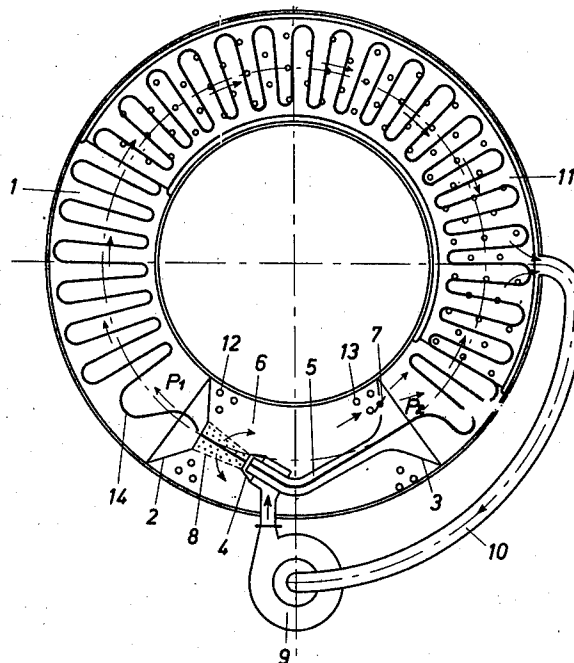
Primary Examiner—William I. Price

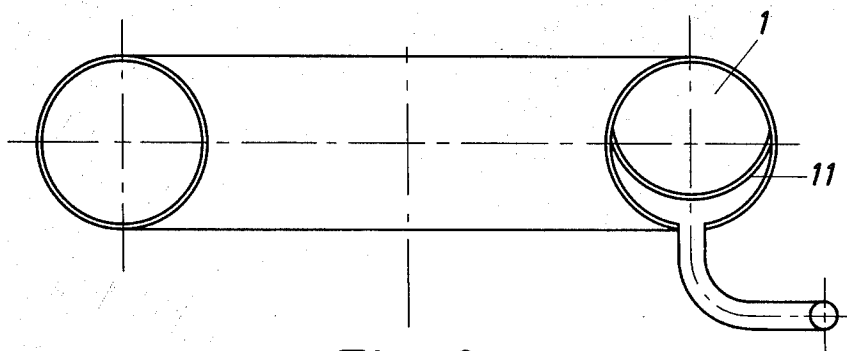
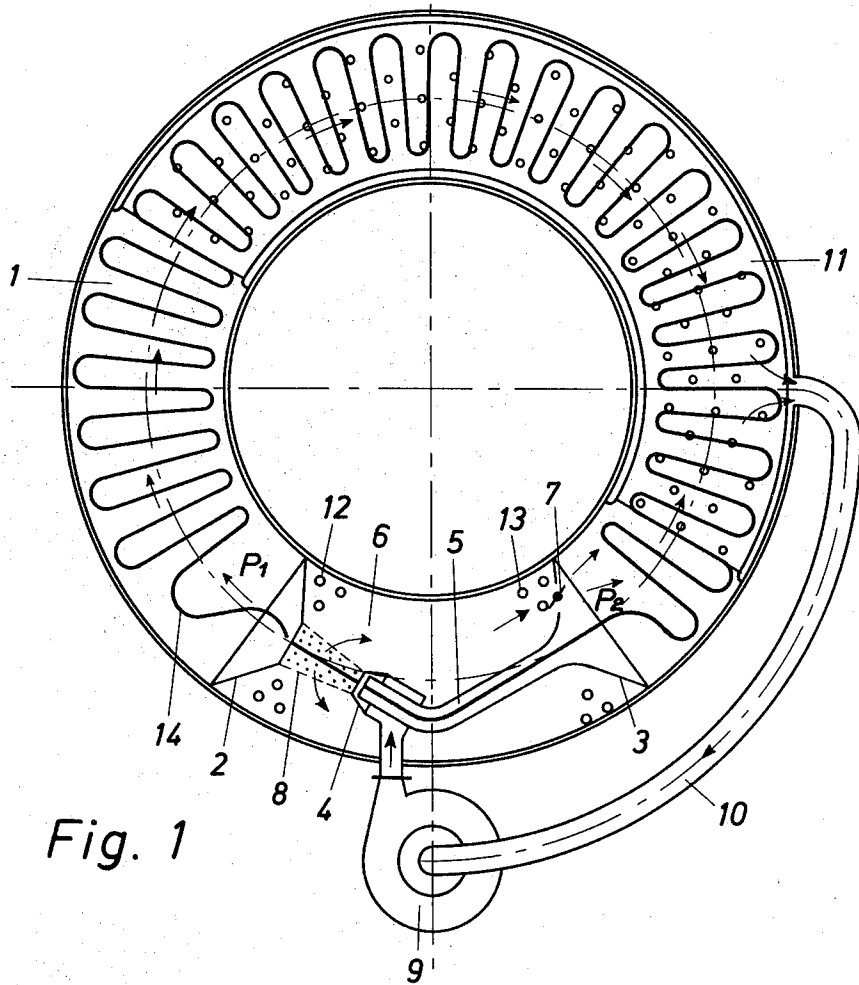
Attorney—Waters, Roditi, Schwartz & Nissen

[57] ABSTRACT

An apparatus for liquid treatment of textile materials in string form in which the textile material is transported by the flowing liquid through a wide channel and a narrow channel along a horizontal or slightly inclined annular path with constant radius of curvature.

6 Claims, 4 Drawing Figures





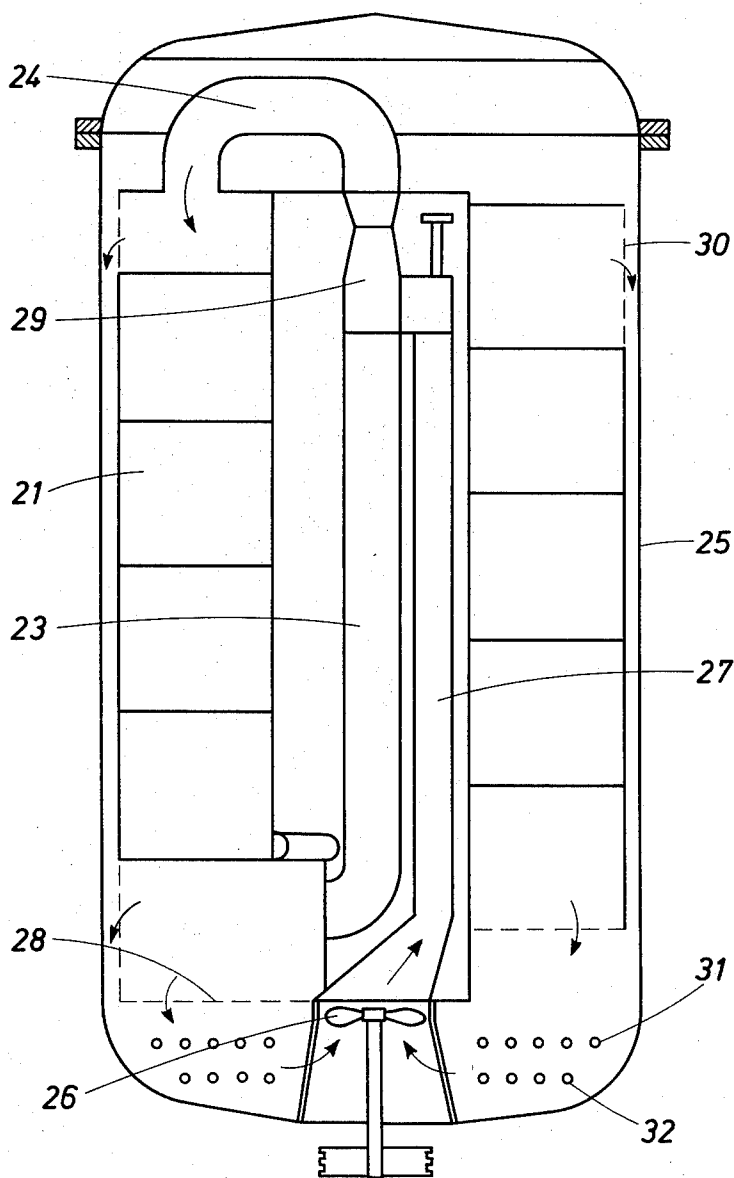


Fig. 3

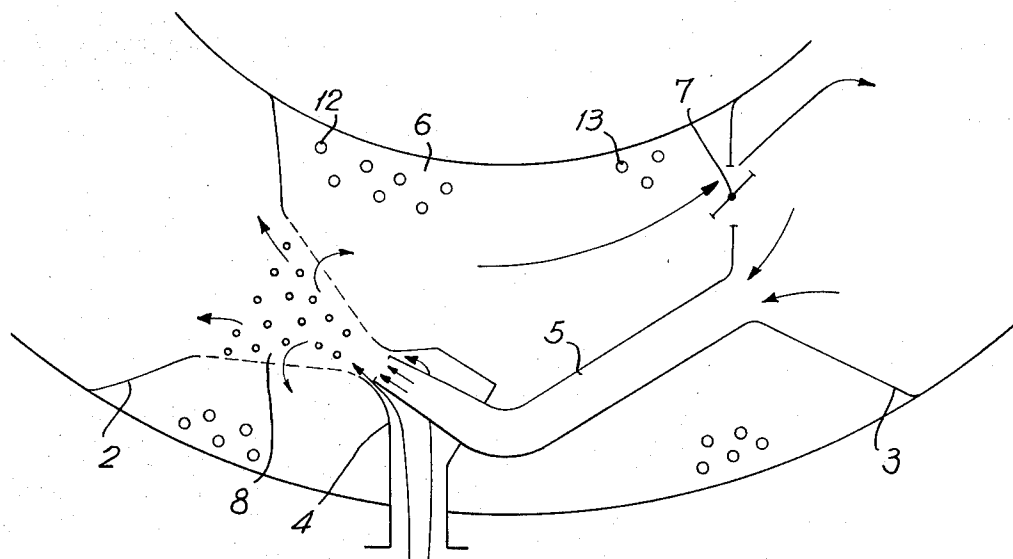


FIG. 4

## APPARATUS FOR LIQUID TREATMENT OF TEXTILE MATERIALS OF STRING FORM

The present invention relates to an apparatus for liquid treatment, more particularly dyeing, of textile materials of string form.

The apparatus is of the kind which is known, e.g., from U.S. Pat. No. 99,008 and in which the textile material in the form of an endless string is circulated through the liquid in a closed circuit, the apparatus having a tank for the liquid and a narrow channel which communicates with the tank and through which the liquid is caused to flow rapidly, thereby carrying with it the textile material, the apparatus having a by-pass pipe which is provided with a pump and through which the liquid is drained from the tank and introduced into the narrow channel.

The apparatus known from U.S. Pat. No. 99,008 has serious drawbacks, among other things because the narrow channel is located in such manner that the textile material has to be lifted out of the liquid and because that part of the string of textile material which in its folded condition is stored in the tank where the movement of the liquid is slow will readily get into disorder.

Improved embodiments of the said apparatus are known in which the said drawbacks are partly relieved by the liquid tank being formed as a wide channel which is completely filled with liquid and connected with the narrow channel in such manner that the textile material at no time gets out of the liquid, and which simultaneously forms limitations for the folded, stored part of the string of the textile material so that the said string is less liable to get into disorder.

Also these known apparatus have, however, drawbacks due to the fact that the wide channel has vertical sections and transitions from rectilinear to curved sections which involve non-uniform stoving together of the stored folded string of textile material, which may cause non-uniform dyeing owing to varying rate of liquid flow and cause the textile material to be subjected to varying pressures, or the said material may receive lasting marks of the foldings.

These drawbacks are relieved by the apparatus according to the invention. It is of the kind having a tank formed as a wide channel in which the string is stored in its folded condition and which communicates with a narrow channel in which the liquid is caused to flow rapidly so as to carry with it the textile material, and a by-pass pipe through which the liquid is drained from the tank and introduced into the narrow channel. The essential feature of the invention is that the wide channel is formed as a horizontal or slightly inclining annular path with a constant radius of curvature.

As a result, the textile material is throughout the tank subjected to uniform, compressing and tensioning forces so that also the dyeing will be uniform and physical damage to the textile material is avoided.

According to the invention the wide channel is preferably a horizontally arranged pipe formed as a circular ring containing the built-in narrow channel.

As a result, any conveyance of the textile material with or against gravity is avoided, also in the narrow channel, and this ensures the best control of the tension and pressure to which the textile material is subjected in the wide channel.

In another advantageous embodiment of the apparatus according to the invention the wide channel is formed as a vertical circular helical path having its upper and lower ends connected with the narrow channel. This will certainly give the narrow channel a vertical extent, but when the apparatus is completely filled with liquid, the textile material in the channel will not be subjected to any injurious amount of tension and the folded, stored string of textile material is everywhere inside the broad channel subjected to uniform stresses. The apparatus possesses the advantage of having substantial capacity and of being capable of being inserted in the vertical cylindrical tanks in conventional use for dyeing of yarn in such manner that the propeller used in the yarn dyeing apparatus for circulating the dye stuff liquid may be used for circulating the liquid in the bypass pipe and for producing the rapid flow in the narrow channel.

In one embodiment of the apparatus in which the wide channel is a horizontal pipe formed as a circular ring the said pipe is appropriately of circular cross-section, since this will ensure to a maximum extent that the folded string of textile material moving through the pipe is not entangled. The said form of the pipe is furthermore easier and cheaper to manufacture and is better able to resist pressure.

Since the textile material in the section of the wide channel from which the liquid is drained is reducing its volume, the wide channel is according to the invention preferably of reduced cross-section in the said section so that the walls of the channel also in this area constitute an effective guide for the folded string.

In the section of the wide channel from which liquid is drained to the by-pass pipe, the movement of the folded string of material will be retarded, which is convenient since it will thus be easier to avoid that the folded string is entangled at the transition to the narrow channel or is stoved up against the narrow channel where the string is straightened, the string in its non-folded condition being entrained by the liquid flow through the narrow channel.

To further improve the said retarding effect before the transition to the narrow channel the said channel may according to the invention appropriately be provided with perforations which divert part of the liquid flow through the narrow channel leading it through a valve to the wide channel in a direction counter to the direction of movement of the textile material. The apparatus may in a manner known per se be provided with tube coils for heating and cooling the liquid.

The invention is further illustrated in the drawing, in which

FIG. 1 shows an embodiment of an apparatus in horizontal section,

FIG. 2 a vertical section of the same apparatus,

FIG. 3 another embodiment of an apparatus in vertical section, and

FIG. 4 is an enlarged, fragmentary view of the apparatus of FIG. 1.

In FIG. 1, the liquid tank 1 of the apparatus is a horizontally arranged annular pipe of circular cross-section constituting a wide channel for conveying a string 14 of textile material in its folded condition.

Along a great part of its length the wide channel is provided with a perforated plate 11 mounted above the

bottom of the channel. From the said section part of the liquid is drained off by means of a by-pass pipe 10, by which the advance movement of the string of textile material is retarded and the volume of the said material is reduced. In this area the wide channel is therefore of slightly smaller cross-section suitable for the reduced volume of the textile material.

The by-pass 10, in which there is a pump 9, opens into a nozzle 4 which produces a rapid unidirectional flow of the liquid in the narrow channel 5. The narrow channel has at one end a perforated part 8 which causes a part of the liquid flow to be diverted to a chamber 6 limited by partitions 2 and 3, from which it passes through a valve 7 provided in the partition 3 in the return direction counter to the main direction of the liquid flow. The said amount of liquid is drained through that part of the perforated plate 11 lying closer to the partition 3, and a pressure  $P_2$  arises which has a regulating effect on the retardation so that the textile material is not stoved together against the partition 3.

The folded material in the wide channel is advanced by the pressure  $P_1$  arising by throttling of the valve 7.

In the chamber 6 is provided a tube coil 12 for heating the liquid and a tube coil 13 for cooling the liquid. The pump 9 effects the flow of the liquid through the entire ring-shaped apparatus, in effect, broad channel 1 and narrow channel 5. Although a portion of the liquid is drained through the by-pass pipe 10, the flow through the narrow channel 5 is more rapid than that through the broad channel 1; and effect which is enhanced by the suction generated at the nozzle 4. The heating coil 12 and cooling coil 13 are never simultaneously operated, but in an alternative manner, as required, since they provide the dyeing cycle for the apparatus.

In the narrow channel 5 the string of textile material in its straightened condition is entrained by the rapid flow of liquid produced by introducing the liquid through the nozzle 4 by means of the pump 9. In the wide channel 1 the velocity of the liquid flow decreases and the string of textile material folds up as indicated in the drawing and is advanced in the said folded condition through the channel. Since the channel is horizontal and everywhere has the same radius of curvature, the folded string will everywhere be subjected to uniform stresses. Since further the channel is of circular cross-section, the walls of the channel will everywhere act uniformly as limiting surfaces for the folded string, regardless whether the folds are formed as indicated in the drawing or in another direction. The apparatus will therefore efficiently prevent any disorder or entanglements of the string of textile material that may involve mechanical injuries or non-uniform dyeing.

In the embodiment of the apparatus disclosed in FIG. 3 the liquid tank is constituted by a wide channel in the form of a vertical circular helical path 21 with a low

pitch. The narrow channel is constituted by a vertical pipe 23 with a bend 24 which connects the lower and the upper end of the helical path 21. The apparatus is inserted in a vertical cylindrical tank 25 of the kind used for dyeing yarn in skeins and has at the central part of its bottom a propeller 26 for circulating the dyestuff liquid. The said propeller is utilized as a pumping means in the by-pass pipe 27 of the apparatus, liquid being drained from the helical path 21 through a perforated bottom 28 and introduced into the narrow channel through a nozzle 29. At the upper end of the wall of the helical path may be provided other perforations 30 for draining off excess liquid. At the bottom of the cylindrical tank 25 are tube coils 31 and 32 for heating and cooling the liquid.

The liquid flows in the direction of the arrows indicated in the drawing, carrying with it the string of textile material up through the pipe 23 and depositing it at the upper end of the helical path 21, where the string folds up and fills out the channel while moving downwards along the slightly inclining surface. The conveyance is facilitated owing to the surface inclining slightly in the direction of movement without, however, being so steep that the folded textile material is subjected to pressure by overlying layers.

We claim:

1. An apparatus for liquid treatment of textile materials of string form, and having a tank formed as a wide channel in which the string is stored in its folded condition and a narrow channel which is connected therewith and in which a rapid flow of the liquid is produced, carrying with it the textile material, and a by-pass pipe through which liquid is drained from the tank and introduced into the narrow channel, characterized in that the wide channel is formed as a substantially horizontal annular path with constant radius of curvature.

2. An apparatus as claimed in claim 1, characterized in that the wide channel is a horizontally arranged pipe formed as a circular ring containing built-in narrow channel.

3. An apparatus as claimed in claim 1, characterized in that the wide channel is formed as a vertical circular helical path the upper and lower ends of which communicate through the narrow channel.

4. An apparatus as claimed in claim 2, characterized in that the pipe is of circular cross-section.

5. An apparatus as claimed in claim 2, characterized in that the wide channel is of reduced cross-section in the section from which liquid is drained off by the by-pass pipe.

6. An apparatus as claimed in claim 2, characterized in that the narrow channel is provided with perforations which divert a part of the liquid flow circulating through the narrow channel, leading it through a valve to the wide channel in the direction counter to the direction of movement of the textile material.

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