Dec. 3, 1963 H. W. WILKINSON, JR 3,112,633

DYEING MACHINE FOR PRODUCING VARIEGATED YARN

Filed Oct. 31, 1960 3 Sheets-Sheet 1

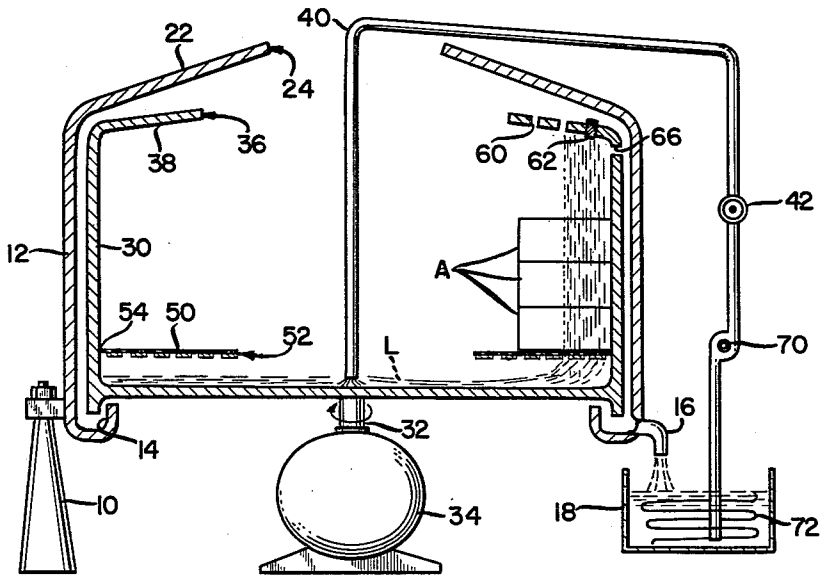


Fig. 1

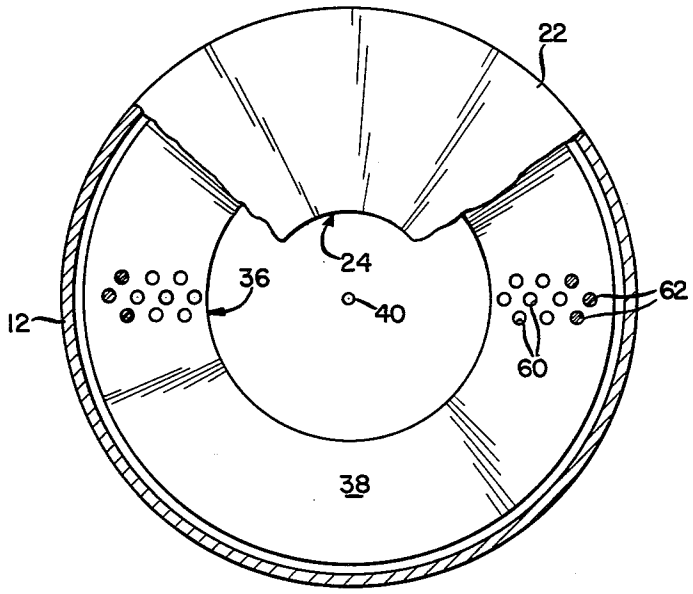


Fig. 2

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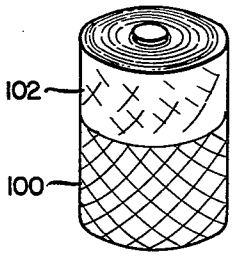


Fig. 3.

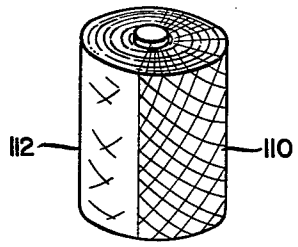


Fig. 4.

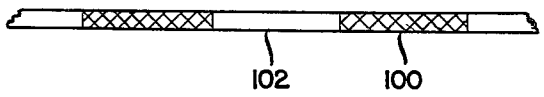
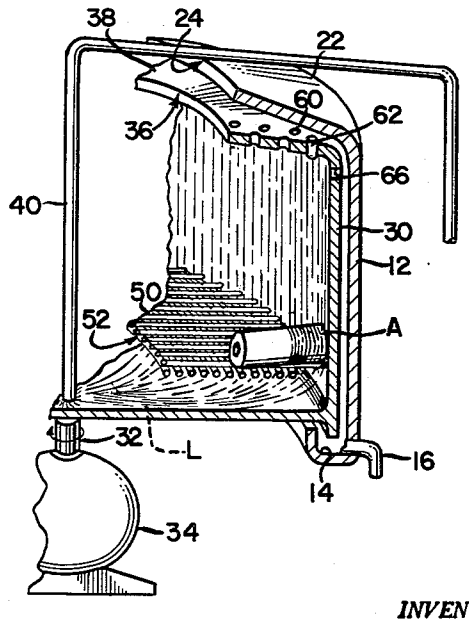


Fig. 5.

Fig. 6.



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DYEING MACHINE FOR PRODUCING VARIEGATED YARN

Filed Oct. 31, 1960 3 Sheets-Sheet 3

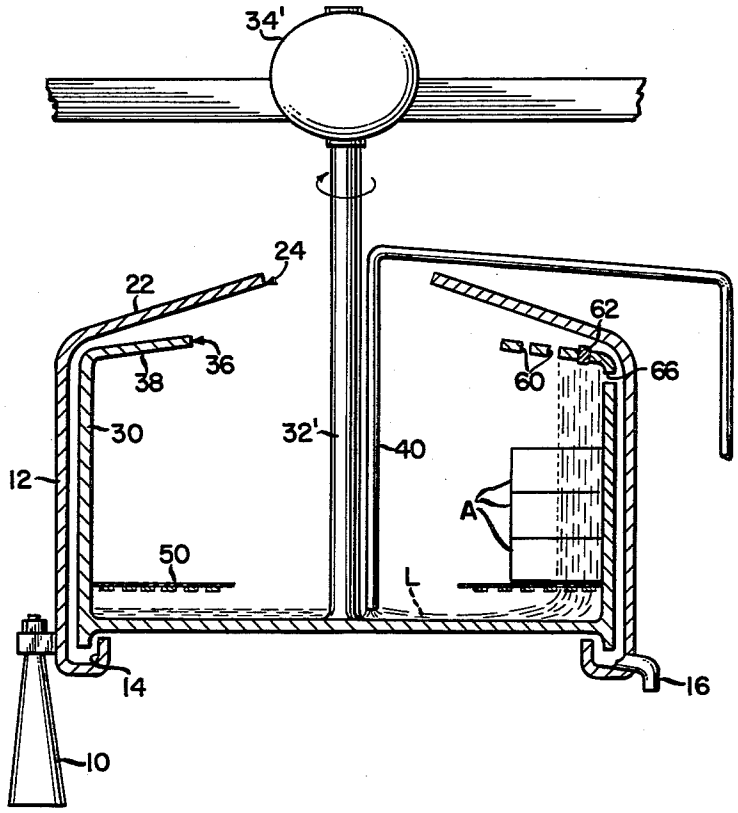


Fig. 7.

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DYEING MACHINE FOR PRODUCING VARIEGATED YARN

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6 Claims. (Cl. 68—142)

The present invention relates generally to new and useful improvements and structural refinements in a means for impregnating articles of various kinds through the action of centrifugal force upon a rotating body of treatment liquid in which the articles to be impregnated are partially or fully submerged and it is directed more especially to the provision of a system and apparatus for controlling the amount of dyestuff impregnated into a package, tube, cone or small beam of yarn by a unique means of control of the thickness or depth of the wall of the treatment liquid in which the material being treated is submerged.

Additionally, the invention has general utility in the arts as it relates to a device for producing a variegated yarn, and more particularly it envisions a multicolored yarn which is provided with repeating sections of different colors throughout its length.

It will be helpful to an understanding of the present invention first to briefly consider some of the essential points and more important features and aspects thereof, so that same may be kept in mind during the subsequent reading of the detailed description of the practical embodiments of my improvements and of the illustrations thereof in the hereunto annexed drawings.

Accordingly, it is first to be noted that the invention may be employed on any yarn such as a vegetable yarn, synthetic yarn, animal yarn, or any product in the fibrous or monofilament yarn state.

It is frequently desirable to use such a yarn, containing a variety of colored portions interspersed throughout its length, in the manufacture of textile products, such as fabrics, braids, knitted goods, and the like, where it is desirable to produce a multicolored pattern.

Multicoloring of yarn has heretofore been effected by subjecting a continuous length of yarn to a printing process whereby different colors are printed onto the yarn at intervals therealong so as to produce the desired variegated effect. Another method heretofore in common use has been to immerse different sections of a skein of yarn into different colored dye solutions. Such prior art methods have necessitated the use of equipment offering a low rate of production and resulting in an expensive end product, all so as to limit the use of variegated yarn in practical applications.

Without intending to place undue limitations upon the scope of this invention beyond what may be required by the state of the prior art, same may be briefly described as embracing the concept of a system and means for effectuating a selective centrifugal impregnation process whereby multi-colored yarns can be dyed in a suitable package or tube or cone or the like with a controlled amount of dyestuff, all so as to make possible a partial, as contrasted with a complete or total impregnation thereof.

Yarn is normally supplied in the form of packages or tubes wound upon hollow or perforated cores or spools. According hereto, I provide a simple, expeditious, economical and highly efficient method of and apparatus for partially and uniformly coloring the yarn while in such package or tube.

Now the use of centrifugal force for the impregnation of liquids into fibrous materials is admittedly old. However, a centrifugal impregnator of the type herein described to impregnate yarns in the production of a multicolored or variegated effect is novel and unique.

The existing practices, as exemplified by the known prior art, all have certain common and obvious objections in that total submersion of and complete impregnation of the material is a necessary, but limiting, feature thereof. In contradistinction, I have devised a novel means whereby such limitation is obviated, by the provision of a structure which permits the control of the dyeing of the package from one end to the other and additionally permits the partial impregnation of a liquid, such as a coloring material or of a multiplicity of such liquids.

It is, therefore, an object of the present invention to furnish an improvement in the art which, on the basis of the factors involved, is capable of solving the objections previously encountered.

Herein, a suitable treatment liquid is passed into a centrifuge containing the package, tube, cone, or spool, or the plurality thereof, disposed therein in predetermined position or positions, which centrifuge is rotated uniformly about its axis of symmetry so as to cause the treatment liquid constituents to move upwardly relative to the inner vertical wall thereof and certain thereof to escape through the top wall of the centrifuge and in the course thereof to spot certain portions of the yarn on the package, tube, cone, or spool or the plurality thereof.

One general object of the present invention is to provide a means for developing hydrostatic pressure through the action of centrifugal force in a rotating body of treatment liquid contained within a centrifuge carrying the articles desired to be impregnated, which pressure acts radially with reference to the axis of rotation of the body of liquid whereby the liquid is impregnated into the articles in a predetermined manner, resulting in a type of impregnation, which I call partial impregnation, such as has heretofore not been obtainable, and same comprehends a particular construction, arrangement, combination, and relationship of various elements, components and instrumentalities of a centrifugal means for accomplishing this object.

Another primary object hereof is to provide a centrifuge which will permit the disposition therein of one or more packages or the like in such manner that the centrifuge, upon rotation thereof, will permit a treatment liquid to be passed through a predetermined portion or part of the package or packages by means of centrifugal force.

One salient feature hereof lies in the fact that I project a treatment liquid from the exterior inwardly to the interior of the package or packages.

Broadly stated, it is one of the key objects hereof to provide a system whereby the depth of the wall of the liquid coloring employed or the portion of the cross sectional volume of the package or packages being treated or dyed may be effectively controlled.

Other chief objects and purposes hereof are to provide advantageous structural and operational features in a device of the class to which reference has been made so as to offer an apparatus having the following inherent meritorious characteristics; first, engineeringwise, a uniqueness in design of coacting parts wherefor the components are coordinated for facile assembly; second, a susceptibility to easy installation; third, a high degree of efficiency and dependability in its operation use; fourth, the securement of a higher degree of accuracy and greater degree of variety in the manner of work performed therewith than has heretofore been possible with prior devices known in the art; fifth, the attainment of a convenience of arrangement of parts and a flexibility or a capability of adjustment; and sixth, the provision of a construction which is well adapted to withstand the

usage to which a centrifugal machine is ordinarily subjected.

These objects and other incidental ends and advantages will in part be obvious and apparent and will in part be more fully pointed out in the progress of the disclosure below.

The invention consists substantially in the combination, construction, location and relative arrangement of parts, as herein described in detail, and in the method of use of such construction so as to achieve the claimed results. These physical embodiments, albeit the preferred exemplifications, are only indicative of but two of the various ways in which the invention's principles may be employed and in which the component instrumentalities may be combined and arranged.

The invention reverted to is not restricted or confined to said embodiments. Same are not intended to be exhaustive of, nor limiting of, the spirit or scope hereof. The precise constructions illustrated need not be slavishly followed as, of course, the parts may have to be adapted or alternatively constructed or modified in accordance with any specific use contemplated therefor, such adaptations and/or alternative constructions and/or modifications being intended to be comprehended within the meaning and purview and range of equivalence of the below subjoined claims.

The characteristic features which I consider to be novel with my invention, as to its construction and organization and method of operation, will be better understood from a consideration of the following detailed description forming a part of this specification, when read in conjunction with the illustrations in the accompanying drawings, and in which:

FIG. 1 is a more or less diagrammatic side elevational view with certain parts shown in section, illustrating one form of the apparatus for carrying out the invention, and showing a plurality of open tubes of fiber disposed on their horizontal axes;

FIG. 2 is a top plan view of certain components of the apparatus shown in FIG. 1;

FIG. 3 is a perspective view of a dyed package of yarn, same having been disposed upon its horizontal axis during the dyeing operation;

FIG. 4 is a view, similar to FIG. 3, showing a dyed package of yarn, same having been disposed upon its vertical axis during the dyeing operation;

FIG. 5 is a fragmentary side elevational view of a piece of the yarn which has been dyed according to the process of this invention;

FIG. 6 is a fragmentary perspective view showing certain details of the apparatus shown in FIG. 1; and

FIG. 7 is a view, similar to FIG. 1, showing a modified form of the apparatus of the invention.

In the following description and in the appended claims, various components and details thereof will be identified by specific names for purposes of convenience. Such phraseology or terminology is for the purpose of description and not of limitation and is intended to be as generic in its application as the art will permit and is not intended to exclude any reasonable equivalents of the features shown and described or portions thereof.

It will be readily appreciated, however, that other types of apparatus incorporating the key or essential features hereof may be employed without departing from the underlying principles hereof.

With continued reference now to the drawings, which illustrate typical and preferred embodiments of the invention for the purpose of disclosure and form a part of this specification, I have shown, in FIGS. 1 and 2, an apparatus which comprises a plurality of legs or supports 10 adapted to support a hollow, cylindrical, outer casing 12 having a lowermost annular inwardly-and-upwardly-extending flanged trough 14 for the collection of liquid therewithin, which liquid may be withdrawn

therefrom through a conduit means 16 leading to a supply tank or reservoir 18 disposed adjacent the casing 12.

Casing 12 additionally is provided with an uppermost inwardly-extending, inclined, annular top wall 22 having a central opening 24 therethrough.

A hollow, circular bowl or centrifuge 30 of slightly smaller diameter than casing 12 is disposed substantially coaxial therewith and is rotatively supported within the circumjacent casing 12 by means of a vertically-extending shaft 32 driven by a motor 34 and fixed to the lower planar surface of the bottom wall of said centrifuge in any conventional manner.

Centrifuge 30 is provided with a central opening 36 through a top or cover wall 38 which wall extends inwardly and slightly upwardly from the upper edge of the vertical side of said centrifuge. Through said central opening, a pipe or conduit 40 is extendable, said pipe leading from storage tank 18 for the discharge of the fluid supplied therefrom into centrifuge 30. Said pipe or conduit is fitted with a control valve 42 along its length for the well known control function.

Centrifuge 30 is provided with a false bottom 50 spaced upwardly of and substantially parallel to the real centrifuge bottom wall and rotates therewith, functioning to keep the packages disposed within the bowl upwardly from the floor so that any superfluous and unwanted dyeing is made impossible.

Preferentially, false bottom 50 is composed of a grate-like material or the like, has a central opening 52 therethrough, and at portions along its outer peripheral edge 54 is fixed to centrifuge 30. It is especially preferred that the peripheral edge of the false bottom adjacent the inner vertical wall of the centrifuge offer no continuous resistance to the passage of liquid upwardly relative to said inner vertical wall. In the accomplishment of this objective, said false bottom is provided with peripheral circumferentially-spaced cleat-like projections (not shown) which engage with the centrifuge so as to space the peripheral edge of the false bottom inwardly of the vertical wall of the centrifuge in the portions thereof between the adjacent cleat-like projections.

That is, the relationship of false bottom 50 and the inner vertical wall of the centrifuge is such as to provide a plurality of concentric parti-circular openings or slots annularly spaced from one another by the cleat-like projections which extend outwardly from the outer annular edge of the false bottom.

Top or cover wall 38 of the centrifuge 30 is provided with control or wall-determining openings 60, which openings may be sealed off, when and as desired, by the insertion of plugs 62 thereinto.

The vertical wall of centrifuge 30 is provided with one or more bleeder openings 66 therethrough which function to allow bleeding and/or extraction of liquid therefrom. Preferentially, said bleeder openings 66 will be disposed in a horizontal plane above the upper horizontal plane of the topmost package disposed within the centrifuge.

In the modified construction shown in FIG. 7, I have shown substantially the same apparatus as shown in FIGS. 1, 2 and 6 including legs or supports 10 adapted to support a cylindrical outer casing 12 having a lowermost annular inwardly-and-upwardly-extending flanged trough 14 for the collection of liquid therewithin, same being dischargeable through a conduit means 16 leading to the storage tank (not shown).

Casing 12 has an uppermost, inwardly-extending, inclined, annular top wall 22 having a central opening 24 therethrough.

Centrifuge 30, of slightly smaller diameter than casing 12, is disposed substantially coaxial therewith and is rotatively supported within the surrounding casing 12 by means of a vertically-extending shaft 32' driven by a motor 34' and fixed to the upper planar surface of the bottom wall of the centrifuge in any conventional manner.

Thus, in this case, the centrifuge is driven by a means suspended downwardly thereinto.

As in the form previously described, centrifuge 30 is provided with a central opening 36 through a top or cover wall 38 which wall inclines inwardly and upwardly from the upper side of the centrifuge and through this opening a pipe or conduit 40 is extendable, said pipe leading from the storage tank for the discharge of the fluid supplied therefrom into the centrifuge.

Pipe or conduit 40 may be fitted with a control valve (not shown) for the well known control function.

Centrifuge 30 will be again provided with the false bottom 50 spaced for the aforedescribed function.

Top or cover wall 38 of centrifuge 30 is similarly provided with the wall determining openings 60, which openings may be sealed off, when and as desired, by the insertion of plugs 62 thereinto, as before stated.

The vertical side wall of centrifuge 30 is similarly provided with one or more bleeder openings 66 which function to allow bleeding and/or extraction of liquid from the centrifuge, as before stated.

In carrying out the invention with the above described apparatus, the articles A to be impregnated with the selected treatment liquid are positioned within the centrifuge 30 in stacked relationship so as to rest upon false bottom 50 and to be stacked upwardly thereof, they being held tightly in position by their relationship with each other or by suitable mechanical means.

The rotation of the centrifuge is initiated through energization of motor 34 so as to attain a sufficient speed thereof.

A pump 70 in conduit 40 is then started so as to drive the treatment liquid from supply tank 18 (which may be heated if necessary as by coils 72 of known type in said tank), and into the centrifuge at the desired rate of flow.

The treatment liquid L, which may be a dye liquor, is discharged into the centrifuge. The centrifugal force acting radially outward from the axis of rotation thereof causes the treatment liquid to flow to the sides of the centrifuge and to be pressed, in the form of a thin wall, adjacent the inside of and along the vertical wall thereof. As the treatment liquid meets resistance at said wall, it is caused to build up in the form of an annular vertical wall of liquid thereat.

The depth or thickness of such liquid wall is controllable by the wall-determining openings 60 in the centrifuge top wall 38, which openings may be selectively closed by the insertion of plugs 62 thereinto, as aforesaid.

By the time that the centrifuge is up to optimum speed of rotation, the treatment liquid will tend to assume the dotted line position, shown in FIG. 1, with a clear annular space circumferentially around the middle of the bowl, along the edges of which space excess treatment liquid escapes through the openings 60 and 66 into the casing 12 as the pressure builds up within the centrifuge.

The inwardly extending top wall 22 of casing 12 overlies top wall 38 of centrifuge 30 in manner to preclude the loss, outwardly of the casing, of any of the treatment liquid being discharged through the wall-determining opening or openings 60 by deflecting same downwardly away from said top wall 22 and downwardly between the adjacent walls of members 12 and 30 and into trough 14 for discharge into storage tank 18 through conduit means 16.

As the centrifuge rotates, the treatment liquid is impregnated into the desired portions of the packages at a rate depending upon the speed of rotation, the radius of the centrifuge, the density or fluidity of the treatment liquid and the permeability of the packages.

The vertical wall of liquid increases in volume and moves toward the axis of rotation, according to the control. When the wall of liquid meets the first open wall determining opening in the top wall, the treatment liquid, in excess of the quantity required to maintain

the wall of liquid at the point immediately adjacent said wall-determining opening, is expelled from the centrifuge.

As long as the flow of liquid is continually pumped into the centrifuge, this wall of liquid will be maintained at this depth of thickness.

The force of centrifugal impregnation is employed to force the treatment liquid into that portion or cross-sectional area of the porous yarn package or packages within the boundaries of the formed wall of liquid. The remaining portion of the yarn package or packages interiorly of said formed wall of liquid is unimpregnated, hence partial impregnation is attained.

The depth of the wall of treatment liquid is varied by the employment of the wall-determining openings 60 as a series thereof beginning at the outer edge of cover 38 and running inwardly towards the center thereof, plugging one or more of said openings from the outer edge up to that predetermined point of the thickness or depth of the liquor wall.

In a true dyeing of textile fibers, it is required that certain conditions of temperature, pressure, and flow of dye liquor or other treatment liquid in contact with the fibers be met. This apparatus is so constructed so as to allow the liquid to be pumped into the system under appropriate temperature conditions, a sufficient rate of rotation of the centrifuge to be maintained for proper fiber impregnation, and the pump to be alternately stopped and started at intervals to allow dye liquor to be alternately impregnated into the package and then to be extracted from the package and then to be expelled through the small bleeder openings 66 in the rotating centrifuge. All of the various operating conditions can be varied in accordance with the type of yarn being dyed, dyestuff, formula, and the like.

As the pressure builds up in the liquid, it is obvious that centrifugal force will serve to expel the liquid from the centrifuge through wall-determining openings 60 and bleeder openings 66. After the centrifuge has come up to speed, control valve 42 is turned so as to supply just enough liquid through conduit 40 to compensate for the loss of liquid through openings 60 and 66 and the amount of liquid absorbed by the articles.

With such mode of operation, the pressure developed in the centrifuge by centrifugal force and the circulation of liquid by pump 70 insures a continuous supply through conduit 40 from tank 18.

After the desired degree of impregnation has been obtained, valve 42 may be closed with the centrifuge still rotating, whereupon the centrifuge starts to empty itself through openings 66. Obviously, as long as any liquid remains in the centrifuge, it will tend to climb up the walls of the centrifuge and to be expelled through openings 66, until finally the centrifuge will be entirely emptied.

When this condition is reached, continued rotation of the centrifuge with the impregnated articles A therein will cause the articles to be subjected to a draining action tending to expel excess liquid contained within the particles themselves. This expulsion of entrained liquid has been found to increase the impregnating action in effect, due to the fact that it really reverses the flow of the impregnating liquid through each article until all excess liquid is expelled.

Therefore, when the empty centrifuge is finally brought to rest, the impregnated articles in the centrifuge will be partially impregnated and excess liquid drained therefrom.

From the foregoing, it is apparent that, by the present invention, there is provided an improved method and means for impregnating articles of various kinds by various liquids in which the articles to be impregnated are submerged. In the practice of the invention, the articles are subjected to high pressure developed in the impregnating liquid by centrifugal force as the body of liquid with the articles therein rotates at high speed. The pressure developed in the liquid against the walls of

the bowl containing the articles acts in such a manner that the impregnating liquid works radially inward from the region of greatest pressure so as to completely expel any air in the articles.

An additional advantageous feature of the invention resides in the ability of the apparatus to automatically discharge all of the impregnating liquid while the centrifuge is rotating, which results in the liquid retraversing the interior of the articles under treatment and the expulsion of any excess treating liquid from the articles.

With particular reference to FIG. 3, I have shown a partially dyed package which was disposed upon its horizontal axis during the dyeing operation to illustrate the effect of producing variegated colors when the yarn is dyed while in suitable package form.

It can be seen that, if the cross sectional volume of the package represented by **100** is colored or dyed by one color and the remaining portion of the package **102** is colored another color or else left uncolored, the yarn, when it is unwound from the package, will take on an appearance as illustrated in FIG. 5.

With reference to FIG. 4, I have shown a partially dyed package which was disposed upon its vertical axis during the dyeing operation. Here, a similar effect is produced in that the package is colored in the cross sectional volume which is represented by **110** and the remaining portion of the package **112** is colored another color or left uncolored. The yarn, which it is unwound from the package, will take on a similar appearance to that illustrated in FIG. 5.

In practicing the invention, any one or combination of the above dyeing conditions can be performed on the same package and made to produce a variety of colored variegated yarn patterns. For example, it is possible to dye with the packages disposed vertically or horizontally with one color and to dye with different colors in subsequent operations.

If desired, the whole package could first be completely impregnated or dyed with one color followed by a partial dyeing with another color along the same or other axis.

Other modes of applying the principles of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

It is believed that the gist of the invention will be clearly understood from the foregoing disclosure and accordingly, further analysis thereof at this point is considered unnecessary, as I have, in accordance with the provisions of the patent statutes, described the construction and principle of operation of my invention together with the apparatus which I believe to represent the best embodiment thereof, to the end that others can, by applying current knowledge, readily adapt it for various applications without omitting features which, from the standpoint of prior art, fairly constitute essential characteristics of its generic and/or specific aspects. The substitution of equivalents and other changes, modifications and alterations as circumstances may suggest or render expedient, are reasonably contemplated, the invention being susceptible of such without departing from its rear spirit or underlying principles.

I therefore particularly point out and distinctly claim as my invention:

1. In a centrifugal device, the combination of, a receptacle comprising a rotatable annular centrifuge and cover thereof, said receptacle being revolvable around its own axis, control means in the cover of said receptacle for effectuating permanent control of the width of a vertically-disposed centrifuged annular wall of a treatment liquid developed within said receptacle adjacent the inner wall thereof, and means fixed to the annular wall of said centrifuge for supporting the articles to be treated to be partially disposed between the outer and inner vertical planes of the wall of the treatment liquid and above the bottom wall of said centrifuge.

2. A centrifugal basket comprising, a shell of approximately cylindrical form and having a bottom, a false bottom for said shell comprising a circular grate disposed upwardly of the bottom of said shell and fixed to the inner vertical wall of said shell, control means for permanently controlling the depth of a wall of centrifuged treatment liquid within said shell upon the rotation thereof, and bleeder means for extracting excess liquid from said shell.

3. In a centrifugal device, the combination of, a receptacle comprising a centrifuge and cover thereof, said receptacle being revolvable around its own axis, and means in the cover of said receptacle for permanently controlling the width of the vertically-disposed annular wall of a centrifuged treatment liquid developed within said receptacle by the rotation thereof, and means within the centrifuge for extracting excess liquid therefrom.

4. In the centrifugal device of claim 3, including bleeder openings for discharging from said receptacle any liquid causing an excess of width of the annular wall of centrifuged treatment liquid beyond a predetermined limit.

5. In a centrifugal device, the combination of, a receptacle comprising a rotatable annular centrifuge and cover therefor, said receptacle being revolvable around its own axis, control means in said cover for effectuating control of the thickness of a vertically-disposed centrifuged annular wall of a treatment liquid developed within said centrifuge adjacent the inner wall thereof, and means fixed to the annular wall of said centrifuge for supporting the articles to be treated in positions relative to the outer and inner vertical planes of the wall of the treatment liquid and upwardly of the bottom wall of said centrifuge for the predetermined impregnating passage of the treatment liquid through the articles undergoing treatment.

6. In a centrifugal device cooperant with a supply of treatment liquid, the combination of, a receptacle comprising a cylindrical centrifuge and cover, said receptacle being revolvable around its own axis, a drive mechanism for rotating said receptacle and developing and compressing an annular vertically-disposed centrifuged wall of the treatment liquid into adhering relationship with respect to the inner peripheral surface of said receptacle, means in the cover of said receptacle for controlling the thickness of the annular wall of treatment liquid, a false bottom comprising a grate disposed upwardly of and coplanar with the bottom of said receptacle and fixed to the inner vertical wall thereof, and bleeder means for extracting from said receptacle any portion of the treatment liquid causing an excess of width of the annular wall beyond a predetermined limit.

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