Jan. 12, 1932. J. P. GAREY ET AL 1,841,024

METHOD AND APPARATUS FOR DYEING YARN

Original Filed April 8, 1926 2 Sheets-Sheet 1

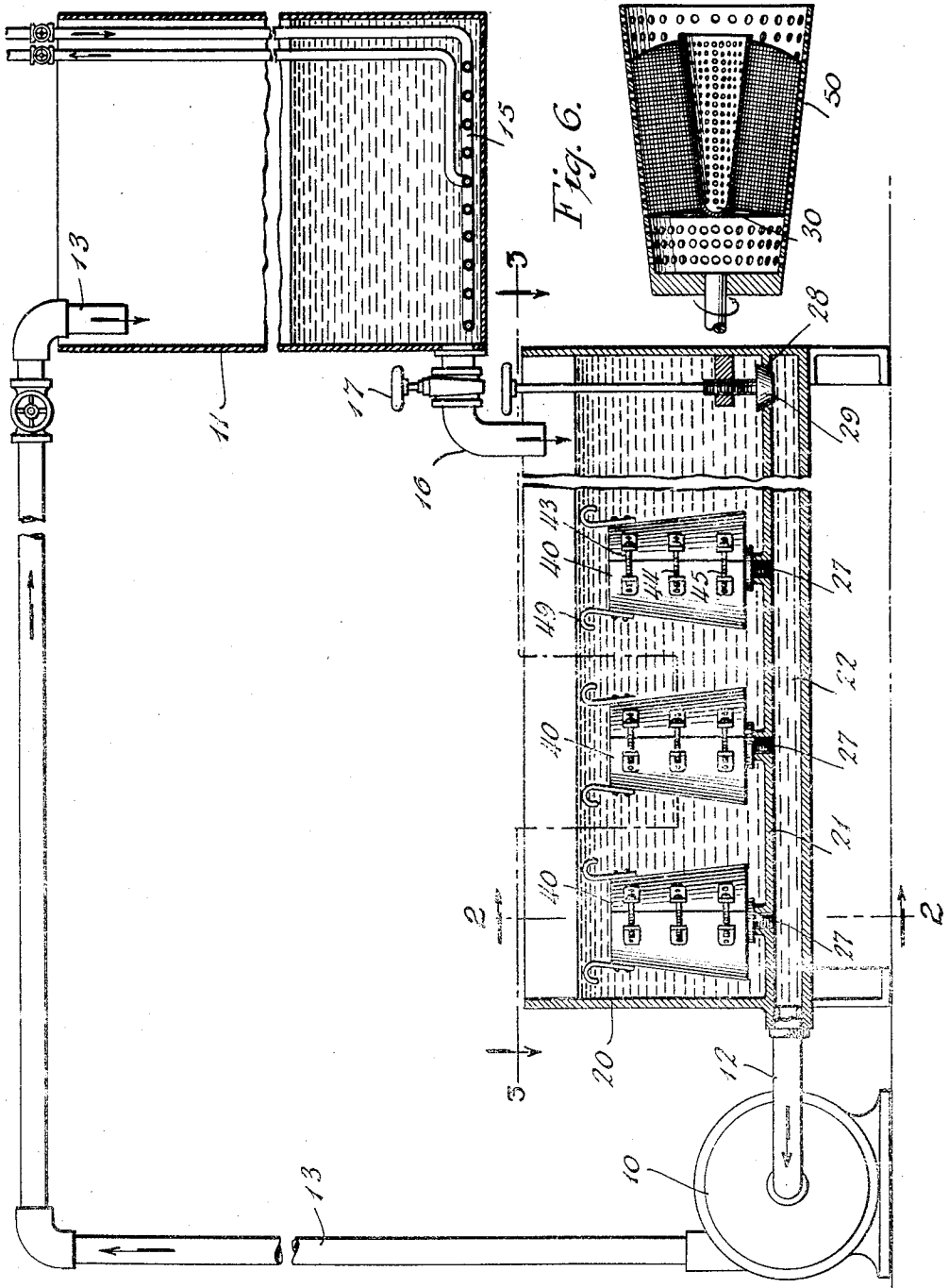

Fig. 1.

Fig. 6.

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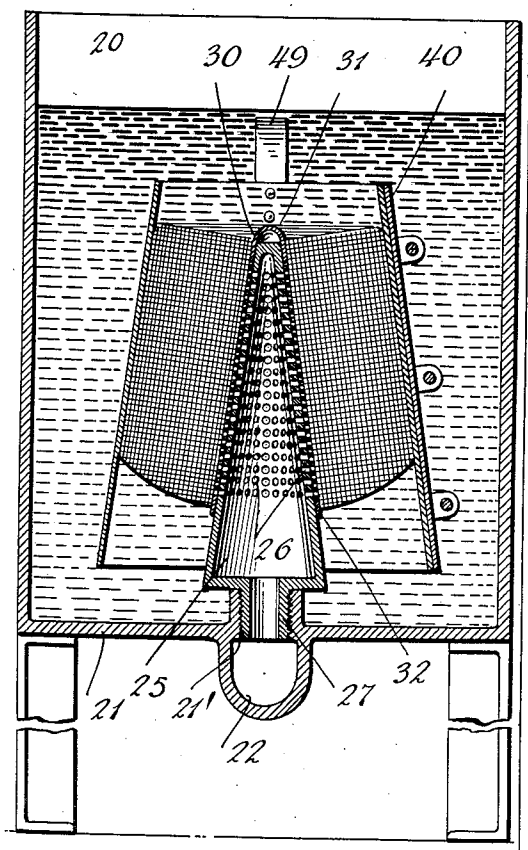
Fig. 2.



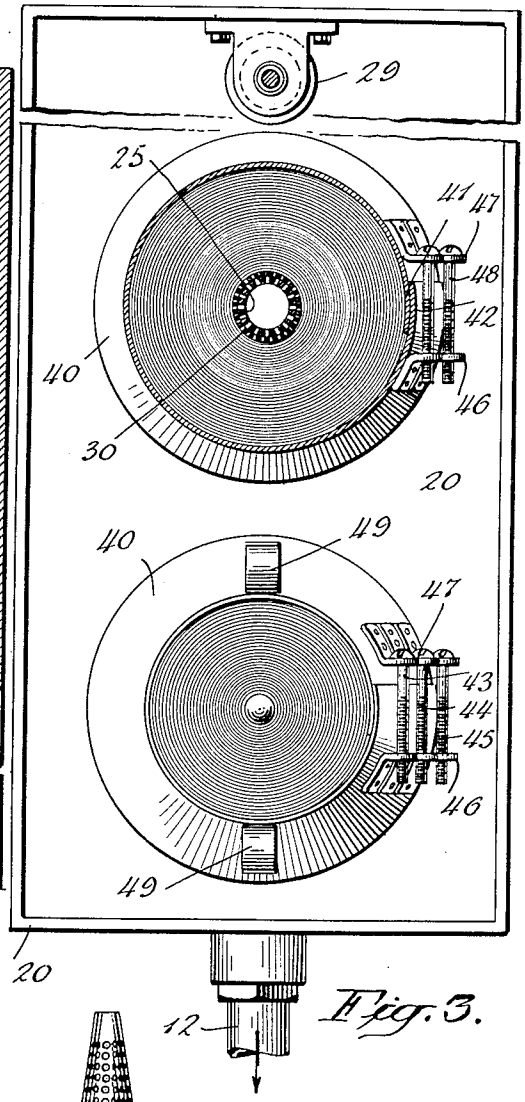


Fig. 3.

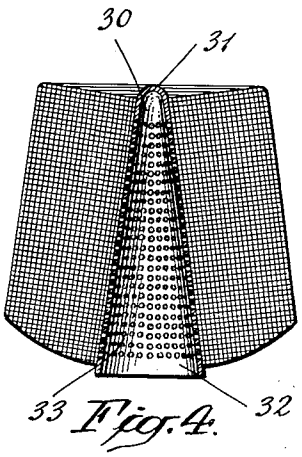


Fig. 4.

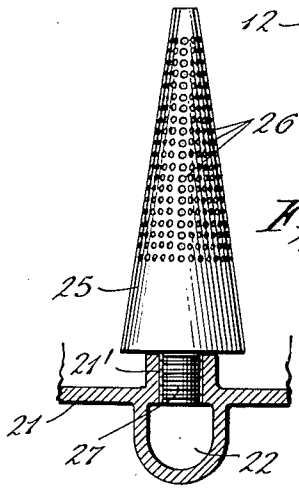


Fig. 5.

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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR DYEING YARN

Application filed April 8, 1926, Serial No. 100,581. Renewed May 15, 1931.

This invention relates to a method and apparatus for dyeing yarn.

The invention aims to enable knitting mills and other users of yarn to dye yarn effectively and economically in their own establishments. With this end in view, the invention provides for dyeing and drying yarn quickly while wound in a commercial form ready for use on a knitting machine, so that no rewinding is necessary either before or after dyeing, and avoids the use of large and expensive apparatus, such for example, as air-tight tanks.

In accordance with the invention, a commercial package of yarn, such as a cross-wound cone of yarn, is dyed in an open tank. This, so far as we are aware, has not been successfully accomplished heretofore, owing to the difficulty of obtaining with certainty a complete and even penetration of a cone of yarn by the dye. This problem we have solved by drawing the dye into a cone of yarn from both ends, by changing the path of the dye through the cone during the dyeing operation, and by providing a tight joint between the yarn and a perforated holder on which it is mounted so that the dye is drawn in evenly.

These and other features of the invention may best be understood by a detailed description of a specific method embodying the invention. Such a method may be carried out by means of the apparatus illustrated in the accompanying drawings:—

Fig. 1 is a side elevation of a complete dyeing apparatus showing the front wall of the storage tank broken away, and the dyeing tank sectioned on the line 1—1 of Figs. 2 and 3;

Fig. 2 is an end elevation of the dyeing tank sectioned on the line 2—2 of Fig. 1;

Fig. 3 is a plan view of the dyeing tank sectioned on the line 3—3 of Fig. 1;

Fig. 4 is an axial section of a cone of yarn wound on a perforated fibrous core;

Fig. 5 is an elevation of one of the suction holders on which such a cone may be mounted; and

Fig. 6 is a sectional elevation showing a centrifugal extractor for drying the yarn.

The complete apparatus which is illustrated in Fig. 1 includes a pump 10, an open storage tank 11 and an open dyeing tank 20. Under the bottom 21 of the dyeing tank and formed integral therewith, is a conduit 22 one end of which is connected by a pipe 12 to the intake of the pump 10. To the outlet of the pump, is connected piping 13 which extends into the storage tank 11. The storage tank 11 contains near its bottom a heater 15. A spigot 16 controlled by a valve 17 leads from the lower part of the storage tank 11 and is directed into the open dyeing tank 20.

On the bottom 21 of the tank 20 are mounted a number of hollow metal conical holders 25 provided with closely spaced perforations 26. Each holder has at its bottom a threaded stem 27 which is screwed into a tapped hole 21′ so as to place the interior of the holder in communication with the conduit 22. A passage 28 through the bottom 21, controlled by a manually operable valve 29, provides for making direct communication between the tank and the conduit 22.

In addition to the tanks and associated parts, the apparatus includes perforated cores 30 for cones of yarn and side covers 40 for such cones.

The cores 30 are of conical form, being closed at their smaller ends 31 and open at their larger ends 32. The material of which they are made is of such a character that it is stiff when dry, but becomes both soft and pliable when saturated with a liquid. The cores may be similar to the cardboard cores on which cones of yarn are ordinarily wound, except that they contain a large number of closely spaced perforations 33. The cardboard of which such a core is made may be perforated before it is formed into a cone, and, in consequence, a cone of yarn wound on such a perforated cardboard core costs little, if any, more than an ordinary cone of yarn wound on an imperforate core of cardboard.

The side covers 40 are removable and adjustable. Each is made of a piece of sheet metal which is given a frusto-conical form. The edges 41 and 42 of each cover are overlapped. In order that both the circumfer-

ence and taper of a cover 40 may be adjusted to make the cover fit tightly against the outer surface of any commercial cone of yarn, three adjustable fastening means 43, 44, 45 are provided, of which two, 43 and 45, are located near the ends of the cover. Each fastening means includes a bracket 46, secured to the cover some distance from its edge 42, and a bracket 47, secured to the cover some distance from its edge 41, and a screw 48 which passes through a hole in the bracket 46 and is threaded to engage a tapped hole in the other bracket 47. Each cover may be provided with two handles 49.

A specific method of dyeing embodying the invention, which may be carried out by means of the apparatus described, is as follows:

The yarn is first cross-wound in frusto-conical form on the perforated fibrous cores 30 in any suitable winding machine. The cones of yarn are placed on the suction holders 25 in the tank 20, and the covers 30, which previously have been adjusted to fit the cones of yarn, are placed around the cones. The valve 17 is then opened to admit to the dyeing tank 20 a hot aqueous dyeing solution contained in the tank 11. When the level of the solution in the tank 20 is well above the tops of the covers 40, the pump 10 is placed in operation, the valve 29 being closed. This results in sucking dye through the cones of yarn from their ends. One of the first effects of the dyeing solution is to saturate the cardboard cores 30, placing them in a soft and pliable condition in which they serve as packings between the yarn and the suction holders 25. The suction draws the softened cores tightly against the holders and also draws the yarn itself against the cores. This effectively prevents any leakage of dye in an axial direction along the inner surface of the mass of yarn, and thus causes the dye to be drawn evenly into all parts of the core of the mass. The suction also draws the covers 40 firmly against the outer sides of the cones.

During the operation of the pump, the valve 17 is manipulated or set so that a constant level is maintained in the dyeing tank. The dyeing solution in the dye tank may be kept very hot by the heater 15 in the storage tank 11, through which the solution circulates.

The operation is continued for a period of sufficient length to permit the coloring matter in the dyeing solution to permeate the fibres of the yarn. The length of the period depends upon the strength and character of the dyeing solution. Under ordinary circumstances, we have found fifteen minutes satisfactory. At the end of this period, the covers 40 are removed from the cones of yarn. The suction is momentarily released, by opening the valve 29 or stopping the pump 10, to make this possible. The operation is then continued for a second period of substantially the same length as the first period. During the second period, the course of the dye through the cones is different from that during the first period, since during the second period the dye enters from the entire outer surface of each cone, while during the first period it enters the cones from their ends only.

At the end of the second period, the valve 29 is opened, the valve 17 is closed, and the operation of the pump 10 is continued until all the dye in the dyeing tank has been returned to the storage tank. The cones of yarn and their cores, which are in a softened condition when removed from the suction holders 25, are placed in external perforated frusto-conical holders 50 of a centrifugal extractor (Fig. 6) which are rotated rapidly to dry the yarn and the cores by centrifugal force. During the rotation, the centrifugal force urges the softened cores outwardly against the yarn, so that they dry and stiffen in their original circular shape. The dyed cones of yarn are then in condition to be placed directly in a knitting machine.

Changes may be made in the specific method described without departing from the invention. While we shall not attempt to catalog such changes, it should be noted that the second step of the dyeing in the specific method described—that is, the step in which the dye is sucked in with the cones of yarn uncovered—is not always necessary. In fact, experience shows that in nine cases out of ten a complete dyeing is effected by the first step—that in which the sides of the cones are covered—alone. In some cases however, it is found that cones which have been subjected to the first step only contain small undyed portions. These may be the result of imperfect or irregular winding; but, whatever their cause, they are highly detrimental, as they cause undyed spots in the fabric made from the cone. When both the first and second steps are used, no portion of any of the cones can remain undyed. The two steps together, therefore, give the method the quality of certainty, which is of great practical value. The order in which the two steps take place is not important and may be reversed.

The centrifugal extractor shown in Fig. 6 is not claimed herein, as it forms the subject of our co-pending application filed April 8, 1926, Serial No. 100,580.

What is claimed is:

1. The method of dyeing a cross-wound mass of yarn on a perforated core, which comprises covering the sides of the mass to prevent circulation of dye therethrough, and circulating dye through the mass in paths which extend from both ends of the mass to its core.

2. The method of dyeing a cross-wound mass of yarn on a perforated core, which

comprises covering the sides of the mass to prevent dye from entering them and drawing dye into the core of the mass from both ends of the mass at the same time.

3. The method of dyeing a mass of yarn wound on a perforated core, which consists in submerging the mass in a bath of dye, circulating dye between one part of the outer surface of the mass and its core, and thereafter circulating dye between another part of the outer surface of the mass and its core.

4. The method of dyeing a mass of yarn wound on a perforated core, which comprises submerging the mass in a bath of dye and circulating dye through the mass in two different paths successively.

5. The method of dyeing a cross-wound cone of yarn on a perforated core, which consists in immersing the cone in dye, causing a circulation of the dye through the cone by drawing it into the core of the cone, covering the sides of the cone during a part of such circulation, and exposing them during another part thereof.

6. The method of dyeing a cross-wound cone of yarn on a perforated core, which comprises immersing the cone of yarn in dye, covering the sides of the cone and drawing dye into the core from the ends of the cone, and drawing dye into the core of the cone with the sides of the cone uncovered.

7. The method of dyeing yarn, which comprises winding yarn on a perforated fibrous core closed at one end, placing the perforated core about a perforated hollow metal holder, saturating the core with liquid so that it is softened, and applying suction at the interior of said metal holder to hold the soft fibrous core in firm contact with the metal holder, so as to make a liquid-tight joint between the metal holder and the yarn wound on the fibrous core.

8. The method of dyeing and drying yarn, which comprises winding yarn on a circular perforated core of fibrous material, softening the fibrous core by wetting it, and using it when wetted to make a tight joint between the yarn and a suction holder, drawing dye through the yarn into said suction holder, removing the core from the holder, and holding the mass of yarn externally and rotating it about the axis of its core to dry the yarn and the core, so that the core is forced outward against the mass by centrifugal force and dries and stiffens in its original circular form.

9. Apparatus for dyeing a cross-wound mass of yarn, comprising the combination with a perforated core on which the mass is wound, of a tank containing a dye in which the mass is immersed with both of its ends exposed to the dye in the tank, an impervious cover for the sides of the mass, and means for reducing the pressure within the entire core so that dye is drawn from the tank into the core.

10. In apparatus for dyeing a cone of yarn, an imperforate sheet metal cover of frustoconical form and means for adjusting the circumference and taper of said cover.

11. In apparatus for dyeing a cone of yarn, an imperforate sheet metal cover of frustoconical form having overlapped edges, attachment means for said edges located near opposite ends of the cover, and means for independently adjusting said attachment means to vary the amount of overlap of the edges of the cover at each end thereof.

12. Apparatus for dyeing a cross-wound mass of yarn, comprising a dyeing tank, a perforated hollow holder for the mass of yarn in the dyeing tank, means for drawing dye into said holder from the tank, a soft perforated packing between the holder and the inner surface of the mass to prevent leaking of the dye along the inner surface of the mass, and an imperforate cover for the outer surface of the mass.

13. Apparatus for dyeing a wound mass of yarn, comprising a dyeing tank, a perforated hollow holder for the mass of yarn in the dyeing tank, means for drawing dye into said holder from the tank, and a soft perforated packing between the holder and the inner surface of the mass to prevent leaking of the dye along the inner surface of the mass.

14. Apparatus for dyeing a cone of yarn, comprising a dyeing tank, a perforated hollow conical metal holder in the tank for supporting the cone of yarn therein, a soft and pliable fibrous perforated cone closed at one end and located between said holder and the inner surface of the cone of yarn, and means for drawing dye into said holder from the tank.

In testimony whereof we have hereunto set our hands.

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