

March 1, 1938.

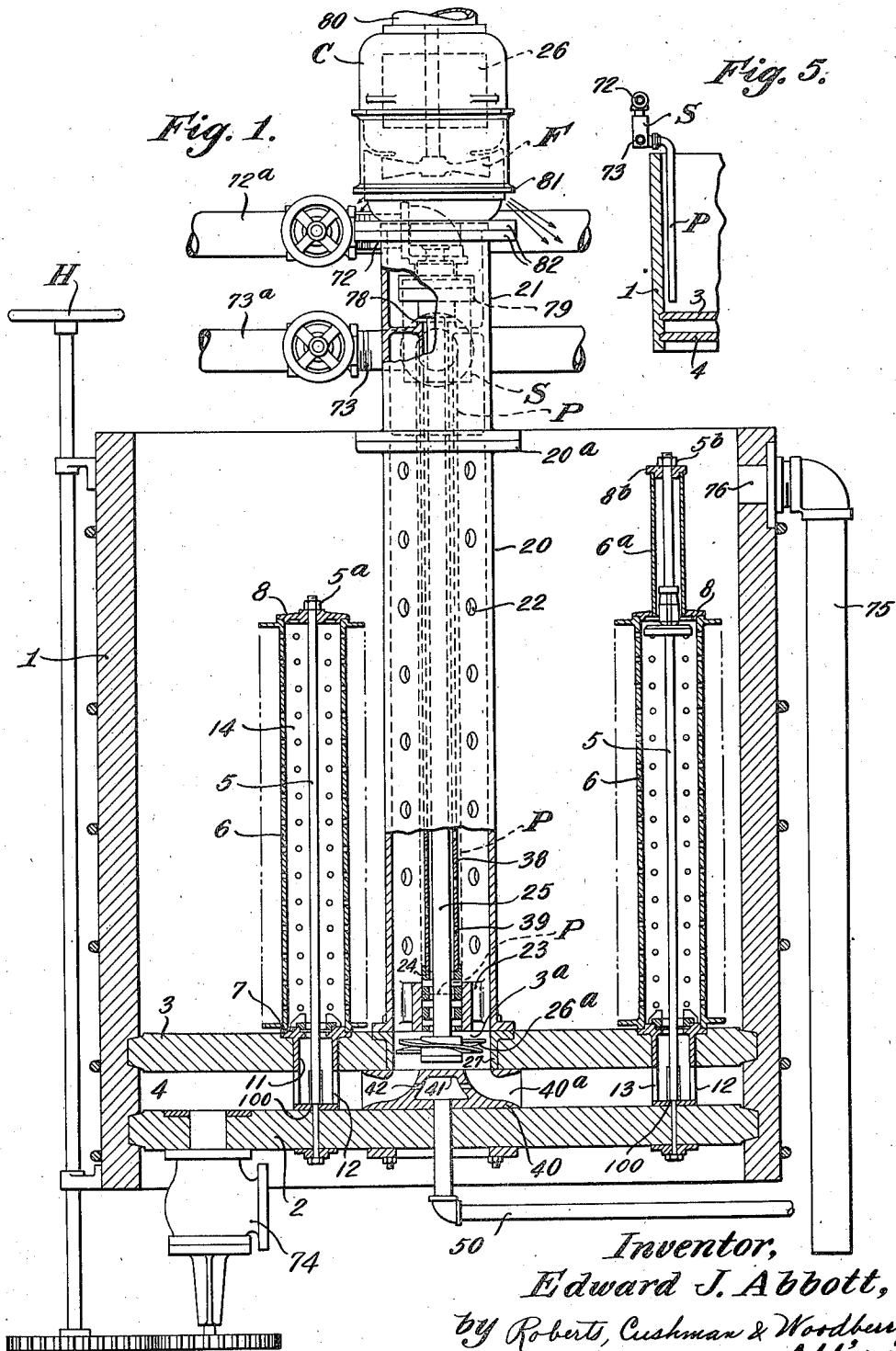
E. J. ABBOTT

2,109,893

DYEING APPARATUS

Original Filed June 25, 1930

2 Sheets-Sheet 1



March 1, 1938.

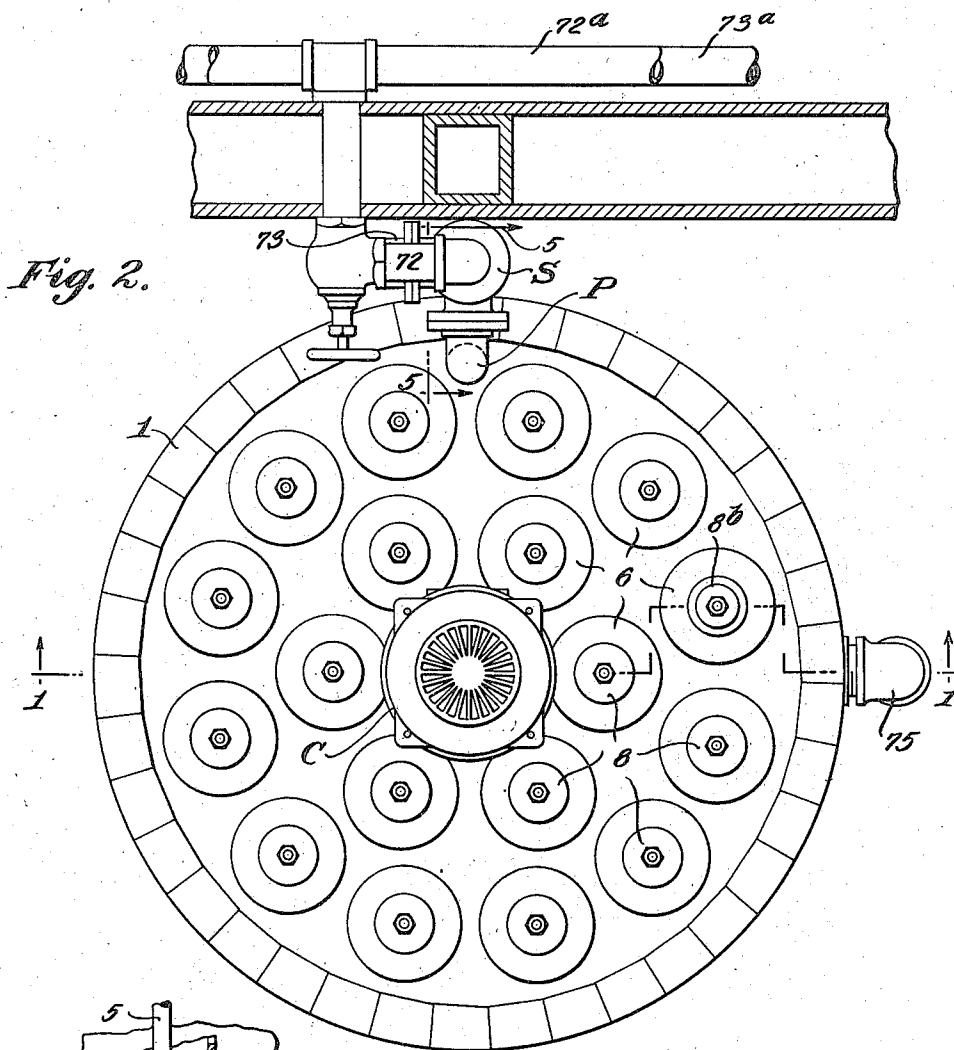
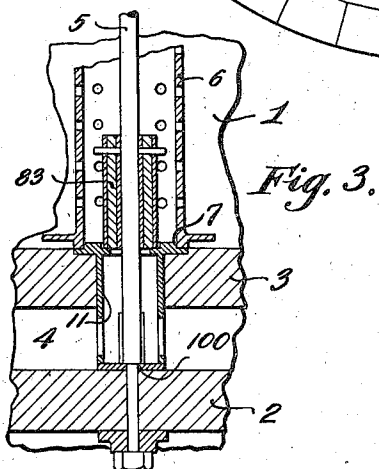
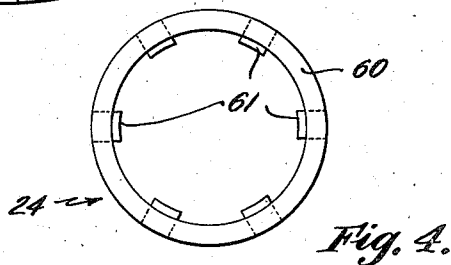
E. J. ABBOTT

2,109,893

DYEING APPARATUS

Original Filed June 25, 1930

2 Sheets-Sheet 2



Inventor,
Edward J. Abbott,
by Roberts, Cushman & Woodberry,
Attys.

UNITED STATES PATENT OFFICE

2,109,893

DYEING APPARATUS

Edward J. Abbott, Wilton, N. H., assignor to Abbott Machine Company, Wilton, N. H., a corporation of New Hampshire

Original application June 25, 1930, Serial No. 463,649. Divided and this application April 25, 1935, Serial No. 18,206

3 Claims. (Cl. 8—19)

This application is a division of my application Serial No. 463,649, filed June 25, 1930, now issued as Patent Number 2,031,588 February 25, 1936. This invention pertains to the fluid treatment of textile materials, and relates more particularly to apparatus, to wit, a kettle or vat, for use in such fluid treatment, for example, as dyeing, bleaching, or preshrinking textile yarns, the principal object being to provide a kettle or vat of improved construction by means of which the fluid treatment may be carried out in a highly efficient and expeditious way with assurance of substantial uniformity of product and under improved conditions and ease of operation.

As respects certain aspects of the invention, the kettle or vat may be either of the open or closed type and may be used in carrying out any of the usual methods of dyeing or other fluid treatment of textiles or the like, but I have herein chosen to illustrate the invention as embodied, by way of example, in an open topped kettle or vat equipped for pressure dyeing or fluid treating yarns, slivers, etc., wound upon spools.

The present invention provides an improvement in the apparatus for changing the fluid in the dye kettle. The kettle is provided with means for admitting fresh water at a point near the bottom of the kettle, and with an outlet for discharging water from a point near the top of the kettle. An overflow pipe leads from the outlet to a point below the bottom of the kettle, so that when the fluid in the kettle rises and completely fills the outlet, the weight of the water column in the overflow pipe creates a motion effect increasing the velocity of flow through the dye kettle.

Other features of advantage and utility will be apparent from this specification and its drawings, wherein the invention is explained by a description of a preferred embodiment thereof.

In the drawings:

Fig. 1 is a central sectional view of one embodiment of my invention;

Fig. 2 is a top plan view of the same;

Fig. 3 is a fragmentary vertical section showing pressure relief means which may be used when the kettle is not provided with its full complement of spools;

Fig. 4 is a top view to larger scale of a preferred form of drive shaft bearing; and

Fig. 5 is a small scale, diagrammatic section, at right angles to the section of Fig. 1, showing the arrangement of the inlet pipe.

While my invention may be of more general utility, I regard it as particularly desirable in its

illustrated embodiment in apparatus for spool dyeing yarn or the like. Referring to Fig. 1, the numeral 1 designates a dye vat or kettle having a bottom 2 and a false bottom 3 spaced from the bottom 2 to provide a plenum chamber 4 between them. The false bottom 3 has a plurality of openings, each preferably provided with a tubular bushing sleeve 11, the lower ends of the sleeves resting upon the bottom 2, while the upper end of each sleeve or bushing is provided with an annular seat-flange 7 adapted to support the lower end of a spool 6. The lower part of each bushing is provided with one or more elongate slots 12 permitting the flow of fluid from the plenum chamber upwardly and into the hollow barrel of the spool resting upon the seat-flange 7 and thence outwardly through suitable perforations 14 in the spool barrel, so that liquid supplied under pressure to the plenum chamber flows out through the yarn or roving wound upon the spool barrels.

A vertical rod 5, anchored at its lower end to the bottom 2, projects upwardly and axially through each bushing 11 and is provided with suitable means for clamping a spool 6 against the corresponding seat 7. Preferably these rods 5 are reduced in diameter at their lower portions, providing shoulders at 10 which bear upon the lower ends of the corresponding bushing 11. Since the seat flange 7 of the bushing rests upon the upper surface of the false bottom 3, and the shoulder on rod 5 holds the lower end of the bushing against the bottom 2, the two bottom members are firmly clamped together and kept from spreading,—a very necessary feature in a wooden kettle. Such clamping means preferably comprises a retaining cap 8 or the like, adapted to bear against the top of the spool 6 and to close the upper end of the tubular spool barrel being held tightly against the upper end of the spool by a nut 5^a engaging the screw threaded upper end of the rod 5. As shown at the right of Fig. 1, the cap 8 for a selected one of the spools may carry an upward extension 6^a adapted to project above the highest possible liquid level within the dye vat, such extension being closed at its upper end by a cap 8^b held in place by a suitable clamping nut 5^b engaging the corresponding rod 5. This arrangement permits such spool to be unclamped (without lowering the level of the hot dye liquor) for sampling purposes.

The false bottom 3 is provided with a large opening 3^a preferably centrally located, and a vertically disposed hollow column 20 is arranged to extend upwardly concentrically with this open-

ing 3^a from the false bottom 3 to a point above the top of the kettle. Preferably this column consists of a plurality of aligned sections, the lower section which is within the kettle preferably being perforated, as indicated at 22, to serve as a strainer. The fluid within the dye kettle proper freely enters the column through these perforations and passes downwardly through the opening 3^a into the plenum chamber 4. At the lower end of the column 20, I arrange a spider-like frame 23, which supports a suitable bearing 24 in which a vertical drive shaft 25 is mounted. This shaft preferably extends downwardly below the bearing and carries a suitable pump impeller 26^a at or near its lower end, such impeller preferably being arranged directly within the opening 3^a in the false bottom, the opening, if desired, being furnished with a lining sleeve or bushing 27. The pump impeller 26^a is preferably of the axial flow type, for example, a screw propeller, and the shaft 25 may be connected to any suitable (preferably reversible) driving means, for example, an electric motor 28 mounted upon the upper end of the column 20.

A part 40 (conveniently a metal casting) is arranged directly below the column 20 between the false bottom 3 and the true bottom 2 of the kettle, and acts to brace the central part of the false bottom and to support the weight of the column and parts carried thereby. This casting 40 preferably has a plurality of downwardly and outwardly curved ducts or passages 40^a having walls which tend to overcome any tendency of the liquid to swirl or take up a marked rotary motion within the plenum chamber. These passages compel the liquid to enter the plenum chamber in a plurality of independent and substantially horizontal streams, such passages communicating at their upper ends with the opening 3^a and at their lower ends with the plenum space 4.

A hollow frusto-conical portion 41 of the part 40 is arranged directly below the center of the pump impeller 26^a and defines the lower walls of the passages 40^a. A supply pipe 50 is arranged to deliver steam or other hot fluid into the chamber in part 41 and from this chamber ducts 42 lead outwardly to the passages 40^a, so as to deliver the hot steam into the fluid flowing through said passages 40^a, thereby heating the fluid without substantial tendency to produce hammer, and at the same time utilizing the kinetic energy of the steam for increasing the velocity of the flowing fluid.

The bearing 24 above referred to is illustrated in detail in Fig. 4. This bearing preferably comprises a tubular shell 60 carrying spaced inwardly projecting wooden plugs or blocks 61, the inner faces of which substantially define a cylindrical surface of the diameter of the drive shaft 25. The grain of the wood of these elements 61 is preferably disposed radially in relation to the shaft, so that the end of the grain provides the bearing surface. This arrangement gives a suitable non-metallic bearing for the shaft, which is not injuriously affected by the dye liquor, and which leaves ample room between the bearing elements 61 for axial movement of the liquid which is depended upon for lubrication of the shaft and bearing. In contrast to a plain bushing, this arrangement is less likely to be injured by dirt or grit which tends to collect between the shaft and bushing and to wear these parts, and furthermore, the end of the grain provides a better bearing surface than the side of the grain,

while the tendency of a plain wooden bushing to shrink and crack in hot liquids, alkalies, acids, etc., is avoided.

Preferably, although not necessarily, I provide a sleeve 38 to enclose the drive shaft 25, said sleeve having a few openings 39 permitting entrance to fluid into the space about the shaft. This sleeve or guard prevents the rotating shaft from causing cavitation of the liquid above the pump impeller, while the openings 39 permit sufficient liquid to enter the space about the shaft to afford adequate lubrication for the bearing.

Supply pipes 72 and 73, leading from 72^a and 73^a respectively and provided with the necessary controlling valves, are arranged to deliver water, dye liquor, or the like to a strainer S, from which a pipe P (Fig. 2) leads downwardly (preferably within the kettle) to a point closely adjacent to the upper surface of the false bottom 3 as most clearly shown in Fig. 5.

Any usual drain connection 74 may be arranged to lead from the bottom of the plenum chamber, said drain being controlled by a valve of suitable type, preferably actuated by a handle H disposed at a convenient point. An open overflow pipe 75 leads from an outlet opening 76 near the top of the kettle downwardly to a discharge below the level of the kettle bottom, said outlet opening defining the maximum height of the dye liquor in the kettle.

The cap 8^b at the upper end of the extension 6^a (already described) is preferably disposed above the lower part of the opening 76 so that the cap 8^b and the nut 5^b are exposed above the surface of the fluid in the kettle during the dyeing operation.

The arrangement of inlet and outlet pipes just described is of great advantage in connection with the rinsing process, since for rinsing the material it is merely necessary to admit fresh water through the pipe P which enters through the strainer S and rising in the lower part of the kettle gradually displaces the warm and dirty or spent dye liquor in the kettle, such dirty or spent liquor flowing out through the outlet 76 and the pipe 75. When the water rises with sufficient rapidity to fill the outlet opening 76, the column of water in the pipe 75 (which extends to a point below the bottom of the kettle) produces a suction effect which materially increases the velocity of flow through the kettle, thus cutting down the time of the rinsing operation. This method of rinsing also substantially prevents the mixture of incoming clean water and the outflowing dirty water so that the saving of water necessary, as well as in the time consumed in the operation is considerable.

As above noted the motor 26 is preferably supported by the fixed column 20, the latter being arranged at the center of the kettle. This arrangement leaves the entire peripheral portion of the kettle top free and unobstructed so that the spools may readily be placed in the kettle and removed therefrom without interference from shafts or motor supports extending transversely of the kettle top.

Preferably the upper portion of the column 20 terminates in a flange 20^a adjacent the top of the kettle and an extension 21 of the column is secured to this flange in any desired manner, this extension forming the immediate support for the motor. Preferably this extension is provided at an intermediate point with a septum 77 having a central opening for the passage of the shaft 25, the edge of such opening having an up-

turned lip 78 forming a trap for grease which might pass downwardly from the motor. Preferably the shaft 25 is connected to the motor shaft proper by means of a coupling 79 which comprises radial flange members, such coupling being disposed within the extension member 21 and above the septum 77. Thus any grease flowing down the motor shaft will be thrown outwardly from the coupling 79 by centrifugal action and will accumulate in the upper part of the extension 21 and will be caught by the septum and its upturned lip 78 so that the grease can not pass downwardly.

The motor is preferably of the air cooled type having an outer shell or casing C provided at its upper end with an inlet which may if desired be connected by a pipe C0 to a source of fresh cool air,—for example, this pipe may extend to the outside of the building. Within this casing there is arranged a fan F, preferably of centrifugal type, that is to say having straight blades so that it will deliver a current of air in the same direction regardless of the direction of rotation of the motor. The air thus set into motion cools the motor and is then delivered from the lower part of the casing between the flange 81 and attaching flanges 82 by means of which the motor is secured to the extension 21. These several flanges cause the air discharged from the casing to move outwardly and downwardly in a more or less conical or umbrella shaped stream which passes transversely across the open top of the kettle and thus entrains and carries away steam and vapor rising from the kettle top.

The motor is preferably of reversible type so that the pump impeller 26a may be turned in either direction at will, thus causing the dye liquor to flow radially of the spool, either inwardly or outwardly as may be preferred, it being noted that by placing the impeller within the large opening 3a in the false bottom 3 the operation of the impeller, even at high speeds, does not produce any substantial cavitation effect, so that for any motor speed a substantially constant and predetermined pressure may be maintained even though the dye liquor is at the boiling point.

When using a constant speed motor, the speed is so determined with reference to the pitch and size of the pump impeller 3a and with reference to the number of spools and the thickness of material wound thereon as to maintain within the plenum chamber 4, the constant pressure necessary to ensure the proper fluid velocity through the material on the spools. If, however, for any reason the full complement of spools should not be used, and one or more of the seats 7 were to be completely closed in order to maintain the desired fluid flow through the spools on the other seats, it is found that with a constant speed motor, the pressure in the plenum chamber would rise with accompanying rise in fluid velocity, and to avoid this condition I prefer, as illustrated in Fig. 3, to provide valve members 83 adapted to be associated with any vacant seat 7 for normally closing the opening through said seat. Preferably such valve members 83 are cylindrical plugs of a diameter adapted to close the opening through the seat, each plug having an axial opening for the reception of a clamping rod 5 so that the plug may slide vertically on the rod. When one of the seats 7 is to be left vacant (that is, unprovided with a filled spool) the valve member 83 is slipped over the clamping rod 5 and allowed to drop onto the seat, the weight of the valve member being such that if the pressure in the plenum chamber

rises beyond a predetermined amount, the valve will automatically rise in response to the pressure and allow some of the dye liquor to escape through the opening in seat 7. Preferably when using such a valve plug 83, I clamp an empty spool on the seat which is closed by the plug, the barrel of the spool being of sufficient diameter to receive the plug freely without interfering with the rise and fall of the latter. I find the spool surrounding the plug to be advantageous since it breaks up the stream of fluid escaping from beneath the valve plug, which, if permitted to enter in a single rapidly flowing stream, might cause snarling or injury to the stock on adjacent spools.

If desired, a variable speed motor may be used instead of the single speed motor above referred to and in such case the relief or safety valves may or may not be employed as desired. If a multi-speed motor is employed, I find that a standard alternating current three-phase motor wound to give different speeds provides the requisite change in pump velocity for different conditions, and such motors are relatively inexpensive and may be controlled in a very simple way.

In referring to the use of the safety valve 83, it was stated that the barrel of the spool was large enough to receive the valve plug without interfering with the movements of the latter. The large barrel spools I find to be highly advantageous from the standpoint of uniformity of production, since, assuming that the head of the spool is of normal diameter, the large barrel limits the thickness of the material wound on the spool and thus prevents abnormal difference in the velocity of the fluid at the outer and inner peripheral surfaces of the material wound on the spool. Thus a spool which is forty inches long between its heads, and has heads ten and one-half inches in diameter, with a barrel six inches in external diameter is found in practice to ensure a velocity of radial flow not more than 60% greater at the inner periphery of the material than at the outer periphery. This is highly important since it is desirable to maintain as high a velocity as is permissible in order to cut down the time of the operation while at the same time to avoid a velocity which will cause blowing and tangling of the material. In other words, by the employment of a spool of this type, the thickness of the material which may be wound on the spool is kept within the predetermined minimum limits desirable for the best results. Moreover, by the employment of spools which limit the thickness of material as stated, it is possible to circulate the liquid with considerably less than the customary pressure, and in much larger volume. For example, in a five hundred pound kettle holding six or seven hundred gallons, the liquid may be circulated at the rate of one thousand gallons per minute at approximately three pounds pressure and with a power consumption of from eight to ten horse power per kettle, whereas with the usual arrangement, a circulation of from two to four hundred gallons per minute requires the expenditure of from ten to fifteen horse power. Not only is the present arrangement economical of power but by reason of the large volume of liquid which is circulated, a very unusual uniformity of product is obtained.

While the apparatus described is particularly useful in dyeing or bleaching material wound upon spools, I find it also of great utility in the preshrinking treatment of certain types of yarn. In dealing with some kinds of yarn, for example,

mohair or coarse wool, it is found that when the yarn is wet, the longer fibers shrink more than the shorter ones, giving the yarn a cockled or bouclé appearance. When such yarn is woven
5 since all of the fibers do not come into action at the same time to carry the stress, and it has been customary as a preliminary step in the dyeing operation to wind such yarn upon a stretcher or
10 reel, immerse it in hot water, and then expose it to warm air to dry and set the fibers, after which the material may be dyed without cockling. The same results may readily be obtained by the use of the apparatus above described by wind-
15 ing the yarn under heavy tension on the perforated spool, which is then placed in the kettle, and subjected to the action of hot water and then dried. The heavy tension necessary for this setting operation would make so dense a
20 mass that it could not be uniformly dyed on the spools in this form, although the hot water may be circulated to an extent sufficient to set the yarn. After drying, the yarn is then rewound but under less tension upon a spool of the same
25 kind and may be restored to the dye kettle for the dyeing operation.

Doubtless other uses of the improved apparatus will occur to those familiar with the textile arts, it being understood that various changes in
30 relative arrangement, size, proportion of parts, and substitution of equivalents may be made without departing from the spirit of the present invention.

I claim:

35 1. Apparatus for the fluid treatment of textile material wound on hollow perforate spools, comprising a kettle, a false bottom in the kettle providing a plenum chamber in the lower part of the kettle, spool supports in the false bottom
40 affording communication between the plenum chamber and the interiors of the hollow spools, a vertical perforate column into which and through which the treating liquid is adapted to flow to the plenum chamber, a liquid impeller

associated with the lower part of said column for forcing liquid from the column into the plenum chamber, a conduit for discharging rinse water into the kettle near its bottom but above the im-
5 peller, and an overflow drain conduit leading from the kettle near the top thereof.

2. Apparatus for the fluid treatment of textile material wound on hollow perforate spools, comprising a kettle, spool supports for holding the
10 spools vertically during treatment in the kettle, means for supplying treating liquid under pressure to the interiors of the spools, said liquid-supplying means including a vertical perforate column adapted to collect liquid from a plurality
15 of levels in the kettle and a fluid impeller associated with the lower part of the column for pumping said liquid from the column into the interiors of the spools and through the material wound thereon, a conduit for discharging rinse
20 water into the kettle near its bottom but above the impeller, and an overflow drain conduit leading from the kettle near the top thereof.

3. Apparatus for the fluid treatment of textile material wound on hollow perforate spools, comprising a kettle, spool supports for holding the
25 spools vertically during treatment in the kettle, means for supplying treating liquid under pressure to the interiors of the spools, said liquid-supplying means including a vertical perforate column adapted to collect liquid from a plurality
30 of levels in the kettle and a fluid impeller associated with the lower part of the column for pumping said liquid from the column into the interiors of the spools and through the material wound thereon, a conduit for discharging rinse
35 water into the kettle near its bottom but above the impeller, and an overflow drain conduit leading from the kettle near the top thereof, the overflow drain conduit extending down below the bottom of the kettle so that the weight of
40 a water column in the drain conduit creates a suction effect increasing the velocity of flow through the kettle.

EDWARD J. ABBOTT.