

June 25, 1963

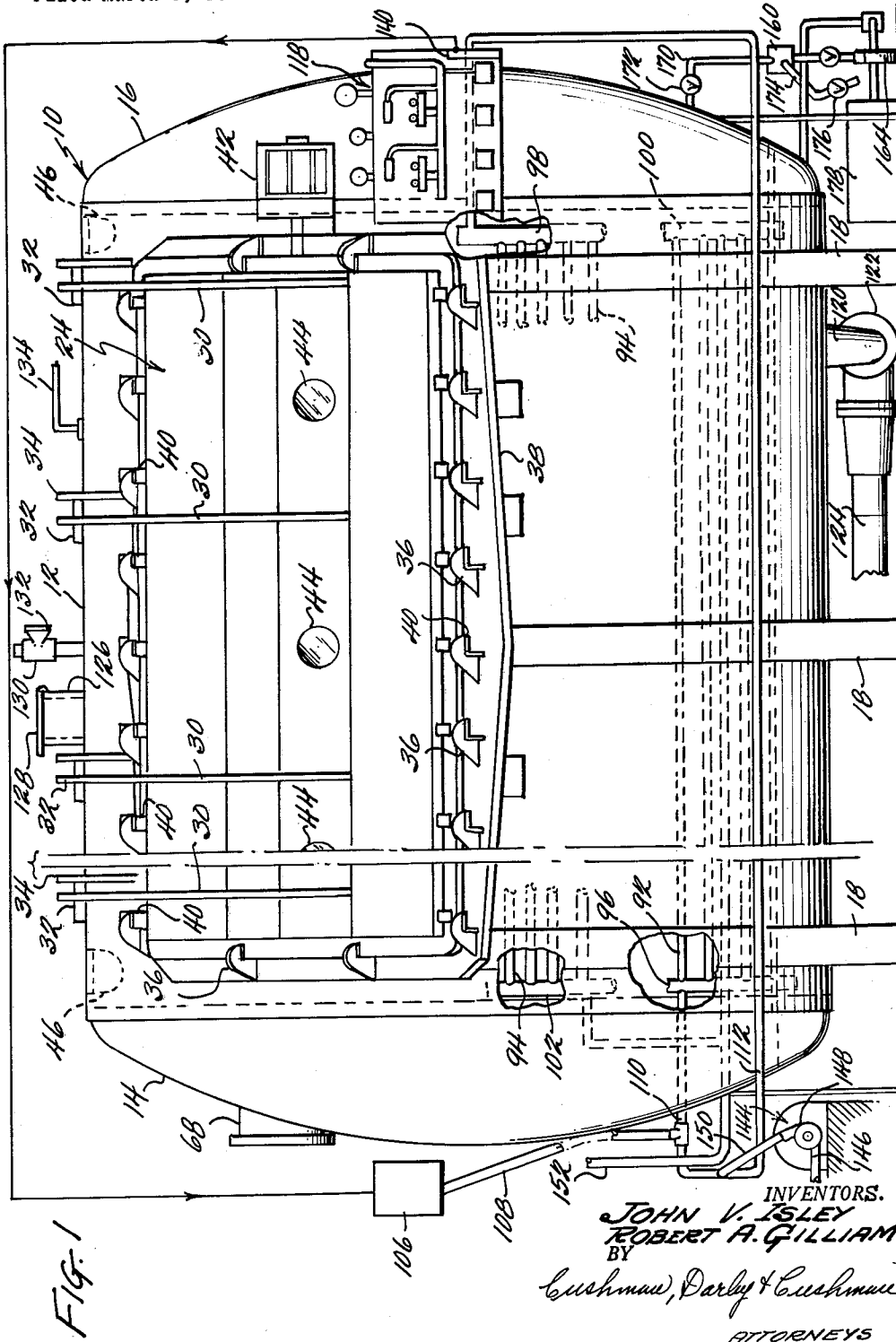
J. V. ISLEY ETAL

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HIGH PRESSURE, HIGH TEMPERATURE DYE BECK

Filed March 1, 1961

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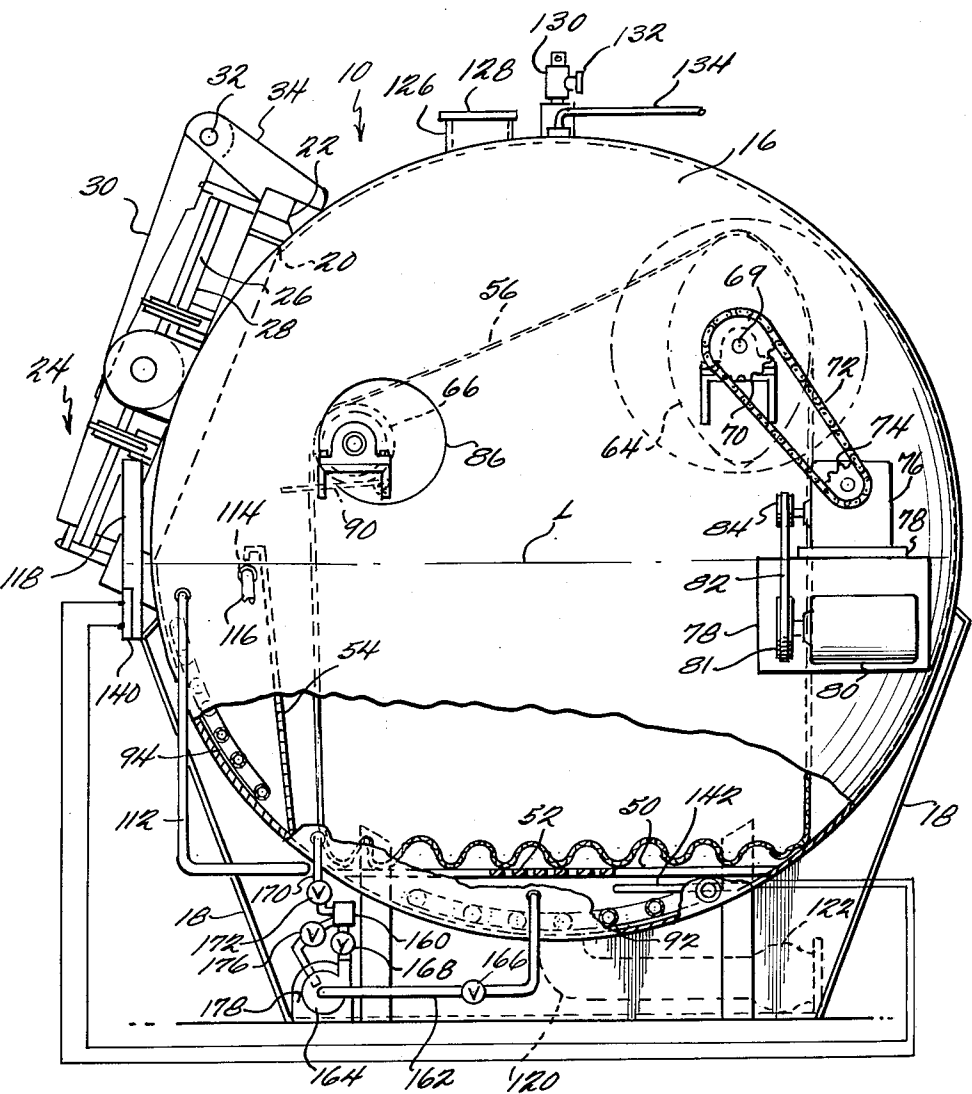
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FIG. 2



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**HIGH PRESSURE, HIGH TEMPERATURE
DYE BECK**

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5 Claims. (Cl. 68—15)

The present invention relates to dye becks or dye machines and, more particularly, to pressure dye becks adapted to treat fabrics in rope form at elevated temperatures in the range of 240° F. to 250° F. and under pressures in the order of 10 to 16 pounds per square inch.

It has been found highly desirable to dye synthetic or man made fibers in rope form at temperatures elevated above the boiling point of the dye liquor at standard atmospheric pressure, the dye liquor being under a pressure above standard atmospheric pressure. Such prior machines for accomplishing pressurized dyeing have not been able to dye man made or synthetic fibers in rope form without experiencing cracks and/or creases in the dyed fabric as the dye liquor was permitted to boil or in other instances rapid circulation of the dye liquor was permitted and even initiated. By permitting the dye liquor to boil whereby turbulence within the dye beck was created, the fabric was not uniformly dyed. In instances where subsequent additives were supplied to the initial bath, the boiling of the dye bath would cause rapid striking of the fabric by the additives, thus producing streaks and blotches. In those machines which created turbulence by injection of live steam directly into the dye liquor for heating the dye liquor, the steam mixing with the dye liquor resulted in undesirable turbulence and quicker dilution of the dyestuff, and consequently, a maximum amount of fabric could not be dyed uniformly as variations in shade resulted.

An object of the present invention is to provide an improved and efficient dye beck machine particularly suited for the processing of fabric in rope form at elevated temperatures and pressures with the dye liquor having "a still boil." By "still boil" it is meant that the dye liquor is heated to temperatures above the temperature at which the dye liquor would normally boil under a standard atmosphere, the dye liquor having none of the usual boiling characteristics which create turbulence therein.

Another object of the present invention is to provide an improved dye beck particularly suited for the processing of fabric in rope form at elevated temperatures and pressures without the dye liquor being diluted during the heating process or boiling away when elevated to temperatures above its normal boiling point.

Still another object of the present invention is to provide an improved dye beck for dyeing fabrics in rope form, the dye liquor being heated above the normal boiling point without turbulence therein, thus eliminating the possibilities of tangles of the fabrics being dyed.

A further object of the present invention is the provision of an improved dye beck machine capable of dyeing synthetic or man made fabrics in rope form without streaks, blotches, shading, off shades, etc., thus insuring an improved quality control of the finished product.

Ancillary to the preceding object, it is a further object of the present invention to provide a dye beck having negligible waste of dyestuff by application of pressure of the body of gas above the dye liquor to thereby prevent the dye liquor from boiling away, thus resulting in a maximum utilization of dyestuff.

A further important object of the present invention is to provide an improved dye beck having better dyestuff exhaustion thereby making it possible to reduce the time of the dyeing cycle resulting in increased utilization of

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the dye beck with a reduction in labor and fixed cost per yard of the fabric being dyed.

A further object of the present invention is to provide an improved dye beck utilizing less water and steam during each cycle of dyeing at controlled predetermined temperatures and pressures.

A still further object of the present invention is to provide an improved dye beck in which the time for the dyeing cycle is reduced by including means for the rapid cooling of the dye liquor at a controlled rate of cooling after the fabric has been dyed to a desired color.

Still another important object of the present invention is to provide a pressurized dye beck wherein accurate control of temperature and pressure of the dye liquor is maintained when the dye liquor is being initially heated for accomplishing the dyeing operation and wherein accurate rapid cooling of the dye liquor may be accomplished at completion of the dyeing cycle thereby reducing the overall time of the dyeing cycle.

Another object of the present invention is to provide an improved dye beck of the type being horizontally disposed and cylindrically shaped, the dye beck having means for heating the dye liquor so that temperatures of the dye liquor throughout the length of the dye beck are elevated evenly, thereby eliminating turbulence within the dye liquor and offshading of fabric being dyed.

A still further and important object of the present invention is to provide a pressurized dye beck having means for preventing temperature of the dye liquor and pressure of the superposed body of gas from increasing above predetermined limits.

Another object of the present invention is to provide an improved pressurized dye beck wherein steam is used for heating the dye liquor, the steam being confined within the dye beck by means of a closed system of steam coils thereby reducing cooling and ventilation problems in the dye house, especially during summer months.

A further object of the present invention is to provide a dye beck whereby the corrosive elements resulting from the use of water and chemicals in the dyestuffs is not released to atmosphere in the dye house, thereby decreasing building maintenance.

Still another important object of the present invention is to provide a dye beck machine in which test samples of the dyeing operation may be accomplished simultaneously with the dyeing operation of the fabric in rope form.

Further, another object of the present invention is to provide an improved dye beck having means for testing the dyeing of a patch of fabric simultaneously with the dyeing of the fabric within the dye beck in order to determine color characteristics of the same.

Ancillary to the immediately preceding object, it is an object of the present invention to provide a dye beck with means for testing a patch of fabric, the test sample being subjected to the same temperatures and pressures as in the main dyeing chamber.

Another object of the present invention is a provision of a dye beck provided with means to enable the dyers to follow the progress of dyeing without exhausting the pressure from the dye beck or altering the temperature therein.

A further important object of the present invention is to provide a pressurized dye beck having a patch box associated therewith and subjected to the temperatures and pressures within the dye beck, the patch box being capable of being isolated from the dye beck so that the dyer can check color of a patch of fabric therein without effecting temperature and pressure within the main body of the dye beck.

These and other objects and advantages of the present

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invention will appear more fully in the following specification, claims and drawings wherein:

FIGURE 1 is a side elevational view of the dye beck of the present invention, portions being broken away to illustrate features of the same;

FIGURE 2 is an end elevational view of the dye beck of FIGURE 1 looking from the right thereof, portions of the dye beck being broken away to better illustrate features of the invention.

Referring now to the drawings wherein like character and reference numerals represent like or similar parts, the dye beck of the present invention is preferably an elongated, cylindrically shaped tank generally designated by the numeral 10, the tank being disposed upon a horizontal axis. All interior parts of the tank 10 or parts of the system which come in contact with the corrosive water or chemicals in the dyestuff are desirably constructed of stainless steel, similar corrosive resistant metal or corrosive resistant plastic. The cylindrical tank 10 is made of an elongated cylindrical center section 12 which is closed at each of its ends by dome shaped end walls 14 and 16 respectively. Since the tank 10 must be capable of withstanding internal pressures above normal atmospheric pressure, the end walls 14 and 16 are preferably welded to the cylindrical center portion or section 12; however, such end walls may be bolted to the center section with suitable pressure tight gaskets interposed therebetween.

The cylindrical tank 10 is provided with a plurality of cradle shaped supporting legs 18 longitudinally spaced along its length, as best shown in FIGURE 1. The cradle shaped legs 18 are welded to the outer wall of center section 12 and extend upwardly on the tank on each side thereof to a point adjacent a horizontal plane through the longitudinal axis of the tank.

The tank 10 is provided with an elongated access opening 20 extending longitudinally of the center section 12, the opening 20 being disposed in the wall of the center section above a horizontal plane through the longitudinal axis of the tank. A peripheral flange 22 welded to the center section 12 about the access opening 20 extends outwardly of the tank 10 and provides a seat for a pressure tight door generally designated at 24. The door 24 is provided with a gasket 26 that abuts and seats upon the outer edge 28 of peripheral flange 22 when the door is in a closed position. A plurality of lever arms 30 are fixedly connected to the door in spaced relationship with respect to each other, the lever arms being welded thereto. Each of the lever arms 30 has its outer free end pivotally connected by a pivot pin 32 to a bracket 34 welded to the upper portion of the tank. When it is desired to open the door 24, the door is merely pivoted about the pins 32 to an upper position. Suitable automatic means may be utilized for opening and closing the door.

Since the tank 10 is intended to operate at internal pressures of 10 to 16 pounds per square inch, a plurality of door lock dogs 36 are suitably provided on an actuating mechanism 38 for cooperating with lugs 40 provided on the door. A suitable pneumatic cylinder assembly 42 supported on the tank 10 is operatively connected to the actuating mechanism 38 to latch and unlatch the dogs 36 from the lugs 40 of the door. Further, access door 24 is provided with a plurality of glass windows 44 so that the dyer may observe the interior of the tank during the complete dyeing operation. In this respect, the interior of the tank may be provided with suitable light fixtures 46 mounted in the upper portion of the tank for the purpose of illuminating the interior of the tank.

As best shown in FIGURE 2, the interior of the tank is provided with a false bottom 50 having its center section 52 perforated so that dye liquor may pass there-through. The perforated center section 52 of false bottom 50 may be wire screening of a desired mesh or it may be a metal plate having a suitable number of aper-

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tures therein. Adjacent the forward end of the tank and extending upwardly from adjacent the forward edge of false bottom 50 in spaced relationship with the curved side walls is a removable perforated baffle plate 54. The baffle plate 54, which extends for the length of the tank and terminates at its upper edge adjacent the lower edge of access opening 20, may be removed by merely reaching through the access opening 20 and picking the same out. It may be desirable to make the baffle plate 54 in sections so that individual sections may be removed and cleaned.

The false bottom 50 and the baffle plate 54 provide surfaces for confining path of travel of the fabric 56 as it is moved through the dye liquor and superposed body of gas above the dye liquor. In more detail, the fabric material 56, which is in rope form, passes over an ovate main drive reel 64 and an idler drive reel 66. The drive shaft 69 of ovate main drive reel 64 is suitably journaled in a bearing (not shown) housed in a bearing well 68 provided in the end wall 14 of the tank. The other end of drive shaft 69 of the ovate main drive reel 64 is supported in a bearing carried in a bearing well (not shown) provided in end wall 16 of the tank, the end of drive shaft 69 for the reel extending through the end wall 16 and being provided with a pinion gear 70 on the outside of the tank. An endless drive chain 72 passes over the pinion gear 70 and a gear 74 of a right angle reduction gear box 76 which is suitably supported on a bracket 78 carried on the end wall 16. An electric motor 80, also carried on the bracket 78, is provided with a pulley 81 over which passes an endless V-belt 82. The endless V-belt 82 in turn passes over an input pulley 84 for the right angle reduction gear box 76 and, thus, it will now be seen that the motor 80, through pulley belt 82 and endless drive chains 72, rotates the ovate main drive reel 64.

The idler reel 66 has its drive shaft journaled at one end of the tank 10 in a removable plate and supporting bracket 86 suitably carried on the end wall 16. The opposite end of the drive shaft of the reel 66 is journaled in a suitable well (not shown) provided in the end wall 14. By providing a removable plate and supporting bracket 86, easy access to the idler reel may be obtained without opening of the access door 24. A peg rack generally designated by the numeral 90 and including a plurality of spaced fingers is carried beneath the idler reel 66 and provides means for guiding separate lengths of fabric in rope form passing about the idler reel 66 and the main drive reel 64. The peg rack prevents the separate lengths of fabric in rope form from becoming entangled as the fabric is moved through the dye liquor.

As is now evident, rotation of the ovate main drive reel 64 in a clockwise direction, as viewed in FIGURE 2, will cause the fabric 56 in rope form to move from the front of the dye beck toward the rear across the top of the same. The fabric then passes downwardly where it is supported on the false bottom 50 in a pleated form as it moves from the rear of the dye beck toward the front of the dye beck and then upwardly over the idler reel 66.

As shown in FIGURES 1 and 2, steam coils 92 are provided between the false bottom 50 and the curved bottom wall of the cylindrical section 12 of tank 10. Other steam coils 94 are positioned between the upwardly extending baffle plate 54 and the curved front side wall of the cylindrical section 12 of tank 10. In FIGURE 1, the series of steam coils 92 and series of steam coils 94 are shown extending longitudinally of the tank and being connected to inlet manifold sections 96 and 98 respectively as well as outlet manifold sections 100 and 102 respectively. While the coils 92 and 94 have been illustrated as extending longitudinally along the tank with their respective manifolds extending concentrically of the longitudinal axis of the tank, it is, of course, within the scope of the present invention that the coils may be arranged to extend in a curved path concentric to the axis of the tank

with their respective manifolds being disposed longitudinally of the tank. The closed steam coils 92 and 94 are supplied with steam from a suitable steam generator 106 schematically shown in FIGURE 1. An inlet conduit 108 from the steam generator 106 supplies steam to conduits 110 and 112. The conduit 110 delivers the steam to the inlet manifold 96 of coils 92 at one end of the tank whereas the conduit 112 delivers steam to the inlet manifold 98 for the coils 94 adjacent the opposite end of the tank. By having steam supplied to the steam coils from opposite ends of the elongated cylindrical tank 10, the temperature of the dye liquor in the dye beck may be elevated evenly throughout the entire length of the dye beck, and consequently, the tendency to create a flow current in the dye liquor from one end of the tank toward the other transverse to the movement of the fabric is reduced, and consequently, turbulence in the dye liquor is eliminated. A further advantage of supplying the steam to the coils from opposite ends is that better control of the dyeing of the fabric is obtained as the dye liquor contacting the fabric has the same characteristics throughout. It will be understood that other arrangements of supplying steam to the coils may be utilized and still come within the scope of the present invention so long as steam is supplied evenly to the coils from opposite ends of the elongated tank 10.

By positioning the steam coils 92 beneath the false bottom 50 and the steam coils 94 between the perforated baffle plate 54 and the front side wall of the tank 10, a "chimney" effect in heating the dye liquor occurs. No turbulence occurs in the dye liquor since the steam coils are of the closed type and no raw steam is flowed directly into the dye liquor. The heat is evenly transferred from the heating coils to the dye liquor throughout the length of the elongated dye beck and any flow of dye liquor which occurs from heating will be a smooth laminar flow through the perforated baffle plate 54 and the perforated center section 52 of the false bottom 50.

The dye liquor is flowed into the tank 10 through a suitable perforated dye distributor pipe 114 extending longitudinally of the tank and connected to a dye inlet pipe 116 leading from a suitable source of supply. Conventional pump means, including the usual auxiliary equipment such as valves, sight gauges, storage tanks and the like are provided for pumping the dye through the inlet pipe 116 to the dye distributor pipe 114.

The control of the dye liquor to the dye distributor line is provided on a control panel generally designated at 118 which also has controls coupled to the steam generator 106 for operating the same. The tank 10 may be provided with a water inlet connected to the water system of the dyeing plant so that the tank can be flushed at the end of a run or when changing from one color dye to another color dye. The controls for the water may also be located on the central control panel 118 suitably mounted on the side wall of the dye beck.

Positioned in the bottom portion of tank 10 is a suitable drain outlet 120 which is closed by an air operated drain valve 122. The drain valve 122 is connected to a suitable discharge pipe 124 which leads to the sewer system of the plant, and thus when it is desired to drain the tank of dye liquor or cleaning solutions, it is merely necessary to operate the air operated drain valve 122 so that the liquid in the tank may flow by gravity through the drain 120 and pipe 124 to the sewer.

Pressure tank 10 is provided with a vent pipe 126 in the top portion thereof. The vent pipe 126 is provided with a damper 128, the damper being locked in its closed pressure tight position during a dyeing operation so that the tank may be pressurized. An exhaust fan (not shown) may be provided in the vent 126, and thus when it is desired to empty the tank of dye liquor and clean the same, it is possible to quickly remove fumes from within the tank by operation of the exhaust fan.

A pressure relief valve 130 having a suitable gauge

132 thereon is provided in the upper portion of the tank. While the tank 10 is designed to withstand pressures up to 50 pounds per square inch, it is not necessary to approach such values in the dyeing operation. As mentioned at the outset of the specification, the dyeing operation is accomplished at temperatures in the order of 240° F. to 250° F. whereas the pressure of the superposed body of gas necessary to maintain the dye liquor at these elevated temperatures in a state of "still boil" is in the order of 10 to 16 pounds per square inch. Consequently, it is desirable to set the pressure relief valve at approximately 20 pounds per square inch so that the operator is warned should the temperature and pressure inadvertently increase above a temperature and pressure in the predetermined desired range.

In order to quickly elevate the temperature of the dye liquor to the desired range of 240° F. to 250° F., the tank is first filled with dye liquor to the level L and then after the tank has been made pressure tight by closing of the access door 24 and all of the necessary valves and dampers, an initial pressure of 5 pounds per square inch is applied to the superposed body of gas above the dye liquor by flowing compressed air from a suitable source of compressed air through the line 134 into the tank. Suitable valves may be provided on the control panel 118 for applying the initial charge of compressed air to the superposed body of gas.

Once the dye liquor within the tank has been placed under an initial pressure of 5 pounds per square inch, suitable controls on the control panel 118 are actuated so as to allow steam from steam generator 106 to flow into the steam pipes at opposite ends of the tank 10. The heat from the steam is transferred through the pipes to the dye liquor, and as the temperature of the dye liquor increases, the pressure within the tank will also increase. Since an initial pressure of 5 pounds per square inch has been applied to the tank, the temperature will rise to approximately 228° F., and upon increases of temperature above 228° F., the pressure within the tank will also increase to where the pressure is approximately 16 pounds per square inch when the temperature is at 250° F. By controlling the increase of temperature with the increase of pressure within the tank 10, the dye liquor may be heated without reaching a point where it boils and creates turbulence within the tank. It has been found that the following table represents temperature and pressure conditions occurring within the tank, and thus from this table pressure values for any temperature may be arrived at by interpolation.

Temperature	Pressure
212° F.-216° F.-----	4 oz. per sq. in./degree of temperature rise.
216° F.-228° F.-----	5.33 oz. per sq. in./degree of temperature rise.
228° F.-250° F.-----	8.0 oz. per sq. in./degree of temperature rise.
Therefore, at:	
216° F.-----	1 p.s.i.
228° F.-----	5 p.s.i.
250° F.-----	16 p.s.i.

In order that the temperature of the dye liquor may be elevated to a predetermined temperature and maintained at that temperature with a predetermined pressure, the control panel 118 is provided with a temperature controller schematically represented at 140. The temperature controller 140 controls the flow of steam from the steam generator 106 to the coils 92 and 94, such control being in response to a signal from a temperature probe 142 positioned within the tank 10 below the false bottom 50. The temperature controller 140 is set to a predetermined temperature at which it is desired to operate, and it will permit steam to be flowed through the coils 92 and 94 until such time that the temperature responsive probe 142 senses that the temperature of the dye liquor has risen to or above the desired setting. The

temperature controller will then cut off the supply of steam from the steam generator 106 to the coils 92 and 94. Conversely, if the temperature should drop during the dyeing operation below the predetermined set value, the temperature probe immediately senses such a drop and the temperature controller will then permit the steam generator to again deliver steam to the coils 92 and 94.

As best shown in FIGURE 1, a motor driven water pump 144 has its inlet 146 connected to a suitable source of supply of fresh cold water. Water pump 144 has its outlet 148 connected to a conduit 150 which delivers cold water to the pipes or conduits 110 and 112. The pump 148 which may be suitably controlled from the control panel 118 normally does not run during the dyeing operation. However, upon completion of the dyeing operation when it is desired to depressurize the tank 10 and remove the dyed fabric therefrom, the pump 144 is operated so that it pumps fresh cold water into the lines 110 and 112, the water being circulated through the steam coils 92 and 94 so as to quickly cool the dye liquor within the tank. The water is discharged through a thermostatic trap (not shown) but associated with the condensation discharge traps of steam coils 92 and 94 through the discharge pipe 152. By providing means for quickly cooling the dye liquor within the dye beck after the dyeing operation has been completed, the time for completion of the overall dyeing cycle is materially reduced as the dyed fabric may be more quickly removed from the dye beck.

To further decrease the time of the complete dyeing cycle, the dye beck of the present invention is provided with a patch box 160 in which a patch of fabric may be placed, the patch box then being closed and subjected to internal pressures and temperatures of the dye liquor within the tank 10. In more detail, patch box 160 is supplied dye liquor from the interior of tank 10 through an inlet conduit 162. A liquid pump 164 is provided in the conduit 162 and valves 166 and 168 are provided on the inlet and discharge sides of pump 164. The dye liquor is returned to the tank 10 from the patch box 160 through a return conduit 170, the return conduit 170 also having a valve 172 therein. Patch box 160 is provided with a drain conduit 174, the drain conduit being provided with a valve 176. Pump 164 is operated by a suitable motor 178 controlled from the control panel 118.

The dyer may follow the progress of the fabric being dyed within tank 10 by placing a patch of this fabric in the patch box 160. The valves 166, 168 and 170 are then opened while the valve 176 is closed. The pump 164 is then started and dye liquor is pumped from the tank through the line 162 to the patch box 160 and then back into the tank through the line 170. The dye liquor is continually circulated through the patch box and will have the same temperature as the dye liquor in the tank. Also, the pressure on the dye liquor in the patch box will be the same as the pressure on the dye liquor in the tank. When the dyer wants to check the patch, it is not necessary for him to reduce the pressures within the tank or the temperature of the dye liquor within the tank as he can isolate the patch box from the tank by closing the valves 166, 168 and 170. The valve 176 in the drain line 174 is then opened to drain off a small amount of the dye liquor left in the patch box 160, the patch box being then opened and the patch removed for examination. The patch may be placed back into the box and subjected to further treatment of the dye liquor by reversing the operation, that is, by closing the valve 176 and opening the valves 166, 168 and 170. This procedure of testing a patch materially reduces the time cycle for the dyeing operation and provides a means of obtaining a more accurate control of the dyeing of the fabric within the tank to a desired shade.

It will now be obvious to those skilled in the art that the improved dye beck heretofore described is sus-

ceptible to some modifications and changes without departing from the spirit and principles of the invention. The specific embodiment described is merely for the purpose of illustrating the conception of the invention and to disclose a structure which has fully and effectively accomplished the objects and advantages of the invention. Therefore, the terminology used in the specification is for the purpose of description and not limitation, the scope of the invention being defined in the claims.

We claim:

1. In a dye machine for dyeing fabrics in rope form moving through a dye liquor at a temperature above a boiling point of the dye liquor at atmosphere and under an elevated pressure, the improvement comprising: a horizontally disposed cylindrically shaped pressure tank for the dye liquor and a superposed body of gas; means initially supplying compressed air to the tank for placing the dye liquor under an initial pressure of the superposed body of gas; means for heating the dye liquor to a temperature above its boiling point in a standard atmosphere and thereby further increasing pressure of the superposed body of gas on the liquid, said heating means including a plurality of closed steam coils positioned within said tank beneath the level of dye liquor therein, some of said coils having an inlet manifold for steam at one end of said tank and other of said coils having an inlet manifold at the opposite end of said tank whereby temperature of the dye liquor throughout the length of said tank is uniformly controlled; means in said tank for moving the fabric through the dye liquor and superposed body of gas; means responsive to temperature changes of the dye liquor for controlling said heating means and thereby maintaining the dye liquor at a predetermined elevated temperature; and safety means for relieving pressure of the superposed body of gas within the tank when the pressure reaches a predetermined maximum limit.

2. A dye machine of the character described in claim 1 including means for cooling the dye liquor at completion of the dyeing operation, said cooling means controlling the rate of cooling of the dye liquor.

3. A dye machine of the character described in claim 1 including means operatively connected to said closed coils for circulating cold water through said steam coils for rapidly cooling the temperature of the dye liquor at the end of a dyeing cycle.

4. In a dye machine for dyeing fabrics in rope form moving through a dye liquor at a temperature above the boiling point of the dye liquor at atmosphere and under an elevated pressure, the improvement comprising: a horizontally disposed cylindrically shaped pressure tank for the dye liquor and a superposed body of gas; means for heating the dye liquor, said heating means including steam coils positioned in the lower portion of said tank and immersed in and beneath the level of dye liquor therein, said steam coils including at least one inlet adjacent one end of said tank and at least a second inlet adjacent an oppositely disposed end of said tank whereby steam may be supplied to said coils from opposite ends of said tank toward the center thereof so that temperature of the dye liquor may be evenly elevated throughout said tank, means for moving fabric through the dye liquor and superposed body of gas when the dye liquor has reached a predetermined temperature and the superposed body of gas is at a predetermined pressure; and means for circulating cold water through said steam coils after the dyeing operation is completed whereby the dye liquor may be quickly cooled at a controlled rate of cooling.

5. A dye machine of the character described in claim 4 wherein said last-mentioned means includes a water circulating pump, said pump having its outlet connected to the inlet of said steam coils.

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