June 25, 1963 J. V. ISLEY ETAL 3,094,858

LOW PRESSURE, HIGH TEMPERATURE DYE BECK

Filed March 1, 1961 2 Sheets-Sheet 1

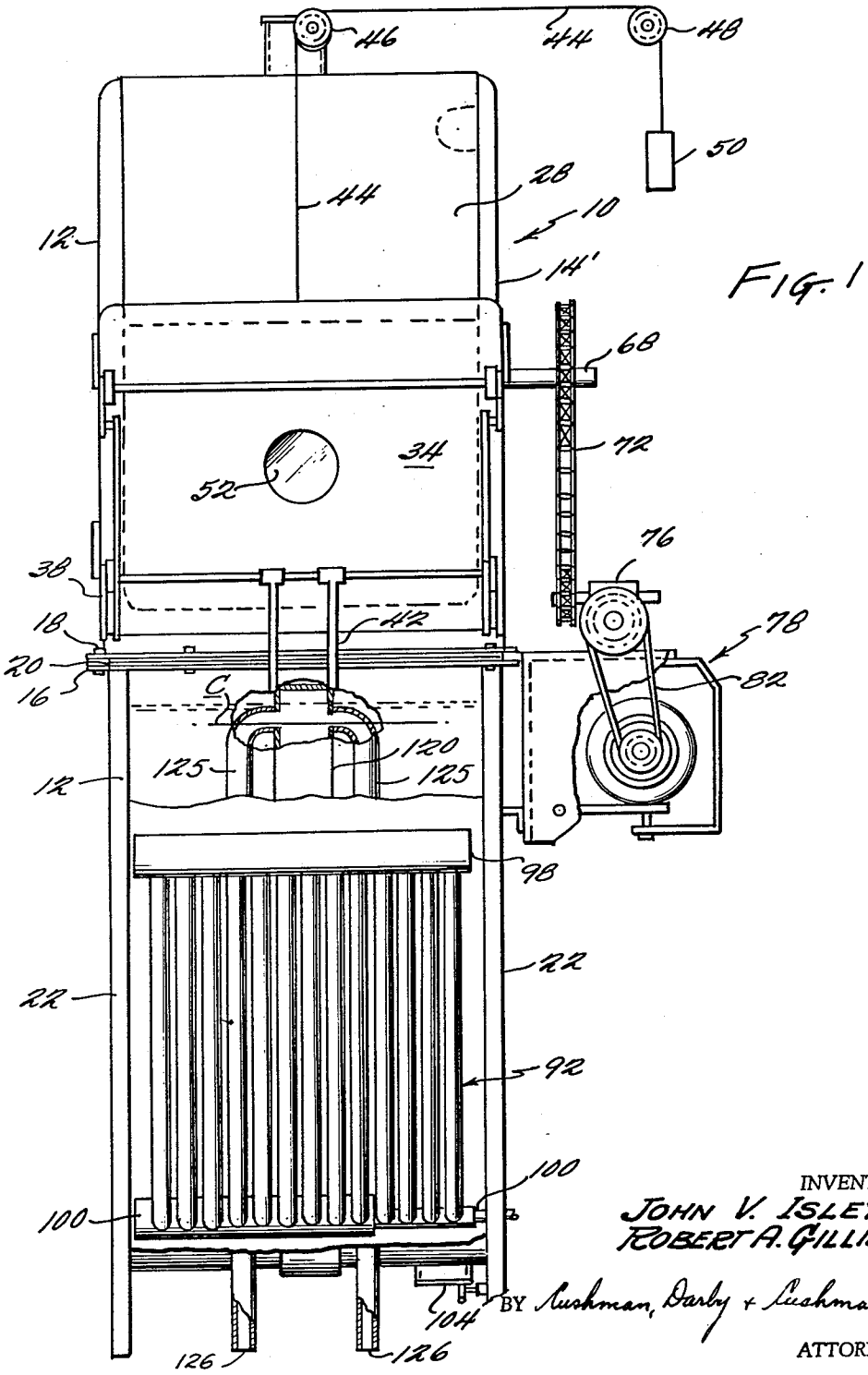


FIG. 1

INVENTORS
JOHN V. ISLEY
ROBERT A. GILLIAM

BY Cushman, Darby & Cushman

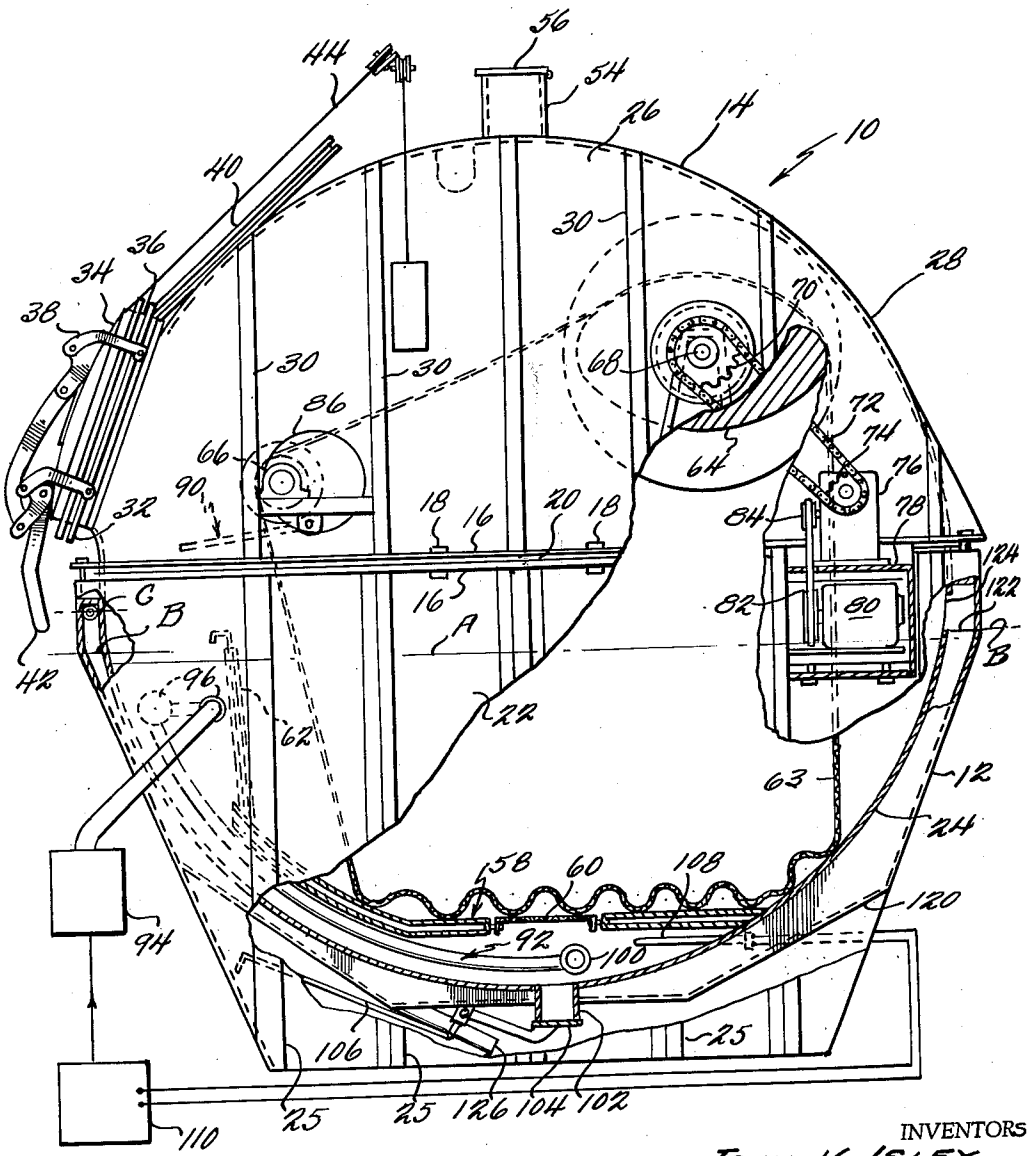
ATTORNEYS

June 25, 1963 J. V. ISLEY ETAL 3,094,858

LOW PRESSURE, HIGH TEMPERATURE DYE BECK

Filed March 1, 1961 2 Sheets-Sheet 2

FIG. 2



INVENTORS
JOHN V. ISLEY
ROBERT A. GILLIAM

BY Cushman, Darby & Cushman

ATTORNEYS

United States Patent Office 3,094,858 Patented June 25, 1963

3,094,858
LOW PRESSURE, HIGH TEMPERATURE DYE BECK

John V. Isley, Burlington and Robert A. Gilliam, Greensboro, N.C., assignors to Burlington Industries, Inc., Greensboro, N.C., a corporation of Delaware

Filed Mar. 1, 1961, Ser. No. 92,659
9 Claims. (Cl. 68—5)

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 and low pressures above atmospheric pressure.

It has been found highly desirable to dye synthetic or man made fibers in rope form at temperatures beyond the normal boiling point of the dye liquor at atmospheric pressures. While machines for dyeing fabrics have been heretofore designed for dyeing under elevated temperatures and pressure, such prior machines have not controlled the temperature and pressure in an efficient manner to obtain uniform dyeing characteristics. Further, such prior machines injected live steam directly into the dye liquor for heating the dye liquor and such injection resulted in quicker dilution of the dyestuff in the dye liquor, and consequently, a maximum amount of fabric could not be dyed uniformly and variations in shade of the material 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 without the dye liquor being diluted or boiling away.

Another object of the present invention is to provide an improved dye beck which makes it possible by elevated temperatures and elevated pressures to economically and advantageously dye otherwise hard to dye synthetic or man made fibers.

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

A further object of the present invention is to provide an improved dye beck which has a better dyestuff exhaustion and makes it possible for the reduction in the time of the dyeing cycle thereby increasing utilization of the dye beck with a resultant reduction in labor and fixed cost per yard of fabric dye.

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

Ancillary to the preceding object, it is a further object of the present invention to provide a dye beck having negligible waste of dyestuffs by applying pressure to the body of gases above the dye liquor to prevent the same from boiling.

Another important object of the present invention is to provide a pressurized dye beck whereby accurate control of temperature and pressure is accomplished.

A still further and important object of the present invention is to provide a pressurized dye beck having means for preventing the temperature of the dye liquor and the 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 the steam for heating the dye liquor is confined within the dye beck thereby reducing the cooling and ventilation problems in the dye house, especially during the summer months.

Still another object of the present invention is to provide a dye beck whereby the corrosive elements resulting from use of water and dyestuffs is not released into the air of the dye house, thereby decreasing building maintenance.

A further object of the present invention is to provide a negligible waste of dyestuffs by completely closing the dye beck and utilizing means to effectively prevent overflow of dye liquor or evaporation of the same and release from the dye beck.

These and other objects of the present 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 the present invention, the view being broken away in portions to illustrate features of the invention and further schematically illustrating the temperature control means.

Referring now to the drawings wherein like character or reference numerals represent like or similar parts, the dye beck of the present invention is generally designated by the numeral **10** and is preferably a cylindrical tank disposed upon a horizontal axis. All interior parts of the tank **10** or parts of system which come into contact with the corrosive water or dyestuffs are desirably constructed of stainless steel, similar corrosive resistant metal or corrosive resistant plastic. The cylindrical tank **10** is made of a lower semi-cylindrical section **12** and an upper semi-cylindrical section **14**, each having peripheral flanges **16**, bolted together in an air-tight relationship, as indicated at **18**. A suitable gasket **20** is interposed between the flanges **16** of the lower and upper sections **12** and **14** so that the tank will be pressure tight along its connecting seam. The lower section **12** is provided with a pair of opposed end walls **22** having welded therebetween a wrapper member **24** which is semicircular in cross-section. A plurality of vertically extending ribs **25**, which may be angle irons or the like, are welded or otherwise secured to each of the end walls **22** so as to provide them with the necessary rigidity sufficient to withstand the internal pressures to which they are subjected. While the present dye beck is referred to as a "low pressure" dye beck, it will be understood that internal pressures are greater than atmospheric pressure. The maximum pressure to which the tank **10** is subjected is in the order of **29** ounces per square inch above atmospheric pressure.

The upper section **14** is similarly constructed to the lower section **12** in that it is provided with a pair of opposed end walls **26** and a semi-cylindrical wrapper member **28**. The end walls **26** are suitably braced by the vertically extending ribs **30** welded or otherwise suitably secured thereto. The wrapper member **28** of the upper section **14** of tank **10** is provided with an elongated access opening therein having a peripheral flange **32** surrounding the same. The opening in the upper wrapper member **28** is adapted to be closed by a door **34** having a suitable gasket **36** thereon for making sealing contact with the flange **32**. The pressure door **34** is provided with any desirable operating linkage such as the bell crank linkage **38** and is adapted to move on a door track **40** carried by wrapper member **28** to an open position whereby access may be obtained to the interior of the dye beck. A handle **42** operates the bell crank linkage **38** to release the door from sealing engagement with the flange **32**, the door then being capable of sliding on the door track **40** to an upper position. A cable **44** connected to the door and passing over a pair of pulleys **46** and **48** respectively is provided with a counterweight **50** at its other end so that when the operator releases the handle **42** the door **34** may be easily pushed to and retained in its open position until it is desired to close and relock the same. The ac-

cess door **34** is provided with a glass window **52** whereby the operator can observe operation of the material being dyed within the dye beck.

The tank **10** is provided with a vent pipe **54** in its upper section **14**, the vent **54** normally being closed by a damper **56**. The damper **56** may be manually opened to vent the interior of the tank **10** during cleaning of interior of the same or in between dyeing cycles. However, during a dyeing cycle, and when the tank **10** is pressurized, the damper **56** is locked in a closed position and provides a seal for the vent pipe **54** so that no fumes or pressure from the interior can leak to atmosphere.

The semi-cylindrical wrapper member **24** defines a curved bottom portion and curved side wall portions for the lower section **12** of the tank. Spaced from the bottom portion of the wrapper **24** is a false bottom generally indicated by the numeral **58**. The false bottom **58** includes a horizontally extending perforated section **60** and a removable perforated baffle plate **62** spaced from one side wall portion of the same. As clearly shown in FIGURE 2, the false bottom **58** provides a surface for supporting the fabric material **63** when the material is being moved through the dye liquor in an endless path and in rope form. In more detail, the fabric material **63** passes over an ovate main drive reel **64** and an idler drive reel **66**. The ovate drive reel **64** is suitably journalled in the opposed end walls **26** of the upper section **14** of tank **10**, the drive shaft **68** for the main drive reel extending through one end wall **26** and being provided with a gear **70** over which passes an endless drive chain **72**. The endless drive chain **72** engages a gear **74** of a right angle reduction gear box **76** carried on a bracket **78** suitably mounted on the external surface of the tank. A motor **80** also mounted on the bracket **78** is adapted to drive a V-belt **82** which in turn drives an input pulley **84** of the reduction gear box **76**.

The idler reel **66** is journalled at one end in a removable plate and supporting bracket **86** suitably carried on one end wall **26** of tank **10** so that easy access for repair or inspection of the idler reel may be accomplished. A peg rack generally designated by the numeral **90** is provided for guiding separate lengths of fabric in rope form passing about the idler reel **66** and the main drive reel **64**.

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 **63** in rope form to move from the front of the dye beck toward the rear across the top of the same, the fabric **63** being pleated as it moves from the rear toward the front of the dye beck along the false bottom **58**.

Closed curved steam coils **92** are mounted within the interior of the tank **10** between the false bottom **58** and the wrapper **24**. The steam coils, as shown in FIGURE 2, extend from a position beneath the bottom portion of the false bottom **58** to a position adjacent the perforated baffle **62** and have a curvature concentric with the curvature of the wrapper member **24**. Steam from a suitable steam generator schematically represented at **94** flows through a steam inlet **96** into a manifold **98** for the steam coils **92**. The steam is discharged from the coils **92** through a steam trap **100** to a suitable condenser or the like. As is now evident, the positioning of the steam coils **92**, as described and illustrated, provides a "chimney" effect in heating the dye liquor. Since there is no raw steam flowing into the dye liquor, there is no turbulence, the heat being transferred smoothly through the dye liquor, the flow of dye liquor resulting from the transfer of heat being a smooth laminar flow through the perforated baffle plate **62**.

Positioned in the bottom portion of the tank **10** is a suitable drain outlet **102** which is closed by a dump valve **104**. The dump valve may be operated by a suitable mechanical linkage **106** when it is desired to drain the tank of dye liquor or cleaning solutions.

Pressure tank **10** is provided with a suitable inlet fitting

(not shown) which is connected to conventional pump means for pumping dye liquor into the tank prior to the starting of a dyeing cycle. The pumping system includes the usual auxiliary equipment such as valves, sight gauges, storage tanks and the like. Also the tank **10** may be provided with a water inlet connected to the water system of the plant so that the tank can be flushed at the end of a run.

The temperature of the dye liquor within the tank **10** is controlled by the amount of steam passing through the steam coils **92**. In order that the temperature may be elevated to a predetermined temperature and maintained at that temperature, a temperature responsive probe **108** is suitably positioned within the lower section **12** of the tank so that it is constantly sensing the temperature of the dye liquor therein. The temperature responsive probe **108** is connected to a suitable temperature controller schematically designated by the numeral **110**, the temperature controller controlling the amount of steam flowing from the steam generator through the coils **92**. Thus, after the controller has been set for a predetermined temperature and if the temperature of the dye liquor is below this predetermined temperature, the probe **108** will sense the temperature and signal the temperature controller so that it operates the steam generator **94** or the like in a manner to supply more steam to the coils **92** whereby the dye liquor is heated until such time it reaches the predetermined desired temperature. Conversely, if temperature of dye liquor is too high, the temperature controller **110** reduces or stops the flow of steam through coils **92**.

By making the tank **10** pressure tight, the air above the dye liquor, which is defined herein as a superposed body of gas, is heated by heat from the dye liquor, and consequently, the pressure of the same is increased due to the expansion of the gas in a confined area as the temperature of the dye liquor is increased. Since the dye liquor boils at approximately the same temperature as water, namely, 212° F., at a standard atmospheric pressure, the increase in pressure of the superposed body of gas on the dye liquor will prevent the dye liquor from boiling when its temperature increases above 212° F. It has been found that the temperature-pressure relationship within the tank for giving a satisfactory dyeing of man made fabrics without boiling of the dye liquor is accomplished according to the following table:

Temperature:	Pressure, per inch
212° F.	0 oz.
213° F.	4 oz.
214° F.	8 oz.
215° F.	12 oz.
216° F.	16 oz.
217° F.	21.33 oz.
218° F.	26.66 oz.
218.44° F.	29 oz.

In order that the temperature of the dye liquor and the pressure of the superposed body of gas does not exceed a maximum predetermined amount where there is danger of structural failure of the dye beck, the dye beck **10** is provided with a U-shaped duct **120** having one end **122** thereof communcating with the interior of the tank **10** through a suitable opening **124** at a point slightly above the level A of the dye liquor within the tank. The U-shaped duct **120** extends downwardly beneath the tank and upwardly on the other side to a level C above the level of the liquid A which is also higher than the level B of the opening **122**. A pair of downwardly extending tubes **125** communicate with the upper end of the U-shaped duct **120** at the level C, the tubes **125** extending downwardly beneath the tank to a point **126** where they can discharge liquid to a suitable drain. Since the tubes **125** are open to atmosphere at **126**, effectively the duct **120** is open to atmosphere at the level C. The U-shaped duct **120** is filled with a liquid to the level B.

As the pressure of the superposed body of gas in the tank **10** increases above atmospheric pressure, the pressure acting on the liquid at the level of opening **122** will cause the liquid to be forced down in the duct **120** and upwardly towards the level C. When the pressure within the tank **10** reaches, for example, 29 ozs. per square inch which has been found as a suitable maximum limit when the temperature of the dye liquor is at 218.44° F., the liquid within the duct **120** will start flowing outwardly through the discharge escape tubes **125** and be discharged therefrom at **126** into the drain. The operator of the dye beck will then have an indication that the internal pressure of the superposed body of gas and the temperature of the dye liquor has increased to a maximum limit and suitable corrective action may be taken. The U-shaped duct **120** will overflow at a pressure of 29 ozs. per square inch at a temperature of 218.44° F. when it is designed with a resulting volume of liquid that will be approximately equal to a vertical column of water 40 inches high. By utilizing a liquid seal in the duct **120**, the dye liquor is prevented from boiling and overflowing, and also fumes are prevented from being released into the shop air.

The liquid used in the U-shaped duct **120** is preferably water for the reasons given heretofore, but it, of course, may be dye liquor. By providing a liquid seal between the interior of the tank and atmosphere, an efficient means has been accomplished for controlling the maximum pressures and temperatures within the tank.

When a dyeing cycle has been completed and the tank is depressurized, the fabric being removed through the access door **34**, the tank may be washed out by passing water therethrough and letting the level of the water rise to level B of the opening **122**. Continued flow of water through the tank will cause the water to be circulated therethrough and discharged through the overflow tubes **125**. When the cleaning operation of the tank is completed, the flushing water is turned off and the dump valve **104** is opened so as to drain the water from the interior of the tank. However, the water remains in the duct **120** at the level B so that during the next cycle of operation the duct **120** already is provided with a suitable liquid for providing a liquid seal between the interior of the tank and atmosphere. When the tank is ready for a new batch of dye liquor, the dye liquor may be supplied to the tank in the usual manner until it reaches the level A which is at or just below the level B.

By utilizing the temperature controller unit **110** with the liquid column as defined by the duct **120** filled with liquid, an improved dyeing operation results in that accurate temperature of the dye liquor with a predetermined pressure may be maintained so that the dye liquor does not boil at temperatures in excess of its normal boiling point under standard atmospheric conditions. The time of the dyeing cycle is decreased as the dye-stuff exhaustion is increased, and a more uniform dyeing of fabric in rope form results.

It will now be obvious to those skilled in the art that the improved dye beck heretofore described is susceptible 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 the boiling point of the dye liquor at atmosphere and under an elevated pressure, the improvement comprising: a pressure tank for the dye liquor and the fabric to be dyed, said pressure tank having an opening therein positioned above the normal level of dye liquor; a closure for said opening including means for sealing the same; said tank having a curved bottom and side walls; a false bottom carried in said tank and spaced from said curved bottom and side walls, said false bottom having at least a portion thereof perforated; closed coils positioned between said false bottom and said side walls and the bottom of said tank; means to circulate a hot fluid through said coils whereby heat is transferred to and elevates the temperature of the dye liquor and pressure in said tank; and liquid column means open to the interior of said tank at a position at least at the normal level of dye liquor therein, said liquid column means being open to atmosphere at an elevation higher than its opening to the interior of said tank, said liquid column means being responsive to a predetermined elevated pressure in said tank at a predetermined elevated temperature of the dye liquor for controlling further increase in temperature of the dye liquor and pressure in the tank, said liquid column means including a U-shaped duct extending externally about the side walls and bottom of said tank, said duct opening at one end thereof to the interior of said tank and at the other end thereof to atmosphere.

2. A dye machine of the character described in claim 1 including means responsive to the temperature of the dye liquor in said tank for controlling flow of hot fluid through said coils.

3. 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 pressure tank having a dye liquor therein at a predetermined level and a superposed body of gas; means in said tank for endlessly moving the fabric through the dye liquor and the superposed body of gas; conduction heating means positioned in the tank below the predetermined level of the dye liquor therein for heating the dye liquor and thereby increasing the pressure of the superposed gas and causing the dye liquor to circulate; and a U-shaped duct in open communication at one end thereof to the interior of the tank at a level above the predetermined level of dye liquor therein and at the other end thereof to the atmosphere above its opening into the tank, said duct being filled with a liquid and providing a liquid seal between the superposed body of gas within said tank and the atmosphere.

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 pressure tank for the dye liquor and a superposed body of gas; means in said tank for moving the fabric through the dye liquor and the superposed body of gas; means for heating the dye liquor and thereby increasing the pressure of superposed gas; a U-shaped duct having one end thereof open to the superposed body of gas within said tank and the other end thereof open to atmosphere at an elevation above its opening within said tank, said U-shaped duct extending externally beneath said tank and being filled with a liquid to define a liquid column whereby an increase of pressure within said tank causes said liquid column to rise in said duct toward its opening with atmosphere.

5. A dye machine of the character described in claim 4, including at least one discharge tube communicating with said duct at its opening to atmosphere, said discharge tube extending downwardly beneath said tank for discharging overflow liquid from said duct when pressure within said tank increases beyond a predetermined pressure.

6. A dye machine of the character described in claim 4, including means responsive to temperature of the dye liquor in said tank for controlling the means to heat said dye liquor.

7. A dye machine of the character described in claim 6 wherein said last-mentioned control means includes a

temperature responsive probe positioned in the dye liquor in said tank.

8. A dye machine of the character described in claim 4 wherein the liquid in said duct is dye liquor and wherein superposed body of gas is air.

9. A dye machine of the character described in claim 4 wherein the liquid column defined by said U-shaped duct has an effective vertical height of approximately 40 inches of water and wherein said liquid column discharges from said duct at a pressure of approximately 29 ounces per square inch with a temperature of the dye liquor at approximately 218.44° F.

References Cited in the file of this patent

UNITED STATES PATENTS

685,949	Seither	Nov. 5, 1901
747,108	Wolff	Dec. 15, 1903
1,497,075	Elliott	June 10, 1924
2,271,874	Platt	Feb. 3, 1942
2,412,188	Wolfenden	Dec. 3, 1946
2,431,246	Hallanan	Nov. 18, 1947
2,485,710	Derby	Oct. 25, 1949
2,593,640	Whittington	Apr. 22, 1952
2,706,391	Belcher	Apr. 19, 1955
2,978,291	Fahringer	Apr. 4, 1961