April 15, 1969 S. B. CLARK 3,438,071

DYEING OF CELLULOSE CASING

Filed July 27, 1967 Sheet 1 of 2

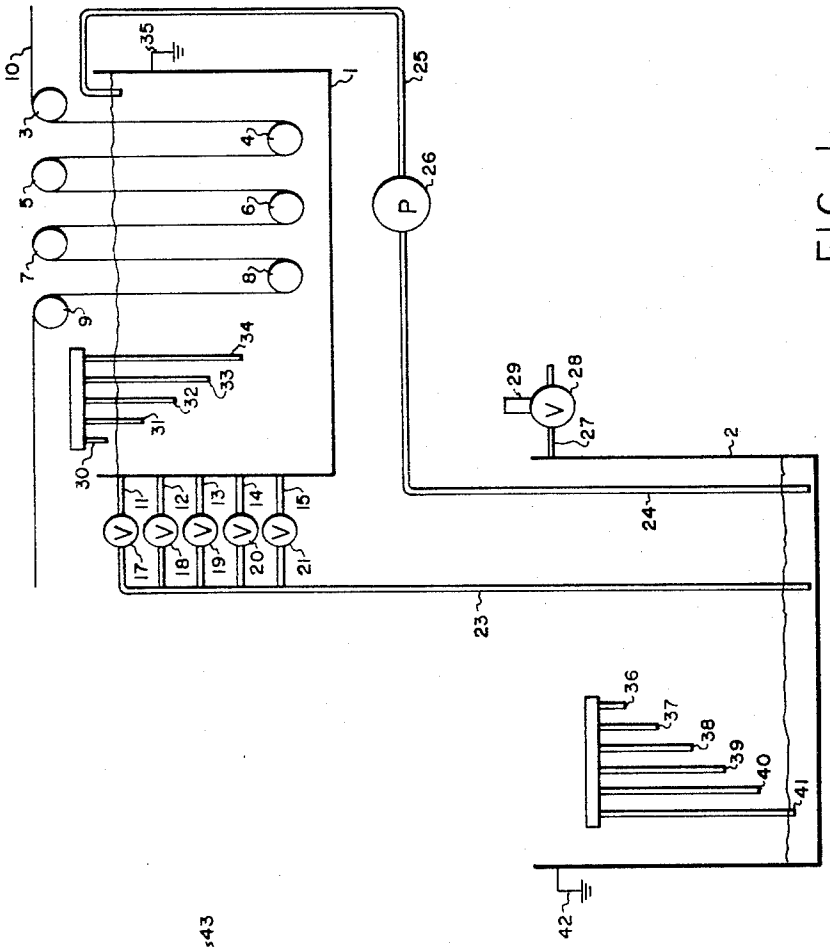


FIG. 1

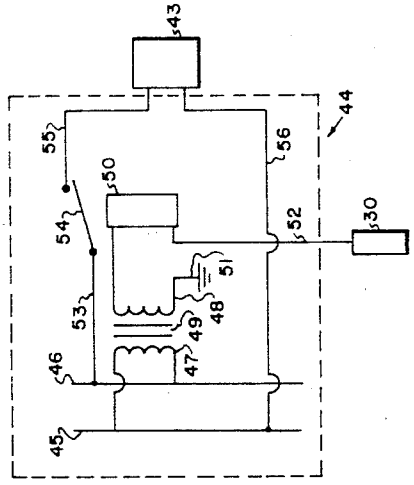


FIG. 3

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DYEING OF CELLULOSE CASING

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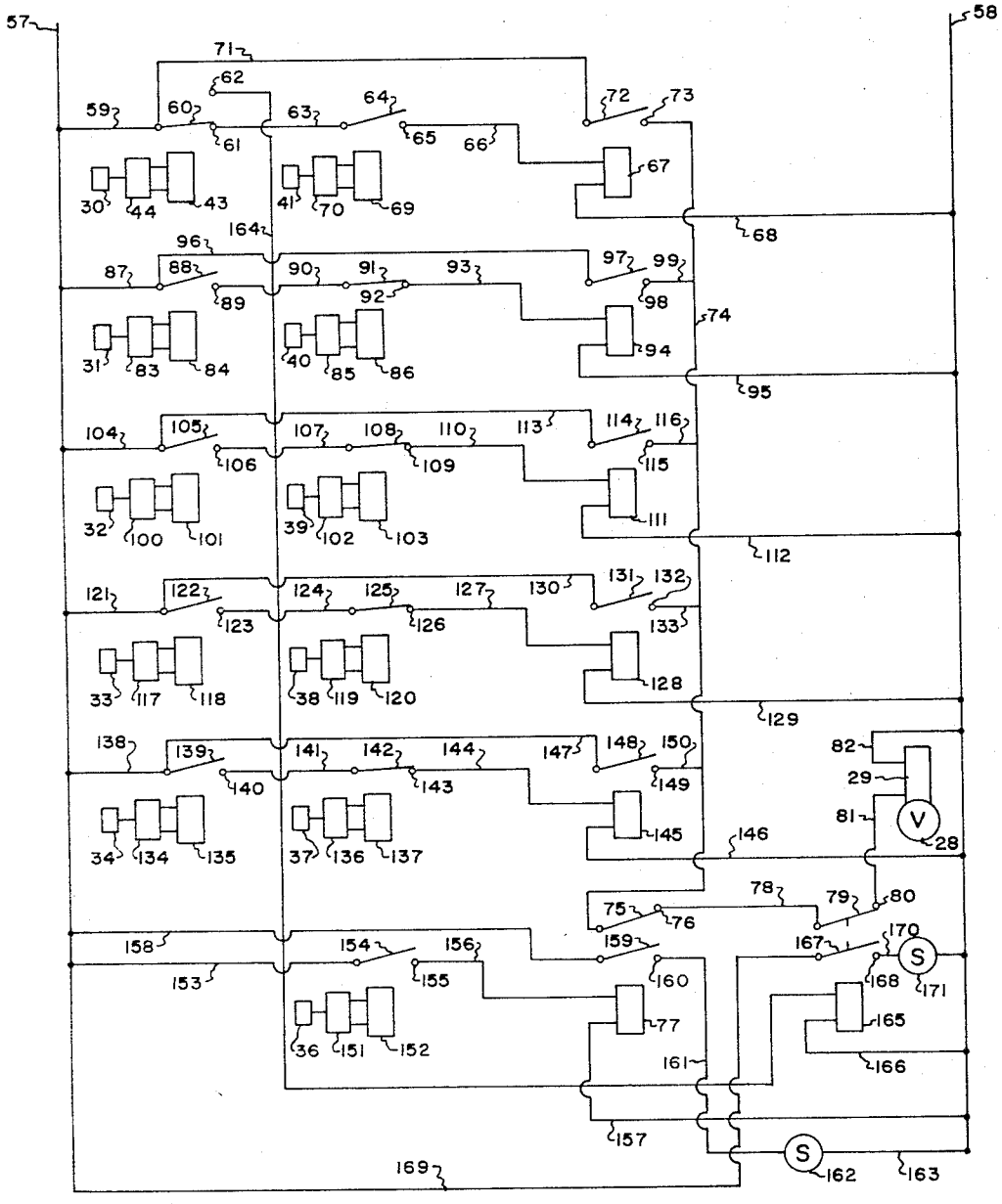


FIG. 2

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United States Patent Office 3,438,071 Patented Apr. 15, 1969

3,438,071

DYEING OF CELLULOSE CASING

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Filed July 27, 1967, Ser. No. 656,495
Int. Cl. D06f 37/00, 39/00; F16k 21/18
U.S. Cl. 8—158 9 Claims

ABSTRACT OF THE DISCLOSURE

In the dyeing of cellulose casings or other continuous lengths of material wherein the amount of dye added to the material is a function of the residence time of the material in the dye bath, the casing or other continuous length of material being treated is passed through a dye tank having a plurality of outlets which establish predetermined dye levels in the tank. A storage dye tank is provided at a lower level to receive the dye solution withdrawn from the main dye tank. A continuously operating pump circulates dye from the lower storage tank continuously to the dye tank where excess dye is continuously removed through one of said outlets. Means are provided responsive to the level of dye solution in the main dye tank and in the storage tank to actuate a valve for admission of make-up water to maintain the total volume of the dye system constant (which greatly simplifies the regulation of dye content of the solution). The means for maintaining the dye system at a constant volume include means responsive to the presence of an excessive amount of solution in either of the tanks to register an alarm whenever a high level of dye solution occurs and to shut off the flow of make-up water through the supply valve occurrence of such a high level. The control means includes a plurality of electric probes responsive to predetermined dye levels in each of the dye tanks, said probes being connected in a plurality of control circuits controlling an electrically operated make-up supply valve and also controlling a high level alarm signal for each of the tanks.

Background of the invention

In the dyeing of continuous lengths of materials, particularly continuous lengths of cellulose sausage casings, wherein the amount of dye or coloring material retained in the material being treated is a function of the residence time of the material in the dye bath the intensity of dye pick-up has been controlled or varied by appropriate variation of the residence time of the material in the bath by varying the length of travel therein. For example, in the dyeing of cellulosic sausage casings with food grade dyes. e.g. FD&C Red #2, FD&C Red #3, FD&C Yellow #6 etc., cellulosic casings are customarily passed through a dye bath over a plurality of rollers which provide for an extended residence time of the casing in the dye bath. Whenever a darker or lighter shade of coloring is required in the casing an additional pass of casing through the bath would be provided or a pass would be dropped. This necessitated the breaking of the casing and threading it around additional rollers or around a lesser amout of rollers in the bath with the result that the casing machine operator would have to handle a number of lengths of casing within the dye bath which is quite a disagreeable task. Also, changes in the rate of dye pigment are often encountered due to variation in the casing composition or physical or chemical properties which necessitates relatively frequent changes in the number of passes of casing through the dye bath to maintain a satisfactory control of casing color. There has therefore been a need for a control system for dye bath for dyeing continuous lengths of material such as celluose casings which provides an inexpensive and efficient means for varying the length of pass of the material being dyed in passing through the dye bath and which also provides for controlling the total amount of dye solution accurately and provides for a signal or other control of an excessively high or excessively low level of the dye solution.

Summary of the invention

Continuous lengths of a material, such as cellulose sausage casings, may be dyed or colored uniformly by passing through a dye bath in which the amount of dye taken up by the material is proportionate to the length of time that the material is immersed in the dye bath. The casing or other material being dyed passes through a dye bath in multiple passes over a plurality of rollers which determine the length of travel and thus the time of immersion in the dye bath. The length of travel and the time of immersion in the dye bath are controlled by varying the level of dye in the dye tank through a plurality of valved outlet openings. Whichever valve is opened determines the level of dye solution in the tank. The dye solution which overflows through the opened valve flows into a storage tank at a lower and continuously recirculates by a continuously operating pump from the storage tank back to the dye bath tank. At the storage tank on the lower level there is provided an automatically controlled inlet valve for supplying make-up water to the dye solution. The dye bath tank on the upper level and the storage tank on the lower level are each provided with a plurality of electrical probes positioned at predetermined levels in the tanks and connected in a plurality of electric circuits arranged to control the automatic valve for supply of make-up water. Whenever the total amount of liquid in the dye system decreases below a predetermined level for the particular valve opening on the dye tank, the probe circuits from the level will cause the automatic valve to open and supply additional make-up water to the system. If the dye level in either the main dye tank or the storage tank rises above a predetermined level one of the probes in each of the tanks is responsive to such a high level in such tank and will cause the automatic valve to be closed and an alarm signal to be given which indicates at a control panel that an excessive level of dye solution has occurred in one of the tanks. The total volume of dye solution is maintained substantially constant, thus facilitating the regulation of dye content.

Brief description of the drawing

In the accompanying drawings, to be taken as a part of this specification, there is clearly and fully illustrated a preferred embodiment of this invention, in which drawings,

FIG. 1 is a schematic view of a dye tank arrangement representing a preferred embodiment of this invention,

FIG. 2 is an electric wiring diagram for the control circuits controlling the make-up water valve for the dye system shown in FIG. 1 and for the high level alarm signals for the dye system, and

FIG. 3 is a wiring diagram for one of the electrical probe circuits for the dye tank arrangement shown in FIG. 1 and illustrating the interconnection between the probe circuit and the control relays for the water control valve as shown in FIGURE 2.

Description of the preferred embodiment

Referring to the drawings by numerals of reference and more particularly to FIG. 1 there is shown a dye control system for the dyeing of continuous lengths of material, such as cellulose casings. In FIG. 1, there is shown a dye tank 1 and a storage tank 2 for containing the dye used for coloring or dyeing continuous lengths of a material such as a regenerated cellulose, or fibrous reinforced regenerated cellulose, sausage casing. The main dye tank

1 is provided with a plurality of rollers 3, 4, 5, 6, 7, 8 and 9 over which there is threaded a flattened tube or casing 10 of regenerated cellulose. The cellulose casing passes over the rollers in the dye bath and has a period of exposure to the dye bath which is determined by the linear speed of motion of the casing, a number of rollers over which the casing is threaded, and the level of dye solution in the dye tank 1. In the preparation of regenerated cellulose sausage casings, food dyes of appropriate color are added to the casing in the dye bath and are dried in the wall of the casing when the casing is passed through the dryer (not shown). The finished casing is ultimately used for preparation of sausages, such as frankfurters, and the food color is transferred to the outer surface of the sausage to give it the desired color.

Dye tank 1 is provided with a plurality of outlet passages 11, 12, 13, 14, and 15 controlled by valves 17, 18, 19, 20 and 21 respectively. When one of the valves is opened the level of dye solution in tank 1 is adjusted to the level of the corresponding outlet passage and the excess amount of dye flows through the open valve and conduit 23 to the lower storage tank 2. Dye solution from the lower tank 2 is returned to dye tank 1 by conduits 24 and 25 and continuously circulating pump 26. The continuous circulation of the dye solution by pump 26 maintains the level of the dye solution in tank 1 at the desired level set by the opened valve and also allows for supply of make-up water to the system at the lower tank. The dye storage tank 2 is provided with an inlet conduit 27 controlled by an automatically operated valve 28 which is operated by electric solenoid 29. The control arrangement for the dye system is arranged to maintain the total volume of dye solution relatively constant. Whenever the dye solution in the storage tank drops below a predetermined level, which level is set in accordance with the level maintained in tank 1 by the outlet valves to that tank, make-up water is supplied to the system through solenoid operated valve 28. The addition of make-up water to the system may be required as a result of evaporation losses or as a result of depletion of the dye solution in dye tank 1. The dye solution is also analyzed, from time to time, and additional dye added to maintain the dye composition essentially constant.

In the control arrangement for dye tank 1 there are provided a plurality of electric probes 30, 31, 32, 33, and 34 which complete the various control circuits through the dye solution and the wall of the dye tank 1 which is grounded as at 35. Probes 30, 31, 32, 33 and 34 are arranged to operate control circuits according to the level of dye solution maintained by opening appropriate ones of valves 17, 18, 19, 20 or 21 respectively.

In the dye storage tank 2 there is provided a plurality of probes 36, 37, 38, 39, 40 and 41 respectively which are connected in various control circuits as illustrated in FIGS. 2 and 3. Probes 36 to 41 operate by completion of an appropriate circuit through the dye solution and the wall of dye storage tank 2 which is grounded as at 42.

In FIG. 2, there is shown a wiring diagram for controlling solenoid valve 28 and high liquid level alarm signals through the use of the electrical probes in dye tanks 1 and 2. In FIG. 3, there is shown a detail of one of the probe circuits showing the connection of a control relay in relation to the liquid level control probes. In FIG. 3 there is shown a probe circuit for controlling relay coil 43. The portion of the circuit closed by dotted lines corresponds to the probe control circuit shown as box 44 controlling relay 43 in FIG. 2. The probe control circuit includes 110 v. lines 45 and 46 (the voltage of this circuit is not critical and other voltages could be used) which are connected to transformer primary 47. The secondary coil 48 of the transformer 49 is connected on one side to relay coil 50 and on the other side to ground as indicated at 51. The other side of relay coil 50 is connected by wire 52 to probe 30 in dye tank 1. A wire 53 is connected to normally closed switch 54 which is connected to wire 55 to one side of relay coil 43, the other side of which is by wire 56 to power line 45. When the liquid level in the dye tank 1 is below the level of probe 30 the transformer secondary circuit is open and relay coil 50 is de-energized so that switch 54 is closed and relay coil 43 is energized. Whenever the liquid level in the dye tank is above the probe 30 the transformer secondary circuit is completed from probe 30 through the dye solution to ground and relay coil 50 is energized to open switch 54 and de-energize relay coil 43. Each of the various probes 30, 31, 32, 33 and 34 in tank 1 and probes 36, 37, 38, 39, 40 and 41 in the storage tank 2 is connected in identical circuit which causes the control relay operated by the probe to be de-energized whenever the liquid level in the tank is above the end of the probe and to energize the relay whenever the level of liquid is below the end of the probe. This control function is the same with respect to each of the various relays controlled by the various probe circuits and so the probe circuits will not be described in detail but will be indicated diagrammatically and also by reference to the particular probe which is in the bath circuit.

Referring to FIG. 2, there is shown a pair of high voltage lines 57 and 58 (110 v. is used but other voltages may be used) across which various control circuits are connected. Wire 59 is connected from line wire 57 to switch arm 60 which is a double throw switch operating between contacts 61 and 62. Wire 63 is connected from switch contact 61 to switch arm 64 which operates against switch contact 65. Switch contact 65 is connected by wire 66 to one side of relay coil 67 the other side of which is connected by wire 68 to line wire 58. Relay coil 43 which operates switch arm 60 is controlled by probe circuit 44 and probe 30 which is described in more detail in FIG. 3. Relay coil 69 operates switch arm 64 and is controlled by probe circuit 70 and probe 41. Probe circuit 70 and probe 41 function identically to the probe and probe circuit described in FIG. 3. In fact, the other probe circuits and probes described in association with the various relay coils in this wiring diagram function identically to the circuit and probe arrangement in FIG. 3 unless otherwise described. Wire 71 leads from wire 59 to switch arm 72 which is operated by relay coil 67 and moves into and out of closed position against switch contact 73. Wire 74 connects switch contacts 73 to switch arm 75 which is closed against switch contact 76 and is arranged for actuation by relay coil 77. Switch contact 76 is connected by wire 78 to switch arm 79 closed against contact 80. Wire 81 connects switch contact 80 to one side of solenoid 29, the other side of which is connected by wire 82 to line voltage wire 58. The circuit for energizing solenoid 29 extends from line voltage wire 57 through wires 59 and 71, to switch arm 72 and contact 73, closed, wire 74, switch arm 75 and contact 76, wire 78, switch arm 79 and contact 80, wire 81, and wire 82 back to line voltage wire 58. The energization of solenoid 29 requires that all of the switches in the described circuit be closed. Solenoid 29 is also controlled by any of several other parallel control circuits which will be subsequently described.

A parallel control circuit for solenoid 29 is provided which is controlled by probes 31 and 40. Probe 31 is connected to probe circuit 83 which controls relay coil 84. Probe 40 is connected to probe circuit 85 which controls relay coil 86. Wire 87 is connected from line 57 to switch arm 88 which is actuated by relay coil 84 and which is shown in open position in relation to switch contact 89. Switch contact 89 is connected by wire 90 to switch arm 91 which is shown in closed position against switch contact 92 and is actuated by relay coil 86. Switch contact 92 is connected by wire 93 to one side of relay coil 94, the other side of which is connected by wire 95 to line 58. Wire 87 is connected by wire 96 to switch arm 97 which is arranged for actuation by relay coil 94 and is shown in an open position in relation to switch

contact 98. Switch contact 98 is connected by wire 99 to wire 74 in the solenoid control circuit previously described.

A control circuit for still another level of dye solution in tanks 1 and 2 is controlled by probes 32 and 39. Probe 32 is connected to probe circuit 100 which controls relay coil 101. Probe 39 is connected to probe circuit 102 which controls relay coil 103. Wire 104 connects line 57 to switch arm 105 which is actuated by relay coil 101 and is shown in open position in relation to switch contact 106. Switch contact 106 is connected by wire 107 to switch arm 108 which is actuated by relay coil 103 and is shown in closed position in relation to switch contact 109. Switch contact 109 is connected by wire 110 to one side of relay coil 111 the other side of which is connected by wire 112 to line 58. Wire 113 connects wire 104 to switch arm 114 which is actuated by relay coil 111 and is shown in open position in relation to switch contact 115 which is in turn by wire 116 to wire 74 in the solenoid control circuit.

Probes 33 and 38 cooperate to control still another circuit for a different level of dye solution in tanks 1 and 2. Probe 33 is connected to probe circuit 117 which controls relay coil 118. Probe 38 is connected to probe circuit 119 which controls relay coil 120. Wire 121 is connected to switch arm 122 which is shown in open position in relation to switch contact 123. Contact 123 is connected by wire 124 to switch arm 125. Relay coil 120 is arranged to actuate switch arm 125 which is shown in closed position in relation to switch contact 126. Wire 127 connects switch contact 126 to one side of relay coil 128, the other side of which is connected by wire 129 to line 58. Wire 130 connects wire 121 to switch arm 131 which is actuated by relay coil 128 and is shown in open position in relation to switch contact 132 which is in turn connected by wire 133 to wire 74 in the solenoid control circuit.

Still another level of dye solution in tanks 1 and 2 is controlled by probes 34 and 37. Probe 34 is connected to probe circuit 134 which control relay coil 135. Probe 37 is connected to probe circuit 136 which controls relay coil 137. Wire 138 is connected from line 57 to switch arm 139 which is actuated by relay coil 135 and is shown in open position in relation to switch contact 140. Wire 141 connects contact 140 to switch arm 142. Relay coil 137 is arranged for actuation of switch arm 142 which is shown in closed position in relation to switch contact 143. Wire 144 connects contact 143 to one side of relay coil 145, the other side of which is connected by wire 146 to line 58. Wire 147 connects wire 138 with switch arm 148 which is actuated by relay coil 145 and is shown in open position in relation to switch contact 149, which is in turn connected by wire 150 to wire 74 in solenoid control circuit.

A high level alarm circuit for tank 2 is actuated by probe 36. Probe 36 is connected to probe circuit 151 which controls relay coil 152. Wire 153 connects line 57 to switch arm 154 which is actuated by relay coil 152 and is shown in open position in relation to switch contact 155. Wire 156 connects contact 155 to one side of relay coil 177 the other side of which is connected by wire 157 to line 58. Wire 158 connects line 57 to switch arm 159 which is arranged for actuation by relay coil 77 in association with switch arm 75. Switch arm 159 is shown in open position in relation to switch contact 160. Energization of relay coil 77 will cause switch arm 159 to move to closed position against switch contact 160 and to move switch arm 75 out of contact with switch contact 76. Switch contact 160 is connected by wire 161 to one side of alarm signal 162, the other side of which is connected by wire 163 to line 58. Alarm signal 162 may be a signal light or bell or any other suitable electrically operated signal. Alarm signal 162 is turned on whenever relay coil 77 is energized to close switch arm 159 against contact 160 to complete the alarm signal circuit.

A high level alarm circuit for dye tank 1 is actuated by probe 30. When probe 30 is covered with dye solution to complete the circuit through that probe, probe circuit 44 is operated to de-energize relay coil 43 to permit switch arm 60 to move away from contact 61 to a closed position against contact 62. Switch contact 62 is connected by wire 164 to one side of relay coil 165, the other side of which is connected by wire 166 to line 58. Relay coil 165, when energized, causes switch arm 167 to move to close position to relation to switch contact 168 and simultaneously moves switch arm 79 out of contact with switch contact 80, thus energizing a high level alarm signal and de-energizing the make-up water control solenoid 29. Wire 169 is connected from line 57 to one side of switch arm 167 which is shown in open position in relation to switch contact 168. Wire 170 connects switch contact 168 with one side of alarm signal 171, the other side of which is connected by wire 172 to line 58. Alarm signal 171 may be a signal light, bell, horn or any other suitable electric signaling device.

Operation

In operation, a continuous material, such as a cellulosic sausage casing 10 is fed through dye tank 1 over the various rollers. The amount of dye pick-up on the casing is dependent upon the residence time in the dye bath. The dye pick-up is determined by the number of passes over the various rollers through the bath, the speed of the movement of casing through the bath and the depth of the dye bath. The various outlet valves 17, 18, 19, 20, 21 and 22 determine the level of dye in tank 1. Whenever one of the valves is opened the dye solution overflows through that valve and the level of solution in tank 1 is at the level of the outlet pipe connected to the valve. The dye solution which overflows through the open valve passes through conduit 23 into storage tank 2. The total volume of dye solution in the system is maintained constant and the dye solution is continuously circulated by pump 26. Dye solution is pumped from tank 2 up to tank 1 where it overflows through one of the open valves and conduit 23 back to storage tank 2. Valve 28 controlled by solenoid 29 is arranged to control the introduction of make-up water into the system in the event of loss of liquid due to evaporation or depletion of the dye solution. The electric probes 30, 31, 32, 33 and 34 in tank 1 and electric probes 36, 37, 38, 39, 40 and 41 in tank 2 monitor the level of dye solution in tanks 1 and 2 and cause solenoid 29 to open valve 28 and supply make-up water to tank 2 whenever the total volume of dye solution drops below the predetermined level. The system of probes in the two tanks is also arranged to provide a suitable alarm signal in the event that the dye solution exceeds a predetermined level in either of the tanks.

Tanks 1 and 2 are each grounded as previously described. The electric probe circuits used in controlling the valve solenoid 29 works by electrical conductivity through the dye solution. Whenever a probe is immersed in the dye solution its circuit is completed through the grounding of the tank and thus completes the secondary circuit portion as shown in FIG. 3. Whenever the dye solution is above the level of any given probe, the probe circuit for that probe is complete and its relay is energized to open the switch contact which controls the relay coil which is controlled by that probe circuit.

The control circuit as shown in FIG. 2 is in the state of energization and actuation which occurs when the main lines 57 and 58 are connected to a power source and the dye solution in tank 1 is of the level of outlet conduit 11 and control valve 17 and the dye solution in tank 2 is just covering the end of probe 41. In this position, probe 30 in tank 1 is above the level of the dye solution and probe 41 in tank 2 is immersed in the dye solution. In tank 1, probes 31, 32, 33, and 34 are positioned in controlling relation to outlets 12, 13, 14 and 15 and are immersed in the dye solution. In tank 2, probes 37, 38, 39 and 40 are

positioned out of the solution and are connected to control the same circuits as probes 31, 32, 33 and 34 respectively in tank 1. Probe 36 in tank 2 is a high level control probe and is arranged to actuate a high level alarm in the event that the dye solution in tank 2 rises to contact the end of probe 36.

With the dye solutions at the levels indicated in tanks 1 and 2 and with the probes in the positions indicated, the circuits in FIG. 2 are as indicated therein. In tank 1, probe 30 is the only probe which is above the liquid level. Probe 30 therefore causes probe circuit 34 to energize relay 43 and hold switch arm 60 against contact 61. Since probes 31, 32, 33 and 34 are immersed in the dye solution their probe circuits 83, 100, 117, and 134, respectively, are actuated to de-energize relays 84, 101, 118 and 135, respectively, to cause their respective switches to be opened. In tank 2, probe 41 is the only probe immersed in the dye solution and it actuates its probe circuit 70 to de-energize relay 69 and cause switch arm 64 to be moved to an opened position in relation to switch contact 65. The other probes 36, 37, 38, 39 and 40 in tank 2 are all positioned above the liquid level and cause their respective probe circuits to energize or de-energize the respective relay coils to hold the various switches in the positions indicated. The switches actuated by probes 37, 38, 39 and 40 are initially closed in this position while the switch operated by probe 36 is initially opened and is closed to actuate a signal when probe 36 makes contact with the dye solution.

In the condition indicated in FIG. 2, if the dye solution in tank 1 were to rise and make contact with probe 30, probe circuit 44 would be actuated to de-energize relay 43 and cause switch arm 60 to move out of engagament with contact 61 and to make contact with switch contact 62. The making of contact with switch contact 61 would prevent solenoid coil 29 from being energized to supply additional make-up water in tank 2 and the closing against switch contact 62 would cause relay coil 165 to be energized to close switch arm 167 against contacts 168 to energize the high level alarm signal 171.

In the condition of the circuit shown in FIG. 2, if the liquid level in tank 2 were to drop below the end of probe 41 probe circuit 70 would be actuated to energize relay coil 69 and move switch arm 64 into contact with switch contact 65. This would complete the circuit through relay coil 67 and cause switch arm 72 to move into contact with switch contact 73 to complete the circuit to solenoid 29 and thus open valve 28 to supply additional water to tank 2. When the solution in tank 2 reached the level of probe 41, switch arm 64 would be opened by de-energization of relay coil 69 thus causing switch arm 72 to open and de-energize solenoid 29.

If one of the lower valves, e.g. valve 18 were opened to establish a lower dye level in tank, and therefore a higher dye level in tank 2, a different set of probes and a different set of control circuits would be placed in operation. When valve 18 is opened, the level of liquid in tank 1 is just below the end of probe 31 but covers the probes 32, 33 and 34. At this condition, probes 40 and 41 in tank would be covered by the increase in dye level in that tank but probes 36, 37, 38 and 39 would remain above the dye solution level.

With valve 18 open the probe circuits controlled by probes 31 and 40 would be in control. At this condition of operation of the dye system, the various switches would be changed to the following positions. The probe circuit and relay coils associated with probe 30 would remain as shown in FIG. 2. Probe 41 and its circuits would remain essentially as shown in FIG. 2. Probe 31 would be exposed above the surface of the dye solution in tank 1 and would cause probe circuit 83 to energize relay coil 84 and move switch arm 88 against contact 89. In tank 2, probe 40 would now be covered by dye solution and would cause probe circuit 85 to de-energize relay coil 86 and allow switch arm 91 to move out of contact with switch contact 92. The remaining circuits would be in the same condition as shown in FIG. 2. In this condition, if the level of dye solution in tank 1 were to increase, probe 31 would actuate relay coil 84 to permit switch arm 88 to move out of contact with switch contact 89 and thus prevent solenoid 29 from being energized, even if the level of dye solution in tank 2 had decreased to a point where the need for additional water might be indicated. However, if the level in tank 1 is at the level of the overflow valve, and the level in tank 2 drops below the end of probe 40, probe circuit 85 is actuated to energize relay coil 86 and move switch arm 91 back into engagement with contact 92. This would cause relay coil 94 to be energized and close switch arm 97 against contact 98 and thus complete the circuit for energizing solenoid 29 and thus opening valve 28 to supply additional water to tank 2. The operation of each of the probe circuits is the same as has been described for the other pairs of probes. Thus, while probes 31 and 40 control the operation solenoid 29 at the level established by control valve 18, probes 32 and 39 control at the level established by valve 19, probes 33 and 38 control at the level established by valve 20 and probes 34 and 37 control at the level established by valve 21.

If the solution level in tank 2 rises above the end of probe 36, probe circuit 151 actuates relay coil 152 to close switch arm 154 against contact 155. This energizes relay 77 and moves switch arms 75 and 159. Switch arm 75 is moved out of contact with switch contact 76 to prevent energization of solenoid 29 and switch arm 159 is moved against the contact 160 to energize high level alarm signal 162.

The control circuit shown in FIG. 2 and described above, includes distinct controls for five separate levels of solutions in the main dye tank 1 and storage tank 2. It should be noted that the control circuits at each level are essentially duplicates of the circuits at the next higher level. It is therefore apparent to anyone skilled in the art that additional control circuits could be added for controlling the operation of solenoid 29 at additional levels or fewer circuits could be used if a lesser degree of control were required.

The control system described above operates to maintain any one of several predetermined levels of dye solution in the dye tank while continuously recirculating the dye solution and maintaining the solution at a constant volume. The use of a constant volume system is essential to permit a reasonably simple control of the dye concentration. As long as a constant volume system is used, the dye concentration is varied by addition of predetermined increments of dye.

While this invention has been described with special emphasis upon a single preferred embodiment of the invention it should be apparent that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

I claim:

1. In the continuous dyeing of synthetic casings wherein casing is fed through one or more passes in a dye bath, the amount of dye pick-up being proportional to the residence time in the bath, the improvement which comprises,

(a) continuously circulating dye solution between the dye bath and a storage tank while maintaining a substantially constant liquid volume,

(b) predetermining the residence time of casing in the dye bath by maintaining the predetermined liquid level of dye solution therein,

(c) measuring the level of dye solution in said dye bath and said storage tank, and

(d) automatically feeding make-up water to said storage tank when the liquid level in said dye bath or said storage tank is below a predetermined level.

2. A method in accordance with claim 1 in which the dye solution is maintained at any of a plurality of selected

levels in said dye bath and the level in the dye bath and in said storage tank is measured for each selected level and make-up water added when the total volume of dye solution is less than said predetermined constant amount.

3. In a system for continuous dyeing of synthetic casings,

(a) a first tank for containing a dye solution having a plurality of rolls for establishing one or more passes of casing through a dye bath,

(b) a storage tank for containing dye solution removed from said first tank,

(c) said first tank and said storage tank containing a predetermined constant volume of dye solution,

(d) means to continuously circulate dye solution from said storage tank to said first tank,

(e) a plurality of valved outlets at selected levels in said first tank and individually operable to permit overflow of said dye solution therefrom and determine the liquid level of dye solution therein,

(f) means to conduct dye solution overflowing from said first tank through one of said valved outlets to said storage tank, and

(g) means responsive to the level of dye solution in each tank at any selected valve opening in said first tank to effect the addition of water to said storage tank when the dye solution level in either tank is below a predetermined level.

4. An apparatus in accordance with claim 3 which includes,

(a) means to supply water to said storage tank,

(b) valve means controlling said water supply means, and

(c) said level responsive means being operatively connected to said valve means to cause the same to open when the dye level in either tank is below a predetermined level at any selected valve opening of the valve outlets from said first tank.

5. An apparatus in accordance with claim 4 in which,

(a) said valve means is an electrically operated valve, and

(b) said level responsive means includes electric means responsive to liquid level in each tank and operable to actuate said electrically operated valve.

6. An apparatus in accordance with claim 5 in which said level responsive means comprises electric probes positioned in said tanks and electric circuits for said probes and connected to actuate said electrically operated valve when said liquid level in either tank is below the predetermined level for a selected valve opening.

7. An apparatus in accordance with claim 6 in which,

(a) there are provided a plurality of electric probes in each tank,

(b) one probe in each tank of the plurality of probes therein being at a predetermined level in the tank to measure liquid level in accordance with a selected valve opening in said first tank,

(c) a plurality of electric circuits inter-connecting a pair of probes, one in each tank, for each selected valve opening, to control operation of said electrically operated valve, and

(d) said probes and the electric circuits connected therewith being operable upon opening of a probe circuit by drop of liquid level below a predetermined level in the tank wherein the probe is located.

8. An apparatus in accordance with claim 7 in which each of the tanks and the dye solutions are a part of the control circuit whereby a drop in liquid level below any probe opens the circuit in which that probe is located.

9. An apparatus in accordance with claim 8 in which said plurality of probes in each tank includes a probe positioned above the maximum normal level of liquid for said tank and electric signal means actuated when said last named probe is contacted by rise in liquid level in that tank.

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U.S. Cl. X.R.

68—175, 207; 137—392