Dec. 17, 1940. F. C. RANKIN 2,225,350

AUTOMATIC DYEING MACHINE

Filed June 24, 1938 5 Sheets-Sheet 1

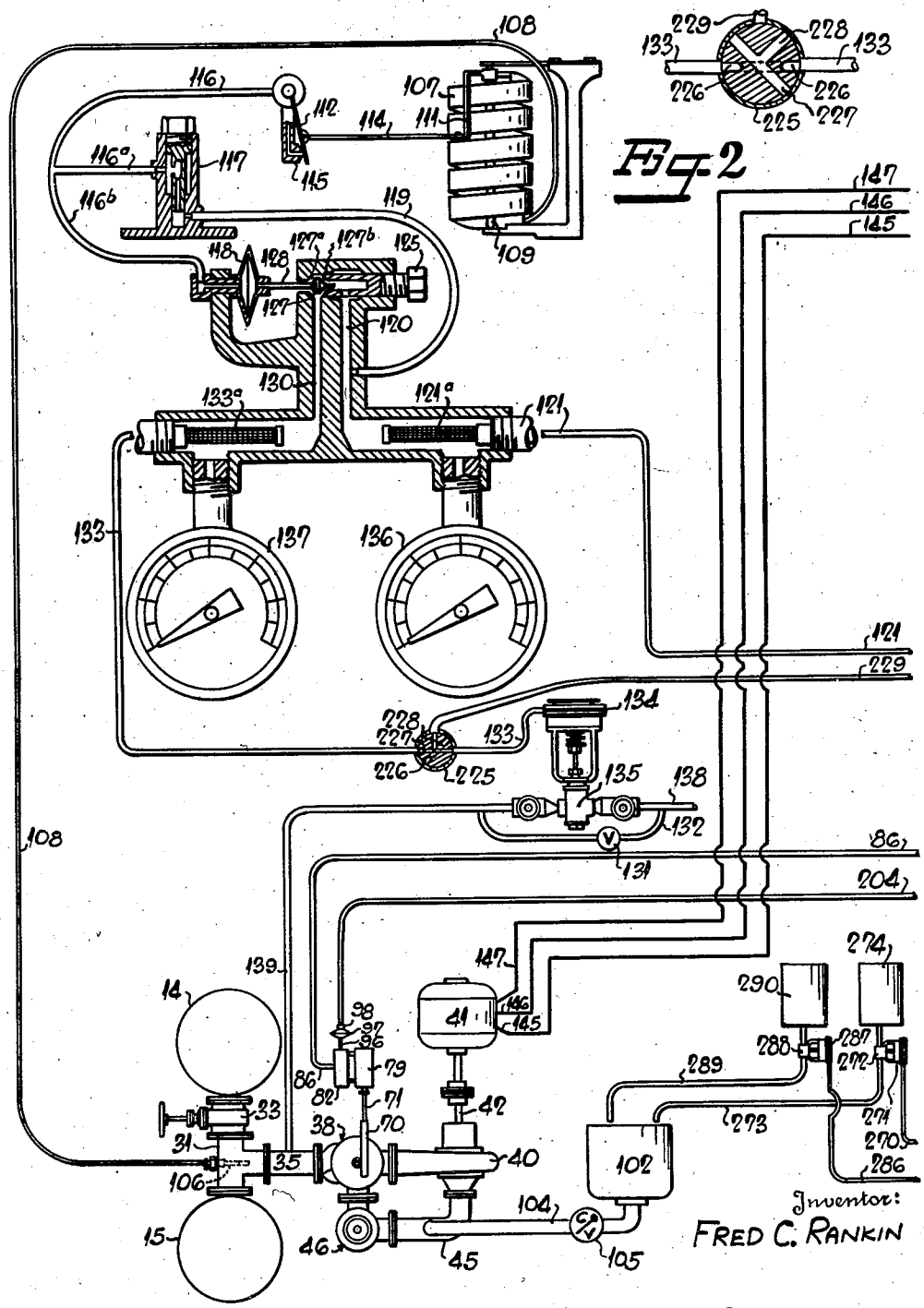


FIG-2

FIG-1

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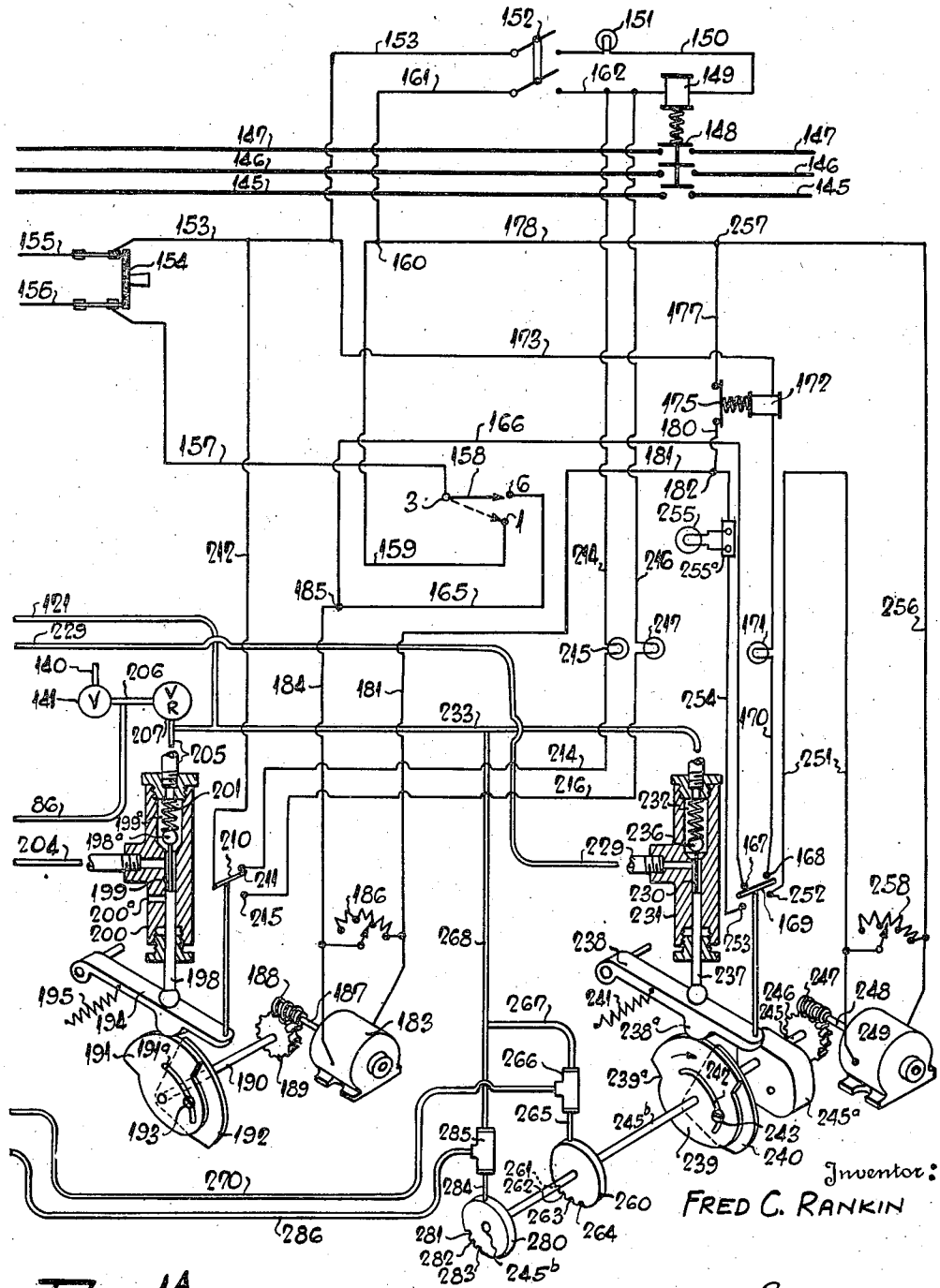
By Paul & Eaton

Attorney

Dec. 17, 1940. F. C. RANKIN 2,225,350

AUTOMATIC DYEING MACHINE

Filed June 24, 1938 5 Sheets-Sheet 2



Inventor:
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Fig. 1A

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AUTOMATIC DYEING MACHINE

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Fig. 3

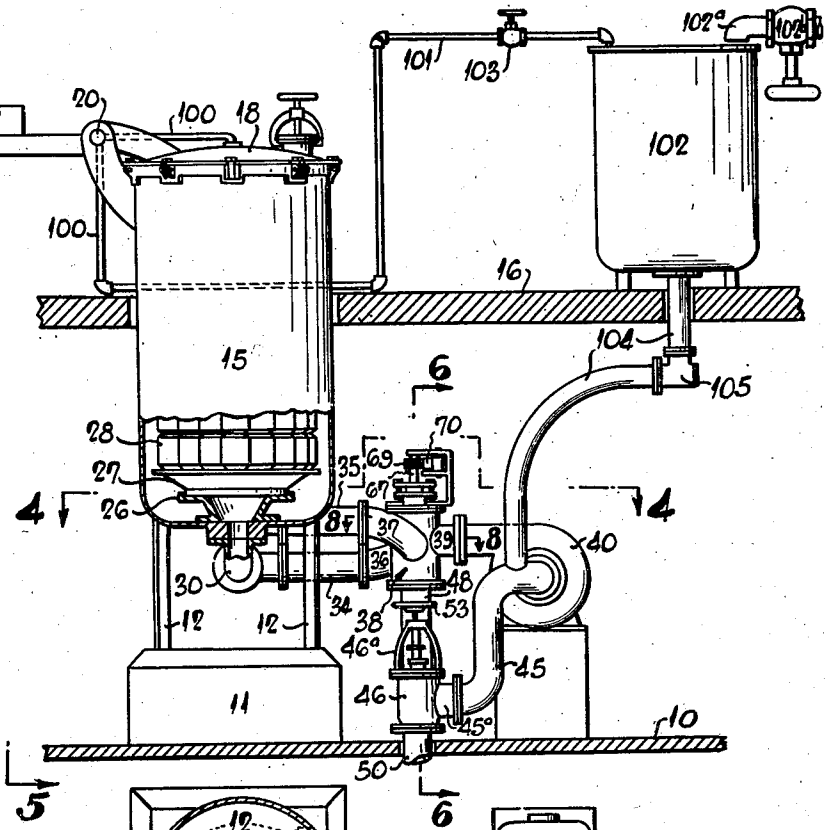
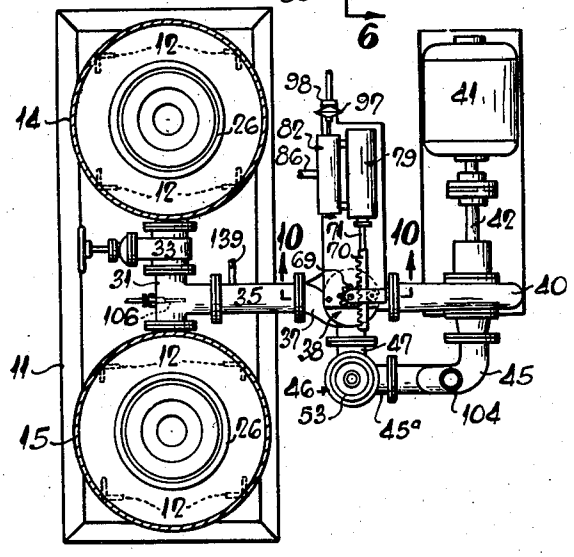


Fig. 4



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AUTOMATIC DYEING MACHINE

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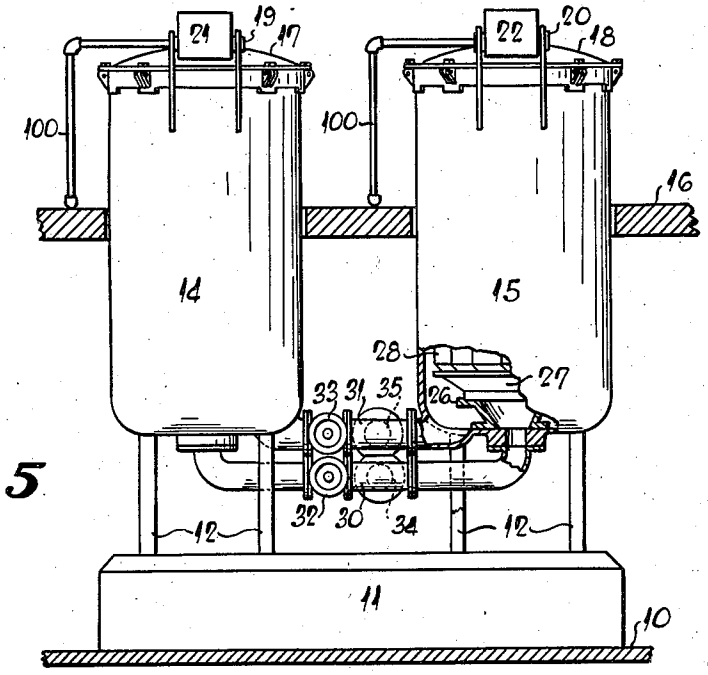


Fig. 5

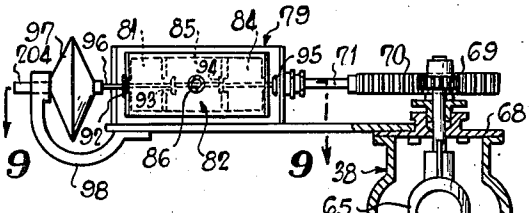


Fig. 6

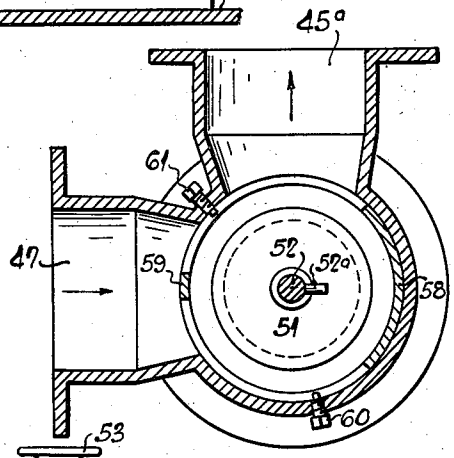
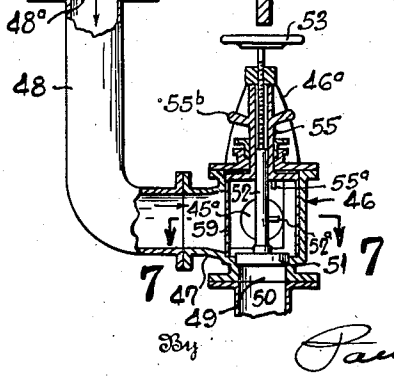


Fig. 7



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AUTOMATIC DYEING MACHINE

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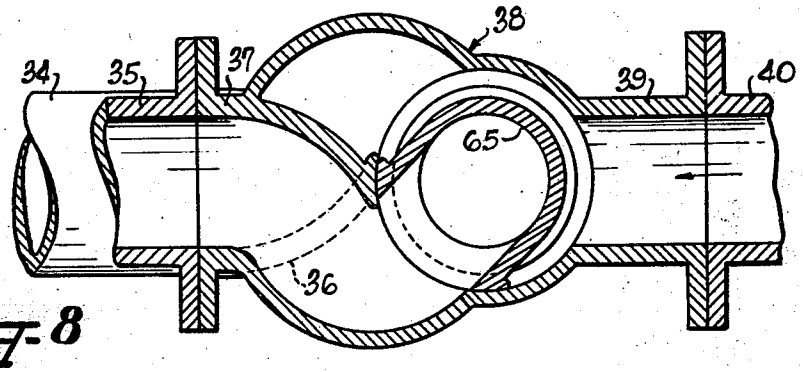


Fig. 8

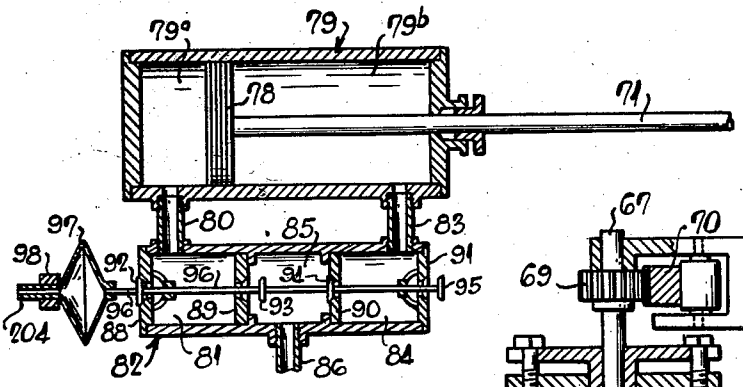


Fig. 9

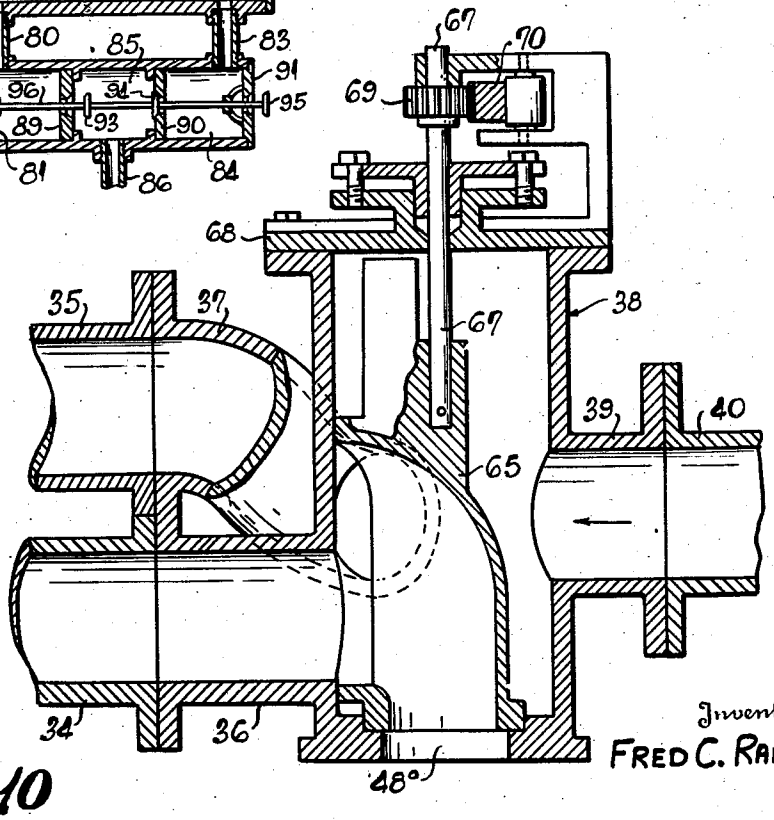


Fig. 10

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Patented Dec. 17, 1940 2,225,350

UNITED STATES PATENT OFFICE

2,225,350

AUTOMATIC DYEING MACHINE

Fred C. Rankin, Stanley, N. C., assignor to Gaston County Dyeing Machine Company, Stanley, N. C., a corporation of North Carolina

Application June 24, 1938, Serial No. 215,697

2 Claims. (Cl. 68—184)

This invention relates to an improved apparatus for dyeing and treating packages of yarn such as warp beams or smaller packages wound on perforated tubes. The conventional method of treating yarn comprises placing a warp beam or a plurality of packages in a suitable tank and then circulating the dyestuffs through the yarn, first in one direction, and then in the opposite direction at intervals of time varying from two to four minutes. After the solution has been circulated back and forth for several times, it is drained from the circulating system and fresh water is circulated through the yarn in the same manner. In many types of yarn it is very essential that the time interval that the dyestuff is circulated in one direction through the yarn be equal to the interval that the same dyestuff is circulated in the opposite direction. Of course, in many cases it is desirable to circulate the dyestuff for a longer period in one direction than in the other. In either case, however, it has required the constant attention of an operator to see that these time intervals were properly balanced. It also is very important that the total time interval of the reversing flow be accurately timed, otherwise, a difference in the shade of the finished batches of yarn will be very noticeable.

In the conventional method of treating the yarn, it has also been the practice to dye a batch of yarn in one kier and then remove it to another kier where it is washed. This batch of yarn usually weighs several hundred pounds, and its removal entails much time, labor and machinery.

It is, therefore, an object of this invention to provide a dyeing machine for dyeing and treating yarn comprising a kier into which the yarn is placed with means associated with the kier for automatically reversing the direction of flow of the dyestuffs through the yarn at predetermined intervals and also with means for controlling the total time interval, during which the flow takes place.

It is another object of this invention to provide an apparatus of the class described which is capable of performing a washing operation on the yarn after it has been dyed and while it is still in the dyeing kier. Of course, after the dyeing solution has been circulated back and forth for several times, the solution is drained from the circulating system and fresh water is circulated through the yarn direct to the sewer, the direction of flow of the water through the yarn being reversed at intervals. The time interval during which the fresh water flows in each direction is positively and automatically controlled. In other words, in the reversible wash, the same water is not circulated and recirculated as in the case of the dyeing operation, but only its direction of travel through the yarn is reversed.

It is a further object of this invention to provide a dyeing apparatus for dyeing warp beams, cones, spools, cops, and the like, comprising a plurality of kiers, a reversing valve, an expansion tank with suitable pipe connections connecting said members and a suitable pump for circulating the dyestuffs first in one direction through said kiers and said yarns and then in the opposite direction, said valve and pipes being so positioned relative to the pump and kiers that the direction of flow of the dye liquor will only be reversed between the valve and the kiers, and will flow in the same direction at all times through the pump to the valve. By providing a system of this type, it is not necessary to have an elaborate pipe system. The pump is allowed to run continuously in one direction since the reversal of flow in the kiers is performed by the valve for either washing or dyeing the yarn.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which—

Figure 1 is a schematic view of a portion of the invention;

Figure 1A is a schematic view of the other portion of the invention;

Figure 2 is a schematic view of one of the valves shown in Figure 1, said valves being turned to a different position;

Figure 3 is an elevation of the circulating system showing portions thereof in sections and omitting the electrical control apparatus;

Figure 4 is a sectional plan view taken along the line 4—4 in Figure 3;

Figure 5 is an elevation taken along the line 5—5 in Figure 3, showing portions in section;

Figure 6 is a transverse vertical sectional view taken along the line 6—6 in Figure 3;

Figure 7 is an enlarged sectional plan view taken along the line 7—7 in Figure 6;

Figure 8 is an enlarged sectional plan view through the reversing valve and taken along the line 8—8 in Figure 3;

Figure 9 is a sectional plan view taken along the line 9—9 in Figure 6;

Figure 10 is a vertical sectional view through the reversing valve and taken along the line 10—10 in Figure 4.

Referring more specifically to the drawings, the numeral 10 denotes the basement floor of a building having a footing 11 extending upwardly therefrom, upon which is mounted posts 12. These posts support kiers, or dye vats, 14 and 15 which extend upwardly through a first floor 16 of the building. The tops of the kiers 14 and 15 have lids 17 and 18 pivoted thereto as at 19 and 20, respectively. These lids are equipped with suitable counterweights 21 and 22 for counter-

balancing the lids when the same are in open position.

Each of these tanks has a seat 26 in the lower portion thereof upon which a yarn supporting means 27 is adapted to be placed, and upon this yarn supporting means is mounted a plurality of cones of yarn 28 for dyeing purposes, or a beam of yarn can be placed on the seat. Supporting means 27 and the yarn cones 29 are removed as a unit when the dyeing and washing operation has been performed, and another, identical in form, is placed in its stead when another operation is begun.

The means for supporting the packages of yarn 28 usually consists of a hollow manifold having a plurality of perforated pipes connected at their lower ends to said manifold and communicating with the interior of the manifold. The packages of yarn are disposed on perforated tubes which are stacked on the perforated pipes, and the upper ends of the pipes are stopped by any suitable means. The structure of a suitable yarn holding means is disclosed in the Hornbuckle and Craig patent, Number 1,933,980. Or, if desired, instead of having a plurality of packages of yarn, as shown in the drawings, warp beams may be processed by having one end of a yarn beam resting on the seat, and having the upper end closed by suitable means, the barrel of the yarn beam being perforated as shown in Hornbuckle and Craig patent, Number 1,939,816. The manner in which a yarn beam is used in dyeing is shown in Hornbuckle and Craig patent, Number 1,799,421.

The lower interior portion of yarn seat 26 communicates with pipe 30 which pipe leads from the bottom of one kier to the bottom of the other (Figures 3 and 5). Disposed directly above pipe 30 is another pipe 31, the ends of which communicate with the interior of kiers 14 and 15. The pipes 30 and 31 have suitable hand valves 32 and 33, respectively, which are manipulated when it is desired to use only one kier.

Also leading from the pipes 30 and 31 are pipes 34 and 35, respectively, whose other ends are connected to nipples 36 and 37, respectively, of reversing valve 38. The valve 38 has another nipple 39 to which the outlet port of pump 40 is connected. This pump is driven by a suitable electric motor 41 through shaft 42.

The intake side of pump 40 has pipe 45 connected thereto and the other end of this pipe is connected to outlet port 45a of drain valve 46. The drain valve 46 has an intake port 47 (Figure 6) to which pipe 48 is connected, and pipe 48 communicates with outlet port 48a in the lower portion of reversing valve 38.

The drain valve housing 46 also has a drain port 49 in its lower end to which a drain pipe 50 is connected (Figure 6). This port is normally closed during a reversing dye operation by means of closure member 51. This closure member is mounted on the lower end of a suitable rod 52 which rod projects upwardly and is threadably secured at its upper portion, in cover 46a. A hand wheel 53 is secured to the upper end of the rod 52 for use when it is desired to open the port 49 to allow the dye liquor to flow directly to the sewer through pipe 50. By observing Figures 6 and 7, it is seen that the shaft 52 has slidably mounted around its upper end, a hollow pipe member 55, the lower end of the pipe member having a cut away cylindrical shell having portions 58 and 59 which tightly fit against the interior sidewalls of valve housing 46. In the drawings the position of the parts show the port 49 closed and the inlet port 47 and outlet port 45a open, thereby allowing the dye liquors to flow from the lower portion of the reversing valve 48 through valve housing 46, and to the pump 40.

When it is desired to cause the liquor to flow from the valve housing 46 to the sewer through pipe 50, the hand wheel 53 is turned, thus causing the closure member 51 to be raised. When the member 51 has been raised a considerable amount, a pin 52a which projects radially from the lower portion of the rod 52, will engage pin 55a projecting down from the lower portion of pipe member 55 and upon this engagement, the cylindrical portion 58 will be rotated to close the port 45a, thereby preventing the liquor from again returning to the pump. Suitable stop screws 60 and 61 (Figure 7) are provided to limit the rotation of the cylindrical portions 58 and 59. Of course, when it is desired to restore the parts to original position, the valve cap 51 is lowered to the position shown in Figure 6 and at the same time the cylindrical portion 58 is restored to the position shown in Figure 7 by rotating enlarged portion 55b which is integral with the pipe 55. This will uncover port 45a.

It should be noted that during a dyeing operation the dye liquor always flows from the reversing valve 38 downwardly through pipe 48, valve housing 46, pipe 45, pump 40, and back again to the reversing valve 38. The direction of flow of the dye liquor through the pipes 34 and 35, however, is reversed at predetermined intervals. This reversal is effected by a dejector valve 65 (Figures 6, 8 and 10), the lower portion of which communicates with outlet port 48a in the lower end of the valve 38. The intake port of the dejector 65 is adapted to alternately communicate with the opening in the nipple 36 and then with the opening in nipple 37.

In Figure 8, the dejector 65 is shown in communication with the nipple 37 at which time the dye liquor, which is forced into the valve housing 38 by the pump 40 through the nipple 39 will flow out of this same valve housing, through the nipple 36 and through pipe 34, pipe 30, seat 26 and to the interior of packages 28. From the interior of the packages of yarn, the liquor will flow to the outside and into the kiers, then through pipe 31, pipe 35, nipple 37 and into the intake port of dejector 65. The liquor will then be directed downwardly through pipe 48, valve housing 46, pipe 45, pump 40 and back again to the reversing valve 38. With the dejector 65 communicating with the nipple 36, however, reverse flow will take place through the yarn. That is the liquor flowing into valve 38 will flow out through nipple 37, pipe 35, pipe 31, and from the exterior of packages of yarn 28 to the interior seat 26, pipe 30, pipe 34 and nipple 36 back to reversing valve 38, from whence it will follow the same route to the pump 40 as in the previous case.

Dejector 65 has a vertically disposed shaft 67 connected thereto which extends upwardly through the cover 68 of the valve housing 38. A suitable pinion 69 is fixedly secured on the upper end of the shaft, which is adapted to mesh with a rack 70 (Figures 6 and 10). This rack is secured to one end of a piston rod 71 which has a piston 78 on the other end thereof (Figure 9), said piston being disposed on the interior of cylinder 79.

It is seen that piston 78 divides the interior of

cylinder 79 into two compartments, namely, 79a and 79b. The compartment 79a has a pipe 80 communicating therewith which also communicates with compartment 81 of valve cylinder 82, whereas the compartment 79b has a similar pipe 83 communicating therewith and also with compartment 84 of valve cylinder 82. Cylinder 82 has an air intake compartment 85 into which air or some suitable operating fluid is introduced by means of intake pipe 86. The compartments 81, 84, and 85 have valve seat members 88, 89, 90 and 91, each of which has an opening therein which is adapted to be closed, at times, by valves 92, 93, 94 and 95, respectively. All of these valves are fixedly secured on rod 96, one end of which extends to the exterior of the cylinder 82 and is connected to an expansible diaphragm 97, which diaphragm has its other end fixedly secured in bracket 98, said bracket forming a portion of the supporting means for the cylinders 79 and 82.

This diaphragm 97 is operated by a suitable controlling mechanism at predetermined intervals. For example, when it is desired to reverse the direction of flow of the dye liquor through the valve housing 38 as well as the yarn packages or package, within the kiers, it is necessary to reverse the position of the dejector 65 within this valve housing (Figures 6, 8 and 10). In order to reverse the position of the valve 65 the shaft 67 and the pinion 69 must be turned. This turning is effected by means of the rack 70, which is operated by the piston 78. By introducing air into the compartment 79a the rack 70 is moved towards the observer in Figures 4 and 8, thus causing the dejector 65 and its associated shaft to rotate in a clockwise manner, causing the opening in the dejector to communicate with the nipple 36. On the other hand, if it is desired to move the valve into the opposite direction, air is introduced into compartment 79b.

In the position of the valves shown in Figure 9, the air will be allowed to enter chamber 81 and from chamber 81 it will flow through pipe 80 into compartment 79. At this time, the diaphragm 97 is in an expanded position. On the other hand when it is desired to reverse the flow, it is necessary to rotate the dejector 65 in a counterclockwise manner at which time the air pressure is released from the expansible diaphragm 97 thereby causing the rod 96 to move to the left in Figure 9. Then the valves 93 and 95 will seat and the valves 94 and valves 92 will open. This will allow the air to flow from compartment 85 into the compartment 84, through pipe 83 and into compartment 79b, to cause the piston 78 to move to the left in Figure 9 and rotate the shaft 67 and dejector 65 in a counterclockwise manner in Figures 4 and 8 so that the intake port or opening of the dejector 65 will communicate with nipple 37. The valves 92 and 95 alternately exhaust the air from chamber 79a and 79b when the travel of piston 78 is reversed.

When the dyeing machine is in operation the valve 38 is reversed at intervals varying from two to four minutes, therefore, mechanism must be provided whereby controlling air will be introduced into or released from the expansible diaphragm 97 to bring about the reversing. This mechanism is shown in a schematic form and will be described later.

Likewise means are also provided for automatically stopping the machine when the reversing mechanism has been in operation for a predetermined length of time. This will also be described in conjunction with the operating means for the reversing mechanism. The total time necessary for the dye liquor to flow once through the yarn in both directions is known as a cycle and the sum of all the cycles is known as the total time period.

Leading from the top of each of the kiers 14 and 15 are pipes 100, which, in turn, are connected to pipe 101, said pipe 101 communicating with the upper portion of expansion tank 102. A suitable hand valve 103 is provided in the pipe 101. The lower portion of expansion tank 102 has a pipe 104 leading therefrom, which has its lower end connected to the pipe 45. The pipes 100, 101 and expansion tank 102 are conventional.

The function of these pipes is to vent the kiers while the machine is being filled with water or dye liquor. Another function is to let the entrapped air escape from the contents of the kier and also to permit increase of expansion of water or dye liquor within one or more of the kiers.

It will be noted that a check valve 105 is provided in the pipe 104 to prevent the liquid from being forced upwardly through pipe 104 into the expansion tank 102 while the pump 40 is in operation.

After the dye liquor has been reversed through the yarn 29 the desired number of times, the drain port 49 of valve 46 is opened and the port 45a is closed. The pump is stopped automatically as will be explained later. The dye liquor drains by gravity from the system through pipe 50 to the sewer. Then water will be admitted to empty expansion tank 102 by any suitable means such as spigot 102a having a suitable cut-off valve 102b. The pump will then be started and will draw fresh water from the expansion tank 102 through the pump 40, and be forced through reversing valve 38 and through the yarn 28 in the kiers, first in one direction and then in the other, from whence it will return to the reversing valve and be directed downwardly through the pipe 48, valve 46 to the sewer through the pipe 50.

While this operation is being effected, of course, the reversing mechanism will be in operation which will cause the packaged yarn to be washed from the interior to the outside and conversely.

In order to properly dye the yarn, it is necessary that the dye liquor be heated to a predetermined temperature and held substantially at this temperature. Automatic means for regulating the temperature is provided. A vapor pressure bulb 106 is disposed within the pipe 31, or at any convenient position within the circulating system (Figure 1). This bulb communicates with helical tubes 107, through a connecting tube 108.

As the temperature rises, the corresponding gas or vapor pressure in the bulb 106 is transmitted through the tubing 108 to the helical tube 107, thus causing this helical tube to unwind. The tube 107 is also connected to a vertically disposed shaft 109 upon which a lever 111 is fixedly mounted. Secured between the free end of this lever and a flapper leaf 112 is a link 114. This leaf is adapted to close nozzle 115 when the temperature reaches a predetermined high point in the pipe 31.

Air is supplied to this nozzle by means of a tube 116 which has branches 116a and 116b, the fork

116a being adapted to communicate with a reducing valve 117, whereas the fork 116b communicates with diaphragm 118. Leading from the lower portion of pressure reducing valve 117 is a tube 119. This tube has its other end communicating with a suitable bore 120, said bore communicating with air supply pipe 121, which pipe has air strainer 121a therein. The upper end of bore 120 has communicating therewith an adjustable valve seat 125, said valve seat being adapted to be contacted by valve 127. This valve is disposed on a suitable rod 128, which in turn is secured to the diaphragm 118. The valve 127 is located in the upper portion of bore 130, and the lower end of this bore communicates with pipe 133. This pipe is connected to diaphragm motor 134. The pipe 133 has a strainer 133a secured to the upper end thereof for straining the air. In order to determine the relative pressure on both sides of the valve 127 suitable gauges 136 and 137 are provided.

The operating air enters from any suitable source through pipe 140 (see Figure 1A), from whence it flows to hand valve 141. From the valve 141 the air flows to pipe 206, through reducing valve 207, thence through pipe 121 which in turn conducts the air to bore 120, adjustable valve seat 125, bore 130, pipe 133, and to a diaphragm motor 134 which will close a valve 135 and cut off the steam which is supplied through a pipe 138 and enters the pipe 35 of the circulating system through a pipe 139 (Figure 1).

Of course, this action of the valve 135 is effected only when the temperature has reached a predetermined high point. The thermostatic control bulb 106 being in the circulating system will respond to the increased temperature and transmit the vapor pressure to the helical tube 109 which will unwind and allow air to escape through the nozzle 115.

When this is done, the pressure will be released upon the diaphragm 118 allowing it to contract, and cause the valve 127 to seat as at 127a. With the valve seated as at 127a, the air supplied through pipe 121 will be caused to flow upwardly through port 120, reducing valve 125, bore 130, pipe 133 and to the diaphragm motor 134 which will close the valve 135. When the temperature reaches a predetermined low point, then the vapor pressure will cause the reverse action to take place, at which time the helical tube 107 will wind up and cause the orifice 115 to be closed. Then the valve 127 will seat as at 127b, because the closing of the orifice 115 will set up a pressure in the lines 116 and 116b to cause the diaphragm 118 to be expanded. At this time the air from the motor 134 will escape through valve seat 127a and consequently the steam valve 135 will be automatically opened to admit steam to the circulating system.

As heretofore stated, means are provided for automatically stopping the dyeing machine after it has run a predetermined length of time and also means have been provided for intermittently changing the direction flow of dye liquor through the yarn. In order to accomplish this result, three wires 145, 146 and 147 have been provided, one end of each wire being connected to pump motor 41, and their other ends are connected to a suitable source of electrical energy. These wires have a suitable magnetic switch 148 installed therein, said switch being operated by magnet 149.

Leading to magnet 149 is wire 150, having a signal light 151 therein. The other end of this wire leads to one side of a switch 152 and from the other side of the switch 152 another wire 153 leads to throw switch 154. A low voltage current is supplied to this switch, from any suitable source of low voltage electrical energy of 110 volts or less, for example, through wires 155 and 156 for supplying the operating circuit whereas the current for operating the motor 41 may be 220 volts or greater.

The switch 154 has a wire 157 leading therefrom, to switch 158 as at point 3, and from the other side of switch 158 as at point 1, a wire 159 leads to point 160. Point 160 is connected to switch 152 by means of wire 161. From the other side of switch 152, wire 162 leads back to magnet 149 to complete a circuit.

When it is desired to operate the pump only in conjunctiton with the dye machine as in the case where the operator is heating up the solution preparatory to adding the dye stuffs thereto, the switch 158 is positioned so that the current will flow from point 3 to contact point 1. Switches 152 and 154 are manually closed. This will allow the current to flow through wire 157, switch 158, wire 159, point 160, wire 161, switch 152, wire 162, magnet 149, wire 150, light 151, switch 152, wire 153 and back to the other side of the switch 154, to close switch 148 at which time the light 151 will be illuminated to indicate that the pump is running. Of course, when the magnet 149 is energized the switch 148 will be closed, thereby allowing the current to flow through wires 145, 146 and 147 to the pump motor 41. With the switch 158 connecting points 3 and 1, only the pump motor will operate.

When the valve 135 is closed and it is desired to admit steam into the circulating system, a hand valve 131 is opened to allow steam to flow around valve 135 through by-pass pipe 132.

Let us assume that it is desired to reverse the liquid in the circulating system through the yarn at predetermined intervals, and also operate the pump, but that it is not desired to limit the total time during which this operation takes place. In such a case, the switch 158 is positioned so that the points 3 and 6 will be connected. In order to provide such a circuit, a wire 165 has one end thereof leading from the terminal 6 and branching from this wire as at 185, is another wire 166, whose other end leads to terminal 167. This terminal is adapted to be normally contacted by switch bar 169, when the total timing mechanism is not in operation, said bar 169 also simultaneously contacting another terminal 168.

Leading from the terminal 168 is wire 170, having an indicating light 171 installed therein to indicate that the switch bar 168 is closed and that the total timing mechanism is out of operation. The other end of the wire 170 leads to one side of magnet 172, and from this magnet is a wire 173 which leads back and contacts the wire 153.

With the switch 169 in closed position, it is evident that the magnet 172 will be energized through the series of wires just described, resulting in the switch 175 being forced to a closed position. One side of switch 175 has wire 177 which contacts another wire 178, as at 257, said wire 178 joining wires 159 and 161 as at 160. The other side of switch 175 has wire 180 leading therefrom, which contacts wire 181 as at 182. This wire leads to one side of cycle control motor 183.

From the other side of cycle control motor 183, wire 184 leads to point 185 where this wire joins

wires 165 and 166. A suitable rheostat 186 is connected in parallel with the motor 183 to control the speed of the motor and thereby control the time necessary to complete a cycle in the circulation system.

In other words, when the motor 183 is running, the dye liquor is being reversed in the yarn at predetermined intervals, by means of the reversing valve 38 and its controls. Also at this time, the pump is placed in operation to circulate the liquor. The circuit for performing these two functions, namely, the running of cycle control motor 183 and the supplying of current to pump motor 141 is completed by connecting points 3 and 6. The current will then flow through wire 156, one side of switch 154, wire 157, point 3, switch 118, contact point 6, wire 165, wire 184, motor 183, wire 181, switch 175, wire 177, wire 178, wire 161, one side of switch 152, wire 162, magnet 149, wire 150, signal light 151, the other side of switch 152, wire 153, the other side of switch 154 and back to the wire 155.

Since the magnet 149 will be energized, of course, the switch 148 will be closed and the current will be supplied to the pump motor 41. Likewise the magnet 172 will be simultaneously energized by a parallel circuit just described, which in turn will close the switch 175 and allow the cycle control motor 183 to operate.

Motor 183 has a shaft 187 extending therefrom upon which is mounted a worm 188. This worm meshes with a pinion 189 which in turn is mounted on a shaft 190, and the other end of this shaft has a pair of disk segments 191 and 192. The friction between the segments and the shaft is sufficient to prevent any slippage from occurring during normal operation; however, when it becomes necessary to reposition the segments relative to the shaft, the segments can be turned on the shaft by exerting slightly more than the operating rotative force. This repositioning is seldom necessary except at the beginning of a dyeing operation. The disk 191 has a slot 191a therein which is penetrated by set screw 193 and this set screw is threadably secured in the disk 192. When it is desired to vary the length of the high circumference of these disks, it is only necessary to loosen the set screw 193 and move the disks 191 and 192 to the proper relative positions. The disks 191 and 192 are adapted to be contacted by the lower side of a suitable lever 194.

Lever 194 is normally forced against the disks 191 and 192 by means of a tension spring 195. The upper portion of the lever 194 has a vertically disposed rod 196 resting thereon, which rod extends upwardly and is slidably mounted in bore 199 of valve housing 200. This bore communicates with a larger bore 199a in the upper end of the housing and at the point where the two bores adjoin a suitable valve seat is provided. This valve seat is adapted to be closed by means of a suitable ball 198a which is disposed on the upper portion of rod 198. This ball is normally forced downwardly by means of compression spring 201.

Also communicating with the bore 199 is a pipe 205 in which any suitable pressure fluid flows for the operation of the control devices. Pressure fluid is supplied to the valve housing 200 from the intake pipe 140 from whence it passes through valve 141, pipe 206, a reducing valve 207, and a pipe 205. With the ball 198a in a raised position as shown in Figure 1A, the fluid will be allowed to move downwardly through bore 199a into the upper portion of bore 199 and out of the housing 200 through the pipe 204. The other end of this pipe is connected to the expansible diaphragm 97 which has been previously described, and upon the application of air pressure within these lines, the diaphragm 97 will expand, thereby opening the valves within the cylinder 82 and causing the reversing valve to be oscillated.

Of course, this pressure is only applied while the lower portion of the lever 194 rests upon the high sides of disks 191 and 192. As motor 183 continues to operate, the low side of the disks 191 and 192 will pass beneath the lever 194 and this lever, under the tension of spring 195, will move downwardly allowing the ball 198a to close the valve seat and prevent any of the air from entering the bore 199. At this time the enlarged portion of rod 198 will be low enough to allow the port 200a to be opened while ball 198a is seated, at which time the air can exhaust from the line 204, and bore 199. This will release the pressure within the lines and allow diaphragm 97 to contact thus closing valves 93 and 95 in Figure 9.

As heretofore stated, the liquor in the circulating system is flowing in one direction through the yarn when the lever 194 is on the high side of the plates 191 and 192 and the liquor is flowing in the opposite direction through the yarn when the low side is contacted.

It is very desirable to have means whereby an operator can tell at an instant's notice in which direction the liquor is flowing. By the inspection of the drawings, it will be seen that when the lever 194 is on the high side that the dye liquor will be flowing from the outside to the inside of the yarn, because the diaphragm 97 will be in expanded position as shown in Figure 9, at which time the piston 71 will be moved to the right in this same figure, thereby rotating the dejector shaft 67 in a clockwise manner in Figures 4 and 8. This, of course, will cause the intake of the dejector to communicate with the nipple, which in turn, will cause the liquor to flow into the kiers 14 and 15 through pipes 35 and 31. When the lever is on the low side of the disk the opposite flow will occur.

By referring to Figure 1A, it is seen that when the lever 194 is in an elevated position that a suitable switch bar 210 will be caused to contact terminal 211. This bar has current supplied thereto by means of a wire 212, which wire branches from wire 163. Leading from the terminal 211 is a wire 214, having a signal light 215 therein, said wire contacting wire 162. When the light 215 is burning it will indicate that the dye liquor is flowing from the outside to the inside of the yarn.

When the lever 194 contacts the low side of the disks, the dye liquor will flow from the inside to the outside of the yarn, then the switch bar 210 will be resting on terminal 215. Terminal 215 has a wire 216 leading therefrom, said wire having a signal light 217 installed therein.

When the switch 210 contacts the terminal 215 the light 217 will be illuminated to indicate the direction of flow of the dye liquor. If desired, these lights 215 and 217 can be placed behind suitable translucent signs having indicia thereon such as "Outside to inside" and "Inside to outside," so there will be no doubt in the mind of the operator as to the direction of flow.

When the pump and cycle controller are in op-

eration together with the thermostatic control, a valve 225 is operated manually or automatic means may be provided.

For example, the valve 225 which is disposed in pipe 133 must be positioned in the manner shown in Figure 2. In this position the cross-port 226 will allow the air to flow from pipe 133 to the diaphragm motor 134 to close valve 135 when a predetermined high temperature has been reached, and conversely when a predetermined low temperature has been reached, the valve 135 will be opened. In the meantime the pipe 229 will be shut off.

When it is desired to operate the machine in a fully automatic manner, that is with the pump, cycle controller and total time controller in operation, the valve 225 is rotated through an angle of approximately 45 degrees to the position shown in the central portion of Figure 1. At this time, the port 227 will have its ends directly in alinement with the pipe 133 and at the same time, a port 228 which is disposed substantially at right angles to port 227, will communicate with pipe lines 229. The other end of the pipe 229 communicates with bore 230 which is disposed on the interior of valve housing 231 (see Figure 1A).

When the machine has been in operation for a predetermined length of time, and it is desired to cut off the steam which flows from pipe 138 through valve 135 and into the circulating system through pipe 139, it is necessary to introduce air from pipe 229 into pipe 133, diaphragm motor 134, to cause the valve 135 to be cut off. The introduction of the air is controlled by the mechanism associated with valve housing 231. The bore 230 within this housing communicates with an enlarged bore 232 to which is secured one end of an air supply pipe 233. This pipe taps air pipe 205 at a point between casing 200 and reducing valve 207.

At the point of merger of the two bores 230 and 232, a suitable valve seat is provided, which is adapted to be closed at times, by a ball 236, which ball is secured upon the upper end of a vertically disposed rod 237. The lower end of this rod rests upon the upper portion of lever 238, which lever in turn rests upon disks 239 and 240. The lower side of the lever 238 is held in contact with the periphery of these disks by means of tension spring 241. It will be noted that the disks 239 and 240 are similar in many respects to the disks 191 and 192 just described. The disk 239 has an arcuate slot 242 therein which is penetrated by a set screw 243, the end of set screw 243 being threadably embedded in disk 240.

When it is desired to vary the length of the low periphery of the disks 239 and 240, it is only necessary to loosen the set screw 243 and move the disks to the proper position. The disks are frictionally mounted upon a shaft 245*b* which shaft leads into housing 245*a*, which has suitable reducing gears therein. By frictionally mounting the disks 239 and 240 upon shaft 245*b*, these disks can be reset manually at the beginning of a dyeing operation so as to occupy the proper position relative to the projection 238*a* thereabove. The friction normally present between the shaft 245*b* and disks 239 and 240, however, is sufficient to prevent any relative movement during operation. Shaft 245 extends from this housing. This shaft 245 has a pinion 246 fixedly secured on its other end, said pinion being engaged by a suitable worm 247 on motor shaft 248. The shaft 248 is driven by total time control motor 249. It is seen that as the motor turns, the disk, comprising parts 239 and 240, will be rotated. It should be further noted that the shaft 245*b* and its associated disks are only supposed to rotate a partial revolution for each batch of material that is dyed; consequently, the speed of the shaft 245*b* must necessarily be many times slower than the speed of the shaft 190 and its associated disks, because the disks on shaft 190 are supposed to make one revolution per cycle, that is a cycle being the total time necessary for the liquor to flow once in each direction through the yarn.

Motor 249 has a wire 251 leading therefrom which is connected to terminal 252. The switch bar 169 is adapted to contact the terminal 252 and also a terminal 253 to which a wire 254 is secured, said wired 254 having a light 255 installed therein to indicate when the current is flowing through the motor 249. Leading from the other side of the motor 249 is a wire 256 which contacts the wire 178 at point 257. In order to vary the speed of the motor 249, a suitable rheostat 258 is provided and connected in parallel with the motor 249.

When it is desired to operate this machine in a fully automatic manner, the switches 152 and 154 are manually closed and then the terminals 3 and 6 are connected by switch 158. Also the disks 240 and 239 initially set in a position where point 239*a* on the low side of these disks will be contacted by point 238*a* on the lever 238, which will allow the bar 169 to contact the terminals 252 and 253. When this is done, the signal light 255 will be lighted to indicate that the current is being supplied to the motor 249. After this motor has run its total time period, a partial revolution has been made by the shaft 245, the high side of the disk 239 and 240 will contact the lower side of lever 238 thereby raising the bar 169 into contact with the terminals 167 and 168. This will cause the light 171 to show up and indicate that the total time period is over. At the same time the rod 237 will be moved upwardly within housing 231 and allow air to be introduced from pipe 233 into housing 231, and from whence it will flow into pipe 229, valve 225 as shown in Figure 1, and into diaphragm motor 134 to close the valve 135 and thereby cut off the steam to the circulating system.

As heretofore stated the valve 135 is operated to closed position by applicaion of pressure to motor 134, and the control valve 236 thereby acts as a master control valve to abridge the operation of the thermostatically responsive valve 127.

It should be noted also that when the terminals 252 and 253 are disconnected at the end of a period, the magnet 149 will be de-energized, thereby causing the switch 148 to break the circuit to the pump motor 41. Since the cycle control motor 183 is in the same circuit as the total time controller motor 249, it is evident that upon the breaking of the contacts 252 and 253 that both motors will be stopped and the parts must be reset before another dyeing operation can be begun. When the point 239*a* engages the portion 238*a* the bar 169 is raised and the circuit between contacts 252 and 253 is broken as previously described. The circuit between contacts 167 and 168 is simultaneously closed, thereby energizing magnet 172 and causing the circuit between wires 177 and 180 to be broken, which in turn, causes the circuit to motor 183 to be broken, said last-named circuit being designated by reference characters 165, 184, 183, 181, 180, 175, 177, 178, 161, 150, 153, 154, 157 and 158.

When the dyeing machine is placed in fully automatic position, it is necessary to add a quantity of dyestuffs to the heating solution in the circulating sytsem. After this quantity has been circulated through the system for several minutes, it is then necessary to add additional quantities at timed intervals to compensate for the dye absorbed by the yarn, so that the solution will have substantially the same dyeing properties throughout the dyeing operation. Furthermore it is very desirable to add a suitable catalytic agent, such as salt, at predetermined intervals in order to assist the dyestuffs in properly dyeing the materials.

The intervals at which these quantities are added are automatically controlled by the total time controller just described. The shaft **245** has a suitable cam **260** thereon, said cam having a plurality of notches **261**, **262**, **263** and **264** in the periphery thereof. The notch **261** is not in the same corresponding position relative to shaft **245**, as the point **239***a* on the disk **239**, but instead it is farther advanced. It should be kept in mind that when the machine is started in a fully automatic position that the point **239***a* is disposed directly beneath the contact surface **238***a* of lever **238**. The notch **261** will not be engaged by plunger **265** of valve **266** until the shaft **245** has made a partial revolution. The valve **266** is identical in construction to valve **200** previously described and which is shown in the lower left-hand portion of Figure 1A. Leading to the top of valve **266** is an inlet fluid pressure supply pipe **267**, the upper end of which taps pipe **268**. This pipe in turn taps fluid supply pipe **233**. Also leading from valve **266** is an outlet pipe **270**, the other end of which leads to conventional diaphragm motor **271** (Figure 1). This diaphragm motor is adapted to operate valve **272** in pipe **273**. The pipe **273** has its upper end communicating with a brine tank **274** which supplies brine to expansion tank **102** at the desired intervals. In other words, when the rod **265** falls in either of the notches **261**, **262**, **263** or **264**, the valve **266** is closed, and the air in pipe **270** is allowed to exhaust from this valve to allow the diaphragm motor **271** to open the valve **272** and thereby admit a quantity of brine into the expansion tank **102**. When it is desired to vary the number of quantities it is only necessary to replace disk **260** with another disk having a set of differently spaced notches.

In a similar manner quantities of dyestuffs are admitted to the expansion tank at predetermined intervals. This mechanism is likewise controlled from the shaft **245***b*. A disk **280** having notches **281**, **282** and **283** in the periphery thereof, is secured on the end of shaft **245***b*. This disk has a rod **284** engaging its periphery, said rod being slidably mounted in valve **285** which is identical to valves **200** and **266**, just described.

The air is supplied to this valve through pipe **268**. An exhaust pipe **286** leads from this valve to diaphragm motor **287** (Figure 1). This motor controls valve **288** in pipe **289**, said pipe having its lower end communicating with the expansion tank **102** and its upper end communicating with dye mixing tank **290**. When the point **238***a* is disposed on point **239***a* of the plate **239**, the rod **284** will be disposed in notch **281** of disk **280**, at which time the air which normally flows from pipe **268** to diaphragm motor **287** through the pipe **286** will be cut off, thereby allowing the air to exhaust from valve **285** and also allow the diaphragm **287** to open valve **288** and admit dyestuffs from tank **290** to expansion tank **102**. In other words, each time the plunger **284** is allowed to fall into a notch, the valve **288** is opened for the admission of dyestuffs. By providing this automatic means it is seen that the human element of treating yarn is practically eliminated, since the reversing operation, the addition of brine, and dyestuffs, and the total time operating period is automatically controlled by the device which has just been described.

In the drawings and specification there has been set forth a preferred embodiment of the invention and although specific terms are used they are used in a generic and descriptive sense only, and not for purposes of limitation, the scope of the invention being set forth in the appended claims.

I claim:

1. A dyeing machine comprising a reversing valve having an intake port and a discharge port, a conduit having each end thereof communicating with said valve independently of said ports, a yarn kier interposed in said conduit, a pump having its outlet port communicating with the intake port of said valve, and having an intake port connected to the discharge port of said valve, a liquid supply connected to the intake port of said pump, means for reversing said valve to thereby cause the flow to be reversed in the conduit immediately preceding its discharge through said discharge port, the connection between the discharge port of the valve and the intake port of said pump having a two-way valve therein at a point in advance of the liquid supply connection which when in one position discharges the liquid after it passes through the kier and when in the other position permits the liquid to be drawn again into said pump.

2. A dyeing machine comprising a valve casing having an intake port and a discharge port, a pump having its outlet port communicating with said casing intake port and having its intake port connected to said casing discharge port, a conduit having each end thereof communicating with said casing, a yarn kier interposed in said conduit, a dejector fitting turnably mounted in said casing and having one end thereof coinciding with the discharge port of the casing, the other end of said fitting being adapted to selectively coincide with either end of said conduits, means for turning said dejector fitting to cause the flow to be reversed immediately preceding its discharge through said discharge port of the casing, a housing interposed in said connection between the casing discharge port and the pump intake port, a liquid supply disposed between said housing and the pump intake port, said housing having a normally closed discharge opening, means mounted in the housing for closing communication between the discharge port of the first casing and the pump and for simultaneously opening the discharge opening of the housing to thereby discharge the liquid after it passes through the kier.

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