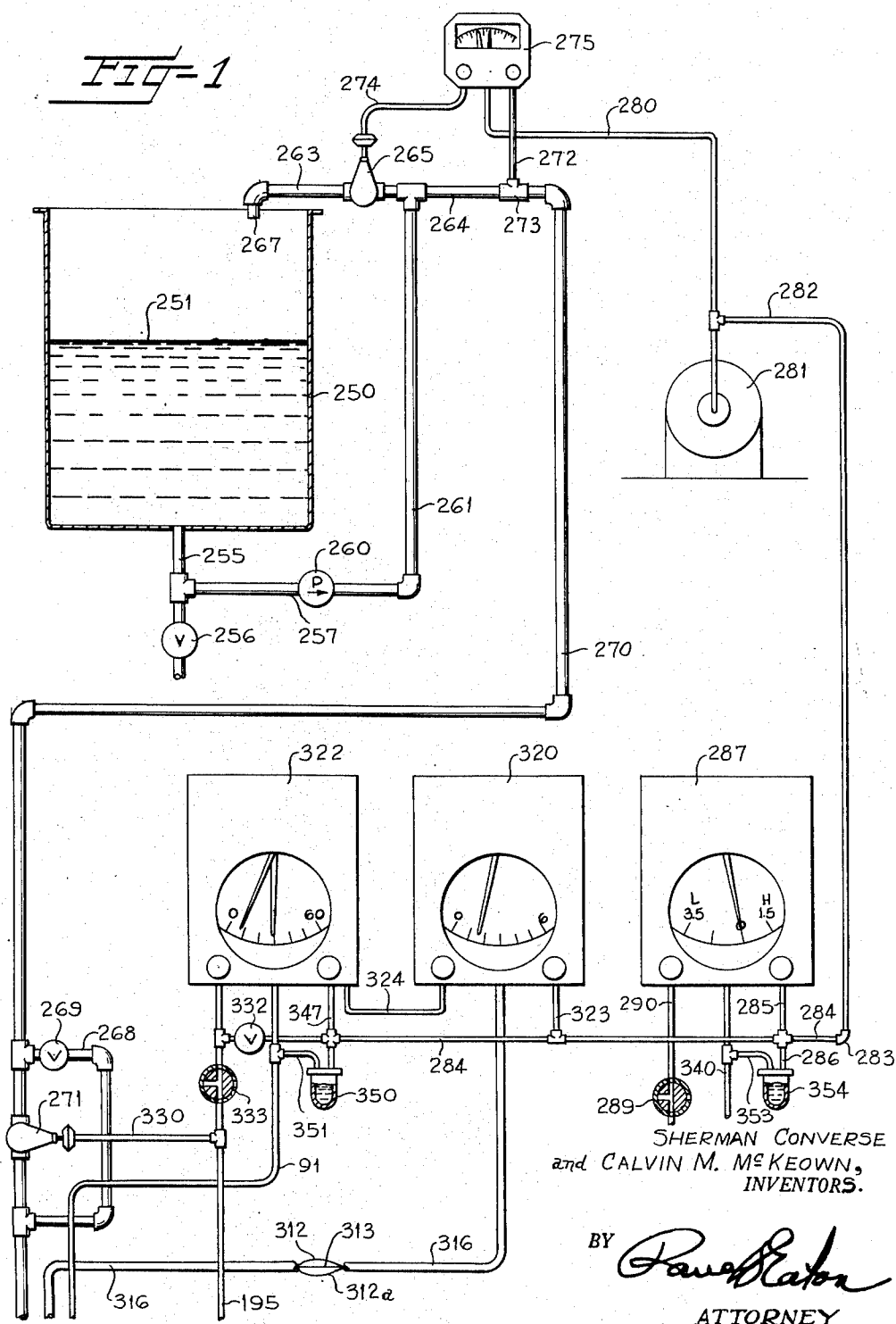


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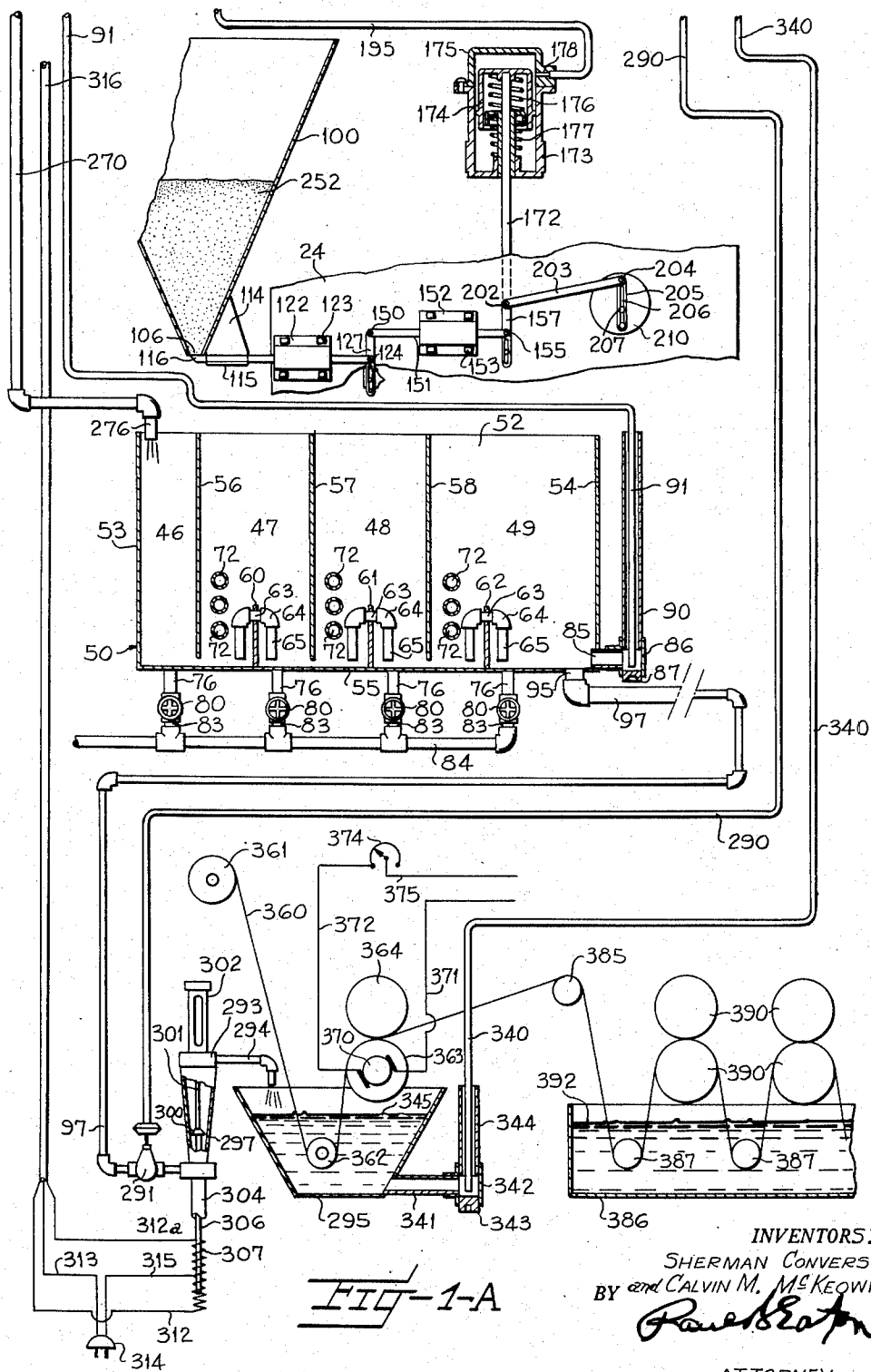
March 3, 1953

S. CONVERSE ET AL
AUTOMATIC DEVICE FOR MIXING AND FEEDING
DYESTUFF TO DYEING APPARATUS

2,630,002

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5 Sheets-Sheet 2



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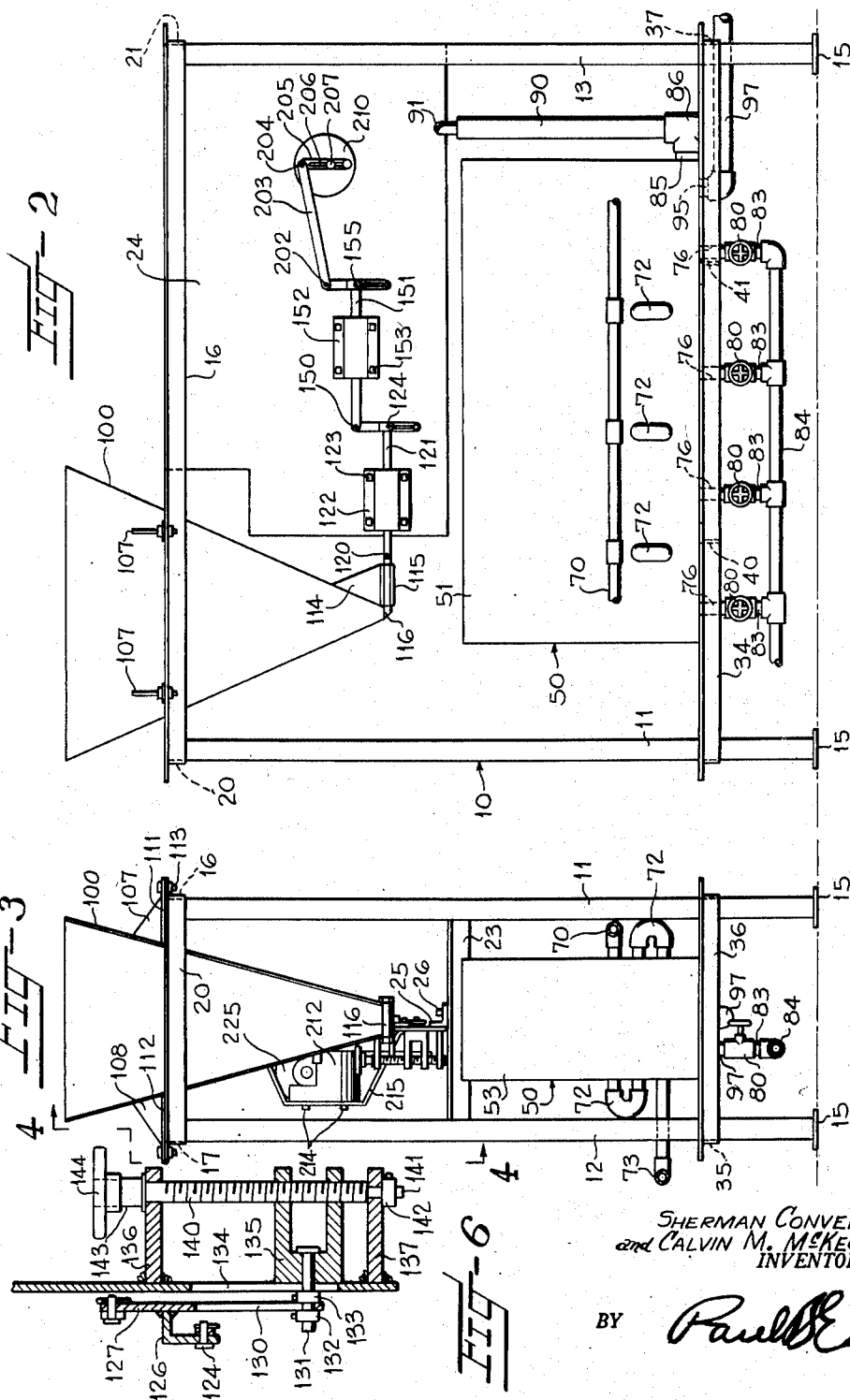
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S. CONVERSE ET AL
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5 Sheets-Sheet 3



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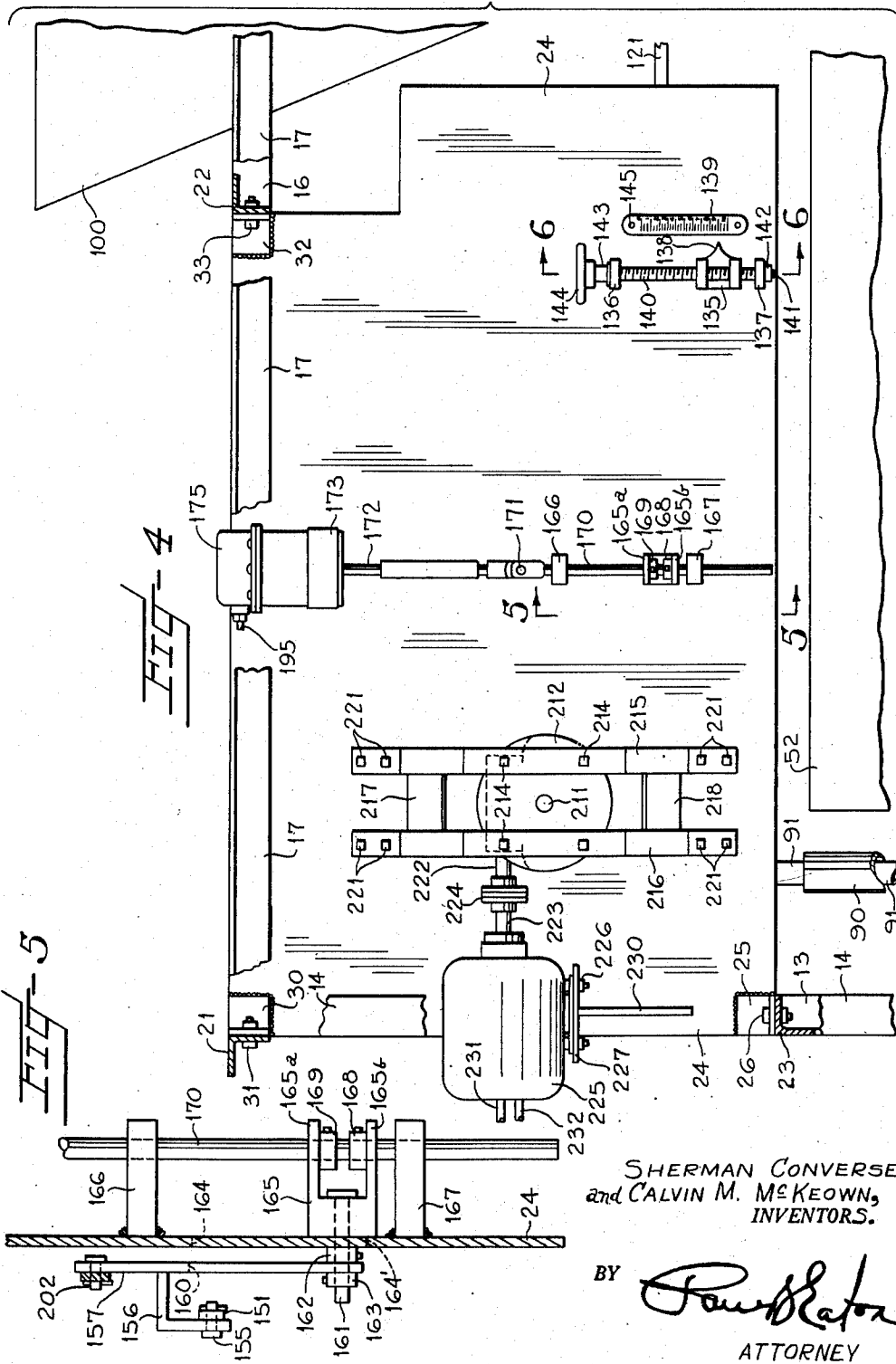
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5 Sheets-Sheet 4



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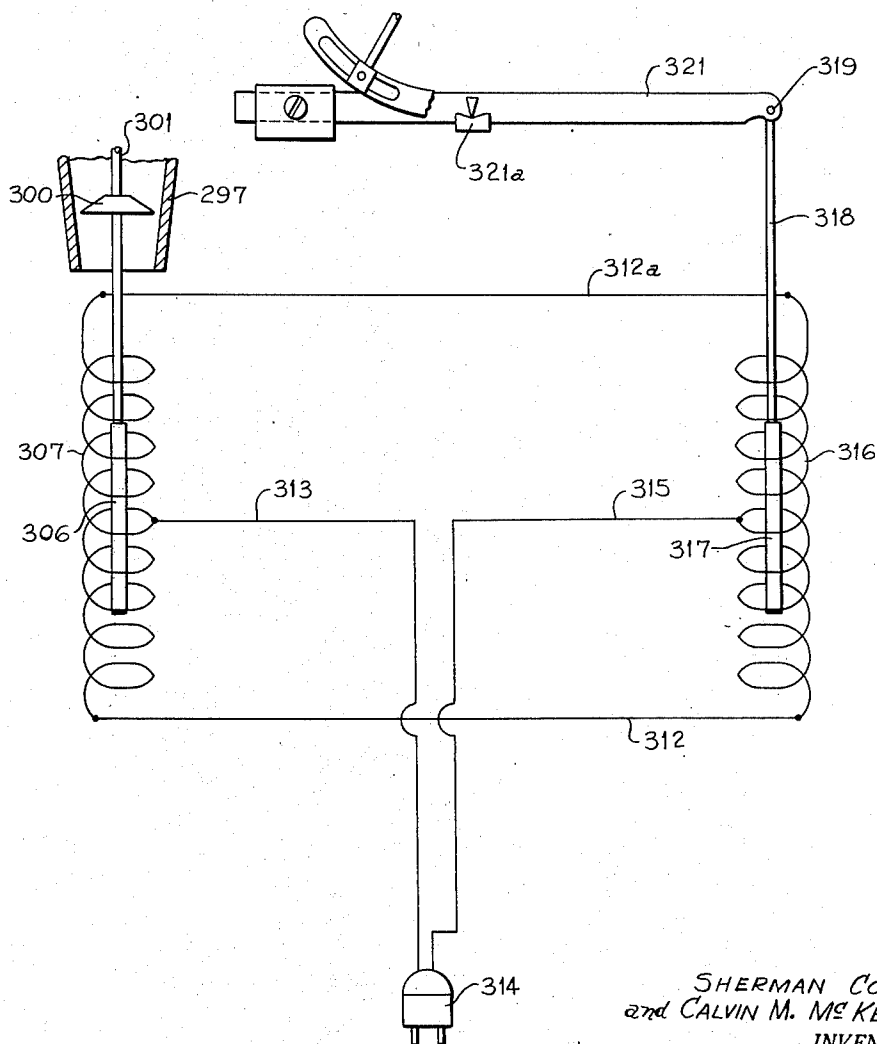
S. CONVERSE ET AL
AUTOMATIC DEVICE FOR MIXING AND FEEDING
DYESTUFF TO DYEING APPARATUS

2,630,002

Filed Oct. 14, 1948

5 Sheets-Sheet 5

FIG-7



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UNITED STATES PATENT OFFICE

2,630,002

AUTOMATIC DEVICE FOR MIXING AND
FEEDING DYESTUFF TO DYEING AP-
PARATUSSherman Converse, Aiken, and Calvin M.
McKeown, Graniteville, S. C.

Application October 14, 1948, Serial No. 54,374

6 Claims. (Cl. 68—207)

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This invention relates to apparatus for treating cloth, and more especially to a system for automatically and continuously treating dye for a padding operation.

The primary object of this invention is to provide means for continuously and automatically adding the desired amount of salts, such as granular sodium hydrosulphite to a given volume of dye liquor or a liquid ingredient of dye liquor and if such is required, as in the case of reduced dye padding, to provide means for automatically detaining the dye in a reducing tank for a predetermined length of time before admitting the dye to the padding operation.

In the case of reduced dye padding, due to the fact that the exact weight of granular salt, such as granular sodium hydrosulphite, must be added to the liquid dye in a specific proportion, and also that the action of the salts on the dye must take place for a predetermined length of time, no more or less, before application of the dye to the cloth, it has heretofore been necessary to mix the granular salt and liquid dye manually to insure the correct proportions, and it has also been necessary to entirely use up this liquor before mixing another batch of the salt and dye, and this has not only resulted in a considerable loss of time but also has required a larger number of operators than is required in the present invention.

It is another object of this invention to provide a dye tank in which a suitable vat dye is stored, and having automatically controlled means for delivering the dye from the storage tank, through a reducing tank to a pad box or booster tank and also provide a hopper disposed above one end of the reducing tank and in which granular sodium hydrosulphite is stored and from which the sodium hydrosulphite is delivered to the reducing tank and which has automatically controlled means for delivering this sodium hydrosulphite to the reducing tank in exact proportions to the vat dye from the dye storage tank, to thus insure that the exact required proportion of vat dye to the granular sodium hydrosulphite will always be delivered to the reducing tank.

It is another object of this invention, in the instance of reduced dye padding, to provide automatic means for maintaining such a level of dye liquor in the reducing tank as to provide the required time for the salts, such as granular sodium hydrosulphite and dye, to properly react before the dye passes to the padding operation.

It is another object of this invention, in the instance of dyeing cloth by pigment padding, to

2

provide a means for automatically and continuously proportioning salts, such as granular sodium hydrosulphite, and an alkaline liquid such as an aqueous solution of sodium hydroxide, to produce a liquid to reduce the dye after application to the cloth in pigment form.

The invention broadly contemplates the dyeing of textile materials, such as cloth, warp yarns and the like, by providing a pad box or booster tank and a tank for holding a reducing solution and a tank for storing the reducing solution with means automatically controlled for supplying the dyestuff from the storage tank to the tank for holding the reducing solution and the tank having the reducing solution therein having automatically controlled means for feeding a regulated amount of granular sodium hydrosulphite to the tank for holding the reducing solution, together with means automatically controlled by the rate of travel of the material being dyed through the pad box or booster tank for regulating the amount of the reducing solution which is fed from the tank for holding the reducing solution to the pad box or booster tank.

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 diagram showing the dye tank and various control apparatus which is adapted to be associated with this invention;

Figure 1-A is an extension of the lower portion of Figure 1 and showing the hopper, the reducing tank, and the associated pad box or booster tank schematically and the control means connected to the same;

Figure 2 is a side elevation of the hopper and reducing tank and the framework in which it is mounted;

Figure 3 is an end elevation looking from the left-hand side of Figure 1 to the right;

Figure 4 is an elevation taken along the line 4—4 in Figure 3 and showing parts of the framework broken away;

Figure 5 is an enlarged vertical sectional view taken along the line 5—5 in Figure 3;

Figure 6 is an enlarged vertical sectional view taken along the line 6—6 in Figure 3;

Figure 7 is a schematic detail showing the relationship between the rotameter in the lower left-hand portion of Figure 1-A and the instrument 320 in Figure 1.

In order that a clear understanding of the various parts of the invention may be had in combination, the various parts will first be described. The tank for holding the reducing solution for a

predetermined time and shown in Figures 1-A and 2 to 6 inclusive will first be described.

The numeral 10 broadly designates a framework for supporting the hopper and reducing tank to be presently described. This framework 10 comprises vertical legs 11, 12, 13 and 14, each of the lower ends of which has a plate 15 welded to the same. The upper ends of the vertical legs 11 and 13 and 12 and 14 are connected by longitudinally extending angle bars 16 and 17, respectively, and the upper ends of the legs 11 and 12 and 13 and 14 are connected by transverse angle bars 20 and 21 respectively, all of which are welded to the upper ends of the vertical legs 11, 12, 13 and 14. An angle bar 22 is welded at each end thereof to the longitudinally extending angle bars 16 and 17 intermediate their ends.

Welded at each end thereof to intermediate portions of the vertical legs 13 and 14 is a horizontally disposed transverse angle bar 23 and this angle bar 23 supports, intermediate its ends, one end of a vertically disposed plate 24 having an angle clip 25 at the lower left-hand edge in Figure 4, welded thereto, which is secured, as by a bolt 26, to the transverse angle bar 23.

This vertically disposed plate 24 also has an angle clip 30 welded to its upper left-hand corner in Figure 4 and this angle clip 30 is secured, as by a bolt 31, to the transverse angle bar 21. The plate 24 also has an angle clip 32 welded to the upper right-hand corner of the same, in Figure 4, and this clip 32 is secured, as by a bolt 33, to the transverse angle bar 22 and it is thus seen that the vertically disposed plate 24 is supported by the angle bars 21, 22, and 23.

Disposed a substantial distance upwardly from the lower ends of the vertically disposed legs 11, 12, 13 and 14 are angle bars 34, 35, 36 and 37. The angle bars 34 and 35 extend longitudinally of the frame work 10 and are welded at opposite ends thereof to the vertically disposed legs 11 and 13 and 12 and 14, respectively. The angle bars 36 and 37 are disposed transversely of the framework 10 and are welded at opposite ends thereof to the vertically disposed legs 11 and 12 and 13 and 14, respectively (Figure 2).

Spanning the distance between the longitudinally extending angle bars 34 and 35 and being spaced apart from each other are angle bars 40 and 41, which are welded at each end thereof to the longitudinally extending angle bars 34 and 35. Resting on the angle bars 40 and 41 and extending longitudinally of the framework 10 is a reducing tank, broadly designated at 50.

This reducing tank 50 comprises vertical side-walls 51 and 52 (Figures 1-A, 2, and 3) and right-hand and left-hand end walls 53 and 54, respectively. The reducing tank 50 also has a bottom 55 and this tank is divided by partitions 56, 57, and 58, which extend from the upper edges of the walls 51 and 52, downwardly, and terminate approximately one-half inch above the bottom 55 of the reducing tank 50, thus forming chambers 46, 47, 48 and 49 in the tank 50.

Disposed between the partitions 56, 57 and 58 and the end wall 54 in parallel spaced relation thereto are vertically disposed partitions 60, 61 and 62 which extend upwardly from the bottom 55, spanning the distance between the sidewalls 51 and 52, and they extend approximately 12 inches from the bottom 55 which is a substantial distance from the upper edges of the side walls 51 and 52 (Figure 1-A).

Each of the partitions 60, 61 and 62 is penetrated adjacent their upper edges by nipples 63 and each of the nipples 63 has elbows 64 con-

nected to opposite ends thereof to which are connected suitable siphoning pipes 65 (Figure 1-A). A steam pipe is indicated at 70 (Figure 3) and is led from a suitable source of steam, not shown. This steam pipe has one of the ends of a plurality of steam coils 72 connected to the same which penetrate the side walls 51 and 52 of the reducing tank 50 and pass through the chambers 47, 48, and 49 in the reducing tank 50.

The steam coils 72 pass back and forth through the reducing tank 50 a number of times and the other ends of the steam coils extend out of the wall 52 and are connected to a pipe 73 which extends to a suitable steam trap, not shown, and thus to a suitable condensate return pipe line, not shown.

Extending from the bottom plate 55 of the reducing tank 50 and cooperating with the chambers 46, 47, 48 and 49 is a plurality of nipples 76 (Figures 2 and 3), each of which has a suitable manually controlled valve 80 connected to the same and the valves 80 are connected to branch pipes 83 extending to a suitable drain pipe 84.

A nipple 85 penetrates the right-hand end wall 54 in Figures 2 and 1-A, and the nipple 85 has a pipe T 86 connected thereto which is plugged as at 87 at its end and has a pipe 90 connected to its upper end and extending upwardly therefrom and the upper end of the pipe 90 being disposed at a point adjacent the upper edges of the right-hand end wall 54. The pipe 90 and the pipe T 86 have a pipe 91 disposed therein and extending longitudinally thereof, the lower open end of which is spaced from the plug 87, and the outside diameter of this pipe 91 is considerably smaller than the internal diameter of the pipe 90, to thus provide a space around the pipe 91 between the pipe 91 and the pipe 90. The pipe 91 extends to a liquid level indicator and controller (Figure 1) to be later described. Penetrating the bottom plate 55 of the reducing tank 50 adjacent the right-hand end wall 54 (Figures 2 and 1-A) is a nipple 95 which is connected to a pipe 97 extending to a conventional rotameter and pad box (Figure 1-A) to be later described in detail.

Disposed between the longitudinally extending angle bars 16 and 17, adjacent the left-hand end of the framework 10 as observed in Figure 1, is a hopper 100, the upper end of which is open and the walls of which slope inwardly and downwardly to form a discharge opening 106 (Figure 1-A) at the lower end thereof. The hopper 100 has the proximate edges of support plates 107 and 108 welded to the same, at opposite sides thereof, and these plates 107 and 108 have bars 111 and 112, respectively, welded to the lower edges of the same and the remote edges of the bars 111 and 112 are penetrated by bolts 113 which also penetrate the angle bars 16 and 17 to thus secure the hopper 100 to the longitudinally extending angle bars 16 and 17 (Figures 2 and 3).

Welded to the lower portion of the hopper 100, as the right-hand side thereof in Figure 2 is one edge of a triangular plate 114 (Figure 2), to the lower edge of which a guide block 115 is welded and in which a closure plate 116 has horizontal sliding movement. This closure plate 116 is adapted to intermittently open and close the discharge opening 106 at the lower end of the hopper 100 in a manner to be later described.

The closure plate is pivotally connected as at 120 to a horizontally disposed link member 121 mounted for horizontal sliding movement in a

guide block 122 secured, as by screws 123, to the vertically disposed plate 24 (Figures 2 and 1-A). The other end of the link member 121 is pivotally connected as at 124 to an inverted L-shaped portion 126 (Figures 2 and 6), which is welded to the medial portion of a lever arm 127. The lever arm 127 has a longitudinally extending slot 130 therein (Figure 6) which is slidably penetrated by a pin 131, having collars 132 and 133 fixedly mounted thereon which are adapted to slidably engage opposite sides of the lever arm 127.

The plate 24 has a vertically disposed slot 134 therein which is also slidably penetrated by the pin 131 and the left-hand surface of the plate 24 in Figure 6 is slidably engaged by the collar 133 on the pin 131. The right-hand surface of the plate 24, in Figure 6, is slidably engaged by a yoke member 135 in which the pin 131 is secured, as by a pressed fit.

Disposed above and below the opposite ends of the vertically disposed slot 134 in the plate 24 (Figure 6) are guide members 136 and 137, respectively. Rotatably mounted in the guide member 136 and extending downwardly therefrom is a threaded shaft 140, which threadably penetrates the yoke member 135 and has a restricted portion 141 at the lower end thereof which is rotatably mounted in the guide member 137.

This restricted portion 141 penetrates the guide member 137 and has a collar 142 fixedly mounted on the lower end thereof. The threaded shaft 140 has an enlarged portion 143 at the upper end thereof which engages the top surface of the guide member 136 in Figure 6 and this enlarged portion 143 has a suitable hand wheel 144 fixedly mounted thereon.

It is thus seen that by rotating the shaft 140, in one direction or the other, the yoke member 135 may be raised and lowered relative to the plate 24 and this will, of course, move the pin 131 in a like manner to change the position of the pivot point of the lever arm 127 relative to the link member 121 and to thus increase or decrease the stroke of the link member 121, as desired.

Referring to Figure 4, it may be observed that the yoke member 135 has a pointed portion 138 which serves as an indicator and there is disposed adjacent the end of this pointed portion 138 a suitably graduated plate member 139 which is secured, as by screws 145, to the vertically disposed plate 24. This plate member 139 is properly graduated to serve as a guide in establishing the height at which the yoke member 135 and its associated pin 131 shall be disposed for determining the amount of material to be later disclosed, which will be allowed to fall, by gravity, from the opening 106 at the lower end of the hopper 100.

Pivotally connected to the upper end of the lever arm 127 in Figure 2 as at 150, is the left-hand end of a link member 151 which is mounted for horizontal sliding movement in a guide block 152, secured as by screws 153, to the vertically disposed plate 24. The right-hand end of this link member 151 in Figures 2 and 1-A, is pivotally connected as at 155 to an inverted L-shaped portion 156 (Figure 5) welded to a medial portion of a vertically disposed lever arm 157.

The lever arm 157 is identical to the lever arm 127, heretofore described, and has a slot 160 therein which is slidably penetrated by a

pin 161 having collars 162 and 163 fixedly mounted thereon which slidably engage opposite surfaces of the lever arm 157. The vertically disposed plate 24 has a vertically disposed slot therein the upper and lower limits of which are indicated by the reference characters 164 and 164' in Figure 5 and which is also slidably penetrated by the pin 161. This pin is secured, as by a pressed fit, in a yoke member 165 which has vertical sliding movement against the right-hand surface of the plate 24 as observed in Figure 5.

Disposed above and below the limits of the slot 164 in the plate 24 are outwardly projecting guide members 166 and 167, respectively (Figure 5). The yoke member 165 has outwardly extending ears 165a and 165b integral therewith and rotatably mounted in the ears 165a and 165b is a vertically disposed shaft 170 which is also mounted for vertical sliding movement and rotational movement in the guide members 166 and 167 (Figures 4 and 5). Collars 168 and 169 are fixedly mounted on the shaft 170 between the ears 165a and 165b and slidably engage proximate surfaces of the same for moving the yoke member 165 on a vertical plane in unison with the shaft 170 as will be later described.

Pivotally connected to the upper end of the vertically disposed shaft 170 (Figure 4), as at 171, is the lower end of a piston rod 172, which extends into a cylinder 173 (Figures 1-A and 4). This cylinder 173 is a part of a conventional "Johnson Size 3" piston-type damper operator such as is manufactured by the Johnson Service Company, Milwaukee, Wisconsin. The operation and structure of this damper operator is clearly described in Johnson Service Company's Instruction Bulletin No. M-101A relating to automatic temperature and humidity control, Edition No. 1, page 8, and is illustrated in Figures 9 and 10 of said Instruction Bulletin.

The cylinder 173 is capped as at 175 and a diaphragm 174 has vertical sliding movement in the cylinder 173 and is normally urged upwardly against the cap 175 by the compression springs 176 and 177 and the upper end of the connecting rod 172 is secured to the diaphragm 174 in a conventional manner. All of the parts 172 to 177 inclusive, being conventional parts of the said piston type damper operator, a further description of the associated parts is deemed unnecessary. The cap 175 of the cylinder 173 has a port 178 therein which communicates with a pipe 195 which extends upwardly in Figures 1 and 1-A to an instrument for indicating and controlling liquid level as will be later described.

Referring to Figure 2 it may be observed that there is pivotally connected to the upper end of the lever arm 157 as at 202, a link member 203, the other end of which is pivotally connected, as at 204 to one end of an adjustable arm 205 having a longitudinally extending slot 206 therein and which is penetrated by screws 207 for securing the arm 205 to a disk 210. The disk 210 is fixedly mounted on one end of a shaft 211 (Figure 4) which rotatably penetrates the vertically disposed plate 24 and extends from a conventional gear reduction unit 212 (Figures 3 and 4).

This gear reduction unit 212 is secured as by screws 214 to spaced strap iron members 215 and 216 which have interconnecting plates 217 and 218 welded thereto. These strap iron bars 215 and 216 are secured, as by screws 221, to

the vertically disposed plate 24 as observed in Figure 4.

Extending from the gear reduction unit 212 in Figure 3, is a shaft 222 which is connected to a shaft 223, by a suitable flexible coupling 224. The shaft 223 extends from an electric motor 225 secured, as by bolts 226, to a horizontally disposed plate 227 welded to the upper end of a bracing plate 230 (Figure 4), which is welded to the vertically disposed plate 24. The electric motor 225 has electric wires 231 and 232 extending therefrom to a suitable source of electrical energy, not shown.

Figures 1 and 1-A show the various pneumatic and electrical controls which are adapted to be associated with the hopper 100 and the reducing tank 50 and which have been omitted from the Figures 2, 3 and 4 for purposes of clarity, because, as a matter of fact, the various controls may be disposed remotely from the hopper and the reducing tank.

The upper left-hand corner of Figure 1 shows a suitable storage tank 250 which contains a vat dye solution 251 having sodium hydroxide admixed therewith and the hopper 100 has granular salts 252, such as sodium hydrosulphite therein, and the primary object of this invention is to automatically feed the liquid vat dye 251 from the tank 250 and the salts 252 from the hopper 100 into the reducing tank 50 in predetermined proportions where the vat dye and sodium hydrosulphite are heated and mixed for a predetermined length of time as they pass through the reducing tank 50 and to then pass the mixture from the tank 50 to the padding apparatus to be later described, at a rate of flow commensurate with the rate at which the vat dye mixture is used from the pad box by the cloth, as will be later described.

A pipe 255 is connected to the bottom of the tank 250 and has a suitably manually operated valve 256 (Figure 1) therein which may be opened for discharging the vat dye 251 from the tank 250 when it is desired to change the dye for some reason or other, or for cleaning the tank 250. However, when it is desired to feed the dye 251 from the tank 250 to the reducing tank 50, the manually operated valve 256 is closed and the dye passes through a pipe line 257 connected to the pipe 255 by a T and extending to a suitable hydraulic pump 260.

The pump 260 has a pipe 261 connected to the same (Figure 1), which is connected by a T to branch pipes 263 and 264. The pipe 263 has an air operated diaphragm valve 265 therein the other end of which has a discharge opening 267 for discharging the dye from the pipes 255, 261 and 263 and returning the dye to the dye tank 250, when so desired, as will be later described.

The pipe 264 (Figure 1) is connected by an elbow to a pipe 270 which extends to the tank 50 (Figure 1-A) for discharging dye into the chamber 46 of the reducing tank 50. The pipe 270 has an air operated diaphragm valve 271 therein for controlling the flow of dyestuff, the control means being later described. The pipe 270 has the opposite ends of a by-pass pipe 268 connected to the same and this pipe 268 has a manually operated valve 269 therein and is provided to by-pass the diaphragm valve 271 for manually controlling the flow of sodium hydroxide vat dye to the reducing tank 50, as will be necessary in the initial starting of this process.

The pipe 264 has a pipe 272 connected to the same by a T 273. The air operated valve 265

(Figure 1) has a pipe 274 connected to the same, the other end of which is connected to an automatic air operated indicating pressure controller such as is manufactured by the Taylor Instrument Company, Rochester, New York, and is shown in their Catalogue No. 86R issued November 1944, page 15, and bearing their number 86RF335. The pipe 272 extending from the pipe 264, is connected at its other end to the other side of the indicating pressure controller 275.

Means are also provided for controlling the rate of flow of the granular sodium hydrosulphite from the hopper 100 and likewise for controlling the flow of the dyestuff from the storage tank 250 to the tank 50 and for also controlling the rate of flow of the finished dyestuff from the tank 50 to the pad box or booster tank.

By referring to Figure 1, it is seen that there is a pipe 280 connected to the indicating pressure controller 275, the other end of which is connected to a suitable source of compressed air 281. The pipe 280 has a branch pipe 282 connected to the same which is connected to a pipe 284.

The pipe 284 (Figure 1) is connected by a pipe cross to branch pipes 285 and 286. The pipe 285 (Figure 1) is connected to one side of an instrument 287, which is a pressure type liquid level indicating controller such as is manufactured by the Brown Instrument Company, Wayne and Roberts Avenues, Philadelphia, Pennsylvania, and is shown in their Catalogue No. 2204, on page 13, Figure 21.

The purpose of this pressure type liquid level indicating controller 287 is to indicate, to the operator of this apparatus, the level of the reduced dye in the pad box or booster tank to be later described, as well as to insure that the proper level of the reduced dye in the pad box or booster tank is maintained in a manner to be later described.

The liquid level indicating controller 287 has a pipe 290 extending from the bottom at the left-hand side thereof in Figure 1. The pipe 290 has a manually operated 3-way valve 289 therein and this pipe 290 extends to an air operated diaphragm valve 291 in Figure 1-A. The valve 291 is disposed in the pipeline 97 extending from the nipple 95 in the bottom 55 of the tank 50 employed for reducing the dyestuff. This pipe 97 is connected at its other end, adjacent the valve 291, to the lower portion of a conventional rotameter 293 with an inductance bridge transmitter, to be later described, attached thereto. This rotameter is of a type such as is manufactured by Fischer and Porter Company, Hatboro, Pennsylvania, and is described in their catalog No. 50-B of November, 1945, various parts of the rotameter also being described in patents issued to Kermit Fischer, numbered 2,323,320, 2,350,343 and 2,441,350.

This rotameter 293 has a discharge pipe 294 connected to the upper portion of the same which is adapted to discharge the reduced dye from the reducing tank 50 into a pad box or booster tank 295. The rotameter 293 has a tapered wall portion 297 (Figures 1-A and 7) in which a float member 300 is disposed and is penetrated by a vertically disposed rod 301, the upper end of which extends into a sight tube 302 and the lower end of which extends into a tubular portion 304 which is sealed, by means not shown, from the tapered wall portion 297.

The rod 301 which penetrates the float member 300 in the rotameter 293 (Figure 1-A) extends downwardly and has a soft iron armature rod 306 (Figures 1-A and 7) connected thereto, but

being insulated therefrom. This rod 306 is a part of an inductance bridge transmitter, or, in other words, an inductor having an adjustable core, the rod 306 being the adjustable or movable core of the inductor. A transmitter impedance coil 307 surrounds the lower end of the armature rod 306 and has electric wires 312 and 312a connected to opposite ends thereof and a wire 313 is connected to the center of the coil 307. The electric wire 313 extends to a male plug 314, which is adapted to be plugged into a suitable source of electrical energy not shown. The other side of the male plug 314 has an electric wire 315 connected to the same and the wires 312, 312a and 315 extend through a cable 316 to an instrument 320.

The instrument 320 (Figure 1) is an electric indicating air operated controller for liquid flow having an inductance bridge receiver, said instrument being such as is manufactured by the Brown Instrument Company, Wayne and Roberts Avenues, Philadelphia, Pennsylvania, and is shown on page 18, Figure 23, in their catalogue Number 2204. Although the said inductance bridge receiver is a conventional part of the instrument 320, in order that the relationship between the instrument 320 and the rotameter 293 may be clearly understood, the schematic wiring diagram in Figure 7 shows a receiver impedance coil 316 which is the basic component part of the said inductance bridge receiver housed in instrument 320.

The receiver impedance coil 316 has the electric wires 312 and 312a connected to opposite ends thereof, and which extend from opposite ends of the transmitter impedance coil 307 (Figures 1-A and 7) and the wire 315 from the male plug 314 extends to the center of the receiver impedance coil 316. The receiver impedance coil 316 surrounds a soft iron armature 317 having a rod 318 connected to and insulated therefrom on the upper end thereof, the upper end of the rod 318 being pivotally connected as at 319 to the right hand end of a conventional rocker arm 321 pivoted as at 321a and this rocker arm 321 is a conventional part of the instrument 320 as described in the said Brown Instrument Company's Catalogue No. 2204, and a further description is thus deemed unnecessary.

This electric flow indicator and controller 320 is provided to indicate the rate of flow in gallons per minute of the reduced dye as it flows through the rotameter 293 and is to also control the index setting of an instrument 322 in Figure 1, by means of a branch pipe 323 extending from the pipe 284 to one side of the instrument 320 and an interconnecting pipe 324, extending from the other side of the instrument 320 to one side of the instrument 322. When the reduced dye flows through the rotameter 293 at a very slow rate, the float 300 would be in a lower position relative to the tubular member 297 (Figure 7) and consequently the soft iron armature 306 would cause electrical energy to flow from the male plug 314 through the wire 313, through the lower half of the transmitter impedance coil 307 and through the wire 312 to the lower half of the receiver impedance coil 316 and the circuit would then be completed through the wire 315 to the other side of the male plug 314.

This would cause the soft iron armature 317 to move downwardly to thus move the rocker arm 321 in a clockwise direction in Figure 7 to actuate conventional parts, not shown, of the instrument 320 for indicating the flow of the reduced dye in

gallons per minute as well as to control the admittance of compressed air to the instrument 322. Obviously, as the rate of flow of the reduced dye through the tubular member 297 increases, the metering float 300 would move upwardly thus transmitting energy through the coil 307 by means of the wire 313 to the male plug 314 to thereby cause the soft iron armature to move upwardly and to move the rocker arm 321 in a counterclockwise direction to actuate the conventional parts, not shown, of the instrument 320, in the manner heretofore described, to thus indicate and control the flow of dye accordingly.

The instrument 322 is another pressure type liquid level indicating controller, similar to 287, but has an "Indexet" mechanism associated therewith and is described in the said Brown Instrument Company's Catalogue 8904 on page 13, Figure 13. Broadly, the purpose of this instrument 322 is to control the flow of compressed air to the piston-type damper operator 173 shown in the upper portion of Figure 1-A so as to permit ingress and egress of air through the pipe 195 to the cylinder 173 and to thereby assist in controlling the size of the opening 106 at the bottom of the hopper 100 as will be later described. The pipe 195 which extends from the cap 175 of the damper operator cylinder 173 in Figure 1-A extends to the left-hand side of the instrument 322 in Figure 1.

The pipe 195 has a branch pipe 330 (Figure 1) connected to the same by a T. The other end of the pipe 330 is connected to the diaphragm valve 271 heretofore described. It will be noted in Figure 1 that the pipe 284 is connected by a T to the pipe 195 adjacent the instrument 322. A manually operated valve 332 is mounted in the pipe 284 adjacent the pipe 195 to thus admit compressed air to the valve 271 for purposes to be later described.

There is a manually operated 3-way valve 333 (Figure 1) in the pipe 195 which is disposed between the points at which the pipes 284 and 330 are connected to the pipe 195. This valve 333 is provided to control the passing of air between the instrument 322 and the diaphragm valve 271 as well as between the instrument 322 and the damper operator cylinder 173 and is a 3-way valve instead of a 2-way valve in order that the pressure on the diaphragms of the valve 271 and the cylinder 173 may be bled off in the event the control air through the instrument 322 is stopped for any reason. The 3-way valve 289 in the pipe 290 functions in a manner identical to that of the 3-way valve 333 in the pipe 195 to relieve the pressure against the diaphragm in the valve 291 in the instance that the instrument 287 is inoperative for any reason.

The pipe 91, which extends from within the pipe 90 in Figure 1-A, is connected at its upper end to instrument 322 in Figure 1. The purpose of the pipe 91 is to transmit the pressure of the dye in the tank 50 against the lower end of the pipe 91 to the instrument 322, it being understood that the higher the level of the dye in the tank 50 the greater the pressure will be at the lower end of the pipe 91 to thus actuate the conventional indicating and controlling mechanism of the instrument 322 accordingly in a conventional manner.

The liquid level indicating controller 287 (Figure 1) has a pipe 340 extending from the same to the pad box or booster tank 295 (Figure 1-A). The pad box or booster tank 295 has a nipple 341 connected to the same, on the outer end of

which a pipe T 342 is mounted (Figure 1-A) and is plugged at the lower end thereof, as at 343. This pipe T 342 has a pipe 344 extending upwardly therefrom, the upper end of which is disposed at an elevation substantially level with the top edges of the pad box or booster tank 295. The pipe 340 extends into the pipe 344 and terminates at the level of the bottom of the pad box or booster box 295 and it will be noted that there is a space between the lower end of the pipe 340 and the plug 343 so the pressure of the reduced dye indicated at 345 in the pad box or booster tank 295 at the lower end of the pipe 340 will be transmitted to the instrument 287 in Figure 1.

The instrument 322 in Figure 1 has a pipe 347 connected to the same, to which the pipe 284 is connected by a pipe cross, and this pipe 347 extends into a conventional sight feed bubbler 350, to the other upper side of which a branch pipe 351 is connected. The other end of the pipe 351 is connected to the pipe 91 by a T. The pipe 340, extending from the instrument 287 (Figure 1) has a branch pipe 353 connected to the same by a T, and the pipes 286 and 353 extend into a conventional sight feed bubbler 354.

Referring to Figure 1-A it may be observed that the fabric or yarn to be padded by the reduced dye is indicated at 360 and extends from a suitable source, such as a roll 361. The fabric 360 extends downwardly into the pad box or booster tank 295, passing beneath an immersion roll 362, rotatably mounted in the pad box or booster tank 295, and then extends upwardly out of the reduced dye 345 and passes between squeeze rolls 363 and 364. The fabric 360 is pulled off the roll 361 and around the immersion roll 362 by the squeeze rolls 363 and 364.

The lower squeeze roll 363 is usually driven by a D. C. electric motor 370, having electric wires 371 and 372 extending therefrom, the wire 371 extending to the side of a suitable source of D. C. current and the wire 372 extending to one side of a rheostat 374, which is usually manually controlled. From the pointer of the rheostat 374, a wire 375 leads to the other side of the source of D. C. current.

It is thus seen that the rheostat 374 will control the speed of the electric motor 370 and will thus control the speed at which the fabric 360 is drawn through the pad box or booster tank 295. After the fabric 360 passes between the squeeze rolls 364 and 363, which, incidentally, squeeze a major portion of the liquid out of the fabric 360, the fabric extends to an idler roll 385 disposed above a suitable development tank or process container 386. This tank 386 is shown as having a plurality of immersion rolls 387 therein, above and between which sets of squeeze rolls 390 are disposed.

It is to be noted that the immersion rolls 387 are submerged in suitable treating solution indicated at 392 and disposed within the tank 386, and that the sets of squeeze rolls 390 are disposed above the tank 386 in which the solution 394 is disposed.

Obviously there are many processes through which the fabric 360 may be passed after having been passed through the squeeze rolls 364 and 363 associated with the pad box or booster tank 295 and among these processes is a steam ager, such as is shown in the patent to Sherman Converse, No. 2,441,992, of May 25, 1948, after which the fabric or yarn is washed, soaped, and otherwise treated in a conventional manner.

Method of operation

In the operation of this device, it is, of course, first necessary to fill the tank 250 with the required vat dye sodium hydroxide solution 251 and to provide a quantity of the granular sodium hydrosulfite 252 in the hopper 100. The pump 260 (Figure 1) is then started to thus pump the vat dye 251 from the tank 250, through the pipes 255, and 261 through one or the other of the pipes 263 or 264, depending upon whether or not the valve 265 is open and also whether or not one or the other of the valves 269 or 271 is open.

Assuming the reducing tank 50 and the pad box or booster tank 295 to be empty, it is necessary to feed a predetermined amount of the vat dye from the tank 250 to the reducing tank chamber 46, which may be done any one of three ways. One method of feeding the dye from the tank 250 to the tank 50 is by opening the valve 269 in the by-pass pipe 268 to thus permit the pump 260 to pump the vat dye through the pipes 255, 257, 261, 264 and 270, successively, the vat dye passing through the by-pass pipe 268, through the opening 276 in the lower end of the pipe 270 and into the reducing tank 50.

When the estimated required amount of dye has passed through the pipe 270 into the tank 50, the valve 269 in the by-pass pipe 268 is then closed preparatory to normal operation of the machine as will be later described.

The second method of feeding the dye from the tank 250 to the tank 50, which is very similar to the method heretofore described, is by opening the valves 332 and 333 in the pipe lines 284 and 195, which will, in effect, by-pass the instrument 322 in Figure 1. The compressed air will then flow from the source of compressed air 281, through the pipes 282, 284, 195 and 330 to the air operated diaphragm valve 271 thus opening the valve and permitting the pump 260 to pump the vat dye through the lines 255, 257, 261, 264 and thus through the pipe 270 and the opening 276 in the lower end of the pipe 270 and finally into the reducing tank 50. As in the preceding method, the valve 332 in the pipe 284 would have to be closed when the estimated required amount of dye had passed into the tank 50.

The third and preferred method of delivering the vat dye from the storage tank 250 to the reducing tank 50 through the pipe 270, is to close the valves 333 and 289 in the respective pipe lines 195 and 290. The liquid level indicating controller 322 (Figure 1) is then manually adjusted to indicate the estimated required number of gallons of dye that is to be fed to the reducing tank 50, this having been determined from a particular dyeing formula, and which we will assume to be thirty (30) gallons. The required number of ounces of granular hydrosulphite per gallon of vat dye is then determined from the said formula, and the pointer 138 on the yoke member 135 is adjusted to indicate the required number of ounces as is shown on the graduated plate 139 in Figure 4. This yoke member 135 is adjusted by means of the hand wheel 144 connected to the threaded shaft 140 manually, the yoke 135 will be caused to move upwardly or downwardly, as desired, and will thus change the fulcrum point of the lever arm 127.

It might be stated that the liquid level indicating controller 322 is manually adjusted ac-

cording to the type of goods to be dyed and the speed at which they are to be carried through the pad box 295 to indicate the required number of gallons that it is estimated should be in the reducing tank 50 for allowing a predetermined reducing time of, say, 10 minutes.

The indicating pressure controller 275 at the top of Figure 1 is adjusted to a predetermined pressure of, say, ten pounds per square inch, and compressed air passes through the pipe 280 from the source of compressed air 281 to the instrument 275 and as long as the pump 260 (Figure 1) pumps the vat dye 251 through the pipes 255, 257, 261, and 264 at a pressure not exceeding ten pounds per square inch, the air operated diaphragm valve 265 will automatically remain closed. However, if the pressure in the line 264 becomes as high as ten pounds per square inch, this pressure will be transmitted through the pipe 272 to the indicating pressure controller 275 which will automatically permit compressed air to pass through the pipe 274 to the air operated valve 265 to thus open the same, so that as long as there is a pressure of ten pounds per square inch or greater in the line 264, the excess vat dye will pass from the pipe 261 to the pipe 263 and outwardly through the opening 267 and return to the tank 250.

It is thus seen that a constant pressure of ten pounds per square inch, or, of course, any other desired pressure, may be maintained in the pipe 270, although the hydraulic pump 260 operates continuously. This also assists in mixing the vat dye 251 in the tank 250, especially when the valve 271 is closed, due to circulation of the dye from the tank 250 through the pipes 255, 257, 261 and 263 and through the opening 267 back into the tank 250. It might be stated that in order that the proportion of vat dye to sodium hydrosulphite remain constant at the desired values, the pressure of the dye in pipe 270 must be the same as it was at the time when the plate member 139 in Figure 1-A was calibrated. This is essential because the same air pressure that acts on the damper operator cylinder 173 also acts on the diaphragm valve 291, which controls the flow of vat dye solution from the tank 50 to the pad box 295 in a manner to be later described.

The manually operated valve 333 is then opened and compressed air from the instrument 322 passes through the pipe 195 and through the branch pipe 330 to the valve 271, it being assumed that the manually operated valve 269 in the bypass pipe 268 is closed, to thus open the valve 271 and to thereby permit the vat dye solution to pass from the tank 250 and into the chamber 46 of the dye reducing tank 50. This valve 271 will remain open until the required thirty gallons of dye shall have passed into the dye reducing tank 50 at which time the air under pressure to the pipe 195 will be automatically reduced by conventional means, not shown, associated with the instrument 322, the amount of liquid in the reducing tank affecting the instrument 322 by means of the pipe 91 extending into the pipe 90 associated with the dye reducing tank 50.

As the dye gradually enters the reducing tank 50 and the pipe 90 through the nipple 85 and the pipe T 86 pressure is created on the lower open end of the pipe 90. This flow continues until it has reached the predetermined amount of 30 gallons. Obviously the more liquid there is in the pipe 90, surrounding the pipe 91, the more pressure there would be exerted on the air in the pipe 91, and thus when the tank has received 30 gal-

lons of dye, the pressure would be transmitted through the pipe 91 to the instrument 322 to thus close a valve means disposed therein, not shown, for automatically stopping the air from passing from the source of compressed air 281 through the pipes 282, 284, and 347 through the instrument 322 to the pipes 195 and 330, also automatically releasing the air in these lines thereby permitting the valve 271 to close, which will automatically stop the flow of vat dye 251 from the tank 250 through the pipe line 270, and instead the pump 260 will then pump the dye back into the tank 250, in the manner heretofore described.

The conventional sight feed bubbler 350 is provided so that whenever the liquid level in the dye reducing tank 50 drops below its optimum level, the pipe line 91 will be purged by the pipe 351 connected to the bubbler 350 and to the pipe 91 thereby permitting the level of the liquid at the lower end of the pipe 91 to fluctuate according to the level of liquid surrounding the pipe 91 and being disposed in the pipe 90.

Now, as the compressed air passes from the instrument 322 through the lines 195 and 330 to the valve 271, thus opening the same, the compressed air also passes through the pipe 195 to the cap 175 of the damper operator in Figure 1-A. This causes the diaphragm 174 to move downwardly and will thus move the vertically disposed shaft 170 (Figures 4 and 5) downwardly to thereby cause the yoke 165 and its associated pivot pin 161 to move downwardly and to thus transmit a maximum stroke of the lever arm 157, which will be oscillatably driven by the link member 203 extending from the disk 210 driven by the motor 225 (Figures 2 and 1-A). It is thus seen that reciprocal motion will be transmitted to the closure member 116 (Figure 2) through the links 203, 151 and 121 and the lever arms 157 and 127 to thus permit the granular sodium hydrosulphite 252 in the hopper 100 to fall by gravity, through the opening 106 at the lower end of the hopper 100 and to thus fall into the chamber 46 at the left-hand end of the reducing tank 50, the size of the opening 106 being determined by the said damper motor and the pointer setting relative to the plate member 139.

Now, when the desired amount of liquid vat dye has passed into the reducing tank 50 and the flow of compressed air to the pipe 195 has been automatically reduced through action of the conventional instrument 322 in the manner heretofore described, the pressure exerted by the compression springs 176 and 177 on the diaphragm 174 will cause the diaphragm 174 to move upwardly in Figure 1-A commensurate with the pressure transmitted to the instrument 322 by the pipe 91 extending from the tank 50. It is manifest that the level of the liquid in the tank 50 will transmit pressure through the pipe line 91, through the instrument 322 and through the pipe 195 to the cap 175 of the damper operator thus controlling the size of the opening 106 at the bottom of the hopper 100 relative to the amount of liquid vat dye stuff being fed into the tank 50.

Now, as the diaphragm 174 in Figure 1-A moves upwardly in the manner heretofore described, the yoke member 165 will also move upwardly and will thus move the associated pivot pin 161 (Figure 5) upwardly and, in the event that the diaphragm 174 is moved to its uppermost position, the pivot pin 161 would be moved into alignment with the pivot point 155 of the connecting link 151 (Figure 5) and therefore, although the

connecting link 203 will continue to reciprocate through rotation of the disk 219, reciprocatory motion will not be transmitted to the link 151 due to the fact that the pivot point 155 of the link 151 and the pivot point 161 of the lever arm 167 will be on the same axis and consequently the lever arm 157 will merely rotate about the axis of the pivot point 155 and the closure member 115 will, of course, remain disposed in such a manner as to close the opening 106 at the lower end of the hopper 100.

The estimated required amount of vat dye sodium hydroxide solution and the granular sodium hydrosulphite, now being in the reducing tank 50, the apparatus is ready for continuous operation. However, it is necessary that the dye and the granular sodium hydrosulphite remain in a mixing stage for a predetermined length of time which is called the "reducing time" and it has been found that a ten minute reducing time is preferable in this process. As the vat dye and the granular sodium hydrosulphite pass into the chamber 46 (Figure 1-A) of the reducing tank 50, this mixture also passes beneath the lower edges of the partitions 56, 57 and 58 into the respective chambers 47, 48 and 49 and over the respective partitions 60, 61 and 62 in the chambers 47, 48 and 49 and this mixture is heated by the steam coils 72 passing therethrough, heretofore described.

As the dye passes through the tank 50, it also passes through the nipple 95 at the bottom 55 and through the pipe 97 and is stopped against the valve 291 in the lower right-hand corner of Figure 1-A. The valve 289 in the pipe 290, extending from the left-hand side of the liquid level indicating controller 287, is then opened and compressed air passes from the source of compressed air 281 through the pipes 282, 284 and 285 and into the instrument 287 (Figure 1).

This instrument 287 has an optimum setting at zero which indicates the desired level to be maintained of the liquid 345 in the pad box 295. Now, when the pad box or booster tank is empty, as is now the case, air under pressure will be transmitted through the instrument 287 until the optimum condition exists relative to the amount of liquid in the pad box or booster tank 295 according to instrument 287. The pad box or booster tank 295 being empty, air pressure passes through the pipe 290, through the valve 289 and to the valve 291 to thus open the same and to permit the reduced dye to pass from the tank 50 through the nipple 95 and the pipe 97 to the lower end of the portion 297 of the rotameter 293 (Figure 1-A).

The faster the rate of flow of the vat dye through the tapered tubular portion 297 of the rotameter 293, the higher the float member 300 will be disposed in the tubular portion 297 to thus relatively decrease the force of the compressed air transmitted from the instrument 320 to the instrument 322 through the pipe 324, the movement of the float member 300 causing the soft iron armature 306 to move correspondingly whereby the soft iron armature 306 will react on the transmitter impedance coil 307 to cause the relative reaction to be transmitted to the receiver impedance coil 316 and the soft iron armature 317 in the manner heretofore described.

As the reduced dye passes through the rotameter and through the pipe 294 and is discharged into the pad box or booster tank 295, the rheostat 374 is manually adjusted to transmit the desired speed to the electric motor 370 and

to thereby transmit rotation to the squeeze rolls 363 and 364 and this will, in turn, cause the fabric 369 to be drawn beneath the immersion roll 362, through the reduced dye 345 in the pad box or booster tank 295.

Now as soon as the required amount of dye has entered the pad box or booster tank 295, the weight of the liquid reduced dye will create a pressure on the lower end of the pipe 340 which projects into the pipe 344 connected to the pad box or booster tank 295 and the other end of this pipe 340, being connected to the instrument 287, will automatically stop or reduce the pressure of the air, from the pipe 285 at one side of the instrument 287 (Figure 1) through the pipe 290 at the other side of the instrument 287 against the diaphragm of valve 291.

Now, when the air pressure is thus released from the valve 291, it will automatically close, conversely, as the dye is used up in the padding operation, by the fabric 369 passing through the reduced dye 345 in the pad box or booster tank 295, the pressure on the lower end of the pipe 340 will be reduced slightly and proportionately, and will thereby partially open the valve 291 to thus cause an automatically controlled continuous flow of reduced dye from the reducing tank 50 to the pad box or booster tank 295. The sight feed bubbler 354 serves the same purpose for the pipe 340 as the bubbler 350 does for the pipe 91.

In order that the rate of flow of the vat dye and sodium hydrosulphite may be uniform throughout the operation of this apparatus, when the rate of flow required is established by the cloth 369 passing through the reduced dye 345 in the pad box or booster tank 295, the rod 306 will remain at a particular level to transmit a certain reaction to the receiver impedance coil 316 in the electric indicating liquid level air operated controller 320 in the manner heretofore described, which will, in turn, indicate the flow in gallons per minute of the liquid passing through the rotameter 293. As the rate of flow of liquid in gallons per minute increases through the rotameter 293, this is indicated in the indicator 320 and the air under pressure then passes from the pipe 284 (Figure 1) through the pipe 323, through the instrument 320, through the pipe 324 to the instrument 322 and according to the gallons per minute as indicated in the instrument 320, there is an automatic means, not shown, disposed in the instrument 322, which is called "Indexet" mechanism and is a commercial part of this device, which will automatically reset the instrument 322 to the required number of gallons of liquid to be maintained in the reducing tank 50 and which will, in turn, permit the air under pressure to pass through the pipe 347 from the pipe 284, and in the event that the instrument indicates that there is not sufficient liquid in the reducing tank 50, the air under pressure will continue through the instrument 322 through the pipe 195 and to the valve 271 as well as the cap 175 associated with the cylinder 173 of the damper operator and will thus permit the vat dye to pass into the reducing tank 50 in the manner heretofore described.

It is thus seen that the valves 271 and 291 as well as the diaphragm 174 in the cylinder 173 and associated parts would fluctuate in their operation according to the rate of flow of the reduced dye from the tank 50 to the pad box or booster tank 295.

The sight feed bubblers 350 and 354 are merely

provided to indicate, to the operator, if the pressure of the liquid in the reducing tank 50 and the pad box 295, respectively, is creating the desired effect in the corresponding pipes 91 and 340 to insure operation of the instruments 287 and 322. Each of the sight feed bubblers 350 and 354 is in fact a needle valve confined in a glass bulb filled with water or some other clear liquid so that the flow of air in the needle valve confined in a glass bulb may be determined by the rate at which air bubbles are formed in each of the sight feed bubblers. The pressure of the air supplied to the sight feed bubblers 350 and 354 from the instruments 322 and 287, respectively, must, of course be higher than the pressure of the maximum head of liquid at the lower ends of the pipes 91 and 340, respectively. The respective sight feed bubblers permit a small amount of air to pass from the corresponding instruments through the same and through the respective pipes 344 and 90 in Figure 1-A and thus into the atmosphere.

However, the air within these pipes 91 and 340 will not escape into the atmosphere until after sufficient pressure has been built up by the air from the respective sight feed bubblers to balance the pressure exerted by the head of the liquid at the lower ends of the pipes 91 and 340. In operation the pressure on the respective instruments 322 and 287 will always be equal to the pressure exerted by the head of the liquid at the lower ends of the pipe lines 91 and 340.

There are various combinations of formulae, timing and speeds that may be used with this apparatus; however, to better understand the operation of this apparatus, one example of the manner in which this apparatus may be operated is as follows:

Assuming that it is desired to dye 15,000 yards of 2.50 drill fabric in a tan shade and which will require 500 gallons of dye solution of the following formula:

Ounces per gallon	
Ponsol Brown AG Double Paste.....	2
Caustic (sodium hydroxide).....	1
Sodium hydrosulphite.....	1.5

Therefore 62½ pounds of Ponsol Brown AG Double Paste and 31¼ pounds of caustic are mixed with sufficient water in the storage tank 250 to make a total volume of 500 gallons of mixed dyestuff 251.

It is desired to run the cloth 360 at a speed of 90 yards per minute and it is known that one gallon of dyestuff solution 345 will be taken up by 30 yards of 2.50 drill. Therefore the consumption of dyestuff solution 345 will be at the rate of 3 gallons per minute. Since it is desired that the dyestuff shall have a reducing time of 10 minutes it follows that the volume of dyestuff in the reducing tank 50 should be 30 gallons.

Therefore 30 gallons of dye liquor from the storage tank are run into the reducing tank. Since 1½ ounces of sodium hydrosulphite per gallon of dye liquor are required to reduce the dye, the pointer 138, Figure 4, is set at "1½" on the calibrated scale 139. Since the hydrosulphite feed is automatically controlled by the flow of dye liquor from the storage tank to the reducing tank, 1½ ounces of hydrosulphite will be delivered to the first chamber 46 of the reducing tank 50 for each of the 30 gallons of dye liquor from the storage tank 250.

When the dye liquor reaches the 30 gallon level in the reducing tank 50, the flow of both dye

liquor and hydrosulphite is automatically shut off by action of the level control in the manner heretofore described.

After the 10 minute reducing time is up, the reduced dye solution in the reducing tank 50 is allowed to flow, by gravity, at approximately the predetermined rate of 3 gallons per minute into the pad box or booster tank 295 which is presumed to have a capacity of approximately five gallons. This automatically starts the flow of dyestuff 251 from the storage tank 250 to the reducing tank 50 and the addition of sodium hydrosulphite 252 in the proper proportion from the hopper 100.

When the pad box or booster tank 295 is filled, the flow of dye from the reducing tank 50 is cut off by the level control in the manner heretofore described.

The apparatus is now started and, as the cloth 360 passes through the pad box or booster tank 295 and absorbs dye, the dye liquor 345 in the pad box or booster tank 295 is maintained at a uniform level by the action of the level control in controlling the flow of dyestuff solution from the reducing tank 50, as has heretofore been described.

If for some reason, the absorption of the dye liquor by the cloth is more or less than anticipated and, resultantly, the rate of flow of the dye liquor from the reducing tank through the rotameter to the pad box or booster tank is more or less than the predetermined rate of 3 gallons per minute, the control instrument 320 (Figure 1) connected with the rotameter 293 (Figures 1-A and 7) will reset the level control in the reducing tank 50 to give a total volume of liquor in the reducing tank 50 which, at the actual rate of flow, will still retain the dye liquor in the reducing tank 50 for the necessary 10 minutes reducing time. At the same time, the flow of dye liquor from the storage tank 250 to the reducing tank 50 will be automatically regulated, in the manner heretofore described, to conform to the new rate of dye liquor consumption.

For example, if the rate of flow is 3¼ gallons per minute, the volume in the reducing tank is automatically adjusted to 32½ gallons and, if the flow is 2¾ gallons per minute, the reducing tank volume would be maintained at 27½ gallons. The hydrosulphite feed is, of course, automatically adjusted to provide 1½ ounces for each gallon of dye liquor entering the reducing tank 50, in the manner heretofore described.

It is to be understood that this apparatus may be used in other ways, such as, in feeding a prepared reducing liquor to a booster tank where cloth is treated to reduce dye that has been applied to the cloth in pigment form. In this instance, the cloth 360 (Figure 1-A) may be fed to the pad box or booster tank 295 from a suitable pad box (not shown) in which the cloth has been impregnated with dye in pigment form and, in this instance, the tank 295 would be used as a booster tank.

In this instance, the storage tank 250 would contain an ample supply of an aqueous solution of sodium hydroxide, which would be fed to the tank 50 (serving as a mixing tank) in the same manner in which the dyestuff had been fed to the tank 50 from the storage tank 250, and wherein the sodium hydroxide solution would be mixed with a predetermined amount of the granular sodium hydrosulphite from the hopper 100, in the manner heretofore described, to thus provide a reducing liquor consisting of an aqueous

solution of sodium hydroxide and sodium hydrosulphite which would flow, by gravity, to the tank 295 at a controlled rate, in which instance the tank 295 would serve as a booster tank. After the cloth 350 has passed through the reducing solution in the pad box or booster tank 295 it would then be squeezed between the squeeze rolls 364 and 370 and fed to a suitable development tank or a steam ager such as is shown in the patent to Sherman Converse, No. 2,441,992, of May 25, 1948, after which the fabric or yarn is washed, soaked, and otherwise treated in a conventional manner as in the process previously described.

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

We claim:

1. Apparatus for dyeing cloth having a dye storage tank, a dye reducing tank and a hopper adapted to hold granular sodium hydrosulphite, means automatically controlled by the level in the dye reducing tank for feeding the dye from the storage tank to the dye reducing tank and also for automatically feeding the granular sodium hydrosulphite from the hopper to the reducing tank in direct proportion to the amount of dyestuff fed from the storage tank to the reducing tank, a pad box, means automatically controlled by the level of the dyestuff in the pad box for feeding the dyestuff from the reducing tank to the pad box, a pair of squeeze rolls disposed above the pad box and automatic means for maintaining the level of the reduced dyestuff in the pad box regardless of the speed at which the reduced dyestuff is used up by the material as it passes through the same and whereby the squeeze rolls squeeze excess vat dyestuff from the cloth after it passes through the pad box and means automatically controlled by the depth of the dyestuff in the pad box for controlling the rate of flow of the dyestuff from the reducing tank to the pad box.

2. Apparatus for dyeing cloth having a dye storage tank, a dye reducing tank and a hopper adapted to hold granular sodium hydrosulphite, means automatically controlled by the level in the dye reducing tank for feeding the dye from the storage tank to the dye reducing tank and also for automatically feeding the granular sodium hydrosulphite from the hopper to the reducing tank in direct proportion to the amount of dyestuff fed from the storage tank to the reducing tank, a pad box, means automatically controlled by the level of the dyestuff in the pad box for feeding the dyestuff from the reducing tank to the pad box, a pair of squeeze rolls disposed above the pad box and automatic means for maintaining the level of the reduced dyestuff in the pad box regardless of the speed at which the reduced dyestuff is used up by the material as it passes through the same and whereby the squeeze rolls squeeze excess vat dyestuff from the cloth after it passes through the pad box and means automatically controlled by the rate of flow of dyestuff into the pad box for regulating the rate of flow of dyestuff and sodium hydrosulphite from their respective sources to the reducing tank.

3. In an apparatus for dyeing cloth by padding having a dye reducing tank and having a storage tank for liquid vat dyestuff and having a hopper for holding a quantity of granular sodium hydro-

sulphite disposed above the dye reducing tank and having an opening at the bottom thereof and also having a pad box through which the cloth is passed, means for conducting the liquid vat dyestuff from the storage tank to the reducing tank, means controlled by the head pressure of the liquid vat dyestuff in the dye reducing tank for automatically controlling the flow of the liquid vat dyestuff from the storage tank to the dye reducing tank and proportionately controlling the size of the opening at the lower end of the hopper for releasing the granular sodium hydrosulphite from the hopper to the dye reducing tank, a pipe line extending from the dye reducing tank to the pad box for discharging the dye from the dye reducing tank to the pad box, means controlled by the liquid level in the pad box for feeding dyestuff from the reducing tank to the pad box, and means controlled by the rate of flow of dyestuff into the pad box for regulating the rate of flow of the liquid dyestuff and sodium hydrosulphite from their sources into the reducing tank.

4. Apparatus for reducing dye for application to cloth in pigment form having a storage tank adapted to contain a supply of vat dyes and sodium hydroxide mixed with water, said apparatus also having a mixing tank and a pipe feeding the solution in the storage tank to the mixing tank, said apparatus also having a hopper adapted to hold a quantity of granular sodium hydrosulphite and being disposed above the mixing tank and having an opening at the bottom thereof, means automatically controlled by the level of the solution in the mixing tank for proportionately controlling the size of the opening at the bottom of the hopper and also controlling the rate of flow of the solution from the storage tank to the mixing tank, whereby the opening at the lower end of the hopper will permit a predetermined amount of the granular sodium hydrosulphite to fall by gravity from the hopper into the mixing tank thus forming a reducing solution, said apparatus also having a pad box disposed below the level of the mixing tank and through which the cloth is passed, a pipe line extending from the mixing tank to the pad box, for discharging the reducing solution from the mixing tank to the pad box and means automatically controlled by the level of the solution in the pad box for controlling the flow of solution from the mixing tank to the pad box.

5. In a structure according to claim 4, automatically controlled means whereby, after the flow of the reducing solution from the mixing tank to the pad box has been started, the rate of flow of the sodium hydroxide solution from the storage tank into the mixing tank will be such as to permit the sodium hydroxide solution and the granular sodium hydrosulphite to remain in a mixed state for a predetermined length of time regardless of changes in the rate at which the reducing solution is fed to the pad box.

6. In a structure according to claim 4, manually adjustable means for adjusting the ratio of the amount of granular sodium hydrosulphite that is released from the hopper to the mixing tank relative to the rate of flow of the sodium hydroxide solution from the storage tank to the mixing tank as desired.

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