R. SYKORA.

COLORING MACHINE.

APPLICATION FILED FEB. 11, 1920.

1,401,504. **Patented Dec. 27, 1921.**

3 SHEETS—SHEET 1.

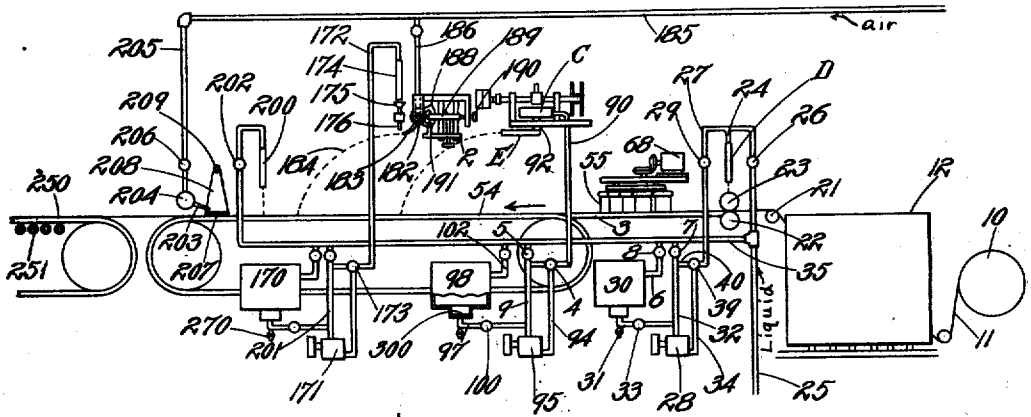


Fig. 1.

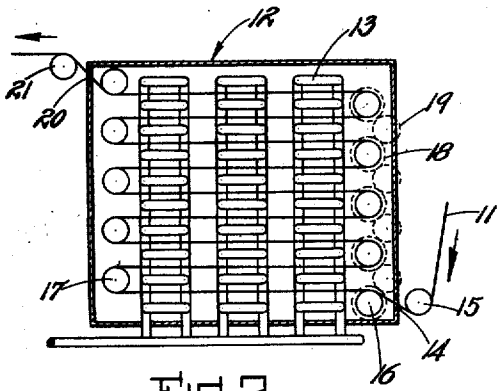


Fig. 2.

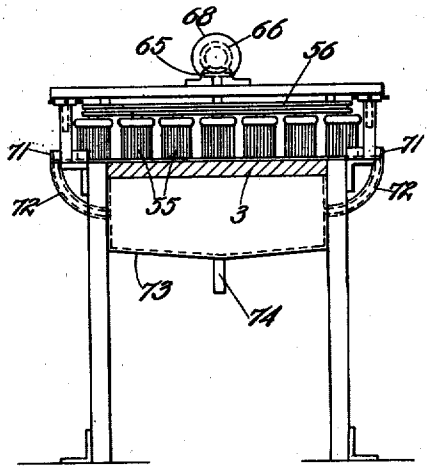


Fig. 4.

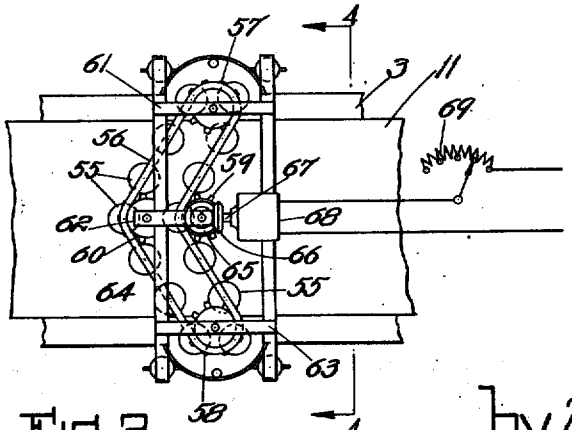


Fig. 3.

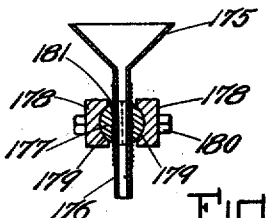


Fig. 9.

INVENTOR.

Rudolf Sykora

by Macleod, Calver, Copeland & Dike

Attys.

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3 SHEETS—SHEET 2.

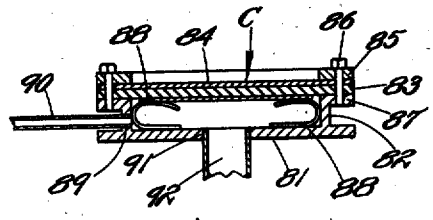


Fig. 7.

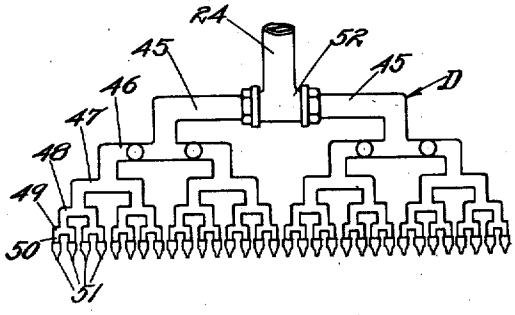


Fig. 6.

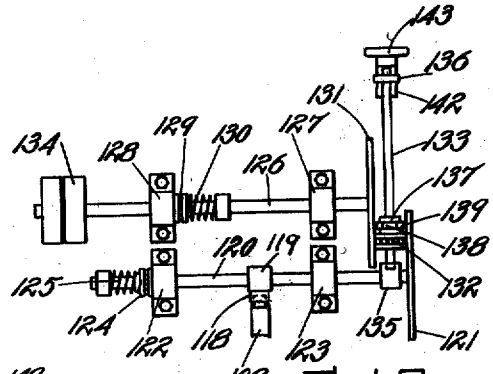


Fig. 8.

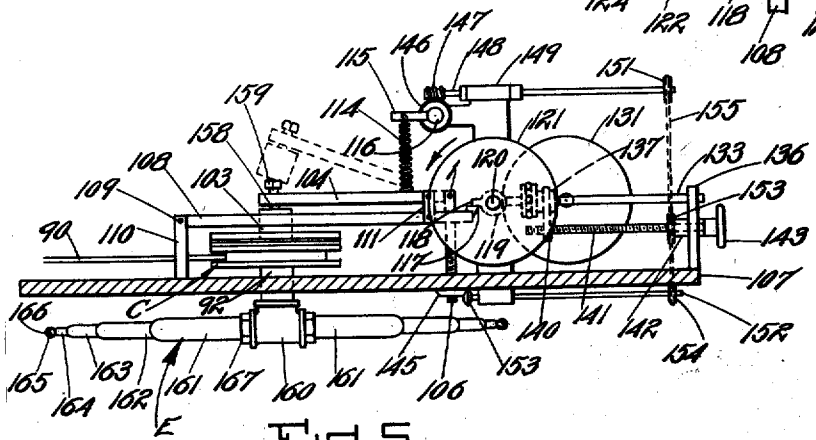


Fig. 5.

INVENTOR:

Rudolf Sykora

by Macleod, Calver, Copeland & Dike

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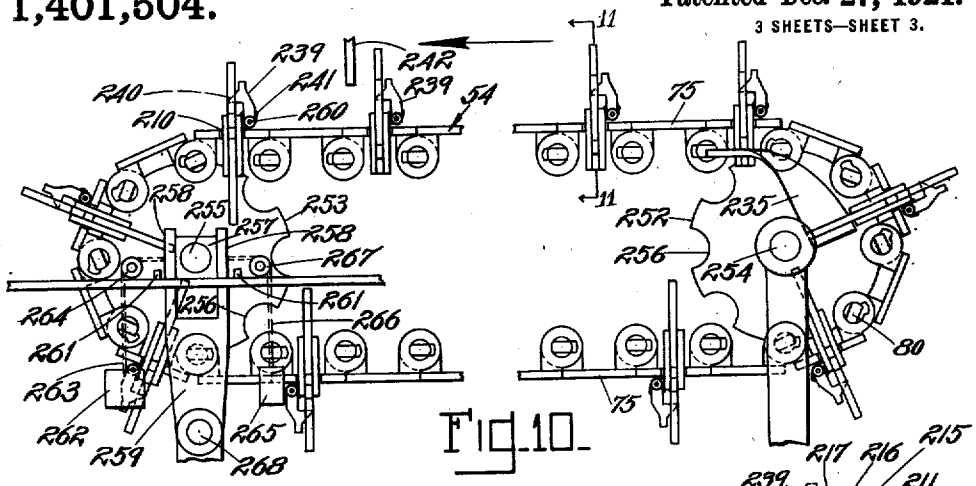


Fig. 10.

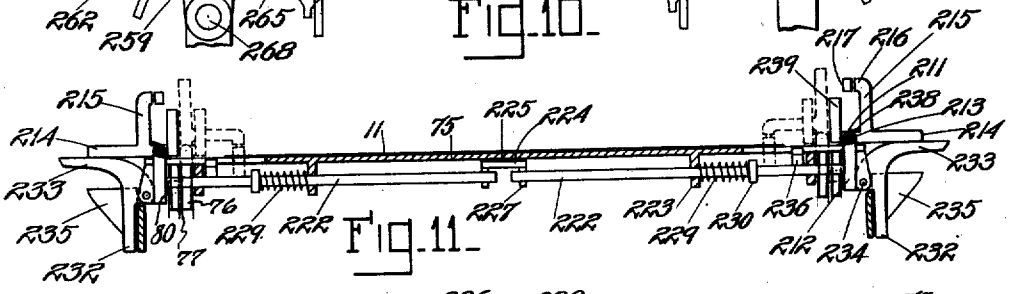


Fig. 11.

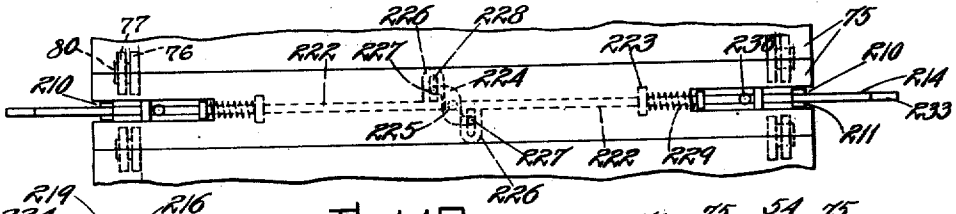


Fig. 12.

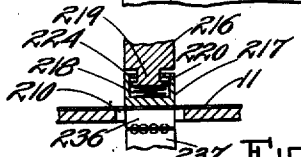


Fig. 14.

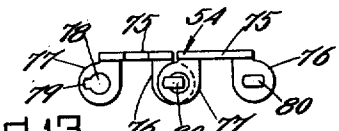


Fig. 13.

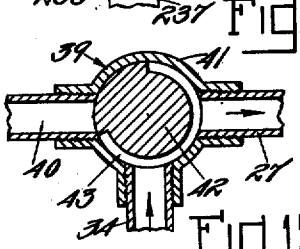


Fig. 15.

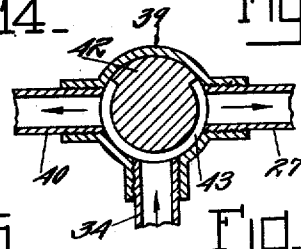


Fig. 16.

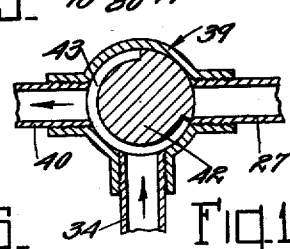


Fig. 17.

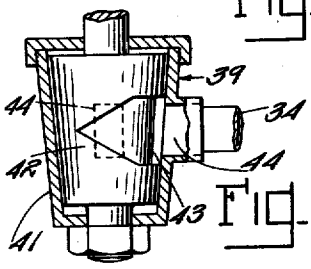


Fig. 18.

INVENTOR.

Rudolf Sykora

by Macleod, Calver, Copeland & Dike

Attys.

UNITED STATES PATENT OFFICE.

RUDOLF SYKORA, OF BOSTON, MASSACHUSETTS.

COLORING-MACHINE.

1,401,504. Specification of Letters Patent. Patented Dec. 27, 1921.

Application filed February 11, 1920. Serial No. 357,778.

To all whom it may concern:

Be it known that I, RUDOLF SYKORA, a citizen of the United States, residing at Boston, county of Suffolk, State of Massachusetts, have invented a certain new and useful Improvement in Coloring-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

Water-colored paper is used for a great variety of purposes. Sometimes for highly artistic effects, wall paper is water-colored. Paper of this character is also employed for coverings for boxes and for numerous other purposes. Heretofore most of this coloring has been done by hand and this is not only a slow and expensive process but also it is difficult and practically impossible to uniformly distribute the chemical or coloring matter on the paper, so that when large sheets or long strips of paper, such as wall paper, are treated in this way it lacks uniformity of appearance and this is a great detriment to the use of water-colored paper where considerable surface is to be covered.

One object of my invention is to provide a machine through which the strip or sheet of paper, or other material, may be run by an automatic feed and having automatic devices for spreading the coloring matter upon the paper and distributing it in a uniform manner. Another object of the invention is to provide means for regulating the amount of coloring matter, the strength of the coloring matter and the distribution of the same according to the design intended to be made on the paper.

The wetting of paper causes expansion of its fibers, thus enlarging the size of the paper in all directions proportionately to the amount of moisture absorbed. As the density of said fibers varies, the expansion is not uniform and this causes the surface of the paper to undulate. One object of the invention is to provide mechanism which takes up the expansion and also which yields to the contraction so as to always keep the paper taut.

In apparatus embodying the invention the paper is run from a roll through the machine which contains the various instrumentalities for performing the different operations upon the paper to properly color it and to dry it, and preferably it is run from the machine up on another roll in its finished form. In the preferred form of apparatus and as shown in the drawings, the paper is first run through a drying system which gives the paper the proper, uniform dryness. It then passes under a device for applying water, coloring matter, or chemicals to the surface of the paper, thence to a system of brushes by which the coloring matter is brushed into the paper, thence to a diaphragm system by which if desired additional coloring matter is distributed to the paper by means of a hammering process on the drum which forces coloring matter out of the drum through a system of nipples, thence to a spray device by which either coloring liquid or water may be applied to the paper through nozzles and distributed by compressed air acting upon the spray as it comes from the nozzles, thence to another air blast system for further distributing or spreading the coloring matter upon the paper before it becomes dry so as to give varying effects according to the force of the air blast, thence through a drying system for drying the paper before it goes on the wind-up roll.

Means are provided whereby the amount of coloring matter and the degree of the air blast is controlled so as to vary the amount or even to entirely shut off any particular one of the said instrumentalities while the others are in operation, also to adjust the angle at which the application of the spray or air blast is applied.

The various features of the invention will be more fully set forth hereinafter.

The invention will be fully understood from the following description when taken in connection with the accompanying drawings, the novel features thereof will be pointed out and clearly defined in the claims at the close of this specification.

In the drawings, Figure 1 is a diagrammatic view of a machine embodying the invention.

Fig. 2 is a vertical sectional view of the drying chamber through which the paper first runs from the reel.

Fig. 3 is a plan view showing the brush mechanism for brushing the water or coloring matter into the paper.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is a detail elevation partly in section as viewed from the right-hand of Fig. 1 showing the spray nozzles and diaphragm chamber for discharging the coloring mat-

ter through the spraying nozzles and the adjusting mechanism therefor.

Fig. 6 is a detail view of one set of spraying nozzles.

Fig. 7 is a sectional view of the diaphragm chamber shown in Fig. 5 on a slightly larger scale.

Fig. 8 is a detail view showing the variable speed mechanism for use in connection with the operation of the diaphragm chamber.

Fig. 9 is a detail view on an enlarged scale of one of the funnels for the liquid applying mechanism used in connection with an air blast.

Fig. 10 is a side elevation view as in Fig. 1, showing the paper supporting mechanism and the mechanism for gripping the paper to hold it against buckling when passing through the wetting and drying process.

Fig. 11 is a section on line 11—11 of Fig. 10.

Fig. 12 is a plan view of the parts shown in Fig. 11.

Fig. 13 is a detail view of a portion of the paper supporting mechanism shown in Fig. 10.

Fig. 14 is a portion of the paper gripping mechanism.

Figs. 15, 16 and 17 are views showing the special form of valve employed in three different positions.

Fig. 18 is a side view of the special form of valve shown in Figs. 15, 16 and 17.

Referring now to the drawings, 10 represents a roll from which the long strip or sheet of paper 11 is unrolled to be fed through the machine. The paper first passes through a drying chamber 12 in which is contained a steam or hot water pipe system 13, the paper being caused to pass back and forth between the coils of pipe so that it will have a long run and stay in the drying chamber a sufficient length of time to give to the paper the desired degree of dryness. Preferably it enters the drying chamber through a slot 14 near the bottom of the chamber, passing first around under a guide roll 15, thence through the slot 14, thence back and forth over a series of guide rolls 16 and 17. The guide rolls 16 on one side of the chamber having driving connection with each other by means of gears 18 mounted on the shafts of said guide rolls 16 and intermediate gears 19 which transmit the drive from one guide roll to the next guide roll above. The rolls 17 on the other side of the chamber are simply idler rolls and do not need any gear connection.

From the upper left-hand idler guide roll 17 the strip of paper passes out through the slot 20 over an idler roll 21 and thence passes between two rolls 22—23. The roll 22 is preferably a metal roll and the roll 23 is preferably a felt roll through the medium of which the paper receives its first application of either water or chemical or coloring matter.

The water or coloring matter as the case may be is supplied to the felt roll 23 through a pipe 24, the supply being controlled in such manner that not only may the quantity be regulated, but also the proportion of water to coloring matter or the water may be entirely shut off or the coloring matter may be entirely shut off, or both may be entirely shut off. The water is supplied to the pipe 24 through a water pipe 25 connected with any suitable source of supply and having a valve 26 which may be adjusted to either cut off the water or to admit water as desired.

The coloring matter, chemical or liquid, is delivered to the pipe 24 from a pipe 27 into which it is delivered through a pipe 34 connected with a pump 28. Said pipe 27 is provided with a valve 29 which controls the admission of coloring matter. In this manner by means of the two valves 26 and 29 either the water or the coloring matter may be admitted or shut off.

The coloring matter is drawn by the pump from a tank 30 through an outlet pipe 31 leading from the tank and tapped into a return pipe 32 which leads back to the pump. The passage from the tank 30 to the pump is controlled by a valve 33 by means of which the supply from the tank may be entirely cut off if desired. It is delivered by the pump 28 to the pipe 27 through a feed pipe 34 which is tapped into the pipe 27. The pipe 32 is also tapped into a water pipe 35 which has a connection with the main water supply pipe 25, but this is usually closed by a valve 7 which is only opened when it is desired to clean out the pump. Said water pipe 35 runs through the machine to supply water to the various further distributing points, as will be hereinafter described. There is also a branch pipe 6 leading from the water pipe 35 into the tank 30 for the purpose of flushing out the tank when desired, when the machine is not in operation. The tank should be provided with a waste cock. Said pipes 32 and 6 are respectively supplied with valves 7 and 8 to shut off the flow of water to the tank and to the pump through the pipes 32 and 6 in the ordinary operation of the machine.

The valve 7 is located between the water pipe 35 and the point where the pipe 27 taps into the pipe 34 through the connection 40. At the junction of the pipe 34 with the pipe 27 there is provided a two-way cock 39 preferably of special form such as shown in Figs. 15, 16, 17, and 18. This special form of valve is such that it may be made to serve either as a two-way valve or a three-way valve. The valve 39 should be adjusted so that the passage to the pipe 27 and the passage to the return pipe 32 are

both always open, but it may be adjusted so as to vary the relative proportions of the two openings.

In Fig. 15 the plug is shown as closing the passage from the pipe 40 and opening the passage from the pipe 34 to the pipe 27.

In Fig. 16 the plug is turned to open all three ways, that is the ways to the pipe 40, pipe 34 and pipe 27. In Fig. 17 the plug is shown as turned to close the passage to the pipe 27 and to open the passage between the pipes 34 and 40.

The preferred form of this three-way valve consists of a conical casing 41 and a tapered plug 42 fitting therein, as shown in Fig. 18. Said plug is preferably solid to enable it to be more readily cleaned. Said plug is formed with a groove slot 43 which extends somewhat more than halfway around the periphery of the plug, preferably about 240°, and so located on the plug that it may be brought into registration with the several pipes 27, 34 and 40, as already described. This groove is preferably tapered toward each end so that when the plug is turned to open connection between all three pipes, 27, 34 and 40, the wider portion of the groove will make the connection with the pipe 34 and the smaller portions at each end will make connection with the pipes 27 and 40. The amount of flow through the pipe 34 will always be equal to the sum of the flows through the two pipes 27 and 40. When opened to make connection between the pipes 34 and 40 or between the pipe 34 and the pipe 27 and to cut off connection with the other, the wider part of this slot will be in registration with both of the open pipes. It is obvious that the plug may be turned to any intermediate point between the positions shown in Figs. 15 and 16, or between those shown in Figs. 16 and 17, so as to vary the relative size of the openings from one point to another.

The casing 41 is formed with three slots 44 placed 90° apart from each other through which the connection is made from the several pipes 27, 34 and 40 to the groove 43 in the plug.

In ordinary use of the machine the plug 42 will be turned so as to close the passage to the pipe 40 and open the passage from the pipe 34 to the pipe 27 so that the pump 28 can deliver the liquid coloring matter to the pipe 27 in full strength.

The liquid which passes through the pipe 24 should be delivered by a very uniform distribution to the periphery of the roll 23 and for that reason the stream is divided and sub-divided several times until finally it passes out through a large number of small nozzles at uniform short distances apart for the full length of the roll 23. This distribution system is indicated at D in Fig. 1 and is shown in detail in Fig. 6. Preferably it is divided first into halves, then the halves are divided into quarters, the quarters into eighths, the eighths into sixteenths and the sixteenths into thirty-seconds. The exact number of divisions and sub-divisions, however, is not so essential but may be varied according to experience and width of the roll of paper which is being treated, and other conditions. As shown in the drawings the liquid is delivered from the pipe 24 to two oppositely extending branch connections 45—45 which are connected by a union 52, and each branch 45 is connected to the middle of a pipe 46 which at each end has a right-angled turn which is connected to two pipes 47 intermediate its ends, and each of the said pipes 47 is connected to a similar shaped pipe 48, which in turn is connected to the middle of a U-shaped pipe 49, thus making a series of thirty-two terminal portions 50, all disposed in a straight line series at equal distances apart, and each terminal number 50 is provided with a nozzle 51.

The branch arms 46 are preferably provided with valves, so that the flow through any one or more of them may be shut off if desired.

After passing between the rolls 22 and 23 and receiving the application of water or coloring matter by the felt roll 23, the paper is delivered onto a table 3 and thence it passes to the endless carrier 54. While passing over the table 3 it is subjected to a brush action by a series of brushes which are actuated to travel in a continuous path for the purpose of brushing the water or coloring matter into the paper. This brush system is shown more in detail in Figs. 3 and 4. To get the best results the brushes should not travel in a circular path nor reciprocate in a straight path. I have found that I obtain the best results by having the brushes move in what I term a biangular path transversely of the paper and pass entirely off the paper on each side and freshly engage the paper on its return movement. The construction of this brush system is as follows:

A series of brushes 55 are secured at regular intervals apart to an endless chain 56 which passes over two opposite end sprockets 57—58 and over the two intermediate sprockets 59—60, positioned so as to cause each run of the chain to move in an angular path, the two angular paths being parallel with each other and lying in a horizontal plane, so that the chain and brushes travel in a horizontal plane but in an angular path. Said sprockets 57, 58, 59 and 60 are respectively mounted on shafts which are journaled in an overhead frame having cross-pieces 61, 62 and 63 which contain the bearings for the said shafts. The sprocket 59 which may be termed the driving sprocket is mounted on a shaft 64 on which is

mounted a beveled gear 65 which is engaged by a beveled gear 66 mounted on the shaft 67 which is driven by a motor 68. The driving sprocket drives the chain which runs over the other sprockets. Preferably a rheostat 69 is employed by which the speed of the sprocket chain may be regulated.

The brushes 55 are hung vertically, each brush being provided with a head 70 which is connected with the sprocket chain. The sprocket chain is mounted in such position that the lower ends of the brushes will just have a rubbing contact with the surface of the paper 11 as it passes along over the table 3. It will thus be seen that the brushes all travel in an angular path, moving forward in one path and returning by an angular path parallel with the path of forward movement, and the paper is also moving in a straight-forward direction at the same time. During the travel of the paper underneath the brushes the coloring matter or water or whatever liquid has been applied to the paper will be uniformly distributed.

It will be seen from Fig. 3 that each brush traverses the entire width of each web of paper and passes off at the side edge before it starts on its return movement.

The reason for having the brush leave the paper at one side before it begins its return stroke is that any brush saturated with the moisture substance sliding upon a surface and then stopping to move in a different direction will show a mark on the wet surface. By having the brush move entirely out of contact with the paper at the end of each stroke it has more the effect of painting than of rubbing.

A distinction should be made between rubbing and painting. Water colors are very thin and if deposited upon a web the texture of the web shows through the covered surface (or painted surface). A brush carrying water color and moving over the surface of a web will continue to deposit the coloring substance uniformly upon the surface of the web. If, however, the brush stops at any point on the surface of the web with the intention of moving in an opposite direction, or nearly so, the inclination of the bristles is changed to the direction of the lead which will produce a visible mark on the surface of the painted web; that is to say, the uniform deposit of liquid substance released from a saturated brush upon the web is proportionate to the uniform travel of the brush over the web. Any form of retardation on the part of the brush will manifest a break in the uniform deposit.

The reason for having the biangular motion so that the brush engages the edge of the paper in a diagonal forward direction is to reduce the tension on the edge of the paper to avoid tearing the paper.

By reason of the fact that there are a series of brushes and that the brushes on one run engage one edge of the sheet while at the same time those on the return run engage the other edge of the sheet, and both runs are in a forward diagonal direction with the same inclination to the plane, and at the time the brushes engage the edge of the sheet, the tendency of the friction of the brushes moving in one direction to move the sheet laterally will be offset by the opposite action of the returning brushes on the other side.

The table has on its two sides upwardly extending flanges 71 which serve to prevent any surplus liquid from running off at the sides, and pipe connections 72 are provided which lead from the table near its two sides down underneath the table to a tray 73 into which any waste liquid will be conveyed, and thence it will pass off through an outlet pipe 74.

Preferably the brushes are removable or separable from the chain carrier so that there may be no brush action, if it is desired to omit the brush action for any reason, or so that other brushes may be substituted for the removable brushes if desired; for instance if the brushes have been used with one color and it is desired to treat the paper with some other coloring matter, then the brushes which have become saturated with the previous color should be removed and new brushes substituted, so as to prevent mixing of the colors, or the whole brush system may be lifted out of active position.

As the paper passes out from beneath the brushes it will pass onto the endless carrier 54, as already explained, which will carry it through the remaining processes of the machine.

This endless carrier (see Figs. 10, 11, 12 and 13) is preferably composed of a series of link sections 75 which consist of flat-topped plates extending transversely of the machine, each being of a length sufficient to let the full width of the strip of paper pass freely inside of the clutch mechanism. The several link sections should follow each other in close order with very little, if any, gap between them, so that the paper may be constantly supported in perfectly flat condition. If the supporting surface were uneven it would tend to wrinkle the paper. I have provided a peculiar form of union between the different link sections. See particularly Fig. 13. Each link section 75 is provided with two sets of lugs 76 and 77 on its under side, there being a lug 76 at each end of the link section near its rear edge and a lug 77 at each end near the forward edge. Each forward lug 77 is provided with a journal opening 78 which is circular and on one side merges into a groove 79 to widen the

journal opening at that point. Each rear lug 76 is provided with a flat-faced journal 80 which at its greatest width is equal to the diameter of the circular portion of the slot 78 and fits into said slot 78. When the said journals 80 are all wholly within the circular portion of the slot, the two adjacent link sections 75—75 will be in close relation to each other but the extension 79 of the slot allows for a separation of the link sections 75—75 from each other for a limited distance, that is, from the position shown in Fig. 10 to that shown in Fig. 13, and this will accommodate the stretch of the paper, as will be more particularly described hereinafter in connection with the description of the mechanism for keeping the paper taut.

After the paper passes from the brush system onto the endless carrier it passes under another system for applying additional water or coloring matter, or both, to the paper in a somewhat different manner from that applied through the felt roll 23. This system I term the diaphragm system because I make use of a diaphragm and a tapper or hammer to secure a spurting effect. This diaphragm system will now be described. (See Figs. 1, 5, 7 and 8.)

A diaphragm chamber indicated at C in Fig. 1 is provided consisting of a closed box having a metal bottom 81 and rim 82, and a diaphragm top which preferably consists of a rubber disk 83. For purpose of protecting the rubber disk against the wear from the hammer, the diaphragm is covered with a leather disk 84, said two disks 83 and 84 being clamped to the metal box by a clamp ring 85, which is secured in position by screws 86 which pass through the clamping ring and the disks 84 and 83 into the flange 87 of the rim 82. Preferably springs 88 are inclosed in the chamber between the bottom 81 of the chamber and the diaphragm 83 to afford greater resiliency to the diaphragm.

In one side of the diaphragm box is an inlet aperture 89 which passes through the side wall of the metal portion of the chamber, and an inlet pipe 90 is connected with this apperture 89. In the bottom 81 of the box there is an outlet aperture 91 with which is connected an outlet pipe 92, the outlet aperture 91 being of considerably greater area than the inlet aperture 89.

The pipe 90 is tapped by a pipe 94 which leads from a pump 95. The pump 95 has an inlet pipe 9 into which is tapped a pipe 97 leading from a tank 98 which contains coloring matter or chemicals, and said pipe 9 is also tapped into the water supply pipe 35 so that the pump 95 can draw liquid from the tank 98 or water from the pipe 35. The tank 98 is provided with a screen or filter, as shown at 300, by which the liquid coloring matter is strained before passing into the various delivery pipes. A valve 5 is provided in the pipe 9 so that the communication with the water pipe may be closed or left open, as desired, and the pipe 97 is provided with a valve 100 which controls the opening or closing of the communication with the liquid color tank 98. At the junction of the pipe 94 with the pipe 90 there is provided a two-way valve 4 of similar construction to the special two-way valve 39 already described, so that by adjusting the several valves 4, 5 and 100, the pump may supply the diaphragm chamber with coloring matter from the tank 98 or with colored water, or with both coloring matter and water, and in any proportion desired. Preferably a valve controlled water pipe 102 is provided leading from the water pipe 35 into the upper part of the coloring tank 98 to supply water for flushing out the tank 98 when desired.

The outlet pipe 92 connects with a distributer system of nozzles indicated at E in Fig. 1, similar to that already described and shown in Fig. 6 as being provided for supplying the felt moistening roll 23. This nozzle system is connected with the pipe 92 by a swivel joint connection or union in such manner that the nozzles may all be allowed to point downward like the distributer system shown in connection with the pipe 24, or it may be turned up into horizontal position as shown in Fig. 1 in connection with the diaphragm chamber, so that the liquid matter will be ejected horizontally, or it may be set at an angle between the horizontal and the vertical. The object of having it sometimes set in the horizontal position as shown in Fig. 1 in connection with the diaphragm is so that the liquid will squirt out horizontally and gradually curve downward, and therefore fall with less force upon the paper than if it is caused to fall directly down.

It is preferred to have the liquid forced out through the pipe 92 and the several nozzles by a sort of spurt instead of a steady flow, and this is accomplished by means of a rapid hammering action on the diaphragm, and this hammering action I control or regulate so that the blows shall be of a greater or less intensity and greater or less frequency according to the effects which I desire to produce. The hammering mechanism and its actuating mechanism will now be described. See Figs. 1, 5 and 8.

A hammer head 103 is carried on the under side of a lever 104 near its outer end, the other end of said lever 104 being fulcrumed at 1 to the post 106 rising from and journaled in a bottom support 107. Said lever 104 is caused to rise and fall and to cause the hammer to strike upon the diaphragm. A lever 108 is pivotally connected at 109 to the upper end of a post 110 rising

from the frame 107 and extends parallel with the pivoted lever 104, the other end of said lever 108 being connected near its other end by a link 111 with the lever 104 near the pivoted end of the lever 104, said link being pivotally connected to the levers 108 and 104. The fulcrum of the lever 108 is at the opposite end from the fulcrum of the lever 104. Thus it will be seen that the movable end of the lever 104 is at the end of the long arm of said lever, and the movable end of the lever 108 is on the short arm of said lever 108. A coil spring 114 is connected at one end with the long arm of the lever 104 and at its other end it is connected with an arm 115 which projects rigidly from a shaft 116 which is normally stationary, but it is adjustable as will be hereinafter described. The spring 114 holds the lever 104 with its hammer 103 in an upwardly inclined position, as shown by the dotted lines in Fig. 5, with the hammer raised some distance above the diaphragm. The short arm of the lever 108, that is the right-hand end as shown in Fig. 5, carries a lug 117 which projects into the path of a tappet or finger 118 which projects from a collar 119 on a rotary shaft 120. Said shaft rotates in the direction of the arrow in Fig. 5, and as the shaft rotates the said tappet or finger 118 engages with said lug 117 carrying down the short arm of the lever 108 slightly below the position shown in Fig. 5 until the tappet rides off the lug 117. When the moving end of the lever 108 is thus carried down it pulls down the free end of the hammer lever 104 by reason of the link connection 111, stretching the spring 114 and causing the hammer 103 to strike the diaphragm chamber. As soon as the tappet or finger 118 has ridden off the lug 117, the spring 114 will immediately lift the hammer into the position shown in dotted lines in Fig. 5, and thereby through the link 111 will lift the lever 108 again into position for the lug 117 to be engaged by the finger 118 at the next rotation of the shaft 120. In Fig. 5 the full line position of the hammer shows it in an intermediate position, that is slightly above its lowermost position. The diaphragm will yield very slightly, sufficiently to allow the further tipping of the lever under the stress of the blow by the finger 118 upon the lug 117.

It will thus be seen that a succession of blows will be delivered by the hammer upon the diaphragm, the rapidity of the blows depending upon the speed of rotation of the shaft 120.

I have provided a variable friction drive for the shaft 120 which is one of the features of my invention.

Mounted on the shaft 120 is a friction disk 121. Said shaft 120 is journaled in bearings 122—123, being slidable therein longitudinally and being also rotatable therein. It is provided with a ball thrust bearing 124 having a spring 125, which tends to pull the shaft toward the left, as viewed in Fig. 8.

A shaft 126 is journaled in bearings 127—128, being slidable therein longitudinally as well as being rotatable therein in similar manner to the shaft 120 in its bearings. This shaft is provided with a thrust bearing 129 having a spring 130 which tends to push the shaft 126 endwise to the right, as viewed in Fig. 8. Mounted on this shaft 126 is a friction disk 131. The springs 125 and 130 of the two-ball thrust bearings 124 and 129 therefore tend to push the two friction disks 121 and 131 toward each other. A ball friction pulley 132 is mounted loosely on a shaft 133 between the two disks 121 and 131 and engages both of said disks. Mounted on the shaft 126 is a drive pulley 134 which rotates the shaft 126, and thereby through the friction disk 131 and the ball friction pulley 132 rotates the disk 121, thus rotating the shaft 120 and rendering operative the tappet 118, as already described, to actuate the hammer 103. The ball friction pulley 132 takes up the annular as well as the thrust stress.

It is obvious that if the ball friction pulley 132 is made to engage the two disks 121 and 131 at equal radial distances from the centers of the two disks, the two disks being of the same diameter, then the speed of rotation of the disks will be equal, but if the pulley 132 should engage the driving disk 131 nearer its center than the point of engagement of the said pulley with the disk 121, then the speed of rotation of the disk 121 will be made slower, and that if the adjustment be changed so that the radial distance of engagement of the said pulley with the driving disk 131 is greater than its engagement with the driven disk 121, then the speed of the disk 121 will be increased, and by making these variations the speed of the shaft 120 and therefore of the strokes of the hammer will be varied. I provide means whereby the ball friction pulley 132 may be shifted so as to vary its point of contact with the said two friction disks 121 and 131. The mechanism for this purpose is as follows:—

The shaft 133 is supported at one end in a sleeve 135 which is loose on the shaft 120, and at its other end it is supported in a post 136 which forms a part of the frame. The ball friction pulley 132 is loose on said shaft 133 so as to rotate thereon, and is also slidable thereon lengthwise of the shaft. Rigidly connected with the said friction pulley is a spool 137 having an annular groove 138 in which are engaged the arms 139 of the fork 140, the shank end of said fork 140 having a tapped-out hole with

which a screw-threaded shaft 141 engages. Said shaft 141 passes through a sleeve 142 rigidly connected with the support 136. Said shaft is provided at its outer end with a wheel 143 whereby the said shaft may be rotated by hand. The said wheel abuts against the outer end of the fixed sleeve 142, so that when the wheel 143 and the shaft 141 are rotated the shaft 141 will be held against longitudinal movement, and thus it will act as a feed for the fork 140, causing the fork 140 to slide longitudinally of the shaft 133 in one direction or the other according to the direction of rotation of the wheel 143. The movement of the fork will by reason of the engagement of its fork branches 139 with the spool 137 move the spool and the ball friction pulley 132 lengthwise of the shaft 133. By this means the relative points of engagement of the friction 132 with the disks 121 and 131 may be varied as previously mentioned.

I find it is desirable to be able to adjust the hammer to varying lengths of throw in order to get delicate adjustments and variations in the effect upon the diaphragm. For this reason I provide means whereby the fulcrum 1 of the lever 104 may be varied and adjusted, and to this end the post 106 is cylindrical and screw-threaded toward its lower end, which passes loosely through the frame 107, and it is provided on its lower end with a bevel gear 145 which is set up against the under side of the frame 107 so as to hold the post 106 at its adjusted elevation. By turning the bevel gear 145 one way or the other, as the case may be, the post 106 may be raised or lowered.

It is also desirable to vary the tension of the spring 114 so as to vary the force of the stroke of the hammer. In order to accomplish this I provide means whereby the arm 115 to which the upper end of the spring 114 is connected may be moved up or down. When the outer end of the arm 115 is moved up it will increase the tension. I accomplish this by providing means for turning the shaft 116 in its bearings. Means which I provide are as follows:—

Mounted on the shaft 116 is a worm gear 146 which engages with the worm 147 mounted on the shaft 148; said shaft 148 is journaled in a bearing 149 in the frame of the machine. It will be obvious that by rotating the shaft 148, thereby turning the worm gear 146 and shaft 116, the arm 115 may be turned so as to be upwardly inclined or downwardly inclined according to the direction of rotation of the shaft 148. I also provide a shaft 152 journaled in suitable supports and carrying at one end a beveled gear 153 which engages with the beveled gear 145 on the post 106.

Said shafts 148, 141 and 152 may all be adjusted independently of each other, if desired. I prefer, however, to have them adjusted simultaneously and by a common actuating mechanism. In order to do this I provide the shaft 148 with the sprocket wheel 151, the shaft 141 with the sprocket wheel 153, and the shaft 152 with the sprocket wheel 154. The sprocket chain 155 runs over said sprocket wheels 151, 153 and 154, so that the three shafts 148, 141 and 152 will be operated in unison. Thus when the shaft 141 is turned it causes the fork 140 to slide on the shaft 133 and thereby shift the ball friction pulley 132 to vary the speed; the arm 115 which controls the spring 114 is turned up or down, and the bevel gear 145 is turned so as to vary the elevation of the fulcrum 1.

It is rather important that the hammer 103 shall always strike the diaghragm squarely, and I therefore provide the hammer with adjustable connection with the lever 104 so as to be able to vary the distance from the striking face of the hammer to the lever to correspond with the variation in the position of the fulcrum 1. To provide for this the hammer head 103 is connected with the lever 104 by a screw-threaded shank 158 which has a screw-threaded connection with the lever 104 and is provided at its upper end with a clamp nut 159.

When the inlet pipe 90 to the diaphragm chamber and the outlet pipe 92 are both open there will always be a flow of liquid from the pipe 92 to the distributing nozzles connected with the said pipe 92, yet the hammer blows upon the diaphragm will cause the liquid to be ejected by a continued series of spurts.

As already stated, this system of nozzles is substantially like that shown in Fig. 6 previously described. It is therefore not deemed necessary to show it in full detail. See Fig. 5. The pipe 92 is connected with the distributing system by the T-shaped coupling 160, the distributing pipes being divided and sub-divided so as to form the several branches 161, 162, 163, 164, 165 respectively, corresponding with the branches 45, 46, 47, 48 and 49, shown in Fig. 6, and the nozzles 166 corresponding with the nozzles 51. The first pair of branch pipes 161 have swivel connection with the coupling 160 so that the distributing members may be adjusted to varying angles to point either directly down or horizontally, or to any angle between the vertical and horizontal position. When adjusted it will be clamped in its adjusted position by the check nuts 167.

The paper next passes under another nozzle system where either coloring matter or chemicals, or a mixture of both, is applied in a somewhat different way from that by which it was applied at the preceding stage. In this case I provide for an even finer adjustment of the nozzle discharge, and also

provide for an air blast to blow each jet of liquid as it comes from the nozzle, so that it will be even more finely sprayed than when it drops or spurts directly from the nozzles in the manner previously described. The tank and pump and distributing nozzle system is the same as already described except for the additional elements used in connection therewith. There is a color liquid tank 170 and a pump 171 with suitable pipe connections with the water pipe 35 and with the delivery pipe 172 having the various valves at suitable places in connection with the pipes, including the special valve 173 similar to the valve 39, so as to control the pumping of either water or chemical into the pipe 172, and thence to the nozzle system 174. Underneath every nozzle is a funnel 175, (See Figs. 1 and 9) into which the liquid drops from the nozzle, and the funnel is provided with a tubular stem 176 through which the liquid passes out from the funnel. The funnels are adjustably mounted so that they may be held either in vertical position or at an angle thereto as desired, but in whatever position they are adjusted they should preferably all be in the same plane and in a straight row. For instance, if one is vertical they should all be vertical, and if one is inclined at an angle of 45° they should all be inclined at the same angle. The variation, however, will necessarily be so slight that it scarcely will exceed 5°. The mouth of the funnel is of sufficient diameter to insure that the nozzles will discharge into the funnels, whatever may be the angle of inclination of the funnels within any range of adjustment that is practically desired.

The preferable form of mount for the funnels is as follows:—The stem of each funnel passes through a hole in a ball 177 which is clamped between two parallel rods or bars 178 which extend transversely of the machine. Each of said rods is formed with a series of semi-spherical recesses 179, the recesses in one rod being directly opposite those in the other rod, so that each pair of recesses forms a fit for one of the said balls. Bolts 180 pass through the two rods in the intervals between the balls, and by setting up the nuts of the bolts the said holding rods will clamp the balls in their adjusted position. The rods are spaced apart somewhat more than the diameter of the stem 176 to allow for the adjustment of the funnels from a vertical to an inclined position. The funnel stems 176 are screw-threaded and the holes through the balls 177, through which the funnel stems pass, are also screw-threaded, so that the funnel stems may be screwed into the balls and maintained in any position to which they are adjusted, up or down. The balls also are preferably split, as shown by the dotted line in Fig. 9. from the hole out to one side. This allows the balls to have a sort of yielding spring grip on the funnel stems when the rods are clamped to them by the bolts. The vertical adjustment of the funnels is obtained by rotating them in their threaded holes while the bolts are loosened. By loosening the bolts the balls may be turned in their seats to adjust the funnel stems to any angle within the range allowed by the width of the space 181 between the rods 178 in excess of the diameter of the stem 176, and after the adjustment is made the bolts should be tightened up to hold the balls in that adjusted position.

Preferably the liquid as it falls through the nozzles is subjected to a lateral blast of air which spreads it into a finer spray and also causes it to shoot out in a downward curve instead of falling vertically. This gives a somewhat different effect to the surface of the paper by reason of the liquid falling in this way, and this effect can be varied quite a little by varying the strength of the air blast or varying the angle at which the air blast strikes the stream from the nozzle or the quantity of liquid passing the nozzle. The means shown for applying the air blast is as follows:—

An air pipe 182 extends parallel with the rods 178 and connected therewith is a series of air nozzles 183, one for each of the funnel nozzles 176. The air nozzles are adjusted so that the jet of compressed air will be driven from the air nozzle against the liquid from the funnel nozzles at right angles thereto just below the outlet from the liquid funnel nozzle, as shown in Fig. 1. The air blast will strike the liquid as it drops from the funnel nozzle 176, and cause it to shoot out in a curve as shown by the dotted line 184 in Fig. 1. Of course the curve will vary according to the strength of the air blast and the angle of inclination of the compressed air nozzle 183. Preferably the air nozzle is slightly curved as shown in Fig. 1.

The air pipe 182 is capable of swiveling on its axis so as to vary the angle of the air nozzles 183. The air pipe 182 receives its supply of compressed air from the supply pipe 185 connected with a suitable pump or other source of compressed air, not shown, the connection between the pipe 185 and the pipe 182 being through a branch pipe 186 with which the pipe 182 has a swivel connection.

The pipe 182 may be swiveled on its axis by means of a sector 188, which is pivoted at 191 to the vertically adjustable support 2. The sector 188 may be rocked on its pivot, thereby swinging the pipe 182 bodily in an arc of a circle. If it is rocked to the right as viewed in Fig. 1, it will cause the nozzle 183 to swing upward and at the same time will swing the pipe 182 farther away from

the clamping rods 178. This movement of the sector arm 188 may be accomplished by means of a rod 189 which has a slotted connection with the sector arm 188, and which is moved longitudinally by means of a feed screw 190 which passes through a threaded bearing in the frame and is rotated by a handle.

To compensate for the raising or lowering of the pipe 182 when the sector 188 is turned on its pivot, the arm to which the sector 188 is pivoted should be capable of being lowered and raised, that is it should be lowered to compensate for the lifting effect of swinging the sector 188 up and it should be raised to compensate for the lowering action when the sector 188 is turned down. This is accomplished by providing means for raising and lowering the support 2, to which the sector is pivoted. This is accomplished by means of a feed screw which passes up through the supporting member 2.

Each of the tanks 30, 98 and 170 is provided with a waste cock to permit drawing off the contents of the tank and cleaning it out.

At a still further stage in the movement of the paper after passing under the liquid distribution nozzles 176, it will pass under another distribution system 200, through which there will be distributed upon the paper, if desired, coloring matter or water, or chemicals, or a combination of two of the three, the water being furnished through the pipe 35 and the coloring matter being furnished from the tank 170 by means of the pump 171 and pipe 201. The distribution of this liquid is controlled by a valve 202 so that the distribution through this system may be entirely cut off if desired. Means are provided by which if liquid, either coloring matter or water, or chemical, is supplied to the paper at this point it will be spread out in a sort of a streaky form. I accomplish this by the following means:—

A system of air nozzles 203 is connected with an air pipe 204 which is supplied with compressed air through the feed pipe 205 connected with the main compressed air pipe 185. There is a valve 206 provided in the pipe 205 to control the admission of compressed air, so as to either admit it or shut it off, as desired. These air nozzles are located only a short distance above the paper, as will be seen from Fig. 1. Instead of having the air blast act upon the liquid as it is discharged from the nozzles 200, as was done in the case of the air nozzles 183 acting on the liquid distribution nozzles 176, the liquid first falls upon the paper in the fine jets which issue from the distribution nozzles 200, but I desire to still further spread the liquid in a streaky form already referred to after it has been discharged upon the paper. The air nozzles 203 might be allowed to act directly upon the thin volume of water or liquid which is upon the surface of the paper, but I prefer to still further spread it out in a sort of fan shape, and this I accomplish by having the air nozzles 203 direct the compressed air first upon a plate 207 just above the surface of the paper, and from there it will be deflected upon the paper in a sort of fan shape at a very acute angle almost parallel with the paper. This plate 207, which I term a shovel, is mounted in a hanger 208 sustained by a pivot or support 209. This should be made removable so that the shovel may be used or not as desired.

As previously stated the paper expands when wet and shrinks again when dry, and has a tendency to wrinkle. I have provided means to overcome this tendency. I have provided means for this purpose to compensate for the expansion both widthwise and lengthwise. The said means which are provided are as follows:— (See Figs. 10, 11, 12, 13 and 14.) To take care of the lateral expansion I provide a series of clamping members at intervals apart on each side of the carrier which are so actuated that they come into clamping position to clamp the paper to the carrier at the beginning of the upper run of the carrier at the entrance end of the machine, and which are tripped to disengage them from the paper at the end of the upper run of the carrier, and means are provided by which the clamping members on the two opposite sides shall move laterally with the lateral expansion of the paper.

These clamping members may be arranged at intervals of such distance apart as desired. I have found in practice that it is sufficient to have a pair of these clamping members connected with every alternate plate section 75 of the carrier. The means shown are as follows:— Each alternate plate section 75 is formed with a slot 210 extending some distance inwardly from each end thereof, with which the clamps are connected. See Fig. 12. A lug 211 is mounted in the slot 210 of the plate section 75, as will be hereinafter described, and has an arm 212 which projects down through the slot, as shown in Fig. 11. A clamping lever of bell-crank shape is pivoted at 213 to the said lug 211, and has one arm 214 which normally lies in horizontal position and projecting laterally outward beyond the edge of the carrier section 75, and has another arm 215 which extends upward at right angles to the arm 214 and terminates in a short arm 216 bent at right angles to the arm 215 and parallel with the arm 214 but extending in the opposite direction to the arm 214. Preferably this short arm 216 which is the clamping arm of said lever has a yielding head so it may give an elastic pressure on the paper 11, as shown in Fig. 14. The means which I have shown for

giving such elastic pressure is to provide a head member 217 having a recess in the inner end which contains a spring 218. The arm 216 is formed with a neck 219 which terminates in a flange 220 which when seated upon said spring is prevented from withdrawing from said recess by an inturned flange 221 on the head member 217. The lug 211 is mounted upon the outer end of one part of the two-part shaft 222, which is slidably mounted in bearings 223 on the under side of the carrier section 75 and extends underneath the slot 210 of the carrier section 75.

Said two-part shaft sections 222—222 are slightly separated from each other at their inner ends, as shown in Figs. 11 and 12, and are connected together by a link 224 which is pivoted at 225 intermediate its ends to the under side of the carrier section 75. Each of the shaft sections 222 has a slotted lug 226 projecting from one side thereof, the two lugs projecting from opposite sides of the two sections, and offset from each other as shown in Fig. 12. The said link 224 has a pin 227 at each of its two ends which engages respectively with the slots 228 in said lugs 226. Said slots 228 are elongated to allow a sliding movement of the pins in said slots and to permit longitudinal extension of said shaft by the endwise movement of said shaft sections 222 in opposite directions. The normal position of said shaft sections is shown in Figs. 11 and 12. Each shaft section has a spring 229 coiled around it, one end of which abuts against a collar 230 on the shaft, and the other end of which abuts against the bearing 223, which is attached to the under side of the carrier section 75. Whenever the said shaft sections are contracted by the longitudinal movement of the shaft in an inward direction so that their inner ends are brought nearer together, said springs 229 will be compressed, and when the inward stress upon the shafts is removed, the said springs will carry the said shaft sections apart from each other again.

A bell-crank shaped lever having the two arms 232—233, is pivoted at 234 to the under side of the carrier section 75, and when in its normal position, as shown in Fig. 11, the arm 233 is in horizontal position bearing against the under side of the horizontal arm 214 of the bell-crank shaped clamping member. A cam 235 is attached to the frame of the machine in position to be engaged by the arm 232 of said bell-crank lever at the entrance point of the paper upon the carrier, in such position that it will be engaged by said bell crank lever 232 during the turn from the bottom run to the upper run of the carrier. This cam is of such shape that it causes the said bell crank lever 232 to turn on its pivot into the dotted line position shown in Fig. 11, and by so doing to cause the clamping lever 214 to swing up on its pivot through an angle of 90° from the position shown in full lines to the position shown in dotted lines in Fig. 11, and at the same time it causes the lug 211 to which the said clamping member is pivoted to move in the slot 210 in a lateral inward direction, so that the clamping member swings down into clamping position with the clamp head 217 in contact with the paper, where the paper stretches over the slot 210. At this point, the under side of the paper is engaged by a co-operating underneath support 236 which projects upward through the slot 210 to the level of the upper face of the carrier member 75, as shown in Fig. 14. This underneath support 216 is mounted on the shaft 222. Preferably this underneath support 236 is made in two sections 236—237, the member 236 being the head of said support, and having a ball-bearing connection with the lower portion 237 so as to allow for any slipping action of the said supporting member 236 and to reduce the friction.

The bell-crank shaped member 214 is normally held in its full line position shown in Fig. 11, that is with the clamping arm turned up in inoperative position by means of a spring 238. This spring tends to pull the member back into its normal position when permitted to do so, but the said clamping member is retained in its clamping position as long as it is needed by a spring controlled catch 239. This spring controlled catch has a hook 240 formed with a cam face which is engaged by the arm 215 when said arm 215 is swung into its downward position and turns the said catch 239 back on its pivot 260 until the arm 215 has passed below the hook, and then the spring 241 throws the hook forward into latched position over the upper side of the arm 215 and thus retains the clamping arm 215 in its clamping position against the paper. It continues in this position until the latch 239 is disengaged just at the end of the forward run of the carrier when the latch 239 abuts against a stop 242 which turns the latch on its pivot, disengaging the hook from the arm 215 and holding it disengaged long enough for the spring 238 to turn the said clamping member back into its normal inoperative position.

By reason of the expansible character of the shaft 222, the clamping members on the two opposite sides of the carrier being connected respectively with the two shaft sections, then when the paper expands laterally the said clamping members together with the shaft section on which they are mounted will be moved outwardly, being carried by the frictional contact of the clamping members with the paper. The springs 229 are so light and the whole apparatus so delicate that the stretch or ex-

pansion of the paper will easily cause the extension of the clamping members and shaft without tearing the paper, and then when the paper contracts by drying after expansion, the springs 229 will yield to the pull caused by the contraction of the paper and thus allow the contraction of the shaft 222.

The longitudinal expansion of the paper is compensated for by the expansible connection between each pair of carrier sections 75, as already explained. It will be seen by reference to Fig. 10 that on the end turns of the carrier member the flattened end portions 80 of the shafts which are journaled in the slots 78 are in the circular portions of the slot, but on the horizontal run, both the upper run and the under run, the said flattened portions 80 of the shafts are in alinement with the elongated portions 79 of the slot, which allows a movement or play of said journaled ends 80 so as to permit the several carrier sections 75 to separate from each other.

The endless carrier 54 made up of sections 75 and mounted on lugs 76—77 as described, runs over the two toothed wheels 252 and 253, as shown in Fig. 10, said wheels being mounted respectively on shafts 254 and 255. Said toothed wheels are sort of sprocket wheels formed with pockets 256, which are engaged by the lugs 76—77 to cause the movement of the carrier. The shaft 254 may be considered as the driving shaft and may be driven by any suitable mechanism not shown.

In order to allow for the lengthwise expansion and contraction of the endless carrier in accordance with the lengthwise contraction and expansion of the paper, as already described, the shaft 255 is mounted in movable bearings. In the construction shown in Fig. 10, said shaft 225 is journaled in a box 257 which in turn is slidably mounted between the forked arms 258 of an arm 259 which is fulcrumed at 268 to a fixed support. The arm 259 can rock on said support forward or backward to allow the shaft 255 to move forward and back to accommodate the expansion and contraction of the carrier 54. Stops 261 limit the forward and backward rocking movement of the arm 259. A weight 262 is suspended from a chain or rope 263 which runs over an idler 264 and is connected with one side of the arm 259, and another weight 265 is suspended from a rope or chain 266 which runs over an idler 267 and is connected with the other side of said arm 259. These two weights are for the purpose of steadying the arm 259. The weight 262 is preferably a little heavier than the weight 265, and therefore tends to pull the arm to its most forward position toward the stop 261, which will be the position when the carrier is in its extended form. The overbalance of the weight 262 over the weight 265, however, is not great, but that when the paper shrinks the pull of the paper together with the pull of the weight 265 will over come the weight 262.

Preferably there is another drying system for the paper after it has passed through the various stages of color application and spreading already described. It is delivered after leaving the endless carrier 54 onto another carrier 250. Steam or hot water pipes 251 located under the carrier 250, are the preferred method of furnishing the final drying means. From there it will be delivered wherever desired.

While I have shown in the drawings and have described the apparatus and the sequence of operations so that the paper after having passed under the moistening roll 23 next passes under the operation of the brushes, thence under the first set of nozzles with the diaphragm, and next under the set of nozzles with the elevated air blast combined, and then under another set of nozzles which applies liquid directly to the paper, the paper then being subjected to a low-down series of compressed air nozzles in combination with a deflector plate to give the stream effect, it is obvious that the order in which these various agencies are arranged may be varied, and also that some of the agencies may be duplicated so as to subject the paper to two or more of any one kind of the said several agencies in different points of travel of the paper, thus producing a greatly varied effect upon the paper. I have simply shown one of each kind of agency for illustrative purposes, and as a rule one of each kind of agency in a single apparatus is sufficient. Moreover, as already explained, the valves which control the distribution through these several agencies allow such control that any one of the nozzle systems may be cut off independently of the others.

While I have for convenience in describing the machine made special reference to its use in connection with coloring paper, it is adapted for use in coloring other kinds of material than paper, and it is my intention to have the claims understood as broadly covering the machine of the type described whether it may be used for coloring paper or other material.

What I claim is:—

1. An apparatus for applying liquid coloring matter to a web of sheet material, having means for applying liquid to the surface of the web, and having a series of brushes which move in sequence transversely over the surface of the web from one side of the web to the other and back, and means for moving each brush in such manner that it moves entirely off the web at each side before it begins its return movement.

2. An apparatus for applying liquid matter to a web of sheet material, having means for applying liquid to the surface of the web, a series of brushes which move transversely over the surface of the web from one side to the other and back, and means for moving the brushes in such manner that each brush moves entirely off the web at each side before it begins its return movement, the movement in one direction being in a separate path but parallel with the path of movement in the other direction.

3. An apparatus for applying liquid coloring matter to a web of paper or other sheet material having means for moving the web, means for brushing the web after the liquid is applied to it, and means for causing said brushes to reciprocate in a biangular path transversely of the sheet in such manner that the brushes will move onto the web from each side alternately in a path which intersects the path of travel of the web diagonally thereto in a forward direction and move in that path partway across the paper, and then turn at an angle to its first path of movement and move to the farther edge of the web diagonally thereto in a rearward direction and off from said farther edge, and then move back again across the surface of the web in a path parallel with its full first transverse movement.

4. An apparatus for applying liquid to a web of sheet material having means for moving the web, means for applying liquid to the web while the web is in motion, a plurality of brushes and means for moving the brushes in a V-shaped path transversely over the surface of the web after it has received the liquid, the apex of the V-shaped path being midway of the web and pointing in the direction the web is traveling, each brush passing entirely off the web at the side thereof after each crossing movement.

5. A machine for applying liquid to a web of paper or other sheet material, having means for moving the web in a forward path, means for applying liquid matter to the surface of the moving web, and a brush system which travels over the surface of the web in a biangular path alternately from one side of the web to the other, the path in one direction across the web being parallel to the path in the reverse direction, and passing entirely off the surface at each edge, the brushes entering from each edge to engage the surface of the web while the brushes are traveling in a forward diagonal direction to the path of movement of the web, and passing off the web on the opposite side in a backward diagonal direction to the path of movement of the web.

6. An apparatus for applying liquid to paper or other sheet material, having a plurality of nozzles, means for supplying liquid to said nozzles through which the liquid is discharged, and a system of compressed air nozzles adjacent the liquid distributing nozzles, the compressed air nozzles extending in an angular direction to that of the liquid nozzles whereby a blast of compressed air may be directed against each liquid jet after it is discharged from the liquid nozzle to deflect and more widely diffuse the liquid, and means for simultaneously adjusting the air nozzles alike to such angle as desired with relation to the liquid discharge nozzles.

7. A machine for producing water color surface on sheet material having means for moving the sheet, a series of downwardly projecting nozzles arranged in a line transversely above the path of movement of the sheet through which the liquid matter is discharged, a series of air nozzles located adjacent the said liquid discharge nozzles in position for each one of the air nozzles to direct a blast of air against a liquid jet at an angle thereto, and means for adjusting the air nozzles toward and away from the line of discharge of the liquid from the liquid nozzles in such manner as to vary the lateral distance of the mouths of the air nozzles from the mouths of the liquid nozzles without substantially varying the elevation of the air nozzles with relation to the mouths of the liquid nozzles.

8. A machine for producing water color surface on sheet material having means for moving the sheet, means for spreading liquid matter on the surface of the sheet, a brush system under which the sheet is carried, and which travels over the surface of the sheet transversely to the direction of feed of the sheet, means for applying additional liquid matter, either water or coloring matter, at the will of the operator, to the surface of the sheet after it has passed the brush system through a series of nozzles extending transversely above the path of movement of the sheet, air nozzles located adjacent said liquid discharge nozzles, and means whereby a discharge of compressed air through said air nozzles may be directed against the jet of liquid as it is discharged through said liquid nozzles to deflect and spread the liquid.

9. A machine for producing water color surface on sheet material, having a traveling carrier which supports and carries the sheet, means for spreading coloring matter upon the surface of the sheet, a brush system under which the sheet is carried after it has received an application of coloring matter, means for operating said brush system so that it will travel over the surface of the sheet transversely to the direction of feed of the sheet and brush the coloring matter into the sheet, means for applying additional water or coloring matter or both, at the will of the operator, to the surface of the sheet

after it has passed the brush system, means for still further applying either water or coloring matter, or both, at the will of the operator, to the surface of the sheet through a series of nozzles extending transversely above the path of movement of the sheet at a still further stage in the path of travel on the sheet, means for causing the discharge of either water or coloring matter, or both combined, through said nozzles, air nozzles located adjacent to said liquid discharge nozzles, and means whereby a discharge of compressed air through said air nozzles may be directed against the jet of liquid as it is discharged from one set of said liquid nozzles.

10. A machine for producing water color surface on sheet material, having a traveling means for moving the sheet, means for spreading coloring matter upon the surface of the sheet, a brush system under which the sheet is carried after it has received the application of coloring matter, means for operating said brush system so that it will travel over the surface of the sheet transversely of the direction of feed of the sheet and brush the coloring matter into the sheet, means for applying additional water or coloring matter, or chemical, or both, at the will of the operator, to the surface of the sheet after it has passed the brush system, means for still further applying either water or coloring matter, or both, at the will of the operator, to the surface of the sheet through a series of nozzles extending transversely above the path of movement of the sheet at a still further stage in the path of travel on the sheet, means for causing the discharge of either water or coloring matter, or both combined, through said nozzles, air nozzles located adjacent to said liquid discharge nozzles, and means whereby a discharge of compressed air through said air nozzles may be directed against the jet of liquid as it is discharged from said last liquid nozzles, an additional system of liquid distributing nozzles which may discharge water or coloring matter, or chemicals, any one or more upon the surface of the sheet at a still further stage in the travel of said sheet to distribute said matter upon the surface of the sheet, a series of compressed air nozzles located just above the surface of the sheet at a still further point in the travel of the sheet, and a deflector surface against which the air blast is directed and which deflects and spreads the current from air nozzles to the surface of the sheet.

11. A machine for producing water color surface on sheet material, having means for feeding a web of sheet material, means for distributing liquid matter upon the surface of the web while it is moving, an air blast, and a deflector against which the air blast is directed and which deflects and spreads the air current on the surface of the web after the liquid has been distributed thereon.

12. An apparatus for applying liquid color to the surface of paper or other sheet material having a traveling carrier which supports and carries the sheet beneath the water color applying mechanisms, a plurality of water and color applying mechanisms located above the path of travel of the sheet at different points in the path of travel, means for regulating the distribution of the water and coloring matter upon the said sheet material, clamping mechanism which clamps the sheet to the carrier on which the sheet is supported and carried, said clamping mechanism being movable with the carrier and being laterally extensible, the extensibility being controlled by the expansion and contraction of the sheet.

13. An apparatus for applying liquid color to the surface of paper or other sheet material, having a traveling carrier which supports and carries the sheet beneath the color applying mechanisms, a plurality of water and color applying mechanisms located above the path of travel of the sheet at different points in the path of travel, means for regulating the distribution of the water and coloring matter upon said sheet material, clamping mechanism which clamps the sheet to the carrier on which the sheet is supported and carried, said clamping mechanism being movable with the carrier and being laterally extensible, the extensibility being controlled by the expansion and contraction of the sheet, said carrier being in the form of an endless carrier composed of a plurality of sections linked together, and expansion connections between said sections whose expansion is controlled by the expansion and contraction of the sheet lengthwise.

14. An apparatus for applying liquid to the surface of a web of sheet material, having a traveling carrier which supports and carries the web, means for applying liquid to the web, mechanism which clamps the web to the carrier on which it is supported and carried, said clamping mechanism being movable with the carrier and being laterally extensible, the extensibility being controlled by the expansion and contraction of the web.

15. An apparatus for applying liquid to the surface of a web of sheet material, having a traveling carrier which supports and carries the web, means for applying liquid to the web, mechanism which clamps the web to the carrier on which it is supported and carried, said clamping mechanism being movable with the carrier and being laterally extensible, the extensibility being controlled by the expansion and contraction of

the web, said carrier being composed of a plurality of sections linked together, and expansion connections between said sections whose expansion is controlled by the expansion and contraction of the web lengthwise.

16. A machine for producing water color surface on sheet material, having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, a central supply pipe leading into the drum, an outlet pipe therefrom, and a series of distribution pipes connected with said outlet by division and sub-division in pairs, and means for automatically delivering a continued series of blows upon the diaphragm.

17. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a distribution system connected with said outlet pipe, said distribution system comprising a plurality of branch pipes leading from said outlet pipe, each of said branch pipes connecting with a plurality of sub-divided branch pipes terminating in nozzles, and means for automatically delivering a continued series of hammer blows upon the diaphragm.

18. A machine for producing water color surface on sheet material, having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, a spring inserted in said drum between the base and the diaphragm to give added resiliency to the diaphragm, and means for automatically applying a continued series of hammer blows to the diaphragm.

19. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, and means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, and means for automatically vibrating the hammer by rocking it on its pivot.

20. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, and means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer by rocking it on its pivot, a mount in which said handle is pivoted, and means for adjusting said mount so as to adjust the fulcrum of the handle to varying elevations.

21. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, and means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer by rocking it on its pivot, a mount in which said handle is pivoted, a pivoted lever having link connection with the hammer head, a spring which normally holds the hammer in raised position, a rotary member having a projection thereon which at each rotation engages said lever to which the hammer handle is pivoted and rocks it on its fulcrum, and thereby causes a downward stroke of the hammer through its intermediate link connection, and then moves out of engagement with the said lever, whereby the spring is allowed to again raise the hammer.

22. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes

terminating in nozzles connected with said outlet pipe, and means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer by rocking it on its pivot, a mount in which said handle is pivoted, a pivoted lever having link connection with the hammer head, a spring which normally holds the hammer in raised position, a rotary member having a projection thereon which at each rotation engages said lever to which the hammer handle is pivoted and rocks it on its fulcrum, and thereby causes a downward stroke of the hammer through its intermediate link connection, and then moves out of engagement with the said lever whereby the spring is allowed to again raise the hammer, one end of said spring being connected with said hammer handle, an adjustable support to which the other end of said spring is connected, and means for adjusting said support whereby it may be raised or lowered to vary the tension of the spring.

23. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer by rocking it on its pivot, a mount in which said handle is pivoted, a pivoted lever having link connection with the hammer handle, a spring which normally holds the hammer in raised position, a rotary member having a projection thereon which at each rotation engages said lever to which the hammer handle is pivoted and rocks it on its fulcrum and thereby causes a downward stroke of the hammer through its intermediate connection, and then moves out of engagement with the said lever, whereby the spring is allowed to again raise the hammer, one end of said spring being connected with said hammer handle, an adjustable support to which the other end of said spring is connected, and means for adjusting said support whereby it may be raised or lowered to vary the tension of the spring, a shaft carrying said rotary hammer actuating member, a friction disk mounted on said shaft, a driving shaft having a friction disk mounted thereon, a ball friction pulley which engages simultaneously both of said friction disks, whereby the rotation of the driving shaft rotates said friction disks and through the previously mentioned connections actuates the hammer.

24. A machine for producing water color surface on sheet material having a liquid distribution system for distributing the liquid upon the surface of the sheet, comprising a drum having a diaphragm top, an inlet supply pipe extending through the side wall, an outlet pipe leading from the base of the drum, a system of branch pipes terminating in nozzles connected with said outlet pipe, means for automatically applying a continued series of hammer blows to the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer by rocking it on its pivot, a mount in which said handle is pivoted, a pivoted lever having link connection with the hammer handle, a spring which normally holds the hammer in raised position, a rotary member having a projection thereon which at each rotation engages said lever to which the hammer handle is pivoted and rocks it on its fulcrum and thereby causes a downward stroke of the hammer through its intermediate connection, and then moves out of engagement with the said lever, whereby the spring is allowed to again raise the hammer, one end of said spring being connected with said hammer handle, an adjustable support to which the other end of said spring is connected, and means for adjusting said support whereby it may be raised or lowered to vary the tension of the spring, a shaft carrying said rotary hammer actuating member, a friction disk mounted on said shaft, a driving shaft having a friction disk mounted thereon, a ball friction pulley which engages simultaneously both of said friction disks, whereby the rotation of the driving shaft rotates said friction disks and through the previously mentioned connections actuates the hammer, and means for adjusting said ball friction pulley so as to engage said friction disks at varying radial distances from the center of said disks increasing the distance from the center of one and at the same time dimin-

ishing the distance from the center of the other, whereby the speed of rotation and the rapidity of stroke of the hammer is varied.

25. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a liquid supply pipe leading into the drum, an outlet pipe, and means for automatically delivering a continued series of blows upon the diaphragm.

26. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a bottom, a liquid supply pipe leading into the drum, an outlet from the bottom of the drum, nozzles connected with said outlet, and means for automatically delivering a continued series of blows upon the diaphragm.

27. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, said diaphragm comprising an inner disk of rubber and an outer protecting disk of flexible material other than rubber, a liquid supply pipe leading into the drum, an outlet pipe, and means for automatically delivering a continued series of blows upon the diaphragm.

28. Means for distributing liquid upon sheet material, comprising a drum having a diaphragm top, a bottom, a liquid supply pipe leading into the drum, an outlet pipe, means for automatically delivering a continued series of blows upon the diaphragm, and a spring inserted in said drum between the bottom and the diaphragm to give added resiliency to the diaphragm.

29. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a liquid supply pipe leading into the drum, an outlet pipe, means for automatically delivering a continued series of blows upon the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer, a pivoted lever having link connection with the hammer head, means for normally holding the hammer in raised position, and a rotary member having a portion which at each rotation engages said lever to which the hammer handle is pivoted, and thereby causes a downward stroke of the hammer and then moves out of engagement with the said lever allowing the hammer to be again raised to its normal upward position.

30. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a liquid supply pipe leading into the drum, an outlet pipe, means for automatically delivering a continued series of blows upon the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer, a pivoted lever having link connection with the hammer head, a spring for normally holding the hammer in raised position, means for adjusting the tension of said spring, and a rotary member having a portion which at each rotation engages said lever to which the hammer handle is pivoted and thereby causes a downward stroke of the hammer, and then moves out of engagement with the said lever allowing the hammer to be again raised to its normal upward position.

31. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a liquid supply pipe leading into the drum, an outlet pipe, means for automatically delivering a continued series of blows upon the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer, a pivoted lever having link connection with the hammer head, means for normally holding the hammer in raised position, a rotary member having a portion which at each rotation engages said lever to which the hammer handle is pivoted, and thereby causes a downward stroke of the hammer and then moves out of engagement with the said lever allowing the hammer to be again raised to its normal upward position, a shaft carrying said rotary hammer-actuating member, a friction disk mounted on said shaft, a driving shaft having a friction disk mounted thereon, and a ball friction pulley which engages simultaneously with both of said friction disks whereby the rotation of the driving shaft rotates said friction disks and through the previously mentioned connections actuates the hammer.

32. Means for distributing liquid upon sheet material comprising a drum having a diaphragm top, a liquid supply pipe leading into the drum, an outlet pipe, means for automatically delivering a continued series of blows upon the diaphragm, said hammer mechanism comprising a hammer head provided with a handle pivotally mounted in position for the hammer to strike upon the top of the diaphragm when the hammer handle is rocked on its fulcrum, means for automatically vibrating the hammer, a pivoted lever having link connection with the hammer head, means for normally holding the hammer in raised position, a rotary member having a portion which at each rotation engages said lever to which the hammer handle is pivoted, and thereby causes a downward stroke of the hammer and then

moves out of engagement with the said lever allowing the hammer to be again raised to its normal upward position, a shaft carrying said rotary hammer-actuating member, a friction disk mounted on said shaft, a driving shaft having a friction disk mounted thereon, a ball friction pulley which engages simultaneously with both of said friction disks whereby the rotation of the driving shaft rotates said friction disks and through the previously mentioned connections actuates the hammer, and means for adjusting said ball friction pulley so as to engage said friction disks at varying radial distances from the centers of said disks thereby increasing the distance from the center of one and at the same time diminishing the distance from the center of the other, whereby the speed of rotation and the rapidity of stroke of the hammer is varied.

33. A machine for producing water color surface on sheet material, having a liquid distribution system in which there is a supply pipe, a system of branch pipes with nozzle terminations, a series of funnels one for each of said nozzles mounted just below the nozzles, means for discharging a blast of air against the liquid as it passes from the funnels, said mount for the funnels comprising a pair of parallel rods having a series of curved recesses therein, the recesses in one of said rods coöperating with the recesses in the other rod to form a series of spherical pockets, a ball mounted in each of said pockets, each of said balls having means for clamping said two rods together so as to hold said balls in the said pockets, each of said balls being formed with a perforation through which the stem of one of said funnels extends, said funnels being adjustable to varying angles by loosening the bolts, turning the balls and again setting up the bolts.

34. A machine for producing water color surface on sheet material having a series of funnels, means for discharging liquid into the funnels, and a mount for each of said funnels comprising a pair of parallel rods having a series of curved recesses therein, the recesses in one of said rods coöperating with the recesses in the other rod to form a series of spherical pockets, a ball mounted in each of said pockets, and means for clamping each of said rods together so as to hold said balls in the pockets, each of said balls being formed with a perforation through which the stem of one of said funnels extends, said funnels being adjustable to varying angles by loosening the bolts, turning the balls and again setting up the bolts.

35. A liquid distributing device comprising a supply pipe, a funnel into which the liquid is discharged from the said pipe and a mount for said funnel comprising a pair of parallel rods, each having a curved recess therein, the recess in one of said rods cooperating with the recess in the other rod to form a spherical pocket, a ball mounted in said pocket and means for clamping the two rods together so as to hold the ball in the pocket, said ball being formed with a perforation through which the stem of a funnel extends, said funnel being adjustable to varying angles by loosening the bolt, turning the ball, and again setting up the bolt.

36. An apparatus for applying water color to paper or other sheet material having a distributing system, comprising a main pipe, a series of branch pipes formed by division and sub-division from said main pipe, said subdivided branches terminating in a series of discharge nozzles, a series of funnels one for each of said discharge nozzles, into which said nozzles discharge and means for discharging compressed air against the liquid after it passes from the funnels.

37. An apparatus for applying water color to paper or other sheet material having a distributing system, comprising a main pipe, a series of branch pipes formed by division and sub-division from said main pipe, said sub-divided branches terminating in a series of discharge nozzles, a series of funnels one for each of said discharge nozzles into which said nozzles discharge, and an adjustable holder for said funnels, said holder comprising a pair of parallel rods each formed with a series of curved pockets in the adjacent faces, each pair of curved pockets forming a spherical seat for a ball, a ball mounted in each of said seats, means for clamping the said rods against the balls held in said pockets, each ball being formed with a screw-threaded hole passing diametrically therethrough, and each funnel being formed with a screw-threaded stem which fits in said hole and means for discharging compressed air against the liquid after it passes from the funnels.

38. An apparatus for applying water color to paper or other sheet material having a distributing system, comprising a main pipe, a series of branch pipes formed by division and sub-division from said main pipe, said sub-divided branches terminating in a series of discharge nozzles, a series of funnels one for each of said discharge nozzles into which said nozzles discharge, and an adjustable holder for said funnels, said holder comprising a pair of parallel rods, each formed with a series of curved pockets in the adjacent faces, each pair of curved pockets forming a spherical seat for a ball, a ball mounted in each of said seats. means for clamping the said rods against the balls held in said pockets, each ball being

formed with a screw-threaded hole passing diametrically therethrough, and each funnel being formed with a threaded stem which fits in said threaded hole, the bars when clamped against the ball being spaced slightly apart from each other adjacent the stem of the funnel, thereby permitting the adjustment of the funnel to varying angles of inclination, and means for discharging compressed air against the liquid after it passes from the funnels.

39. An apparatus for applying liquid coloring matter to sheet material, having a liquid distributing nozzle, means for supplying liquid to said nozzle, a funnel into which the liquid is discharged from said nozzle, a compressed air nozzle located adjacent the mouth of said liquid nozzle, and means for supplying compressed air to said air nozzle, said air nozzle directing the blast of air against the liquid after it passes from the funnel.

40. A machine for producing water color surface on sheet material, having means for moving the sheet, a series of liquid nozzles for distributing liquid upon the sheet, means for supplying liquid to said nozzles, a series of air nozzles arranged in line transversely above the path of movement of the sheet, a compressed air pipe with which said air nozzles are connected in series, means for directing a blast of air through all of said air nozzles simultaneously to strike the jets of liquid from the liquid nozzles, and means for adjusting at one operation all of the air nozzles uniformly to any angle desired with relation to the liquid nozzles.

41. A machine for producing water color surface on sheet material, having means for moving the sheet, a series of liquid nozzles for distributing liquid upon the sheet, a series of air nozzles arranged in a row transversely above the path of movement of the sheet, a compressed air supply pipe with which said air nozzles are connected in series, means for controlling the admission of air to all of the air nozzles in said series, means for adjusting at one operation uniformly all of said air nozzles in the series by moving the air supply pipe in a plane parallel with the plane of the ends of the liquid nozzles, and thereby changing the distance of the ends of the air nozzles from the ends of the liquid nozzles in the same plane.

42. A machine for producing water color surface on sheet material, having means for moving the sheet, a series of liquid nozzles for distributing liquid upon the sheet, a series of air nozzles arranged in a row transversely above the path of movement of the sheet, a compressed air supply pipe with which said air nozzles are connected in series, means for controlling the admission of air to all of the air nozzles in said series, means for adjusting at one operation uniformly all of said air nozzles in the series by moving the air supply pipe in a plane parallel with the plane of the ends of the liquid nozzles, and thereby changing the distance of the ends of the air nozzles from the ends of the liquid nozzles in the same plane, and means for adjusting the air supply pipe so that the air may be caused to strike the liquid from the liquid nozzle at varying distances from the outlet from the liquid nozzle.

43. A machine for producing water color surface on sheet material, having means for moving the sheet, a series of liquid nozzles for distributing liquid upon the sheet, a series of air nozzles arranged in a row above the path of movement of the sheet and connected in series with a single compressed air supply pipe in such manner that the air nozzles will discharge a blast of air against the liquid which is discharged from said liquid nozzles, and means for uniformly moving all of the air nozzles to vary and regulate the distance from the outlet from the liquid nozzles that the blast of air will strike the liquid.

44. A machine for producing water color surface on sheet material, having means for depositing liquid upon the surface of the sheet, an air blast, and a deflector by which the air blast is deflected to spread the depositing liquid on the sheet.

In testimony whereof I have affixed my signature.

RUDOLF SYKORA.