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PROCESS OF AND APPARATUS FOR DYING TEXTILE FABRICS

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This invention relates to an improved process for dyeing or coloring fabrics such as textile fabrics, or for dyeing or coloring any other articles, and relates more particularly to an improved process of dyeing materials or articles preferably in the form of a continuous web, such as continuous pieces of ribbons, silk, cotton, linen and the like; the process is also applicable to the coating of articles or materials with liquids of all classes and descriptions.

The invention also relates to improved apparatus for dyeing or coloring materials or articles, and more particularly to an improved apparatus for dyeing textile materials; the invention also relates to apparatus for uniformly coating webs of fabric or for uniformly coating articles.

Among the objects of the invention is to provide a process and an apparatus for substantially uniformly dyeing a textile fabric either on one side or on both sides thereof, either with the same color or with different tones of the same color or with different colors. Another object of the invention is to provide an apparatus which will continuously and uniformly dye a permeable textile fabric first on one side thereof and then on the other side thereof. Further objects of the invention will be apparent from the following description of some preferred forms of the process, and some preferred embodiments of the apparatus which are illustrated in the accompanying drawings. In the drawings

Fig. 1 is a part section and part elevation along the line A—A of Fig. 2, said drawing being partly diagrammatic;

Fig. 2 is a sectional plan of Fig. 1 with certain parts being broken away to show more clearly the parts beneath them;

Fig. 3 is an enlarged elevation of the front end of the machine looking in the direction in which the fabric enters the machine;

Fig. 4 is an enlarged section taken on the line B—B of Fig. 1;

Fig. 5 is a view of the driving mechanism;

Fig. 6 shows the mounting of the atomizing means;

Fig. 7 illustrates means for smoothing or stretching the fabric;

Fig. 8 illustrates diagrammatically a pair of apparatus suitable for dyeing the material on both sides thereof with different colors and different tones.

In accordance with the preferred embodiment of my process, I move a substantially dry web of material in contact with a cloud or body of fine particles of liquid dye, preferably made by atomizing the liquid dye to form extremely small particles thereof; when this material is permeable, it will be found that the dye does not penetrate through the material, which is therefore colored on one side thereof only; it may be similarly colored on the other side thereof to produce a twotone effect. I prefer to form a cloud of extremely finely divided particles of liquid dye or coloring matter from which the drops or large particles have been separated out, and I submit the material or articles to be treated to the action of this color cloud, preferably by traversing the material through a path located at the lower portion of the color cloud, so that the finely divided particles of the color cloud settle upon the material, and being free from drops, impurities, and other matter which would form spots upon the material, dyes the material evenly, so that the material presents a substantially evenly colored surface, and is suitable for commercial use in the industry in which it is employed, and compares for commercial purposes substantially with the color surface obtainable in the ordinary vat dyeing processes. I prefer the cloud to be "dry," that is to say, the finely divided particles are so small that when they settle upon a fabric which is otherwise color-absorbent, they do not pass completely through the fabric, as would be the case with larger drops, so that the material is colored on the side which is presented to the cloud but not on the other side. While the cloud may be run dryer or wetter, that is to say, with finer or coarser particles in the color cloud, according to the thickness of the material to be colored, when it is desired to color the material with different colors or tones on both sides thereof,
care must be taken that the cloud is not so wet that the color will pass completely through the material by the time that the material has traversed the cloud. In some cases I prefer to dry or to heat the material before it is exposed to the color cloud. In dyeing textile materials on one side thereof, or with different tones of the same color on different sides, or different colors on different sides, I arrange so that the dye does not penetrate entirely through the material, or beyond a predetermined extent; if the material is to be dyed on both sides thereof, after passing it through a color cloud, it is turned over and passed through another color cloud; in both cases it is important that the dye should actually enter sufficiently into the thickness of the material. In the preferred method of carrying out the invention the process is carried on to a point where the material is not merely colored on its surface, but the penetrating the dye into the material takes place to a substantial extent and is followed by the usual steaming operation to fix the dye. The process is of particular value in connection with the dyeing of silk piece goods, and I find that even extremely thin silks can be dyed successfully on both sides thereof. Silks and ribbons made in this form are capable of penetration to a substantial extent below the surface, but not to such an extent that the dye on one side passes to the other side thereof.

I will now describe the process with reference to the apparatus embodying my invention and illustrated in Figs. 1 to 6.

The apparatus comprises broadly three main mechanisms, these being as follows: the dyeing means comprising chamber a, the drying means comprising chamber b and the driving mechanism designated by the reference letter c.

The continuous web or length of material 1 which is to be colored in the apparatus passes from the roller 2, 2a through the dyeing and drying chambers a and b respectively to the roller 3, 3a and is dyed and dried in transit.

Dyeing means.—The chamber a is wider than the width of the material as shown in Fig. 2, and at each side thereof is provided with atomizing means 4, here shown in the form of well-known air-brushes; said atomizing means may consist of any suitable atomizing devices capable of producing a cloud of extremely fine atomized coloring matter or dye in suspension which is preferably in a substantially "dry" condition, as described hereinafter. These brushes 4, of which six are shown herein, three on each side, for being arranged at the right hand end and two at the left hand end, are located in the transverse walls 5, 5 of the dye chamber, and in proximity with the longitudinal walls 6 thereof, and these brushes are not located directly above the material passing through the dye chamber, but are at one side thereof, with their nozzles substantially parallel to the length of the material, and are also located some considerable distance below the roof. The chamber is supported upon a table 7 and the transverse walls 5, 5 are formed with slots 8, 8 to permit the passage of the material through the chamber. A curved bed 9 is located on the table 7 and provides an arcuate support for a belt 10 passing over rollers 11 and 12 the shafts 13 and 14 of which are suitably mounted in bearings 15 and 16 on frames 17 and 18, roller 11 being journaled in sliding bearings 15 which are adjustable by means of the screw-controlled members 19 to tighten the belt. The belt 10 and material passes through slots 20, 20 in the drying chamber b beneath the material thereon and over a tension roller 21 beneath the dye chamber a. The rollers 2, 2a and 3, 3a are mounted on shafts 22, 22a, 22b and are journaled in bearings 24, 25 respectively supported by brackets 26, 27 on frames 28, 29. (See Fig. 2.)

The dye chamber is provided with doors 30 having windows 31 through which the operator can observe the running condition of the atomizers and the density of the cloud of atomized coloring matter within the chamber. Electric lamps 32 in the walls 5, 5 located in proximity with the longitudinal side walls 6 facilitate observation within the chamber a. Fig. 3 shows an electric conduit 33 supplying current to sockets 33a of said lamps and connected to a suitable source of current (not shown).

The air brushes here shown have given excellent results in practice as atomizing means. These brushes are adjusted to a point where they produce a stream of extremely fine minute particles of liquid coloring matter in suspension, which in turn form a cloud within the dye chamber.

Referring to Fig. 6, the nozzle 34 of the brush 4 enters an opening 35 in the transverse wall 5 of the dye chamber, and is mounted upon an adjustable bar 36 connected with the brackets 37 screwed to the outer wall 5 of the dye chamber by screw 38. It will be noted that the bar 36 is located between the liquid dye inlet 39 of the brush and the air-control trigger 40 which is normally spring-pressed into a closed position, but the effect of mounting the brush upon the bar 36 is to force said trigger 40 into a position to permit continuous passage of air into the brush through the conduit 41. The brush is controlled to alter the ratio of air and liquid passing therethrough in the usual manner by means of the screw-threaded needle valve member 42, which is provided with a lock-nut 43 mounted upon the outer casing 44 of the trigger of the air-brush, in order to hold the needle valve member 42 against play.
The liquid inlet 39 of the air-brush is connected by means of the conduit 45 with the dye tank 46 mounted on a shelf 47 to the outside of the wall 5. The flexible air conduit 41 of each brush is connected with the main air manifolds 48 located one on each side of the dye chamber, and these air manifolds are connected together under the chamber by pipe 49, and by pipe 50 with a source of compressed air, liquid carbonic acid gas or other fluid pressure medium; the supply of fluid pressure medium to the manifolds 48 is controlled by the cock 51, and the supply of pressure medium to each individual atomizing device is controlled by individual cocks 52 mounted on the manifolds and located in the connections 53 between the manifolds 48 and the air pipes 41.

It will be noted by inspection of Fig. 4 that the air-brush nozzle openings are located at a point to one side of the fabric and not directly above the fabric; it has been found that in the operation of atomizing mechanisms small particles tend to form at the spray, and minute particles of dye or solid matter tend to accumulate around the needle and to clog up the small passages of the atomizing device, thereby causing the atomizer to operate irregularly; this irregular operation is also sometimes due to fluctuations in the supply of pressure fluid to the brush; moreover, it is usually necessary to perform adjustments of the brush from time to time to regulate its operation, and were the brush located directly over the fabric, or were its spray to pass directly over the fabric, this would result in the fabric being spattered with spots or drops from the brush; moreover, when the brush is not adjusted, there are periods when the spray is very "wet," that is, contains large particles of the coloring matter in suspension, and periods when the spray is "dry," that is, contains very fine or very minute particles of coloring matter in suspension. If the brush is located directly over the fabric and runs too "wet" with the formation of larger particles than is desirable, these larger particles tend to cause spots and otherwise prevent the desired even dyeing of the fabric.

By locating the aforesaid atomizing means to one side of the apparatus, and away from the fabric itself, there is provided a zone within the chamber which may be referred to as the separating zone, which is here indicated as the zone d bounded by the dotted lines 54. (See Fig. 4.) In this separating zone any wet particles or drops coming from the atomizing means will fall under their own weight into troughs 55, 55 located at each side of the chamber, because these drops are heavier than the fine and minute particles of coloring matter in suspension which find their way toward the center of the apparatus into the zone e, which I call the settling zone, and through which zone the material to be colored passes. There is thus effected so to speak, a separation of the drops from the lighter particles of the cloud, so that the cloud which comes in contact with the material to be treated is made up only of fine or minute particles of coloring matter in suspension without containing particles which are large enough to form spots on the material. It will be obvious however that where atomizing means are employed which work continuously without adjustment or without spitting, these may be located above the fabric itself. It will be noted from inspection of Fig. 1, that the atomizing means 4 at the front end of the machine are staggered relative to the atomizing means at the back of the machine so that the stream of minute particles issuing from the lowest brush at one end does not come into forcible contact with the minute particles coming from the other end; in other words, the stream of minute particles coming from the different brushes do not directly oppose one another, and thus form a large quantity of drops or "wet" matter. It is further to be noted that the atomizing members shown in Fig. 3 are arranged in sets one above the other, the distance therebetween being equal to or greater than the distance between the streams of minute particles in suspension issuing from the atomizing means, so that these streams do not overlap and form drops. It is further to be noted that the roof 55 of the dye chamber is located at a substantial height above the uppermost set of atomizing means, thereby avoiding the formation of drops by the coalescing of the particles of liquid coloring matter upon the roof, which will take place if the roof is located in too close proximity with the atomizing means; any desired number of atomizing means arranged in tiers may be provided according to the rapidity with which it is desired to dye the material, or the depth of the color desired. I prefer to arrange an observation window 56 between the two lowermost brushes 4 as shown in Fig. 3, whereby a view of the material can be obtained as it enters the dye chamber. This window may be secured in its open position by means of clips 57. The longitudinal and transverse walls and roof of the chamber are preferably built of smooth-surface wood, beaver-board and the like, and transverse and longitudinal curved portions 58, 59 may be provided between the roof 55 and the top of the chamber walls, to guide the upper portion of said cloud to move towards the center of the chamber.

Drying means.—The drying chamber B comprises the transverse walls 60, 61, longitudinal walls 62, 62, roof 63 and bottom wall 64. The chamber is mounted upon a frame 65 and the bottom wall 64 thereof sup-
ports a heating element here shown as a steam-box 66 divided by longitudinal baffles 67 (see Fig. 3) and having a slightly inclined upper face 68 over which the aforesaid belt 10 and material 1 passes.

The steam-box is insulated from the bottom wall 64 by asbestos packing 69 arranged in the casing 70. Steam is supplied to said steam-box through the steam inlet 71 controlled by cock 72 and the steam and condensation water is withdrawn from said steam-box through a suitable conduit 73.

Driving means.—Means are provided for driving the belt 10 and for traversing the fabric across the dye chamber and drying chamber with or without tension according to the nature of the material. The driving mechanism comprises a drive motor 80 which drives through a suitable belt and pulleys, a change-speed mechanism 81 connected to drive a speed-reducing mechanism 82. Speed-reducing mechanism 82 has a removable sprocket 86 connected by chain 87 with the sprocket 89 on shaft 14 of the roller 13 (Fig. 3). Another removable sprocket 88 is provided on said shaft 14 connected by chain 87 with removable sprocket 89 on the shaft 23 of the roller 3.

The ends of shafts 14 and 23 may be elongated to receive sprockets 86a, 86b, 88a, 88b, respectively, attached to said shafts by set screws. Wide variations in speed between the shafts 14 and 23 can be effected according to whichever pair of sprockets are connected up by a sprocket chain; whereby the relative speeds of the belt and the fabric may be altered at will. Furthermore, by means of the change-speed mechanism both the speed of the belt and the speed of the fabric may be changed without disturbing the predetermined ratio of speed desired between the belt and the material. The shaft 22 of the roller 2 may be provided with a removable sprocket 89 which may, when desired, be connected with a removable sprocket 90 on the shaft 13 of roller 11 by means of a chain 91 whereby to drive said roller 2 when it is desired to feed the material through the dye chamber without tension at the incoming end.

While it is preferred to have the belt and fabric travel at the same speeds, good results have been obtained with the belt travelling slightly faster than the fabric. The construction and operation of the change-speed mechanism and the speed-reducing mechanism will be understood with particular reference to Fig. 5, from which it will be noted that the drive motor 80 has a pulley 100 thereon, driving belt 101 connected to pulley 102 of the aforesaid change-speed gearing which is diagrammatically represented herein. Being of a well-known type, not forming any part of the present invention it need not be described in detail. Suffice it to say that rotation of the handle 103 causes differences in speed between the pulley 102 and the pulley 104; it being understood that any suitable change-speed device can be employed instead of mechanism of the Reeves type. Pulley 104 is connected by belt 105 to pulley 106 of speed-reducing mechanism frame 107, which pulley 106 is mounted on shaft 108 provided in bearings 109 and provided with a worm 110 driving worm-wheel 111 on transverse shaft 112 mounted in bearings 113, and provided at one end with a gear 114 meshing with gear 115 at the end of shaft 116 mounted in bearings 117 on the frame 107. The other end of said shaft 116 has a smaller shaft end 118 carrying the aforesaid removable sprocket 86 secured thereon by means of set screw 85a.

Smoothing or stretching means.—In connection with some materials which have a tendency to wrinkle or form folds either longitudinally or transversely as it passes through the dye chamber, a may provide means for stretching the fabric having a movement to the folds in the fabric in a transverse direction as it passes through the dye chamber, as illustrated in Fig. 7, which is a transverse horizontal section taken through the portion of the dye chamber in the plane of the openings 8 and represents the belt and fabric passing through said dye chamber similar to the arrangement shown in Fig. 2. As here shown diagrammatically, the means employed are V-shaped elements 150, arranged beneath the fabric but above the belt (see Fig. 2) with the apices 151 of said members out of alignment with one another, but pointing in the direction opposite to that in which the fabric passes through the apparatus, and projecting slightly above the belt. These elements are preferably formed by bars covered with smooth rubber, and the ends 152 thereof do not project out from under the edges of the fabric; these elements serve to stretch the fabric transversely, and have the effect of smoothing out the wrinkles which tend to form in the material as it passes through the dye chamber. The V-shaped elements 150 are connected together and held in position in the chamber by means of the wires 153 all of which are protected from the effect of the deposition of coloring matter owing to the fact that they are located below the material to be dyed. The end wires 154 project outside the dye chamber and are suitably anchored to any convenient portion of the frame.

Pressing and heating.—The rollers 22, 22a may sometimes, though not necessarily always, be employed for pressing or heating or both pressing and heating the fabric prior to its passing into the dye chamber. To this end roller 2 may be mounted in adjustable bearings 161, as shown diagrammatically in Figs. 1 and 2, controlled by hand-wheels 160. The bearings 161 may be substantially similar to the adjustable bearings of the shaft 190.
13. Roller 2a constitutes the pressing roller and roller 2 constitutes the heating roller, and to that end may be connected by pipe 162 to a source of steam supply. The pressure upon the material as it passes between the rollers 2 and 2a can be varied by adjusting the hand-wheel 160; moreover, the material can pass through said rollers without pressure, if desired, in which case the upper surface of the material will be heated; the employment of this device is optional, and the same may be driven at variable speeds as already explained. Means are provided for preventing the formation of drops on the edges of parts which overhang the fabric as it passes through the machine, which drops would fall upon the fabric; these means are here illustrated as heating means comprising the transverse pipes 170, which are located in the slots 8, 8 of the transverse walls 5, 5, and are connected with steam-pipe 171, the arrangement being such that by opening cock 172, steam enters said pipes 170 whereby to heat them; any particles of coloring matter or dye which may collect upon the transverse walls 5 and tend to creep down the sides of said walls and form drops at the edges of the openings 8, 8 come in contact with the hot surface of the pipes 170, and are thereby evaporated. The two transverse pipes 170 are also connected to an exhaust pipe 173 connected with the steam outlet pipe 174 to which is also connected the steam outlet from the conduit 73.

The operation of the improved machine will now be described:

Operation of apparatus.—The fluid medium is preferably supplied at a constant pressure, although this pressure can be varied to the extent of dyeing to be effected in the apparatus; in the form of airbrush here illustrated, the dye in liquid form in the container 46 is drawn into the airbrush by aspiration; the liquid dye is prepared in the same manner as in the usual vat dyeing processes, but the solution may in some cases be considerably more concentrated and should be carefully strained. The degree of concentration depends upon the final tint of color desired, as hereinafter described. The airbrush is regulated so as to produce a stream of extremely minute particles of liquid dye held in suspension in the air. With some or all of the brushes in operation, depending upon the depth of color required, a cloud soon forms in the apparatus; each brush can be individually adjusted by means of the cocks 52 and needle valves 42, and the entire battery of brushes can be shut off simultaneously by means of cock 51 when the cocks 52 are open. The minute liquid particles in the cloud begin to settle upon the material as it passes through the settling zone E of the dye chamber, and colors it on one side thereof. It is to be noted that the cloud forms in front of the air-brush spray, and that no portion of this air-brush spray is located directly above the fabric, so that any large particles, drops, or particles of solid matter which may drop from the air-brush spray by gravity, do not drop on the fabric itself, but drop to one side thereof; in other words, the fabric is not subjected to the direct action of the air-brush spray itself, or to the droppings or spatterings of the air-brush, but only to the action of the cloud. This cloud is continuously formed by the battery of airbrushes and continually depleted of color which settles by gravity on to the material as it moves across the bottom of the chamber. The particles and drops which settle or fall in the zones D, D in proximity with the airbrushes collect in troughs 55 (Fig. 4). The material is preferably drawn through the chamber by sewing to the leading edge thereof a wide piece of muslin or the like, which is then attached to the belt 10 and drawn through the chambers A and B by the belt 10; the leading edge of the muslin is then passed between rollers 3, 3a; the chamber A is charged with the color cloud, and when the desired density is obtained, which is observed through the windows 23 or determined by the length of the operation of the brushes, all the length of muslin is drawn through the chambers and the other textile such as silk or the like attached thereto passes into the dye chamber A and moves continuously through the chamber while receiving therein a continuous exposure to the settling of minute particles of coloring matter from the cloud, and by the time the material has passed through the dyeing chamber, it has received a substantially evenly distributed settling of minute particles of coloring matter, and is therefore substantially evenly dyed and presents a substantially evenly colored surface. It is important that the material in passing through the machine, should be evenly presented to the cloud to avoid the formation of streaks, and to this end the tension upon the material is adjusted so that the material lies flat upon the belt 10, but where the material tends to form longitudinal folds, it may pass over the aforesaid V-shaped smoothing or stretching elements 150 which break up the folds or wrinkles; that is, the folds or wrinkles tend to be smoothed out so that when a given length of material has traversed the dye chamber, it will be found that all portions thereof have been substantially evenly exposed to the deposition of coloring matter. The material before passing over the roller 3 passes through the drying chamber B, the heat of which is such that both the belt and the material is thoroughly dried before leaving the chamber. The function of the belt 10 which preferably travels slower than the material, is not only to provide a moving surface on which the material
passing through the machine travels, but the edges of said belt preferably project somewhat beyond the edges of the fabric as shown in Fig. 2, and these edges form a surface for the edges of the material to travel along which protect the undersurface of the fabric from streaking; the belt 10 in passing through the drying chamber, is also dried, so that said belt performs the function of continuously conveying color from the top of the bed 9 which would otherwise form puddles and drying up said color in the drying chamber. As a result, the material if it should shift slightly sidewise, does not pick up moisture from the belt as would be the case were it to travel along the wet bottom of the bed or of the chamber without the intervening belt surface. By passing the belt 10 through the drying chamber, and thereby drying it, the entering material always travels upon a substantially dry surface. Moreover, the same apparatus may be used to color different widths of material without any adjustment. The extent of penetration of the dye into the fabric depends upon the length of time the material remains in the chamber and the wetness of the cloud. It is to be noted as to that portion of the cloud above the settling zone which consists of very fine particles of coloring matter in suspension that this cloud is in motion, and while certain portions of said cloud may be denser than other portions thereof, it presents the characteristic that it is made up of particles which are so fine that they do not form drops in settling on the fabric, so that even though the cloud may be uneven as to the density of the particles therein, nevertheless since any given portion of the material which traverses the apparatus is subjected to the same conditions as any other portion of the material, the material comes out evenly colored after it has passed through the dye chamber. Moreover, where the material tends to form folds or creases, and the use of the smoothing or stretching devices hereinbefore described is adapted, by the time a given length of material has passed through the apparatus, the folds or wrinkles therein have been forced to shift their positions successively, so that no one fold or wrinkle has remained undisturbed for more than a short part of its traverse through the chamber, and by the time the given portion of the fabric has entirely passed through the chamber, the folds will have been so disturbed and smoothed out that the fabric will be found to present a substantially even surface throughout. Where the material lies flat upon the belt, without forming folds, it will not be necessary to use the aforementioned smoothing or stretching members, which have been found to be particularly useful in connection with the dyeing of certain silks which tend to form creases during the dyeing operation. The material leaves the dye chamber in a damp condition and by the time it has passed through the drying chamber it should be quite dry. It is preferable to use the apparatus for dyeing the material on one side only; nevertheless a complete penetration of the dye through the fabric can be effected if the spray is made quite wet, or if the material passes through the dyeing chamber extremely slowly. But if it is not desired to penetrate more than a predetermined amount, as is the case where the process is employed for coloring material on both sides, the material will be moved through the dye chamber at such speed that the penetration of the dye will not exceed the desired point; thereafter it may be dyed on the opposite side thereof by placing it in a second apparatus similar to the apparatus just described, as illustrated diagrammatically in Fig. 9, wherein / represents the apparatus for dyeing a piece of fabric one color or tone on one side thereof, while g is the apparatus for dyeing the material a second color or tone on the opposite side thereof. Attention is directed to the fact that the shape of the cloud is substantially rectangular but that the longitudinal dimension is far greater than the transverse dimension; in other words, I use a substantially long cloud and traverse the material through this long cloud. It will be understood from reference to Fig. 7 that as much as the V-shaped bars therein illustrated do not project out underneath the fabric they will form a narrow selvage or bar of light color at the extreme longitudinal edges of the fabric, which is not at all objectionable since a large number of materials are employed with a selvage; said V-shaped members can extend out beyond the edge of the fabric when the fabric is passed through the dye chamber with a continuous web, as is common in textile machinery; it will of course be understood that this web will be of relatively thin material and will be fed along with the fabric to be colored on the under side thereof over the belt 10.

In the case where the fabric tends to shrink substantially in the dyeing process, as is the case with certain grades of crépe de Chine, I prefer to traverse it beneath the color cloud by means of any suitable tenter frame mechanism well-known in the art which slightly stretches the material and prevents it from shrinking.

It will be noted that a cock 100 is adapted to connect the air-pipe with the supply of steam, so that the apparatus may run on steam as the atomizing medium when desired, or steam may be mixed with compressed air or the like when desired.

What I claim is—

1. The process of coloring a web of permeable fabric consisting in forming two color clouds while separating the heavy particles or drop from the lighter particles of said...
clouds, and traversing the material under the separated lighter particles of said clouds, and exposing one face to one of said clouds and the other face to the other of said clouds.

2. The method of coloring materials which consists in forming two clouds of atomized coloring matter, heating the material and traversing the material relative to one cloud, while exposing one side thereof to said cloud, again heating the material, and traversing the material relative to the other cloud, while exposing the other side of the material to the other cloud.

3. A dyeing or coloring apparatus comprising a dye chamber, means for traversing a continuous web of material along a path in said chamber, and atomizing means located in a plane substantially parallel with but out of vertical alignment with the path of the material in said chamber.

4. A dyeing or coloring apparatus comprising a dye chamber, atomizing means for said chamber disposed to produce a zone for separating drops from the smaller particles issuing from the atomizing means, and a settling zone for a cloud of finely divided particles in said chamber and means for traversing the material through the settling zone.

5. A dyeing or coloring apparatus comprising a dye chamber and means for traversing a continuous web of material along a path in said chamber, and atomizing means including a nozzle arranged with its axis in a plane substantially parallel with but out of vertical alignment with the path of the material in said chamber.

6. A dyeing or coloring apparatus comprising a dye chamber, means for traversing a continuous web of material along a path in said chamber, atomizing means producing a stream of finely divided particles of liquid dye in said chamber, said stream being projected by said means in a plane substantially parallel with but out of vertical alignment with the path of the material in said chamber.

7. A dyeing or coloring apparatus comprising a dye chamber, means for forming a color cloud therein, said chamber formed with openings therein; a drying chamber having openings therein, and a belt traversing the openings in the dye chamber and in the drying chamber.

8. A dyeing or coloring apparatus comprising a table, a heating element forming a continuation of the path of the upper surface of said table, a dye chamber on said table, means for forming a color cloud in said chamber, and means for traversing material to be colored across said table and heating means.

9. A dyeing or coloring apparatus including a dye chamber with atomizing means forming separating zones with an intermediate settling zone, and a bed located at the bottom of said chamber in said settling zone.

10. A dyeing or coloring apparatus including a dye chamber with atomizing means located therein and forming separating zones with an intermediate settling zone, an arcurate bed located at the bottom of said chamber in said settling zone, and a conveyer belt traversing said arcurate bed.

11. A dyeing or coloring apparatus comprising a dye chamber, an atomizing device, a pan located directly below said atomizing device in a position to receive droppings from said atomizing device, and means for traversing a continuous web of material through said chamber at the side of said pan.

12. A dyeing or coloring apparatus including a dye chamber, atomizing means located at either end of said chamber and disposed to produce with the chamber separating and settling zones for a cloud of finely divided particles of liquid color or dye in said chamber, and means for traversing the material through the settling zone.

13. A dyeing or coloring apparatus comprising a dye chamber, atomizing means for said chamber adapted to produce streams of finely divided particles of liquid matter, said atomizing means located at opposite ends of the chamber in such positions that said streams do not substantially intermingle, and said atomizing means being disposed in said chamber to produce separating and settling zones for a cloud of the said finely divided particles in said chamber, and means for traversing the material through the settling zone.

14. A dyeing or coloring apparatus comprising a dye chamber and a plurality of atomizing means adapted to produce a stream of finely divided particles, said atomizing means arranged in tiers with the distance between each tier greater than the thickness of one of said streams, to avoid a substantial intermingling of said streams.

15. A dyeing or coloring apparatus comprising longitudinal and transverse walls, openings in said transverse walls, means for continuously traversing the material through said openings in said transverse walls, all portions of said longitudinal and transverse walls being spaced away from the path of the material (except the portions overhanging said openings) whereby to avoid drops from said walls falling on the material.

16. A dyeing or coloring apparatus including a dye chamber, means for forming a color cloud in said chamber, a flexible web, means for traversing said web through said chamber, and means for varying the relative speed between the flexible web and the material traversing means.

17. A dyeing or coloring apparatus comprising a dye chamber having walls formed with openings therein, means for forming a color cloud in said chamber, and means located on said walls overhanging said mate.
18. Apparatus for dyeing textile materials comprising means for forming a cloud of minute particles of finely divided coloring matter, means for traversing a textile fabric relative to said cloud and controlling means whereby said cloud only partially penetrates said textile material.

19. Apparatus for dyeing textile materials comprising means for forming a cloud of minute particles of finely divided coloring matter, means for traversing a textile fabric relative to said cloud and controlling means whereby the extent of penetration of the dye can be varied.

20. A process of dyeing textile fabrics which consists in atomizing the dye liquid in a gaseous medium, and in conveying the dye laden medium in addition to driving it by fresh oncoming quantities of the same away from its source of formation to a sufficient extent to eliminate drops and particles of appreciable size and to substantially expend the kinetic pressure of the said dye or color laden medium, and thereafter, but not till then, causing the resultant substantially quiescent cloud to make contact with the fabric by traversing the fabric relative to the cloud.

21. A process of dyeing textile fabrics which consists in accumulating the finer atomized particles issuing from an atomizing device in a cloud chamber in the form of a cloud of substantial volume and traversing the fabric to be dyed under said cloud without exposing the fabric in its path of travel to the spraying of liquid particles issuing from the atomizing device and while said particles are under substantial spray velocity.

22. Process of coloring a web of permeable textile fabric which consists in spraying a liquid dye in one locality, leading the atomized dye spray to form a color cloud in another locality, and continuously traversing the fabric relative to and in contact with the cloud in said other locality.

23. Process of coloring or dyeing fabrics consisting in exposing the fabric to a color cloud while preventing portions of said color cloud from settling on the fabric by evaporating the dye particles of said portions.

24. Method of coloring textile fabric comprising forming a color cloud, heating the color cloud, and passing the fabric in contact therewith.

25. A dyeing or coloring apparatus comprising a chamber, means for forming a color cloud in said chamber, means for traversing a textile material through said chamber relative to the color cloud, and means for heating the color cloud.

In testimony whereof, I have signed my name to this specification.

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