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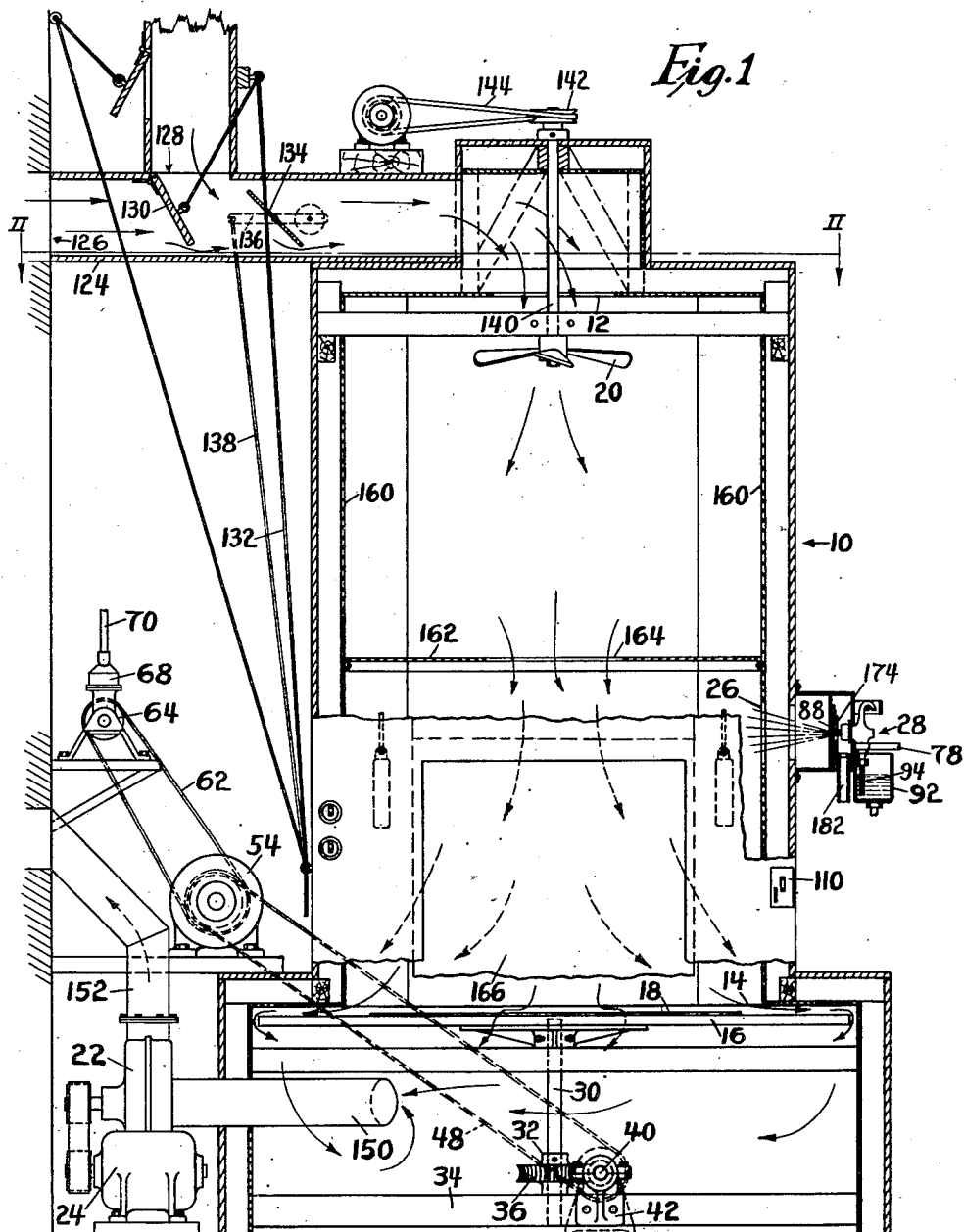
M. M. MERRITT

2,028,796

APPLICATION OF FINELY DIVIDED MATERIAL TO ARTICLES OF MANUFACTURE

Filed May 14, 1932

3 Sheets-Sheet 1



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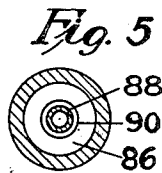
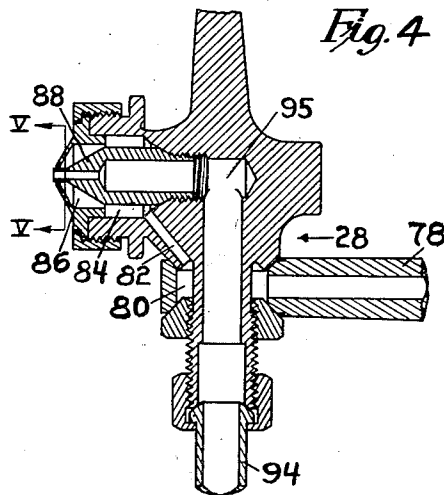
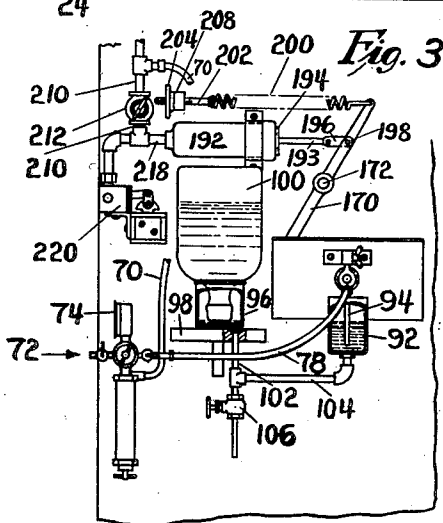
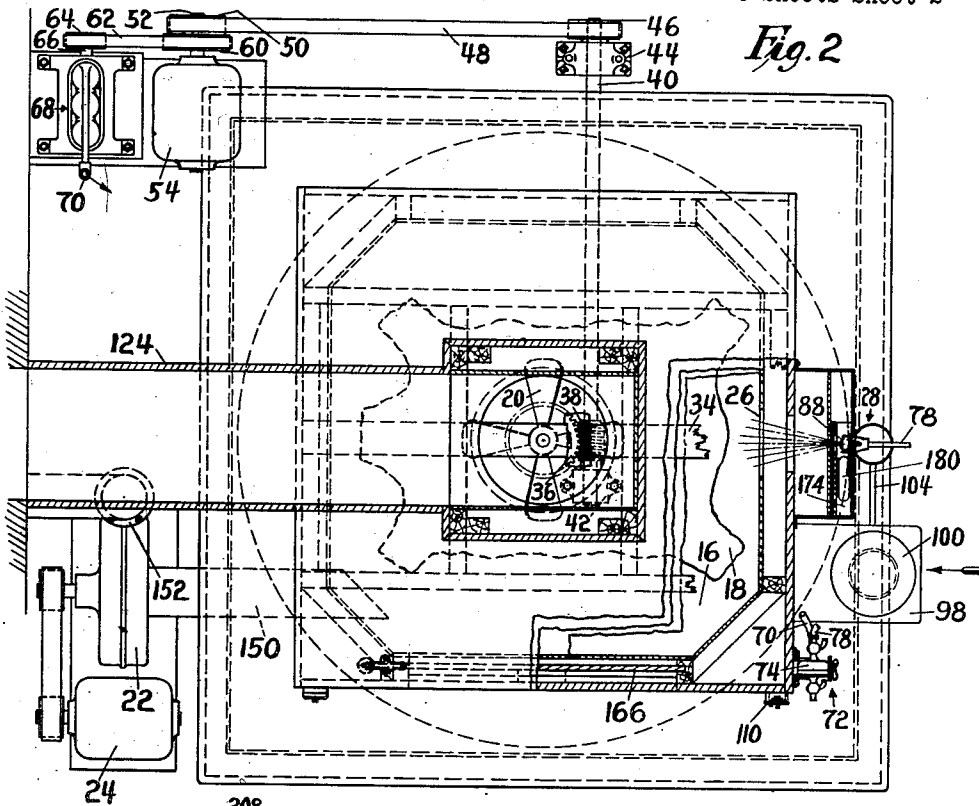
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APPLICATION OF FINELY DIVIDED MATERIAL TO ARTICLES OF MANUFACTURE

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3 Sheets-Sheet 2



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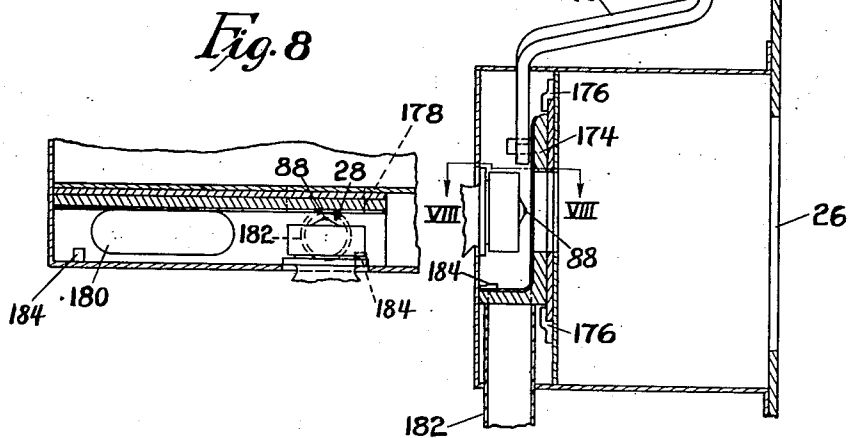
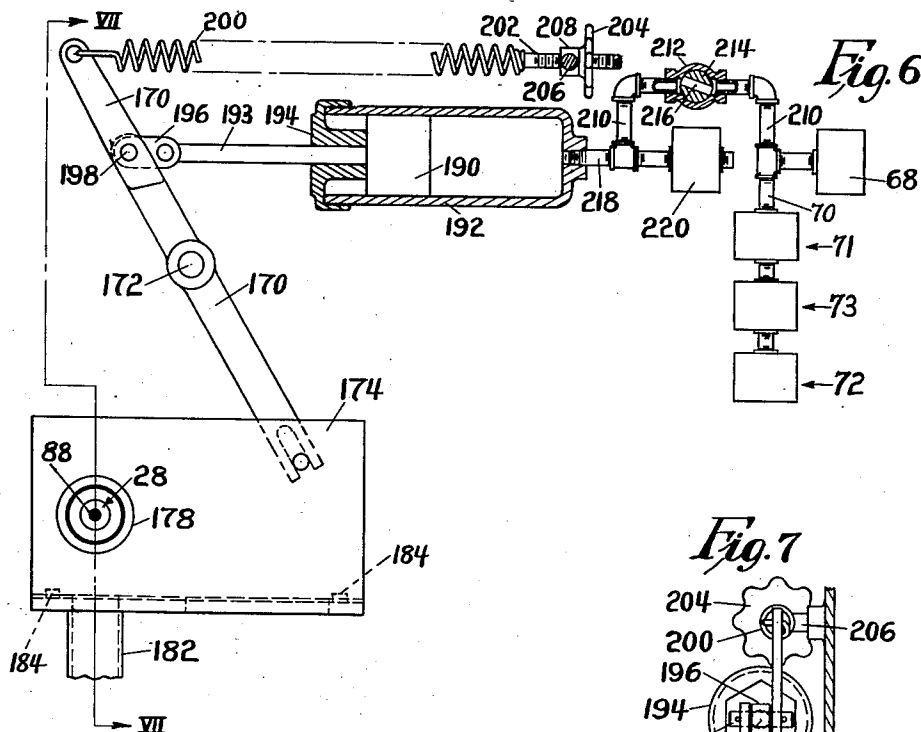
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APPLICATION OF FINELY DIVIDED MATERIAL TO ARTICLES OF MANUFACTURE

Filed May 14, 1932

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,028,796

APPLICATION OF FINELY DIVIDED MATERIAL TO ARTICLES OF MANUFACTURE

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Application May 14, 1932, Serial No. 611,425

27 Claims. (Cl. 91—45)

This invention relates to the treatment of articles of manufacture with finely divided material. While the invention is described with reference to the coloring of pieces of leather with nebulized dye material, it is to be understood that the invention and various important characteristics and features thereof may have other applications and uses.

In the coloring of pieces of leather with the aid of hand-supported spraying devices, as heretofore practiced, a piece of leather was placed upon a slanting work supporting surface in a sort of booth with an overhead hood to draw off the vapors and excess nebulized material. The operator standing at the entrance to the booth directed the nebulized material upon the work and moved it back and forth at different levels in an attempt to cover the surface of the leather in a uniform manner and with the requisite amount of dye material to secure the desired shade of color. An expert in the work who exercised extreme care secured very good results for a limited time. It will be readily understood, however, that the quality of the work depended entirely upon the skill, the endurance, and the faithfulness of the operator to his conception of a finished piece of work of the quality desired by the manufacturer. With some operators the factor of endurance may have been the most important, it being obvious that, after several hours, fatigue, particularly in the muscles of the arm and hand, would militate against the attainment of good results. More often, however, failure to get good results was due to the speed of the traveling spray being too great for any but the most skillful operators to control properly the application thereof to the work and to the fact that only a small part of a piece of leather was treated at any given instant. There was thus required a high degree of accuracy in eyesight and in control of the application of the spray in order to secure uniform results in all parts of the work piece. As a matter of fact pieces of leather colored, or otherwise treated, with the aid of nebulizers or spray devices in accordance with methods heretofore commonly practiced were rarely uniform in quality or in color. The goods thus manufactured were, however, saleable at a price and this may account in part, but only in part, for the fact that in the course of many years so little has been accomplished in the many attempts made to overcome the deficiencies and defects of methods and mechanisms long employed in the coloring of leather.

It is an object of the invention to secure uniformity in the quality of the product obtained in

the treatment of articles of manufacture by liquid material in finely divided form. It is a further object of the invention to standardize the treatment of such articles and to speed up production while maintaining high quality in the appearance of the finished product.

To these ends and in accordance with important characteristics of the invention, a controllable body of air, adequate in volume, is first treated with nebulized or finely divided liquid material and subsequently moved in a direct line to an exposed surface of an article placed substantially centrally in said body of air for treatment. The purpose is to secure wide and uniform distribution of the finely divided liquid material before it reaches the piece of work to be treated and then to deposit the dispersed material uniformly on the exposed surface of said work piece.

In the method as practiced, nebulized or finely divided liquid material in a relatively restricted amount of air is projected in a given direction and at high speed into a controllable body of air of substantially greater volume and moving in a different direction to the piece of work to be treated. It follows that air currents are set up in the body of air by the entering nebulized material which assist in the desired distribution of the material throughout the controllable body of air. Moreover, by projecting the nebulized material, during its introduction into the controllable body of air, in a direction other than directly toward the work, more time is given to effect the desired distribution of such material than if it were shot directly toward the work.

Preferably and as disclosed herein, the controllable body of air is drawn to and through a space all around the periphery of the piece of work, the purpose being to cause the treated air to move over the surface of the piece of work from central portions thereof out to all of its marginal portions, so that uniform distribution of the finely divided material over the whole surface of the work may be secured.

For practising the method by which articles of manufacture may be treated with finely divided or nebulized liquid material there is provided, in the illustrated construction, a chamber as the most convenient means of securing a controllable body of air of the desired volume movable directly toward a piece of work to be treated, together with means operative to introduce a cloud of finely divided material into the controllable body of air and mix it thoroughly therewith. In order to facilitate distribution of the finely divided material uniformly through the air mov-

ing toward the work, said means is arranged to project the said material into said controllable body of air at an angle to its direction of movement. This angle may be varied within wide limits but should not be such as to project any part of the finely divided liquid material directly toward the piece of work.

Preferably and as shown, the chamber has an inlet for air and also an outlet, a work supporting means being located at or adjacent to the outlet and centrally of the latter so that the treated body of air is controllable to a larger degree than would otherwise be the case by reason of the fact that the air must escape all around the periphery of the piece of work. Due to this arrangement for the escape of the material-laden air, it passes over, and treats all portions of the surface of the piece of work from the center outwards to the peripheral portions thereof. To facilitate uniform distribution of the material over the article being treated provision is made to move the piece of work, for example, by moving the work support at a predetermined speed whereby the effect of variations in the direction and speed of currents of air set up within the body of air moving toward the piece of work will be largely neutralized.

In the illustrated construction, the controllable body of air within the chamber is caused to move toward the work support by having a blower operative to withdraw air from the chamber through a space surrounding the periphery of the work support upon which the work rests. To assist in drawing air into the chamber a fan is provided near the inlet thereof but the capacity of the fan is substantially less than the capacity of said blower so that the latter may draw upon the air at the outlet in the manner already described.

It is a well-known fact that upon starting a nebulizer (of the size commonly used in manufacturing operations) there is almost invariably ejected a small body of liquid material and also droplets of considerable size which, if allowed to reach the work, would produce imperfections in the appearance thereof. Hence, it is desirable to prevent the introduction of such material from the nebulizer into the chamber. Furthermore, in order to secure work of high quality notable for the uniformity of its finished surface it is desirable that the nebulized material be introduced into the chamber invariably at the pressure selected as the normal pressure at which a given material should be nebulized to produce a uniform, finely divided material. For both of these reasons there is provided, in the illustrated construction, means to control the introduction of nebulized material into the chamber in such manner as to secure, in the chamber, only finely divided material uniform in its fineness and distribution. This is conveniently accomplished through the provision of a shutter operable in timed relation to the operation of the nebulizer to intercept unnebulized material or only partially nebulized material, the said shutter being withdrawn at the proper time to permit of introduction of material nebulized at the normal pressure. Preferably also the shutter is operated in timed relation to the nebulizer to prevent entrance of nebulized or only partially nebulized material as the air pressure is sinking in the nebulizer during discontinuance of its operation. Conveniently, the shutter is operated by the pneumatic means which furnishes air under pressure to the nebulizer. As illustrated, an air op-

erated piston is connected to the shutter to move the latter in timed relation to the action of the nebulizer, the construction and arrangement being such that when, after a short interval, the nebulizer has started to nebulize material at the normal or predetermined pressure the piston moves to retract the shutter to inoperative position. The shutter may be moved in the opposite direction, that is, to operative position, by means of a spring, the air being released from the piston cylinder (to permit retraction of the piston) by a release valve controlled by the same switch which starts the pneumatic means and, perforce, the nebulizer in operation.

These and other important characteristics and features of the invention will now be described in detail and then pointed out more particularly in the appended claims.

In the drawings,

Fig. 1 is a view in side elevation and partly in section of a machine illustrating one embodiment of the invention;

Fig. 2 is a sectional view of the machine shown in Fig. 1 taken along the line II—II and looking in the direction of the arrows;

Fig. 3 is a detail view partly in section of the liquid supplying and nebulizing devices;

Fig. 4 is a vertical section through the nebulizing device;

Fig. 5 is a section along the line V—V in Fig. 4;

Fig. 6 is a detail view of a special means for controlling a shutter in timed relation to the nebulizer;

Fig. 7 is a view of the device shown in Fig. 6 looking from the left in the latter figure along the line VII—VII; and

Fig. 8 is a view taken along the line VIII—VIII of Fig. 7.

In the illustrated machine, which is specially designed for the application of coloring material to pieces of leather, there is provided a chamber 10 having at its upper end an inlet 12 for the entrance of air and at its lower end an outlet at 14 for the exit of air. At the outlet of the chamber there is provided a work support 16 upon the upper surface of which a piece of leather 18 may be supported in the path of the air passing through the chamber. For drawing air into the chamber through the inlet 12 and causing it to move toward the work support 16 there is provided a suitable fan 20 located in the upper end of the chamber below the inlet 12. Preferably and as shown, means is provided for drawing air from the chamber 10 at the outlet thereof, the said means comprising a blower 22 of a well-known construction arranged to be driven by belt connections with a motor 24, the capacity of the blower 22 being substantially greater than that of the fan 20 so that there is a distinct tendency to draw the air downwardly through chamber 10 to the piece of work supported on the work support 16. As shown, the outlet 14 is constructed so as to provide an opening all around the periphery of the lower end of the chamber 10, the work support 16 being larger than the lower end of the chamber so that the air is directed in a lateral direction at the outlet from the chamber, the idea being to cause air currents to spread outwardly in all directions from a central portion of the table. At a point intermediate between the inlet 12 and the outlet 14 of the chamber there is provided an opening 26 through which nebulized material may be introduced into the chamber 10 from a spray gun or nebulizer 28. It will be noted that the cloud of nebulized or otherwise

finely divided material is projected at an angle to the path of movement of the body of air passing through the chamber 10 from the inlet 12 to the outlet 14 thereof. In this way the nebulized material is well distributed within the larger body of air passing through the chamber before any part of the nebulized material reaches the piece of work 18 on the work support 16. Due to the suction of the blower 22 upon the air at the restricted peripherally arranged outlet of the chamber 10, the air spreads out in all directions from a central portion of the work support to the periphery thereof. Hence the nebulized material is further distributed to include all portions of the piece of work exposed for treatment.

As illustrated the work support 16 is carried at the upper end of a vertical shaft 30 (Fig. 1) to which is secured a collar 32 arranged to rest upon the upper side of a cross piece 34 by which the collar and shaft are supported. Secured to or integral with the collar 32 is a spiral gear 36 (Figs. 1 and 2) arranged to be in mesh with a worm 38 secured to the horizontal shaft 40 carried by bearings in brackets 42 and 44. At its other end the shaft 40 carries a pulley 46 around which passes a belt 48 to a second pulley 50 secured to armature shaft 52 of motor 54, the arrangement being such that the table 16 is rotated at a relatively slow rate while the motor 54 is running. It is clear that by rotation of the table 16 a piece of work such as that shown at 18 is moved at a uniform speed in a plane transverse to the direction of the path of movement of the air through the chamber 10, thereby substantially neutralizing the effect of variations in the distribution of the nebulized material in the body of air moving toward the work and also of variations in air currents set up by both the fan 20 and the blower 22 in forcing air through the container and out around the periphery of the table 16 at the outlet of the chamber.

Conveniently the motor 54 is utilized to provide air under pressure for effecting nebulizing of a liquid dye material at the nozzle of the nebulizer 28. For this purpose the motor shaft 52 (Fig. 2) is provided with a pulley 60 about which passes a belt 62 to a second pulley 64 on a shaft 66 of an air compressor indicated by reference character 68. From the air compressor 68 a tube 70 (Figs. 2 and 3) carries the air to an air controlling device 72 which is conveniently a widely used commercial unit known as an aerograph control comprising an air strainer or cleaner, a pressure reducing valve and a pressure indicator 74. While the air compressor 68 sends air into the pipe 70 at a pressure around one hundred pounds, the reducing valve brings the pressure down to a desired lower pressure. In this case the tube 78 carries air under an adjusted pressure of six pounds to the nebulizer 28 (Figs. 1, 3 and 4). As will be evident from an inspection of Fig. 4 the air from tube 78 is conducted by passageways 80, 82 to a chamber 84 from which it is allowed to escape through a circular opening into a chamber 86 surrounding a liquid carrying nozzle 88, the air passing from chamber 86 through a circular opening 90 (Fig. 5) surrounding the reduced circular end of the nozzle 88. By the force of the air rushing from the restricted space 90 the liquid is drawn from the nozzle 88 and reduced to a finely divided or nebulized condition. Furthermore, the pressure of the air escaping from the opening 90 is such as to project the nebulized material with considerable force into the chamber where the cloud of nebulized material becomes well distrib-

uted in the body of air traveling toward the piece of work to be treated.

The nebulizer 28 comprises a receptacle 92 (Fig. 3) for a liquid material to be projected into the chamber 10, a pipe 94 (Figs. 3 and 4) being arranged to dip well below the surface of the liquid constantly maintained in the receptacle 92 to conduct the liquid via passageway 95 to the nozzle 88 of the nebulizer 28 as it is drawn thereto by the action of the air escaping under pressure through the opening 90. For maintaining the liquid at a certain level in the receptacle 92 there is provided a cup 96 (Fig. 3) supported at the proper level by a bracket 98 attached to the wall of the chamber 10, the cup 96 being constructed and arranged to receive the neck portion of a standard size bottle container 100 (Fig. 3) of liquid dye material. This is the well-known barometric feed arrangement for maintaining within the cup 96 a liquid in an amount and at a level determined by atmospheric pressure. From an opening in the bottom of the cup 96 there extends a tube 102 which communicates by a second tube 104 with the bottom of the receptacle 92. It will be readily understood that the level of the liquid in the receptacle 92 will be maintained through the connecting tubes 102, 104 at substantially the same level as the liquid in the cup 96. The lower end of the tube 102 is normally closed through proper manipulation of a valve closure contained in a valve 106, it being possible to manipulate the valve closure so as to discharge all the liquid from the receptacle 92 and from the cup 96 when it is desired to change from one liquid to another, for instance, in substituting one dye or color for another.

When it is desired to introduce nebulized material from the nebulizer 28 into the chamber 10, the operator throws a switch indicated at 110 (Fig. 1) whereupon the motor 54 is energized to operate the air compressor 68 whereupon air pressure is quickly built up in the air line 70 and in part of the device 72 by reason of the resistance offered by the reducing valve in the device 72, and material is sprayed from the nozzle 88 beginning at a low pressure but quickly reaching the maximum of six pounds fixed by the adjustable reducing valve. At the beginning of the spraying or nebulizing operation, the liquid material is apt to be ejected in relatively large droplets which, if allowed to reach the chamber 10, would be almost certain to be deposited upon the work and cause an imperfection on the surface of the latter. Hence, a shutter or shield member, hereinafter more specifically described, is mounted in the wall of the chamber 10 in such manner that it may be readily shifted into a position where it is interposed between the end of the nozzle 88 and the opening 26 in the chamber wall, the shutter or shield being left in position until the air pressure has risen to a point where it is operating at its normal maximum pressure. This requires only a second or two after which the shutter is withdrawn to permit the nebulized material to be introduced directly into the chamber 10. In order to facilitate introduction of a uniform amount of nebulized material during the treatment of successive pieces of work, the switch 110 will preferably be of a time controlled type such as that afforded by the well-known mark-time switch, disclosed in United States Letters Patent No. 1,773,697, granted Aug. 19, 1930, upon application of M. H. Rhodes. As stated above, the motor 54 operates not only the compressor 68 but also the rotating means for the table 16. Hence, when 75

the switch 110 is operated to initiate a work treating operation, the table 16 is set in rotation and at the same time the nebulizing device becomes operative to introduce nebulized material into the chamber 10. Clearly, when the switch, at the end of a timed period (such as fifteen seconds), automatically shuts off the current to the motor 54, the table comes to rest and the nebulizer becomes inoperative through lack of air pressure.

For introducing air to the top of the chamber 10 through the inlet 12 there is provided a conduit 124 (Fig. 1) which may lead to the outside air through an opening 126. However, in order to provide for air conditioned both as to temperature and humidity in such degree as to maintain the liquid condition of the sprayed material, an opening 128 is provided in the upper wall of the conduit 124 leading to an air conditioner (not shown) of any well-known construction where the air may be prepared at the proper temperature and humidity for introduction into the chamber 10. It has been found that, if the air drawn into the chamber 10 be too dry, it would be detrimental if not destructive with respect to the desired results through its drying effects on the spray. To control the amount of air drawn through the openings 126 and 128, there is provided a valve member 130 which may be manipulated by means of a cord or cable 132, the end of which is brought down within reach of the operator, a second valve member 134 being also provided to serve as a further control of the air passing through the conduit 124 to the inlet 12 of the chamber 10, the valve member 134 being operable through a valve lever 136 having attached thereto a cord 138, the lower end of which is also within reach of the operator. As shown more particularly in Fig. 1, the fan 20 is fixed to the lower end of a vertical shaft 140 mounted in suitable bearings and carrying at its upper end a pulley 142 around which passes a belt 144 arranged to be driven from any suitable source of power. As before stated, the air is pulled from the lower end or outlet of the chamber 10 by means of the blower 22 mounted at the end of an outlet pipe 150 which projects well under the table 68, the blower 22 discharging the air withdrawn from the chamber 10 through a pipe 152 to the outdoor air or to a suitable receptacle for reclaiming solvents or dye materials which escape from the chamber 10.

It will be noted that the chamber 10 has an inside wall 160 which is preferably made of sheet absorbent material such as a commercial wall-board product known as "homosote" which, because of the facility with which it absorbs liquid material, retains nebulized material coming in contact therewith and thus prevents any spattering or dripping of material from the side walls of the chamber to the work or to the work support.

Preferably, and as shown, a baffle plate, 162 having a median opening 164 is provided between the fan 20 and the level of the nebulizer 28. By reason of the presence of the baffle plate 162 nebulized air is prevented from reaching the upper end of the chamber 10 where it would be likely to collect upon the fan 20. Moreover, because of the relatively restricted size of the opening 164 in the baffle plate 162, air currents are set up in the air passing through the opening 164 to the lower part of the chamber 10 which contribute to the desired distribution of the nebulized material from the nebulizer 28 in the larger

body of air moving toward the piece of work 18 on the table 16.

In one wall of the chamber 10 there is provided a sliding door 166 which may be readily lifted or lowered, as the case may be, to permit of introduction of fresh pieces of work after removal of work that has been treated.

In the illustrated device (Figs. 6, 7 and 8) for moving a shutter in timed relation to the operation of the nebulizer 28 there is provided a lever 170 fulcrumed at 172 on a wall of the chamber 10, the lever 170 having a pin-and-slot connection (Fig. 6) with a shutter 174. As most clearly shown in Fig. 7, the shutter 174 is guided by members 176 for sliding movement in a direction transversely of the opening 26 in the adjacent wall of the chamber 10, the shutter 174 having an opening 178 (Figs. 6 and 8) which may be made to coincide with the opening 26, thus permitting the nebulizer to project the nebulized material into the chamber 10. As most clearly disclosed in Fig. 8, the shutter 174 is also provided, in an angularly projecting portion thereof, with an elongated slot 180 which may be positioned over the upper end of a pipe 182 leading to a chamber below the work support 16 from which air is drawn by the blower 22 through the exhaust pipe 150. When the opening 178 in the shutter 174 is in alignment with the opening 26, the slot 180 in shutter 174 is positioned at one side of the upper end of the pipe 182. On the contrary, when the shutter 174 is positioned so that the opening 178 therein is out of alignment with the opening 26 in the wall in the chamber, the slot 180 or some part of it, is in a position over the upper end of the pipe 182 so that material ejected from the nebulizer 28 and unable to enter the chamber due to the closing of the opening 26, may escape through the slot 180 into the pipe 182 through which it is drawn due to the action of the blower 22. Preferably, and as shown, the outside or exposed surface of the shutter 174 is covered by a sheet 183 of absorbent paper which may be readily replaced by a similar piece of paper since it is held in place by clips such as those shown at 184, it being understood that the sheet of absorbent paper is provided with openings corresponding with those at 178 and 180 in the shutter 174.

For operating the lever 170, there is provided a piston 190 arranged to be driven in one direction by air pressure within the cylinder 192, the piston 190 having a rod 193 fixedly secured thereto and extending through a cap 194 on the cylinder 192. At its free end the rod 193 is provided with a link 196 pivotally attached thereto, the other end of the link 196 being pivoted at 198 in a forked portion of the lever 170. It will be clear from an inspection of Fig. 6 that the lever 170 is swung in one direction through operation of the piston 190 and that said lever 170 is arranged to be swung in the other direction by a spring 200. Said spring 200 is attached to the upper end of the lever 170 and to a screw-threaded member 202 adjustably mounted within a rotatable interiorly screw-threaded member 204 held stationary in place against a wall of the chamber 10 by means of an eye bolt 206 having an eye portion 208 thereof encircling the screw-threaded member 202 so that the latter may freely move longitudinally through the ring 208. This movement of the screw-threaded member 202 through the stationary ring 208 takes place only when the member 204 is rotated to adjust the member 202 axially of the member 208. Ad-

justment of member 202 relatively to the member 208 is for the purpose of adjusting the tension of the spring 200.

Preferably, and as shown, air is admitted to the cylinder 192 from the air compressor 68 through a number of interconnected pipes 210, in one of which is a valve member 212 containing a rotatable choke valve 214 having a passageway 216 therethrough, the choke valve 214 being adjustable to vary the position of the passageway 216 in such manner as to change the amount of air which may pass through the pipe 210 to the entrance pipe 218 leading to the chamber of cylinder 192. It is obvious that, when the passageway 216 in the choke valve 214 is at a substantial angle to the passageway through the pipe 210, air may be admitted in such restricted amounts as to cause only a slow movement of the piston 190 in the chamber 192, to the left in Fig. 6, while, at the same time, pressure is built up so rapidly in the nebulizer that the latter is operating to eject nebulized material while the shutter 174 is still in blocking or closing position with respect to the opening 26 in the wall of the chamber 10. Finally, however, the piston 190 exerts its action upon the lever 170 to shift the shutter 174, thus permitting the nebulizer 28 to introduce the nebulized material directly into the chamber 10. When, at the end of a nebulizing operation, the time controlled switch at 110 shuts off the current to the motor 54, the pressure in the nebulizer 28 is promptly reduced through the failure of the air compressor 68 so that the nebulizing of the liquid material takes place for a time at a pressure substantially below the pressure normal for such liquid material, in which case the nebulized material may contain larger droplets than normal and thus fail to present a uniform appearance on the surface of the work. Hence, it is desirable to prevent introduction of this nebulized material at low pressure into the chamber 10. For this reason the shutter 174 should be promptly moved to close the opening 26 in the chamber. This movement of the shutter 174 is accomplished by the spring 200 which acts promptly because of the tension under which it was placed when the upper end of the lever 170 was swung to the left in Fig. 6 through the action of the plunger 190. In order that the piston 190 in the cylinder 192 may offer very little or no resistance to the action of the spring 200 at the instant that the pump 68 stops working, the cylinder 192 is connected to a release valve 220 which opens at this time to permit free escape of the air from cylinder 192 into the air of the room as the piston 190 is moved to the right in Fig. 6 by the spring 200. Due to the ease with which the lever 170 and the piston 190 may be moved by the spring 200, the shutter 174 is moved promptly to operative position thus preventing nebulized material at lower than normal pressure being projected into the chamber 10 after the switch 110 cuts off current to the motor 54. Preferably and as shown, the release valve 220 is of the solenoid-operated type arranged to be controlled by the switch 110 so that when the switch is turned off at the end of a nebulizing operation, the valve at 220 is opened to permit free escape of air from the cylinder 192. The valve 220 remains open until the switch 110 is turned on to start the motor 54. Then the valve is closed by the solenoid so that pressure may be built up in the cylinder 192 to operate the piston 190.

To summarize briefly, the operation of the

shutter operating means, it is pointed out that the shutter 174 is moved to its operative position in timed relation to the operation of the nebulizer to close the opening 26 in the wall of the chamber 10 through which the nebulizer 28 would otherwise project partially nebulized material into the chamber 10. This movement of the shutter 174 is accomplished through the operation of the spring 200 when the air in the cylinder 192 is allowed to escape through the opening of the solenoid-operated valve 220, the opening of the valve taking place instantly upon movement of the automatic switch 110 to "off" position. On the other hand, when the switch 110 is moved to "on" position and the air compressor 68 is thus started to furnish air under pressure for operating the nebulizer 28, the shutter 174 is moved, after a predetermined interval, to inoperative or uncovering position with respect to the opening 26, this movement of the shutter being accomplished by the plunger 190 under pressure of air admitted through the choke valve 214. In order that the shutter 174 may remain in its operative or closed position with respect to the opening 26 for a brief but sufficient interval after the starting of the nebulizer 28, the choke valve 214 is so adjusted as to permit only a restricted amount of air to pass along the pipe 210 to the cylinder 192, thereby causing a delayed movement of the piston 190 against the tension of the spring 200. Both the spring 200 and the choke valve 212 may be readily adjusted to secure the desired timing of the movement of the shutter 174 operated by piston 190. It is a well-known fact that, upon starting a nebulizer in operation after it has been at rest, there is almost invariably ejected from the nozzle of the nebulizer a small body of liquid material which would produce an imperfection in the work if it reached the latter. Furthermore, at the beginning of the application of air under pressure to the nebulizer, the pressure rises to its desired maximum only after an interval of time so that, during such interval, the air pressure is not up to the point where the nebulized material will be of the desired uniform fineness. For both of these reasons it is desirable to have the shutter 174 in position to close the opening 26 until the nebulizer reaches operation at the desired or normal pressure for the type of liquid preparation which is being nebulized. It is for this reason that the shutter 174 remains in place for a substantial interval after the beginning of the nebulizing of the liquid preparation by the nebulizer 28. After the desired interval, however, the shutter is removed to inoperative position through the action of the piston 190 so that the nebulized material is projected into the chamber 10.

In the operation of the machine a piece of work, such as a skin 18, is placed upon the work support 16 in such manner that the intersection of the transverse and longitudinal axes of the piece of work coincides, at least roughly, with the axis of the shaft 30. The door 166 is then closed and the switch 110 manipulated to start the motor 54. Through the operation of the motor 54 the table or work support 16 is rotated and air compressor 68 and nebulizer 28 set in operation. Due to the presence of the shutter 174 in operative position, the first part of the material to be nebulized does not reach the chamber 10. In a second or two, however, the shutter 174 is moved to inoperative position whereupon the nebulized material is then introduced directly into the chamber 10, thoroughly mixed with the air pass-

ing downwardly through the opening 164 in the baffle plate 162 and carried to the exposed surface of the piece of work 18. Since the air currents are directed downwardly to the middle portions of the piece of work 18 and also to all the peripheral portions of said piece of work, because of the suction through the outlet 14 which extends entirely around the periphery of the table 16, the nebulized material is uniformly distributed, such distribution being facilitated also by rotation of the table 16. In a period of time which may be as short as fifteen seconds, the piece of work is uniformly colored or otherwise treated and is ready for removal.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. That improvement in methods of applying a preparation to pieces of work, such as sheet material, which comprises forming a cloud of finely divided liquid material with a relatively restricted amount of air, mixing the cloud of finely divided material with a considerably larger volume of air in an enclosed space, and drawing on said volume of air at the discharge end of said space to cause it to move in a direct line to and equally in all directions radially over a piece of work placed for treatment in said space centrally of the discharge end of said space thereby to secure uniformity in the deposition of finely divided liquid material on said piece of work.

2. That improvement in methods of applying finely divided material to pieces of work, such as sheet material, which comprises providing in an enclosed space a body of air moving continuously in a downward direction toward a piece of work placed centrally in said space to be treated, forming a cloud of finely divided liquid material, introducing into said body of air at an angle to its downward direction of movement said cloud of finely divided material, and drawing on said body of air at the discharge end of said enclosed space to cause it to move in a direct line to and equally in all directions radially over the piece of work to be treated thereby to secure uniformity in the deposition of finely divided liquid material on said piece of work.

3. That improvement in methods of applying finely divided material to pieces of work, such as sheet material, which comprises blowing a body of air through an enclosed space and simultaneously therewith drawing on said body of air at the discharge end of said enclosed space with a force substantially greater than that which is applied to blow the air into said space, placing a piece of work to be treated in the body of moving air, and introducing into said body of air at an angle to its direction of movement a cloud of finely divided material, the drawing of the air and its clouds of finely divided material toward the discharge end of said space causing said finely divided material to move in a direct line to and equally in all directions radially over the piece of work, thereby to secure uniformity in the deposition of liquid material on said piece of work.

4. In an apparatus for treating pieces of work, such as sheet material, a chamber having an inlet at one end thereof and an outlet at another end thereof, a substantially circular work support located at the outlet end of the chamber transversely of said outlet, means located beyond the work support to withdraw air from the chamber uniformly all around the periphery of said work support, said air-withdrawing means causing air

to move in a direct line to said work support, and means arranged to introduce finely divided material into air traveling through said chamber, whereby the said finely divided material may be moved in a straight line to and deposited uniformly on a piece of work on said circular work support.

5. In an apparatus for treating pieces of work, such as sheet material, a chamber, an inlet at one end of the chamber, an outlet at the other end of the chamber, a substantially circular support for a piece of work positioned at the outlet of the chamber transversely of said outlet, means to cause a body of air to move in a direct line to said support and uniformly over all peripheral portions of the support to said outlet, and means to produce a cloud of finely divided material and project it into the moving body of air at an angle to the direction of movement thereof, whereby the finely divided material is distributed in the body of air and carried directly to the piece of work at the outlet of said chamber for uniform distribution over the exposed surface of said piece of work.

6. In an apparatus for treating pieces of work, such as sheet material, a chamber, an inlet at one end of the chamber, an outlet at the other end of the chamber, a blower to cause a body of air to pass through said chamber, a substantially circular support for a piece of work positioned at the outlet of the chamber transversely thereof to provide space all around the periphery of the work support for the escape of air, and a nebulizer arranged to introduce nebulized material into the moving body of air at an angle to the direction of movement thereof whereby the nebulized material is distributed in the body of air, the wall of the chamber from the nebulizer to the work support being straight so that the nebulized air is carried directly to the piece of work at the outlet of said chamber, and said blower being arranged to withdraw air from the chamber all around the periphery of the work support, whereby nebulized material is distributed in a uniform manner over all portions of the piece of work including peripheral portions of the work piece on said work support.

7. In an apparatus for treating articles of manufacture, a chamber having an inlet at one end thereof and an outlet at another end thereof, a work support located at the outlet end of the chamber centrally of said outlet, a blower beyond the work support to withdraw air from the chamber, a nebulizer arranged to introduce nebulized liquid material into the air traveling through said chamber, and a baffle plate having an opening through the middle portion thereof for the passage of air, said baffle plate being located above said nebulizer.

8. In an apparatus for treating articles of manufacture, a chamber having an inlet at one end thereof and an outlet at another end thereof, a fan at the inlet adapted to draw air into the chamber and blow it therethrough, a work support located at the outlet end of the chamber centrally of said outlet, a blower beyond the work support to withdraw air from the chamber, a nebulizer arranged to introduce nebulized liquid material into the air traveling through said chamber, and a baffle plate having an opening through the middle portion thereof for the passage of air from the fan, said baffle plate being located above said nebulizer and below the fan.

9. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in

said chamber, a support for an article to be treated located in the path of movement of the air in said chamber, a nebulizer arranged to introduce nebulized liquid material into the air in said chamber, an air compressor connected to said nebulizer, means to operate the air compressor, means to rotate said support, an electric motor having an armature shaft carrying pulleys to drive the two last-mentioned means, and means comprising a time controlled switch in circuit with the motor and arranged to determine the length of operation of the nebulizer and of the support rotating means.

10. In an apparatus for treating articles of manufacture, a support for an article to be treated, means to move a body of air to the article, a nebulizer arranged to introduce a cloud of nebulized material into said body of air moving toward said article, means under the control of the operator for operating the nebulizer, and means to prevent application to said article of material nebulized under pressure below normal for said material.

11. In an apparatus for treating articles of manufacture, a support for an article to be treated, means to move a body of air to the article, a nebulizer arranged to introduce a cloud of nebulized materials into said body of air moving toward said article, means under the control of the operator for operating the nebulizer, and a member arranged to be interposed between the nebulizer and said article to intercept the nebulized material for a desired period of time.

12. In an apparatus for treating articles of manufacture, a support for an article to be treated, means to move a body of air to the article, a nebulizer arranged to introduce a cloud of nebulized material into said body of air moving toward said article, means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of time of operation of the nebulizer, and a member arranged to intercept the nebulized material on its way to said article.

13. In an apparatus for treating articles of manufacture, a support for an article to be treated, means to move a body of air to the article, a nebulizer arranged to introduce a cloud of nebulized material into said body of air moving toward said article, means under the control of the operator for operating the nebulizer, and a member arranged to be operated in timed relation to the nebulizer to prevent nebulized material from reaching said article.

14. In an apparatus for treating articles of manufacture, a support for an article to be treated, a nebulizer arranged to introduce a cloud of nebulized material into air moving toward said article, pneumatic means under the control of the operator for operating the nebulizer, and means located beyond the nozzle of the nebulizer and arranged to be operated by said pneumatic means to control application of nebulized material to said article for a predetermined length of time.

15. In an apparatus for treating articles of manufacture, a support for an article to be treated, a nebulizer arranged to introduce a cloud of nebulized material into air moving toward said article, means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a member arranged to be operated in timed relation to the nebulizer to prevent the application of nebulized or partially nebulized material to said article.

16. In an apparatus for treating articles of manufacture, a support for an article to be treated, a nebulizer arranged to introduce a cloud of nebulized material into air moving toward said article, means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a shutter between the nebulizer and the article arranged to be operated in timed relation to the nebulizer to prevent the application to said article of material nebulized under pressure below the normal for said material.

17. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, power means under the control of the operator for operating the nebulizer, and a member located beyond the nozzle of the nebulizer and arranged to be operated in timed relation to the nebulizer to control the introduction of the nebulized material into the chamber.

18. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means under the control of the operator for operating the nebulizer, and means arranged to be operated by said pneumatic means to prevent projection of the nebulized material into the chamber for some time after the start of the nebulizing operation.

19. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, power means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a member arranged to be operated in timed relation to the starting of the nebulizer to control the introduction of the nebulized material into the chamber.

20. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, power means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a shutter between the nebulizer and the chamber arranged to be operated in timed relation to the starting of the nebulizer to control the introduction of the nebulized material into the chamber.

21. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a member arranged to be operated by said pneumatic means in timed relation to the starting and stopping of the

nebulizer for controlling the introduction of material from the nebulizer into said chamber.

22. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, and a shutter arranged to be operated by said pneumatic means, said shutter being normally in position to intercept material from the nebulizer when the latter is not operating and said pneumatic means being operative to withdraw said shutter when the nebulizer becomes operative at normal pressure.

23. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, means comprising a time controlled switch arranged to determine the length of operation of the nebulizer, a shutter arranged to be operated by said pneumatic means in timed relation to the starting of the nebulizer, and means including said pneumatic means arranged to withdraw said shutter when the nebulizer reaches its normal operating pressure and to return said shutter when the pressure in the nebulizer falls below normal.

24. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, and a shutter arranged to be operated in timed relation to the starting of the nebulizer

for controlling the introduction of material from the nebulizer into said chamber.

25. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, and a shutter arranged to be operated by said pneumatic means, said shutter being normally in position to intercept material from the nebulizer when the latter is not operating and said pneumatic means being arranged to withdraw said shutter when the nebulizer becomes operative at normal pressure.

26. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, a shutter in front of the nebulizer arranged to be operated by said pneumatic means, and means including said pneumatic means arranged to withdraw said shutter when the nebulizer reaches its normal operating pressure and to return said shutter when the pressure in the nebulizer falls below normal.

27. In an apparatus for treating articles of manufacture, a chamber, means to circulate air in said chamber, a support for an article located in the path of movement of the air in said chamber, a nebulizer arranged to introduce a cloud of nebulized material into the air in said chamber, pneumatic means for effecting operation of the nebulizer, a shutter, spring means arranged to move said shutter to operative position in front of said nebulizer, and a piston operated by the pneumatic means and connected to the shutter to move the latter to inoperative position away from said nebulizer in timed relation to the starting of the nebulizer by said pneumatic means.

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