The present invention relates to improved methods of applying liquids to textile fibers at some stage of their processing prior to their formation into a lap and also relates to improved apparatus for applying liquids to textile fibers which at some stage of their processing are conveyed in an air stream.

It has been proposed heretofore to treat cotton fibers to increase their moisture content. In one of the methods proposed the cotton fibers are continually progressed through a predetermined path, and during such progression they are continually agitated and repeatedly dropped through a moving column of gas containing sufficient water vapor or moisture to impart a certain amount of the moisture to the cotton being treated. The apparatus used to carry out such method includes a rotatable horizontally positioned drum, the inner walls of which are provided with vanes which serve the purpose of conveying the cotton fibers to the top of the drum so that they will drop through the column of moisture-containing gas moving through the drum. The above described method while it is satisfactory in those instances where relatively small amounts of moisture are introduced into the fiber is not suitable where relatively large amounts of moisture or liquid are present in the moving gas stream. In such instances the fibers become sufficiently wet to adhere to the walls of the drum with the result that the walls of the drum must be cleaned out periodically. The apparatus used in accordance with this method is relatively costly and must be furnished as an additional piece of equipment since such apparatus is not employed in normal textile mill operations.

It has also been proposed heretofore to treat salvaged cotton with slightly moistened ozone. In this method the cotton is conveyed in a moving air stream through a pipe which is provided with a fan which serves to break up the cotton, the slightly moistened ozone being blown into the moving air stream before the cotton reaches the fan. This method is satisfactory in those instances where the amount of water introduced into the air stream is insufficient to wet the fibers. However, when relatively large amounts of liquids, that is, amounts sufficient to penetrate into the fiber are introduced into the moving air stream, the distribution of liquid on the fibers is not sufficiently uniform with the result that some fibers become sufficiently wet to adhere to the walls of the pipe or to other objects and must be removed periodically to prevent operating difficulties.

Various other methods and apparatus have been proposed, heretofore, for applying liquids to loose fibers while they are being processed in various types of apparatus such as beeters, pickers, etc. or while they are being conveyed mechanically, that is, by conveyor belts, wheels, rolls, etc., but none of the methods or devices proposed have been commercially satisfactory for obtaining uniform distribution of the treating liquid through the fibers without the formation of an undesirably large number of "neps," that is, lumps of fibers, which appear as such in the finished yarn.

The present invention has for one object, therefore, the provision of an improved method and apparatus for applying liquids to textile fibers at some stage prior to the formation of the fibers into a lap for the purpose of eliminating or minimizing the difficulties heretofore experienced with the methods and devices which were known in the prior art.

A further object of this invention is to provide an improved method of applying liquids which contain solid or substantially non-volatile materials therein to tufts of textile fibers to secure a substantially uniform distribution of liquid and non-volatile material throughout the fibers and at the same time open or fluff the tufts of fibers so that they become more amenable to further processing operations.

A further object of this invention is to provide a simple, inexpensive and efficient apparatus for applying liquids to textile fibers, which apparatus is easily installed in commercial textile processing equipment and which can be used without interfering with the normal operation of such equipment.

Still further objects and advantages of this invention will appear in the following description when considered with the accompanying drawings and the appended claims.

The methods of this invention are carried out, in general, by first bringing textile fibers, preferably fibers which have been at least partially opened, into contact with a gas stream, for example, an air stream, which is moving at a sufficient velocity to pick up and convey the fibers and to maintain the fibers in a suspended state. The gas stream containing the fibers suspended therein is next directed through a passageway provided with at least one narrow portion which converges to form an opening of substantially smaller cross sectional area than the normal cross-sectional area of the passageway. A jet of air is continuously discharged into the moving
gas stream in the same direction that the gas stream is moving and at such point in the line of travel of the gas stream and at sufficient velocity to accelerate the fibers in their passage through the narrow portion of the passageway. The term "jet of air" is intended to cover only those instances in which the fibers are increased in velocity by the added velocity imparted to the gas stream by the jet of air or gas, and not the normal increase in velocity imparted by the passage of the air stream per se through the narrow portion of the passageway. As the fibers emerge from the narrow portion of the passageway and move into the downstream end of the passageway, they decelerate. At some point between the time the fibers are accelerated by the jet of air and the time they decelerate because of the loss in velocity of the gas stream emerging from the narrow portion of the passageway, the fibers are subjected to a spray consisting of fine droplets or a mist of the liquid which it is desired to apply to the fibers. The fibers are preferably sprayed with the liquid in a direction at some point in their passage between the point where they are accelerated by the jet of air and the point where they emerge from the narrow portion of the passageway. By carrying out the above process it is possible to intimate mix the fibers and the treating liquid and secure substantially uniform distribution of the liquid through the fibers without appreciably overwetting the fibers.

The apparatus of the present invention comprises, in general, a conduit or pipe through which textile fibers are conveyed, means for supplying fibers to one end of the conduit, means for generating a gas stream in the conduit for conveying fibers therethrough, means for discharging a jet of air into the conduit and longitudinally thereof, and means for spraying liquid onto the fibers as they pass through the conduit. The conduit is provided with at least one narrow portion which converges in the direction of flow of the fibers and which may suitably be a converging duct or nozzle inserted within the conduit. When a converging duct or nozzle is used it is positioned in the conduit with its large end closest to the fiber supply means, its other end being spaced from the inner walls of the conduit and terminating in an opening which is substantially smaller in transversal area than the cross-sectional area of the conduit. The air jet means referred to above is located near the large end of the nozzle, while the spraying means is located in the immediate vicinity of the nozzle, that is, either just in front of or within the nozzle or just beyond the small end of the nozzle.

One specific embodiment of such apparatus is illustrated in the accompanying drawings which form a part of this application. In the drawings Figures 1-4 illustrate, semi-diagrammatically, a number of devices employed in a mill which processes textile fibers according to the cotton system, and also illustrates partly in section and semi-diagrammatically the liquid-applying apparatus with which the present invention is primarily concerned, and.

Figure 2 illustrates an enlarged vertical section of a part of the liquid-applying apparatus shown in Figure 1, and

Figure 3 illustrates an enlarged partial vertical section of a modification of the liquid applying apparatus illustrated in Figure 1.

In the drawings in which like numerals refer to like parts, 10 refers to a vertical opener for opening cotton fibers. This opener communicates through pipe 11 with a fiber condenser 12 which is provided with a fan for sucking the fibers from the vertical opener through pipe 11 into the condenser. Adjacent to condenser 12 is a feed chamber 13 which communicates with a cleaning and opening section 14. The latter communicates through pipe 15 with a second condenser 16 which is provided with a fan for sucking fibers from the cleaning section 14 through pipe 15 into the condenser. The fibers in condenser 16 are discharged mechanically on a feed table 17. Positioned adjacent to also the feed table 17 and the fibers thereon is a conduit 18 which is arranged vertically and provided with an opening, the open end of the conduit being in a horizontal plane substantially parallel to the surface of the feed table to which the fibers are supplied. The apparatus described up to this point is conventional and forms no part of the present invention, except to provide a setting in relation to which the present invention may be more readily understood.

The conduit 18 is provided with a horizontally positioned section, shown partially broken away in Figure 1, in which is positioned a tapered nozzle 19 and means for supplying a jet of gas or air and a liquid spray, which means is designated by the numeral 20 in Figure 1. Nozzle 19 and means 20 will be described in greater detail hereinafter. The conduit 18 terminates at a conventional fiber condenser 21 which is provided with a suction fan. The fan sucks air from conduit 18 thus inducing a flow of air into the upstream end of conduit 18 (positioned above feed table 17) at sufficient velocity to pick up the fibers from feed table 17 and convey them through the conduit. The condenser 21 communicates with a conventional feed chamber 22 from which the fibers are fed at a predetermined rate into a conventional picker 23 in which the fibers are further cleaned and opened and eventually formed into a lap.

Referring specifically to the air and liquid-applying means 20, which is illustrated diagrammatically in Figure 1 and in greater detail in Figures 2 and 3, numeral 24 represents a cylindrical pipe, one end portion of which is provided with a valve 25, a pressure gauge 26 and an air pump 27. The other end of pipe 24 is provided with a nozzle 28 which is screwed into the pipe. This pipe is supported in any satisfactory manner, for example, in the conduit by suitable spider-type braces (not shown) or may be supported externally of the conduit by any suitable support (not shown). Joining pipe 24 near the nozzle end thereof and at right angles thereto is a vertically positioned cylindrical pipe 29 which is provided with a curved portion and a horizontal portion, the longitudinal axis of the horizontal portion being in a horizontal plane intersecting the lateral axis of pipe 24. The horizontal portion of pipe 29 terminates inside of conduit 18 in an internally threaded end portion which is provided with a nozzle 30 which is screwed to the pipe.

Pipe 29 passes through the nipple 31 in the wall of pipe 24, which nipple is provided with a bushing 32, and also passes through the nipple 33 in the wall of conduit 18, which nipple is provided with a bushing 34. This arrangement provides some support for pipe 29 and also prevents air from leaking from pipe 24 and conduit 18. The lower end of pipe 29 is externally threaded and screwed into the top portion of
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5 reducing T 35. Positioned inside of pipe 29 is a second cylindrical pipe 36, the center axis of which is coincident with the center axis of pipe 29. Pipe 36 is supported by bushing 37 which is screwed into the lower portion of T 35. The bushing also serves to seal the lower portion of T 35 and prevent leakage of air. The horizontal portion of pipe 36 terminates flush with the end of nozzle 30. The vertical portion of this pipe is provided with a valve 38 (see Figure 1) and a liquid gear pump 39 and terminates near the bottom of container 40 in which the liquid to be sprayed into the fibers is stored.

Extending horizontally from T 35 and screwed therein is cylindrical pipe 41 which is provided with a valve 42 and an air pump 43. Pipes 29, 36 and 41 and container 40 are all supported externally of the conduit 18 by suitable means (not shown).

The nozzle 19 which was referred to above consists of a shell or horn which tapers gradually toward its exit or downstream end and is circular in cross section. The longitudinal axis of the nozzle is coincident with the longitudinal axis of the conduit 18. The end of nozzle 19 closest to the feed table 17, that is, the large or upstream end of the nozzle, abuts against the inner walls of the conduit 18 and is welded thereto. The other end of the nozzle, that is, the small or downstream end, is also annular in form and is spaced equidistantly from the inner walls of conduit 18. The opening in this end of the nozzle is substantially smaller in cross-sectional area than the cross-sectional area of the conduit. In general, the ratio of the cross-sectional area of this opening to the cross-sectional area of the conduit is from about 1:2 to 1:12. These ratios are dependent upon the diameter of the conduit 18 which is generally from 6 to 14 inches but which may be larger or smaller, the velocity of the gas stream flowing through the conduit 18 and the velocity of the air injected into the gas stream through pipe 24. It is preferable, however, to employ a ratio of 1:5 to 1:10 for most satisfactory results.

The apparatus in the present invention is not limited to the use of one nozzle 19 as illustrated in Figures 1 and 2. In Figure 3 is illustrated a specific embodiment of an apparatus constructed for use in accordance with this invention in which more than one nozzle is employed. In Figure 3, numeral 44 represents a cylindrical conduit which is constructed of several cylindrical pipes of different diameters. The upstream portion of conduit 44 is provided with tapered nozzle 19, the downstream end of which opens into a cylindrical chamber 45. The downstream end of chamber 45 is in the form of a second tapered nozzle 46. Welded to the outer wall of nozzle 46 is conduit 47 which serves as a continuation of conduit 44 to conduct the fibers to the fiber condenser, such as shown at 21 in Figure 1.

The operation of the liquid-applying apparatus is as follows:

Textile fibers such as cotton fibers or other natural cellulose fibers, synthetic staple fibers, and non-fibers are, for example, first partially opened as in the vertical opener 10 and the cleaning and opening section 14 and are then supplied to a feeding device such as feed table 17. In the apparatus illustrated in the drawing a moving air stream is created in conduit 18 by sucking air therefrom by means of a fan located in condenser 21 and by discharging a jet of air from pipe 24. This induces a current of air to flow into the lower end of conduit 18 which is positioned immediately above feed table 17. The air stream thus generated has sufficient velocity to pick up the tufts of fibers from the feed table and to maintain the fibers in a suspended state as the air stream moves along conduit 18. As the fibers enter nozzle 19 they are subjected to a jet of air from pipe 24, which air is supplied to pipe 24 by pump 21 at a velocity exceeding the velocity of the air stream in conduit 18. As a result the fibers suspended in the air stream are accelerated in their passage through nozzle 19. That is, they are accelerated to a greater extent than would be possible by the mere velocity of the air stream in conduit 18. The jet of air from pipe 24 also produces a jet flow in the nozzle 19 and this in combination with the acceleration of the fibers through nozzle 19 causes a distortion of the tufts of fiber. The fibers emerging from the downstream end of the nozzle are next conveyed into conduit 18 in which they are conveyed by a jet of air to the fibers is stored. The fibers emerging from the downstream end of the nozzle are next conveyed into conduit 18 in which they are conveyed by a jet of air and are sprayed with a fine mist or fine droplets of the liquid which it is desired to apply to the fibers. This is accomplished by the air and liquid-applying means 20 as follows: liquid is pumped from container 40 at a metered rate through pipe 35 by means of gear pump 39 after opening valve 38. At the same time air is pumped through pipe 41 into pipe 29 thence through nozzle 30 at a velocity sufficient to atomize the liquid emerging from pipe 36. The rate at which the liquid is supplied through pipe 35 is so adjusted in relation to the weight of fibers being conveyed that the desired amount of liquid is applied to the fibers. A slight excess of liquid may be used in those instances where the liquid is volatile in view of the fact that some of the liquid may be vaporized before it penetrates into the fibers. The apparatus described is employed to convey the fibers into the fibers where they are separated from the air stream in the usual manner.

By using the apparatus illustrated in the drawings and described above, it is possible to apply liquids to textile fibers in a uniform manner without wetting the fibers to the extent that they stick to the side walls of the conduit or to other surfaces with which the fibers may come into contact in subsequent processing operations.

The applicant has observed that when tufts of cotton fibers, for example, are sprayed according to the method described herein and using the apparatus described in the drawings such tufts are opened up and expanded, and hence occupy a large volume. Thus, the volume occupied by the original fibers is increased from 1:4 to 5 times by using the methods and apparatus of this invention. The exact explanation for this is not known, but it is believed that the tufts of fibers in their passage through nozzle 19 are subjected to shear by the differential in velocity between the gas stream in conduit 18 and the jet of air from pipe 24 and a resulting differential in pressure existing in nozzle 19. Best results are obtained by supplying a jet of air which has a velocity of from 10 to 100 times the velocity of the gas stream. This shear is believed to distort the tufts of fibers sufficiently to cause the tufts to open up, that is, occupy a larger volume, become
more porous and thus present a larger area. It is also believed that since the tufts of fibers emerging from nozzle 19 are subjected to decreasingly less shear, they are again distorted in an opposite sense by deceleration of the tufts of fibers and are further opened. It is thus seen that when the tufts of fibers are subjected to a fine mist or fine droplets of liquid while they are being accelerated and decelerated in the manner described then the fibers are not only intimately mixed with such liquid but also become more porous and present a larger surface area for penetration of the liquid through the tufts of fibers. At the same time the liquid is worked into the center of the tufts of fibers by the distorting forces to which the tufts of fibers are subjected while being accelerated and decelerated. Although the above explanation is believed to account for the uniform distribution of liquid on the tufts of fibers treated in accordance with the present invention, it is not intended to limit the invention to any theory presented herein.

It has presently been found that satisfactory results are obtained by subjecting the fibers in the gas stream to a fine mist or fine droplets of liquid while they are undergoing acceleration or deceleration, that is, just prior to their entry into nozzle 19, or equivalent narrow portion of the conduit 18, during their passage through nozzle 19, or after they have emerged from nozzle 19 but are not fully decelerated. It is preferred, however, to subject the fibers to the mist or fine droplets of liquid at some point in their passage through nozzle 19.

Various changes and modifications may be made in the apparatus illustrated in the drawings in view of the above discussion. In the first place the nozzle end of pipe 24 may be positioned further inside of the nozzle 19 to obtain a maximum acceleration of the fibers for any given velocity of air pumped through pipe 24, or it may be positioned upstream of and away from the upstream end of nozzle 19. However, the nozzle end 28 of pipe 24 should not be located at such a distance from the flaring or upstream end of nozzle 19 that no appreciable acceleration of the fibers is obtained. The position of the nozzle end of pipe 24 is therefore largely dependent on the extent to which the fibers are to be accelerated and the extent to which it is desired to open the tufts of fibers and on the velocity of the air from pipe 24, and is also dependent on the size of pipe 24 in relation to conduit 18 and the amount of liquid which is to be applied to the fibers. It is preferable however to position pipe 24 so that the jet of air therefrom is directed along the longitudinal axis of conduit 18 and the nozzle end 28 terminates near the upstream end of nozzle 19, or near the end of nozzle 19.

The position of the nozzle end of pipe 25 may be varied to a considerable extent provided that the following conditions be observed. The nozzle end of pipe 25 should not be positioned upstream of the nozzle end of pipe 24 or downstream of nozzle 19 beyond the point at which the fibers are fully decelerated after emerging from the downstream end of nozzle 19. The pipe 29 need not be positioned in or inserted through the pipe 24, but may be positioned between the pipe 24 and the nozzle 19 and at an angle to the longitudinal axis of conduit 18 or even transverse to such axis. Thus, the liquid may be sprayed longitudinally transverse to the direction of flow of the gas stream in conduit 18. It is preferred, however, to position the nozzle end 30 of pipe 25 so that it terminates at some point between the nozzle end 28 of pipe 24 and the downstream end of nozzle 19 and is coincident with the longitudinal axis of conduit 18.

The gas stream may be utilized to atomize the liquid flowing from pipe 26 and, accordingly, pipes 28 and 41, reducing T 35, valve 42 and air pump 43 may be dispensed with. It is preferred, however, to use a separate air pipe such as pipe 29 for atomizing the liquid from pipe 36 since such an arrangement provides for greater flexibility of operation and better control over the size of the atomized liquid particles.

It is not essential that the nozzle 19 and the air and liquid-applying means 20 be located in the horizontal portion of conduit 18 since satisfactory results are obtained if they are located in a vertical or inclined portion of the conduit. In most textile mills conveying conduits such as conduit 18 are usually positioned horizontally and only contain short sections which are inclined from the horizontal or positioned vertically. Therefore, in most instances the apparatus described herein will be utilized in a horizontal section of the conduit. Moreover, the liquid-applying apparatus can be used in conveying conduits other than the conduit which is employed to convey fibers from feed table 17 to condenser 21. Thus, the apparatus may be employed, for example, in the conduit or pipe 11 through which fibers from the opener 10 are conveyed by air to condenser 12, or in the conduit or pipe 15 through which fibers from the cleaning and opening section 14 are conveyed by air to condenser 16, or in any other conduit through which the fibers are conveyed by an air stream prior to their formation into a lap.

The nozzle 19 need not be a flared nozzle such as shown in the drawings for satisfactory operation of the apparatus. Thus, it is possible to use a nozzle which is in the form of a frustrated cone, the sides of which form an angle of less than 30° with the longitudinal axis of the cone. It is also possible to employ a standard Venturi nozzle. Moreover, since the conduit may be rectangular, polygonal, elliptical, square or circular in cross-section, it is possible to employ nozzles which have the same cross-sectional shape as that of the conduit in which they are used. Furthermore, it is possible to dispense with a nozzle as such and provide a conduit, a portion of the walls of which are in the form of a nozzle of the type described. It is preferred to use a nozzle having smooth inner surfaces.

The liquid may be supplied through pipe 36 by means other than a gear pump. Thus, it is possible to use a rodometer for this purpose. In those instances where the liquid is stored above the conduit, or the liquid may be supplied by gravity feed.

A wide variety of liquids may be supplied to textile fibers by the liquid-applying apparatus of this invention or at an angle to the longitudinal axis of conduit 18, or at an angle to the direction of flow of the gas stream in conduit 18. It is preferred, however, to position the nozzle end 30 of pipe 25 so that it terminates at some point between the nozzle end 28 of pipe 24 and the downstream end of nozzle 19 and is coincident with the longitudinal axis of conduit 18. Thus, the gas stream may be projected longitudinally of conduit 18 and at some point in their passage between the point at which they are first accelerated by the jet of air from pipe 24 and the point at which they begin to emerge from nozzle 19.

A separate air stream such as is provided by pipe 28 is not essential for the successful operation of the apparatus. The jet of air from pipe 24 may be utilized to atomize the liquid flowing from pipe 26 and, accordingly, pipes 28 and 41, reducing T 35, valve 42 and air pump 43 may be dispensed with. It is preferred, however, to use a separate air pipe such as pipe 29 for atomizing the liquid from pipe 36 since such an arrangement provides for greater flexibility of operation and better control over the size of the atomized liquid particles.
water in the form of emulsions; liquid hygroscopic agents or water solutions of hygroscopic agents; water solutions of water-soluble dyes or dyeing agents; colloid solutions of dyes or tincturing agents; colloid solutions of silica or other inorganic oxides and the like. The method and apparatus of this invention are particularly suitable for the application of liquids which contain a volatile liquid such as water and a non-volatile substance or substantially non-volatile substance such as colloidal silica or textile oils. The amount of liquid applied to the fibers in accordance with the present invention may be varied considerably depending upon the particular liquid applied and the particular fiber which is being processed. For example, wool fibers or other animal fibers absorb considerable amounts of liquid and particularly water without becoming excessively wet. Since such fibers may contain some water or liquid prior to treatment the weight of liquid applied by the processes described herein together with the liquid present in the fibers should not exceed about 40% by weight based on the bone dry fibers. In the case of natural cellulose fibers such as cotton or linen fibers or regenerated cellulose fibers and viscose staple fibers, the amount of liquid applied together with the water or liquid originally present in the fibers should not normally exceed about 10 to 12% by weight based on the bone dry weight of the fibers. Synthetic staple fibers such as cellulose acetate staple fibers, linear polyamide staple fibers and the like normally do not tolerate more liquid than cotton fibers.

The methods of this invention are particularly directed to the application of aqueous solutions of colloidal silica to fibers which are processed in machine employed in the cotton system, for example, cotton fibers, linen fibers, ramie fibers and jute fibers, and synthetic staple fibers including regenerated cellulose staple fibers. In such instances aqueous solutions of colloidal silica containing not more than 30% by weight of colloidal silica are applied to the fibers in the form of a fine mist or fine droplets in amounts sufficient to deposit from about 0.1 to 5% of colloidal silica based on the weight of the fibers in the fiber.

A further understanding of the present invention will be obtained from the following specific example, which is intended to further illustrate this invention, but not to limit the scope thereof.

**Example**

Cotton fibers in the form of individual tufts of 1 inch size were conveyed through a 6 inch conduit 18 at the rate of 1 to 2 pounds/minute suspended in an air stream moving at a velocity of 1500 feet per minute. In the nozzle 19 which was provided with a two inch opening or throat the cotton fibers were subjected to a jet of air from pipe 24 which was provided with a 3/4 inch nozzle. The velocity of this jet of air was 21,000 feet per minute. At the same time the fibers were sprayed with an atomized aqueous solution of colloidal silica. This solution which contained 15% by weight of silicas and a small amount of water-soluble dye was supplied through pipe 25 at the rate of about 0.03 pound per minute and was atomized by jet of air from pipe 24. The fibers were then removed from the conduit 18 by a condenser. About 0.3% by weight of silica based on the fibers, was supplied to the cotton fibers. The collected fibers occupied about twice the volume occupied by the tufts of cotton fed into the conduit. The tufts of cotton had a dry feel and were uniformly tinted with the dye, which had been added to the solution, which indicated that the liquid was applied uniformly throughout the fibers. The walls of the conduit were found to be substantially free of tufts of fibers.

Modifications and changes in the method and apparatus of the present invention other than those described herein may be made as will be apparent to those skilled in the art to which it pertains without departing from the spirit and intent of this invention. It is to be understood therefore that the scope of the present invention is not intended to be limited in any manner except by the scope of the appended claims.

What is claimed:

1. A method of applying liquids to textile fibers which comprises bringing textile fibers prior to their formation into a lap into contact with a gas stream which is moving at sufficient velocity to pick up the fibers and convey them in a suspended state, directing the gas stream containing the suspended fibers through a passageway provided with at least one narrow portion which defines an opening of substantially smaller cross-sectional area than the cross-sectional area of said passageway, continuously discharging a jet of air into the moving gas stream in the same direction that the gas stream is moving and at such a point in the line of travel of the gas stream and at sufficient velocity to accelerate the fibers in their passage through the narrow portion of said passageway, and subjecting the fibers in said gas stream to a spray consisting of fine droplets of liquid between the point in their travel through said passageway where they are first accelerated and the point at which they decelerate after their passage through the narrow portion of said passageway.

2. A continuous method of applying liquids to textile fibers which comprises continuously bringing textile fibers prior to their formation into a lap into contact with an air stream which is moving at sufficient velocity to pick up the fibers and convey them in a suspended state, directing the air stream containing the suspended fibers through a passageway provided with at least one narrow portion which terminates in an opening of substantially smaller cross-sectional area than the cross-sectional area of said passageway, continuously discharging a jet of air into the moving air stream in the same direction that the air stream is moving and at such a point in the line of travel of the air stream and at sufficient velocity to accelerate the fibers in their passage through the narrow portion of said passageway, and subjecting the fibers in said air stream to a spray consisting of fine droplets of liquid while the fibers are being accelerated by the jet of air and before they emerge from the narrow portion of said passageway.

3. A continuous method of applying liquids to textile fibers which comprises continuously bringing textile fibers prior to their formation into a lap into contact with an air stream which is moving at sufficient velocity to pick up the fibers and convey them in a suspended state, directing the air stream containing the suspended fibers through a passageway provided with at least one narrow portion which terminates in an opening of substantially smaller cross-sectional area than the cross-sectional area of said passageway, continuously discharging a jet of air into the moving air stream near the beginning of the
narrow portion of said passageway and in the same direction that the air stream is moving and at sufficient velocity to accelerate the fibers as they move through the narrow portion of said passageway, and subjecting the fibers in said air stream to a spray consisting of fine droplets of liquids while the fibers are being accelerated by the jet of air and before they emerge from the narrow portion of said passageway.

4. A process substantially according to claim 3, but further characterized in that the velocity of the jet of air is from 10 to 100 times greater than the velocity of the air stream.

5. A process substantially according to claim 3, but further characterized in that the liquid used is an aqueous solution of colloidal silica.

6. A continuous method of applying liquids to textile fibers which comprises directing a moving air stream in which the cotton fibers are suspended through a passageway provided with at least one narrow portion which converges to form an opening of substantially smaller cross-sectional area than the cross-sectional area of said passageway; continuously discharging a jet of air into the moving gas stream near the beginning of the narrow portion of said passageway and in the direction of movement of the air stream, the velocity of the jet of air being from 10 to 100 times greater than the velocity of the air stream, whereby the cotton fibers are accelerated as they move through the narrow portion of said passageway, and subjecting the fibers in said air stream to a spray consisting of fine droplets of an aqueous solution of colloidal silica while the fibers are being accelerated by the jet of air and before they emerge from the narrow portion of said passageway, said solution containing from 1 to 35% by weight of colloidal silica and being supplied in an amount sufficient to provide from 0.1 to 5% by weight of silica on the weight of the fibers.

7. An apparatus for applying liquids to textile fibers comprising a conduit through which textile fibers are conveyed by an air stream; means for supplying textile fibers to the upstream end of said conduit; means for generating a gas stream in said conduit; at least one nozzle positioned in said conduit, the large end of said nozzle being closest to the upstream end of the conduit and abutting against the inner wall of the conduit and the small end of the nozzle being spaced from the inner walls of the conduit and terminating in an opening which is substantially smaller in cross-sectional area than the cross-sectional area of the conduit; means for discharging a jet of air into the conduit and longitudinally thereof near the large end of the nozzle, and means for spraying liquid on said fibers in the immediate vicinity of the nozzle.

8. An apparatus for applying liquids to textile fibers comprising a conduit through which textile fibers are conveyed by an air stream; means for supplying textile fibers to the upstream end of said conduit; means for generating a gas stream in said conduit; at least one nozzle positioned inside of the conduit, the large end of said nozzle being closest to the upstream end of the conduit and abutting against the inner wall of the conduit and the small end of the nozzle being spaced from the inner walls of the conduit and terminating in an opening which is substantially smaller in cross-sectional area than the cross-sectional area of the conduit; means for discharging a jet of air into the conduit and longitudinally thereof near the large end of the nozzle, and means for spraying liquid into said nozzle.

9. An apparatus for applying liquids to textile fibers comprising a conduit through which textile fibers are conveyed by an air stream; means for supplying textile fibers to the upstream end of said conduit; means for generating an air stream in said conduit; a nozzle positioned inside of the conduit, said nozzle being provided with at least one nozzle.}

RALPH S. HODD. No references cited.