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[54] **LIQUID APPLICATOR FOR A TRAVELING TEXTILE STRAND**

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[58] **Field of Search** 118/325, 420; 28/59, 59.5, 28/28, 75, 76; 117/139.5; 57/164; 68/201; 8/149.2, 151.2

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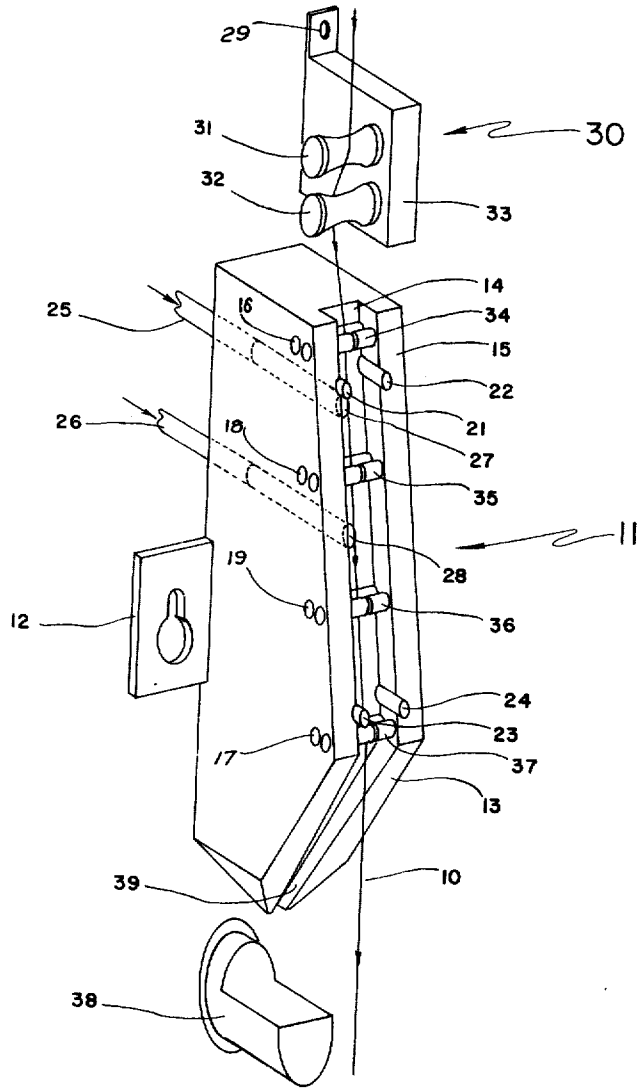
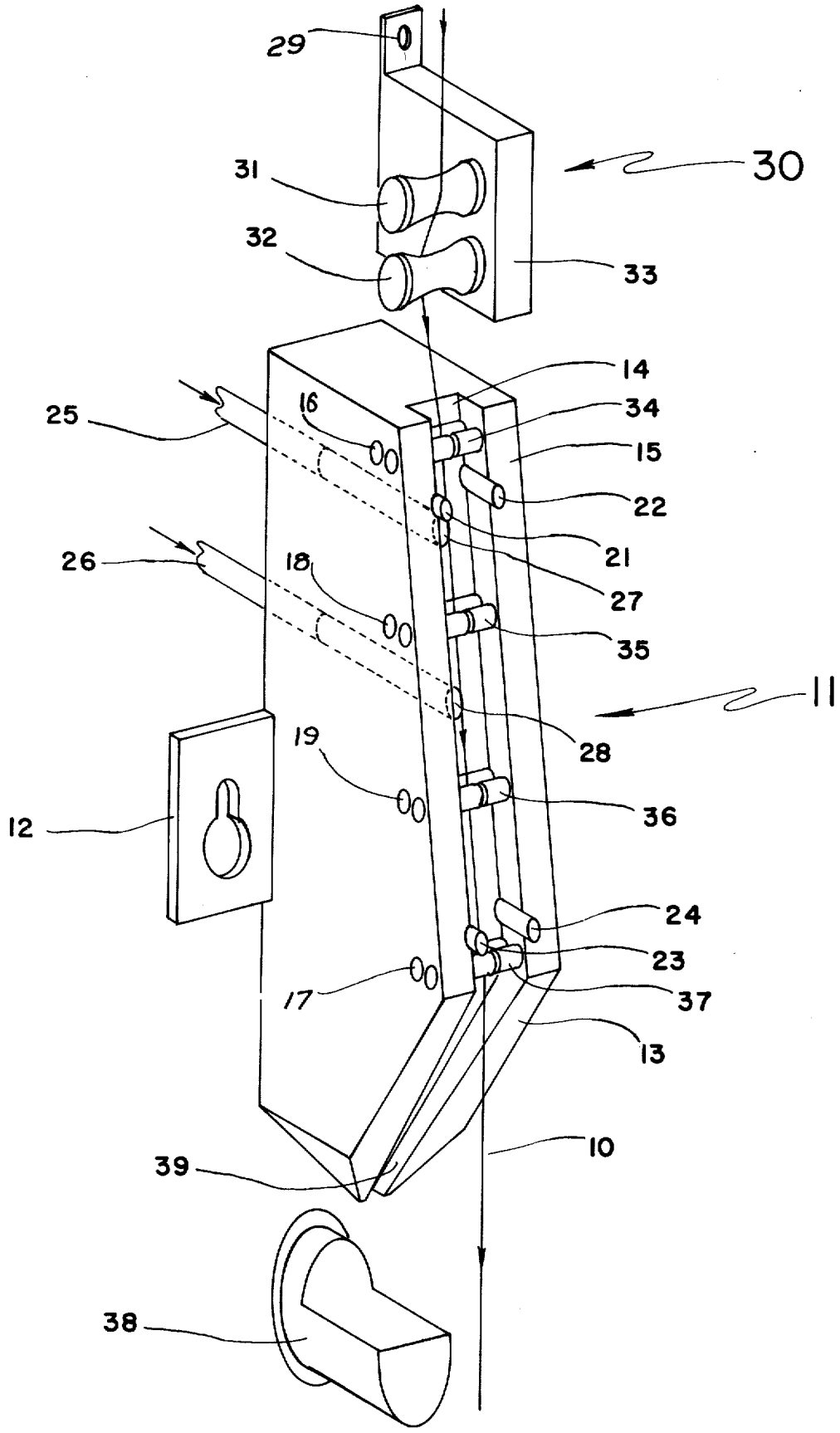
[57] **ABSTRACT**

A traveling textile strand or yarn is aligned and guided into and through an open applicator channel, which extends along the length of an elongated face of an elongated polyhedron. Inside the channel the yarn contacts a plurality of ceramic surfaces which are exposed at the base of the channel. Individual liquid components of a liquid treating composition are supplied to the channel at a pre-determined, controlled rate — either separately or in any degree of combination — through apertures in the base of the channel, each aperture being located a small distance above an exposed ceramic surface. Hereby the liquid treating composition is precisely and uniformly applied to the yarn traveling through the channel, and the inconvenience and expense attending the preparation and utilization of stable emulsions of the liquid components are obviated.

5 Claims, 1 Drawing Figure

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LIQUID APPLICATOR FOR A TRAVELING TEXTILE STRAND

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to textiles in general, and in particular to a device for the precise and uniform application of individual liquid components of a liquid treating composition to an advancing textile strand.

2. Prior Art

In the manufacture of yarns and fabrics from fibers, it is generally required as an intermediate step to apply some kind of liquid composition to the fibers as an after-treatment thereof. For example, following the spinning procedure, fibers are treated to reduce friction against other fibers and against elements of the processing machinery, as well as to lower the surface resistivity of the fibers, thereby reducing the static electric charge thereon. In addition, yarns are generally sized for protection during the actual processing.

For these and a large number of other related purposes, many expedients have been proposed over the years, and a multitude of fiber and yarn treating compositions have been utilized. Most of these compositions are applied in the form of an emulsion — i.e., a substantially permanent mixture of two or more liquids which do not dissolve in each other (e.g., aqueous and organic phases), but which are held in a suspension of minute globules by means of an emulsifying agent. In addition to the cost resulting from the time and effort required in the preparation of stable emulsions, the emulsifying agents themselves are quite costly, and often contribute significantly to fuming and the formation of undesirable deposits on processing equipment such as heater plates, as well as to chemical attack on the yarn and the yarn processing equipment. As a result, there has been a longstanding need in the textile industry for a device to effect the precise application of the individual components of a liquid treating composition to fibers and yarns, thereby avoiding the high cost and the undesirable effects on the fibers and yarns and on the processing equipment, all of which attend the utilization of emulsions.

Moreover, uniformity of application of the liquid treating composition has not been achieved through the utilization of the devices of the prior art. By far the most widely employed of such devices is one which comprises a ceramic roll which, partially submerged, rotates in a pan containing the liquid to be applied. The fibers (or yarns) are caused to travel over, and to contact the non-submerged surface of this roll, picking up adsorbed liquid therefrom. (See, for example, U.S. Pat. No. **3,549,740,** which is among many recently devised processes which still employ this basic device.) The lack of uniformity in the application of liquid treating compositions by means of these and related prior art devices is evidenced by undesirable, wide variations in the amount of treating agent actually found in identical yarns separately treated by identical devices, as well as in segments of the same yarn treated by a single device. That such variations are unacceptable is clear in view of today's requirements for greater uniformity in finished products, as well as enhanced speed and efficiency in manufacturing operations.

SUMMARY OF THE INVENTION

Accordingly, it is the primary object of this invention

to provide a simple, inexpensive, yet highly efficacious device for the precise and uniform application of individual liquid components of a liquid treating composition — either separately, or in any degree of convenient combination as desired — to an advancing textile strand or yarn.

In accordance with the present invention, this object is achieved, and the disadvantages attending the use of prior art devices are obviated by providing a device which comprises:

A. An elongated polyhedron having

1. An open applicator channel extending along the length of an elongated face of the polyhedron, the applicator channel having
   a. Two end pins, preferably of ceramic, each end pin being partially embedded in the body of the polyhedron at the bottom of the applicator channel and located in a transverse position therein in proximity to an end thereof;
   b. One or more middle pins, preferably of ceramic, partially embedded in the body of the polyhedron at the bottom of the applicator channel and positioned transversely therein, the middle pins being spaced from each other and the end pins, the exposed surfaces of the end pins and the middle pins being positioned so that a textile strand traveling through the applicator channel will make contact with each exposed surface; and
   c. At least four guide pins, preferably of ceramic, partially embedded in the body of the polyhedron and positioned so that their longitudinal axes are at right angles to the longitudinal axis of the applicator channel, a guide pin being located on each side of the applicator channel in proximity to each end thereof, the exposed surfaces of the guide pins being positioned so that a textile strand passing through the applicator channel will contact the surfaces of the guide pins instead of the body of the polyhedron at the sides of the applicator channel; and
2. At least one means for the supply of a liquid component of the treating composition to the applicator channel at a controlled rate, each such means communicating with the applicator channel by means of a separate inlet orifice located at the bottom of the applicator channel a small distance above a middle pin; and

B. Guide means for aligning and directing the textile strand into the applicator channel and causing the textile strand to pass through the applicator channel in contact with the exposed surfaces of the end and middle pins.

Moreover, it has been found to be of especial advantage in some applications if the device comprehends in addition a means for the application of a liquid phase of the treating composition to the traveling textile strand prior to its entry into the applicator channel.

Furthermore, especially advantageous results are obtained when each inlet orifice at the bottom of the applicator channel is positioned at least about one-half inch above a middle pin.

Finally, the device is very conveniently employed when it comprises in addition a plurality of outer pins, partially embedded in the body of the polyhedron and positioned transversely in the applicator channel in a plane parellel to and spaced from that of the exposed surfaces of the end and middle pins, so that the travel-

ing textile strand will pass between the plane of the outer pins and that of the exposed surfaces of the end and middle pins, each outer pin having a gap therein of sufficient width to permit passage of the textile strand therethrough in order to facilitate string-up of the device.

In the operation of the device, the traveling yarn is aligned so that the individual strands thereof are placed in a side-by-side relationship. The aligned yarn is guided into and through the applicator channel, wherein it contacts the exposed surfaces (preferably ceramic) of the end and middle pins. The individual liquid components of a liquid treating composition are supplied to the applicator channel at a pre-determined, controlled rate — either separately or in desired, convenient combinations — through separate apertures in the base of the applicator channel, each aperture being located a small distance above the surface of an exposed middle pin. The liquid treating composition is hereby precisely and uniformly taken up by the yarn traveling through the applicator channel, and the inconvenience and expense attending the preparation and utilization of stable emulsions of the liquid components are obviated.

BRIEF DESCRIPTION OF THE DRAWING

For a more complete understanding of the present invention, reference should be made to the detailed description of the preferred embodiments thereof, which is set forth below. This detailed description should be read together with the accompanying drawing, which is a perspective view schematically illustrating the construction and utilization of a device in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With particular reference to the drawing, there is shown a device **11** according to the present invention. Device **11** is positioned between a yarn source (not shown) and yarn take-up means (not shown), and is mounted upon a stationary support (not shown) by means of mounting plate **12.** Device **11** comprises an elongated polyhedron **13** having an open applicator channel **14** extending along the length of an elongated face **15** of polyhedron **13.** Applicator channel **14** may possess a number of acceptable configurations, the most advantageous of which is a generally rectangular, open groove having a rounded bottom, as is shown in the drawing, the longitudinal axis of applicator channel **14** corresponding to the path of traveling yarn **10.** Polyhedron **13** is conveniently constructed from polymeric material, such as cast nylon or polypropylene, although many other common materials of construction may be employed with success. To be sure, polyhedron **13** may even be constructed from a number of well-known ceramic compositions, which present a very hard surface having a relatively low coefficient of friction. Under such circumstances, it is advantageous if at least some of the pins hereinafter described are actually an integral part of polyhedron **13.**

Partially embedded in the body of polyhedron **13** at the bottom of applicator channel **14** are end pins **16** and **17** which are located in a transverse position at the bottom of applicator channel **14,** each end pin being positioned in proximity to an end of the applicator channel.

Also partially embedded in the body of polyhedron **13** at the bottom of applicator channel **14** are one or more middle pins. Two such middle pins, **18** and **19** are shown in the drawing. The middle pins are located in a transverse position at the bottom of applicator channel **14** and are spaced from each other (when more than one is employed) and end pins **16** and **17.** The end pins and the middle pins are advantageously fabricated from very hard substances having a relatively low coefficient of friction, such as the well-known ceramic compositions, e.g., "Henium", distributed by Heany Industrial Ceramics Corp. of New Haven, Conn. The exposed surfaces of end pins **16** and **17** and middle pins **18** and **19** are positioned so that yarn **10** passing thereover will contact each pin surface.

Also partially embedded in the body of polyhedron **13** are guide pins **21, 22, 23** and **24.** These quide pins, which are advantageously constructed from the same material as that employed in the fabrication of the end pins and the middle pins, are positioned so that their longitudinal axes are perpendicular to the longitudinal axis of applicator channel **14,** a guide pin being located on each side of applicator channel **14** in proximity to each end thereof, in order to ensure that yarn **10** traveling through applicator channel **14** will contact only very hard materials having a relatively low coefficient of friction.

The individual liquid components of yarn treating compositions (often denominated "processing aids") such as water, lubricants, antistatic agents, colorants, dye site blocking agents, etc., are supplied to applicator channel **14** either individually or in any degree of combination if convenient and desired, by individual liquid supply means (not shown), each of which affords the supply of a particular liquid component or convenient mixture thereof at a pre-determined, controlled rate. Such a liquid supply means is most advantageously a metering pump such as a "Zenith" metering pump, which is well known and commonly employed in the art. Each liquid supply means communicates with applicator channel **14** through a separate passageway terminating in an orifice located at the bottom of applicator channel **14** a small distance above a middle pin. Pictured in the drawing are two such communicating means, viz., passageway **25,** which terminates in inlet orifice **27,** and passageway **26,** which terminates in inlet orifice **28.** In the utilization of devices according to the present invention, it has been found of especial advantage if the inlet orifices (e.g. **27** and **28** are located at least one-half inch above an associated middle pin (e.g. **18** and **19,** respectively).

Positioned above polyhedron **13** by mounting means **29** is guide means **30,** which, as shown in the drawing, conveniently and advantageously comprises upper roller **31** and lower roller **32,** which are concave rollers constructed from a very hard substance having a relatively low coefficient of friction, e.g., a ceramic, and which are fixedly mounted on body **33.** Guide means **30** aligns the individual strands of yarn **10** in a side-by-side relationship, provides the dimension of yarn **10** required for passage through applicator channel **14,** and positions yarn **10** so that its direction of travel corresponds with the longitudinal axis of applicator channel **14;** as a result of which, yarn **10,** in traveling through applicator channel **14,** will contact the exposed surfaces of end pins **16** and **17,** and middle pins **18** and **19.**

It has been found of especial advantage, although by no means absolutely essential, that device **11** be provided with a number of outer pins (four such pins, viz. **34, 35, 36,** and **37** are shown in the drawing), which are partially embedded in the body of polyhedron **13** and positioned transversely in applicator channel **14** in a plane parallel to and spaced from that of the exposed surfaces of end and middle pins **16, 18, 19,** and **17,** so that yarn **10** passes between the plane of the outer pins and that of the exposed surfaces of the end and middle pins. The spacing between these planes is such that contact between traveling yarn **10** and outer pins **34,** 35, 36 and **37** is not ordinarily made during the operation of device **11.** Accordingly, outer pins **34, 35, 36,** and **37** need not be constructed from ceramic or other such hard materials having a low coefficient of friction. Instead, they are fabricated from stainless steel, as a matter of convenience. In cooperation with end and middle pins **16, 18, 19,** and **17,** outer pins **34, 35, 36** and **37** function as slub catchers, viz., they prevent the passage of slubs or bulky imperfections in the yarn, thereby serving to further enhance the uniformity of application of the liquid treating composition. In order to facilitate string-up of device **11,** outer pins **34, 35, 36** and **37** are each provided with transverse gaps, as shown in the drawing, of sufficient width to permit passage of yarn **10** therethrough.

Mounted below applicator channel **14** is trough **38,** which in cooperation with run-off channel **39** serves to dispose of any liquid which has passed through applicator channel **14** when no yarn was present therein.

In the operation of device **11,** yarn **10** from a suitable source (not shown) is passed between rollers **31** and **32** of guide means **30,** as shown in the drawing, whereby yarn **10** is aligned and provided with the proper dimension for subsequent passage through applicator channel **14.** Yarn **10** is then passed through the transverse gaps in outer pins **34, 35, 36** and **37,** and caused to contact the exposed surfaces of end and middle pins **16, 18, 19,** and **17,** which lie at the base of applicator channel **14.** Yarn **10** is then attached to a suitable take up means (not shown) and tension is applied. The adjustment of mounting means **29** is checked to ensure side-by-side alignment of strands, a "dress" or dimension of the proper magnitude, and contact of yarn **10** with each of the exposed surfaces of end and middle pins **16, 18, 19,** and **17.** Yarn **10** is then caused to travel through applicator channel **14.** Individual liquid components (or a convenient combination thereof) are then separately supplied to applicator channel **14** at a rate which is predetermined and controlled for each component (or convenient combination thereof) by means of separate supply means (not shown) which communicate with applicator channel **14** by means of passageways **25** and **26,** terminating in inlet orifices **27** and **28.** All components of the liquid treating composition are precisely and uniformly taken up by yarn **10** as it passes through applicator channel **14,** the inconvenience and expense attending the preparation and utilization of stable emulsions being obviated. Under certain special processing conditions it has been found desirable to apply one component of the liquid treating composition — most commonly water (the aqueous phase) — to traveling yarn **10** at a considerable distance prior to its entry into applicator channel **14,** and to apply the remaining components of the liquid treating composition in applicator channel **14.** Under such conditions, it has been found acceptable to apply such single component by standard means commonly employed in the art, e.g. utilizing a roll and pan applicator, discussed above. In any event the remaining components of the liquid treating composition must be applied employing the device of the present invention.

The present invention, especially its primary object and advantages, may be better understood referring eferring to the following examples, which are set forth for illustrative purposes only.

EXAMPLE 1

This example is illustrative of the present invention.

A device according to the present invention, specifically one identical to that shown in the accompanying drawing, was employed. Provided also was a particular liquid treating composition of the type referred to as a "spin finish", which composition contained four liquid components, viz.:

1. A soybean oil
2. An ethoxylated amine antistat
3. A glycerol monooleate
4. Water

These components are ordinarily combined with a suitable emulsifying agent to form an oil-in-water emulsion, which is then applied by standard means (e.g., a roller/pan applicator) to a traveling yarn. However, in this instance, device **11** was employed to apply the individual liquid components of this spin finish composition (without an emulsifying agent) to a bulked continuous filament nylon carpet yarn having a denier of **7730/136** and traveling at a speed of greater than **300** meters/minute. Specifically, the following separate runs were carried out:

a. Water was supplied to applicator channel **14** by means of a Zenith metering pump, passageway **25** and inlet orifice **27.** The soybean oil, ethoxylated amine, and glycerol monooleate were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a second Zenith metering pump, passageway **26** and inlet orifice **28.**

b. The soybean oil, ethoxylated amine, and glycerol monooleate were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a Zenith metering pump, passageway **25** and inlet orifice **27.** Water was supplied to applicator channel **14** by means of a second Zenith metering pump, passageway **26,** and inlet orifice **28.**

c. The soybean oil and glycerol monooleate were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a Zenith metering pump, passageway **25** and inlet orifice **27.** Water and the ethoxylated amine were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a second Zenith metering pump, passageway **26** and inlet orifice **28.**

d. Water and the ethoxylated amine were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a Zenith metering pump, passageway **25** and inlet orifice **27.** The soybean oil and glycerol monooleate were mixed in the desired proportions (no emulsifier being necessary) and supplied to applicator channel **14** by means of a second Zenith metering pump, passageway **26** and inlet orifice **28.**

In all of the above runs, the formation of the spin package (total run time approximately one hour) was totally satisfactory. All of the liquid treating agent was taken up by the traveling yarn in each case. The individual packages prepared were then employed to prepare separate 12-minute textured pacakages, and the textured yarn was in turn twisted and submitted for testing. (Texturing and twisting were by standard means known in the art, the same parameters being employed in each case.) Testing of the individual twisted yarn samples included the following: yarn bulk, exhaust dyeing, pad dyeing, bleed. and stain — all of which tests are well known and often employed in the art. The individual test results revealed clearly that no adverse effects on yarn quality and performance resulted from the application of the spin finish components according to this example. Moreover, the average finish-on-yarn content of each sample was measured by extracting each individual sample of the yarn with carbon tetrachloride and measuring the infra red absorbance of the extract. As a result of these tests, the actual application of finish to the traveling yarn was determined to be strikingly uniform.

EXAMPLE 2

This example is also illustrative of the present invention.

A device according to the present invention, i.e., one substantially identical to that shown in the accompanying drawing, was employed. A continuous filament nylon **6** carpet yarn comprising **136** individual strands and having a total denier of **7730** was caused to travel at a rate of about **500** meters/minute through applicator channel **14**. A standard spin finish emulsion was metered through inlet orifice **27** by means of a Zenith metering pump and passageway **25**. The Zenith pump, which delivers **0.584** cc/rev. was set at **55** rpm. Forty very good, individual packages of yarn were produced from four separate spinning positions and the finish-on-yarn content was determined for each package by extracting samples of the yarn with carbon tetrachloride and measuring the infra red absorbance of the extracts. The average finish-on-yarn content was determined to be **1.69%** with a standard deviation of **0.04%**. The standard deviation for the analytical procedure employed was determined to be **0.04%**. The application of finish to the traveling yarn was, therefore, strikingly uniform.

EXAMPLE 3

This example is also illustrative of the present invention.

In this example the same procedure as that employed in Example **2** was followed, except that the continuous filament nylon **6** yarn employed herein comprised **68** individual strands and had a total denier of **3850**. The rate of advance of the yarn was about **730** meters/minute, and the Zenith pump was set at **39** rpm. The average finish-on-yarn content for **6** individual samples from one spinning position was **1.63%** with a standard deviation of **0.04%**. The standard deviation of the analytical procedure employed was **0.04%**. The application of finish to the traveling yarn was, therefore, strinkingly uniform.

EXAMPLE 4

This example, which is not illustrative of the present invention, is set forth for comparative purposes only.

In this example, a liquid applicator of the prior art was employed. This appllicator comprised a ceramic roll which, partially submerged, was allowed to rotate in a pan containing the same standard spin finish emulsion as that utilized in Examples **2** and **3** above. A continuous filament nylon **6** carpet yarn comprising **68** individual strands and having a total denier of **3850** was caused to travel from a yarn source over and in contact with the non-submerged surface of the applicator roll to a take up roll at a speed of about **730** meters per minute. The average finish-on-yarn content for **24** individual samples from **24** separate spinning positions was determined as in Examples **1**, **2** and **3** above. This value was **1.83%**, with a standard deviation of **0.23%**. The standard deviation of the analytical procedure was **0.04%**. The finish application was, therefore, clearly non-uniform, resulting in an unacceptable product.

A device according to the present invention has been also employed to apply both colorants and dye site blocking agents to traveling yarns. In addition to nylon, other man made, as well as natural textile strands and yarns are successfully treated with liquid processing aids employing devices according to the present invention.

Although the present invention has been described in detail with respect to certain preferred embodiments thereof, it is apparent to those of skill in the art that variations and modifications in this detail may be effected without any departure from the spirit and scope of the present invention as defined in the heretoappended claims.

What is claimed is:

1. In a device for the application of a liquid treating composition to a traveling textile strand, the improvement therein for effecting the separate, simultaneous, precise, and uniform application of individual liquid components of the treating composition to the traveling textile strand, which improvement comprises the combination of:

A. An elongated polyhedron having

1. An open applicator channel extending along the length of an elongated face of the polyhedron, the applicator channel having

a. Two end pins, each end pin being partially embedded in the body of the polyhedron at the bottom of the applicator channel and located in a transverse position therein in proximity to an end thereof;

b. One or more middle pins, partially embedded in the body of the polyhedron at the bottom of the applicator channel and positioned transversely therein, the middle pins being spaced from each other and the end pins, the exposed surfaces of the end pins and the middle pins being positioned so that a textile strand traveling through the applicator channel will make contact with each exposed surface; and

c. At least four guide pins, partially embedded in the body of the polyhedron and positioned normal to the longitudinal axis of the applicator channel, a guide pin being located on each side of the applicator channel in proximity to each end thereof, the exposed surfaces of the guide pins being positioned so that a textile strand passing through the applicator channel will contact the surfaces of the guide pins instead

of the body of the polyhedron at the sides of the applicator channel; and

2. At least one means for the supply of a liquid component of the treating composition to the applicator channel at a controlled rate, each such means communicating with the applicator channel by means of a separate inlet orifice located at the bottom of the applicator channel a small distance above a middle pin; and

B. Guide means for aligning and directing the textile strand into the applicator channel and causing the textile strand to pass through the applicator channel in contact with the exposed surfaces of the end and middle pins.

2. The device of claim **1**, which additionally comprises means for the application of a single liquid component of the treating composition to the traveling textile strand before it enters the applicator channel.

3. The device of claim **1**, wherein each inlet orifice at the bottom of the applicator channel is positioned at least about a half inch above a middle pin.

4. The device of claim **3**, which additionally comprises a plurality of outer pins, partially embedded in the body of the polyhedron and positioned transversely in the applicator channel in a plane parallel to and spaced from that of the exposed surfaces of the end and middle pins, so that the traveling textile strand will pass between the plane of the outer pins and that of the exposed surfaces of the end and middle pins.

5. The device of claim **4** wherein each outer pin has a gap therein of sufficient width to permit passage of the textile strand therethrough in order to facilitate string-up of the device.

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