Aug. 22, 1967 E. F. DAUCHERT 3,336,901

APPARATUS FOR APPLYING LIQUID TO MOVING CONTINUOUS FILAMENT YARN

Filed Feb. 12, 1965

FIG. 1

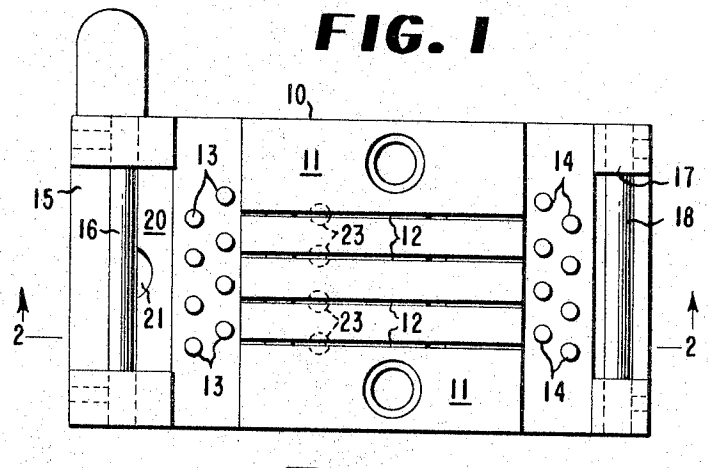


FIG. 2

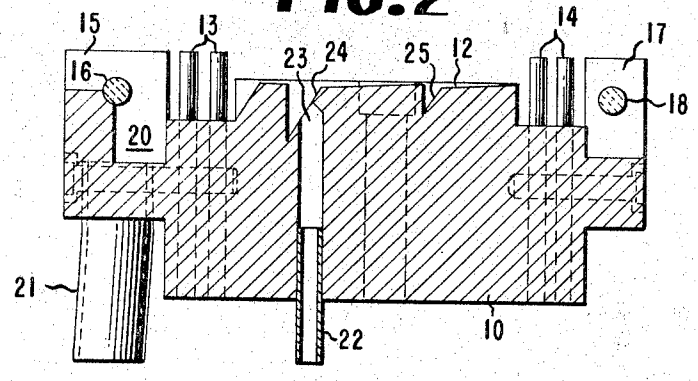


FIG. 3

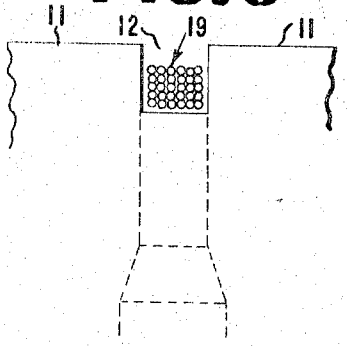
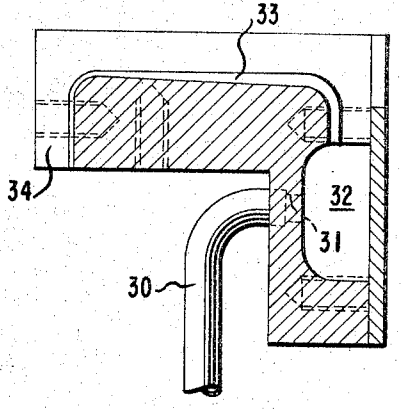


FIG. 4



INVENTOR

EUGENE FRANCIS DAUCHERT

BY Norris E. Rockman

ATTORNEY

United States Patent Office 3,336,901 Patented Aug. 22, 1967

3,336,901
APPARATUS FOR APPLYING LIQUID TO MOVING CONTINUOUS FILAMENT YARN

Eugene Francis Dauchert, Kinston, N.C., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

Filed Feb. 12, 1965, Ser. No. 432,267
4 Claims. (Cl. 118—411)

This invention relates to apparatus for applying a liquid to a moving continuous filament yarn.

It is well known in the art that acceptable processing of synthetic continuous filament yarns requires the application of a textile-treating composition. The application of textile-treating compositions such as lubricants, antistatic agents and the like must be accomplished in such a manner that a uniform coating is applied to the filaments with a minimum of loss of the composition and without damage to the yarn. A common means of achieving this result is by contacting the yarn with a roll rotating in a trough containing a textile-treating composition. However, as processing efficiency is increased by the adoption of higher and higher speeds, it becomes necessary to increase the speed of the roll and/or contact the yarn with an increasingly larger segment of the roll surface in order to apply the proper amount of textile-treating composition. An alternative method uses an applicator in which the yarn contacts the bottom of a groove provided with an orifice through which is jetted the desired quantity of textile-treating composition. At high speeds and with high contact surfaces, excessive wear occurs and results in damage to the yarn.

It is an objective of this invention to provide an improved apparatus for the application of textile-treating compositions.

In accordance with the present invention, there is provided an applicator for liquid textile-treating compositions comprising a block having a yarn groove of a width essentially the same as that of the width of the yarn and a depth of decreasing value in the direction of yarn travel. The applicator is provided with an internal passageway having an exit orifice located near the deeper end of the groove through which the conditioning agent is metered into the groove. The orifice should be sized to apply the treating composition across the full width of the groove and be of sufficient size to avoid plugging. While the orifice may be circular in shape, it it is preferred that the orifice be rectangular and have a minimum length at least as great as its width. The groove is carefully sized so as to be of a width corresponding to the width of the yarn bundle to be treated, or preferably just slightly greater.

In the drawings, which illustrate specific embodiments of the invention,

FIGURE 1 is a plan view of a preferred embodiment of the invention,

FIGURE 2 is a cross-sectional side view taken on line 2—2 of FIGURE 1,

FIGURE 3 is an enlarged end view of a groove portion of the above embodiment, showing yarn positioned in the groove, and

FIGURE 4 is a cross-sectional side view of an alternative embodiment, the cross section being taken in the same manner as in FIGURE 2.

Referring to FIGURES 1 and 2, applicator body **10** has a planar face **11** in which parallel yarn grooves **12** are machined. Guide pins **13** and **14** are provided at opposite ends of the grooves to maintain yarns in axial alignment with the grooves during passage through the grooves. The direction of yarn travel is from left to right. A guide block **15** bearing a guide pin **16** is secured

to the applicator body to support the yarns by passage over pin **16** on their way to the grooves. Another guide block **17** bearing a guide pin **18** is secured to the applicator body at the exit end of the grooves. The pins **16** and **18** are positioned to properly align the yarns relative to the bottoms of the grooves. The various guide pins **13**, **14**, **16** and **18** are desirable to avoid wear in the grooves. The path of the yarn through the groove should be close to the sides and bottom of the groove, but excessive contact should be avoided. Preferably, a yarn **19** never touches the sides or the bottom of the groove, or there is at most only a "kissing" contact as shown in FIGURE 3.

When wet yarn is supplied to the applicator, guide pins **13** and **16** will wipe off excess liquid. Chamber **20** and drain **21** are provided for removal of such liquid. Similar means can be provided at the exit end of the applicator to remove any excess textile-treating composition.

Liquid textile-treating agent is supplied to groove **12** through tube **22** and passageway **23** drilled through the applicator body. This passageway communicates with a step **24** cut in the groove near the yarn entrance end. The liquid is wiped on to the yarn and carried along with the yarn. The groove is made progressively shallower or "tapered" to force the liquid into the yarn. A second step **25**, cut into the groove midway between step **24** and the exit end of the groove, serves to redistribute treating agent over the surface of the yarn. The tapered groove then causes additional liquid to be forced into the yarn.

FIGURE 4 shows an embodiment in which the treating liquid is supplied through tube **30** and passageway **31**, through the applicator body, into a reservoir **32** at the entrance end of the yarn groove **33**. The yarn picks up liquid from the reservoir and carries the liquid along through the groove. The groove **33** is made progressively shallower or "tapered" in the direction of yarn travel. This taper forces the liquid into the yarn, as in the previous embodiment. An opening **34** is provided near the exit end of the groove so that excess liquid can flow back to the source of supply (not shown). In this embodiment, smoother operation is provided by rounding the entrance and exit ends of the groove as shown.

When using either applicator, the yarn may travel vertically, horizontally or at an angle. When the yarn is traveling in an upward direction from the horizontal, the embodiment shown in FIGURE 1 should be used. When the yarn is traveling in a downward direction, the embodiments shown in FIGURES 1 and 4 function equally well.

In operation, the yarn picks up the liquid textile-treating composition at a point corresponding to the deepest part of the groove and carries it forward along the tapered bottom. As the distance between the yarn and the bottom of the groove diminishes, pressure is built up in the liquid and the liquid is forced to penetrate the interstices between the filaments of the yarn. It is for this reason that the groove should be essentially the same as the width of the yarn, since otherwise penetration of the interstices will not occur to any satisfactory extent.

The present invention may be used to apply a liquid to any moving yarn but is most eminently suited to applying a liquid to a yarn moving at high speed and while the yarn is under a high tension. For example, in so-called "jet-drawing" processes, synthetic continuous-filament yarns are passed into a jet enclosure wherein a high velocity stream of a hot fluid, e.g., steam, is impinged on the yarn to facilitate drawing, or stretching, the yarn to several times its original length. In such processes it is not uncommon for the yarn to exit from the jet at speeds of 3,000 yards per minute (2740 meters per minute) or

more, and under a tension as high as 4.0 grams per denier or more. The high velocity steam will strip previously applied coating materials from the yarn, necessitating reapplication. Frequently, due to space limitations, this is most conveniently accomplished in the drawing zone, i.e., while the yarn is under the stress of unusually high tension. Utilizing the applicator of this invention, reapplication of, e.g., a yarn-lubricating oil, is easily and effectively accomplished without incurring the normally attendant disadvantage of excessive wear.

As previously described, the taper of the bottom of the groove is a critical feature of this invention. When an applicator is fabricated with a groove 2.0 inches (5.1 cm.) in length, 0.020 inch (0.051 cm.) in width (for a yarn having a width of 0.015 inch) and having a depth of 0.020 inch (0.051 cm.) throughout, only 0.013% by weight of a liquid yarn-lubricant is applied to the yarn and increasing the flow of lubricant to the groove gives no increase in the amount of lubricant on the yarn. When the bottom of the groove is tapered from 0.06 inch (0.152 cm.) at the yarn entrance to 0.02 inch (0.051 cm.) at the exit, the lubricant on yarn level is increased to as much as 0.73% by weight, and this limit is imposed only by the capacity of the supply system. By increasing the supply capacity, lubricant levels as high as 1% by weight and more can be realized.

As will be apparent, the angle of convergence, i.e., the angle formed by the yarn path and the bottom of the groove, may, on a theoretical basis, vary from any angle greater than 0° to one of less than 90°. However, for practical reasons, excessively small or excessively large angles are not suitable because of the geometrical requirements imposed when selecting a length commensurate with the amount of liquid it is desired to apply. For most textile purposes, a groove length of between about 0.5 and 2.0 inches (1.3 and 5.1 cm.) having an angle of convergence between about 1° and 10°, will be suitable. If desired, the bottom of the groove may have two or more appropriately tapered sections, or it may be curved. If curved, the curvature should be slight for maximum efficiency.

From the above, it will be apparent that the applicator contains a groove, that the yarn must be within the groove and of essentially the same width as the groove, and that the yarn and the bottom of the groove must be in a converging relationship. With respect to the use of the word "taper," it is to be noted that this is primarily for convenience in fabrication, installation, and description. The essential condition is the converging relationship of the yarn and the bottom of the groove. It will, accordingly, be apparent that the applicator could be fabricated in such a manner that the bottom of the groove would be parallel to the face of the block into which the groove is cut; and the applicator could then be mounted in a cocked position relative to the yarn in order to establish the required converging relationship.

The applicator may be fabricated of any suitable material such as, for example, steel, brass, or plastic.

The applicator may be used to apply any liquid material which is not harmful to the yarn or the applicating system. Examples of suitable liquids are solutions, dispersions or emulsions of conventional textile-treating agents such as lubricants, antistatic agents, binders, softeners, and the like. If desired, the material may be heated. The liquid may be applied to any man-made continuous-multifilament yarn such as, for example, rayon, cellulose acetate, polyamides, polyesters, and polyacrylics.

The applicator of this invention is of simple design and readily fabricated. It contains no moving parts and can be used for long periods of time without requiring care to prevent plugging of the orifice or replacement to minimize yarn damage from excessive wear. While preferred embodiments of the invention have been described, it is understood that changes and variations may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. In an apparatus for applying liquid to a moving continuous filament yarn which comprises an applicator body, a yarn-treating face on said body, groove means extending across said face for applying liquid to yarn, said groove means having yarn entrance and exit ends, guide means for directing yarn to pass through said groove means, and means for supplying liquid to the yarn entrance end of said groove means; the improvement which comprises a groove bottom converging toward the yarn axis in the direction of yarn travel to force liquid into the yarn under pressure, groove sides lying in parallel planes and closely adjacent to the sides of the yarn to maintain liquid pressure on the yarn, a first step cavity in the bottom of the groove near the entrance end of the groove for liquid to be applied to the yarn, a passageway through the applicator body to said step for supplying liquid, and a second step cavity in the bottom of the groove for redistributing liquid on the yarn between said first step and the exit end of the groove.

2. In an apparatus for applying liquid to a moving continuous filament yarn which comprises an applicator body, a yarn-treating face on said body, a groove extending across said face for applying liquid to yarn, guide means for directing yarn to travel through the groove, and means for supplying liquid to the groove to be picked up and carried along by yarn while traveling through the groove; the improvement which comprises a groove bottom converging toward the yarn axis in the direction of yarn travel to force liquid into the yarn under pressure, and groove sides lying in parallel planes and closely adjacent to the sides of the yarn to maintain liquid pressure on the yarn, the groove being of rectangular cross section.

3. Apparatus as defined in claim 2 which comprises a step cavity in the bottom of the groove for liquid to be applied to the yarn, and a progressively shallower groove bottom in the direction of yarn travel from said step for forcing liquid into the yarn.

4. Apparatus as defined in claim 2 wherein there are a plurality of said grooves extending across the face of said applicator body for treating a plurality of parallel yarns, the groove bottoms progressively converging toward the yarn axis at an angle of convergence of between 1° and 10°.

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CHARLES A. WILLMUTH, *Primary Examiner.*

J. P. McINTOSH, *Assistant Examiner.*