TRIPLANAR BLADE EDGE FOR YARN TEXTURIZING

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References Cited

UNITED STATES PATENTS
3,140,525 7/1964 Lamb.................28/72.11 UX
3,500,517 3/1970 Dekker et al...........28/1.5
3,619,874 11/1971 Li et al..............28/1.5

FOREIGN PATENTS OR APPLICATIONS
558,297 12/1943 Great Britain............28/72.13

ABSTRACT

The invention is directed to a yarn-texturizing blade having an edge consisting of three intersecting planes. The three intersecting plane edge facilitates fabrication of the blade from very hard materials because of the ease in grinding the planar surfaces and permits ready evaluation of the performance of the blade on the yarn. The blade has the further advantage in that, because of its configuration, it is resistant to chipping and offers processing advantage to the fiber which is passed over the two consecutive edges formed by the three intersecting planes resulting in a better product and allowing a much higher speed for the passage of the yarn over the blade. This triplanar edge also allows use of edges with much smaller radius of curvature without cutting the fiber.

4 Claims, 7 Drawing Figures
The technique of passing a monofilament or yarn over a sharp blade under certain conditions of temperature and tension to impart to the yarn a tendency to coil is known in the art. Yarns produced in this manner avoid undesirable effects due to the torsional stresses which are found in yarns elasticized by other known means. Yarns produced by scraping over a sharp edge are especially useful in the knitting of hosiery and other garments in which a bulky and elastic quality is an important characteristic.

While the design of the blade has received considerable attention and the radius of curvature of the edge tip in particular has been specified to fall within certain specified limits which depend upon the denier of the fiber to be processed, with the advent of relatively high-speed apparatus such as that disclosed in pending application of Li, et al., Ser. No. 3,444 filed Jan. 16, 1970, titled Travelling-Edge Crimper, which is commonly assigned and now U.S. Pat. No. 3,619,874, the design of the edge has become even more important.

Heretofore, it has generally been necessary to specify the radius of curvature of the edge as falling within a fairly wide range for a variety of reasons such as, for example, the difficulty in grinding an edge to a particularly small radius. Other reasons include the difficulty of measuring the radius of curvature of an edge after it has been ground and the fact that under certain conditions of use the abrasive action of the yarn will cause a gradual change in the radius of the curvature of the edge which, as a consequence, precludes conformance to a precise specification of the edge because at best such edges conform at one end of the range when the blade is new and, at the other end of the specified range, when the blade is worn. The consequence of this gradual wear of the edge is reflected in the resultant gradual change of the properties of the processed yarn; such variations in product represent a serious problem.

Although efforts to minimize this problem by frequent changes of the blade have been attempted, this is obviously a costly and time-consuming solution. Efforts to overcome this problem by making the blade of a thickness of the order of twice the radius of curvature such as that described in U.S. Pat. No. 3,025,584 also presents some drawbacks. A blade arrangement of that kind presents problems of support, which become more complicated when the metal sheet is required to be very thin. Also, since the yarn runs in a slot in the blade, this solution is not applicable in special cases where the yarn is required to travel across the blade, as well as over the blade. Thus, because of the nature of such blade structure, attempts to fashion the blades out of very hard materials such as silicon carbide, tungsten carbide, and the like, have generally been unsatisfactory apart from the obviously magnified difficulties of grinding such hard substances to an edge of certain sharpness. There is the additional problem resulting from the extreme brittleness of these materials, which makes any edge prone to chipping during use. As a consequence, the sought advantage of longer wear has not been practically attainable.

The specified radii of curvature of the edges of a texturizing blade are in many cases compromises between two conflicting requirements: the sharpness of the edge and the tension on the yarns. In general, a sharper edge will give a better textured material, and for each sharpness there corresponds an optimum tension with this optimum moving to lower values as the sharpness increases. A limit is reached when either the blade is so sharp that it becomes difficult to control the tension so as to prevent the blade from cutting the yarn or the blade is to blunt that the optimum tension approaches the tensile strength of the yarn.

An important consideration in the production of textured yarn by the so-called "edge crimping" method is the speed at which the yarn can be processed. It is generally found that no matter how temperature and tension are adjusted, an upper limit exists for the linear speed of the yarn beyond which the level of texture falls below an acceptable value. The reason is that the deformation of the yarn by the edge does not occur instantaneously but takes a certain finite time. When the residence time of the yarn on the edge falls below this value, the texturing action is diminished.

SUMMARY OF THE INVENTION

We have discovered that these problems can be overcome by passing the yarn over two or more edges or junctions formed by a blade which comprises three intersecting planes so that at high speeds the deformation begun at the first edge or junction between planes is completed at the next. It is more important in such a case, however, that the yarn be prevented from rotating about its axis in going from one edge or corner of the blade to the next or else the flattening action of the latter blade, by not being superimposed on that of the former, will neutralize rather than reinforce it. Since the two "working" edges of the blade of the invention are immediately contiguous, rotation of the fiber is essentially precluded.

According to the invention, we have found that by fabricating a blade having a particular shape, i.e., one in which the edge consists essentially of three intersecting planes, i.e., two side planes intersected by a third transverse (usually top) plane, hard materials heretofore very difficult to employ may be used and, as a consequence, each of the problems discussed above can be overcome. By use of the configuration of three intersecting planes, blades from a hard material such as silicon carbide, tungsten carbide, titanium carbide, vanadium carbide, diamond, sapphire, or any material of known high hardness either in pure form or in the form of small particles sintered together by some suitable process may readily be fabricated. Of the three intersecting planes, two comprise the planes that normally form a knife edge by their intersection; the third plane being essentially perpendicular to a plane which divides the first two. In other words, the edge is ground so as to replace the conventional apex or region having a small radius of curvature, often referred to as a knife edge, with a flat region of infinite radius of curvature or with a concave region; the width of this region can vary over a wide range—from a new micron to several millimeters. It is readily apparent that advantages in using this configuration resides in the ease in grinding and in evaluating the edge, since all that is necessary is to measure the width of the top surface, which, being generally fairly wide, falls within the limit of resolution.
of an optical microscope. A shape of this kind results in an edge of increased toughness and resistance to chipping permitting it to be used for relatively longer periods of time without appreciable change in performance. With a blade having the shape specified by the present invention, a yarn in effect passes over two consecutive edges (i.e., corners) deriving therefrom the advantage of higher potential speeds as explained previously. Since the two edges, however, are very close together, there is no possibility of the yarn rotating to any significant extent between the first and the second contact of the yarn over the three plane edges, i.e., over the corners, and the effect of the two are therefore always additive.

We have found, also, that, even though the invention utilizes relatively small radii of curvature, no apparent danger of cutting the yarn results even with blades in which the width of the top surface or plane was about 10 microns. In such edges, the radius of the curvature of the two corners formed by the intersection of the three planes must, therefore, have been smaller than 1 micron—a much sharper radius than could normally be used with a single-edge blade. A sharp blade of this configuration may be used for many hours with considerable tension being applied to the yarn without having the yarn break due to cutting at the edge.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary perspective view of a preferred form of yarn crimping apparatus illustrating one form of a carrier for the knife of the invention in a functional environment.

FIGS. 2, 3, and 5 are schematic sectional views of knife edges whose yarn-contacting portion comprises three intersecting surfaces.

FIG. 4 is a schematic sectional view of a knife edge in which one of the three surfaces, i.e., the transverse surface is hollow ground.

FIG. 6 illustrates still another embodiment in which the transverse surface has a tapered shape.

FIG. 7 is a schematic sectional view representing generally the configuration of a conventional knife edge.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Illustrative use of the blade of the invention is described by reference to FIG. 1. As shown, yarn 12 is supplied from a suitable source (not shown), e.g., a storage bobbin or, if desired, directly from extrusion apparatus after conventional pretreatment. The yarn is fed through an appropriate yarn-tension device 13 and then wrapped around the Godet roll 28 in a manner so that the tension on the yarn 30 is reduced to an optimum value prior to passing over the crimping edge 21. The yarn, which will hereafter be referred to by the numeral 30 to indicate that it is on the low tension side, passes over the heater 25 and edges 21 of blade 24. The blade 24 is heated and temperature regulated through heater 25, heater wire 36 and thermocouple 37 in combination with two pairs of slip rings 26 and 35, respectively. After the yarn 30 passes over the heater edge 25 and edges 21, the tension on yarn 31 is increased owing to the frictional drag. The frictional dragging under tension of the yarn over the edges is repeated using as many wraps on the moving edge 21 and driven Godet roll 28 as is necessary to produce the desired texturizing.

Thereafter, yarn 44 is stored on a suitable bobbin, not shown. The Godet roll 28 has a surface to provide the desired frictional characteristics and is mounted on axle 43 and appropriately driven. Either the same or a separate drive rotates the blade frame 20 which carries blades 24 and heater 25. To provide the necessary relative movement between the yarn 31 and blade 24, the blade frame 20 which revolves around the Godet roll surface 28 similar to a planetary motion rotates at different revolutions per minute than the Godet roll 28. The mounting position of blade frame 29 in a slot 45 is adjustable and may be used to control the yarn approach and departure angles with respect to the crimping blade 24, for example, in the manner described in the above-mentioned U.S. Pat. No. 3,619,874.

Referring to FIG. 2, a knife edge formed in accordance with the invention and employed in the apparatus of FIG. 1 is shown comprising a texturizing edge formed of angular planes 45 and 46 and transverse plane 47.

The embodiment shown in FIG. 3 comprises a blade whose texturizing edges a and b are formed by the faces 50 and 51 which diverge toward the transverse plane 52 over which the yarn 53 is drawn as it is texturized.

The blade arrangement shown in FIG. 4 is similar to that of FIG. 3, except that the edges a and b are formed by diverging planes 55 and 56 in conjunction with the hollow-ground surface 57 over which the yarn 58 is texturized instead of the flat plane 52 of FIG. 3.

In the embodiment of FIG. 5, a texturizing blade of essentially rectangular cross-section comprising parallel faces 60 and 61 intersected by transverse plane 62 comprises the edge over which the yarn 63 is texturized.

In the embodiment of FIG. 6, a texturizing blade is shown in perspective. The edges a and b, which effect crimping of the yarn, are formed by the intersection of surfaces 71, 72 and transverse surface 74 over which the yarn 75 is passed. The width of surface 74 decreases, or tapers, along its length as shown. The tapered width of surface 74 is advantageous over constant width surfaces such as surface 52 shown in FIG. 3 for the following reason: FIG. 6 shows schematically that the initial impact between the yarn 75 and the surface 74 i.e., the tendency to cut the yarn, is minimized due to the "wider" width of surface 74 measured along the path where the yarn slides. However, a continuously wider width is not desirable for texturizing yarns; therefore, the second 76, third 77, fourth 78 wrap, and so forth, are arranged to slide over "narrower" portions of surface 74 to achieve the desired quality of texturized yarns.

FIG. 7 depicts essentially the structure utilized in the prior art wherein blade 64 is ground so that the sides converge at 65 and 66 to a point or apex 67 over which yarn 68 is texturized.

In each of the configurations of FIGS. 2-6, it is seen that the yarn passed over the knife edge frictionally engages and is deformed in two separate but immediately successive stages.

It will be apparent that various modifications may be made by one skilled in the art. Accordingly, the invention is not limited to the details of the specific drawing.
and description except as may be required by the scope of the appended claims.

We claim:

1. In an apparatus for producing textured yarn wherein the yarn is textured as it is drawn under tension in frictional engagement with two successive edges of a blade element, the improvement comprising a blade element consisting essentially of an elongated blade comprising a first plane intersecting second and third planes, wherein said first plane has a tapered configuration, and wherein the yarn is textured by passing a plurality of wraps of yarn over the blade element beginning at the wider width of said first plane and progressing to the narrower width while in frictional engagement at the two places of intersection of said planes whereby the wider width portions minimizes the tendency to cut the yarn and the narrower width portions permit the desired quality of textured yarn to be achieved.

2. The improvement as in claim 1, wherein said first plane comprises a concave configuration.

3. The improvement of claim 1, wherein said second and third planes converge at the first plane.

4. The improvement of claim 1 wherein said second and third planes diverge at the first plane.

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