March 8, 1966 J. P. McNUTT III 3,238,828

YARN CUTTER

Filed May 28, 1964

Fig. 1.

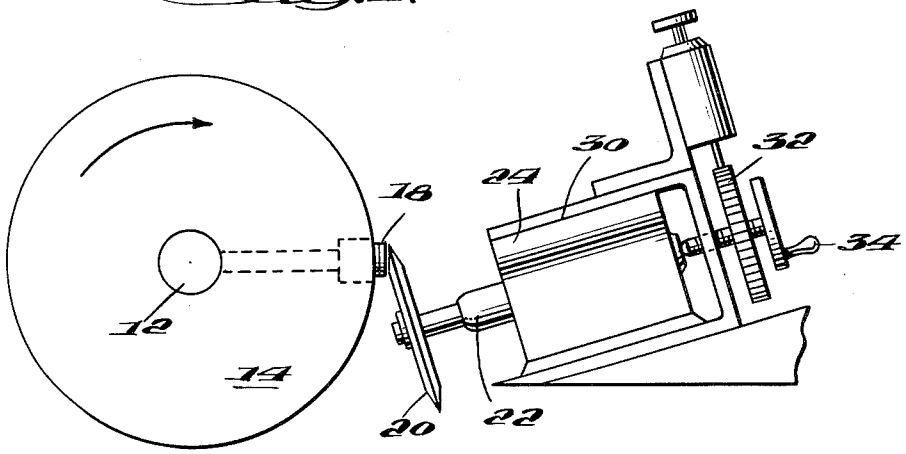


Fig. 2.

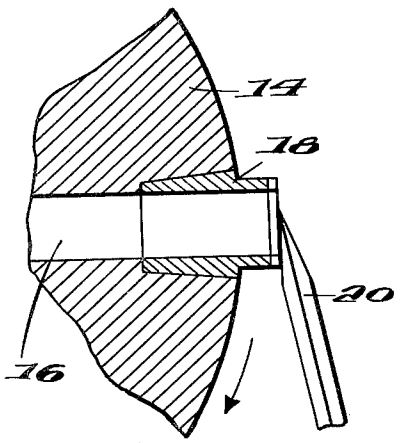
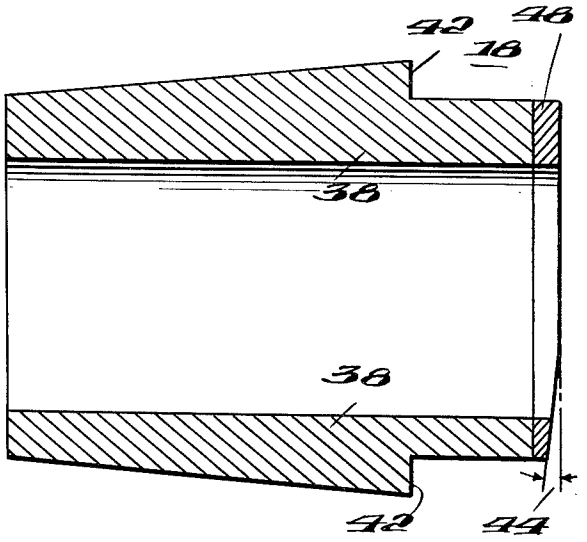


Fig. 3.



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3,238,828

YARN CUTTER

Joseph P. McNutt III, Newark, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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This invention relates to apparatus for cutting continuous filaments of synthetic fibers to staple length fibers, and in particular it is concerned with such apparatus adapted to sharpen the cutting means used during operation.

Although some textiles are produced directly from continuous filament fibers, the majority are produced from short fibers of about 1 to 6 inches in length. The short or staple fibers give warmth, bulk and hiding power or cover to fabrics and are preferred for most uses. In preparing such fibers, it is important that uniform length be provided. If the length varies, then carding and spinning will be difficult and non-uniform yarns and fabrics will result.

Cutting fibers to uniform lengths presents many problems some of which were solved by the Beria cutter first described in U.S. Patent 1,723,998, and refined as described in many later improvement patents. A modern version of this apparatus is shown in U.S. Patent 2,631,667.

The Beria cutter operates upon a tow or rope of continuous filament fibers fed into an axial bore of a rotating disc, the bore leading to a radial channel terminating at the edge of the disc. When the disc is rapidly rotated, centrifugal force causes the rope to move through the disc and be presented to a cutter located at the periphery of the disc.

This apparatus works well with a sharp and well adjusted knife, but in operation the knives gradually become dull and occasionally some filaments will not be cut. At intervals of a few hours at the most for many fibers, the operation must be interrupted and the knives replaced. Because of the fine adjustment between knife and nozzle, this is a time consuming operation. The synthetic fibers such as polyamide, polyacrylic and polyester fibers are tough and knives frequently become dull after operating for little more than an hour. Not only do the dull knives result in long fibers in the staple, but there will be a tendency for heat to develop and cause some fusion and fraying of the fibers, resulting in adhesion at the cuts ends. To maintain satisfactory cutting for even a few hours it is customary to have the fibers wet before cutting.

The use of rotary blades on the Beria cutter in a manner that results in continuous honing of the rotary blade is disclosed in U.S. Patents 2,447,617 to Nelson and 2,634,810 to Cox. However, such equipment does not perform satisfactorily because of the difficulty of maintaining fine adjustment of two separate contacting areas. To keep both contacts adjusted requires so much effort that the advantage of constant honing is lost.

It is therefore a primary object of the present invention to provide apparatus that will cut continuous filaments into staple fibers of uniform length and maintain a sharp cutting edge on the cutting means for an exended period, and yet require but a single contact area for this purpose. It is another object to provide such apparatus that will cut dry fibers without fusion of fiber ends. Other objects will be apparent from the following detailed description and discussion of the invention.

The objects of the invention are accomplished in apparatus comprising a rotating member having a passageway through which filaments are fed, an insert or nozzle at the exit end of the passageway and a cutting means,

the insert having at least a face thereof composed of abrasive material. The cutting means is honed by the abrasive face of the nozzle with which it is in intermittent contact, thereby keeping the cutting means sharp. In this simple manner, the cutting apparatus remains effectively operative for periods far longer than has been possible heretofore because the cutting and honing are carried out in the same operation through but a single contact.

For purposes of the present invention at least the face of the insert or nozzle that comes into contact with the cutting means is composed, a least partly, of material capable honing the cutting means during contact. In the preferred form of the invention the honing material or abrasive is diamond (e.g. 600 grit) and the rotary cutting means or blade is tungsten carbide (e.g. 87% WC and 13% Co), and this combination provides extended service before replacement is needed. Of course other combinations can be used provided the abrasive is harder than the material of the cutting blade. Only the face of the insert that comes into contact with the cutting balde need comprise the abrasive. Thus it is satisfactory to form the insert of a plastic and impregnate or embed an abrasive in its end. Typical plastic materials that can be used are the aromatic polyimide resins as described in Belgian Patents 627,623 and 627,626 as well as polybenzimidazoles, polybenzoxazoles and phenolaldehyde resins. Typical abrasives that can be employed include diamond, silicon carbide, boron carbide, emery and corundum.

A diamond-studded metal insert or nozzle also will serve the purposes of the present invention. The diamonds can be secured in the face of the nozzle by electrolytic deposition of metal around the base of the diamond particles, for example, by methods disclosed in Seligman et al. U.S. Patent 2,360,798 and in Brenner U.S. Patent 2,411,867. The diamond-studded metal surface may also be coated with a hard ceramic covering by conventional methods of flame-spraying metallic oxide ceramic materials, e.g. the plasma method or rod method or the detonation-gun method as described in Machine Design, vol. 33, No. 18, August 31, 1961, pages 82–92. Lapping of the surface to expose the diamonds may be necessary. Instead of diamonds, other abrasives may similarly be embedded in the surface of metals.

The invention will be described further in conjunction with the attached drawings in which:

FIGURE 1 is a plan view of apparatus according to the present invention;

FIGURE 2 a plan view of a portion of the nozzle and cutting means of the apparatus of FIGURE 1; and

FIGURE 3 is a sectional view of a nozzle of the invention.

Referring now to FIGURES 1 and 2 of the drawing, tow of continuous filaments is fed from a source of supply to the apparatus at the axial opening **12** of its rotatable disc **14**. Means (not shown) are provided to rotate the disc at any desired speed. The opening **12** communicates with a radial channel **16** that is fitted at its peripheral exit with a nozzle member **18**. The tow advances through radial channel **16** and passes out of the nozzle **18** upon rotation of disc **14**, in accord with conventional operation of a cutter of this character.

Located to make cutting contact with tow emerging from the nozzle **18** is a cutting means **20**. Preferably the cutting means is a circular blade that is rotated during operation. The blade may be made of any conventional material such, for example, as good quality hardened tool steel or the like, but may not be as hard as the abrasive employed in the insert face. The blade may have a double bevel (FIGURE 2) or even be hollow ground so that only a small surface need be honed. From time to time the blade can be turned to the opposite side so that it will wear evenly.

The cutting means **20** is supported by a shaft **22** that urges it into cutting contact with the nozzle **18**. A motor **24** powers the shaft **22** to rotate it and the cutting means **20** attached thereto.

As noted above, the nozzle **18** hones the cutting means **20** during operation, keeping it sharp and thereby attaining many of the advantages of the invention. Honing causes blade wear and possibly nozzle wear, and it is within the scope of the invention to provide means, preferably associated with the cutting means to advance the latter into cuting contact with the nozzle as necessary. For this purpose the motor can be mounted in a frame **30** having a lock-wheel **32**, capable of fine adjustment, operatively engaging a rod **34** having its free end in contact with the motor **24**. By turning the lock-wheel **32**, rod **34** urges motor **24**, and therefore shaft **22** and the blade **20**, toward the nozzle. Hence as the parts wear, a simple adjustment is made thereby reestablishing good cutting contact. This adjustment can be made very accurate by adapting defined amounts of turn of the lock-wheel to advance the blade some predetermined amount. For example, in testing one particular cutter it was found that after a few hours of operation it was desirable to advance the cutting blade 0.00005 inch, which was sufficient to achieve good operation for several additional hours of cutting and honing. To make that adjustment a notched lock-wheel and gear train assembly was used such that rotation of the wheel one notch achieved the desired adjustment. This or other adjustment can be made completely automatic, for example by providing means to sense wear and make the adjustment as wear occurs. Sensing current changes in the motor due to changes in its load is one system that can be used for automatic adjustment arrangements.

A typical nozzle or insert **18** of the invention is shown in FIGURE 3 in section. It is composed of a main body portion **38** and a peripheral or face portion **40**. The abrasive is located in the face portion **40**. Generally the insert is received by the rotating disc **14** (FIGS. 1 and 2) in a bore provided for that purpose and may be held in place by a lock plate upon which the annular flange **42** on the main body portion **38** of the insert bears. The nozzle may be generally cylindrical. Since the cutting action of fibers takes place largely at the back edge (or trailing portion) of the insert, it is advantageous to make that portion of the side wall of the nozzle thicker than the leading portion to strengthen it against the shock of cutting. Such an arrangement is shown in FIGURE 3, but of course this is merely exemplary and not limiting on the invention.

A suitable nozzle can be a composite of parts. For example a metal liner can be used to which is attached, as by mechanical means or a molding practice, a plastic end member having the abrasive therein. Generally about 0.25 inch of the end of the nozzle is made with abrasive, though smaller or greater portions thereof could be treated.

The abrasive or honing material employed in any practice of the invention should be finely divided to maintain the desired edge on the blade and usually a 600 grit abrasive is used but coarser or finer grades also can be used. A concentration of 100% abrasive, in the material of which the nozzle is made, is preferred. By 100% concentration is meant that the abrasive particles are distributed in the base material just as they would occupy the space if the base material were not present. A lower concentration can be used, but at a sacrifice of some efficiency.

Suitable nozzles can be made using techniques available in the machining, powder metallurgy and plastics arts. A typical practice of molding procedure for making a plastic blank for a nozzle is as follows:

An intimate mixture of 1.91 grams of 600-grit diamond

powder and 2.34 grams of finely divided polyimide resin (the aromatic polyimide from pyromellitic dianhydride and p,p'-diamino-diphenyl ether) is packed into the bottom of a mold and carefully leveled. Another 65 grams of the powdered polyimide is then added to the mold. The mold is closed and a load of 5,000 lbs. is applied. The temperature is then raised to 460° C. and after 10 minutes at this temperature the load is increased to 24,000 lbs. (total pressure on the ram). This load and temperature are maintained for 10 minutes; then the mold is cooled to 325° C. The load is then removed and the temperature further lowered to 125° C. at which time the mold is opened and the blank removed. The blank can then be bored and its face shaped to the desired bevel.

Other resins will require variations of temperatures and pressures according to the properties of the resin, as is evident to those skilled in molding arts.

Nozzles of the invention may be a hollow cylinder of ⅝ to 1.5 inches inside diameter and about ⅞ to 1¾ inches outside diameter. Suitably the leading portion or edge of the nozzle is chamfered, as indicated by the numeral **44** in FIGURE 3. Accordingly, the rotary blade contacts but one-half to three-quarters of the nozzle face. For a typical operation with a disc speed of 1750 r.p.m. (disc and nozzle diameter, 20 inches) and a 6 inch diameter blade rotated at a speed of 7000 r.p.m., for each passage of the nozzle across the knife edge, about 18° of arc on the rotary knife will be honed. The entire surface of the knife edge will be lightly honed approximately 85 times per minute, which keeps the knife in a highly sharpened state. This extremely sharp knife will readily cut wet or dry fibers without fusion of the fibers.

From the foregoing discussion and description, it is evident that the invenion provides a significant advance in the art of cutters used to cut fibers and filaments to staple length. While the invention has been described with respect to specific details, it should be appreciated that changes can be made without departing from its scope.

What is claimed is:

1. Apparatus for producing staple fibers from continuous filaments comprising a rotary cutting means, a rotating member having a passageway therein to feed filaments through said member to the cutting means and a cutting means contacting nozzle protruding from the exit end of said passageway, said nozzle having at least its contact face of a material that hones said cutting means upon sliding contact therewith.

2. In apparatus for cutting fibers comprising a rotating cuting blade, a rotating member having a passageway therein to feed fibers through said member to said blade, and a cooperative contact cutter comprising said rotating cutting blade and a blade-contacting nozzle protruding from the exit end of said passageway, said nozzle being composed of a hard material at its contacting face adapted to hone said blade during contact therewith.

3. Apparatus in accordance with claim **2** in which the nozzle is composed of a plastic having diamond embedded in its blade contacting face.

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WILLIAM W. DYER, JR., *Primary Examiner.*