

[54] **APPARATUS FOR CUTTING TOW INTO STAPLE FIBER**

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[58] Field of Search..... **83/403, 580, 592, 83/591, 913, 509**

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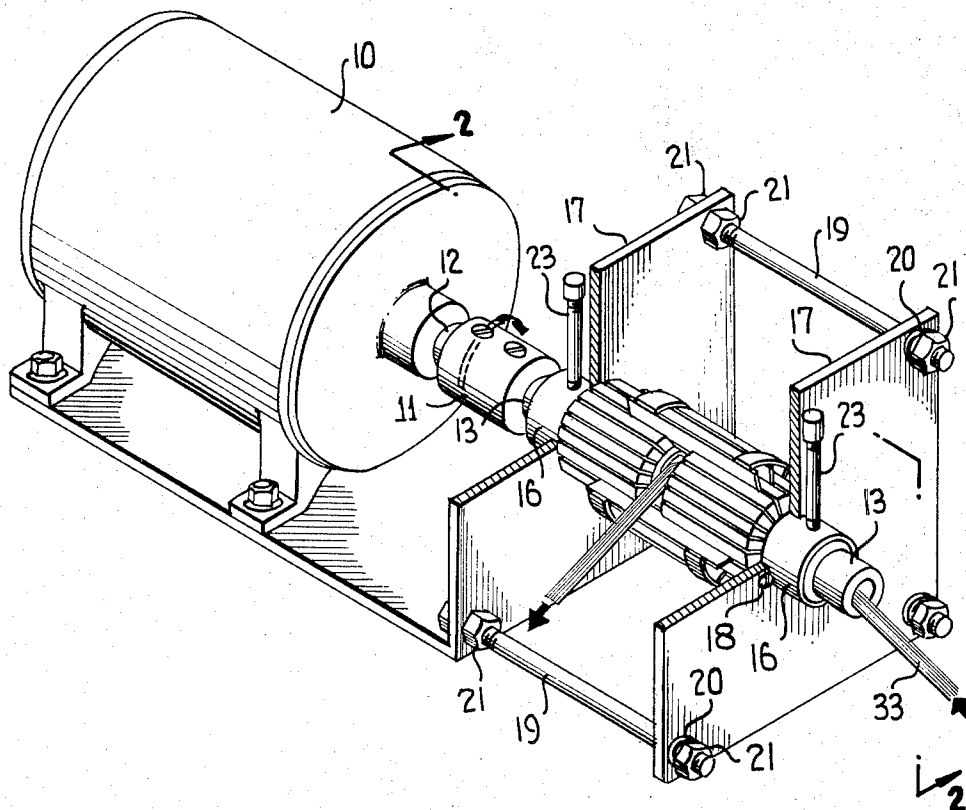
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[57] **ABSTRACT**

An apparatus for cutting staple fibers to predetermine accurate lengths from tow or ropes comprising a power operated rotatable hollow shaft providing a passageway for the tow or rope, an exit opening for the tow, plurality of stationary knives positioned adjacent said exit opening whereby to impinge the front end of the tow against the knives to thereby cut the tow into fibers of uniform length.

4 Claims, 6 Drawing Figures



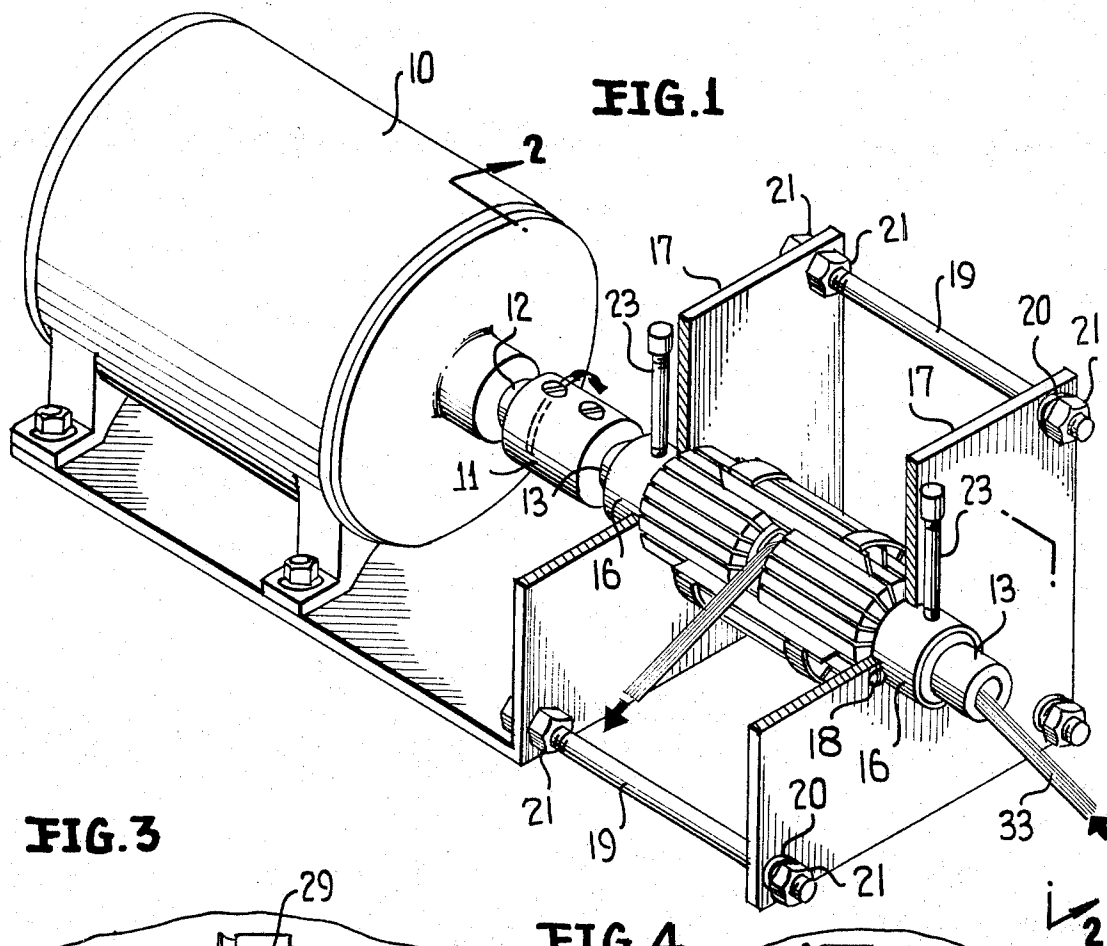


FIG. 3

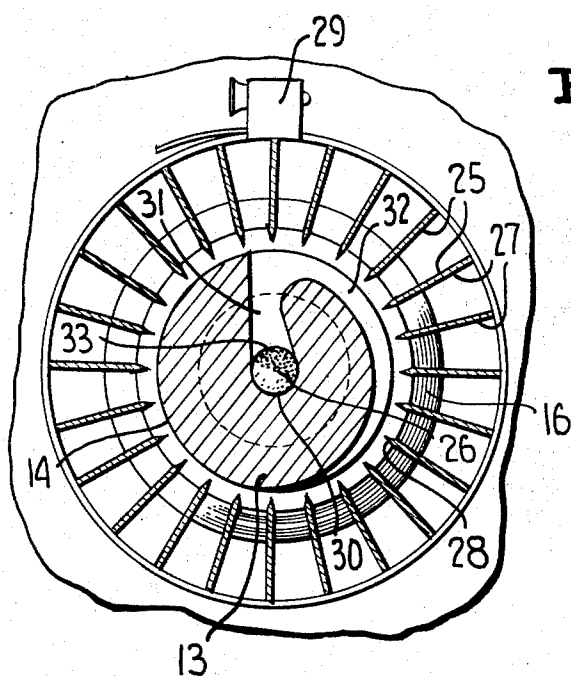
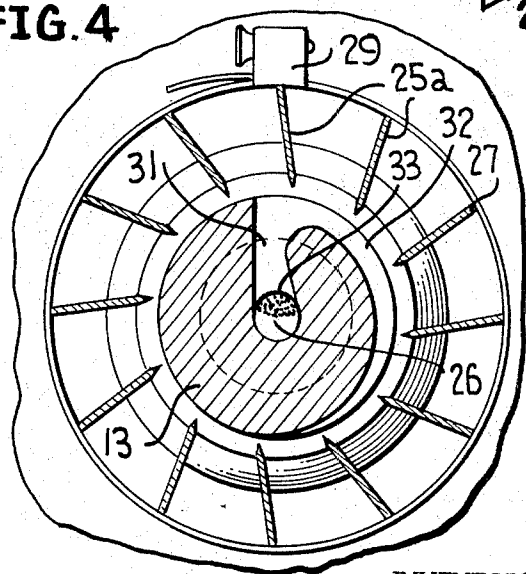


FIG. 4



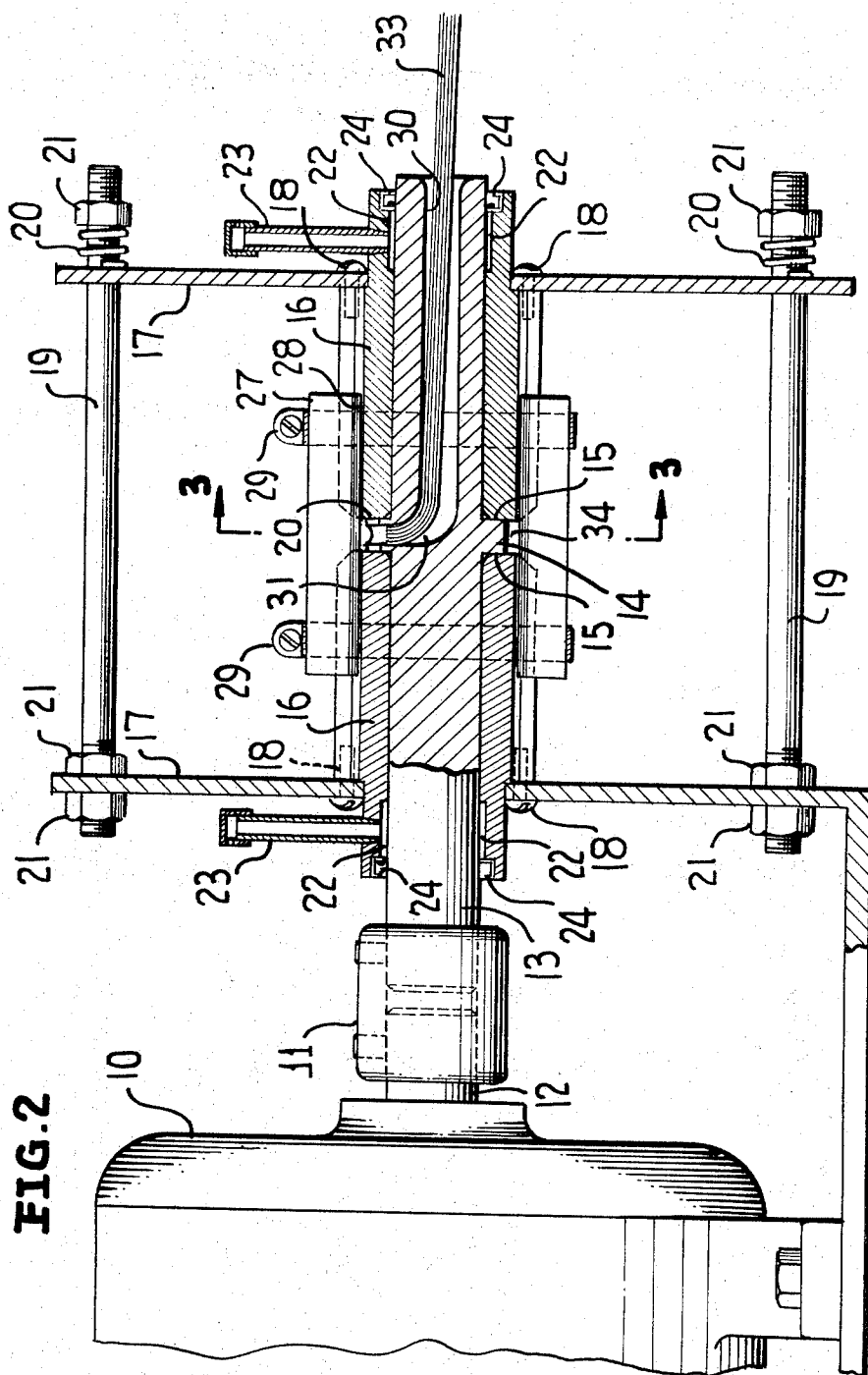
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FIG. 5

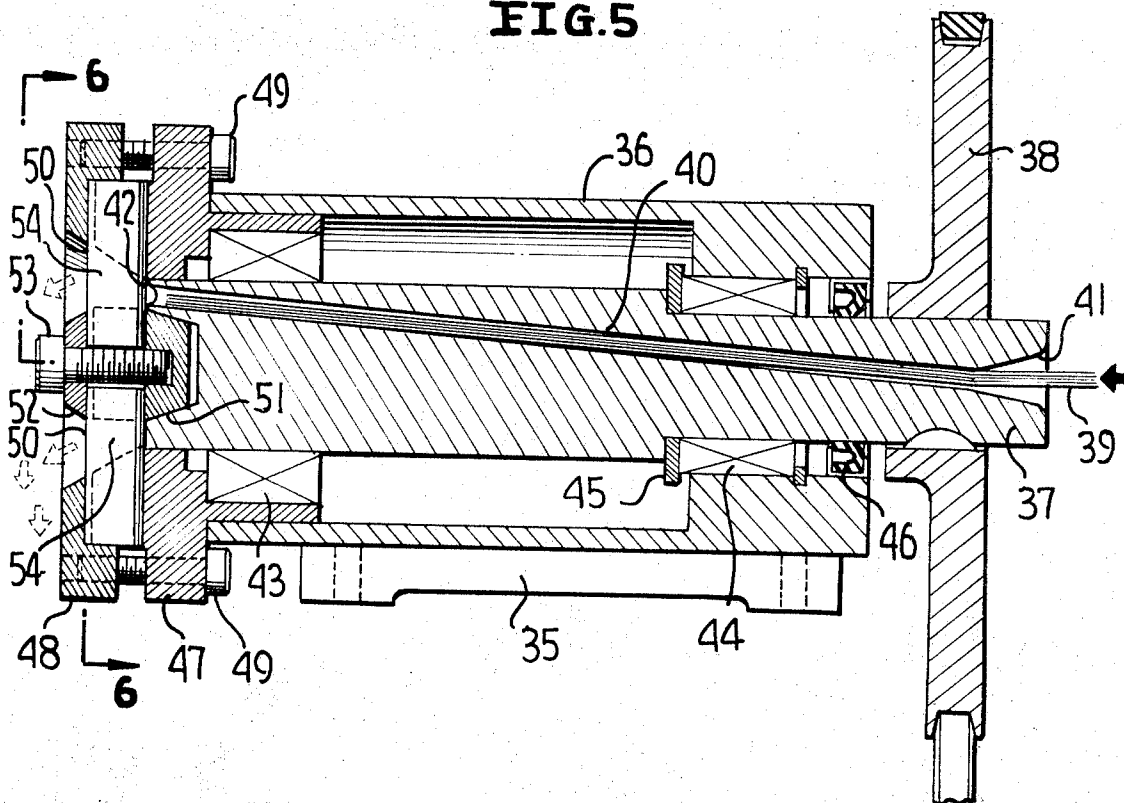
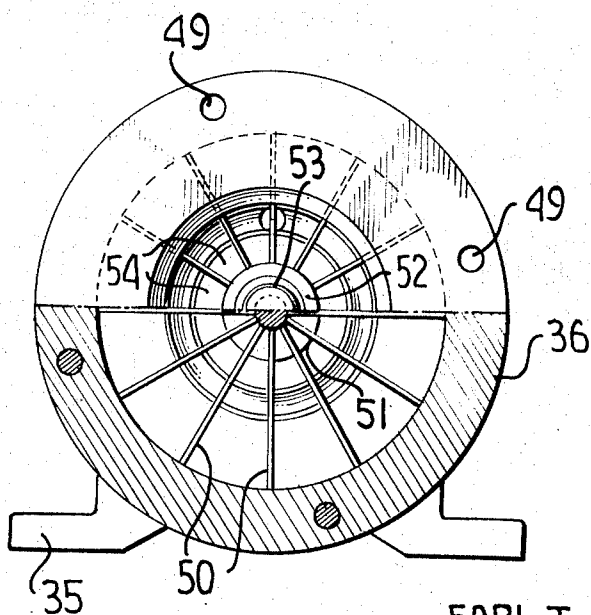


FIG. 6



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BACKGROUND OF THE INVENTION

The problems encountered in the cutting of both crimped and uncrimped fibers in tow or ropelike feed are well known in the textile industry. Uniformity of length is particularly difficult to achieve in staple cut from crimped tows, long ends resulting in extreme difficulty in subsequent processing in the drawing machinery.

Fusing of ends is an additional problem on all cutters particularly where impact of blade and the cutting force combine to produce heat locally which is near the melting point of the material being processed. Wetting down of the tow rope is employed in many instances to dissipate heat of fusion but is an unsatisfactory alternative since it necessitates subsequent drying, hence expensive equipment and unnecessary added cost to the product.

Feed is a problem in most cutters, particularly those of the knife and anvil and Beria types. Vacuum is in common use to direct the tow band from the final feed rolls to the knife-anvil pinch point. While this method produces staple, two problems are inherent in its use; folds or length variation irregularities in the tow are immediately stretched out by the suction, thus producing long ends and obviously equipment must be supplied both to produce the vacuum and to separate cut staple from the air stream at some point downstream of the cutter. The separation problem is particularly troublesome on short flock-like staple. While vacuum is not in common use on the Beria type cutters, centrifugal force stretches out the irregularities in the tow band and produces the selfsame objectionable long ends.

To date no one has come forward with a staple cutter which produces both long and short staple from both crimped and uncrimped tow while employing either a dry or wet feed of the tow band. Additionally, most cutters are either designed for or produce acceptable results with one type of material only while producing mediocre results or failing entirely when employed to cut other types of the ever expanding man made fibers art.

SUMMARY OF THE INVENTION

The invention involves a power operated rotatable hollow shaft, having an inlet and an outlet passage for tow or rope. Adjacent the outlet passage is a frame having a plurality of knives radially positioned in said frame with the sharp edges of the knives closely adjacent the outlet passage. Movement of the tow or rope through the passageway impinges the front end of the tow or rope against the sharp edges to cut the tow or rope into fibers of generally uniform length. The knives are also mounted so as to be adjustable with respect to the outlet passage whereby to continuously present a sharp portion of the knife edge for cutting purposes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the present apparatus for cutting fibrous tow into staple fibers;

FIG. 2 is a partial sectional view of the instant apparatus taken on line 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view similar to FIG. 3 except that it shows a slightly modified form wherein the cutting knives are in a slanted position;

FIG. 5 is a vertical cross-sectional view of a modified form of the invention wherein the cutting knives are positioned in a fan shaped manner instead of being radially disposed; and

FIG. 6 is an end view taken on lines 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 of the accompanying drawings, numeral 10 depicts a driving means, such as an electric motor having a gear box assembly preferably with a variable speed output shaft. A coupling 11 attaches the output shaft 12 of the driving means to a hollow shaft 13 so that the output shaft and the hollow shaft are in essential axial alignment.

Referring to FIG. 2 of the drawings, hollow shaft 13 has a raised land 14 near its axial center whose side surfaces 15 not only have a high finish but are machined to run true and parallel when hollow shaft 13 is rotated about its longitudinal axis. Hollow shaft 13 is rotatably mounted in journals 16 which are fixed to frame plates 17 by screws 18. Frame plates 17 are held in fixed loaded relationship to the entire assembly by a multiplicity of longitudinal threaded rods 19 over which are inserted compression springs 20 and nuts 21, said threaded rods, springs and nuts being located essentially equally spaced on a bolt circle well outside of journals 16 and the more congested machine center. It will be appreciated at this point that the inward ends of journals 16 like the side surfaces 15 of raised land 14 receive a high machine finish since these surfaces mate with the rotating side surfaces 15 and seal in a lubricant either circulated through or stored in reservoirs 22 and standpipes 23 on the outer ends of journals 16. Standard commercial seals 24 prevent escape of lubricant at the outer ends of journals 16.

A further description of journals 16 can be obtained by viewing FIG. 3 where it is seen that they contain a plurality of knife-holding slots 25 cut longitudinally into their outside diameters, each slot centerline being a radial line emanating from the axial centerline 26 of hollow shaft 13, so that the assembly presents a windmill or sunburst array when viewed from the inner end of the journal 16. These slots prevail in like number in each journal 16 and those in one journal are in axial alignment with those in the other journal. The cutting knives 27 adjacent the sharpened edges thereof are angularly milled as indicated at 28 in FIGS. 2 and 3 and the deepest or innermost portions of slots 25 are similarly milled so that the milled portions of the knives, received in said slots, come to rest in a circle and bottom on the angularly milled portions of the slot and not the sharpened edges of the knives. It will be further understood by viewing FIG. 3 that the circle described by the inner sharp edges of knives 27 is slightly larger than the outside diameter of raised land 14 and there is ample clearance to insure that the knives 27 will not be dulled by metal to metal contact with rotating hollow shaft 13 and its accompanying, adjacent rotating raised land 14. The knives are held in their corresponding slots by means of band clamps 29. With this arrangement, it now becomes possible to slightly loosen the band clamps and slide the entire knife assembly to and fro in the aligned slots 25 without danger of dulling the sharp-

ened edges. In this way, it is possible to adjust the knives 27 so that the presently unused or sharp portion is safely sheathed while the portion between the ends of the journals 16 where actual cutting occurs is the only exposed part. Obviously, all the knife edge can be utilized for cutting except that small length on either end required for engagement in the end of the journal to prevent escape of tow without its being cut. The knife assembly is simply moved along axially to expose a new section of sharp edge as the previously used edge area becomes dulled.

As seen in FIGS. 2 and 3, hollow shaft 13 is provided with an axial bore 30 which extends from the outward end of the shaft to a point near raised land 14 at which point it gently curves to a radial aperture 31 emanating on the outermost surface of raised land 14 equidistant from side surfaces 15. Radiused incline 32 extending from radial aperture 31 partially around the periphery of raised land 14 in the opposite direction of intended rotation of hollow shaft 13 now completes the feed canal for tow band 33. Tow band 33 enters this canal at the outermost end of axial bore 30, continues through radial aperture 31, passes up radiused incline 32 and wraps around raised land 14, occupying and essentially filling the generally rectangular annular channel 34 formed by the inner ends of journals 16, the outer diameter of raised land 14 and the inner sharp edges of knives 27. All surfaces upon which the tow band slides have suitable, hard-surfaced, polished finishes, well known in the tow guiding art.

It should be pointed out at this point that there is some relationship between the size of the tow band 33 and the several tow passages which make up the tow canal described above. Generally speaking, axial bore 30 and radial aperture 31 must be of such a diameter or have sufficient cross sectional area that the tow band 33 slides readily through them without fouling, scuffing or otherwise disrupting the flow. Likewise, annular channel 34 has a cross sectional area of approximate like magnitude and obviously the width of raised land 14 must be slightly in excess of the diameter of radial aperture 31, else it would disturb the continuity of highly finished side surfaces 15 on raised land 14.

Actual operation of the apparatus can now be more fully described. Tow band 33 is inserted into the tow canal by air jet, threading wire or other means. It now comes from a continuous tow supply, threads through the hollow shaft thence through the radial aperture and between two knives to the outside. It is now clear that if the hollow shaft is rotated that the tow pressed against the inwardly pointing knives will be arrested from peripheral movement and will be "ironed" firmly against the many sharp knives by the incoming tow. Linear movement of the tow once it leaves the aperture essentially ceases since it is being wound onto the inside of a stationary package. The mounting pressure exerted by the addition of the incoming tow as it is laid onto the annular channel 34 is resisted solely by the plurality of knife edges surrounding the tow pack; likewise, the knife bearing points and the ends of the journals hold the tow pack stationary since the arresting force they exert is much greater than the thread-guide-like force exerted by the polished rotating land. When the outward pressure on the tow reaches a certain magnitude, the fiber shears at the sharp knife edge and the cut staple escapes easily between the diverging surfaces of the knives, falling into a container or onto a product

carrying conveyor (not shown). At this point, it will be readily understood that the shearing pressures will vary from dull to sharp knives, dry to wet tow and with different types of fibers. It is likewise easily understood that the staple length is controlled by the number of knives in the circle, hence the spacing, and that all lengths of staple can be accommodated, even to the point of randomized mixing of different lengths if desired. It can readily be understood here also that since incoming tow pushes outgoing cut staple away from a stationary outer assembly there can be no roping of cut staple due to machine rotation and no problem of getting the cut staple to readily leave the machine. It is likewise apparent that the machine is an inherently safe arrangement where the operator may secure samples from the freshly cut product with no fear of injury to himself.

FIG. 4 discloses a slight modification of the knife positioning shown in FIG. 3. As seen in FIG. 4, the radial slots 25(a) are positioned at a slight angle as distinguished from the radial position of the slots shown in FIG. 3. This slight angle may be referred to as an "attacking angle" and has a slight advantage when cutting tows of higher tensile strength.

FIGS. 5 and 6 disclose a modified arrangement of the aforementioned apparatus showing tow being urged axially through an array of knives whose arrangement is spoke-like or radial as opposed to tow being urged radially through axially aligned knife edges as previously described. Numeral 35 denotes a mount base for supporting a housing barrel 36 through which a hollow shaft 37 is rotated by a driving means generally indicated by numeral 38. The tow 39 is passed through the passageway 40 from the entrance end 41 to the exit end 42. It will be noted that the passageway 40 inclines from the entrance end to the exit end.

As shown in FIG. 5, the assembly is provided with the usual bearings 43, 44, thrust washer 45 and seal 46. Adjacent the left hand end of the housing barrel an inner clamp ring 47 is fixedly mounted to the housing barrel 36 and an outer clamp ring 48 is secured to said inner clamp ring by suitable threaded bolts 49. These rings hold the several knives 50 by their outer ends in a tight clamped assembly. Likewise the inner ends of the knives 50 are clamped between pilot bearing 51 and clamp washer 52, clamping pressure being supplied by single central capscrew 53. This arrangement whereby the knives are held at both the outer and inner ends presents a wheel-like appearance when viewed from the end where the staple exits as in FIG. 6. In this view the clamp washer 52 and capscrew 53 appear as the hub of the wheel, the knives 50 are the spokes, and the outer clamp ring 48 is the wheel rim. It is obvious now that the sharp edges of knives 50 are turned inward toward the incoming tow, where the cutting pressure is exerted by the end of shaft 37, that the tow wraps part way around the channel before cutting begins and this "tail" maintains pull on the incoming tow. It is likewise apparent that the cut staple exits through the space between the knives or "spokes" of the wheel, and in this respect as well as others is similar to the preferred embodiment of the invention. Two important differences, however, should be noted in this arrangement: First, the exit channel for the cut staple is not a diverging one, hence there is a slight tendency to clog. Secondly, the fibers cut nearer the "hub" are slightly shorter than

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those cut nearer the "rim" of the wheel due to the angularity between the knives in this spoke-like array.

While several embodiments of the present invention have been described and illustrated, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. An apparatus for cutting staple fibers, comprising a power operated rotatable shaft, a passageway formed in said shaft, said passageway having its inlet at one end of the shaft and having its outlet extending through the circumference of said shaft, means for passing tow through said passageway and out of the outlet, a plurality of stationary knives axially supported about said rotating shaft with the sharp edges of said knives closely adjacent said outlet end of the passageway, said shaft

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having a raised land therein through which the outlet passageway extends, said land having side surfaces thereon, a pair of journals surrounding said shaft on each side of said raised land, the inward ends of said journals bearing against said side surfaces of the land, said journals having slots formed therein through which the sharp edges of the knives extend, and means for holding said knives in said slots.

2. An apparatus as defined in claim 1, said knives being longitudinally adjustable with respect to the outlet passage.

3. An apparatus as defined in claim 1, lubricant reservoirs adjacent the outer ends of the journals, and seals for preventing the escape of lubricant at the outer ends of the journals.

4. An apparatus as defined in claim 1, said slots in said journals being angularly disposed.

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