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STAPLE CUTTING APPARATUS

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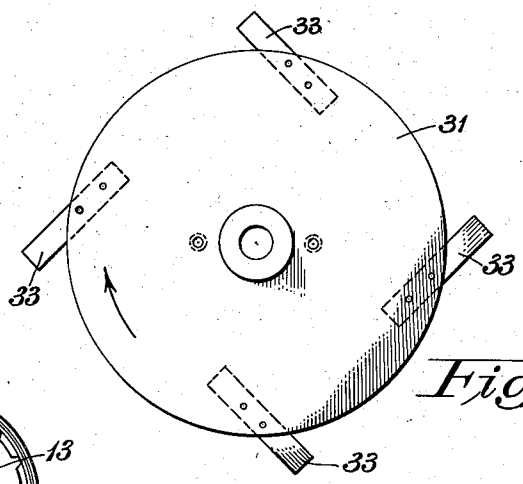

Fig. 2

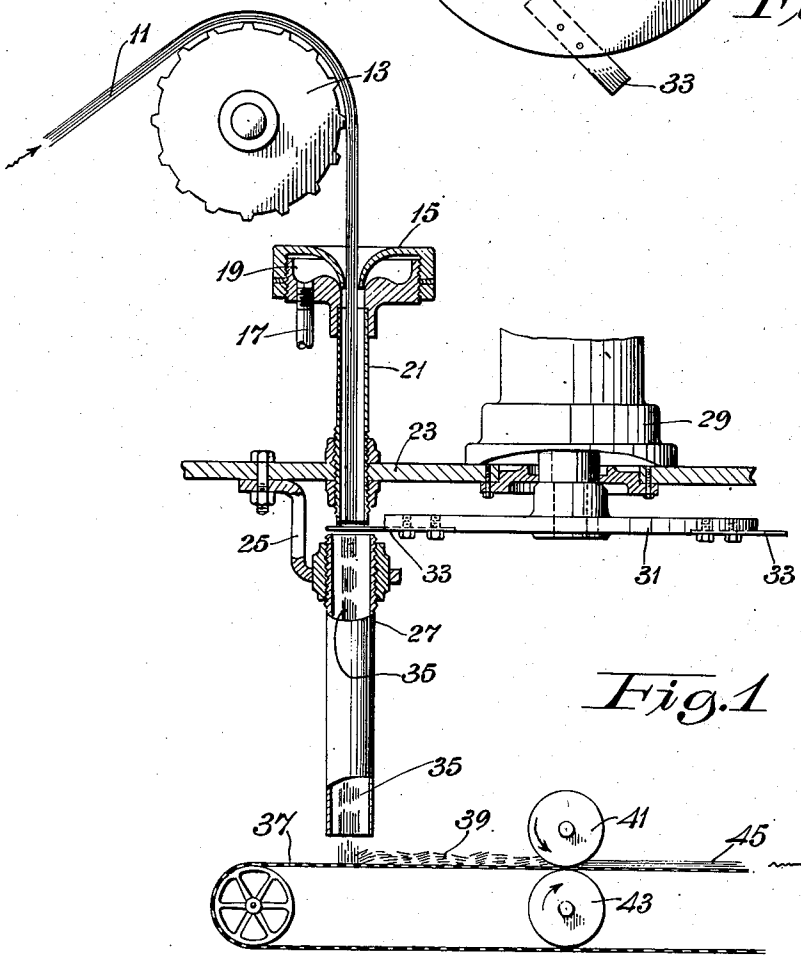

Fig. 1

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STAPLE CUTTING APPARATUS

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1 Claim. (Cl. 164—61)

This invention relates to the production of artificial staple fibers. More particularly, it relates to an improved apparatus for the production of artificial fibers of uniform staple length from bundles of continuous filaments.

The cutting of continuous filaments into fibers of staple length has been accomplished, heretofore, by feeding a bundle of filaments downwardly through a vertical funnel conduit by means of a concurrent flow of liquid which applies a tension to said filament bundle. As the filament bundle, so tensioned, emerges from the bottom of the funnel conduit, it is cut by means of knives mounted on a disc rotating in a horizontal plane. Such previously suggested method and apparatus for the cutting of staple fibers is subject to certain objectionable disadvantages. Unless the knife blades are maintained with exceptionally keen cutting edges, all of the filaments in the bundle will not be cleanly cut. Some of the filaments will merely be pushed aside. Turbulence of the flowing liquid, as it emerges from the funnel, causes a fluttering of the filament bundle which results in the cutting of staple fibers of non-uniform length. If the filament bundle is sheared by cooperation of the funnel end and knife blade, a staple fiber chip is formed which must be subjected to a fiber opening operation.

It is, therefore, an object of the present invention to provide a staple fiber cutting apparatus which is not subject to the above-mentioned disadvantages.

Other objects of the invention will appear hereinafter.

The details of the invention will be more clearly apparent by referring to the following description when taken in connection with the accompanying illustrations, in which:

Figure 1 is a diagrammatic side elevational view, with parts shown in section, of a staple cutting apparatus constructed in accordance with the present invention.

Figure 2 is a top plan view of a horizontally rotating disc containing a plurality of cutting knives.

Referring to the drawing, reference numeral 11 designates a bundle of continuous filaments which may be passed to the feed roll 13 directly from a spinning operation. Alternatively, it may be passed to the feed roll from any other source. The feed roll 13 is preferably of a fluted type in order to prevent sticking of the filament bundle to the surface of the roller. The filament bundle passes downwardly into a funnel head 15. The funnel member is connected to a conduit 17 which is adapted to supply liquid to an annular chamber 19 located within the funnel head 15. A conduit 21 is positioned in the bottom of the funnel head 15 in such a manner that the liquid flowing from chamber 19 is adapted to flow from the bottom of the funnel head into conduit 21. The flow of the liquid through the conduit 21 will impart a drag or tension on the filament bundle 11 which also passes through the conduit. Conduit 21 is fastened to a supporting plate 23. A second conduit 27 is positioned in axial alinement with conduit 21, but is spaced a slight distance from the bottom of conduit 21. Conduit 27 is fastened to supporting plate 23 by means of arm 25. A motor 29 is also positioned on supporting plate 23. A vertical drive shaft of the motor projects through plate 23. A knife disc 31 is connected to the end of the vertical drive shaft of the motor. The knife disc 31 is provided with a plurality of angularly disposed knife blades 33. The knife blades 33 are preferably attached to the knife disc 31 at an angle of about 45° to a radius drawn from the center of the disc to the point of attachment of the blades. The knife disc is positioned so that the knife blades 33 will pass between conduits 21 and 27 upon rotation of the knife disc 31. The knife blades are slightly spaced from either of the two conduits so as to cut the filament bundle with a so-called "flying cut," that is, the knife blades do not have a cooperation with either of the conduits, or other element, to shear the bundle of filaments. Although the thickness of the knife blades may vary considerably, from a standpoint of length of life and ease of cutting with a minimum of sharpening, it has been found that such blades having a thickness of approximately $\frac{3}{32}$ inches are particularly suitable. It has furthermore been found that the spacing between the conduits and a knife blade is of importance. Preferably the distance between the upper conduit 21 and the blade be approximately .04 inch and between the lower conduit 27 and the blade approximately 0.048 inch.

The successful operation of the cutter depends largely on the presence of conduit 27. It is furtheremore essential to the continuous operability of the cutter that the conduit 27 have an internal cross-sectional diameter at least 30%, but not more than 150% greater than the internal cross-sectional diameter of conduit 21. Preferably, the internal cross-sectional diameter of conduit 27 is between 50% and 100% greater than that of conduit 21. The filament bundle does not feed

or cut well unless the relative tube sizes are within the above-mentioned limits. By means of the above-described apparatus, the filament bundle 11 is held in tensioned position as the knife disc rotates and, as a consequence, short lengths 35 are cleanly severed from the filament bundle. These lengths 35 passing through conduit 27 are thrown downwardly by force of the liquid flowing through conduit 27 on to a perforated moving belt 37. The force of the impact of the short lengths 35 causes them to separate into individual filaments on the belt 37. The mass of filaments 39 is continuously passed between wringer rolls 41 and 43 and is matted on the belt 37 in the form of a thick spongy felt 45. The felt 45 can be dried on the belt 37 or may be passed into a water bath or other treating liquid bath and then removed to a drier or the like.

The liquid used in drawing the filaments through conduits 21 and 27 may be a coagulating and regenerating solution for the filaments, or it may be a treating solution for the filaments, such as a desulfuring or bleaching solution, or it may be water or other washing solution. Inasmuch as the various solutions which may be used would have a corrosive action on materials, it is desirable that the various elements of the staple cutter be made of a corrosion-resistant metal, or from hard rubber, resin or other corrosion-resistant material. It is particularly important that the knife blades be resistant to corrosion by any of the solutions which may be used as the tensioning liquid. Not only must the knife blades be resistant to corrosion, but they must be capable of holding a sharp edge for a considerable period of time. It is preferred that the knife blades be made of Hastelloy C. This material is particularly adapted for use as knife blades in the present invention in view of its ability to maintain a sharp cutting edge and also because of its corrosion-resistant properties. The other elements of the cutting apparatus may, if desired, also be constructed of this material. Hastelloy C has a composition as follows:

	Per cent
Nickel	58
Iron	6
Chromium	14
Molybdenum	17
Tungsten	5

It will be understood that the staple fiber lengths into which the bundle of filaments are cut may be varied by suitable adjustment of the speed of feed of the bundle of filaments or by the speed of rotation of the knives. Furthermore, the number of knives on the knife disc 31 may also be varied. A staple fiber of any length between 1 inch or 10 inches may be produced in accordance with the present invention.

In accordance with the present invention, it is essential that the bundle of filaments be tensioned or drawn through the conduits by means of a liquid so as to impart sufficient tension to the bundle of filaments that a rotating knife making a flying cut will sever the filaments to a uniform staple fiber length. It is also essential that an axially alined conduit be positioned below the rotating knife blades. The lower conduit holds the ends of the filaments in a downward position while the knife passes through them. The tendency of the rope to swing or flutter is greatly reduced with the result that staple fibers of remarkably uniform lengths will be produced. By the use of the lower axially alined conduit, the life of the cutting edges of the knives is very greatly increased so that a cutting machine will run for seven to ten days before changing of a blade is required. Substantially no operating time will be lost by replacement of knife blades.

By the use of the present invention, staple fibers cut from the continuous filament bundle will be almost entirely opened, that is to say, there is substantially no chip formation. This is accomplished by a combined action of the tensioning solution, the lower axially alined conduit, the flying cut of the knives, and the perforated conveyor belt. In the absence of a shearing cut, the filaments will not be squeezed together at the point of cutting and, therefore, the small bunch of staple fibers will be very easily opened. The liquid passing through the conduits brings the filaments into parallel alinement and drives the fibers against the conveyor belt. The ends of the cut fibers strike the belt and the various fibers of the small bunch separate in all directions.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited to the said details except as set forth in the appended claim.

I claim:

A staple fiber cutting apparatus comprising a vertical feed conduit, means for feeding a bundle of continuous filaments downwardly through said conduit, means for passing liquid concurrently with said bundle of filaments, through said conduit, a second conduit spaced from the bottom end of said first conduit, said conduits in axial alinement with each other, said second conduit having an internal cross-sectional area between 30% and 150% greater than that of the first conduit, a vertical knife shaft positioned adjacent said conduits, a knife blade positioned on said shaft to rotate therewith and pass between said spaced alined conduits.

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