

Jan. 24, 1950

P. PIERRAT ET AL

2,495,236

APPARATUS FOR CUTTING CONTINUOUS FILAMENTS

Filed June 2, 1947

2 Sheets-Sheet 1

Fig. 1.

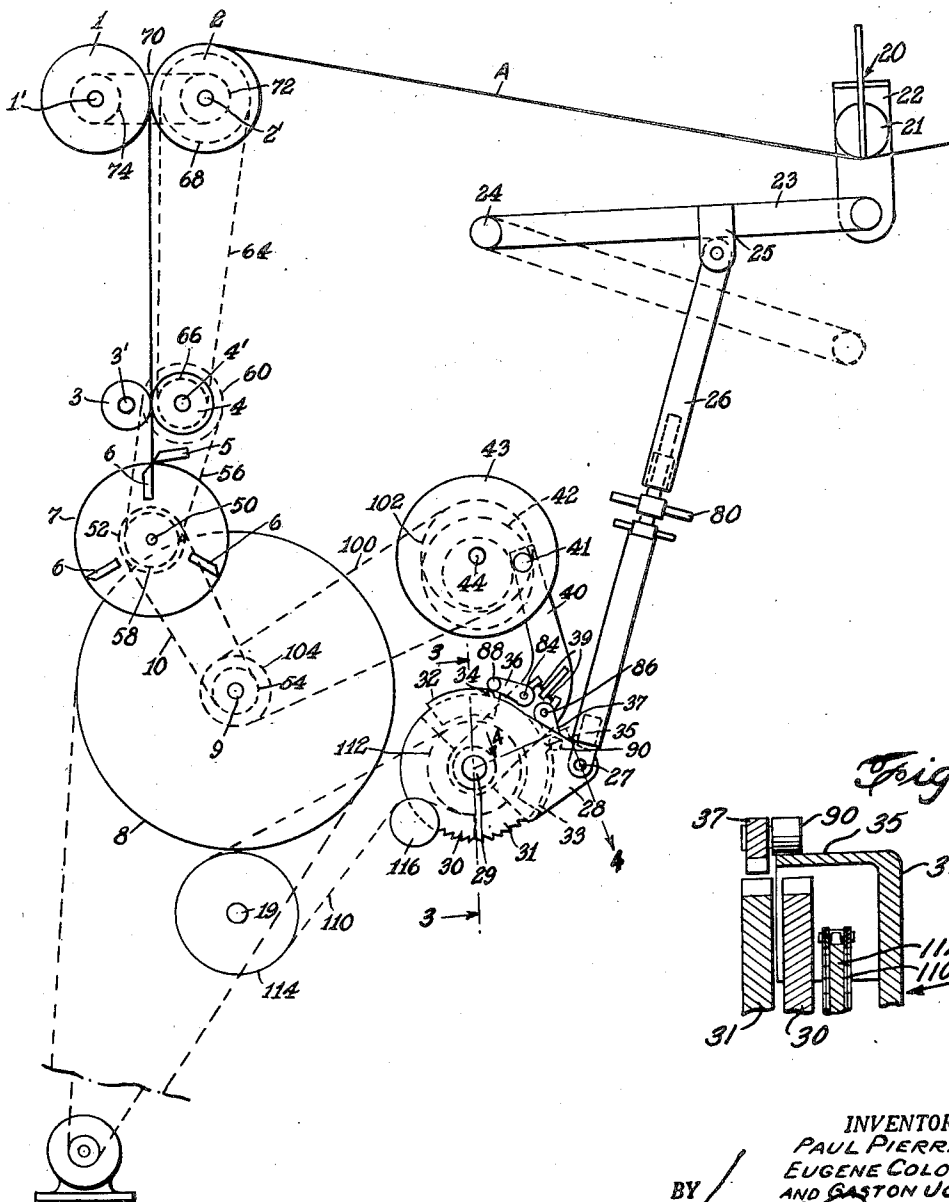


Fig 4.

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2 Sheets-Sheet 2

Fig. 2.

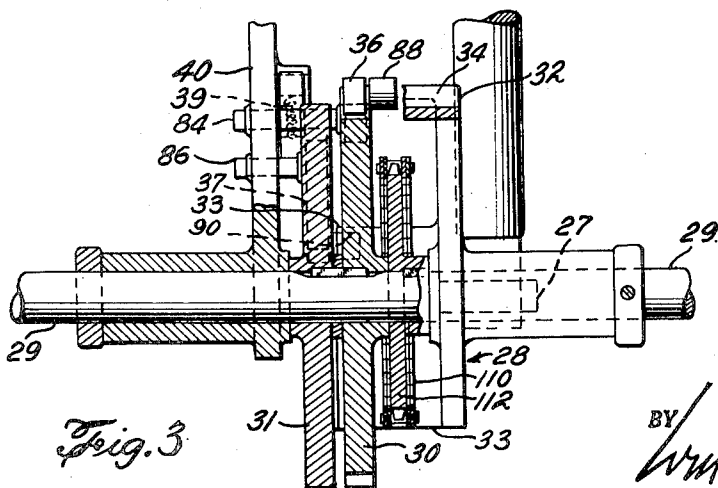
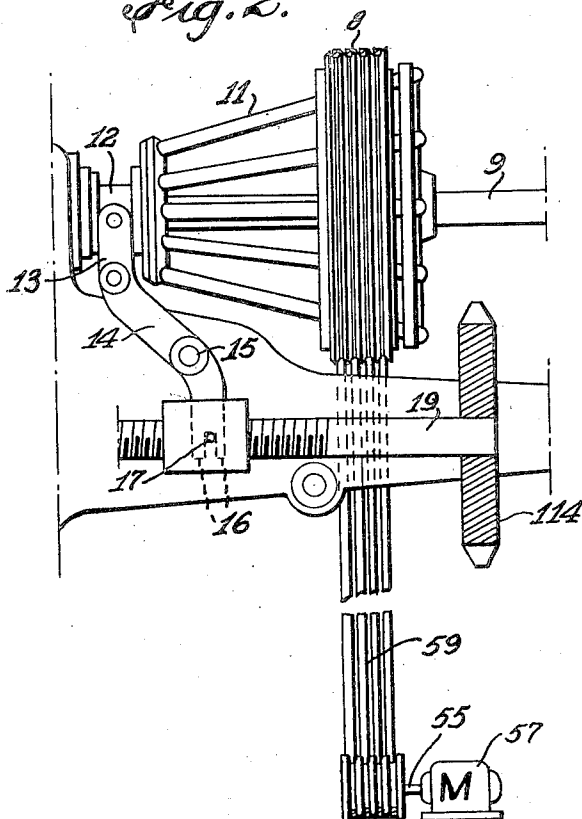


Fig. 3

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2,495,236

APPARATUS FOR CUTTING CONTINUOUS FILAMENTS

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Application June 2, 1947, Serial No. 751,952
In France June 29, 1944

Section 1, Public Law 690, August 8, 1946
Patent expires June 29, 1964

9 Claims. (Cl. 164—68)

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This invention relates to the manufacture of staple rayon. More particularly, it relates to a new and improved apparatus for cutting continuous filaments into staple fiber.

In the manufacture of staple fiber, a thick bundle of continuous artificial filaments containing, for example, 100,000 to 200,000 or more filaments was cut into sections of definite lengths, such as lengths of 28 mm. when a textile, similar to cotton, was desired, or in 44 mm. lengths when a textile fiber for use in the wool industry was desired. The thick bundle of filaments was cut into the desired lengths by a machine wherein knives on a rotating carrier acted perpendicular to the bundle fed into the zone of action of the knives by a pair of feed rolls.

The bundle of continuous filaments was produced in a spinning machine or by assembling yarns from several spinning machines. The bundle of filaments was fed to the cutting machine in accordance with the set-up of the factory producing the staple fiber. According to one technique, the bundle of continuous filaments was fed directly from the spinning machine to the cutting machine. In another embodiment, the bundle of yarn was fed through a number of treating devices, for example, through a number of vats wherein the bundle, temporarily spread into sheet form and guided by rolls, was subjected to the action of various liquids. In still another procedure, the bundle of continuous filaments was fed to the cutting machine from intermediate windings or mass of filaments. Depending on the operations to be performed, the apparatus for producing, treating and cutting were operated either individually or in series.

The apparatus for producing, treating and cutting the bundle were individually controlled. In that embodiment, wherein the cutting machine was employed in combination with the treating machine, wherein the bundle of filaments temporarily spread into sheet form was fed through a number of treating baths before it was gripped by the feed rolls of the cutting machine, the treating machine and cutting machine were driven by separate motors. The separate motors were difficult to synchronize and, as a result, the portion of the bundle between the last guiding roll of the treating machine and the feed roll of the cutting machine varied in tension. The variations in tension were accentuated when motors of different characteristics were used for the various operations, for example, a D. C. motor for the treating machine and an A. C. motor for the cutting machine, were used.

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The variations in tension, due to speed variations, resulted either in a more or less slack or increased tension in the bundle. The decrease in tension was not very detrimental, although when the slack became such that the bundle trailed on the floor between the last treating vat and the cutting machine, the bundle was soiled. However, owing to the comparatively constant feed by the cutting machine, the length of the severed section was not affected. In the case of increased tensions, the rate of feed was reduced, with the result that slippage occurred and too short sections were obtained.

The presence of too short fibers in excessive quantity is considered an indication of poor quality, since better yarns are obtained when the lengths of the fibers are uniform.

Moreover, when the tension exceeded a certain value, the bundle broke and the machine had to be stopped.

To obviate the above defects, the cutting machine was provided with a hand wheel for regulating the speed of the feed rolls and the rotating knife carrier. In one form, the drive means for the feed rolls and knife carrier included an expansible pulley and the driving speed depended on the location of the pulley crown on the conical cage of the pulley. Variation in diameter of the pulley was obtained by means actuated by the hand wheel which changed the location of the crown on the cage, whereby the speed of the cutting machine was accelerated to take up the slack or slowed down to reduce the tension. However, this mode of regulation was unsatisfactory since it depended on the judgment of the operator. Generally, it resulted in a periodic supercompensation of the reduced tensions alternating with supertensions.

An object of this invention is to provide a cutting machine with an automatic device for controlling the speed of the feed rolls and the rotating knife carrier in accordance with the tension of the bundle to be cut.

Another object of this invention is to provide a feeler on the bundle of filaments being fed to the cutter and which, as a function of its position, depending on the tension in the bundle, will actuate means to increase or decrease the speeds of the feed rolls and the rotating knife carrier.

Other and additional objects of the invention will become apparent from the following description when considered in connection with the accompanying drawings, wherein:

Figure 1 is a schematic side elevation of an apparatus embodying the present invention;

Figure 2 is a front elevation of the expansible pulley and its control;

Fig. 3 is a section taken on the line 3—3 of Fig. 1 showing the pawl 36 engaged; and

Fig. 4 is a section taken on the line 4—4 of Fig. 1 showing the pawl 37 disengaged.

Referring now to the drawings wherein like reference numerals and characters designate like parts, the reference character A designates a bundle of filaments after it leaves the last guide roller of the last treating tank or other device preceding the cutting machine. The bundle A is fed by two pairs of feed rolls 1, 2, 3 and 4 in front of a fixed knife 5 and in the zone of action of movable knives 6, 6, 6, cooperating with the knife 5.

As shown in Figure 1, three knives 6 are arranged equidistantly, i. e. spaced 120° apart, on a knife holder 7 which is securely mounted on a shaft 50 driven from a shaft 9 by a chain 10 cooperating with a sprocket 52 on the shaft 50 and a sprocket 54 on the shaft 9. The shaft 9 is driven by an expansible grooved pulley 8 which, in turn, is driven from the shaft 55 of a motor 57 by a plurality of belts 59 cooperating with the grooves of the expansible pulley 8.

The feed rolls 1, 2, 3 and 4 are mounted on shafts 1', 2', 3' and 4' respectively and are driven from the shaft 9 as will now be described. By means of a chain 56 cooperating with a sprocket 58 on the shaft 50 and a sprocket 60 on the shaft 4', roll 4 is driven. By means of a chain 64 cooperating with a sprocket 66 on the shaft 4' and a sprocket 68 on the shaft 2', roll 2 is driven. By means of a chain 70 cooperating with a sprocket 72 on the shaft 2' and a sprocket 74 on the shaft 1', roll 1 is driven. If desired, roll 3, which is friction-driven by roll 4, can be positively driven as, for example, by a chain and sprocket arrangement similar to that utilized in driving roll 1 from roll 2.

The expansible pulley is of the well-known construction, having an expansible grooved pulley 8 and a conical cage 11. The expansion or contraction of the pulley is obtained by movement in the appropriate direction of a sleeve 12 slidably mounted on the shaft 9 and cooperating with the conical cage 11. In the form shown in Figure 2, the sleeve 12 is secured in a fork 13 at one end of a lever 14 which is pivotally mounted on a pin 15. The other end of the lever 14 terminates in a fork 16 which cooperates with a fixed spur 17 on a non-rotating nut screwed on the threaded portion of a shaft 19. It is apparent that, upon rotation of the shaft 19 in the appropriate direction, the size of the pulley 8 can be decreased or increased as desired, with the result that the speed of the shaft 9, and hence the speed of rotation of the knife carrier and feed rolls, will be varied accordingly.

An important feature of this invention resides in automatically controlling the movement of the shaft 19 in accordance with the variations in tension in the bundle of filaments A.

With the foregoing in view, a feeler 20 formed by a roller 21 carried in an arm 22 is supported on and by the bundle A after it has left the last guide rolls of the last treating tank (not shown) and before it is gripped by the feed rolls 1 and 2. The supporting arm 22 of the feeler 20 is pivotally mounted on one end of a lever 23 which oscillates about a pivot 24. Intermediate the feeler 20 and the pivot 24, the lever 23 is provided with two ears 25 which are connected to one end of a transmitting rod 26, the length of

which can be adjusted by a turn-buckle 80. The other end of the rod 26 is connected by a pivot 27 to an oscillating plate 28 rotatably (freely) mounted on a shaft 29 on which two ratchet wheels 30 and 31, having their teeth in opposite directions, are secured.

By means of a chain 110 and a sprocket 112 on the shaft 29 and a sprocket 114 on the shaft 19, the rotary motion of the shaft 29 is transmitted to the shaft 19 whereby, in accordance with the direction of rotation of the shaft 29, the expansible pulley will be expanded or contracted and the speed of rotation of the knife carrier and the feed rolls will be varied accordingly. An adjustable idler sprocket 118 can be utilized to adjust the tension in the chain 110.

The plate 28 is formed with two circular sectors 32 and 33 which are concentric with the shaft 29. The circular sector 32 is provided with a projecting cam 34, and the circular sector 33 is provided with a cam 35. A pawl 36 is adapted to cooperate with the ratchet wheel 30, and a pawl 37 is adapted to cooperate with the ratchet wheel 31. The pawl 36 is pivotally mounted on a pivot 84 on a lever 40. The pawl 37 is pivotally mounted on a pivot 86 on the lever 40. A separate spring 39 cooperates with each of the pawls 36 and 37 and urges them continuously into contact with their respective ratchet wheels. The pawl 36 is provided with a cam follower 88 adapted to cooperate with the cam 34, and the pawl 37 is provided with a cam follower 90 which is adapted to cooperate with the cam 35. According to the position of the plate 28, which depends on the position of the feeler 20, one or the other of the cams 34 and 35 will engage the respective cam follower whereby the pawl carrying such follower will be disengaged from its ratchet wheel while the other pawl will be in engagement with its respective ratchet wheel.

The pawls 36 and 37, as previously mentioned, are pivotally mounted on the lever 40 which oscillates on the shaft 29 and which receives its oscillatory movement from a cam follower 41 disposed in an eccentric cam groove 42 of a disc 43 keyed on an auxiliary shaft 44 of the machine. Preferably, the shaft 44 is driven from shaft 9 in any suitable manner, as, for example, by means of a chain 100, a sprocket 102 on the shaft 44, and a sprocket 104 on the shaft 9.

From the foregoing, it is apparent that the position of the plate 28 is dependent on the movement of the feeler 20 which, in turn, is a function of the tension in the bundle A. In the event the two pawls 36 and 37 mesh simultaneously with the respective ratchet wheels 30 and 31, the lever 40 would transmit its oscillating motion to such ratchet wheels. However, as one of the pawls is disengaged from the ratchet wheel by the cooperation of the respective cam and cam follower, the other ratchet wheel, which will be engaged by the respective pawl, will be rotated and such rotary movement transmitted to the shaft 29 which will, in turn, transmit it to shaft 19 to vary the diameter of the expansible pulley. Thereafter, a number of impulses, all in the same direction, will be transmitted to the ratchet wheel through the pawl engaging therewith, and this will continue until the feeler 20 through the connecting rod 26 has started rotating the plate 28 in the opposite direction. At that time, the cam of the sector, which was in operative position, elevates the pawl to inoperative position, and the other cam is positioned so as to permit the other ratchet wheel to be en-

gaged by its respective pawl, whereby it receives a number of impulses in the direction opposite to that previously described.

It is obvious that the specific embodiment hereinbefore described is in no way limitative of the invention since the specific details thereof can be varied. For example, the invention is not restricted to any particular construction of feeler and any type of feeler can be used. The feeler can be of the dynamometric type or it can be of an electric type, such as a photoelectric mechanism. In order to limit the displacement of the conical cage 11 in both directions, switches may be disposed in the path of travel beyond the desired limits so that, when the pulley engages the same, the circuit to the motor will be opened, thereby avoiding damage to said pulley.

Though the invention has been described as applied to cutting machines for producing staple, it can also be applied to centrifugal or guillotine machines or machines with cutting rollers and the like.

The invention provides an apparatus wherein uniform size staple is obtained by controlling the rate of feed and the rate of cutting in accordance with the tension of the bundle of filament to be cut.

Since it is obvious that various changes and modifications may be made in the above description without departing from the nature or spirit thereof, this invention is not restricted thereto except as set forth in the appended claims.

We claim:

1. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive said feed rolls and said carrier, and means responsive to changes in tension on the filaments before said filaments are gripped by the feed rolls to control said transmission to vary the speed of rotation of said feed rolls and said knife carrier in a sense to maintain constant tension on the filaments.

2. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filament fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive said feed rolls and said carrier, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, and means actuated in response to changes in position of said feeler to control said transmission to vary the speed of rotation of said feed rolls and said knife carrier in a sense to maintain said tension constant.

3. An apparatus for cutting continuous fila-

ments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, a rotating expansible pulley, a shaft driven by said pulley, means to rotate said feed rolls and knife carrier from said shaft at a constant relative speed ratio, means to vary the diameter of said pulley, and means responsive to changes in tension on the filaments before they are gripped by said feed rolls to actuate said last means in a sense to maintain a constant tension on the filaments.

4. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls positioned and adapted to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley to effect gradual changes in the drive ratio connected to drive said feed rolls and said carrier, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, means to vary the diameter of said expansible pulley, and means responsive to changes in position of said feeler to actuate said last means in a sense to maintain said tension constant.

5. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley to effect gradual changes in the drive ratio connected to drive said feed rolls and said carrier, means to vary the diameter of said pulley, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, a shaft connected to actuate said last means, and means responsive to the changes in position of said feeler to actuate said shaft in a direction to maintain said tension constant.

6. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive

said knife carrier and feed rolls, means to vary the diameter of said pulley, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, a shaft, means connecting said shaft in cooperative relationship with the means to vary the diameter of said expansible pulley whereby upon actuation of said shaft the diameter of said pulley will be varied, a pair of ratchet wheels on said shaft, one of said ratchet wheels being adapted to rotate said shaft in one direction and the other in the opposite direction, a separate pawl adapted to cooperate with each of said ratchet wheels respectively, and means actuated in response to the position of said feeler to cause one of said pawls to engage its respective ratchet and actuate said shaft.

7. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive said knife carrier and feed rolls, means to vary the diameter of said pulley, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, a shaft, means connecting said shaft in cooperative relationship with the means to vary the diameter of said expansible pulley whereby upon actuation of said shaft the diameter of said pulley will be varied, a pair of ratchet wheels on said shaft, one of said ratchet wheels being adapted to rotate said shaft in one direction and the other in the opposite direction, an oscillating lever, a separate pawl adapted to cooperate with each of said ratchet wheels respectively carried by said oscillating lever, and means actuated in response to the position of said feeler to cause one of said pawls to engage its respective ratchet and actuate said shaft.

8. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive said knife carrier and feed rolls, means to vary the diameter of said pulley, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, a shaft, means connecting said shaft in cooperative relationship with the means

to vary the diameter of said expansible pulley whereby upon actuation of said shaft the diameter of said pulley will be varied, a pair of ratchet wheels on said shaft, one of said ratchet wheels being adapted to rotate said shaft in one direction and the other in the opposite direction, an oscillating lever, a separate pawl adapted to cooperate with each of said ratchet wheels respectively carried by said oscillating lever, and means actuated in response to the position of said feeler to cause one of said pawls to engage its respective ratchet and actuate said shaft, said means preventing the other pawl from engaging its ratchet wheel.

9. An apparatus for cutting continuous filaments into staple fiber, which comprises a fixed knife, a rotatable knife carrier, a plurality of knives carried by and arranged equidistantly on said carrier, each of said knives on said carrier being adapted to cooperate successively with said fixed knife to sever the filaments fed therebetween, feed rolls to feed the continuous filaments into the zone of action of said knives, means connecting said feed rolls and said knife carrier for rotation in unison at a constant relative speed ratio, a variable speed transmission including an expansible pulley connected to drive said knife carrier and feed rolls, means to vary the diameter of said pulley, a feeler supported on said filaments before said filaments are gripped by said feed rolls and adapted to change its position in accordance with changes in tension on said filaments, a shaft, means connecting said shaft in cooperative relationship with the means to vary the diameter of said expansible pulley whereby upon actuation of said shaft the diameter of said pulley will be varied, a pair of ratchet wheels on said shaft, one of said ratchet wheels being adapted to rotate said shaft in one direction and the other in the opposite direction, an oscillating lever, a separate pawl cooperating with each of said ratchet wheels respectively, each of said pawls being provided with a cam follower, a plate rotatably mounted on said shaft, a pair of cams on said plate, each of said cams being adapted to cooperate with one of said cam followers whereby the respective pawl is rendered inoperative with respect to its respective ratchet wheel, and means actuated in response to the position of said feeler to rotate said plate whereby one of said pawls will be in operative position relative to its respective ratchet wheel while the other pawl will be disposed in inoperative position.

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