

June 15, 1965

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3,189,288

APPARATUS FOR WINDING STRAND MATERIAL

Filed Sept. 18, 1962

3 Sheets-Sheet 1

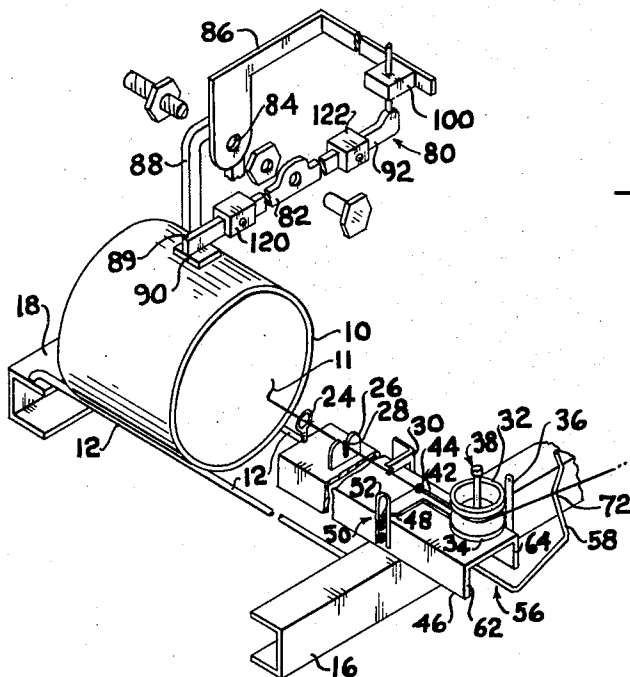


Fig. 1.

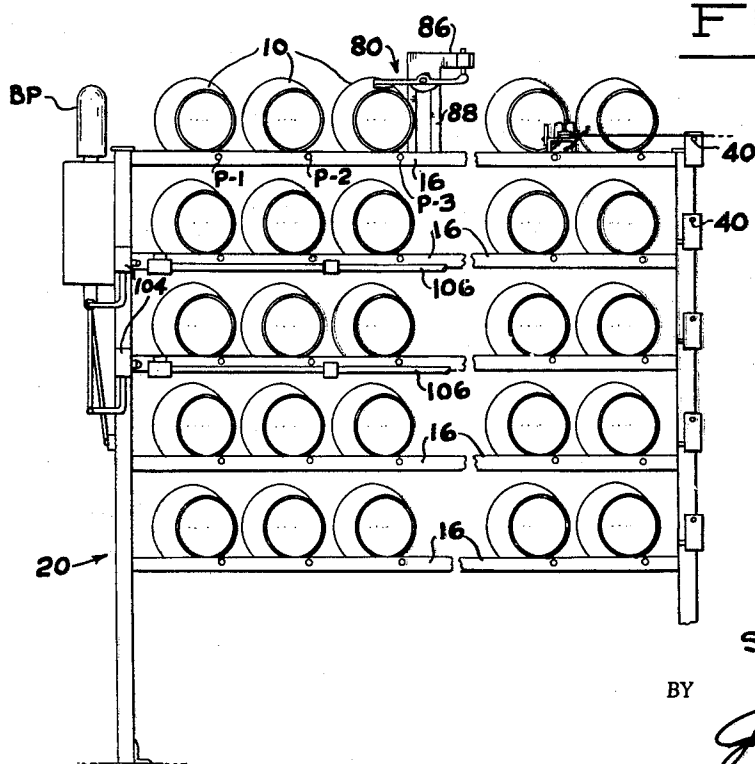


Fig. 2.

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Fig. 3.

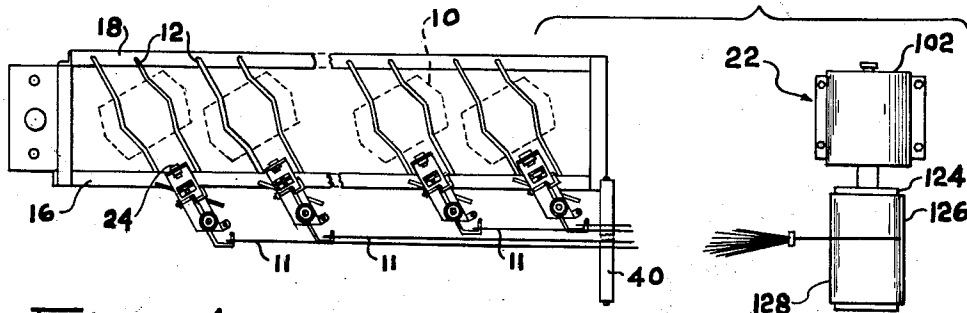


Fig. 4.

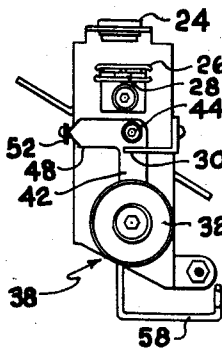


Fig. 5.

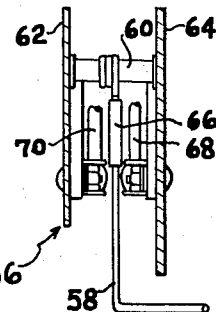
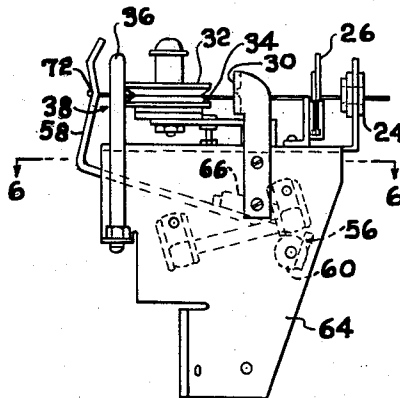


Fig. 6.

Fig. 8.

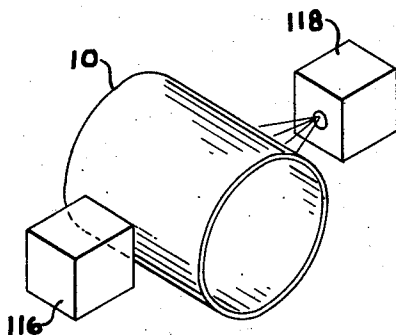
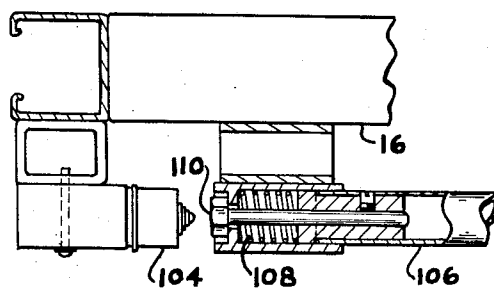


Fig. 10.

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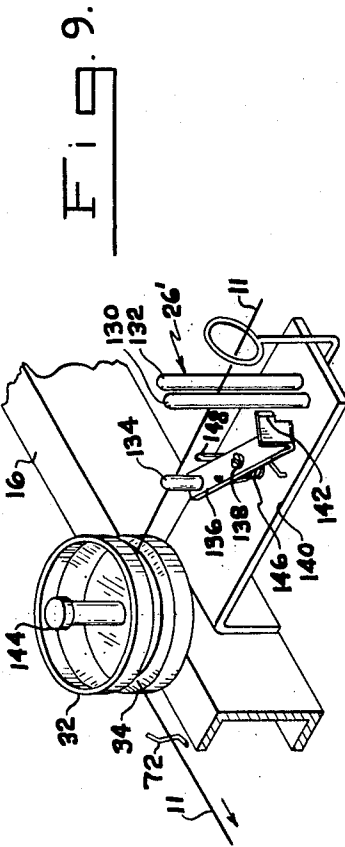
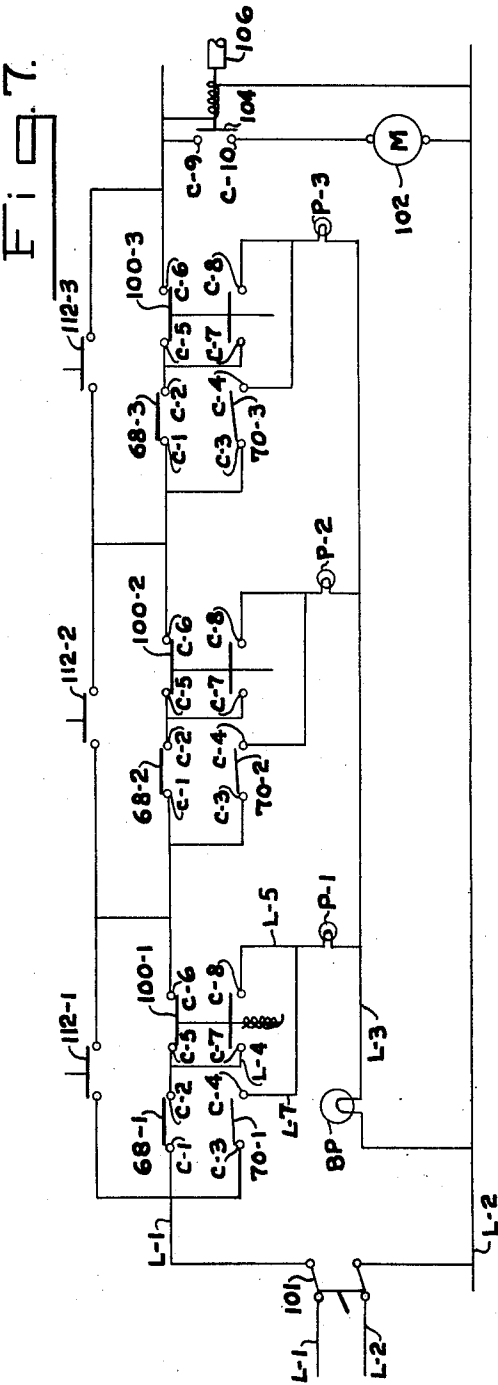
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3 Sheets-Sheet 3



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APPARATUS FOR WINDING STRAND MATERIAL
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11 Claims. (Cl. 242—37)

This invention relates to strand winding apparatus and particularly to the production of wound packages wherein a strand is wound from a primary package onto a secondary package. More particularly this invention relates to the production of roving packages having no lost ends.

A roving as defined in the glass fiber art comprises a plurality of untwisted continuous glass strands, each containing a multiplicity of continuous glass fibers, wherein the strands are arranged in parallel contacting relation as a single large strand.

In the glass fiber industry there is frequently need to wind off definite predetermined yardage from primary packages of strand to form rovings or secondary packages of predetermined lengths and having no loose or lost ends. A lost end may occur whenever a strand being wound is broken and is carried into the secondary package being formed by other strands or when a primary package is run out or exhausted before the secondary package is completed and the end is carried into the secondary package before being detected by the winding operator. It is with these difficulties that this invention is primarily concerned and which it seeks to obviate. A lost end requires considerable time on the part of the operator to find and remove, and if not detected and removed will reduce the quality of the secondary package. Such included lost ends may also interfere with or disrupt subsequent production operations.

End breakage detectors have been previously in use to give an indication of a broken strand and to signal and stop the winding operation of winding creels. Such detectors are positioned along the advancing path intermediate the primary package, or source of strand, and the secondary package, the package being formed. Such devices do not detect the impending collapse of the primary package, due to exhaustion of the strand. More likely than not, the remaining strand in the package becomes entangled and forms a "gob" which is purposely entrapped in a "gob" stop. The entanglement is also created when the remaining mass in the package fails to overcome the force of the remaining strand and hence is carried with the strand before all of the convolutions are unwound. "Gob" stops are usually specifically provided to prevent entangled or increased masses of fibers from being carried into the package being formed. Consequently, increased tension is developed in the entrapped strand and the strand usually breaks at random points along the advancing path and is carried into the secondary package before the winder is stopped. Frequently, the increased tension causes a "snap-back" action in the strand and a loop is formed in the broken strand and wound into the secondary package. In the event of either a lost end or a looped end, the secondary package loses commercial value.

It is an object of this invention to provide method and apparatus for producing rewind strand packages of uniform quality. It is another object to provide method and apparatus for rewinding strand material without the

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attendant disadvantages referred to above. It is a further object to provide method and apparatus for winding roving packages having no intermediate or "lost" ends. It is a still further object to provide method and apparatus for cutting a strand being wound at a preferred location when the strand is subjected to tension exceeding a preselected value.

Lost ends occur frequently when an exhausted forming tube package is nearly exhausted and the remaining strand is pulled into the "gob" stop. The entangled mass cannot pass through the "gob" stop and consequently the strand tension increases until the strand breaks somewhere intermediate the "gob" stop and the winder.

Generally speaking, I have found that the above objectives may be attained by the provision of anticipator means which will anticipate the exhaustion of a primary strand package, by the provision of cutting means adjacent to the "gob" stop means to cut the running strand when the strand tension increases beyond a preselected limit, and by the provision of control means, operatively associated with the anticipator means and with the cutting means, which stop the winding operation to permit the attending operator to splice the broken or exhausted strand and restart the winding operation.

A preferred embodiment of my apparatus is adapted to operate in conjunction with electrically driven winding equipment. In accordance with the preferred embodiment of the invention, the pending exhaustion of a primary strand package is anticipated by detection means such as a cantilevered arm member which normally rests upon the package. When the package nears exhaustion, a point is reached when the remaining convolutions in the primary package can no longer support the arm member. Hence the arm member falls as the primary package collapses. The movement of the arm member causes a corresponding electrical switch, operatively connected to the electrical motive means driving the secondary strand package winder, to be de-energized and consequently stop the winding operation. If for any reason, such as a "gob" becoming entrapped in a "gob" stop, tension builds up in a running strand, severing means are provided to automatically cut the strand at a preferred location and automatically stop the winding operation before the loose end becomes entangled with other strands of the package being formed or before the loose end can become wound into the package. Additionally, visible or other indicia, such as pilot signal lights, may be incorporated into the system so that the operator does not have to spend considerable time in searching for a broken strand or a collapsed package. After the operator splices the broken or cut strand or the end of the collapsed package unto a new primary package and places the new package beneath the cantilevered arm in the position occupied by the previous primary package, the winding operation may automatically continue. Optionally, a restart circuit, including a restart switch, may be provided to delay continuation of the winding operation until the restart switch is actuated.

Further objects and advantages of this invention may appear from the following description of preferred species thereof and from the accompanying drawings.

FIG. 1 is an isometric view, partially "exploded" disclosing the details of the detection means and severing means of this invention, shown in connection with a single strand package;

FIG. 2 is a front elevational view of a bank of strand packages being unwound, of detection means at one of the package stations, and of severing means at one of the package stations (the detection means and the severing means at the other package stations have been omitted);

FIG. 3 is a plan view of the bank of strand shown in FIG. 2 but in connection with the severing means and the winding section (the detection means have been omitted);

FIG. 4 is an enlarged plan view of the severing means, tension means and stop motion means;

FIG. 5 is a side elevational view of the apparatus shown in FIG. 4;

FIG. 6 is a cross-sectional plan view taken along lines 6—6 of FIG. 5 illustrating in more detail the stop motion means;

FIG. 7 is a diagram of an electrical circuit that may be employed in connection with the apparatus of this invention;

FIG. 8 is an enlarged cross-sectional view of one end of the push rod switch actuating means;

FIG. 9 is an isometric view of alternate severing tension means; and

FIG. 10 is an isometric view of alternate package sensing means.

Referring to FIG. 1, a primary strand package 10 is suitably supported by the tie-rods 12 extending between support members 16 and 18 forming a part of rack 20, shown in FIG. 2. Rack 20 supports a bank of primary strand packages 10 and forms the strand supply section for providing strand material to the winding section 22, shown in FIG. 3. The strand winding section 22 includes a power source such as motor 102 carrying arbor 124 upon which is mounted, for rotation therewith, winding tube 126. Winding tube 126 forms the core for the secondary package 128 being newly formed. Although only one motor 102, arbor 124 and tube 126 are shown, it is to be understood that sufficient tubes 126, arbors 124 and cooperating driving means may be provided to correspond in number to the number of strand packages desired to be formed.

Associated with each package 10 is a guide eye 24 suitably secured to support member 16 and adapted to receive the strand 11 extending from the interior of package 10. From the guide eye 24 the strand 11 is advanced through stop 26. Stop 26 is provided with an aperture 28 of preferred size, through which strand 11 is threaded, to preclude entangled masses or strand of undesirable diameter from passing unto the winding section 22. The strand 11 is then normally directed adjacent to, but out of contact with, knife 30 forming severing means the operation of which will be described hereinafter. The strand 11 is then passed between tension discs 32 and 34 and in contact with stop 36 of tension device 38 for advancement under uniform and constant tension over guide rod 40 to winding section 22. The degree of desired tension exerted by the advancing strand 11 may be controlled by adjusting the friction between discs 32 and 34. Control of the strand tension is necessary to compensate for the varying tension "build-in" the primary package 10 when it was wound and for that occasioned by the constantly changing relative distance between the guide eye 24 and the point where the strand 11 leaves package 10. The advancement of strand 11 under controlled tension also serves to actuate certain mechanisms as will now be explained.

The tension discs 32 and 34 are mounted on bracket 42 pivotally secured at 44 to base 46 and normally held in fixed position through engagement of arm portion 48 with lock means 50 shown to be in the form of bent rod 52. When the tension in the running strand exceeds the frictional force between arm 48 and lock means 50, bracket 42 will pivot in a counterclockwise direction and permits strand 11 to come into engagement with knife 30 and thus be severed. Severing of the strand 11

at a point most remote from the winding section 22 provides sufficient time for the winder to be stopped before the strand end is carried into the package. Without such cutting means as knife 30, upon strand tension build-up the strand 11 would break at random locations, probably at the weakest strand point. More likely than not, the strand would break close to the winding section and would be carried into the package.

It will be apparent that the combination of the tension device 38 and knife 30 define severing means responsive to the tension of the strand 11 to sever the strand 11 when the preselected and preferred degree of tension is exceeded.

In conjunction with each package 10 is a stop motion device 56 (FIG. 6) which detects the breakage or exhaustion of the running strand 11 and accordingly controls, through a suitable circuit, the rotation of the winder motor 102. A feeler member 58 of wire is attached to pivot member 60 supported between legs 62 and 64 of base 46. A bar of magnetic material forming a switch actuator 66 is secured to feeler 58 adjacent to switches 68 and 70 which are shown to be of the magnetic reed type and affixed to legs 62 and 64, respectively.

Preliminary to the winding operation, the strand 11 is threaded from tension device 38 into engagement with feeler 58 at notched portion 72 to hold feeler 58 in an upper position indicated by the solid lines shown in FIG. 6. When feeler 58 is in the upper position, switch 68 is actuated to close the winding circuit, in a manner to be described hereinafter in more detail. At the same time the switch 70 is de-energized to open the pilot light circuit. Conversely, when feeler 58 is in a lower position, switch 68 is de-energized to open the winding circuit and switch 70 is energized to close the pilot light circuit. The winding circuit is maintained effective so long as all of the strands 11 leading to the winder remain continuous, i.e., maintain the feeler 58 in the upper position, but becomes ineffective upon breakage of one of the strands or upon actuation by the run-out anticipating mechanism 80, hereinafter described.

After a strand 11 is severed because of built-up tension, as previously described, the severed strand will no longer support feeler 58 in an upper position and consequently the winder circuit will be opened and motor 102 stopped.

The run-out anticipating or sensing mechanism 80 illustrated in FIG. 1 comprises arm element 82 pivotally mounted at 84 and together with bracket 86 is secured to suitable support means as bar 88 which in turn may be fastened to element 18. Mechanism 80 is positioned so that one end 89 of arm element 82 is in contact with primary package 10 placed on the tie-rods 16 and 18. End 89 is preferably provided with a pad 90 to form an extended surface for contact with package 10. The opposite end 92 is positioned to actuate electrical switch 100 upon rotational movement of arm 82. The actuation of the switch 100 and subsequent operation will hereinafter be described in more detail.

As the package 10 is progressively unwound, a point is reached where insufficient convolutions of strand remain to support arm 82 and hence the package 10 collapses. Counterpoises 120 and 122 may be provided on opposite sides of pivot 84 for selectively adjusting the rotational force of arm 82 to cause it to collapse the package 10 when a preselected number of convolutions remain in the package 10. As the package 10 collapses, arm 82 rotates to de-energize the winding circuit and stop the winding operation at the particular winding station involved. As the arm 82 rotates to de-energize the driving means, it can be arranged to energize the pilot light circuit so that the operator can immediately detect which primary package 10 is collapsed when a plurality are being simultaneously unwound.

By referring to the electrical circuit diagram of FIG. 7, the operation of the stop motion device 56 and the sens-

ing mechanism 80 can be better described. Power is supplied to the circuit through supply lines L-1 and L-2 and extending from main switch 101. One lead line L-2 extends to winder motor 102. While the other lead line L-1 also extends to motor 102 and is connected in series with each of the switches 100 of the stop-motion devices 56 and with the switches 68 of each of sensing mechanisms 80, corresponding to each of the primary packages 10 being wound on the mandrel 128. For purposes of illustration, switches corresponding to three package positions have been shown. However, it will be apparent that any number, preferably the number corresponding to the package positions feeding to a winder, may be included so long as they are connected in series. (Like numerals have been assigned to corresponding switches in each position. The suffixes indicate the package position.)

In the event of collapse of a primary package 10, the winding circuit will be opened because of the rotation of the corresponding arm 82 breaking the continuity of the circuit between contacts C-5 and C-6 of switch 100. Thus the winding operation will be stopped until restarted by the attendant operator.

Concurrently with the opening of contacts C-5 and C-6 of switch 100, contacts C-7 and C-8 are closed and current flows through pilot light circuit L-1, L-4, L-5, L-3 and L-2, to light package pilot light indicator P and bank pilot light BP. Bank pilot light BP is provided so that the operator may immediately know in which bank 20 of packages the faulty package position, as indicated by package pilot light P, is located. It will be apparent that pilot lights indicating the row in which a faulty package position is located may also be incorporated into the circuit but have not been shown in order to simplify the circuit diagram.

A restart switch 104 of the relay type may be provided to prevent restarting of the winding circuit until activated by the operator. Upon opening of any of the switches 68 or 100 the circuit to the coil of switch will be de-energized and cause contacts C-9 and C-10 to be opened. The motor 102 will not start until the operator closes contacts C-9 and C-10 by manually actuating switch 104. A push-rod 106 is slidably mounted along the row of packages 10 to facilitate the manual restart of switch 104. The details of the mounting and end construction of the push-rod 106 may be seen in FIG. 8. A spring 108 is provided to automatically return the head 110 of push-rod 106 away from switch 104.

Alternatively, the switch 104 may be omitted. In such event the winding circuit will be automatically re-energized when the operator places a new primary package beneath the arm end 89 corresponding to the position of the exhausted or collapsed package 10. Also, a bypass switch 112 may be provided to circumvent switches 68 and 100 for whatever reason, for example when it is desired to wind from less packages 10 than there are package positions on a rack 20.

In the event the tension in any of the strands 11 is sub-standard, such as when it is severed for reasons previously described and feeler 58 carrying switch actuator 66 is dropped to the lower position, switch 68 is opened and switch 70 is closed. The opening of switch 68, and consequently contacts C-1 and C-2, causes the current to be cut off from motor 102. The closing of switch 70 causes the current to flow through pilot light circuit L-1, L-6, contacts C-3 and C-4, L-7, L-3, L-2 to light P and BP.

Concurrently with the opening of contacts C-1 and C-2 of switch 68, the contacts C-9 and C-10 of restart switch 106 will be opened. After the operator splices the end of an exhausted package 10 or of a severed strand 11 to a new forming package and feeler 58 is raised to the upper position, the winding circuit may be closed by actuating restart switch 104 in the manner above described.

While the signal and driving circuits have been dis-

closed in FIG. 7 as being operated from the same power lines L-1 and L-2, it will be understood that a separate low-voltage signal circuit may be incorporated to operate with the normal voltage driving circuit.

In FIG. 1 is also illustrated means for vertically adjusting the pivot support 84 for arm 82 to accommodate package diameters that may differ from one production run to another. The bracket 86 is vertically adjustable in order to preserve the proper relation between the switch 100 and the actuating arm. Additionally, holding means (not shown) such as a magnet or spring clip, may be provided to hold arm 82 during the package re-loading procedure.

FIG. 9 illustrates alternate severing means for cutting the strand 11 when the strand is subjected to increased tension. The "gob" stop 26¹ therein shown comprises a pair of spaced apart posts 130 and 132. The strand 11 is threaded through guide eye 24 and between the posts 130 and 132 into frictional engagement with post 134 movably carried by arm 136 pivotably mounted at 138 on base 140. At the end of arm 136 opposite to post 134, arm 136 carries knife edge 142. Also mounted on base 140 through post 144 are tension discs 32 and 34. The discs 32 and 34 are free to rotate about post 144 and to spread apart from each other, otherwise they are fixedly secured. In this embodiment, when the strand tension force is sufficient to overcome the force of return spring 146 holding arm 136 against stop 148, knife edge 142 is pivoted about 138 into engagement with strand 11 and consequently severs the strand at a point adjacent to gob stop 26¹.

FIG. 10 illustrates alternate means for detecting or anticipating the run-out of a primary package and accordingly stopping the winding operation so that a new package may be spliced to the nearly exhausted package. An electronic scanner comprising a light transmitter 118 and a receiver 116, is provided to measure, detect or sense the light transmission through the primary package. When the light transmission, as sensed by the receiver 116, receives a predetermined high level the receiver signals and opens the winding circuit to stop the winding operation and concurrently signals and closes the pilot light circuit to turn on the corresponding indicator light.

It will be apparent that the instant invention overcomes the difficulties noted and accomplishes the stated objects. When the winding of secondary strand packages is conducted by the method and apparatus described, the possibility of "lost end" packages is minimized. Furthermore, considerable production time and effort is saved by virtue of the automatic controls and signals. The production of packages with no "lost ends" also saves valuable time and effort in subsequent operations.

Although the method and apparatus have been described in detail as to their component steps and parts, it will be understood that such detail is for the purpose of illustration and not by way of limitation. The appended claims are therefore intended to cover any such modifications coming within the true scope of the invention.

What I claim:

1. Apparatus for winding strand material comprising: a source of strand wound in a package; powered strand winding mechanism, including an electrical motor, advancing said strand from said source; detection means for detecting the pending exhaustion of the strand package; feeler means positioned to engage said strand in its path of travel; severing means responsive to the tension of said strand to sever said strand when the tension exceeds a predetermined value and thus free said feeler means from tension of said strand; and electrical circuit means for controlling the operation of said winding mechanism, said circuit means including a normally closed circuit portion for controlling the rotation of said motor, means responsive to the actuation of said feeler means to open said normally closed circuit portion when free from ten-

sion of said strand, and detection responsive means responsive to the actuation of said detection means to open said normally closed circuit when the number of convolutions remaining in said package have been reduced below a preselected number.

2. Apparatus as described in claim 1 wherein said detection means comprises a cantilevered and rotatable arm having an end thereof in contact with said package, said arm being held against rotational movement by the package when the number of convolutions remaining in the package are in excess of a preselected number representing the pending exhaustion of said package, and said end being of sufficient weight to rotate said arm and collapse said package when the number of convolutions remaining in said package fall below the preselected number representing the pending exhaustion of said package, and wherein said detection responsive means comprises switch means responsive to the rotation of said arm end to open said normally closed circuit portion.

3. Apparatus as described in claim 2 which further comprises pilot light circuit means, including a pilot light, actuated by the rotational movement of said arm and being adapted, to close said pilot light circuit upon collapse of said package.

4. Apparatus as described in claim 1 wherein said detection means comprises an electronic scanner including a transmitter for transmitting a source of light through said package and a receiver for receiving the light as transmitted through said package and for sensing the intensity of said light, said receiver being adapted to transmit a signal to said electrical circuit means to open said circuit when the intensity of light as measured by said receiver reaches a preselected maximum value.

5. Apparatus as described in claim 1 wherein said severing means comprises a tension device pivotably mounted on an arm, and a knife edge mounted in a relatively fixed position, normally adjacent to but out of contact with the strand in its path of travel, said tension device being adapted to frictionally engage said strand along its path of travel and to hold said strand out of engagement with said knife edge until such time the tensional forces in said strand exceed a preselected value, upon exceeding the preselected value the tension device is adapted to pivot and to carry the strand into engagement with the knife edge and consequently sever the strand.

6. Apparatus as described in claim 5 which further comprises pilot light circuit means including a pilot light, and wherein said feeler means closes said pilot light circuit when free from tension of said strand.

7. Apparatus as described in claim 1 wherein said severing means comprises a pivotal arm carrying a knife edge at one end thereof and a post for engagement with the strand at the other end thereof, said arm being adapted to pivot when the tension in said strand exceeds a predetermined value and thereby swing said knife edge into engagement with said strand.

8. Apparatus for winding strand material comprising: a source of strand in wound package form; means external of and for supplying said package in a manner whereby the strand may be unwound from the interior of said package while maintaining the outside diameter substantially constant; powered strand winding mechanism, including an electrical motor, for advancing said strand from the interior of a strand package; detection means revealing a presence of said package; an electrical circuit means for controlling the operation of said winding mechanism, said circuit means including a normally closed circuit portion for controlling the rotation of said motor, detection responsive means responsive to the actuation of said detection means, said detection responsive means opening said normally closed circuit portion when the number of convolutions remaining in said package have been reduced below a preselected number representing the pending exhaustion of said package.

9. Apparatus for winding strand material comprising: a source of strand in the form of a wound primary package; powered strand winding mechanism including a rotatable arbor, a strand receiving spool mounted on said arbor, and driving means, including an electrical motor, for rotating said arbor and thereby advance said strand from said package to said spool; detection means detecting the presence of a wound package at a package position, said detection means being adapted to initiate a signal when the number of convolutions remaining in said package have been reduced below a preselected number representing the pending exhaustion of said package; a feeler member being rotatable about an axis and positioned to engage said strand in its path of travel, said feeler member being rotatable in a first direction by the tension of said strand and in a direction counter to said first direction when free from tension of said strand; severing means responsive to the tension of said strand to sever said strand when the tension exceeds a predetermined value and thus free said feeler member from tension of said strand; electrical circuit means for controlling the operation of said winding mechanism, said circuit means including a normally closed circuit portion for controlling the rotation of said motor; pilot light circuit means including a pilot light; means for opening said normally closed circuit portion and closing said pilot light circuit when the number of convolutions remaining in said package have been reduced below said predetermined number; and means in said circuits responsive to the actuation of said feeler means for opening said normally closed circuit portion and closing said pilot light circuit when said feeler means is free from tension of said strands.

10. The method of rewinding a strand, from a primary package of strand wound in convolutions into a secondary package, which comprises: advancing the strand from the interior of the primary package along a path and with a preferred degree of tension, while maintaining the outside diameter of said primary package substantially constant; sensing the presence of said strand along said path and the degree of tension with which said strand is being advanced; automatically severing said strand at a position closer to said primary package than to said secondary package whenever the strand tension along said package exceeds the preferred degree of tension, and stopping the advancement of said strand upon the severance thereof; and detecting the presence of said primary package and the pending exhaustion of said primary package as represented by a preselected number of convolutions remaining in the package, and automatically stopping the advancement of said strand when said preselected number of convolutions are remaining in the primary package.

11. The method of rewinding a strand, from a primary package of strand wound in convolutions into a secondary package, which comprises: advancing the strand from the interior of the primary package along a path and with a preferred degree of tension, while maintaining the outside diameter of said primary package substantially constant; automatically severing said strand at a position closer to said primary package than to said secondary package whenever the strand tension along said path exceeds the preferred degree of tension, and stopping the advancement of said strand upon the severance thereof; and detecting the presence of said primary package and the pending exhaustion of said primary package as represented by a preselected number of convolutions remaining in the package, and automatically stopping the advancement of said strand when said preselected number of convolutions are remaining in the primary package.

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