Apparatus for cutting and clamping a strand of yarn. Means are included for sensing when a moving strand of yarn becomes excessively slack or breaks. Upon sensing a slack or broken strand, an electromagnet is energized to unlatch a spring loaded barrel member having a cutting edge at one end. The spring axially moves the unlatched barrel so that the cutting edge cuts the strand against a cutting anvil. A clamping surface adjacent the cutting edge clamps the severed end of the strand against an elastomeric pad adjacent the anvil.

The mechanism for latching the barrel in a retracted position and for unlatching the barrel includes ball detents within apertures in the wall of the barrel. An axially translatable stem within the barrel has two portions of different diameters. One portion of the stem urges the ball detents outwardly into a recess in the housing to lock or latch the barrel in a retracted position and the other portion of the stem is of smaller diameter to permit the ball detents to be urged inwardly to disengage from the recess to unlatch the barrel.

10 Claims, 4 Drawing Figures
THREAD CUTTING AND CLAMPING MEANS

This invention relates to a yarn cutting and clamping mechanism which may be employed in yarn or thread manufacturing and/or processing, and in textile mills where yarn and thread is worked into cloth and material. The invention also includes novel means for controlling the operation of one or more such mechanisms.

In the manufacture and processing of threads and yarn and in the weaving of cloth, long substantially continuous lengths or strands of thread or yarn are handled and processed by passing the strands at high speed through various handling and/or treating apparatus. Often many strands move in close proximity to each other and should one or more strands break, loose ends may become entwined with adjacent moving strands with the result that considerable time and production are lost before the malfunction is corrected. To avoid problems of this nature apparatus has been developed to detect when a strand has broken or when excessive slack occurs therein and to cut and hold the strand at a given location. In other instances it is desirable that all of many strands be cut simultaneously and the ends be held at respective given locations.

The present invention is an electromechanical thread or yarn cutting and clamping mechanism which is relatively simple in construction, is positive in its operation, and involves simple electrical circuitry which utilizes an electromagnet only to unlatch a mechanism which is in a set condition. The mechanism utilizes energy stored in a spring to provide the cutting and clamping force, thereby permitting the use of a relatively small electromagnet. The present invention also includes means for simultaneously operating a plurality of cutting and clamping mechanisms upon command from a remote location. This latter operation may be performed independently of the conditions of the strands of thread.

In the drawings:

FIGS. 1 and 2 are sectional views showing the essential features of the mechanism of this invention in, respectively, its set or latched condition and in its unlatched or extended condition; and

FIG. 1a is a sectional view of the latching mechanism of this invention; and

FIG. 3 is a simplified wiring diagram used in explaining the electrical connection and operation of one and of a plurality of the mechanisms illustrated in FIGS. 1 and 2.

Referring in detail to FIGS. 1 and 2, a strand 10 of yarn, thread, or the like, is received within guides 11 and 12 in respective side walls of a substantially hollow or box-like housing 14. Guides 11 and 12 are open at the top surface of housing 14 so that strand 10 may be easily inserted therein so as to span the inner region of the housing. Housing 14 may be formed from molded plastic members. A cutting anvil 16 having a hardened surface 17 is secured to the left end wall of housing 14. Also disposed at the left end of housing 14 is a pad 20 of elastomeric material such as rubber or a plastic. As illustrated, pad 20 may be secured by an adhesive to surface 17 of anvil 16.

On the right side of strand 10 housing 14 is formed with a cylindrical slideaway 22 which is adapted to receive a hollow barrel 24 that is translatable through slideaway 22 toward and away from anvil 16. A setting or latching handle 25, FIG. 1a, is secured to barrel 24 and extends outwardly through an elongated slot 13 in housing 12. The left end of barrel 24 is provided with a cutting edge 26 and with a clamping surface 27 which is set back from cutting edge 26. As will be explained in detail below, upon actuation of the mechanism of this invention, barrel 24 slides to the left within slideaway 22, see FIG. 2, and cutting edge 26 strikes hardened surface 17 of cutting anvil 16, thereby cutting strand 10. Additionally, clamping surface 27 holds a severed end of strand 10 against elastomeric pad 20, thereby clamping that end of the strand in fixed position.

The means for maintaining barrel 24 in its set or latched position illustrated in FIG. 1, wherein cutting edge 26 is retracted away from strand 10 and from cutting anvil 16, now will be explained. Barrel 24 is provided with two apertures 30 and 31 which extend through its wall. Ball detents 33 and 34 are received within apertures 30 and 31 and are free to move radially therein but are held against any significant longitudinal movement relative to barrel 24. Balls 33 and 34 may be inexpensive metal ball bearings. As illustrated in FIG. 1, when the mechanism is in its set or latched condition the radially outermost portions of balls 33 and 34 are positioned in contact with a circular recess 36 formed in housing 14. Recess 36 has a sharp shoulder 38 against which balls 33 and 34 are urged to set or latch the mechanism, as will be explained in more detail below.

A stem 40 is disposed coaxially within hollow barrel 24 and is axially translatable with respect to the barrel. As best seen in FIG. 1a, stem 40 includes three cylindrical portions of different diameters. The center or first portion 41 is proportioned so that it is in close, yet freely slidable, contact with the inside surface of hollow barrel 24. The second portion 42 at the left end of stem 40 is smaller in diameter than the first portion 41. The diameters of the first and second stem portions 41 and 42 are proportioned relative to the diameter of balls 33 and 34, the wall thickness of barrel 24, and the depth of recess 36 so that in the set or latched condition illustrated in FIG. 1 balls 33 and 34 are in contact with the surface of first stem portion 41, and with the bottom and shoulder 38 of recess 36. In the latched position, balls 33 and 34 should extend beyond the outer surface of barrel 24 by a distance which is approximately equal to one-third their diameters. Although this distance is not critical, it always should be less than one-half the diameters of the balls. The proportioning of the above-mentioned parts relative to each other also is chosen so that in the released condition of the mechanism illustrated in FIG. 2, balls 33 and 34 are in contact with the surface of the second stem portion 42 and so that the radially outermost portions of the balls do not extend beyond the outer surface of barrel 24, thus being free of contact with shoulder 38.

Stem 40 also includes a sloping transition section 43, FIG. 1a, which joins the first and second stem portions 41 and 42. Transition section 43 must be constructed and proportioned to assure that as stem 40 translates from right to left relative to balls 33 and 34 the transition section will induce an outward radial movement to the balls without the transition section capturing the balls and causing an undesired locking of the stem 40.
The right end of stem 40 is comprised of an armature 45 of magnetic material which functions with solenoid 46, when the latter is energized, to move the entire stem 40 to the right. Solenoid 46 is firmly secured to housing 14 by any suitable means. Armature 45 is of greater diameter than the first portion 41 of stem 40 so as to form a shoulder 48 against which the right end of barrel 24 abuts, as illustrated in FIG. 1. A light helical spring 49 is disposed between the end of armature 45 and a support within solenoid 46 to urge stem 40 toward the left to maintain shoulder 48 in butting contact with the right end of barrel 24, as illustrated in FIG. 1.

A second and stronger helical spring 50 is disposed about armature 45 and is held in compression between the reduced diameter right end of barrel 24 and a tubular member 51 within solenoid 46. Spring 50 provides an axial force tending to urge barrel 24 toward the left. The force exerted by spring 50 against barrel 24 is significantly greater than the relatively light force exerted by spring 49 against stem 40. As will be explained, spring 50 supplies the force for translating barrel to its extreme left-most position illustrated in FIG. 2 in which cutting edge 26 cuts strand 10 on anvil 16. The left end of spring 50 is fashioned into a straight actuator pin 52 which extends downwardly so that it may engage and depress the contact button 55 of a three terminal, single pole, double throw electrical snap switch 56. As will be explained only two contact connections are actually wired into the operating circuitry.

A second electrical switch 60 has a long actuating lever 61 which is in engagement with the strand of thread 10 when the strand is in its desired taut condition illustrated in FIG. 1. When actuator arm 61 is in contact with a taut strand, switch 60 is held in its open position by the strand. When strand 10 is excessively slack or has parted, actuator arm 61 moves to cause a pair of contacts of switch 60 to close and initiate a cutting and clamping operation. Switch 60 and its lever arm 61 thus function as a thread tension sensor. Tension sensing switch 60 also may be a three contact, single pole, double throw snap switch.

A small neon bulb 65 is included in housing 14. As will be explained below, bulb 65 is lighted when the mechanism is in its extended or clamping position illustrated in FIG. 2 to provide a visual indication that the mechanism has transferred from its normally set condition.

In a cutting and clamping mechanism constructed substantially as illustrated in the drawings, various component parts had the following approximate dimensions.

Barrel 24:
- Outer diameter — ⅛ inch.
- Inner diameter — ⅛ inch.
- Balls 33 and 34:
- Diameter — 3/32 inch.

Stem 40:
- First portion 41 — 1/16 inch diameter.
- Second portion 42 — ⅛ inch diameter.
- Armature 45 — 3/16 inch diameter.

In the operation of the mechanism illustrated in the drawings, assuming that strand 10 is taut and, as will be explained below, switch 60 is in a condition to maintain solenoid 46 unenergized, an attendant or operator grasps latching handle 25 and moves it to its right-most position within slot 13, thus sliding barrel 24 and spring 50 to their respective positions illustrated in FIG. 1. The small spring 49 urges shoulder 48 on armature 45 up against the right end of barrel 24 so that ball detents 33 and 34 are urged outwardly by the first stem portion 41 into contact with outermost portions of circular recess 36. The force exerted by spring 50 causes the right sides of the walls of apertures 30 and 31 in barrel 24 to force balls 33 and 34 against the shoulder 38 of the recess 36 so that the balls are captured between shoulder 38, the first stem portion 41, and the walls of the respective apertures 30 and 31. Barrel 24 is thus held against translation to the left and the mechanism is in its set or latched condition.

When strand 10 becomes excessively slack or breaks, lever arm 61 of tension sensing switch 60 moves to cause switch 61 to energize solenoid 46. Armature 45 and stem 40 then are drawn toward the right by solenoid 46 a sufficient distance to bring the smaller diameter second stem portion 42 into vertical alignment with ball detents 33 and 34. Because more than one-half of balls 33 and 34 are within apertures 30 and 31, the force exerted thereon by the walls of apertures 30 and 31 in response to spring 50 will force the balls down through the apertures and into contact with the second stem portion 42. Balls 33 and 34 now are clear of shoulder 38 and spring 50 pushes barrel 24 to the left with a snap-like action to cause cutting edge 26 to cut strand 10 on anvil 16 and to cause holding surface 27 to hold the severed end of strand 10 against pad 20. Neon bulb 65 is caused to glow when the mechanism is in the condition illustrated in FIG. 2. The mechanism will remain in this condition until reset by an attendant.

The electrical circuitry associated with solenoid 46, switches 60 and 65, and neon bulb 65 will be described by referring to FIG. 3 which is a simplified system wiring diagram for a plurality of N devices of the type illustrated in FIGS. 1 and 2. Only devices 1, 2, and N of a large plurality are illustrated, and since all devices are identical, only device 1 now will be described, using the same reference numerals corresponding to components illustrated in FIGS. 1 and 2. The conditions of switch 56 and tension sensing switch 60 are for the set or latched condition of the mechanism illustrated in FIG. 1, assuming the strand 10 is under tension in its desired taut condition. The movable contact arm of tension sensing switch 60 is held against the normally open (NO) contact by reason of lever arm 61 being held up by taut thread 10. Movable contact arm 55 of switch 56 is held in contact with the normally closed (NC) contact. Solenoid 46 is not energized by the 110V a.c. source in this set or latched condition because of the open condition of switch 60. Similarly, neon bulb 65 is disconnected from power lines 67 and 68. When excessive slack occurs in strand 10, or if the strand is broken, lever arm 61 of switch 60 will move and cause the movable arm 61 of switch 60 to contact the normally closed (NC) contact, thus connecting solenoid 46 through the two closed switches to the 110V a.c. lines 67 and 68 and energizing the solenoid to draw armature 45 and stem 40 to the right, as viewed in FIG. 1. The movement of stem 50 unlashes the mechanism, as previously explained, and permits barrel 24 and the left end of spring 50 to move to the left with a snap type action. In moving to the left, the actuator pin 52 on the end of spring 50 depresses actuator button 55 on switch 56 to transfer the movable arm 55 to the normally open contact (NO). This leaves the parallel branch com-
prised of resistor R and neon bulb 65 is circuit with solenoid 46, and neon bulb 65 now is lighted. The resistance value of resistor R is relatively large, such as 200 kiloohms, so as to limit the current flowing through solenoid 46 and neon bulb 65. This value of current is insufficient to maintain solenoid 46 in an energized state, so that the small spring 49 may move armature 45 and stem 40 to the left, away from the solenoid. Neon bulb 65 continues to glow until the mechanism is reset.

In a textile mill, for example, many of the cutting and clamping mechanisms illustrated in FIGS. 1 and 2 may be employed. In some instances, such as at the beginning of a production run, it is desirable that all strands of thread or yarn have free ends at given locations. It then is desirable that a plurality of the mechanisms of this invention be operated to cut the thread or yarn and hold the free end independently of the operation of the tension sensing switch 60. This may be accomplished by the use of a remote "all cut" switch 71 illustrated in FIG. 3. Switch 71 is connected in series between power line 67 and a shunting line 75. Line 75 is connected by way of leads 72, 73, 74 to the normally open (NO) contacts of the tension sensing switches 60 of the respective mechanisms 1, 2, . . . N. Even though switches 60 are held in their normally open (NO) positions by a respective taut strand, the closure of remote "all cut" switch 71 connects the respective solenoids 46 of mechanisms 1, 2, . . . N across the power lines 67 and 68 to energize the solenoids and unlatch the mechanisms by drawing the respective stems 40 toward the solenoids. It is thus seen that by the simple expedient of utilizing the remote "all cut" switch 71 and a three contact, single pole, double through switch for the tension sensing switch 60 considerably greater utility and flexibility may be obtained in the use of the cutting and clamping mechanisms of FIGS. 1 and 2.

From the above description it is seen that the mechanism of this invention is simple in construction, provides a positive latch and a positive release of the mechanism, and by utilizing energy stored in spring 50 to supply the cutting and clamping force, a relatively small electromagnet may be utilized to provide only an unlatching force. Further, simple electrical circuitry is employed to afford alternative operational capabilities.

What is claimed is:

1. A device for cutting a strand of thread, yarn, or the like comprising,
   means for guiding a strand along a path, a cutting anvil located on one side of said path, a translatable hollow barrel having cutting means at one end thereof, a slidebar disposed on the other side of said path and adapted to receive said barrel for permitting the barrel to slide from a latched position removed from said path to an unlatched position in which said cutting means is in engagement with said anvil,
   spring means for sliding the barrel toward said path to bring the cutting means into contact with the anvil,
   at least one aperture through the wall of said hollow barrel,
   detent means receivable within said aperture and radially movable with respect thereto,
   a stem member disposed within said hollow barrel and axially movable with respect thereto between latched and unlatched positions, said stem having first and second spaced portions of different thicknesses, detent receiving means fixedly positioned exteriorly of said barrel for engaging said detent when the barrel is in its latched position, said first stem portion being proportioned to contact the detent and urge it into engagement with the detent receiving means when the stem and barrel are in their latched positions, the second stem portion being proportioned to engage the detent and permit its radial disengagement from the detent engaging means when the stem is in its unlatched position, electromagnet means fixedly positioned relative to said stem, armature means associated with said stem for moving the stem from its latched to its unlatched position upon energization of the electromagnet, said aperture and detent means being constructed and arranged to move the detent into contact with the second stem portion when the stem is in its unlatched position.

2. The combination claimed in claim 1 wherein said detent receiving means is a shoulder associated with said slidebar.

3. The combination claimed in claim 1 wherein said detent receiving means is a recess formed in said slidebar.

4. The combination claimed in claim 1 wherein said detent is a ball, and wherein said second stem portion is a recess having a diameter such that the ball may be retained therein.

5. The combination claimed in claim 1 and further including:
   a strand clamping means having first and second portions associated respectively with said anvil and barrel, said clamping means being constructed and arranged to engage and clamp a severed end of a strand when the barrel is in its unlatched position.

6. The cutting device claimed in claim 1 and further including:
   a strand sensing switch having first and second switch conditions, said sensing switch having means for sensing a taut strand at a location adjacent said device and being placed in said first switch condition upon sensing a taut strand, means connecting said sensing switch in circuit with said electromagnet and an electric source, said sensing switch being operable to connect the electromagnet to said source when in its second switch condition and to disconnect the source from the electromagnet when in its first switch condition.

7. The cutting device claimed in claim 6 and further including:
   a second switch having first and second switch conditions, means for transferring the second switch from its first switch condition to its second switch condition
upon transfer of said barrel from its latched to its unlatched position,
means connecting said second switch in circuit with said sensing switch, said electromagnet and said source,
said second switch being operable when in its second switch condition to place an open circuit between said source and said electromagnet.
8. The combination claimed in claim 7 and further including,
indicator means in circuit with said second switch for providing an indication when the second switch is in its second switch condition.
9. The combination claimed in claim 6 wherein said sensing switch includes at least three contacts, the first of which is movable between the second and third contacts to provide, respectively, said first and second switch conditions of the sensing switch,
said first contact being connected to one side of said electromagnet and said third contact being connected to a first one of a pair of leads from said source, said combination further including,
means including a third normally open switch connecting said second contact of the sensing switch to said first one of said pair of leads.
10. A strand cutting device comprising
means for receiving a strand of thread, yarn, or the like,
a cutting anvil located on one side of a strand within said receiving means,
a translatable hollow barrel located on the opposite side of a strand within said receiving means, said barrel having a cutting edge at one end which is translatable into engagement with said anvil to cut said strand,
a housing supporting said barrel for permitting a sliding translation of said barrel toward and away from said anvil,
a stem member disposed within said hollow barrel and axially movable with respect thereto,
electromagnet means disposed adjacent the end of said barrel opposite said cutting edge,
said stem including an armature member which is disposed at the end of the stem adjacent said electromagnet and which is adapted to be attracted toward said electromagnet upon energization thereof,
spring means positioned and adapted to urge said barrel into contact with the anvil at least one aperture through the wall of said hollow barrel,
a ball detent member receivable within said aperture and freely movable therethrough,
said housing having in the region of sliding contact with said barrel a shoulder whose radial height is less than one-half the diameter of said ball detent,
said stem comprising first and second longitudinal portions having respective first and second thicknesses, said first stem portion being located closer to said armature than said second stem portion, said first stem portion being proportioned and arranged to contact said ball detent and to urge it outwardly into engagement with the shoulder in said housing to secure said barrel in a retracted position away from said anvil,
said second stem portion being thinner than said first portion and being proportioned and arranged to allow said ball detent to move radially inwardly and into contact therewith and out of engagement with said shoulder when said electromagnet attracts said armature, thereby allowing said cutting edge to translate into engagement with said anvil under urging of said spring means.

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