

United States Patent

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[72] Inventor **Ilmar J. Vilcins**
Northbrook, Ill.
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 [73] Assignee **Signode Corporation**

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Primary Examiner—Billy J. Wilhite
 Attorney—Dressler, Goldsmith, Clement & Gordon

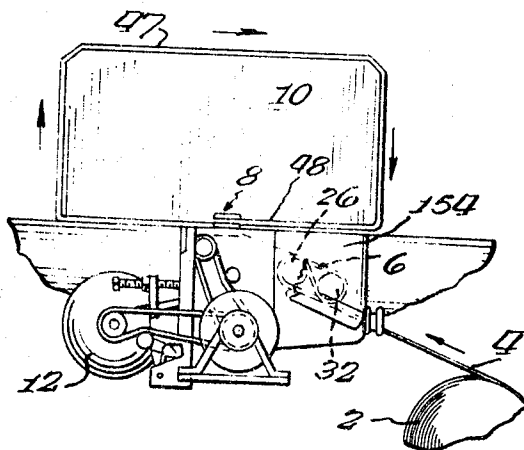
[54] **STRAP FEEDING AND TENSIONING SYSTEM**
 9 Claims, 8 Drawing Figs.

[52] U.S. Cl..... 100/2,
 100/32, 100/33
 [51] Int. Cl..... B65b 13/02
 [50] Field of Search..... 100/25, 26,
 29, 30, 32, 33, 2

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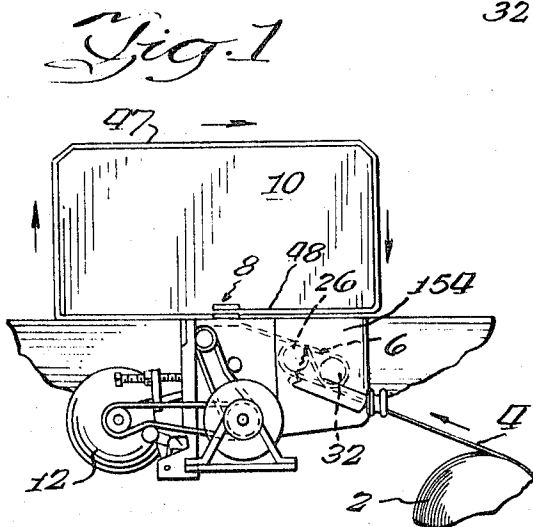
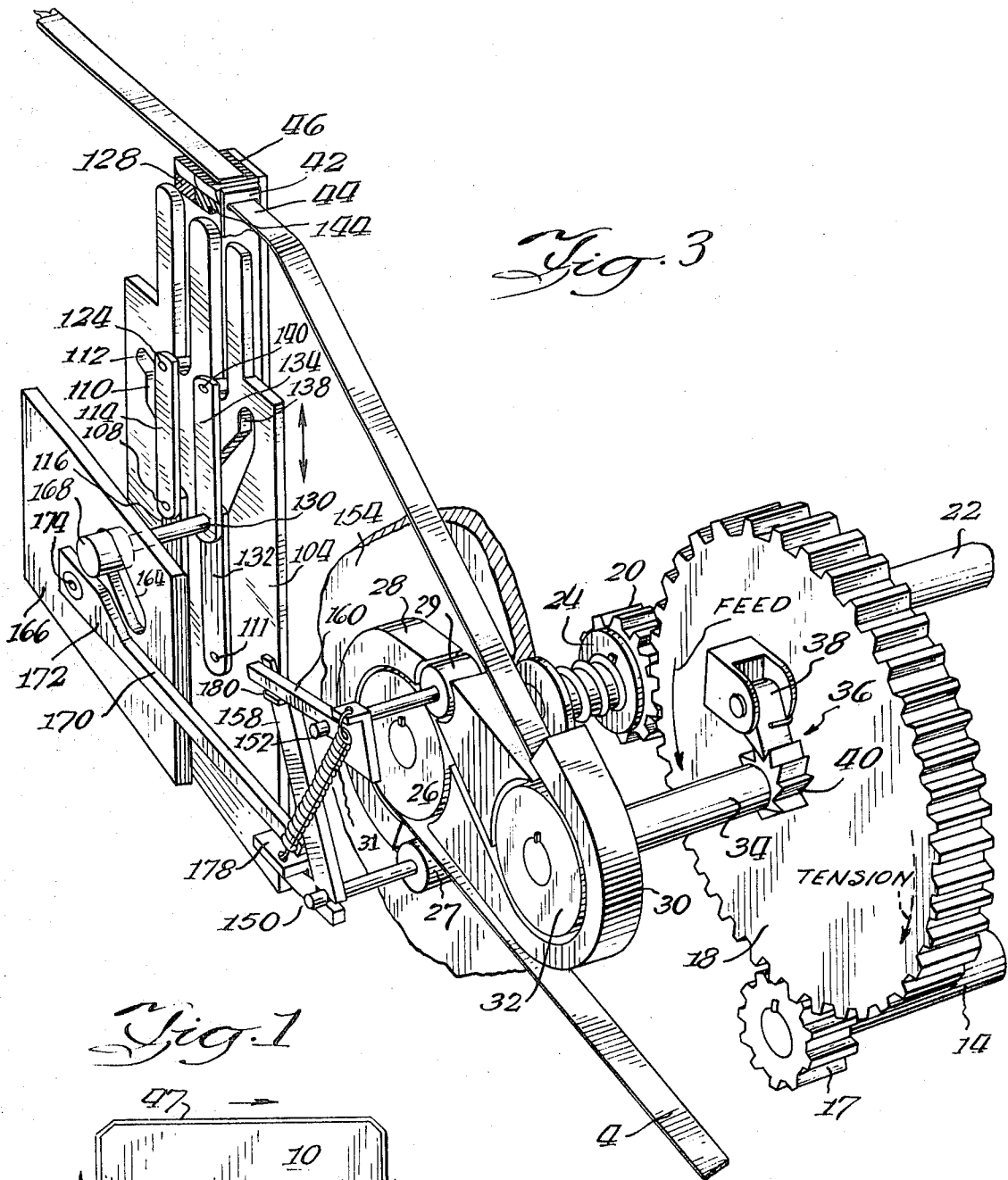
ABSTRACT: A strap feeding and tensioning mechanism for applying strap material about a package, with the mechanism including means for relieving the tension in the strap prior to severing the strap from the supply of strap material. During the strap feeding and tensioning operation, a pair of pinch rolls are positioned adjacent the periphery of a strap material feed wheel, and the pinch rolls are biased into engagement with the feed wheel and the strap material disposed thereabout. The strap tension is relieved by moving the pinch rolls to a position out of engagement with the feed wheel and the strap material.



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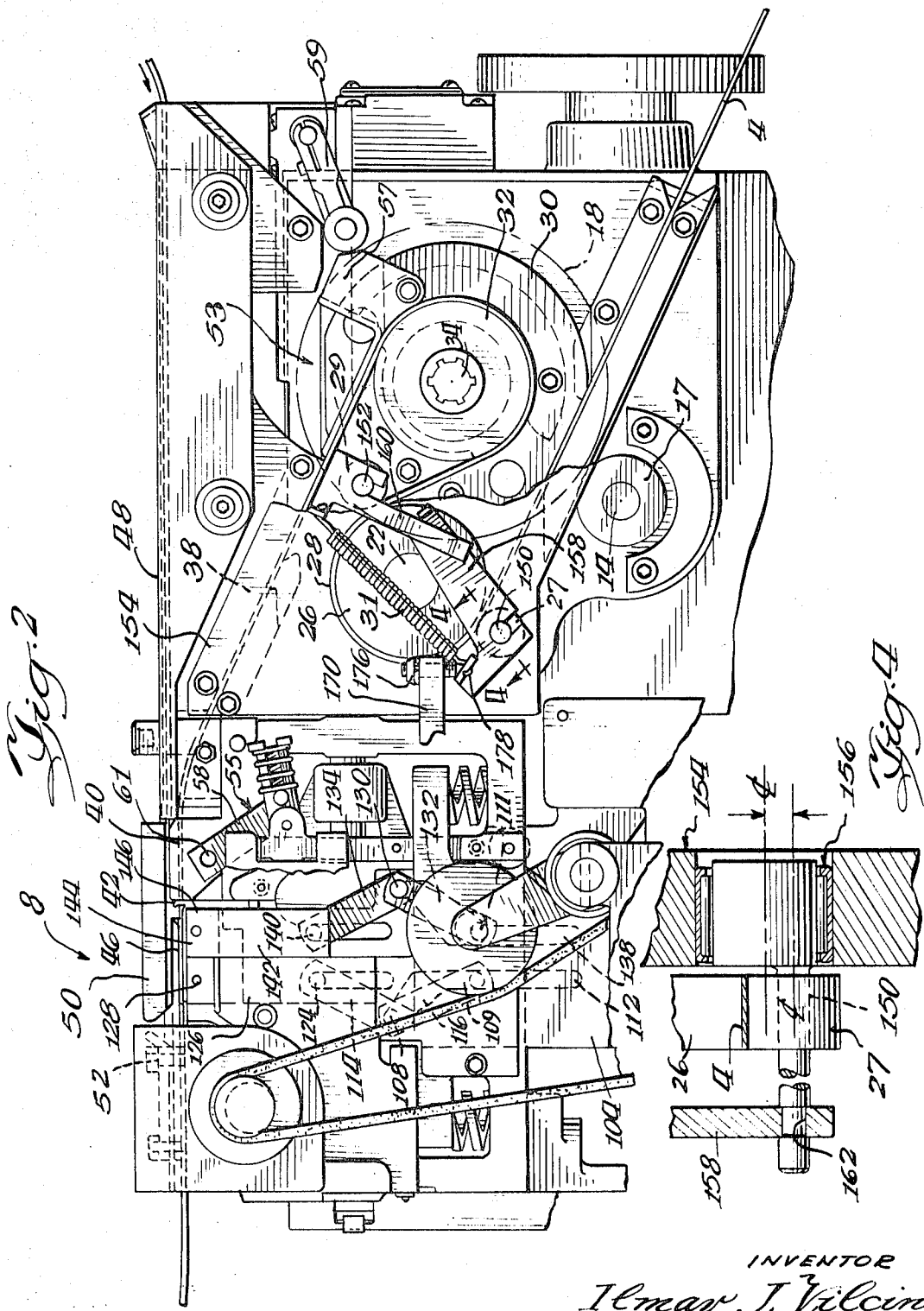
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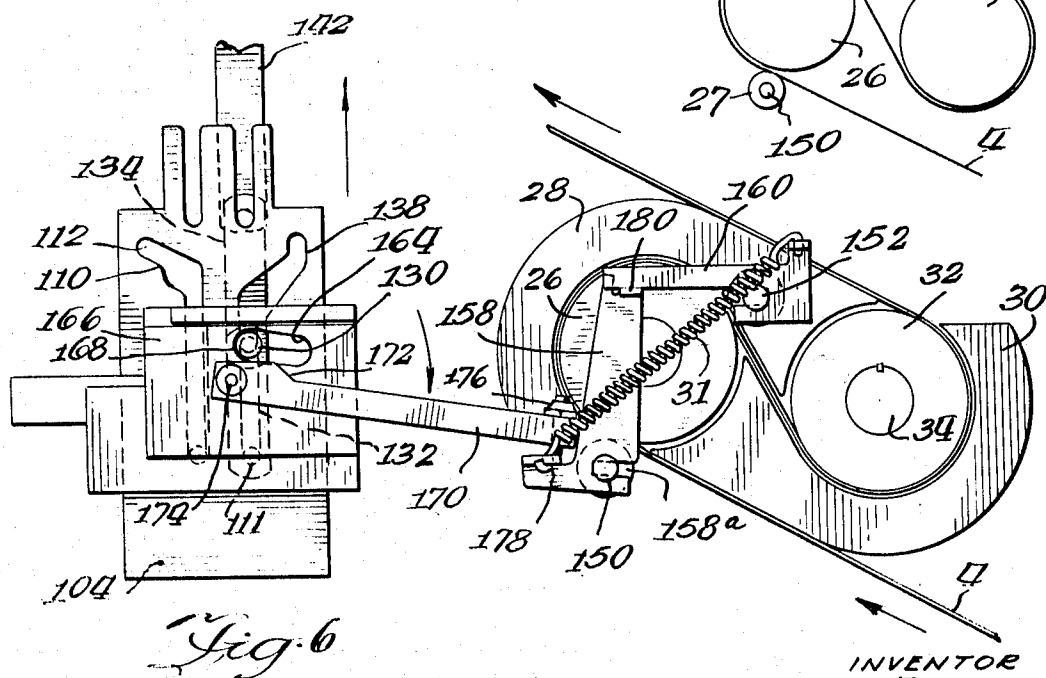
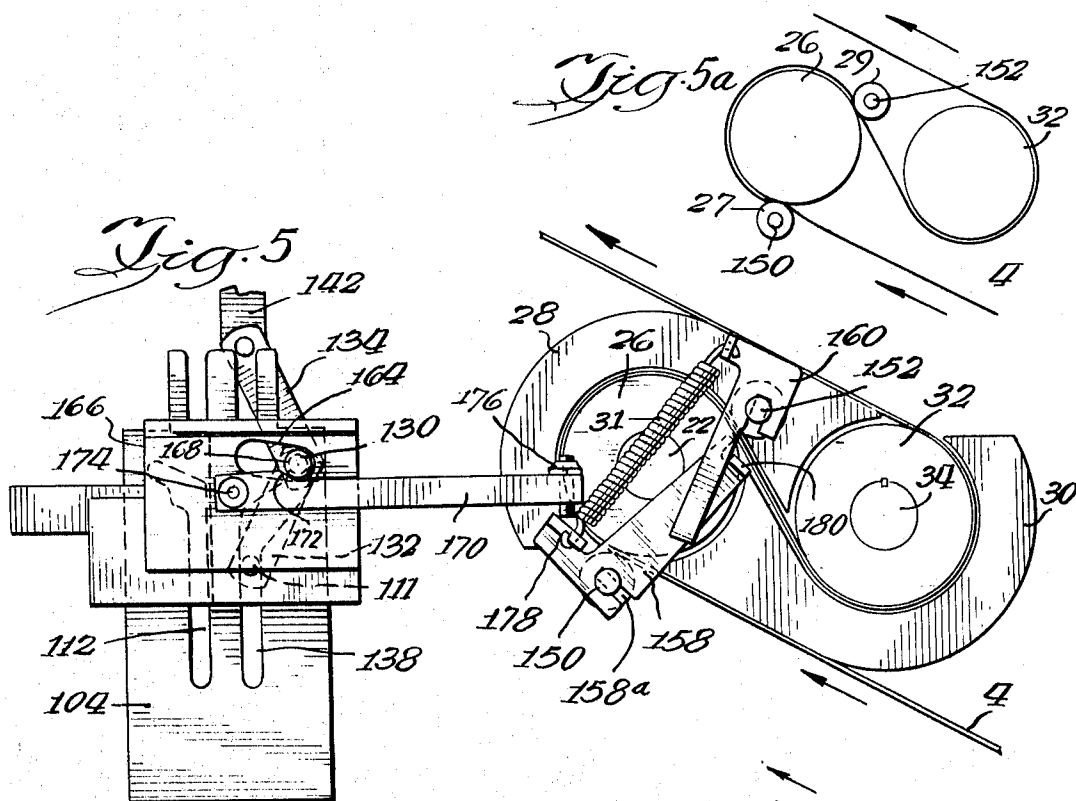
INVENTOR

Ilmar J. Vilcins

BY Drusler, Goldsmith, Clement & Gordon
ATTORNEYS



INVENTOR
Elmer J. Vilcina
BY *Dresser, Gledhill, Clement & Gordon*
ATTORNEYS



INVENTOR

Ilmar J. Vilcins

BY Dressler, Goldsmith, Clement & Jordan
ATTORNEYS

STRAP FEEDING AND TENSIONING SYSTEM

The present invention relates to a combined machine which automatically feeds strap material about a package to form a loop thereabout, draws tension in the loop, and severs the strap material from a supply source, while overlapped portions of the strap material are held tightly about the package for a subsequent sealing and joining operation. The invention is more particularly concerned with a device which relieves the tension in the strap material prior to severing the material from the supply source.

When articles or packages are secured by ligatures, such as various types of plastic and nonmetallic strapping material, it has been the practice to automatically feed the material about the package to form a loop, grip the leading edge of the strap material, and apply a high tension to the strap to remove any slack in order to obtain a suitably tight package. It has been found that unless at least a degree of strap tension is relieved prior to severing the strap material from the supply source, the ends of the strap will splay, leaving jagged, irregular end portions. This undesirable result is not only unsightly but with certain types of strapping material can cause unraveling or pulling apart of the strap, and this material separation can seriously effect the holding power of the strap loop. Furthermore, an irregular or jagged strap leading edge is susceptible to catching on various elements of the automatic strapping machine and guides and therefore impeding a smooth and uninterrupted conveyance of the strap about the package. Accordingly, it is desirable to provide a tightly secured strap on the package with straight, cleancut end portions after the material is severed from the supply source.

An automatic strapping machine with which this invention can be utilized is disclosed in U.S. Pat. No. application Ser. No. 629,799, filed by Robert J. Kobiella on Apr. 10, 1967 (issued as U.S. Pat. No. 3,442,203 on May 6, 1969), and assigned to the assignee of the present invention. More particularly, the present invention is an improvement upon the invention disclosed in U.S. Pat. No. application Ser. No. 612,910, filed by Robert J. Kobiella on Jan. 31, 1967 (issued as U.S. Pat. No. 3,420,158 on Jan. 7, 1969), and also assigned to the assignee of the present invention. U.S. Pat. No. application Ser. No. 629,799 is entitled "Automatic Strapping Machine Employing Friction-Fused Joints" and covers the overall operation of an automatic strapping machine, which feeds, tensions, and secures plastic strapping material about packages. U.S. application Ser. No. 612,910 is entitled "Strap Feed and Tensioning Mechanism" and relates to a particular mechanism for use with various types of strapping material, which require automatic feeding and tensioning prior to securing the strap about a package, in order to provide a tightly wound package.

In accordance with the present invention, the strapping material is fed from a supply source, such as a roll or coil of material, into the automatic strapping machine of the type described and illustrated in U.S. Pat. No. application Ser. No. 629,799 and is guided about the package until the leading edge of the strapping engages a stop and is gripped by a suitable mechanism to retain the loop about the package. A strapping and tensioning mechanism of the type illustrated and described in U.S. Pat. No. application Ser. No. 612,910 operates through a relatively simple drive mechanism to feed material about the package to a point where the leading edge is gripped, after which time the drive mechanism is reversed to pull the slack out of the strap, and to place a high tension in the strap to tightly secure the package.

After the leading edge of the strap has been gripped and the high tension drawn within the strap, a suitable locking mechanism is engaged with the drive which operates the feed and tensioning mechanism to hold the strap tightly about the package. The motor which operates this drive is then free to be disengaged from the strap feeding and tensioning mechanism and is utilized elsewhere on the automatic

strapping machine to additionally grip the overlapped portions of the strap material and retain them in position for a subsequent operation.

At this point, the strap is ready to be severed by a suitable cutting mechanism within the automatic strapping machine, as described and illustrated in U.S. Pat. No. application Ser. No. 629,799. In accordance with the present invention, prior to severing the tensioned strap, the interconnection of the various parts of the automatic strapping machine which operate the gripping and sealing mechanism actuate a cam and linkage arrangement which causes the pinch rolls to move away from the feed wheel periphery, thereby relieving at least a degree of the high tension within the strap between the gripping means of the strapping machine and the supply source. This relief of tension within the strap allows for a clean, sharp severing of the strap from the supply source, thereby eliminating the splayed ends and the disadvantages previously mentioned.

Thus, it will be seen that the present invention provides a simple, efficient and inexpensive improvement to a known automatic strapping machine and strap feeding and tensioning arrangement whereby strap material can be fed around the package, tension applied thereto to tighten it on the package, and the strap material severed from the supply source without interrupting the various sequential steps, while at the same time providing a clean-cut severing of the material from the supply source.

The advantages of this invention will be seen from the following description taken in conjunction with the attached drawings, in which:

FIG. 1 is a schematic front elevational view of a strapping machine and associated strap guide with a package located therein to be strapped;

FIG. 2 is an enlarged side elevational view of a strapping machine, shown partially broken away to illustrate the various component parts;

FIG. 3 is a perspective view of the strap feeding and tensioning mechanism and its associated drive arrangements;

FIG. 4 is a sectional view taken along lines 4-4 of FIG. 2, and illustrating one of the pinch rolls which form a part of the feeding and tensioning mechanism;

FIG. 5 is a fragmentary front elevational view showing various parts of the automatic strapping machine, including the cam and linkage mechanism which operates the pinch rolls;

FIG. 5a is a schematic view of the pinch rolls and the feed and tensioning wheels in the feeding and tensioning position;

FIG. 6 is a fragmentary front elevational view, similar to FIG. 5, but showing the pinch roll cam and linkage mechanism in the tension relieving position; and

FIG. 6a is a schematic view of the pinch rolls and the feed and tensioning wheels in the position of FIG. 6.

STRAP FEED AND TENSIONING MECHANISM

Referring first to FIG. 1, a strap 4 extends from a strap supply roll 2 about a package 10. The strap 4 is directed through a feed and tensioning mechanism 6 and through suitable guides (hereinafter explained) to encircle the package 10. After the leading edge of the strap 4 has overlapped the trailing portion and thereby looped the package 10, it is gripped, tensioned and severed from the supply source 2, by means to be hereafter described. A sealing mechanism 8 of any suitable design is then actuated to secure the overlapped strap portions in place about the package.

The mechanism shown is particularly applicable to various types of plastic and nonmetallic strap material and any suitable type of sealing means can be used to join the overlapped strap portions. A friction-fused joint will be hereinafter discussed as exemplary of one type of strap joining means and as previously mentioned the automatic machine for forming such a joint is fully described and illustrated in U.S. Pat. No. application Ser. No. 629,799.

The various components of the feeding and tensioning mechanism are driven from a single power source 12 through

suitable gear shafts, gears and clutches, and will be described hereinafter. The drive mechanism utilized with this invention is more fully disclosed in U.S. applications Ser. Nos. 612,910 and 629,799, and the disclosures of these applications are hereby incorporated by reference for a disclosure of details not specifically described herein.

Referring now to FIG. 3, there is shown a drive shaft 14 which is driven by the motor 12 through a conventional clutch mechanism (not shown). This clutch can be set at an established maximum torque to be placed on the drive shaft to determine the final tension to be drawn in the strap 4.

Secured to the drive shaft 14 is a drive pinion 17 which meshes with a tension gear 18 that is geared on its opposite side to a slip clutch pinion 20. The slip clutch pinion 20 drives a feed wheel shaft 22 through a friction slip clutch 24. A feed wheel 26 is keyed to one end of the feed wheel shaft 22.

The strap which is drawn from the feed roll 2 is grabbed between the feed wheel 26 and a lower pinch roll 27 and is directed thereabout within a strap guide 28. The strap 4 is drawn into engagement with the feed wheel 26 by an upper pinch roll 29. The pinch rolls 27 and 29 are biased into engagement with the periphery of feed wheel 26 and the strap 4 by a tension spring 31. The mechanism supporting the pinch rolls 27 and 29 will be discussed in greater detail hereinafter under the section entitled "Strap Tension Relief Mechanism."

The frictional engagement of the strap 4 about the feed wheel 26 provides the pulling force for drawing the strap 4 from the feed roll 2. The upper pinch roll 29 provides the initial energizing force for the wrapping effect of the material on the periphery of the feed wheel 26 and the slip clutch 24 is set to provide enough pulling torque.

The strap 4 passes from feed wheel 26 and strap guide 28 to a further strap guide 30 disposed adjacent to and partially surrounding a tension wheel 32. The resistance of the leading edge of the strap 4 going around the internal surface of the guide 30 tends to make the strap 4 hug the curve of the guide 30, thus keeping the strap 4 from any appreciable contact, pressure, or frictional engagement against the periphery of the tension wheel 32. In this manner, the tension wheel 32 will not impede the feeding rate of the strap 4 to the automatic strapping machine.

After passing through the guide 30, the strap 4 moves through suitable guides, hereinafter explained, upwardly and about the article or package 10 to be bound, as will later be described, under the section headed "Strapping and Sealing Mechanism." After the strap has encircled the package 10, the loop is held in position by suitable gripping means which hold the leading edge of the strap 4. Such gripping means are found adjacent the sealing means 8 illustrated in FIG. 1 and are fully described and disclosed in detail in U.S. Pat. No. application Ser. No. 269,799.

The tension wheel 32 is secured to a shaft 34 which interconnects the tension gear 18 through an overrunning clutch 36. A pawl 38 and ratchet 40 of the clutch 36 are designed so that during the feeding rotation of the tension gear 18, which is in this case counterclockwise, as shown by the arrow on the gear face in FIG. 3, the pawl 38 will overrun the ratchet 40 and the tension wheel 32 will remain stationary.

After the strap 4 has been looped about the package 10 and the leading edge gripped and held to retain the strap 4 about the package 10, the drive motor 12 is reverse and the drive pinion 17 and the tension gear 18 are rotated counterclockwise and clockwise, respectively. The rotation of the tension gear 18 for the tensioning operation is illustrated by the dot-line and arrow on the gear face in FIG. 3. The clockwise movement of the tension gear 18 drives the slip clutch pinion 20 in a counterclockwise direction, with the result that the feed wheel rotation is reversed. The lower pinch roll 27 energizes the wrapping effect and insures frictional engagement of strap 4 with the periphery of the feed wheel 26 to pull back the strap 4 to take up the slack. When slack is removed from the strap 4, the strap is then drawn into frictional engagement with the periphery of the tension wheel 32.

The faster running feed wheel 26 pulling back on the strap 4 at a high speed increases the rotation of the tension wheel 32 which is permitted by the overrunning clutch 36. The high speed of the wheel 26, in relation to the speed of the wheel 32, is due to the relative diameters of the tension gear 18 and the at a pinion 20. When the slack in the strap 4 has been taken up, the feed wheel 26 heretofore operating at a high rate of speed meets resistance as the loop of strap material is drawn tighter about the package 10 because of the gripping of the leading edge of the strap, as previously mentioned. The wheel 26 begins to slip with the attendant reduction in speed due to the slippage at the slip clutch 20. The tension wheel 32 also drops in speed and the speed of both of these wheels continues to drop until the speed of the overrunning clutch 36 matches the speed of the tension wheel 32. At this time, the overrunning clutch 36 will then lock to the tension shaft 34 to drive the tension wheel 32 at a lower and consequently higher torque speed. The slip clutch 24 setting provides a continuous driving torque to the feed wheel 26 while it slips, which torque imparts an energizing strap tension that is multiplied by the wrapping of the strap about the tension wheel 32.

After the tension in the strap 4 has been drawn to its predetermined setting as regulated by the main clutch (not shown), suitable mechanisms such as a locking pawl, or a positive clutch, may be used to lock the shaft 22 in position to retain the high tension in the strap 4.

By way of example only, a solenoid, or other suitable remotely controlled means, may be used for operating the locking pawl, or positive clutch. If such an arrangement is used, the lock will be maintained out of engagement with the shaft 22 during the feeding cycle, so as not to effect the movement of the feed wheel shaft 22. When the pawl is in place in shaft 22, the motor 12 may be disconnected from the drive system of the automatic strapping machine and used for other operations of the strapping machine, such as the functioning of the gripping and sealing mechanism hereinafter described.

Referring now to FIG. 2, during the feeding operation, after the strap 4 passes the periphery of tension wheel 32 and moves out of the arcuate guide 30, it passes through an upper guide 38, past a gripper member 40, which, as previously mentioned, functions to hold the lead end of a strap after the strap has been looped in place about the package 10.

Located adjacent the gripper member 40 is a stationary cutter 42 which has an opening 44 through which the lead end of the strap passes (see FIG. 3). The strap then moves under a face gate 46 into the strap chutes of guide 47 which surrounds the package 10, as seen in FIG. 1. The face gate 46 functions to separate the overlapping strap portions during the feeding operation, thus facilitating the feeding operation. As fully described in U.S. Pat. No. application Ser. No. 629,799, the face gate 46 is subsequently moved out of the position shown in FIGS. 2 and 3 to permit the overlapped strap portions to be placed in face to face relationship in order to apply substantial pressure thereto when the sealing operation occurs, in order to form a joint between the overlapping strap portions.

After leaving the chutes or guides 47, the strap travels through a guide 48 and the space provided between a vibrator 50 and the gripper 40. The vibrator 50 forms part of the sealing mechanism 8 illustrated in FIG. 1 and functions to form a friction-fused joint between the overlapped strap portions as fully described in U.S. Pat. No. application Ser. No. 629,799.

The strap is directed over the stationary cutter 42 and the face gate 46 to a point of engagement with a stop 52. When the stop 52 is contacted, the strap which is being continuously fed by the motor 12 and the feed mechanism previously described expands outwardly within a chamber 53 located adjacent the tension wheel 32, and pushes against the action of a pivotally mounted dropout arm 57. Clockwise movement of dropout arm 57 caused by the strap 4 pushing against it as it expands into chamber 53 brings a portion of the dropout arm into contact with a switch 59 that stops the motor 12. After the motor 12 is stopped, a solenoid (not shown) is energized through a suitable electric circuitry through which a linkage 55 causes the gripper 40 to engage and hold a portion of the

leading edge of the strap 4 against the vibrator 50, thereby holding the forward end of the strap to retain the loop about the package during the tensioning operation.

The operation of the gripper 40 and its associated mechanisms is described in detail in U.S. Pat. No. application Ser. No. 629,799. Briefly, the gripper 40 is energized and moved upward into engagement with the strap end by a solenoid (not shown) which causes the linkage 55 to move to the left, as viewed in FIG. 2. The linkage 55 includes a link 58 which is connected to the gripper 40 through a pin 61. By this arrangement, the movement of the linkage 55 to the left results in a clockwise movement of link 58, which raises the gripper 40 into engagement with the underside of strap 4 and acts to secure the strap against the underside of the vibrator 50. The gripper 40 will retain the lead end of the strap in this position during the tensioning operation previously described.

After the tension is drawn and the strap loop is tightly bound about the package, the strapping machine operates to join the overlapped strap portions into a friction-fused joint, as fully described in U.S. Pat. No. application Ser. No. 629,799. The sealing cycle occurs after additional grippers are actuated to bring the overlapped strap portions in face to face contact and the strap tension is relieved between these additional grippers and the supply source. The strap is then severed from the supply source, as will hereinafter explained, prior to formation of the joint between the overlapped strap sections.

As has been mentioned above, when the main clutch (not shown) is disengaged after the final strap tension has been drawn in strap 4, the motor 12 and its associated drive mechanisms are free to operate other parts of the strapping machine, including a cam shaft and rotary cam for operating vibrator 50 and gripper members which cooperate therewith. As is described in application Ser. No. 629,799, a rotary cam (not shown) which is coupled to the entire machine drive mechanism for operating the sealing vibrator 50 is also connected to a movable toggle plate 104. Plate 104 contains a pair of vertically arranged slots 112 and 138 which serve to guide the action of a pair of toggle link mechanisms that function to move associated carrier members 126 and 142, which carry grippers 128 and 144 (see FIG. 3). Gripper members 128 and 144 engage the undersurface of the overlapped strap portions and move them into engagement with the undersurface of vibrator 50 and apply substantial pressure thereto.

The toggle link mechanism for moving carriage 126 upwardly includes toggle links 114 and 116 that are pivotally connected by a pin 108 which has an outwardly extending end portion disposed at the upper part of slot 112. The upper link 114 connects to a pin 124 that is secured in aligned openings in carriage 126. The left hand carriage 126 contains a gripper 128 which has teeth formed thereon that engage the undersurface of the lower strand or portion of strap 4. The right hand carriage 142 contains a gripper 144 of like configuration and is controlled by the action of toggle links 132 and 134, which are connected at adjacent ends by a pin 130. An outwardly extending end portion of pin 130 is located in the upper part of slot 138 formed in the toggle plate 104. The right hand carriage 142 is connected to the toggle link 134 by a pin 140. The lower ends of toggle links 116 and 132 have pins 109 and 111, respectively, which are located at the lower end of slots 112 and 138, respectively.

The slots 112 and 138 are designed so that during the upward movement of the toggle plate 104 the outwardly extending end portion of pin 108 is first positioned therein by an inclined portion 110 of the slot 112 to push the left hand toggle links 114 and 116 inwardly, or to the right, as seen in FIG. 2. During the upward movement of the plate 104, it engages suitable mechanism (not shown) connected to the face gate 46 to cause the face gate 46 to move out of engagement with the overlapped strap portions to permit the carriage 126 and its gripper 128 to squeeze the overlapped strap portions against the underside of vibrator 50. At a slightly later interval, the toggle links 132 and 134, which respond to the upward movement of plate 104, move the gripper 144 and its carriage

142 upwardly into engagement with the overlapped strap portions against the underside of vibrator 50. The right-hand gripper 142 is provided with a sharp corner 146 which cooperates with the stationary cutter 42 to sever the strap 4. Immediately prior to the severance of the strap 4 and the engagement of the gripper 144 with the overlapped strap portions, the gripper 128 has retained the overlapped strap portions in position, and therefore there is no problem of the strap previously tensioned becoming unwound.

However, there is a problem that unless the tension which has been drawn within the strap 4 is relieved immediately prior to the cutting action, the severance of the strap material from the supply will have a jagged, irregular end, which, as previously mentioned, will have undesirable results, such as unraveling, interference problems, and the like. The mechanism to obviate this problem will be discussed hereinafter under the heading "Strap Tension Relief Mechanism."

The relative movements of the grippers 128 and 144 during the gripping cycles, after the strap has been gripped initially by gripper 40 and tensioned, as previously discussed, will be briefly reviewed to keep the operation in mind when considering the associated and interconnected tension relief mechanism discussed hereinafter.

Starting first, the grippers 128 and 144 are out of engagement with the strap ends, or overlapped strap portions, and the gripper 40 is in engagement with the leading end of the strap to maintain it against the underside of the vibrator 50 to hold the material while the tension is drawn thereon. When the toggle plate 104 moves upwardly, the gripper 128 is first moved into engagement with the overlapped strap portions to urge such portions against the underside of gripper 50. Further movement of toggle plate 104 moves gripper 144 upwardly and cutter edge 146 cooperates with the stationary cutter 42 to sever the strap 4. At this time, gripper 40 is still in contact with the leading end of the strap 4.

Continued upward movement of the toggle plate 104 interacts with a mechanism (not shown) to rotate link 58 and the associated gripper 40 in a counterclockwise direction out of engagement with the strap 4. At the completion of the upward stroke of toggle plate 104, the grippers 128 and 144 have forced the overlapped strap portions against the underside of vibrator 50. These various parts are now in position to effect the forming of the friction-fused joint between the strap ends, as previously mentioned, and more fully explained in U.S. Pat. No. application Ser. No. 629,799.

When the strap portions have been forcibly positioned tightly against the lower surface of the vibrator 50 by the grippers 128 and 144, the rotation of a cam shaft and cam (not shown) causes vibrator 50 to move at a suitable frequency and amplitude and thus form the friction-fused joint. After the joint has been formed and a short dwell time is allowed for the joint to cool, continued rotation of the cam moves a cam follower (not shown) located on a track of the cam to move the toggle plate 104 downwardly and thereby retract the grippers 128 and 144 and their respective carriers 126 and 142 from the overlapped joined strap ends.

Rotation of the cam caused causes the return of the toggle plate 104 to the initial position and the toggle links 114 and 116, 132 and 134, and their associated grippers 128 and 144 and carriage members 126 and 142, and the face plate member 46 moves back to their position shown in FIG. 2. At this time, the securely bound package may be removed from the machine and another package placed in position to start the cycle. As soon as the gripping and sealing mechanisms are in their initial position, as shown in FIG. 2, a trip arm (not shown) attached through suitable linkage and electrical circuitry is actuated, which reverses the direction of motor 12 to initiate the cycle for feeding and tensioning operation as hereinbefore explained.

STRAP TENSION RELIEF MECHANISM

Referring now to FIGS. 3, 4, 5, 5a, 6 and 6a, it will be seen that the pinch rolls 27 and 29 are mounted on suitable shafts and are controlled by a cam and linkage mechanism which responds to the up and down movement of toggle plate 104. As previously explained, as the toggle plate 104 moves up and down, it causes toggle linkages 132 and 134 to move sidewise, and when this occurs, the pinch rolls move from a first position (FIG. 5a) in contact with the periphery of wheel 26 to a second position (FIG. 6a) out of contact with the periphery of wheel 26. In other words, as the plate 104 causes sidewise movement of the pivot 130 connecting the toggle links 134 and 132, the tension relief mechanism is actuated.

As will be seen in FIGS. 3 and 4, the pinch rolls 27 and 29 are mounted on crank shafts 150 and 152, which are in turn supported in side frame member 154 of the main frame of the strapping machine. The rollers 27 and 29 rotate concentric on their respective shafts 150 and 152 and in a first position, the peripheries of the pinch rolls are in rolling contact with the periphery of the feed wheel 26 and the strap 4. The crank shafts 150 and 152 are rotatably supported by the side frame 154 in suitable bearing means 156 (see FIG. 4). Thus, the shafts 150 and 152 can turn in relation to the side frame member 154 within bearing 156 while the pinch rolls 27 and 29 can turn concentrically on shafts 150 and 152 in relation to the feed wheel 26.

As mentioned above, if the shaft 150 is turned in its bearing member 156 within the side frame 154, it will cause pinch roll 27 to move toward and away from the surface of the feed wheel 26. This actuation similarly occurs when the shaft 152 of the pinch roll 29 rotates within its bearing 156 and side frame 154.

Nonrotatably secured to the outer ends of the crank shafts 150 and 152 are a pair of links 158 and 160, respectively, which form a toggle linkage that is biased by the tension spring 31. Link member 158 includes a recess 158a that engages a groove 162 (FIG. 4) cut in the end of crank shaft 150. Thus, the movement of the arm 158 from the position shown in FIG. 5 to the position shown in FIG. 6 will cause the crank arm 150 to move the pinch roll 27 away from the periphery of the feed wheel 26, as evidenced by the schematic positioning of the pinch roll 27 in FIGS. 5a and 6a. This action is similarly true of the pinch roll 29, which responds to a movement of link 160 from the position shown in FIG. 5 to the position shown in FIG. 6.

Referring now to FIG. 3, it will be seen that pivot member 130 for the toggle links 132, 134 has an extended end portion which fits through a clearance opening 164 in a side frame plate 166. Rotatably secured to the end of pivot member 130 is a cam roller 168 which rolls within the slot 164 as the pivot member 130 is moved sidewise, together with the links 134 and 132 by the up and down movement of plate 104, as previously explained.

A lever arm 170 is pivotally secured to frame member 166 at 174, and arm 170 is provided with a cam surface 172 that is in rolling contact with the roller 168. As the cam roller 168 moves within the slot 164 due to the sidewise movement of the toggle linkage pivot 130, it causes the lever 170 to rotate about pivot 174, and this pivoting motion moves the lever arm 170 from the position shown in FIG. 5 to the position shown in FIG. 6. The lever arm 170 is upwardly biased against the cam roller 168 by the tension spring 31, which acts through the links 158 and 160 to push on the outer end of the arm 170.

At the outer end of lever arm 170, there is an adjustment screw blocking arrangement 176, which is in contact with an outwardly extending portion 178 of the link 158. This outwardly extending portion 178 also serves as an anchor for one end of the tension spring 31. A similar outwardly extending portion is provided on link 160 to anchor the opposite end of spring 31. An abutment 180 extends outwardly from link 158, and spring 31 holds link 160 against abutment 180 to insure that the motion applied against link 158 at the outwardly ex-

tending portion 178 will be transmitted to link 160. Thus, as lever 170 moves from the position shown in FIG. 5 to the position shown in FIG. 6, the adjustment screw 178 abuts the laterally extending portion 178 of the toggle link 158 and causes the toggle links 158 and 160 to move between a first and second position against the action of tension spring 31. The outwardly extending portion 180 provides a lost motion or sliding connection between the inner ends of the toggle linkage to allow the links to pivot from the position shown in FIG. 5 to the position shown in FIG. 6. Spring 31 continuously biases the links 158 and 160 toward the position of FIG. 5, and thus when plate 104 moves downwardly from the position of FIG. 6 to the position of FIG. 5, spring 31 returns the pinch rolls 27 and 29 into driving relationship with feed wheel 26.

Briefly, as the gripper member 144 moves into the position shown in FIG. 3, the pivot 130 and the toggle links 132 and 134 move to the left, which causes the cam roller 168 to move up the inclined surface 172 of the lever arm 170 and cause the lever arm 170 to rotate about its pivot 174 and move downwardly against the abutment 178 of the toggle link 158. As the lever arm 170 moves downwardly, it causes the toggle links 158 and 160 to move from the position shown in FIG. 5 to the position shown in FIG. 6, and this action stretches tension spring 31, which continuously biases links 158 and 160 to the position of FIG. 6. When links 158 and 160 move to the position of FIG. 6, the crank arms 152 and 150 cause pinch rolls 27 and 29 to move away from the periphery of feed wheel 26. This action occurs immediately prior to severing of the strap 4.

As previously stated, the interaction of links 158 and 160 responding to the downward movement of lever 170 and its adjusting screw mechanism 176 moving against outwardly extending portion 178 of the arm 158 causes the linkage to the position of FIG. 6. As the links 158 and 160 move to the position shown in FIG. 6, the crank shafts 150 and 152 are rotated within their bearings 156 within the frame member 154. This action thereby causes the crank shafts 150 and 152 to assume the position shown in the schematic views, FIGS. 5a and 6a, and moves the periphery of the rollers 27 and 29 out of contact with the strap 4 and the periphery of feed wheel 26.

As the rollers 27 and 29 move out of contact with strap 4, the tension drawn in the strap 4 by the feed wheel 26 and tension wheel 32 during the tensioning cycle previously described is substantially relieved, because the pinch rolls 27 and 29 no longer securely hold the strap in frictional contact with the surface of wheel 26. This allows a degree of relief within the tension imposed by the pulling on the strap and further allows a certain amount of relief to the strap by pulling against that incoming portion from the feed roll 2.

After this action has occurred and the gripper 144 is moving upwardly against the undersurface of the strap 4, the cutter corner 146 of the gripper 144 moves against the stationary cutter 42 and thereby severs the strap. During the cutting action, the strap is no longer pulling against itself and can respond to the clean, sharp cut imposed by these two cutting surfaces and their interaction. Accordingly, a straight, square cut end portion with no irregular or jagged edges is produced.

METHOD OF OPERATION

As strap 4 is drawn from the feed roll 2, it is grasped between the contacting surfaces of the pinch rolls 27 and 29 and the outer periphery of feed roll 26 and pulled thereabout through guide 28. The grasping of the leading edge of the strap 4 between pinch roll 29 and feed roll 26 causes a wrapping effect to pull strap from the feed roll 2 and force the strap around the guide 30 out of contact with the periphery of the tension wheel 32, up through upper guide members 38, and through the opening 44 in the stationary cutter 42. The strap is fed until it encircles package 10 by movement through guides 47, and the leading end of the strap then moves through guide 48 over the top of gripper member 40 until it contacts stop member 52.

At this time, the motor 12 is continuously operating to feed strap, and the strap builds up in chamber 53 to move dropout arm 57 which actuates a motor shutoff switch 59. As soon as this occurs, gripper 40 is actuated to come in contact with the underside of strap 4 and securely grip it and hold it against the underside of vibrator 50. The motor is then reversed and, through suitable linkage mechanism, the strap is drawn backwardly by the movement of feed wheel 26 and the contact of pinch roll 27 with the periphery of feed wheel 26 and the strap 4. This will pull all slack out of the strap and bring it securely around the package 10 until which time the strap will engage the surface of tension wheel 32. The speeds of feed wheel 26 and tension wheel 32 will then become identical, and the larger tension gear 18 will take over and draw a high torque within the strap loop while the gripper 40 remains in contact with the strap end.

When a predetermined torque has been pulled within the strap, the mechanism driving the feed and tensioning means is locked securing the tension within the strap, and the drive is utilized to move plate 104 upwardly to cause gripper member 128 to move into contact with the underside of the overlapped strap portions. As soon as gripper member 128 has moved into contact with the strap to force it upwardly against the underside of vibrator 50, the gripper 144 starts to move upwardly against the action of toggle links 132 and 134. As toggle links 132 and 134 straighten out to the position shown in FIG. 6, the pivot 130 moves sidewise causing cam roller 168 to move to the left end of the slot 164 within the frame member 166. As cam roller 168 moves to the left, it rides over the cam surface 172 of the lever arm 170 and causes the lever arm 170 to pivot downwardly around its pivot 174. As the lever arm 170 moves downwardly, it engages and pushes abutment 178 of the toggle link 158 downwardly and causes it to pivot to the left, while abutment 180 causes upper link 160 to correspondingly move to the position shown in FIG. 6 against the action of spring 31. As soon as the mechanism has reached the position of FIG. 6, the pinch rolls 29 and 27 are no longer in contact with the strap and the feed roll 26, and the tension drawn within the strap is thereby relieved. The strap is still held tightly about the package due to the engagement of gripper 128 with the overlapped strap portions and the underside of vibrator 50.

The continued upward movement of gripper 144 then severs the strap in a clean, sharp cut, and then continues to move upwardly and to also hold the overlapping portions of the strap against the underside of vibrator 50.

At this time, the vibrator 50 causes the bonding of the overlapped strap portions while the strap encompassing the packages is held tightly thereabout. As soon as this occurs, the motor 12 is then reversed and the grippers 128 and 144 are drawn downwardly by the downward movement of plate 104, and pinch rolls 27 and 29 are returned into driving relationship with respect to feed wheel 26, so that the machine is now in position for another feeding and tensioning operation as previously described.

I claim:

1. A method of providing a strap about a package comprising the steps of: feeding a leading end portion of strap material from a supply source about a package to form a loop with the leading end portion of the strap overlapping a trailing strap portion, holding the leading strap end portion while tensioning the strap to remove slack from the loop and to place the strap material in snug binding engagement with the package, gripping the overlapping strap portions, initiating a cutting step by moving a cutter element toward the strap, relieving at least a portion of the tension in the strap between the gripped overlapping portions and the supply source in response to movement of said cutter element, completing the cutting step by moving the cutter element into severing relationship with the strap to sever the strap from the supply source in the area of said relieved tension, and sealing the overlapping strap portions to form a joint.

2. A method as set forth in claim 1 in which said tensioning step is performed by holding the strap in driven relationship

with a rotating member, and wherein the tension relieving step is performed by terminating said driven relationship.

3. A method as set forth in claim 2 in which said strap is held in driven relationship with said rotating member by at least one pinch roll, and wherein the step of terminating said driven relationship is performed by moving said pinch roll away from said rotating member.

4. A strapping machine for providing a tensioned loop of strap material about a package comprising: a strap supply source, means for feeding the strap from the supply source about a package to form a loop with the leading end of the strap disposed in overlapping relationship with the trailing end of the strap, means for holding the leading end of the strap to enable slack to be removed from the loop, means for tensioning the strap to place the strap in snug binding engagement with the package, means for gripping the overlapped strap ends to retain the loop under tension, means for relieving at least a portion of the tension in the strap between the gripping means and the supply source, means for cutting the trailing end of the strap from its supply source, said tension relieving means being operatively responsive to actuation of said cutting means, and means for joining the overlapped strap portions to secure the tensioned strap about the package.

5. In a strapping machine for providing a tensioned loop of strap material about a package including a feed and tension mechanism having a first and second wheel about which the strap is disposed, means for driving the first wheel in one direction to feed the strap from a supply source, means for directing the strap into engagement with the periphery of the first wheel comprising a pair of rotatably mounted pinch rolls, means for guiding the leading edge of the strap about the package, means for holding the leading end of the strap, means for driving the first wheel in the other direction to take up slack, means for driving the second wheel in the other direction to draw a tension on the strap while the leading end is held, means for gripping overlapped portions of the strap to hold the strap loop under tension, cutter means positioned adjacent the gripper, the improvement comprising a strap tension relief means including a supporting and operating linkage connected to said pinch rolls and to said gripping means, a shaft rotatably supporting each of the pinch rolls and rotatably supported on a frame member adjacent the first wheel, toggle means connected to the pinch rolls for moving the pinch rolls from a first position in contact with the strap and feed wheel to a second position out of contact with the strap and feed wheel, spring means connected to said toggle means and biasing said pinch rolls toward the periphery of the feed wheel in said first and second positions, lever means coupled to the gripping means and said toggle means whereby when said gripping means moves into engagement with the overlapped strap portions the lever means acts upon the toggle means to move the pinch rolls from the first position to the second position, thereby relieving the tension within the strap between the gripping means and the supply source, cutter means acting in response to the operation of the gripping means for severance of the strap from the supply source after the pinch rolls have been moved to the second position.

6. A strapping machine for providing a tensioned strap about a package including a feeding and tensioning mechanism having a first feed wheel, a second tension wheel, and a pair of pinch rolls rotatably supported on shafts adjacent the feed wheel and having their peripheries in contact therewith, a supply of strap material, a portion of the the strap material disposed about the feed wheel between the periphery of the pinch rolls and feed wheel, means for guiding strap about the package, means for driving the feed wheel in one direction to feed strap material through said guide means and around the package, means for driving the feed wheel and the tension wheel in the opposite direction to draw slack and tension in the strap, means for holding the leading end of the strap after it is fed about the package and during the tensioning operation, gripping means for holding the leading end of the strap in overlapped relationship with the trailing end of the

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strap after the leading end of the strap has been engaged by the holding means and tension has been drawn on the strap, cutter means for severing the strap from the supply of strap material, strap tension relief means comprising a toggle linkage secured to said pinch roll shafts and constructed to move said pinch rolls from a first position in which said pinch rolls are in contact with the feed wheel and the strap disposed therebetween to a second position in which said pinch rolls are out of contact with said feed wheel and said strap, the toggle linkage including a pair of links each secured to a pinch roll shaft, spring means connected between said links for biasing the pinch rolls toward the feed wheel in said first and second positions, a pivotally mounted lever operatively associated with said toggle linkage, said lever having a cam surface thereon, an operating linkage connected to said gripping means and having a cam follower in contact with the lever cam surface, whereby when said gripping means is moved into engagement with the overlapped strap portions, the lever is moved to cause the toggle linkage to move said pinch rolls

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away from the feed wheel periphery and the strap disposed thereabout, thereby relieving the tension between the gripping means and the supply source.

7. The strapping machine set forth in claim 6 wherein said operating linkage actuates said cutter means after the pinch rolls have been moved away from the periphery of the feed wheel.

8. The strapping machine set forth in claim 6 wherein the pinch roll shafts are provided with a portion offset with respect to rotational axis of the pinch rolls, the offset portions of said shafts being rotatably mounted at fixed locations.

9. The strapping machine set forth in claim 8 wherein a toggle linkage is provided for actuating said gripping means, said toggle linkage having a first link and a second link and a pivot connecting the links, said cam follower being a cam roller rotatably mounted on the toggle linkage pivot and positioned in rolling contact with the cam surface on said lever.

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