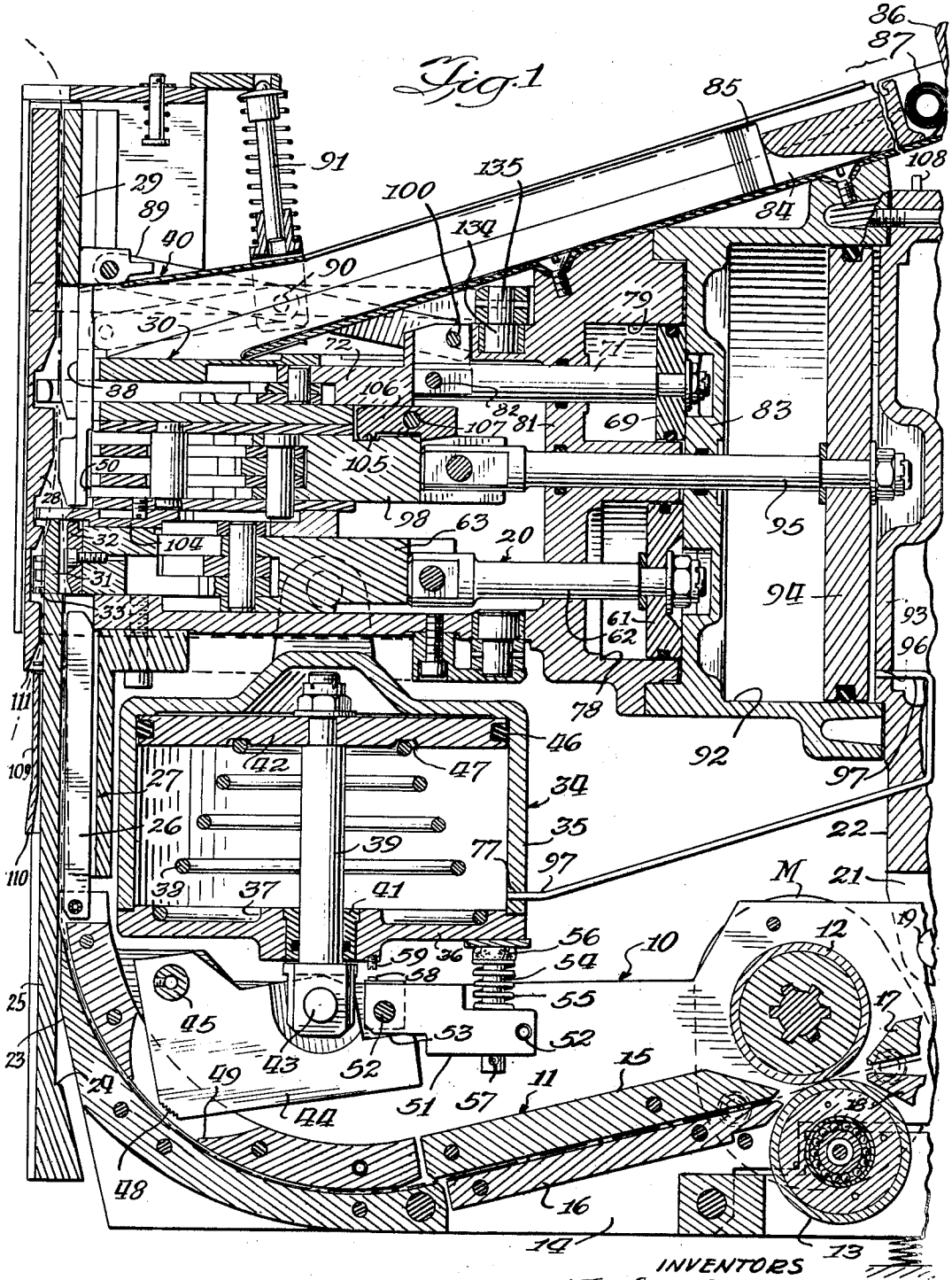
Feb. 3, 1970 R. ORBAN ET AL 3,493,014

TENSIONING MEANS FOR POWER STRAPPING MACHINE

Filed Sept. 5, 1967 3 Sheets-Sheet 1

Fig. 1



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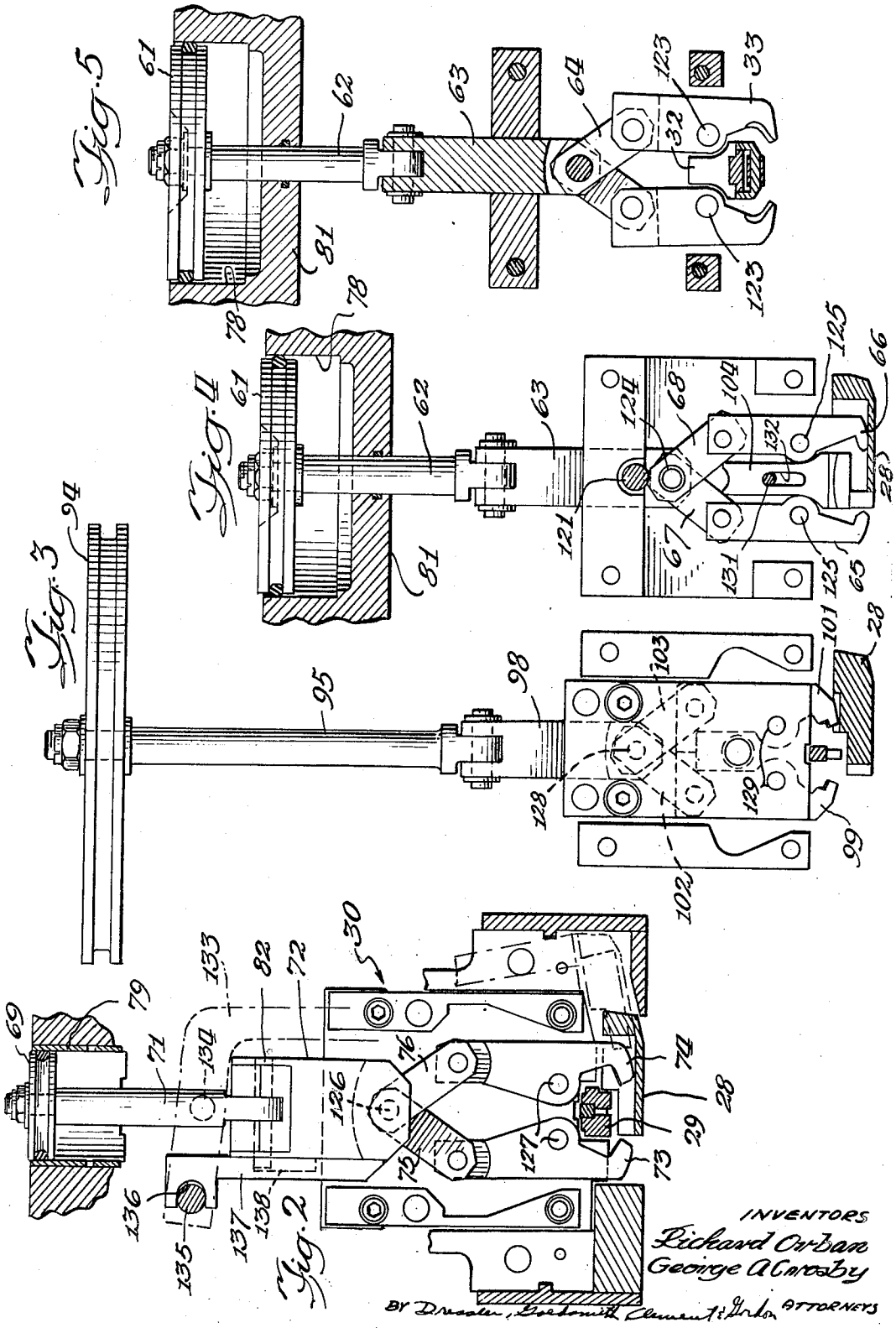
Filed Sept. 5, 1967 3 Sheets-Sheet 2



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TENSIONING MEANS FOR POWER STRAPPING MACHINE

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Fig. 6

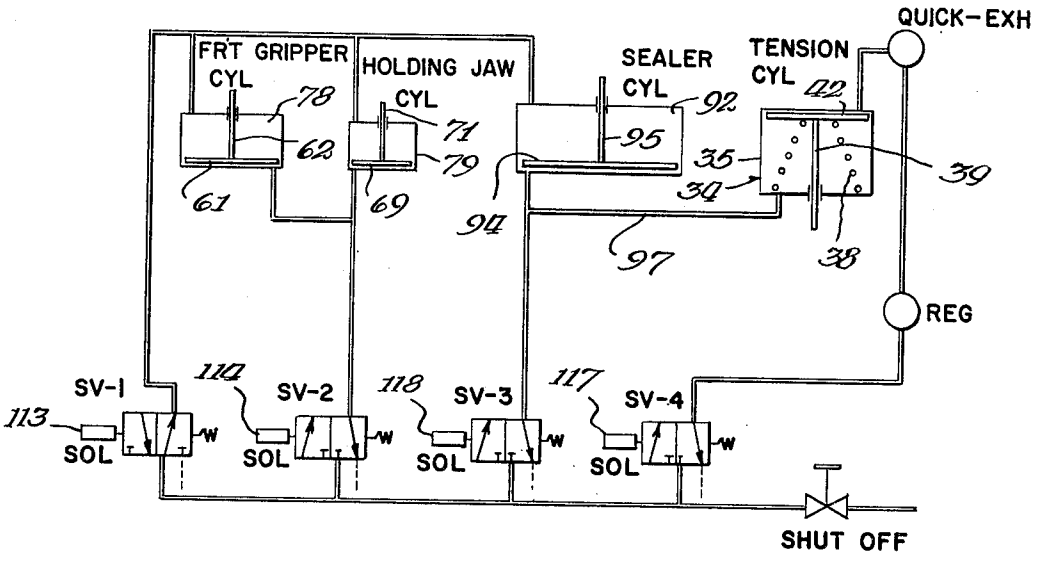
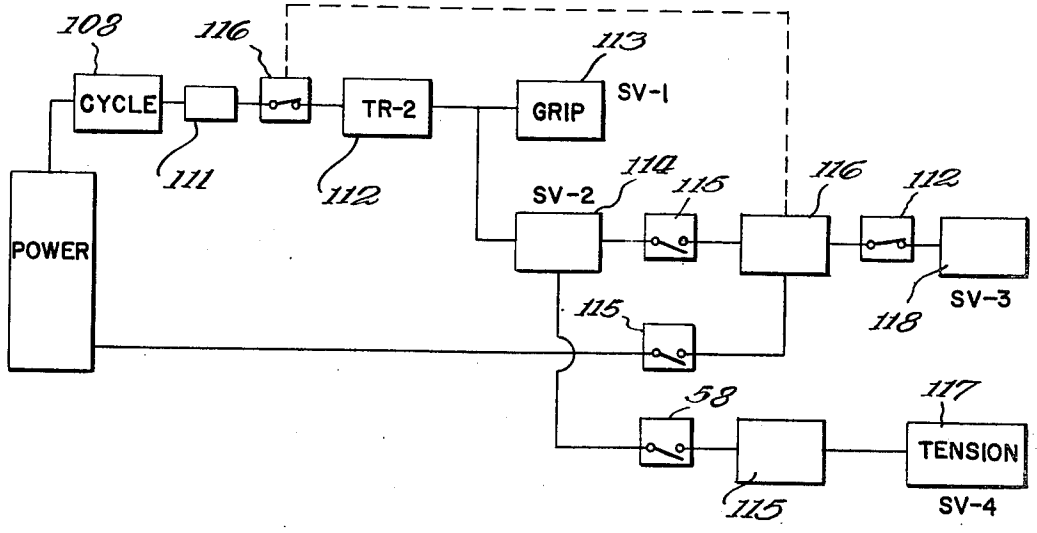


Fig. 7



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3,493,014

TENSIONING MEANS FOR POWER STRAPPING MACHINE

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Int. Cl. B21f 9/02; B65b 13/24, 13/04
U.S. Cl. 140—93.4 5 Claims

ABSTRACT OF THE DISCLOSURE

A power strapping machine of the type having a motor-driven tension roller adapted to tension a metal strap around a package, and having means to crimp a seal around overlapping portions of the strap, is provided with separate tensioning means for exerting high tension on the strap beyond the limit of the tension that can be applied by the motor driven tension roller.

The present invention is specifically directed to the strapping of solid packages, such as bricks and lumber, for example, where high tension is needed. The motor-driven tensioning rollers that are normally found on strapping equipment are not able to produce the force necessary to obtain the required high tension. In such situations, it would tend to cause camber and curl, and also causes milling or excessive knurling which would weaken the strap.

In accordance with the present invention, the strap is tensioned by a conventional motor-driven tensioning roller to the limit of tension attainable with the motor, and then the high tensioning mechanism exerts a direct pull on the strap, and thus avoids the camber, curl and excessive knurl marks of the tensioning mechanisms previously used. The damage to the strap surface heretofore incidental to high tension is eliminated by the tensioning means of the present invention. The strap lies flatter against the package and thereby enhances the appearance of the package. The high tensioning mechanism does not require close tolerances and may be easily regulated to control the tension applied.

An illustrative embodiment of the invention including structure by means of which the above noted and other advantages of the invention are attained is described in the following specification, taken in conjunction with the accompanying drawings which form a part of this specification and in which:

FIGURE 1 is a fragmentary cross-sectional view of a strapping machine embodying the invention;

FIGURE 2 is a cross-sectional view of one holding jaw mechanism and related face gate mechanism;

FIGURE 3 is a cross-sectional view of the sealer jaw mechanism;

FIGURE 4 is a cross-sectional view of a second holding jaw mechanism;

FIGURE 5 is a cross-sectional view of the front gripping jaw mechanism:

FIGURE 6 is a diagrammatic sketch showing the pneumatic system for controlling the fluid flow to the various components of the strapping machine; and

FIGURE 7 is a block diagram of the electrical control circuit.

The present invention may be used with various types of strapping machines. A strapping machine in which the tensioning means of the present invention may be incorporated is fully described in the Ericsson et al. Patent No. 3,198,218, which was granted Aug. 3, 1965, to the assignee of this invention. Reference may be had to said patent for a more detailed description of structure that is common to this application and the aforesaid patent, such as the details of the sealer.

Referring to the drawings, the strapping mechanism comprises a strap feeding and tensioning mechanism 10, a gripping and lower holding jaw mechanism 20, an upper holding jaw mechanism 30, a seal feeding mechanism 40, and a sealing and shearing mechanism 50. The gripping jaw mechanism engages the strap near its leading end, after it has been wrapped around one perimeter of the package, to hold it against movement relative to the package when the strap is pulled back to tension it. The jaw holding mechanisms are coplanar and hold overlapped portions of the strap in sliding engagement in longitudinally spaced areas on opposite sides of the sealing jaw mechanism to provide a straight line contact relationship between the overlapped portions of the strap through the area of the sealing jaw mechanism. The seal feeding mechanism 40 positions a seal adjacent the overlapped portions of the strap between the two jaw holding mechanisms. The sealing and shearing mechanism 50 crimps the seal around the overlapped portions of the strap and cuts the supply end portion of the strap outwardly of the looped portion of the strap that is held closed by the seal.

The strap feeding and tensioning mechanism 10 comprises a lower strap guide 11 and a pair of rollers 12 and 13 rotatably mounted in the guide. The axes of the rollers extend transversely of the guide with the peripheral surfaces of the rollers in engagement. The roller 12 is driven by any suitable reversible motor M, and the roller 13 is a backup roller. The guide comprises a pair of parallel plates 14 secured to opposite longitudinal edges of upper guide members 15 and lower guide member 16. The guide members are spaced apart to provide a passageway for the strap, and have an open end rearwardly of the bight of the rollers 12 and 13. A pair of short guide members 17 and 18 are mounted between the plates 14 adjacent the bight of the rollers 12 and 13. The guide members 17 and 18 coverage toward the rollers to facilitate feeding the strap from a supply coil to the rollers. The lower strap guide 11 is pivoted, by a pin 19, to a lug 21 depending from a valve housing 22.

The end of the strap guide 11 remote from the rollers 12 and 13 is curved to form a front surface that has a shoulder 23 projecting therefrom. The shoulder 23 engages a shoulder 24, projecting from the inner surface of a front strap guide 25, to hold the strap guide 11 in position. One end of a guide finger 26 is pivotally secured to one end of the guide member 15. The guide finger 26 fills the gap between the lower end of the stem 27 and the front end of the guide 15 when it is down. The guide finger and the inner surface of the front strap guide form part of a strap chute for guiding the leading end of the strap as it passes through the strapping machine.

A face gate 28 and a guiding insert 29 cooperate to guide the leading end of the strap after it has passed the sealing jaw mechanism. A stationary cutting block 31 is positioned in an intermediate portion of the strap chute. A block insert 32, positioned in the strap chute adjacent the cutting block 31, cooperates therewith to guide the strap toward the upper holding jaw mechanism. The inner surface of the face gate 28 is shaped to guide the leading end portion of the strap into juxtaposition with the supply end portion of the strap, and is recessed to receive the outermost portion of the upper jaw holding mechanism 30 so that both portion of the strap can pass through both jaw holding mechanisms.

After the leading end of the strap passes through the upper end of the strap chute, the strap is wrapped around one perimeter of the package, and its leading end is threaded between the face gate 28 and the front face of

front strap guide 25. The strap chute for guiding the ding end of the strap around the package and back › the strapping tool is conventional and is not shown the drawings. The forward movement of the strap riers its leading end through gripping jaws 33 and n into overlapping relationship with the supply end tion of the strap. The movement of the strap is stopped omatically at a predetermined point just beyond the per holding jaw mechanism 30.

The gripping jaws 33 grab the strap adjacent its lead- end and hold it against movement while the over- ped portions of the strap are held in sliding engage- nt by the two coplanar jaw holding mechanisms at as spaced longitudinally of the strap on opposite sides the sealing jaws. The motor driving the roller 12 is ersed to remove the slack and apply tension to the ap. The tension is limited by the power of the motor ving the roller 12, and may be substantially equal to tension usually applied to strapping secured around ckages of various kinds. In connection with very solid ckages, such as brick or lumber, for example, it is de- able to apply additional tension to put the strap under h tension before the overlapping portions of the strap secured together by a metal seal.

The motor for driving the roller 12 does not have to be ge because it does not have to pull a high tension. In cordance with the present invention, a fluid-operated linder and piston assembly 34 applies force to exert a aight pull on the supply end of the strap while the lead- end portion of the strap is held. The direct pull on supply end of the strap provides the high tension de- ed. The small size of the motor permits compactness that the strapping tool can fit in a small space and can mounted in any position for various types of packages.

The assembly 34 grips the supply end portion of the ap and the leading end portion is held by the gripping ws 33. A large pulling force is then exerted against the pply end portion of the strap. The assembly 34 com- ises a tension cylinder 35 having an open lower end osed by a centrally apertured plate 36. The inner sur- ce of the plate 36 is recessed, as indicated at 37, to pro- le a seat for one end of a compression spring 38. A ston rod 39, extending through a bushing 41 in the erture of the plate 36, has a piston 42 secured to its d within the cylinder 35. The opposite end of the pis- n rod 39 is pivotally secured, by means of a pin 43, an intermediate portion of a high tension gripper 44. pin 45 pivotally secures one end portion of the gripper the plates 14. The piston 42 has an O-ring 46 sealing peripheral edge to the inner wall surface of the cy- nder, and has a recess 47 in its inner surface to provide seat for the other end of the spring 38.

The corner of the gripper 44 below the pin 43 is urled, as indicated at 48, to enable the gripper 44 to old the strap against movement relative thereto when e gripper is in holding position. The guide member 15 is an opening 49 large enough to permit the knurled rface 48 to engage the surface of the portion of the rap exposed through the opening. The operation of the linder and piston assembly 34 that moves the knurled ortion of the gripper 44 into engagement with the top rface of the strap in the strap guide 11 will be herein- ter described.

The strap guide 11 also includes a spring plunger block l that is secured to the plates 14 by suitable fastening embers 52. One end of the block that is located near e pivot 43 has one edge cut away, as indicated at 53, provide clearance for the adjacent end of the gripper 4. The block 51 is apertured near its opposite end to ceive a spring plunger 54. A compression spring 55 is ased between the spring plunger block 51 and the head 5 of the plunger. The head 56 engages the plate 36, and e spring 55 urges the strap guide 11 downwardly. A n 57 projects transversely through the plunger 54 on the side of the block 51 opposite the spring 55 to hold the spring at a predetermined degree of compression.

The upper surface of the spring plunger block 51 is substantially flush with the upper edges of the plates 14, and a switch 58 is secured to the side plate 14 in vertical alignment with an adjustable screw 49 that extends downwardly from the lower surface of the plate 36. In the lowermost position of the strap guide 11, the adjacent surfaces of the switch 58 and screw 59 are spaced from each other.

The motor M for rotating the roller 12 is secured to the strap guide 11. Accordingly, when the motor has applied tension to the strap, by pulling the supply end portion of the strap as far as possible, its reaction, upon continued operation in the same direction, will move the strap guide 11 pivotally about the pin 19 in a clockwise direction, as viewed in FIGURE 1. This pivotal movement of the strap guide 11 will cause the switch 58 to engage the screw 59 and be energized by it. Energization of the switch 58 will shut off the motor and will actuate the cylinder and piston assembly 34 as hereinafter described.

Actuation of the assembly 34 moves the piston 42 downwardly, as viewed in FIGURE 1, and causes the piston rod 39 to move the gripper 44 clockwise about the pin 45 until the knurled portion 48 of the gripper is moved into engagement with the surface of the strap exposed through the opening 49. Continued downward movement of the piston rod 39 while the knurled portion of the grigper is in engagement with the strap moves the strap guide 11 counterclockwise about its pivot 19, thereby forcing the strap guide down. Since the leading end portion of the strap is held by the gripping jaws 33, this movement, with the strap confined within the strap guide, tightens the strap around the package and places it under high tension.

The gripping jaw mechanism 33 that holds the leading end portion of the strap as the high tension is applied to it is shown in detail in FIGURE 5. It comprises a piston 61 mounted in a cylinder 78 and secured to one end of a piston rod 62. A ram 63 is connected to the other end of the rod 62. The gripping jaws 33 are connected to the ram 63 by links 64 that are pivotally secured to the ram by a pin 124 and to the jaws 33 by pins 122. The gripping jaws are pivoted intermediate their length, as indicated at 123, so that inward movement of the piston 61 spreads the outer ends of the links 64 to move the jaws 33 into gripping position, and movement of the piston in the opposite direction opens the jaws.

One of the holding jaw mechanisms, shown in FIGURE 4 is associated with the gripping jaw mechanism and comprises holding jaws 65 and 66 that are connected to the ram 63 by links 67 and 68 that are pivoted to the ram by a pin 124. The jaws 65 and 66 are pivoted intermediate their length, as indicated at 125. The pivotal connections of the jaws 65 and 66 cause them to move into their holding positions as the jaws 33 move into strap gripping position.

The other jaw holding mechanism 30, shown in FIGURE 2, cooperates with the jaw holding mechanism 20, with which it is complanar, to hold the overlapped portions of the strap in parallel face-to-face relationship through the area in which the sealing and shearing means 50 operates. The jaw holding mechanisms permit the supply end portion of the strap to be retracted while the leading end portion is held securely by the gripping jaws 33.

The jaw holding mechanism 30 comprises a piston 69 mounted in a cylinder 79 and secured to one end of a piston rod 71. A ram 72 is connected to the other end of the piston rod 71 by a pin 82. Two holding jaws 73 and 74 are connected to the ram 72 by means of links 75 and 76, respectively, both of which are pivoted to the ram 72, as indicated at 126. The holding jaws 73 and 74

are both pivoted intermediate their length, as indicated at **127**, so that both jaws move inwardly to holding position when the piston **69** moves inwardly of its cylinder.

The cylinders **78** and **79** have a common end wall **81** that is apertured to allow both piston rods **62** and **71** to extend therethrough. The other ends of both cylinders are closed by an end wall **83** of a third cylinder **92** hereinafter described in connection with the sealing and shearing mechanism **50**.

The seal feeding mechanism **40** comprises a magazine **84** adapted to hold a plurality of metal seals **85** and having an open end adjacent the outer end of the upper jaw holding mechanism **30**. A seal pad **86**, positioned in the magazine **84** above the seals, is urged toward the discharge end of the magazine by a coiled spring **87** to move the stack of seals in the same direction. The seal pad is pushed in the opposite direction against the action of the spring **87** when the seals are being loaded into the magazine. A seal ejector **88** is pivoted to one end of a pair of arms **89**. The other end of each arm **89** is pivoted to the ram **72** of the upper jaw holding mechanism. A pin **90** pivotally connects a spring-pressed plunger **91** to the mid-section of the arm **89**.

Movement of the ram **72** to the right, as shown in FIGURE 1, permits the spring-pressed plunger **91** to move the arm **89** counterclockwise about pin **100**. The movement of the arms **89** in this direction moves the ejector **88** across the open discharge end of the magazine. The ejector pushes the seal **85** at the discharge end of the magazine out of the magazine and in the area between the two coplanar jaw holding mechanisms **20** and **30**. The ejector moves the seal into alignment with the outer end of the sealing jaws where it is secured around the overlapped portions of the strap by the sealing jaws. The details of the sealing mechanism are not important to an understanding of the present invention and if further information is desired, reference can be made to the aforementioned Ericsson et al. patent.

Movement of the ram **72** in the opposite direction forces the arms **89** in the opposite direction against the action of the spring-pressed plunger **91** and moves the ejector **88** across the discharge end of the magazine in the opposite direction, so that it will not interfere with the sealing operation.

The sealing and shearing mechanism **50** includes the cylinder **92**, which has a plate **93** that is part of the valve housing **22** closing its end opposite the end **83**. A piston **94** mounted in the cylinder **92** has one end of a piston rod **95** secured thereto. The piston rod **95** extends through the bottom wall **83** and also through the wall **81** between the cylinders **78** and **79**. The plate **93** is apertured, as indicated at **96**, and a conduit **97** extends from the aperture **96** to an aperture **77** in the tension cylinder **35** near the end closed by the plate **36**. The conduit **97** directs air bled from the cylinder **92**, when the piston **94** is moved outwardly, to the cylinder **35** to cushion the piston **42** after the strap is cut.

As shown in FIGURE 3, the end of the piston rod **95** remote from the piston **94** is connected to a ram **98**. A pair of sealer jaws **99** and **101** are connected to the ram **98** by links **102** and **103**, respectively. Both links **102** and **103** are pivoted to the ram **98** by a pin **128**. The jaws **99** and **101** are pivoted intermediate their length, as indicated at **129**. A cutting blade **104**, slidably secured to the side of the jaw holding mechanism **20** adjacent the sealing and shearing mechanism **50**, is moved past the end of the stationary cutting block **31** after the sealing operation. A pin **131** projecting from the mechanism **50** extends through a longitudinally extending slot **132** in the blade **104** and engages one end of the slot **132** to move the blade after the sealing jaws **99** and **101** have crimped the seal **85** around the overlapped portions of the strap. The blade **104** cooperates with the block **31** to shear the supply end portion of the strap outwardly of the loop formed by sealing the overlapped portions of the stra by the metal seal **85**.

In order to separate the strapped package and th strapping tool, it is necessary to move the face gate late ally of the strap guide **29** to get it out of the way. Th mechanism for moving the face gate is attached to th jaw holding mechanism **30**, and is shown in FIGURE The face gate **28** is secured to one end of an L-shaped arr **133** that is pivoted at **134**. A pin **135** projecting throug the outer end of the arm **133** engages a notch **136** in on end of a plate **137** that is slidably mounted adjacent on side of the ram **72**. The surface of the plate **137** cor tiguous to the ram **72** is provided with a longitudinall extending recess **138** that is engaged by one end of th pin **82** that extends beyond the surface of the ram **72**.

During the first part of the movement of the pisto rod **71** when the piston **69** moves to the left in cylinde **79**, as shown in FIGURE 1, the ram **72**, acting throug the links **75** and **76**, moves the gripper jaws **73** an **74** inwardly toward holding position and the recess 13 permits the pin **82** to move without changing the posi tion of the pin **135**. When the pin **82** is engaged wit the opposite end of the recess **138**, it moves the plate 13 and the pin **135** in the same direction as the piston ro **71**. This swings the arm **133** counterclockwise about th pivot **134** to move the face gate **28** laterally of the stra guide **29** to its open position.

In the movement of the piston rod **71** in the opposit direction, the pin **82** traverses the length of the reces **138** in the opposite direction before it moves the plat **137** and pin **135**. This moves the arm **133** clockwise abou the pivot **134** to swing the face gate **28** into its closec position.

Returning to FIGURE 1, it is noted that the ram 9 has a recess **105** in its side adjacent the upper holdin jaws, and a latch **106** interengages the recess to preven operation of the sealer until the ejector and the face gate **28** move out of the way of the sealing mechanism. The latch **106** is pivoted, as indicated at **107**, so that i can swing out of engagement with the recess **105** wher the lower surface of the ram **72** is advanced out of the way of the front edge of the latch.

The pneumatic diagram and the electrical diagram of the apparatus shown in FIGURES 6 and 7, respectively, will be described in connection with the operation of the strapping machine. In describing the operation of the strapping machine, it will be assumed that the strapping machine is adjacent one surface of the article or package to be wrapped, and the leading end of the strap has been positioned between the rollers **12** and **13**.

The first step in the strapping operation is to close a switch **108** that energizes the motor M to rotate the roller **12** in one direction so as to feed the strap forwardly into the lower strap guide. The leading end of the strap passes through the strap guide **11** and through the strap chute adjacent the front of the strapping machine. Specifically, the leading end of the strap moves upwardly through the space between the front strap guide **25** and the guide finger **26**, then between the stationary cutter **31** and the block insert **32**, and then between the face gate **28** and guiding insert **29**. When the leading end of the strap has passed through the space between the face gate **28** and the guiding insert **29**, a chute (not shown) guides it around one perimeter of the package and between the front surface of the front strap guide **25** and a gate **109** to lead the strap back into the strapping machine. The gate **109** is spaced forwardly of the strap guide **25** and its lower edge is flared outwardly, as indicated at **110**, to facilitate reentry of the strap into the strapping machine.

As the leading end of the strap moves through the strapping machine on its second pass, it closes a switch **111**. The switch **111** energizes a timer relay **112** that actuates two solenoid valves **113** and **14** after a time delay. The relay **12** is set to stop the feeding movement of

strap after a predetermined time interval has passed. e motor and associated brake is designed so that the tor will feed the correct amount of strap past the seal- and gripping jaws. The motor M is then reversed after leading end of the strap passes the gripping jaws **33**. e valve **114** operates to load the cylinders **78** and **79** one side of the pistons **61** and **69**, respectively, and valve **113** serves to bleed the opposite side of the tons.

The piston **61**, operating through the linkage shown in GURE 5, moves the jaws **33** into strap gripping posi- n and, operating through the linkage shown in FIG- RE 4, moves the jaws **65** and **66** into strap holding sition. At the same time, the piston **69**, operating ough the linkage shown in FIGURE 2, moves the vs **73** and **74** into strap holding position.

When the motor M is reversed, it exerts a tensioning ce on the supply end portion of the strap through roller **12** and its backup roller **13**. This tensioning ce removes the slack from the strap, and then forces strap guide **11** clockwise about its pivot **19** against action of the spring **55**. The pivotal movement of strap guide **11** causes the switch **58** to move into gagement with the screw **59**, and pressure of the switch ainst the screw closes the switch.

Closing the switch **58** energizes a control relay **115** at energizes a timer relay **116** and a solenoid valve **117**, d deenergizes the motor M. The valve **117** loads the linder **35** on one side of the piston **42** to move the ipper **44** into engagement with the strap confined in strap guide **11**, and to force the strap guide down. ie gripper **44** holds the strap against slipping during the ovement of the lower strap guide and stretches the strap a direct pulling action on the supply end portion there- , thus putting the strap under high tension that is eater than the maximum tension that can be applied it by the motor M.

When the timer relay **116** is timed out, it energizes solenoid valve **118** to load the cylinder **92** on the piston le of the piston **94**, and deenergizes the timer relay **112**. ie latch **106** prevents the piston **94** from actuating the aling mechanism until the holding jaws **73** and **74** are osed and the ejector **88** is moved out of the way of the aling mechanism, so that it will not interfere with the aling operation. The movement of the piston **94** actuates e sealing jaw mechanism to crimp a seal **85** around erlapped portions of the strap, and also moves the itting blade **104** past the cutting edge of the stationary itter **31** to cut the supply end portion of the strap out- ardly of the seal. Air from the cylinder **92** is bled rough the conduit **97** into the return side of the cylinder **5**, so that when the strap is cut, the movement of the ston **42** will be cushioned.

The deenergization of the relay **112** deenergizes all of ie valves and also deenergizes the relay **116**, to prevent filling of the strap chute until all the pistons of the arious valves have returned to their initial positions. hen the relay **116** is timed out, the motor will be re- tivated to fill the strap chute and thus start another ycle.

Although we have described a preferred embodiment f the invention in considerable detail, it will be understood that the description thereof is intended to be illustrative, rather than restrictive, as many details of construction may be modified or changed without departing from the spirit or scope of the invention. Accordingly, we do not desire to be restricted to the exact structure described.

What is claimed is:

1. Apparatus for providing a tensioned ligature about an article comprising: means for feeding a length of binding material from a supply of material around the article so that the leading end portion of the length of binding material overlaps the supply end portion thereof; means for gripping said leading end portion to hold it against movement relative to said article; pivotally mounted support structure; first means mounted on said support structure for retracting said supply end portion for applying an initial tension to said length of binding material, said retracting means being arranged to pivot said support structure in a first direction when said initial tension has been applied; second means for further retracting said supply end portion for applying a final tension to said length of binding material in excess of said initial tension; and means responsive to pivotal movement of said support structure in said one direction for pivoting said support structure in an opposite direction and for actuating said second means.

2. Apparatus in accordance with claim **1** in which said second means includes a gripper pivotally mounted on said support structure and positioned to engage said supply end, and wherein said means responsive to pivotal movement of said support structure includes a cylinder and piston assembly connected to said gripper for initially pivoting said gripper into engagement with said supply end and for subsequently pivoting said support structure to apply said final tension.

3. Apparatus in accordance with claim **2** in which said means responsive to movement of said support structure in said one direction includes a switch for energizing said assembly.

4. Apparatus in accordance with claim **2** in which said support structure includes means for guiding said binding material.

5. Apparatus in accordance with claim **2** including means for cushioning the movement of the piston of said cylinder and piston assembly.

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U.S. Cl. X.R.

100—26, 30