United States Patent

Weller

[15] **3,636,861**

[45] **Jan. 25, 1971**

[54] STRAPPING MACHINE

[72] Inventor: **Frank C. Weller,** Chicago, Ill.

[73] Assignee: **Interlake Steel Corporation,** Chicago, Ill.

[22] Filed: **Apr. 20, 1970**

[21] Appl. No.: **30,006**

[52] **U.S. Cl.** ..... **100/4,** 100/26, 100/30, 100/33 PB

[51] **Int. Cl.** **B65b 13/02**

[58] **Field of Search** ..... 100/4, 26, 29, 30, 32, 33, 100/33 PB

[56] **References Cited**

UNITED STATES PATENTS

3,139,813	7/1964	Hall et al.	100/4
3,447,447	6/1969	Rutty	100/4
3,269,300	8/1966	Billett et al.	100/33 X
3,470,814	10/1969	Tschappu	100/4

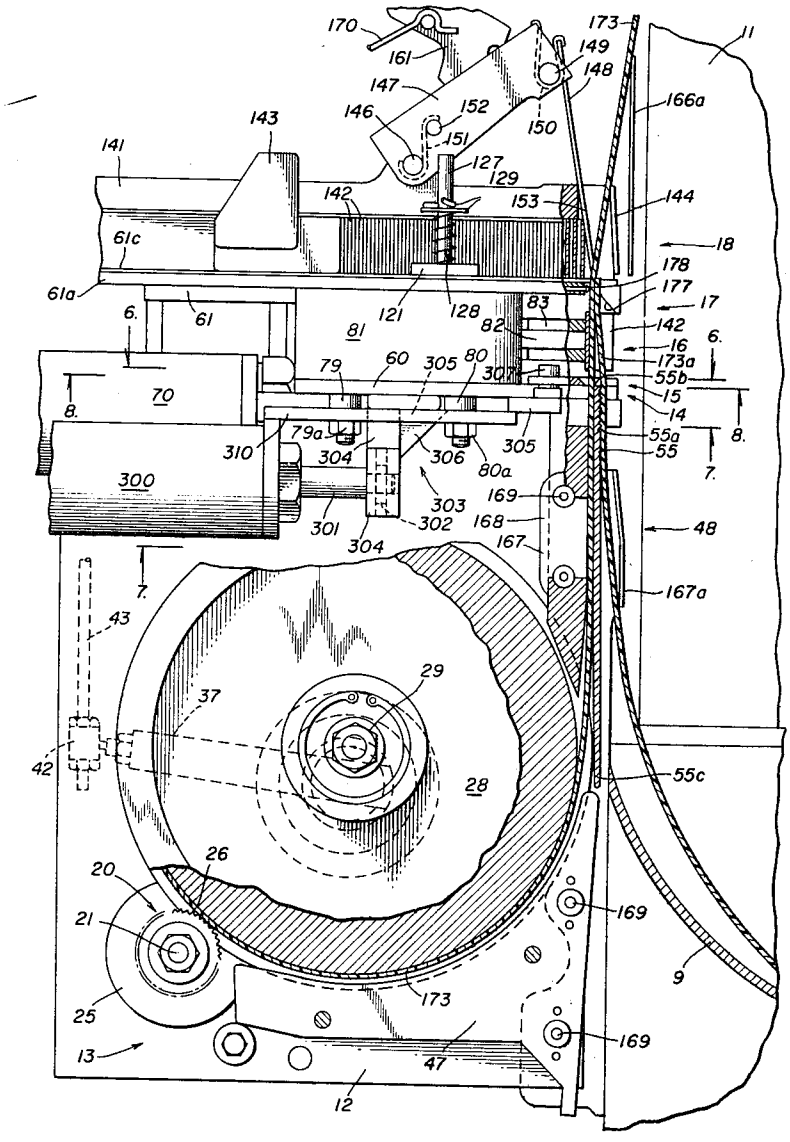
Primary Examiner—Billy J. Wilhite

Attorney—Prangley, Clayton, Mullin, Dithmar & Vogel

[57] **ABSTRACT**

A strapping machine for binding an object by providing plastic strap forming a loop having a supply portion and the leading end thereof overlapping. Tensioning and feeding mechanism, strap-gripping mechanism, strap-severing mechanism, sealing mechanism, strap-gathering mechanism, and seal-feed mechanism are provided.

23 Claims, 15 Drawing Figures



PATENTED JAN 25 1972

3,636,861

SHEET 1 OF 6

FIG. 1

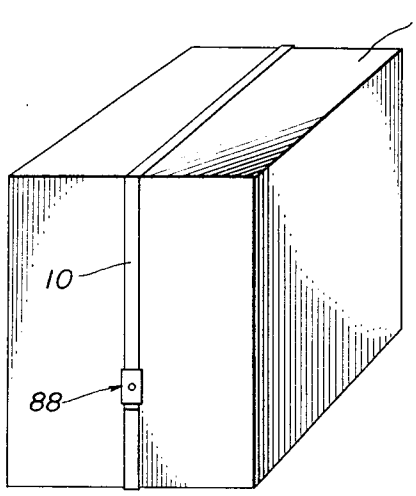


FIG. 2

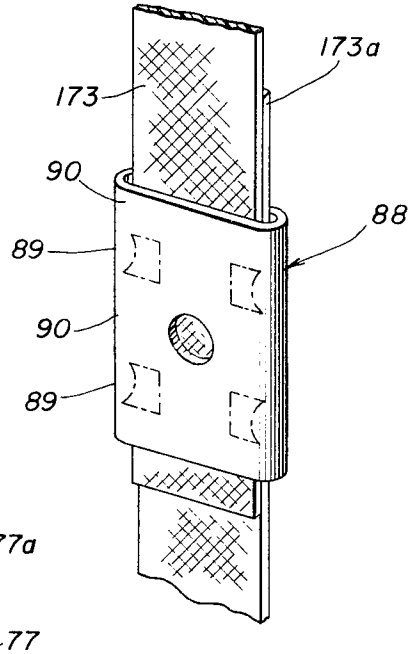


FIG. 6

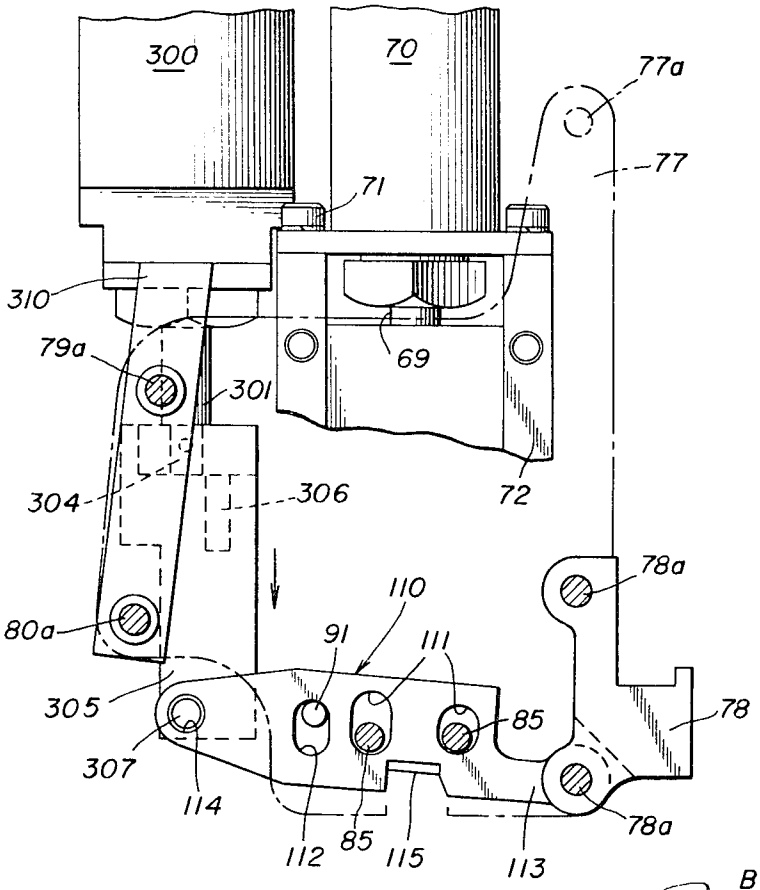
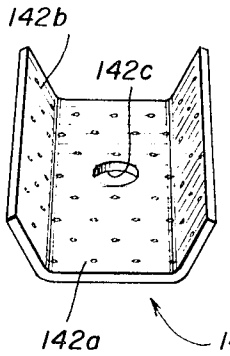


FIG. 3



INVENTOR
FRANK C. WELLER

BY
Prangley, Clayton, Mullin, Dithmar & Vogel
ATTYS.

FIG. 4

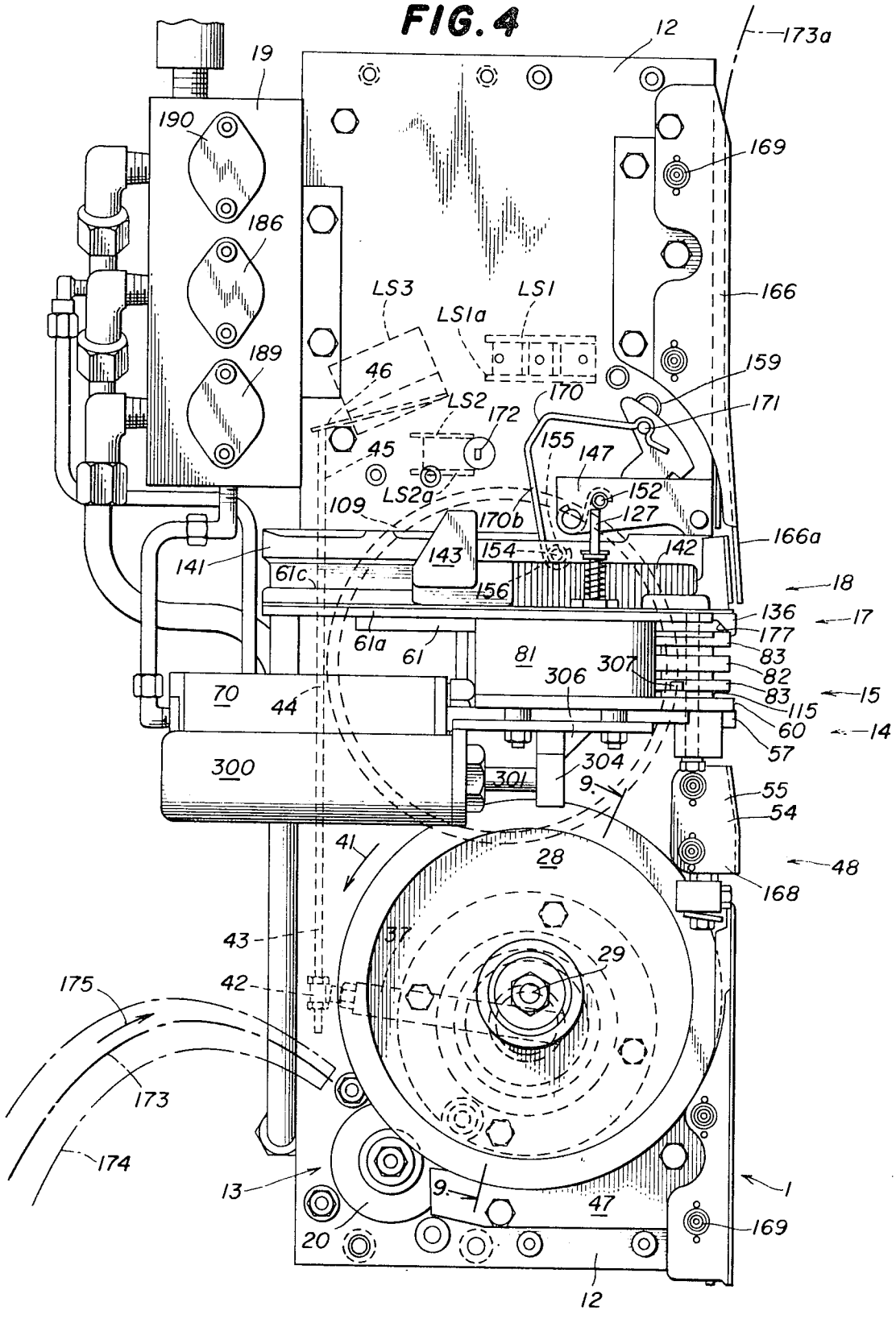
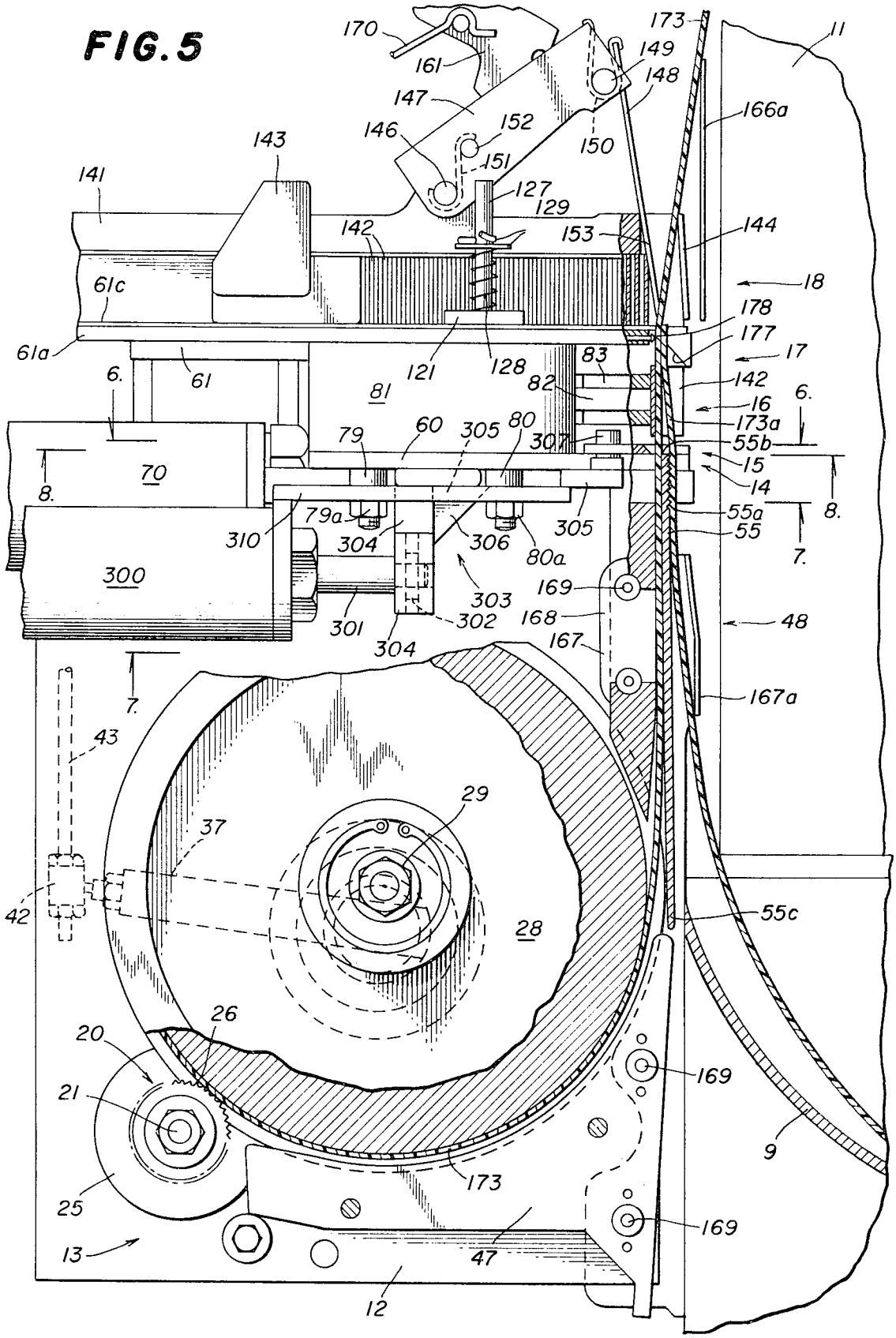

12
173a
19
190
169
186
LS3
LS1
LS1a
166
46
159
189
LS2
172
170
171
45
155
147
152
LS2a
109
170b
127
166a
143
154
142
141
61c
156
18
136
17
61a
61
81
177
83
306
307
82
70
44
83
15
115
60
14
57
300
304
301
9
55
54
41
28
48
168
43
37
29
42
175
173
174
13
9
47
1
20
169
12

FIG. 5


170
161
147
146
143
141
152
151
127
129
142
153
150
149
148
173
11
166a
144
18
178
177
17
61c
61a
61
121
128
83
82
142
16
173a
55b
15
14
55a
55
6.
8.
7.
81
70
79
60
305
80
307
79a
310
304
306
80a
305
300
303
302
301
304
169
168
167
48
167a
43
29
37
42
28
55c
26
20
21
25
13
47
12
173
169
9
169

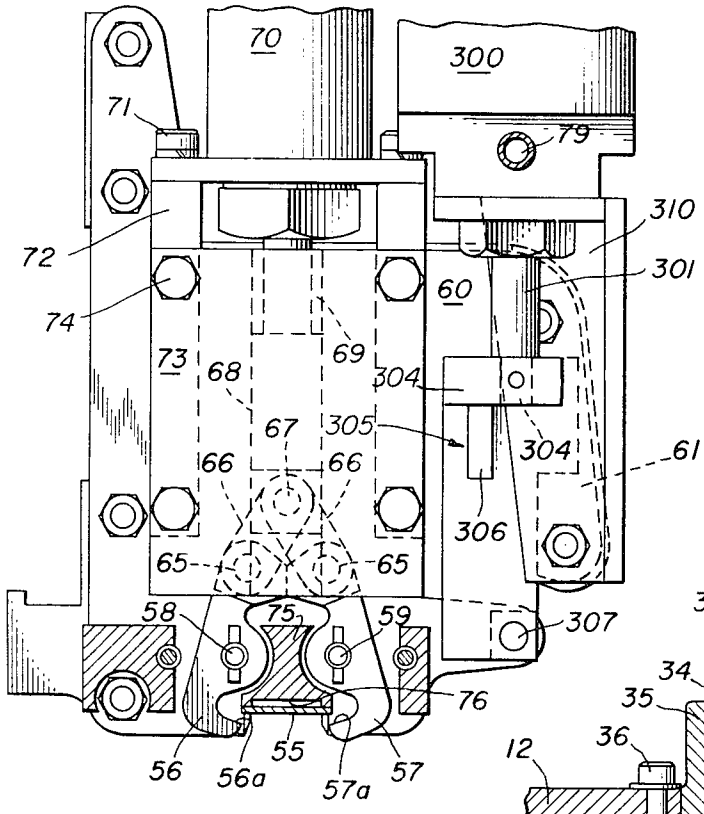


FIG. 7

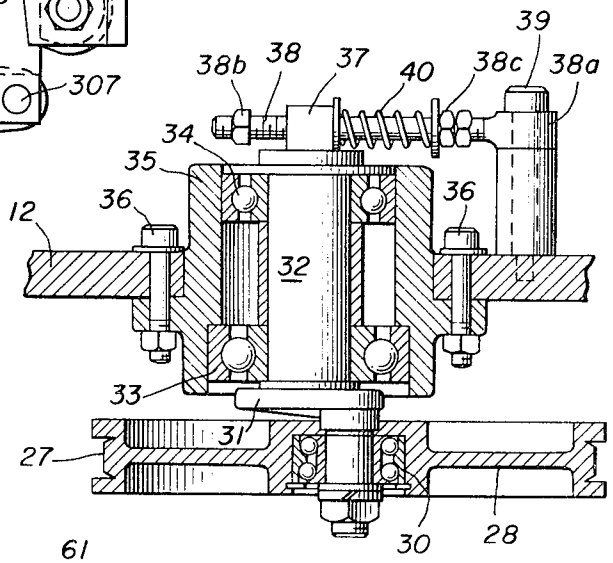


FIG. 9

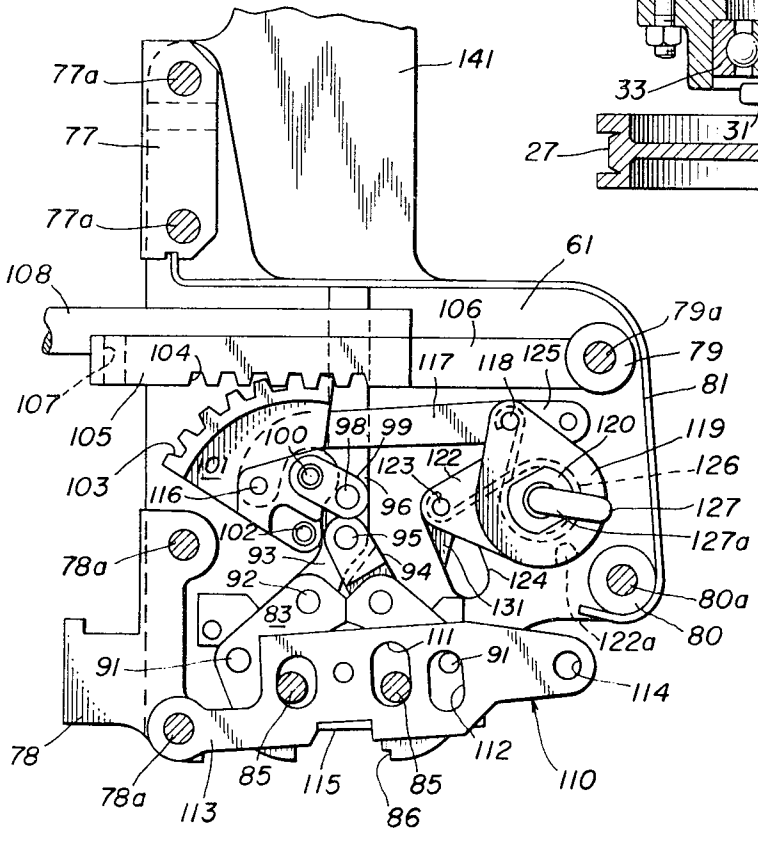


FIG. 8

FIG. 10

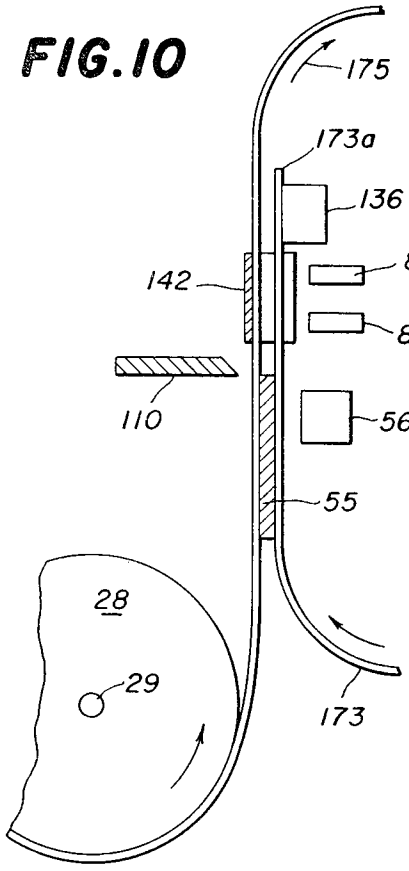


FIG. 11

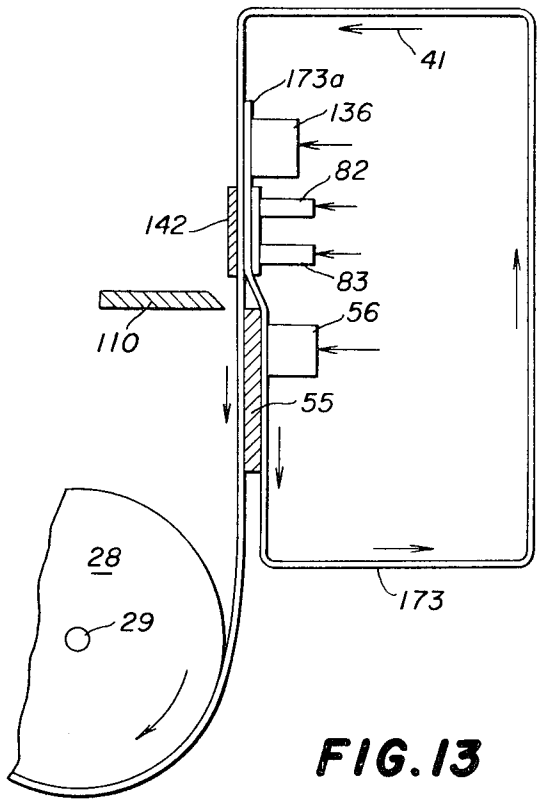


FIG. 12

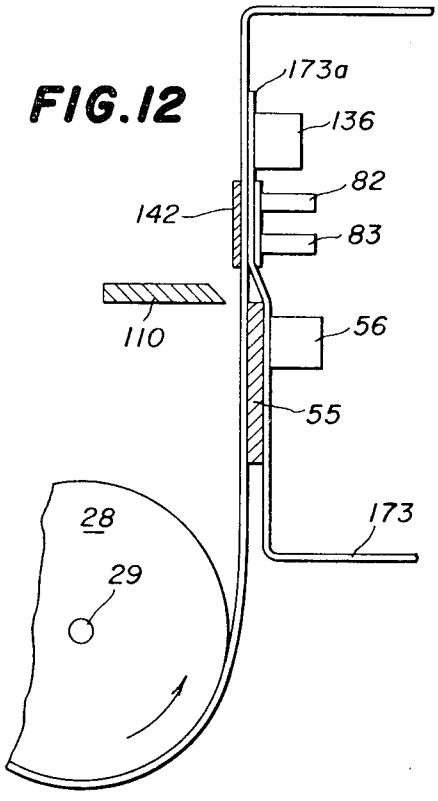


FIG. 13

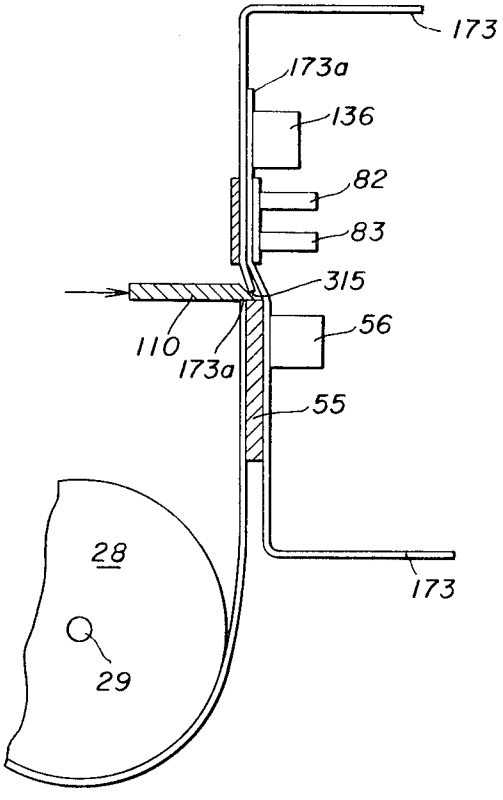
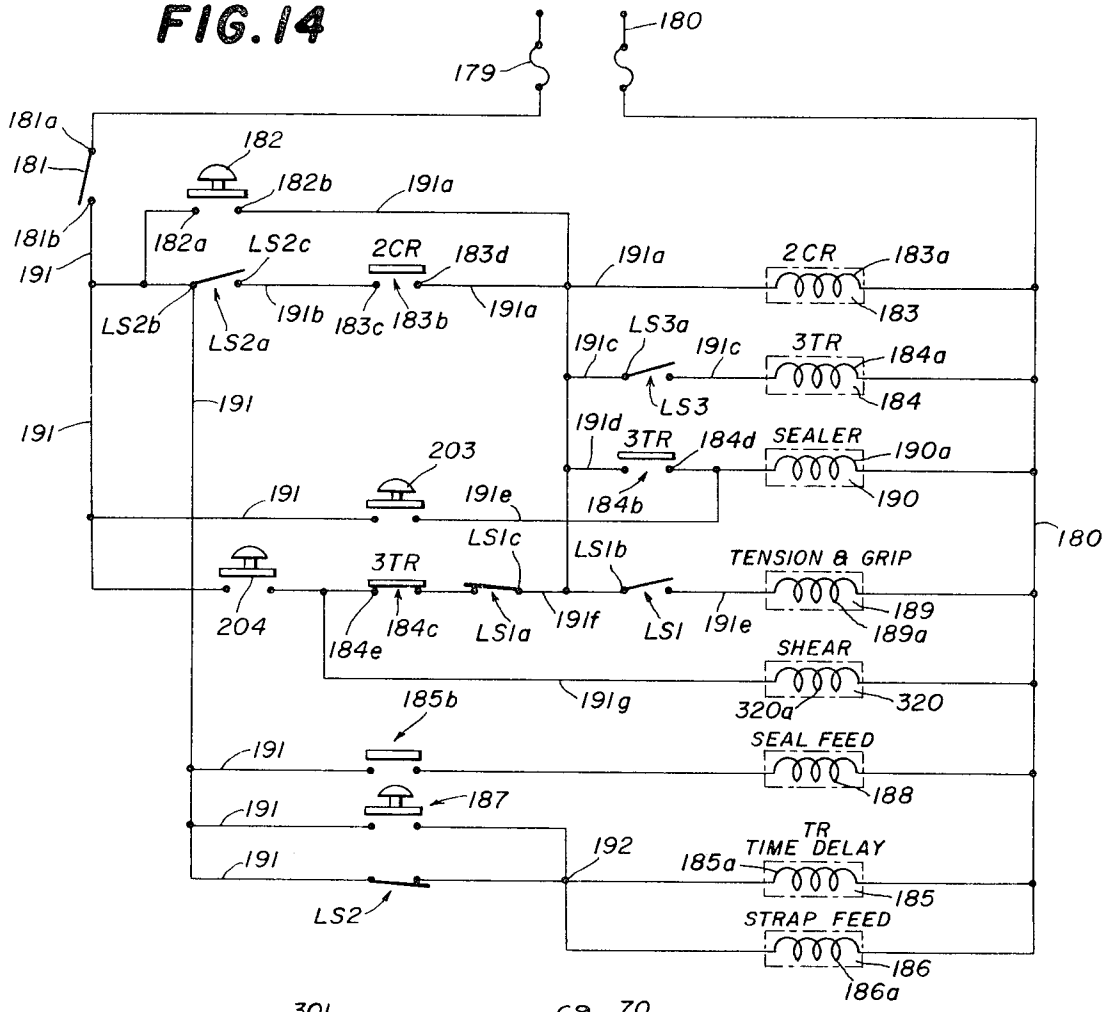


FIG. 14


179
180
181a
181
181b
191
182
182b
182a
191a
LS2c
2CR
183d
LS2b
LS2a
191b
183c
183b
191a
2CR
183a
183
191c
LS3a
191c
3TR
184a
LS3
184
191
191d
3TR
184d
SEALER
190a
203
191
191e
184b
190
180
LS1c
LS1b
TENSION & GRIP
3TR
204
184e
184c
LS1a
191f
LS1
191e
189
189a
SHEAR
320a
320
185b
191g
191
SEAL FEED
188
191
187
191
192
TR
TIME DELAY
185a
185
LS2
STRAP FEED
186
186a

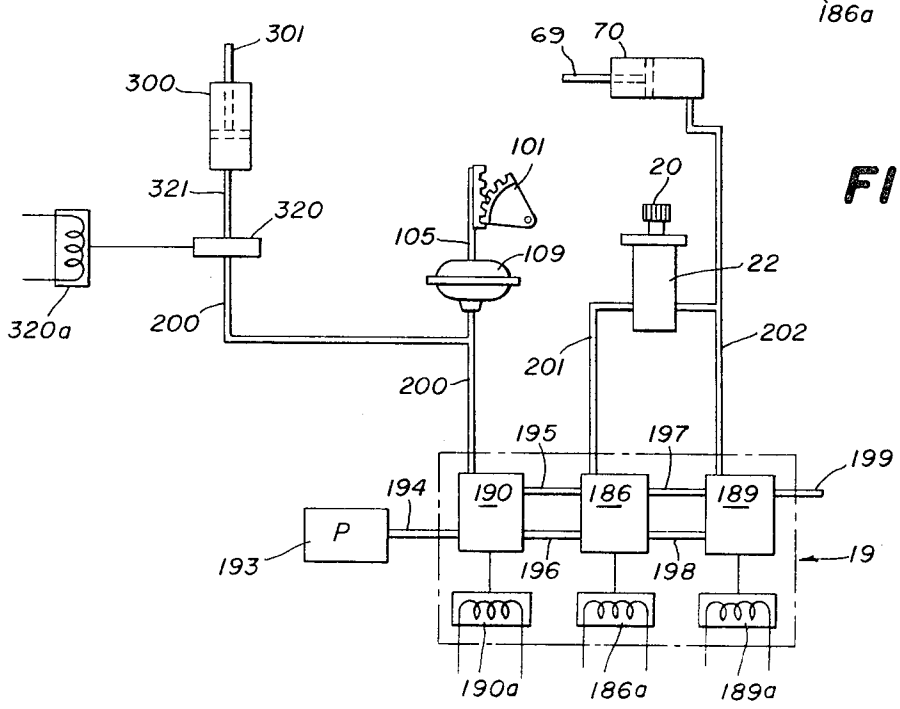

301
300
69
70
101
20
321
320
105
109
22
320a
200
202
201
200
195
197
199
194
190
186
189
P
193
196
198
19
190a
186a
189a

FIG. 15

STRAPPING MACHINE

In operation, as the plastic strap is fed around the object, a seal is positioned within the sealing mechanism and after the leading end of the strap enters the strap-gathering mechanism, the strap-tensioning and gripping mechanisms are simultaneously actuated to grip the leading end of the strap and tension the strap by withdrawing the supply portion thereof, thereafter the strap-sealing mechanism is actuated and at the completion of the sealing, the tension in the supply portion of the strap is released and the strap shearing mechanism is actuated to shear the plastic strap and provide a cleanly severed leading end of the strap and a cleanly severed free end of the strap.

This invention relates to an improvement in a strapping machine of the type disclosed in U.S. Pat. No. 3,139,813 issued July 7, 1964 to Hall et al., the disclosure of which patent is incorporated herein by reference. More particularly, this invention relates to an improved strapping machine for use with plastic strap and still more particularly to use with polypropylene plastic strap.

It is an important object of the present invention to provide a strapping machine for applying a plastic strap around an object, the strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween, control means for the tensioning means responsive to completion of the operation of the sealing means for releasing the tension in the supply portion of the strap, and strap-severing mechanism for severing the supply portion of the strap adjacent to the seal joint after the tension in the strap has been released, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

Another object of the present invention is to provide a strapping machine of the type set forth in which a fluid motor is provided for operating the strap-severing mechanism and control mechanism is provided for the fluid motor responsive to release of tension in the supply portion of the strap for operating the motor.

Another object of the present invention is to provide a strapping machine of the type set forth in which the tensioning means include first and second cooperating drive drums positioned to have the supply portion of the strap passing therebetween and motor means for driving one of the first and second drive drums to supply strap to form a loop encircled about the object and for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap.

Another object of the present invention is to provide a strapping machine of the type set forth in which there is provided control mechanism for the sealing means responsive to a predetermined tension in the loop of strap for activating the sealing means.

Still another object of the present invention is to provide a strapping machine of the type set forth in which there is provided a blade over which the strap passes, the blade having a portion with transverse grooves formed therein and gripping jaws for forcing the material of the strap into the grooves to hold the strap taut during the operation of the tensioning means and a movable strap shear means for coacting against the blade for severing the strap.

A further object of the present invention is to provide a strapping machine of the type set forth in which there is provided a first fluid motor for operating the strap-gripping means and the tensioning means for causing simultaneous actuation of the tensioning means and the strap-gripping means, a second fluid motor for operating the sealing means, a third fluid motor for operating the strap-severing mechanism to sever the supply portion of the strap and control mechanism for the third fluid motor responsive to release of tension in the supply portion of the strap for operating the third fluid motor.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings in which:

FIG. 1 is a perspective view of a parcel or package provided with a binder strap having a sealed joint therein as it would appear after being applied with the apparatus of this invention;

FIG. 2 is a perspective view of a sealed joint as applied by the apparatus of this invention to the overlapping strap ends of a strap loop encircled about a package;

FIG. 3 is a perspective view of a channel-shaped seal employed with the apparatus of this invention;

FIG. 4 is a side elevational view of the strapping machine of the present invention;

FIG. 5 is an enlarged side elevational view of a part of the machine shown in FIG. 4;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5 particularly showing the strap-shearing mechanism;

FIG. 7 is a sectional view taken along line 7—7 of FIG. 5 particularly showing the strap-gripping mechanism;

FIG. 8 is a sectional view taken along line 8—8 of FIG. 5 particularly showing the strap-sealing and shearing mechanism;

FIG. 9 is a sectional view taken alone line 9—9 of FIG. 4 particularly showing the tensioning mechanism;

FIG. 10 is a diagrammatic view of the operation of the machine of this invention showing the strap encircling the object to be wrapped;

FIG. 11 is a diagrammatic view of the operation of the machine of this invention showing the strap gripped, under tension and the seal joint formed;

FIG. 12 is a diagrammatic view of the operation of the machine of this invention showing the seal joint formed and the strap with the tension in the supply portion thereof released;

FIG. 13 is a diagrammatic view of the operation of the machine of this invention showing the strap sheared;

FIG. 14 is a simplified schematic view of the electrical control circuit; and

FIG. 15 is a diagrammatic view of the pneumatic circuit of the present machine.

The strapping machine and head 1 embodying the invention herein used to produce a bound package 11 of the type shown in FIG. 1 are usually provided with two roller conveyors (not shown) for transporting an unbound package to the machine and a bound package away from the machine. The roller conveyors and the strapping machine and head 1 are each suitably supported by appropriate support structure, the support structure having associated therewith a channel-shaped strap guide 9 for suitably guiding a loop of strap 10 around a package 11 being strapped and ensuring that the leading end of the strap loop properly is fed under the package 11 and up into proper location with the working path of the strapping head 1.

With reference particularly to FIGS. 4 and 5, it is seen that the strapping machine 1 is provided with a single large rectangular plate 12 which is the main support frame for all components of the strapping machine or head 1. The major operating portions of the head 1 consist of the strap feed, slack takeup and tensioning portion 13, a leading strap and gripping portion 14, the strap shear portion 15, the joint sealing or forming portion 16, the strap-gathering jaw portion 17, and the strap seal storing and feeding portion 18. In addition, there is a valve manifold 19 which houses three air valves, there being an added air valve for the shear portion 15 separate from the manifold 19, for controlling the air-powered portions of the machine powering the portions 13 to 18.

The strap feed, slack takeup and tensioning portion 13 is provided with a serrated rotary feed wheel or drum 20 which is secured to the end of a shaft 21. The shaft 21 is the drive shaft of an air motor 22 mounted on one side of the frame 12 and projecting through a circular hole 25 on the other side of the frame 12. The rotary feed wheel 20 is positioned so that the teeth or serrations 26 about its periphery are parallel to an

annular wall 27 on a drum or wheel 28 adjacent thereto. The wheel 28 is considerably larger in diameter than the rotary feed wheel 20, the wheel 28 being mounted, particularly as shown in FIG. 9, on a bearing 30 to the outer end of the shaft 29. The wheel 28 is free to rotate on the bearing 30 relative to the shaft 29 except during the tensioning operation, as hereinafter explained. The shaft 29 is secured at its inner end to a flange 31 which is secured to one end of a larger shaft 32. The shaft 29 is mounted on the flange 31 with its center eccentric with the center of the shaft 32. The shaft 32 is mounted between bearings 33 and 34 in a bearing housing 35 secured to the frame 12 by means of bolts 36.

The other end of the shaft 32 is secured to the lower end of an arm 37 which extends radially outward from the shaft 32. The intermediate portion of the arm 37 is provided with an opening through which freely passes a threaded shaft 38 mounted on a stud 39 which is secured to the frame 12. The other end of the threaded shaft 38 is provided with a threaded nut 38*b* which retains the arm 37 from falling off of the shaft 38. Between the arm 37 and a portion near its end 38*a*, where there is a threaded nut 38*c*, is a coil spring 30 reacting between the nut 38*c* and the arm 37 to apply a rotating force on the shaft 32 tending to urge it in a counterclockwise direction shown by the arrow 41 in FIG. 4. The free end of the arm 37 is secured by a universal coupling 42 to one end 43 of a rod 44. The other end 45 of the rod 44 is in line with the actuating arm 46 of a switch LS3, the rod 44 causing actuation of the switch LS3 upon rotational movement of the shaft 32, as will hereinafter be described.

Around the lower portion of the wheel 29 is a guide 47 for guiding the strap 173 around the wheel 28 in the region from adjacent to the rotary feed wheel 20 to the front surface of the head 1.

Above the level of the strap feed slack takeup and tensioning portion 13 is the leading strap and gripping portion 14. With reference particularly to FIG. 7, the gripping portion 14 consists of two grippers 56 and 57 pivoted respectively on two pins 58 and 59 mounted between two side plates 60 and 61. The grippers 56 and 57 are provided with sharpened jaws 56*a* and 57*a* which are adapted to react against the leading end of the strap when it is positioned beneath the blade 55. The blade 55 is provided with transverse grooves 55*a* (see FIG. 5) which coact with the smooth surfaces of jaws 56*a* and 57*a* so that the strap 173, when gripped, is deformed slightly into the transverse grooves for tight gripping thereof.

The blade 55 is secured to the frame 12 by the usual means and the blade 55 has the functions of strap gripping and its leading edge 55*b* acts as a stationary shear blade, as hereinafter described. The blade 55 has an additional function of strap guiding because its rear end 55*c* extends substantially to the region of the guide 47 where it guides the strap 173 from the wheel 28 all the way into the joint sealing or forming portion 16.

The upper ends of the grippers 56 and 57 are pivoted on pins 65 to two toggle links 66 which in turn are pivoted on a pin 67 to a yoke 68. The yoke 68 is secured to a piston rod 69 of a piston contained in an air cylinder 70. In operation, the grippers 56 and 57 are positioned as shown in FIG. 7 and the piston rod 69 of the air cylinder 70 is retracted at that time. Upon extension of the piston rod 69 by admission of air in the proper direction to the air cylinder 70, the pin 67 is moved to cause the link 66 to pivot the grippers 56 and 57 and cause their jaws 56*a* and 57*a* to grip a strap positioned beneath the blade 55. The cylinder 70 is secured by screws 71 to a pair of supports 72 which are provided with a cover plate 73 and secured by means of screws 74 to the sideplate 60. Above the blade 55 in this region is a fixed strap guide 75 which has a groove 76 formed in it to provide an opening larger than the thickness of the strap 173 to be used where the supply strap can be guided and moved freely even though the leading strap end 173*a* is gripped in a fixed position against the lower surface of the blade 55 during tensioning.

Forward of the leading strap end gripping portion 14 is first the strap shear portion 15 and then the joint sealing or joint forming portion 16. Both of these are shown particularly in FIG. 8 and are contained between the two parallel sideplates 60 and 61 Both of the sideplates 60 and 61 are held apart in parallel relationship by means of four spacers 77, 78, 79 and 80. The sideplates 60 and 61 are assembled to the spacers by means of bolts 77*a*, 78*a*, 79*a* and 80*a* so as to provide a substantially closed boxed-in structure. A sheet metal cover 81 surrounds a portion of the structure in order to conceal its mechanism, the housing being hooked around the spacer 80 at one end and hooked onto the spacer 77 at the other end and being easily removable for servicing.

The mechanism for joint sealing in the region 16 consists of a plurality of six jaws 82 and 83, particularly shown in FIG. 8. There are, in this particular showing, four jaws 83 positioned two each opposite the two others and two jaws 82 positioned one opposite each other, also refer to FIGS. 4 and 5. The arrangement is such that the jaws 82 are alternately sandwiched between the jaws 83, the jaws 82 and 83 being pivoted on pins 85 to the sideplates 60 and 61. Each of the jaws 82 and 83 is provided with recessed portions 86 which are adapted to engage the edges of a seal 142 and wrap it around overlapping strap ends 173 and 173*a* adjacent to it and cause a seal joint 88 to be formed by deforming the seal 142 and the strap ends with these recessed portions 86. The result is a seal joint 88, as shown in FIG. 2, having tabs 89 which are the regions not contacted by the jaws 82 and 83 while the recessed portions 86 of the sealer jaws 82, 83 engage beneath the remaining edge portions 90. It should be emphasized at this point that the particular sealer jaws 82 and 83 and sealer mechanism generally used and shown herein are an example of a conventional type well known in the art and is not intended to be restricted to this particular form, it being merely shown by way of example.

In addition to the sealer jaws 82 and 83 being pivoted on the pins 85, they are also secured together by pins 91 so that they pivot integrally. The upper ends of the sealer jaws 83 are pivoted on pins 92 to two toggle links 93 and 94. The toggle links 93 and 94 are in turn pivoted together on a pin 95 which is mounted between two slides 96 and another slide (not shown), see FIG. 8. The slide 96 is hereinafter referred to as the crosshead. Both the slide and the crosshead 96 are provided with another pin 98 which is pivoted to two links 99, one link 99 being adjacent to the slides and the other link 99 being adjacent to the crosshead 96. These links 99 are in turn pivoted on a pin 100 to a gear sector 101. This gear sector 101 is pivoted on a pin 102 between sideplates 60 and 61, the gear sector 101 having teeth 103 which normally engage teeth 104 on a rack 105 which is guided in two oppositely positioned grooves 106 formed in the sideplates 60 and 61. The rack 105 is mounted by means of two screws 107 to the piston rod 108 of the air cylinder 109, as seen in FIG. 4, which is hereinafter referred to as the sealer cylinder. In operation, the sealer parts are initially retracted to their position in FIG. 8. As the piston rod 108 is extended by admitting air under pressure in the proper direction to the sealer cylinder 109, the rack 105 causes the gear sector 101 to rotate on its pin 102 in a clockwise direction, as viewed in FIG. 8, and this causes the sealer jaws 82 and 83 to pivot in such a manner that the oppositely positioned recess portions 86 are moved toward each other to cause a formation of a seal joint 88 when a seal 142 encircling two overlapping strap ends is present in the sealing region. After joint formation, the rack is returned by retraction of the piston rod 108 to return all parts of the sealer mechanism to their original positions as shown in FIG. 8.

The strap shear portion 15 is particularly shown in FIGS. 6 and 8, the strap shear portion 15 including a movable shear blade 100 having two spaced-apart elongated openings therein 111. The elongated openings 111 providing room for the blade 110 to move and not bind on the pins 85 extending through the elongated openings 111. The blade 110 is also provided with another elongated opening 112 which opening 112 receives therethrough the pin 91, the elongated openings

111 and 112 providing for sufficient freedom of movement for the blade 110 so that it may move from its stored position, as shown in FIG. 8, to its cutting position, as shown by the dotted lines in FIG. 6, without binding on the pins 85 and 91. The movable blade 110 is pivoted at one end 113 thereof on pin 78*a*, the blade 110 being provided with a hole for mounting of the blade on the pin 78*a*. At the end of the blade 110 opposite to the pin 78*a* is provided a hole 114, the hole 114 being provided to receive therethrough a connecting link to the actuating mechanism for the movable blade 110. There is further provided an air cylinder 300 having a spring-loaded piston rod 301, which air cylinder 300 will hereinafter be referred to as the shear cylinder. The piston 301 is connected to the shear blade 110 by means of an L-shaped linkage 303, the linkage 303 being connected to the piston rod 301 by a nut 302 connecting the piston rod 301 to a vertical plate 304, the vertical plate 304 is connected to a horizontal plate 305 which is supported by a diagonal support 306 to the vertical plate 304. A pin 307 connected to the horizontal plate 305 extends through the hole 114 in the shear blade 110, thereby to connect the shear blade 110 with the piston 301 of the shear cylinder 300. In operation, when air is admitted under pressure to the shear cylinder 300, the piston 301 is moved outwardly therefrom and causes, by means of the L-shaped linkage 303, the shear blade 110 to pivot around pin 78*a* thereby to move the edge 115 of the shear blade 110 through a strap positioned in its path by reacting with the end 55*b* of the stationary shear blade 55.

Above the joint sealing or forming portion 16 is a strap gathering jaw portion 17, as particularly seen in FIGS. 4, 5 and 8, the strap-gathering portion 17 being provided with an L-shaped link 117 pivoted on pin 116, the link 117 having its other end pivoted on a pin 118 to a first latch plate 119. The latch plate 119 is mounted to pivot on a hollow shaft 120 which is secured to the sideplate 61 by means of a nut 121 threadably engaging its threaded outside surface. One end of the shaft 120 is a flanged end while its remaining portion is that which is threaded. The flanged end retains the latch plate 119 on the shaft 120. Between the first latch plate 119 and the sideplate 61 is a second latch plate 122 which is also pivoted on the shaft 120 and has a protruding portion provided with a pin 123 which projects into an opening 124 extending through the sideplate 61. The pin 118 on the first latch plate 119 also protrudes through an opening 125 extending through the sideplate 61. Both of the openings 124 and 125 are elongated to allow for a limited length of travel of the pins 118 and 123 during pivotal movement of both latch plates 119 and 122 on the shaft 120. A coil spring 126 surrounds the shaft 120 and has its opposite ends connected around the pins 118 and 123 in such a manner that the latch plates 119 and 122 tend to be rotated in opposite directions by the force of the spring 126. There is also provided a latch bolt 127 of circular rod cross section which protrudes through the hollow shaft 120 and is provided with a hook end 127*a* used ordinarily to engage one or both of the two notches 119*a* and 122*a* provided in the latch plates 119 and 122 respectively. The other end 127*b* of the latch bolt 127 protrudes beyond the opposite side of the sideplate 61 and is provided with an encircling compression spring 128 which is mounted to act against the first cotter pin 129 to urge the latch bolt 127 upwardly as viewed in FIG. 4. This tendency of the spring 128 in this direction urges the end 127*a* of the latch bolt 127 into the path of the notches 119*a* and 122*a*. The pin 123 is suitably connected to a pair of gathering jaws 136 which constitutes the strap-gathering jaw portion 17.

In operation, the retracted position of the jaws 136 is such that the jaws 136 are spread apart one from each other, this means that the pin 123 is held toward the bottom of the slotted opening 124 with the latch plate 122 rotated to a position where its notch 122*a* is in alignment with the notch 119*a* on the latch plate 119 and the end 127*a* of the latch bolt 127 is engaged with both notches. When it is time in the operating cycle of the machine for the strap-gathering jaws 136 to pivot into their operative position, the latch bolt 127 is moved downwardly, as viewed in FIG. 4. This allows the force of the spring 126 to pivot the gathering jaws 136 so that their free ends are brought toward each other to intersect the ordinary path of the binder strap 173*a* during the operation of the machine. Next, after the strap-gathering jaws 136 are in their strap-gathering position, the gear sector 101 is rotated by the rack 105 in order to move the link 117. This causes the latch plate 119 to rotate clockwise and have its notch 119*a* moved to a position where it is coincident with the notch 122*a*. When it reaches this position, the end 127*a* of the latch bolt 127 again engages the notch 122*a* and this occurs at the end of the joint sealing operation before strap shearing has occurred. Next, the rack 105 is retracted to rotate the gear sector 101 in the opposite direction and pull the link 117 to rotate both of the latch plates 119 and 122 together until pin 118 returns to the left end of the slot 125 and the pin 123 returns to the lower end of the slot 124. The movement of the latch plate 122 at this time causes the toggle linkage associated with the gathering jaws 136 to spread their free ends apart from each other and out of the ordinary path of travel of the strap 173. With all parts returned, they are ready for a repeat cycle of operation.

Beyond the strap-gathering jaw portion 17 is the strap seal storing and feeding portion 18. As particularly seen in FIGS. 4 and 5, a seal storage magazine 141 extends along the outside wall of the sideplate 61*a*. Sideplate 61*a* is immediately adjacent to sidewall 61 and is secured to it by means of the same bolts 77*a*, 78*a*, 79*a* and 80*a* which maintain the sideplates 60 and 61 assembled together with their respective spacers. Also the sideplate 61*a* is provided with an irregular cutout surface which provides room for the operating mechanism of the gathering jaws 136. In addition, a cover plate 61*c* is positioned over sideplate 61*a* and this conceals the gathering jaw mechanism 17. The bolts holding sideplates 60, 61 and 61*a* together also hold the sideplate 61*c* assembled.

The seal magazine 141 houses a plurality of nested channel-shaped seals 142 which have a shape as shown particularly in FIG. 3. Each seal 142 is provided with a back plate 142*a* bridged between two depending legs 142*b* which extend diagonally away from each other, the back plate 142*a* being provided with an aperture 142*c* therein. The seals 142 are stacked in the seal magazine 141 and remain in there stacked by means of a spring-loaded weight 143 and this manner of stacking and retaining seals in a seal magazine is a relatively common expedient for a strapping machine. As shown, the forward seal in the stack is positioned with its depending legs 142*b* resting on two plates 144 secured to the seal magazine 141 by means of screws in the usual manner.

Pivoted on a pin 146 to the wall of the seal magazine 141 is a seal feed hinge 147. The seal feed hinge 147 has a free end provided with a seal feed bar 148 pivoted to it on a pin 149 and this seal feed bar 148 is urged in a clockwise direction by means of a spring 150 coiled about the pin 149. Another spring 151 encircles the pin 146 and reacts between the seal magazine 141 and another pin 152 mounted through the seal feed hinge 147 in order to urge the seal feed hinge in a clockwise manner. The free end 153 of the seal feed bar is notched with a little shoulder to engage the edge of the endmost seal 142 when it is positioned with its depending legs 142*b* resting on a plate 144. Ordinarily, the seal feed hinge 147 is retracted to the position shown in FIG. 5 with the seal feed bar engaging the forward seal 142, but the forward seal 142 is resisted from being displaced until the seal feed hinge 147 is pivoted on its pin 146 to drive the seal feed bar. As soon as the seal feed hinge 147 is released, endmost seal 142 is moved by the force of the spring 151 applied to the seal feed hinge 147 to cause the seal 142 to be fed into a region between the sealing jaw 82 and 83 in preparation for sealing. After a seal is fed, the pin 152 projecting laterally from the seal feed hinge 147 engages the extreme free end 127*b* of the latch bolt 127 to immediately cause the positioning of the strap-gathering jaws 136, as previously described. The seal feed hinge 147 is returned to its retracted position, see FIG. 4, by means of a

roller 154 moving against the surface 155 on a projecting portion of the seal feed hinge 147. The roller 154 is mounted on a pin 156 which is part of the crosshead 96 actuated during movement of the sealing mechanism, and as previously described.

In order to clarify the relative sequential movement of the seal hinge 147 with the sealer mechanism, the seal feed hinge 147 is first moved from the position shown in FIG. 5 to feed a seal 142 and it moves to a position shown in FIG. 4 during this time. Then, the sealer mechanism is operated to form a seal joint 88 and move the roller 154 against the surface 155 of the seal feed hinge 147 in order to again retract it during the joint forming period. There is a laterally extending plunger 159 which is retracted through the frame 12 in order to release the seal feed hinge 147 initially. Upon return movement of the seal feed hinge 147 to its position shown in FIG. 5, an end surface of a projecting ear 161 on the hinge 147 latches against the plunger 159 to retain the hinge 147 in its retracted position.

Beyond the seal magazine 141 is a strap guide which extends for some distance on both sides of which are mounted side guides 166 which are spring loaded and can be spread apart to allow for removal of the strap 173 from between them. Likewise, there are two sideplates 167 and 168 mounted on opposite sides of the straightening portion 148, as shown in FIG. 4. These are likewise spring loaded laterally against their support. Specifically, all of the side guides 166, 167 and 168 are provided with inwardly turned flanges, such as 166*a* and 167*a* for temporary strap retention. Also, the means for spring loading the guides toward each other is by means of identical springs 169, each of which consists of a helical coil body secured at one end to a straight rod portion which passes essentially through the body portion and terminates in a hooked end. By passing the hooked end through holes in each pair of oppositely positioned side guides 166, 167 and 168 with the hooked end engaging the hole in the side guide positioned opposite to the side on which the body portion is located, the proper retention of the side guides 166, 167 and 168 is achieved.

As shown in FIGS. 4 and 5, the seal feed hinge 147 is provided with a V-shaped link 170 having a central flat portion 170*b*. The link 170 is connected at its one end to the hinge 147 by means of a pin 171 and at its other end, the link 170 encircles the pin 156 of the crosshead 96 so that one end of the link 170 moves with the hinge 147 while the other end of the link 170 moves with the crosshead 96. The reason for this is to prevent actuation of the switch arm 172 of the switches LS2 and LS2*a* by means of the portion 170*b* of the link 170 until both the seal feed hinge 147 and the sealer mechanism have been retracted. This is important to control certain operations of the machine as controlled by the switches LS2 and LS2*a*. The essence of the importance of this arrangement is that the seal feed hinge 147 must be retracted before the sealer mechanism is retracted, but both must be retracted before switches LS2 and LS2*a* are operated and strap feed is initiated. The switches LS2 and LS2*a* are actuated only when the sealer jaws 82 and 83 are open or in the retracted position, but if the jaws 82 and 83 are in the retracted position, then movement of the seal feed hinge 147 may also actuate the switches LS2 and LS2*a*, all as will hereinafter be explained.

As shown in FIG. 5, there is a spring-loaded plunger 178 which is urged to the right as viewed in FIG. 5. The purpose of this spring-loaded plunger is to deflect the leading end 173*a* of the strap 173 when it is initially fed past the gathering jaw region 17 to deflect the strap end away from the seals 142 stacked in the seal magazine 141 to prevent contact of the strap end 173*a* with the seals 142 and thereby arrest strap feed. The tendency for this to happen would be increased in case of a strap 173 with an end 173*a* curved or otherwise deformed in the direction toward the seal magazine 141.

Before describing the electrical and pneumatic circuits, the following summary of the mechanical operation of the strapping apparatus is presented, particular reference being made to FIG. 5 and the sequential figures 10 to 13. Initially, the strapping head 1 is presented with a package 11 and a length of strap 173 is fed from a suitable supply source through a guide 174 in the direction of the arrow 175 (FIG. 10) in order to feed the strap 173 between the rotary feed wheel 20 and the wheel 28. Then, the rotary feed wheel 20 is rotated by its air motor 22 to feed a length of strap around the wheel 28, past the leading strapping end gripping portion 14, the strap shear portion 15, the joint sealing or forming portion 16, the strap-gathering jaw portion 17, the strap seal storing and feeding portion 18, and into a region beyond the side guides 166. This leaves a free end of the strap 173*a* protruding above the level of the strapping head 1. At this time, the seal feed hinge 147 is released by retracting the plunger 159 to feed a seal 142 into a position between the sealer jaws 82 and 83. The strap length positioned in the strapping machine 1 acts as a guide along which the seal 142 is fed and it also acts as a retaining means to prevent the seal 142 from dropping out of the head 1 after it is fed. This leading strap end 173*a* is grasped by the operator and manually encircled forward, around and beneath the package 11 and guided by the bottom of the guide channel 9 provided in front of the machine. This guide channel 9 guides the strap 173 up below the blade 55 between the side guides 167 and 168 on the strap-straightening portion 48, past all of the mechanism leading to the strap-gathering jaw portion 17 and is finally deflected by the gathering jaws 136 where the leading strap end 173*a* is arrested in its forward movement. The front surface of each gathering jaw 136 is provided with a sloped surface 177 which provides a deflection for the strap end 173*a* and terminates its forward movements. At this time, the package 11 rests on the associated conveyor links with the strap loop 10 loosely surrounding it, all as illustrated in FIG. 10.

The leading strap end gripping jaws 56*a* and 57*a* are then pivoted to grip the leading strap end 173 against the bottom surface of the blade 55 and simultaneously the rotary feed wheel 20 is rotated in a reverse direction to cause reverse movement of the strap 173 in order to withdraw a slack from the strap loop 10 loosely surrounding the package 11. At the end of the strap slack takeup period, the rotary feed wheel 20 causes the strap 173 to be tensioned tightly onto the package 11. After tensioning is complete, a signal from the tensioning means causes actuation of the piston of the sealer cylinder 109 to cause the sealing portion 16 to form a seal joint of the type shown in FIG. 2 between the overlapping ends of the strap 173, all as illustrated in FIG. 11. At the end of the joint-forming stroke, a signal from the joint-forming means causes the tensioning means to release the tension in the supply portion of the strap 173, as seen in FIG. 12, and thereafter actuates the shearing means to sever the supply end from the strap loop, as seen in FIG. 13. Thereafter, the leading strap end gripping portion 14 is actuated in the direction to allow removal of the strap loop with the package 11 as the package 11 is moved down the roller conveyors supporting it. Releasing the tension before severing is extremely important when using polypropylene strap because severing the polypropylene strap when it is under tension causes frayed ends while releasing the tension in the strap provides a cleanly severed free end of the strap adjacent to the seal joint 88 and provides a cleanly severed leading end 173*a* of the strap 173 on the supply portion thereof. The leading strap end gripping portion 14 is released when the tension in the strap 173 is released. After a new length of strap has been fed into the machine far enough to pass between the guide blades 166 and beyond them, the machine 1 is ready for a new operating cycle.

Having referred to the general mechanical operation of the machine 1, the electrical circuitry will be described with reference to FIG. 14. As seen, there are two electric wires 179 and 180 which are connected to opposite sides of an electric input, the wire 179 being connected to contact 181*a* of a normally open master switch 181. A wire 191 is connected to the other contact 181*b* of the normally open master switch 181 and leads to a contact 182*a* of a cycle switch 182. A wire 191*a*

is connected to the other contact 182*b* of the cycle switch 182. The wire 191 is also connected to contact LS2*b* of normally open switch LS2*a*. A wire 191*b* connects the other contact LS2*c* of switch LS2*a* to a contact 183*c* of a control relay switch 183*b*, and the other contact 183*d* of the control relay switch 183*b* is connected to wire 191*a*, which wire 191*a* is also connected to a control relay switch 183 including a control relay solenoid 183 *a*. It is noted that the cycle switch 182 is in parallel with the switch LS2*a* and the control relay switch 183*b*.

In parallel with the control relay switch 183 is a normally open switch LS3 having contacts LS3*a*, one of the contacts LS3*a* being connected by a wire 191*c* to a time control relay 184 having a solenoid 184*a*. Also in parallel to the control relay 183 and the switch LS3 is a normally open time delay relay switch 184*b* having contacts 184*d*, one of which contacts 184*d* is connected by a wire 191*d* to the sealer valve 190 and a solenoid 190*a* therefor. Also in parallel to the sealer valve 190, the time delay relay 184 and the control relay 183 is a normally open switch LS1 having contacts LS1*b*, one of which is connected by wire 191*e* to the tension and gripping valve 189 having a solenoid 189*a* therefor. A normally closed switch LS1*a* having contacts LS1*c* is connected in series by wire 191*f* to the other contact LS1*b* of normally open switch LS1. Connected in series to the normally closed switch LS1*a* is a normally closed time delay switch 184*c* having contacts 184*e*. A wire 191*g* connects the other side of the normally closed time delay relay 184*c* to the shear valve 320 and a solenoid 320*a* therefor. It is noted that the shear valve 320 is connected to the opposite side of the normally closed time delay switch 184*c* than the normally closed switch LS1*a*. There is also provided a normally open manual sealer switch 203 connected at one end thereof to wire 191 and at the other end thereof by wire 191*e* to the sealer valve 190. A normally open manual shear valve switch 204 is connected at one end to wire 191 and at the other end to the shear valve 320 by wire 191*g*. Also leading from wire 191 is a branch circuit containing a normally open relay switch 185*b* and a seal feed plunger solenoid 188. Also connected to wire 191 is a normally open manual strap feed switch 187 leading to a juncture 192 in parallel with a normally closed switch LS2 leading to the same juncture 192. Beyond the juncture 192 are two parallel circuits, the first of which contains solenoid 185*a* of a time delay relay 185 and the second of which contains solenoid 186*a* of the strap feed valve 186. It should be noted that the relay switches 184*b* and 184*c* are actuated by energization and deenergization of solenoid 184*a* of time delay relay 184, relay switch 183*b* is actuated by relay solenoid 183*a* and relay switch 185*b* is operated by relay solenoid 185*a*.

In FIG. 15 which shows the pneumatic circuit, there are shown the three control valves, 190, 186 and 189, which valves are physically positioned together in the manifold 19, and a fourth control valve 320 apart from the manifold 19. A source of high-pressure fluid 193 is connected by a conduit 194 to the valve 190. The valve 190 is connected to the sealer cylinder 109 by means of a conduit 200, which conduit 200 also leads to the shear valve 320, the shear valve 320 being connected to the shear cylinder 300 by a conduit 321. The valve 190 is also connected to an exhaust conduit 195 and another conduit 196. Both conduits 195 and 196 lead into valve 186 and this valve has two conduits 197 and 198 leading from it to a third valve 189. From valve 189 is an exhaust conduit 199 leading to the atmosphere. Both the conduits 195 and 197 are connected to a common exhaust leading to exhaust conduit 199. Both conduits 196 and 198 are connected to the common high-pressure conduit 194 leading from the high-pressure source 193. Leading from the valve 186 is a conduit 201 which leads to one side of the air motor 22. A conduit 202 leads from the valve 189 to the opposite side of the air motor 22 and to one side of the strap end gripping cylinder 70, which has the piston 69 spring loaded. There is only a single conduit 200 leading to the sealing cylinder 109 and there is only a single conduit 321 leading to the shear cylinder 300 because their respective piston rods 105 and 301 are also of the spring-return type.

To summarize the entire operation of the machine, with respect to the electrical and pneumatic circuits, initially the machine is put into operation by inserting the leading strap end 173*a* of a supply of strap between the rotary feed wheel 20 and the drive wheel 28. The supply of strap is ordinarily a coil of strap positioned in a convenient fixed place relative to the installation where the strapping head or machine 1 is located. As shown in FIG. 4, the strap can be inserted through a guide 174 which leads into the region between the rotary feed wheel 20 and the wheel 28. Also the operator must fill the seal magazine 141 with a plurality of stacked seals 142 by first removing the spring-loaded weight 143 and then replacing it after the seals 142 have been placed in the magazine 141. Initially the seal feed hinge 147 is latched to a position indicated in FIG. 5, the manual seal switch 203 is open, the manual shear switch 204 is open, the manual strap feed switch 187 is open, the master switch 181 is open, the cycle switch 182 is open, the switch LS2*a* is open, the switch 183*b* is open, the switch LS3 is open, the switch 184*b* is open, the switch 184*c* is closed, the switch LS1*a* is closed, the switch LS1 is open, the switch 185*b* is open and the switch LS2 is closed. At this time, the master switch 181 is closed. This energizes the strap feed solenoid 186*a* and the time delay relay solenoid 185*a* through the contact of closed switch LS2. Energizing the strap feed solenoid 186*a* actuates the solenoid valve 186 to cause air pressure from the high-pressure source 193 to be fed through conduits 194 and 196 to conduit 201. The air pressure in conduit 201 feeds the air motor 22. The piston rod 69 of the leading strap end gripping cylinder 70 remains retracted due to the spring loading thereof so that the strap end gripping members 56 and 57 are retracted out of the path of the strap 173. Feeding of the air pressure to the air motor 22 causes it to rotate the rotary feed wheel 20 in a direction to feed strap 173 into the machine 1 past the operating portions at the front face of the machine. The energized time delay relay solenoid 185*a* permits the strap 173 to be fed for approximately 1 second for the particular embodiment shown herein. This is accomplished by having the solenoid delay the closing of its relay switch 185*b* for one second. After one second, the relay switch 185*b* closes to energize the seal feed plunger solenoid 188. This causes the plunger 159 to retract and allow the seal feed hinge 147 to pivot from a position as shown in FIG. 5 to a position as shown in FIG. 4. During this time a seal 142 is fed from the seal stack in the seal magazine 141 over the strap 173 previously fed into the machine 1 until the seal 142 is positioned within the sealing region of the sealer jaws 82 and 83. The seal 142 is arrested in its forward movement as it contacts the sideplate 60. The pivoting of the seal feed hinge 147 immediately causes the arm 171 to move and cause switch LS2 to open and switch LS2*a* to close. The closing of the switch LS2*a* merely prepares the holding circuit including the control relay 183 for future use when the cycle switch 182 is closed. The opening of the switch LS2 immediately deenergizes the solenoid 185*a* of the time delay relay 185 and also the solenoid 186*a* of the strap feed valve 186 to arrest strap feed. As the time delay relay solenoid 185*a* is deenergized, its relay switch 185*b* again opens to free the plunger 159 of the magnetic pull of the seal feed plunger solenoid 188. The plunger 159 is spring loaded outwardly toward the flange 161 on the seal feed hinge 147 against which it rests at this time.

As the plunger 159 is retracted initially, it strikes the arm of switches LS1 and LS1*a* to close the switch LS1 and to open the switch LS1*a*. Opening of the switch LS1*a* prevents the shear valve 320 from being actuated when the time delay relay 284 is actuated. Closing the switch LS1 merely prepares the strap tensioning and gripping circuit for its later operation. Also, as the seal feed hinge 147 pivots downwardly, the pin 152 on it strikes the latch bolt 127 to release the latch plate 122 and cause the gathering jaws 136 to assume a position where their free ends are in the path of the strap 173.

The one second delay period for the strap feed is calculated to feed out only enough strap **173** that it projects slightly above the head **1**, this not being intended to be enough length of strap for encircling a package. Therefore, the manual strap feed switch **187** is closed to feed out additional strap **173** by energizing the strap feed valve solenoid **186***a*. The manual strap feed switch **187** is held closed for as long a period as required to feed out the length of strap **173** needed. Even though the electrical circuit permits the time delay relay solenoid **185***a* to again be energized to this time, if it is energized long enough to allow its relay switch **185***b* to close and energize the seal feed plunger solenoid **188**, there is no physical effect at this time because the plunger is being held retracted by the flange **161** of the seal feed hinge **147**.

With sufficient strap **173** drawn off, the operator manipulates it over, around and beneath the package **11** to be strapped and forces the leading strap end **173***a* into the guide **9** below the top level of the associated roller conveyors where it is guided into the working regions at the front of the strapping head **1**. The strap **173** is guided up to the strap gathering jaws **136** where its upward movement is halted.

It should be emphasized that the feed of a seal **142** is deliberately delayed until after the strap **173** is fed into the machine **1** during the one second time delay. The reason for this is to feed the strap **173** into position with a minimum of possibility of the leading strap end **173***a* catching on anything in its path. With both the seal feed mechanism and the seal **142** to be fed out of the way at this time, there is a substantially clear path for the strap **173** to follow without too much risk of snagging. The machine was deliberately designed with this sequencing of having the seal feed follow the strap feed to provide another advantage which is that the strap **173** itself acts as a guide during the time the seal **142** is fed into the sealer portion and the strap **173** also acts as a support for the seal **142** to prevent the seal **142** from falling out of the machine **1**. On prior devices, where the strap **173** is not used to support the seal **142**, separate holding means is required for the seal **142** during strap feed.

Next, the cycle switch **182** is closed and this energizes the control relay solenoid **183***a* and the solenoid **189***a* of the tension and grip solenoid valve **189**. Energizing the control relay solenoid **183***a* closes its relay switch **183***b* which acts as a holding contact or circuit upon release of the cycle switch **182** to its open position. When the tension in grip valve **189** is actuated at this time, it causes high pressure air to pass through the conduit **202** and into the opposite side of both the air motor **22** and the leading strap end gripping cylinder **70**. Immediately, the piston rod **69** extends to close the gripping jaws **56***a* and **57***a* to grip the leading strap end **173***a* against the undersurface of the blade **55**. Simultaneously therewith, the air motor **22** rotates in the direction opposite to its rotation during strap feed and this causes withdrawal of the strap **173** around the wheel **28** in a clockwise direction as viewed in FIG. **5** and also FIG. **11**. Strap withdrawal continues until all of the slack is taken up in the strap loop encircling the package **11** and continues until a certain degree of tension is reached. When this certain degree of tension is reached, there is a deflection of the wheel shaft **29** and its related parts and the shaft **21** of the rotary feed wheel **20** in combination with a certain movement resulting from gripping contact of the serrations **26** on the rotary feed wheel **20** with the strap. This movement of the strap feed parts by deflection provides a certain angular movement of the arm **37** and this in turn causes movement of the rod **44** to allow actuation of the switch LS3.

Actuation of the switch LS3 at this time closes its contacts LS3*a* to energize the relay solenoid **184***a* of time delay relay **184**. Energizing the time delay relay **184** closes relay switch **184***b* and opens relay switch **184***c* after a short time delay. Opening of the relay switch **184***c* has no effect because the switch LS1*a* is also open at this time, but prevents actuation of the shear valve **320** until after the tensioning mechanism has been released. Closing of the relay switch **184***b* causes energization of the solenoid **190***a* of the sealer valve **190**. This causes high pressure to flow through conduit **200** and into the sealer cylinder **109** to cause its piston rod **108** to extend and actuate the sealer jaws **82** and **83** to form a seal joint **88** of the type shown in FIG. **2**. The time delay provided by relay **184** ensures that full tension is reached in the strap **173** before the sealer mechanism is operated and provides enough time to ensure that full compression of a compressible object being strapped occurs. Also, when a plurality of heads **1** are being used, the time delay is set long enough to guarantee that full tension is reached by all heads before any one of them operates the seal to form a joint.

While the sealer jaws **82** and **83** are closing around the strap **173** to form a seal joint **88**, the seal feed hinge **147** returns to its latched position and allows the seal feed solenoid plunger **188** to assume its deenergized position which then causes actuation of the LS1 switches. At this time, the LS1 switch opens and the LS1*a* switch closes, but since switch **184***c* is now open the shear valve **320** is not actuated. When the switch LS1 opens, the tension and grip solenoid **189***a* deenergizes and as the tension in the supply portion of the strap **173** backs off, the LS3 switch opens up due to a resumption of the original spatial relationship between wheels **20** and **28** and hence the return of rod **44** and arm **37** to their original position. When the LS3 switch opens, the time delay relay **184** deenergizes and the time delay switch **184***b* opens and the time delay switch **184***c* closes. When the time delay switch **184***b* opens, the sealer solenoid **190***a* is deenergized and when the time delay switch **184***c* closes, the shear solenoid **320***a* and valve **320** associated therewith are actuated. The valve **190** has a pneumatic time delay on deenergization which provides for a given time interval between the deenergization of the solenoid **190***a* and the release of high-pressure air in the conduit **200** to provide time for the shear mechanism to actuate. When high-pressure air was fed to the cylinder **109** through the conduit **200**, it also was fed to the shear valve **320** and actuation of the shear valve **320** by energization of the shear valve solenoid **320***a* at this time admits high-pressure air through conduit **321** into the shear cylinder **300** thereby moving the piston and piston rod **301** forward to cause the shear blade **110** and particularly the edge **115** thereof into shearing relationship with the stationary shear blade **55** thereby to sever the strap **173** after the tension therein has been released to provide a cleanly severed free end of the strap **173** adjacent to the seal joint **88** and to provide a cleanly severed leading end **173***a* on the supply portion of the strap **173**.

When the sealer jaws **82** and **83** open, and the seal feed hinge **147** is in its latched position, the switches LS2 and LS2*a* are again actuated so that the switch LS2 closes and the switch LS2*a* opens. When the switch LS2*a* opens, this deenergizes the shear solenoid **320***a* and also the holding circuit including the relay switch **183***b* and the solenoid **183***a*. During the return movement of the sealer parts, the crosshead **96** is retracted so that the V-shaped arm **170** is also fully retracted to where the portion **170***b* of this arm has contacted the switch arm **172** to activate the switches LS2 and LS2*a* as hereinbefore disclosed. Closing of the switch LS2 and the opening of the switch LS2*a* coupled with the deenergization of the shear solenoid **320***a*, returns all the operating parts to their initial position and initiates the 1-second time period of strap feed caused by the time delay relay **185** and leaves the end of the operating cycle with a portion of strap fed into the machine and extending above the level of the strapping head **1**. The machine is then in readiness for the next cycle of operation which is initiated by again closing the manual feed strap switch **187** to feed out a sufficient length of strap to encircle the next object or package to be strapped.

Ordinarily, at the time when the air is released from the conduit **202**, the leading strap end gripping piston rod **69** is urged to a retracted position by means of an internal spring. Note that the strapped package cannot be removed from the machine before this occurs because the gripping jaws **56***a* and **57***a* are holding the strap loop up against the front face of the strapping head **1**.

Although only a single embodiment of the invention has been shown and described, it should be understood that the invention can be made in many different ways without departing from the true scope of the invention as defined by the appended claims.

What is claimed is:

1. A strapping machine for applying a plastic strap around an object, said strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, control means for said tensioning means responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, and strap severing mechanism for severing the supply portion of the strap adjacent to the seal joint after the tension in the strap has been released and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

2. A strapping machine for applying a plastic strap around an object, said strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, control means for said tensioning means responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, strap-severing mechanism for severing the supply portion of the strap adjacent to the seal joint, a fluid motor for operating said strap-severing mechanism to sever the supply portion of the strap, and control mechanism for said fluid motor responsive to release of tension in the supply portion of the strap for operating said motor and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

3. The strapping machine set forth in 2, wherein said fluid motor for operating said strap-severing mechanism is an air motor.

4. The strapping machine set forth in 2, wherein said fluid motor for operating said strap-severing mechanism is a reciprocating air motor.

5. A strapping machine for applying a plastic strap around an object, said strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, first and second cooperating drive drums positioned to have the supply portion of the strap passing therebetween, motor means for driving one of said first and second drive drums to supply strap to form a loop encircled about the object and for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, control means for said motor means responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, and strap-severing mechanism for severing the supply portion of the strap adjacent to the seal joint after the tension in the strap has been released and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

6. The strapping machine set forth in 5, wherein said driven drum has serrations thereabout for driving the plastic strap.

7. The strapping machine set forth in 5, wherein one of said drums is mounted on an eccentric shaft, said eccentric shaft being so aligned with respect to the other one of said drums that tension in the strap urges rotation of said eccentric shaft and urges the drum mounted on said shaft bodily toward the other one of said drums to increase the grip on the strap passed therebetween as strap tension increases.

8. The strapping machine set forth in 5, wherein one of said drums is mounted on an eccentric shaft, said eccentric shaft being so aligned with respect to the other one of said drums that tension in the strap urges rotation of said eccentric shaft and urges the drum mounted on said shaft bodily toward the other one of said drums to increase the grip on the strap passed therebetween as strap tension increases, and control means for said sealing means responsive to rotation of said eccentric shaft for activating said sealing means.

9. The strapping machine set forth in 5, wherein one of said drums is mounted on an eccentric shaft, said eccentric shaft being so aligned with respect to the other one of said drums that tension in the strap urges rotation of said eccentric shaft and urges the drum mounted on said shaft bodily toward the other one of said drums to increase the grip on the strap passed therebetween as strap tension increases, said eccentric shaft being provided with an arm positioned to move through an angular path as the eccentric shaft is rotated on its axis in response to bodily movement of said drum toward one another, rotation of said eccentric shaft causing said arm to actuate said sealing means.

10. A strapping machine for applying a plastic strap around an object, said strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, control mechanism for said sealing means responsive to a predetermined tension in the loop of strap for activating said sealing means, control means for said tensioning means responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, and said strap-severing mechanism for severing the supply portion of the strap adjacent to the seal joint after the tension in the strap has been released and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

11. The strapping machine set forth in 10, wherein the predetermined tension is the maximum tension attained in the loop of strap by said tensioning means.

12. The strapping machine set forth in 10, wherein said control mechanism for said sealing means is provided with a time delay means for delaying the immediate operation of said sealing means when the predetermined tension has been reached.

13. The strapping machine set forth in 10, and further including control mechanism for preventing the feeding of the supply portion of the strap during the formation of the seal joint.

14. A strapping machine for applying a plastic strap around an object, said strapping machine comprising mechanism for guiding the leading end of a length of strap leading from a strap supply and looped around an object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, a blade over which the strap passes, jaws for gripping the leading end of the strap against the blade, said blade having a portion with transverse grooves formed therein and said jaws forcing the material of the strap into the grooves to hold the strap taut during the operation of said tensioning means, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, control means for said tensioning means responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, and a movable strap shear means for coacting against another portion of said blade for severing the supply portion of the strap adjacent to the seal joint after the tension in the strap has been released and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

15. The strapping machine set forth in 14, wherein said movable strap shear means is activated by a fluid motor.

16. The strapping machine set forth in 14, wherein said movable strap shear means is activated by an air motor.

17. The strapping machine set forth in 14, and further comprising control mechanism to prevent feeding of strap from the strap supply during strap severing.

18. A strapping machine for applying a plastic strap around an object, said strapping machine comprising strap-gripping means for holding the leading end of the strap encircled about the object and overlapping a supply portion of the strap, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, tensioning means for tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap, a first fluid motor for operating said strap-gripping means and said tensioning means for causing simultaneous actuation of said tensioning means and said strap-gripping means, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a seal joint therebetween by applying the seal around the overlapped portion of the strapping, a second fluid motor for operating said sealing means, control mechanism for said second fluid motor responsive to a predetermined tension in the supply portion of the strap for activating said second fluid motor, control means for said first fluid motor responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, strap-severing mechanism for severing the supply portion of the strap adjacent to the seal joint, a third fluid motor for operating said strap-severing mechanism to sever the supply portion of the strap, and control mechanism for said third fluid motor responsive to release of tension in the supply portion of the strap and after said sealing means has been released from applying the seal around the overlapped portion of the strapping, for operating said third fluid motor, whereby to provide a cleanly severed free end of the strap adjacent to the seal joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

19. The strapping machine set forth in 18, wherein said first fluid motor is an air motor.

20. The strapping machine set forth in 18, wherein said second fluid motor is an air motor.

21. The strapping machine set forth in 18, wherein said third fluid motor is an air motor.

22. The strapping machine set forth in 18, wherein said first and third fluid motors are reciprocating air motors.

23. A strapping machine for applying a plastic strap around an object, said strapping machine comprising mechanism for guiding the leading end of a supply portion of a length of strap leading from a strap supply and looped around an object, seal-feeding means for feeding a seal to be sealed around the overlapping portion of said strap after the strap is in the overlapping position thereof, first and second cooperating drive drums positioned to have the supply portion of the strap passing therebetween, a blade over which the strap passes, jaws for gripping the leading edge of the strap against the blade, said blade having a portion with transverse grooves formed therein and said jaws forcing the material of the strap into the grooves to hole the strap taut when the jaws are in the strap-gripping position thereof, a first fluid motor for simultaneously tensioning the loop of strap by withdrawing the supply portion of the strap relative to the leading end of the strap and actuating said gripping jaws, sealing means for securing together the leading end of the strap and the adjacent supply portion of the strap to provide a sealed joint therebetween by applying the seal around the overlapped portion of the strapping, a second fluid motor for operating said sealing means, control mechanism for said second fluid motor responsive to said first and second cooperating drive drums at a predetermined tension in the supply portion of the strap for activating said second fluid motor, control means for said first fluid motor responsive to completion of the operation of said sealing means for releasing the tension in the supply portion of the strap, a movable strap shear means for coacting against another portion of said blade for severing the supply portion of the strap adjacent to the sealed joint, a third fluid motor for operating said strap shear means to sever the supply portion of the strap, and control mechanism for said third fluid motor responsive to release of tension in the supply portion of the strap and after said sealing means has been released from applying the seal around the overlapped portion of the strapping for operating said third fluid motor, whereby to provide a cleanly severed free end of the strap adjacent to the sealed joint and to provide a cleanly severed leading end of the strap on the supply portion thereof.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,636,861 Dated January 25, 1972

Inventor(s) Frank C. Weller

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Item 45 should read --Jan. 25, 1972--.

Signed and sealed this 5th day of September 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 1969 O- 366-334