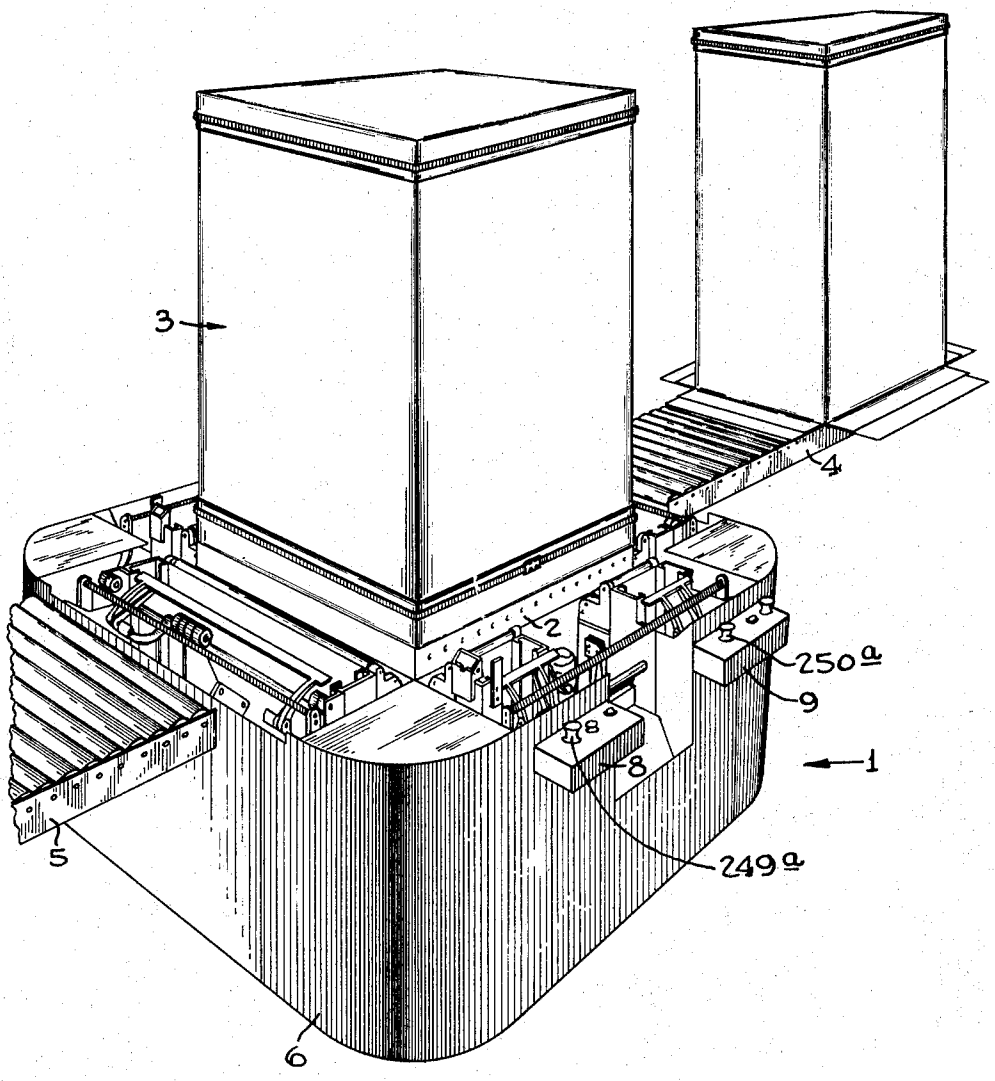
Sept. 22, 1959 A. L. WINKLER 2,905,066

LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

Filed May 16, 1955 13 Sheets-Sheet 1

Fig. 1



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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 2

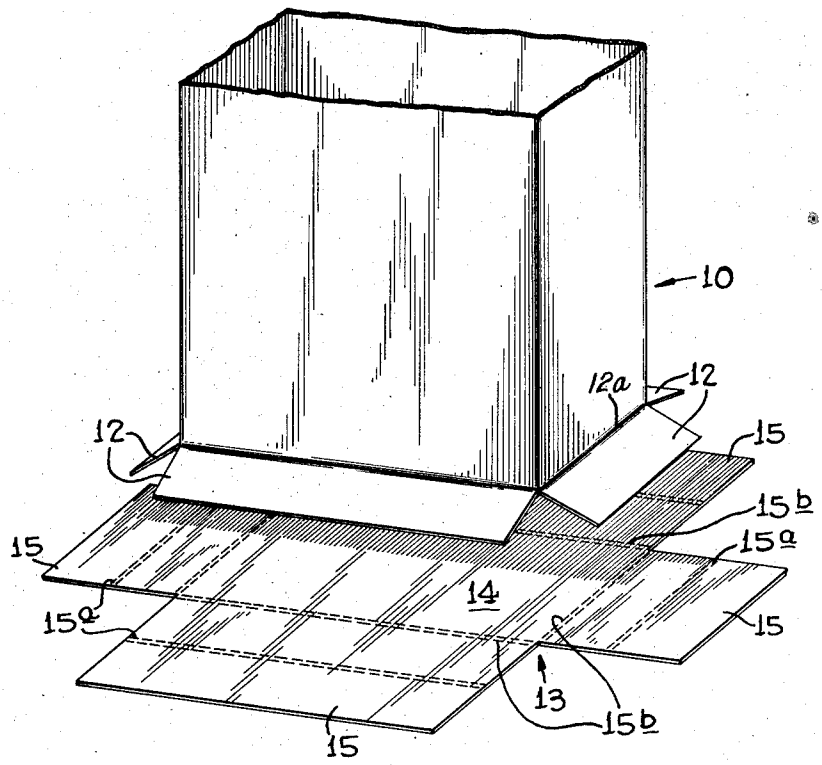


Fig. 3

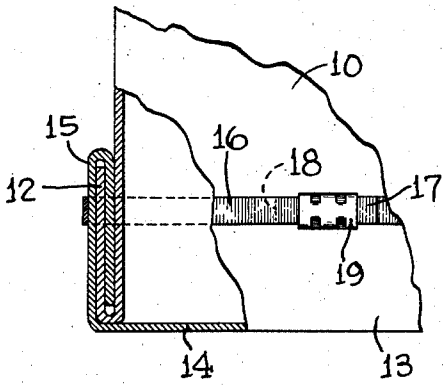
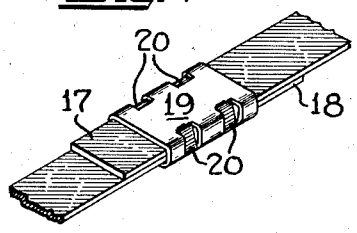


Fig. 4



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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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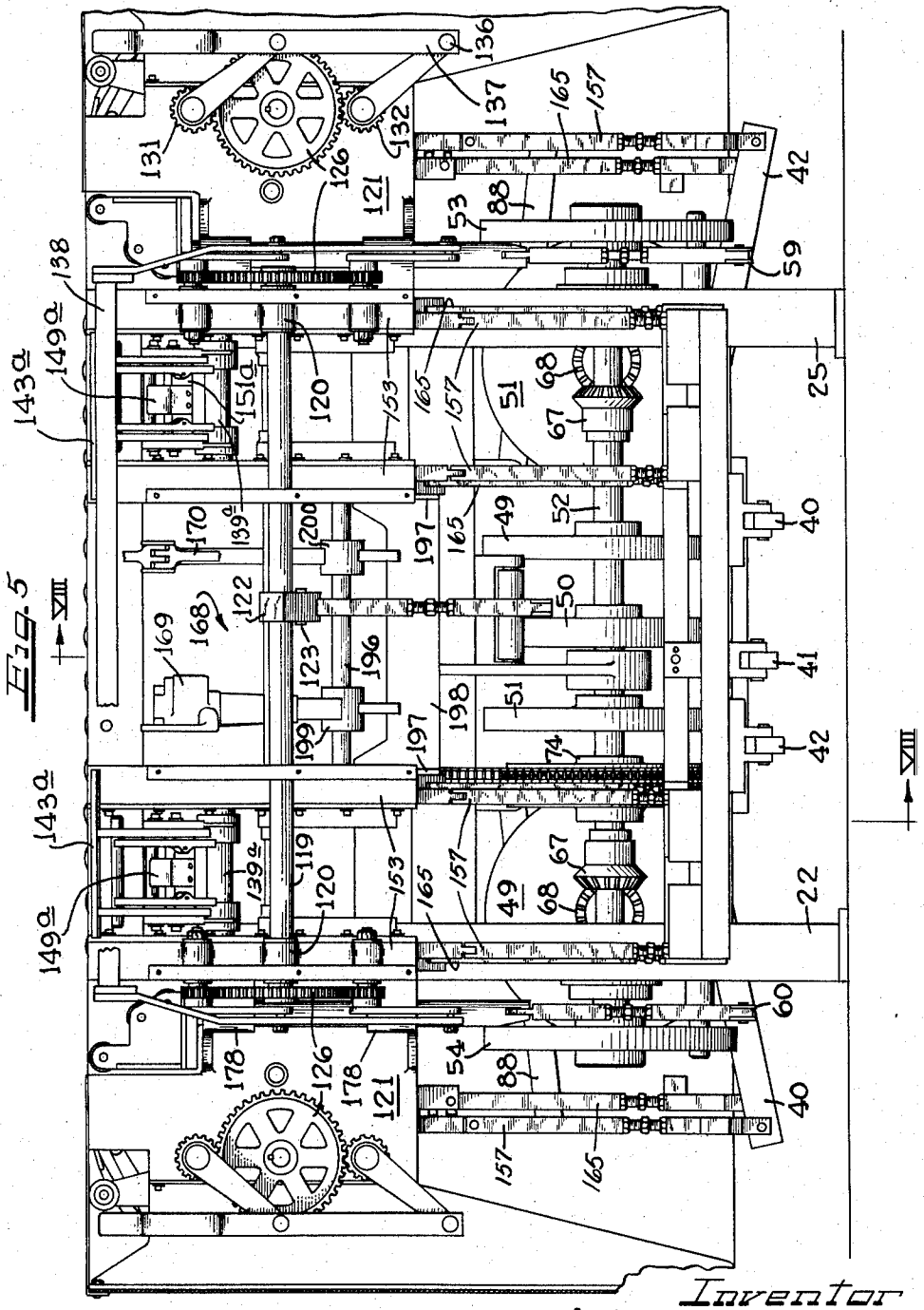


FIG. 5

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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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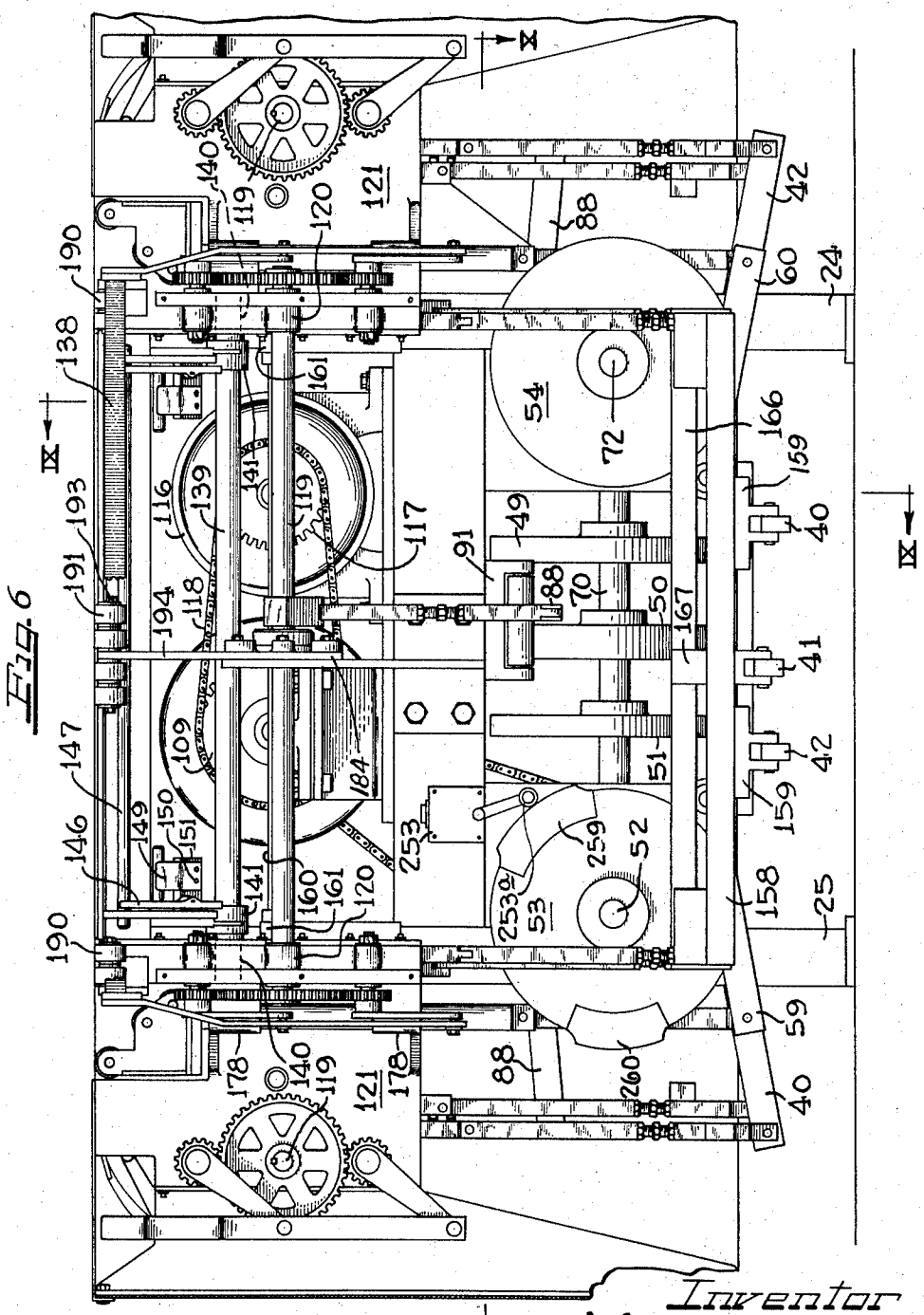


Fig. 6

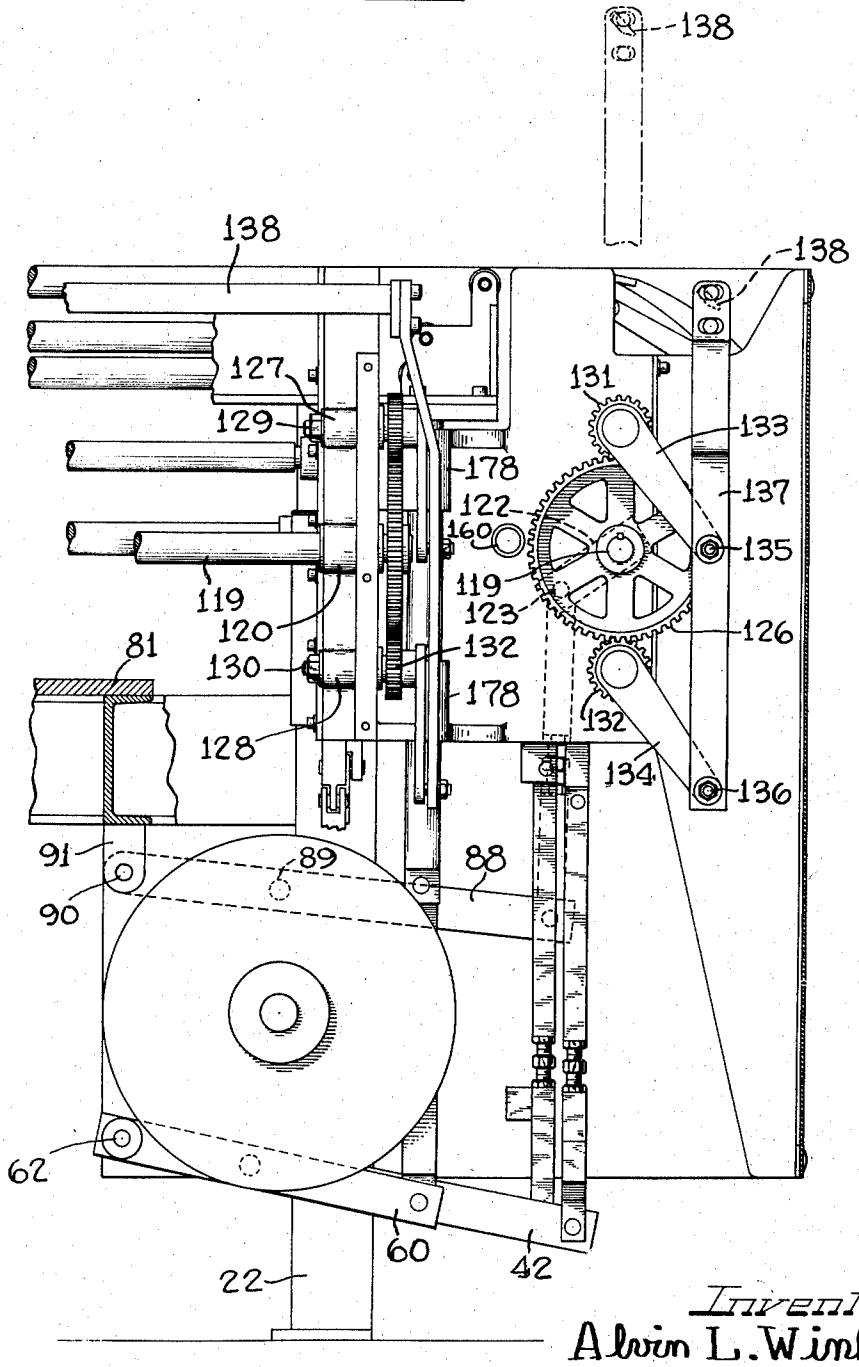
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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 7



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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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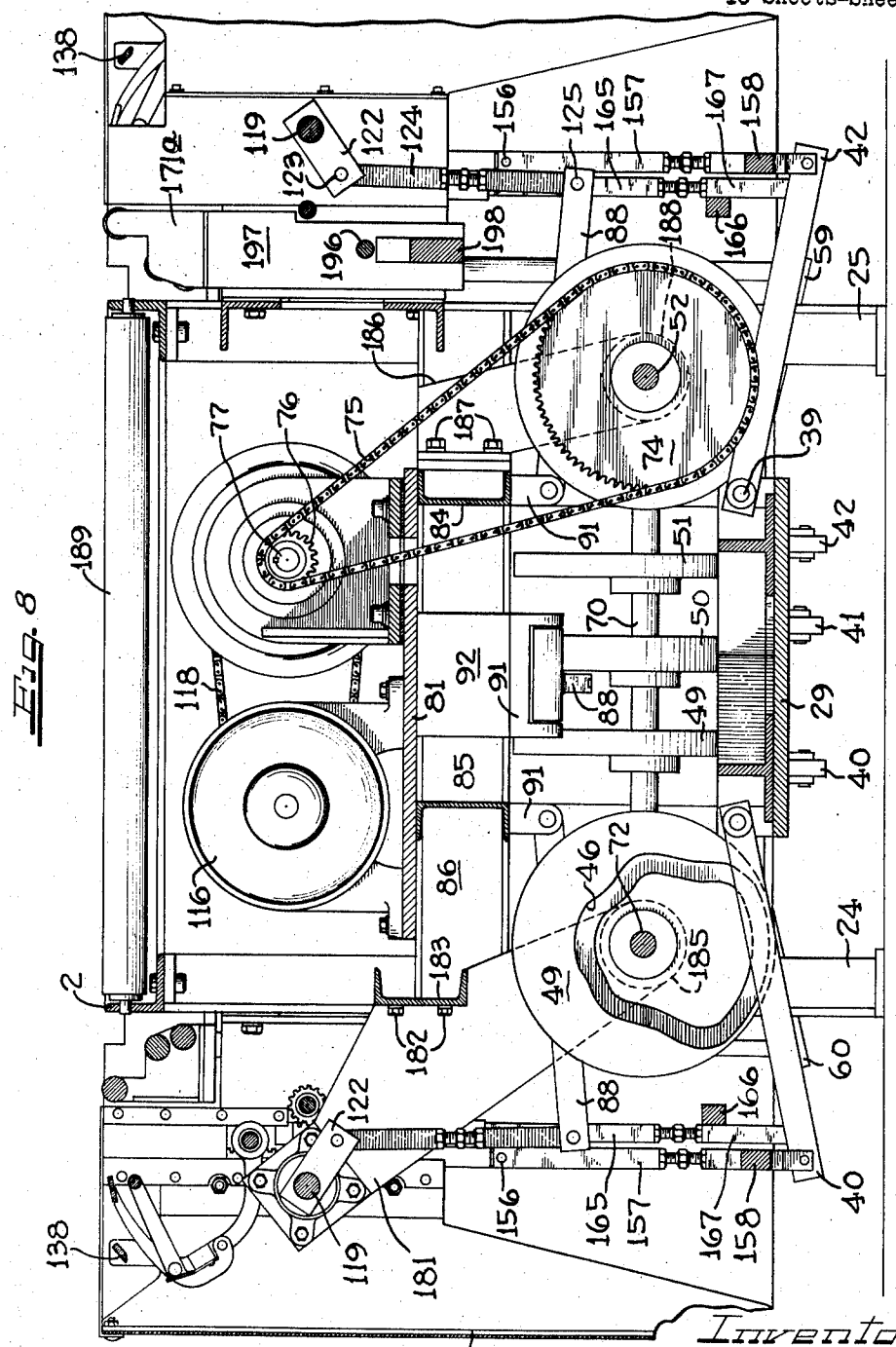


Fig. 8

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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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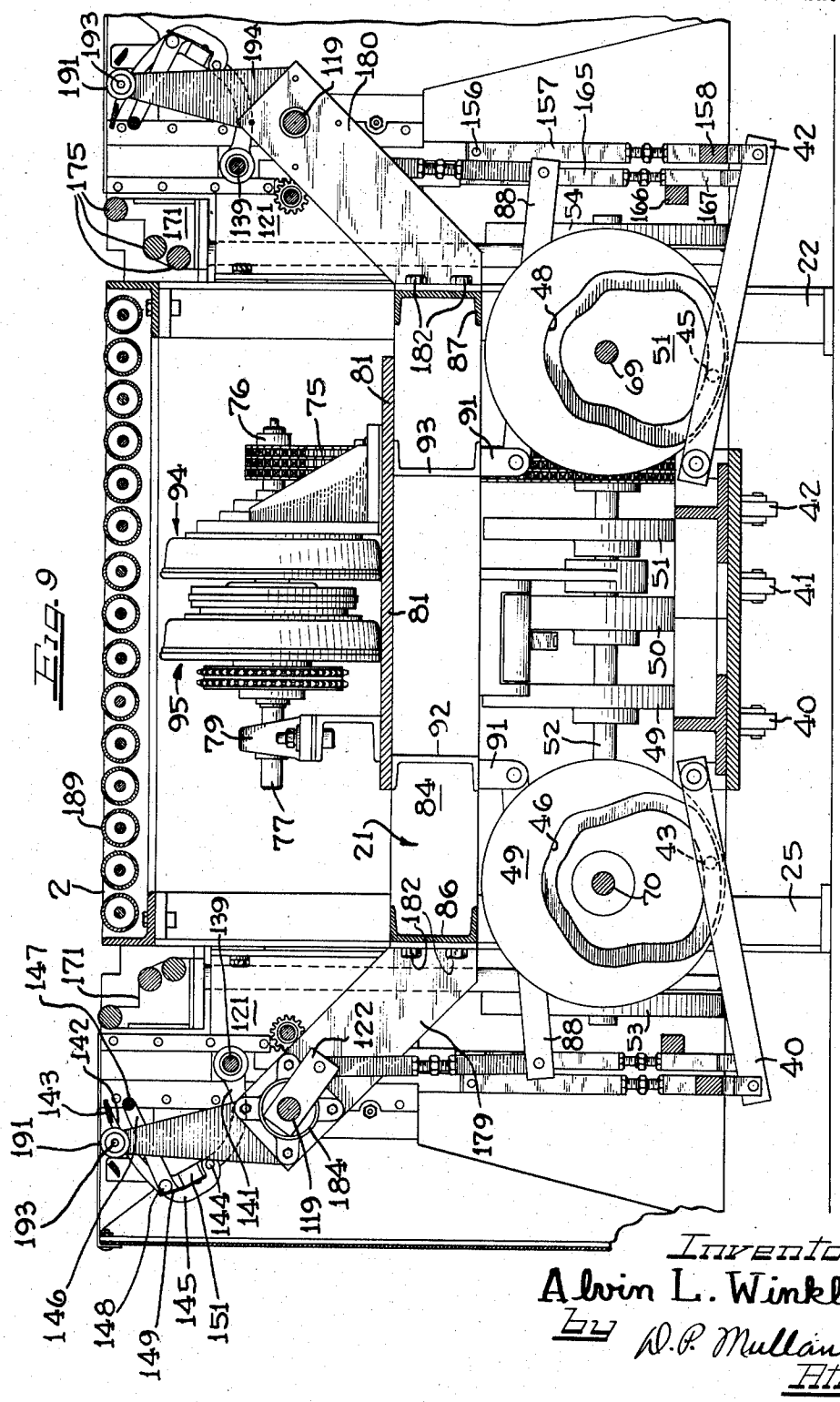


Fig. 9

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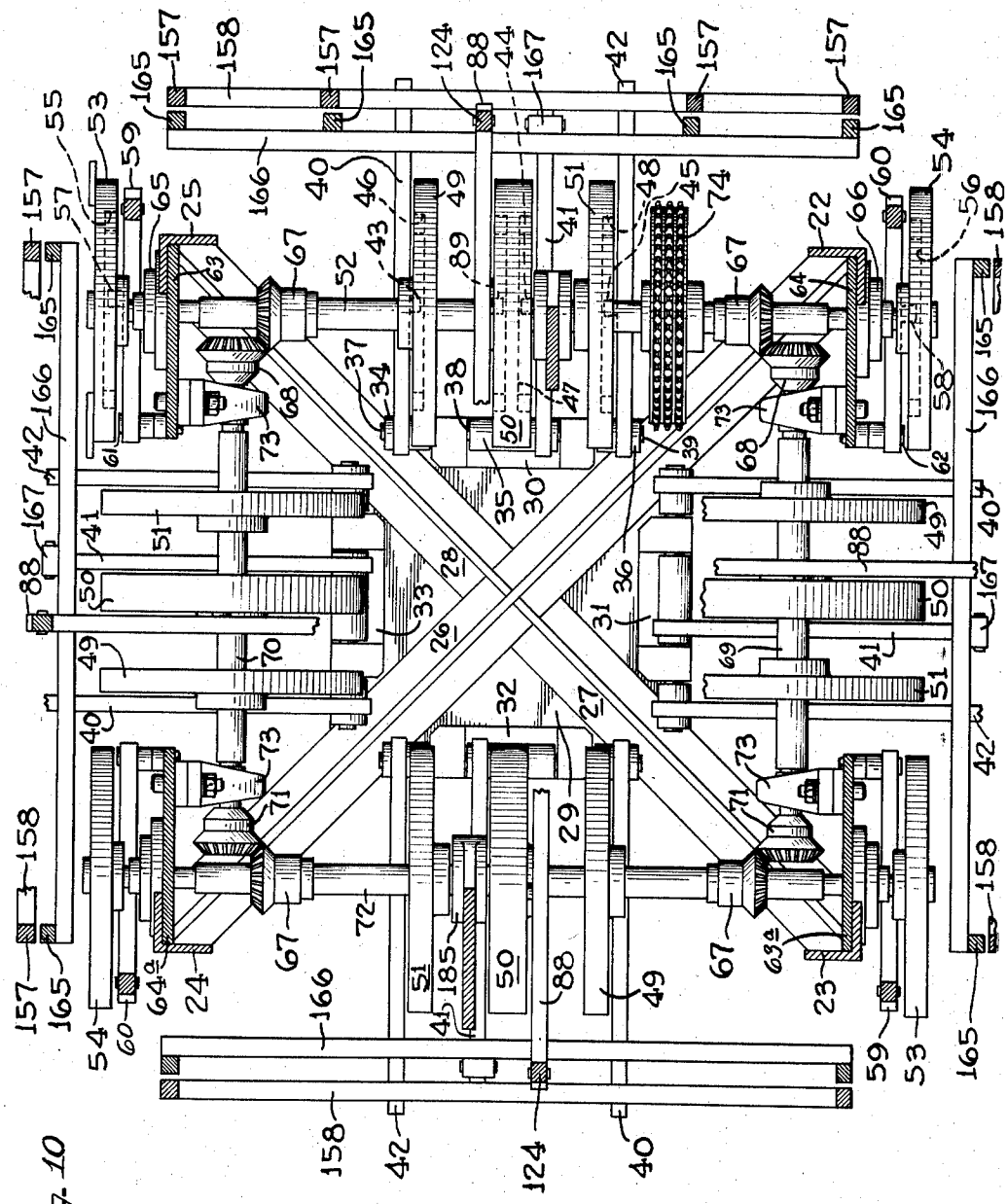


Fig. 10

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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 11

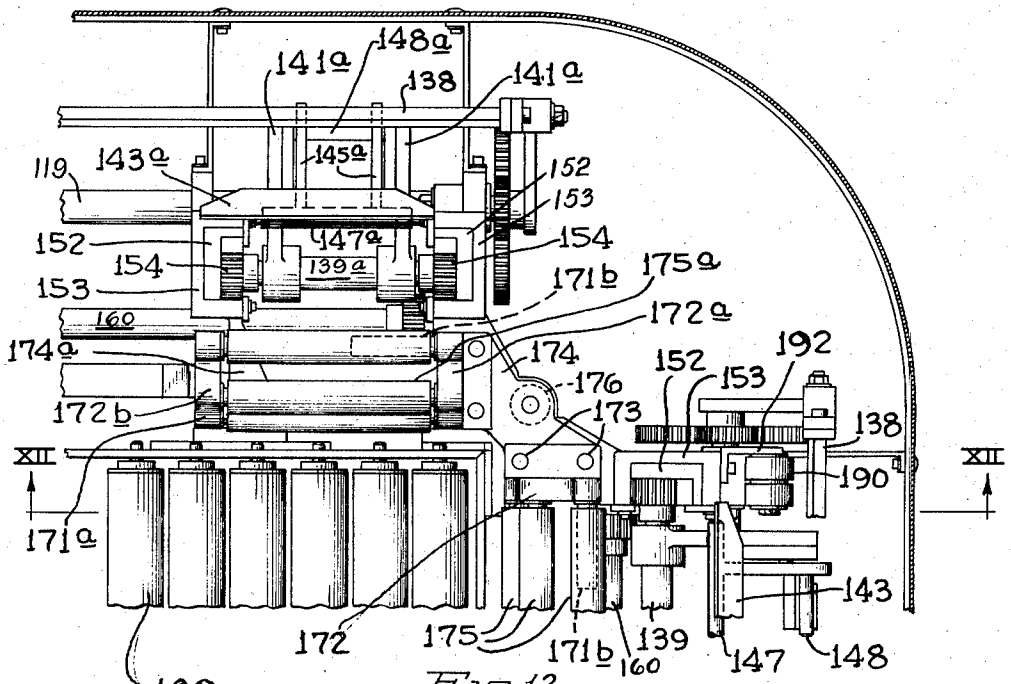
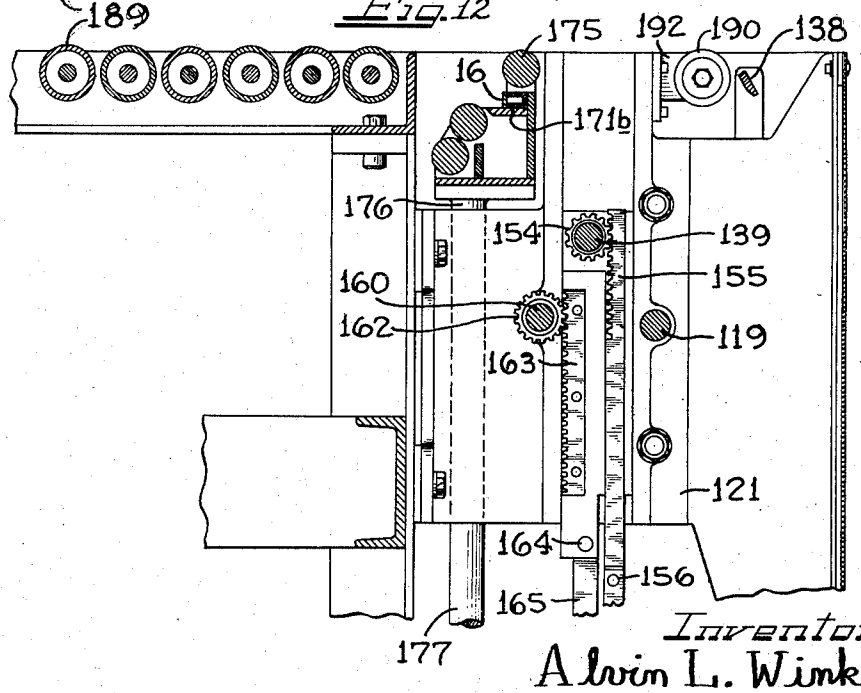


Fig. 12



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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 13

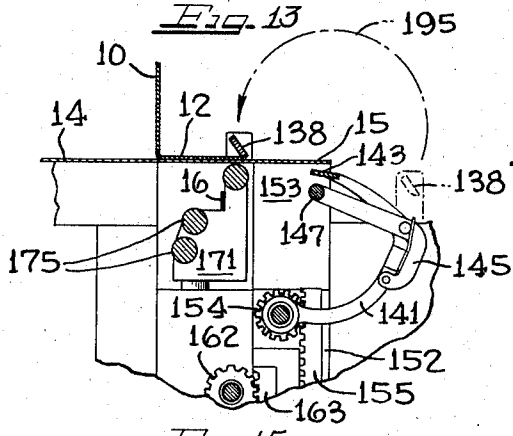


Fig. 14

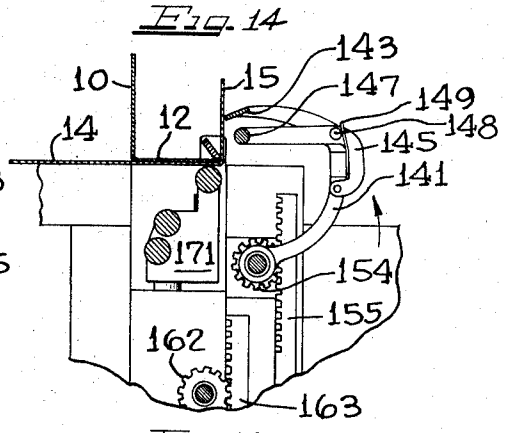


Fig. 15

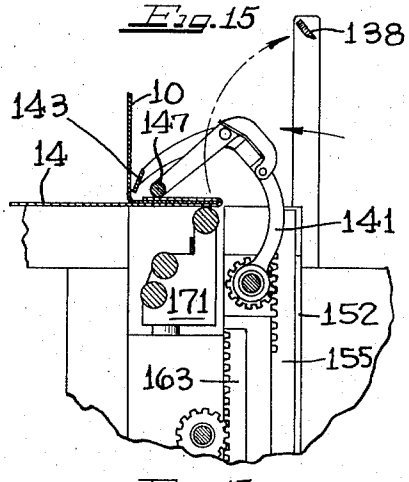


Fig. 16

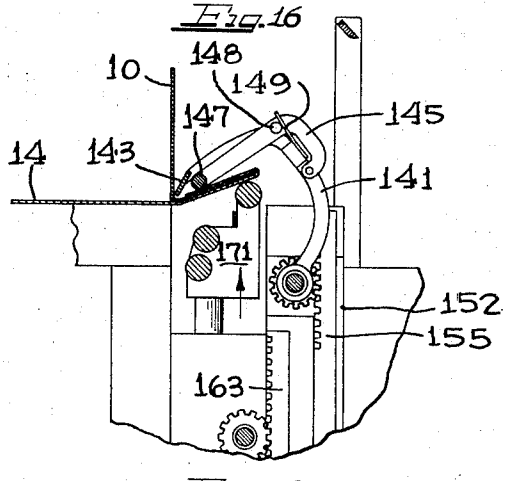


Fig. 17

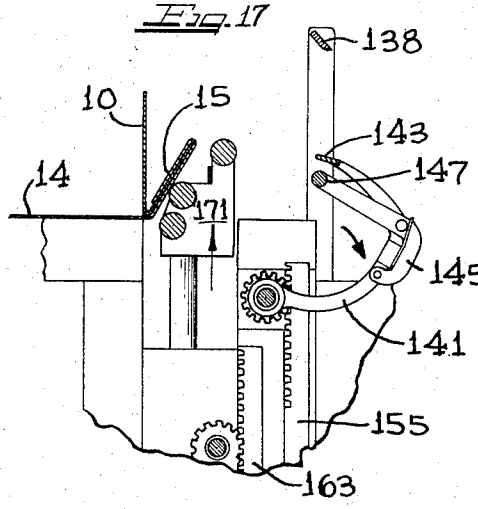
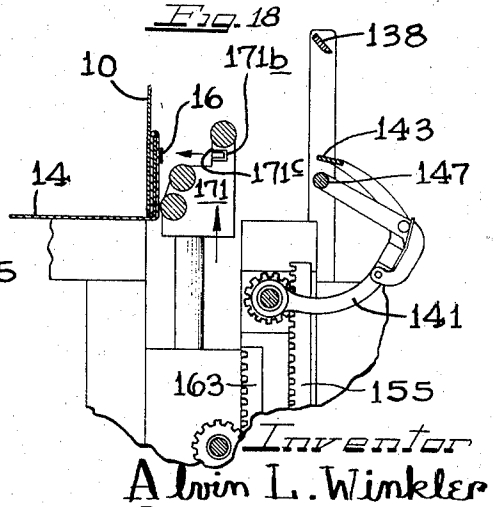


Fig. 18



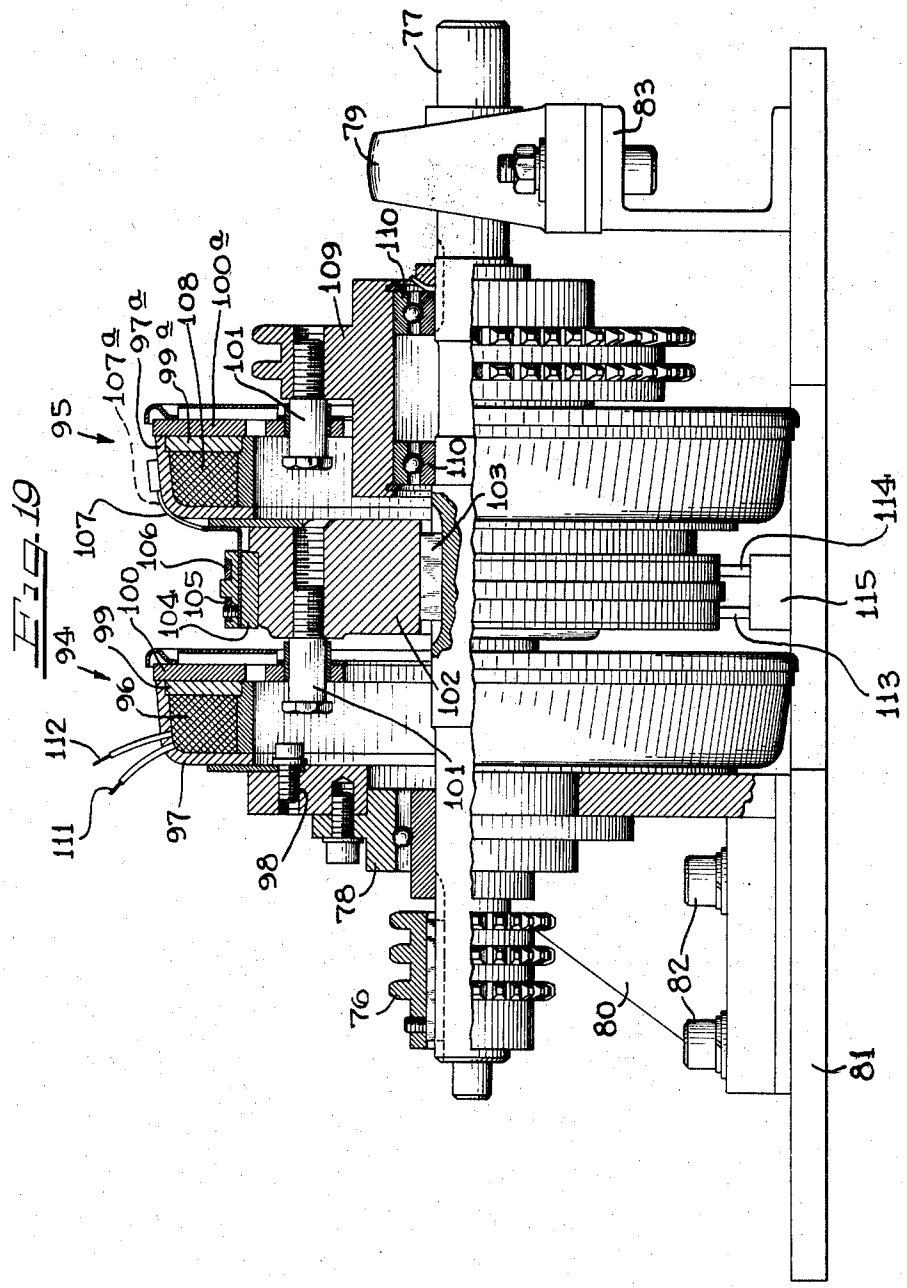
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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 19



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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 22

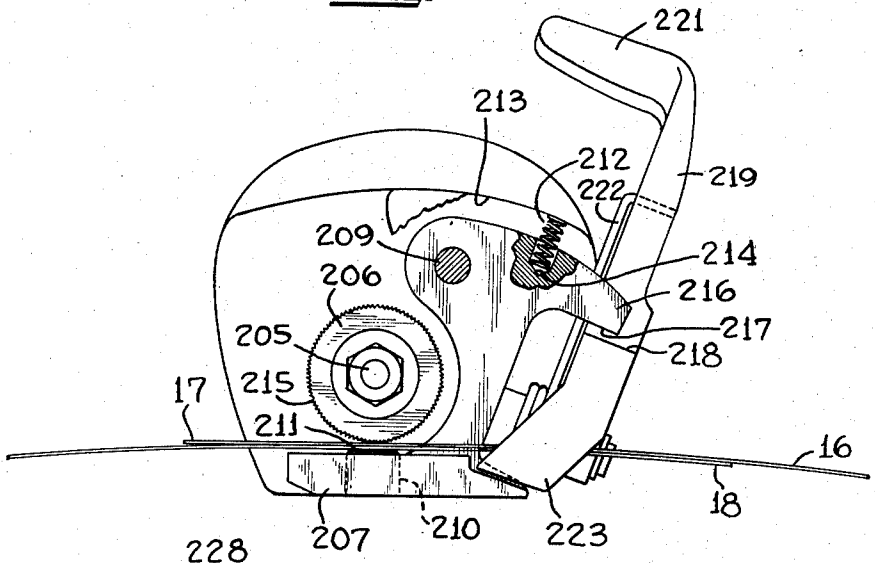


Fig. 20

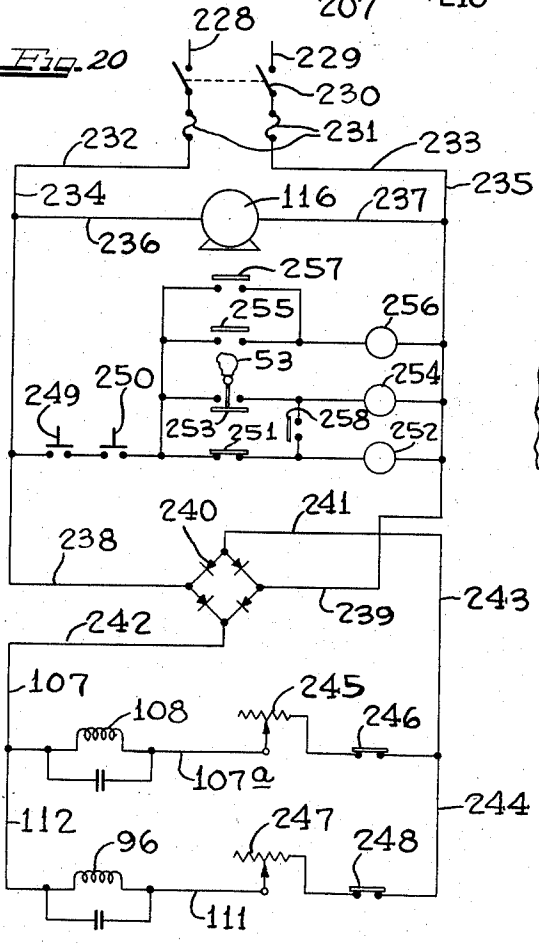
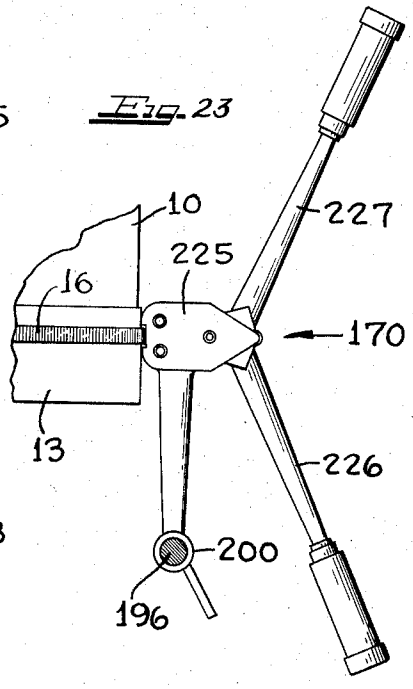


Fig. 23



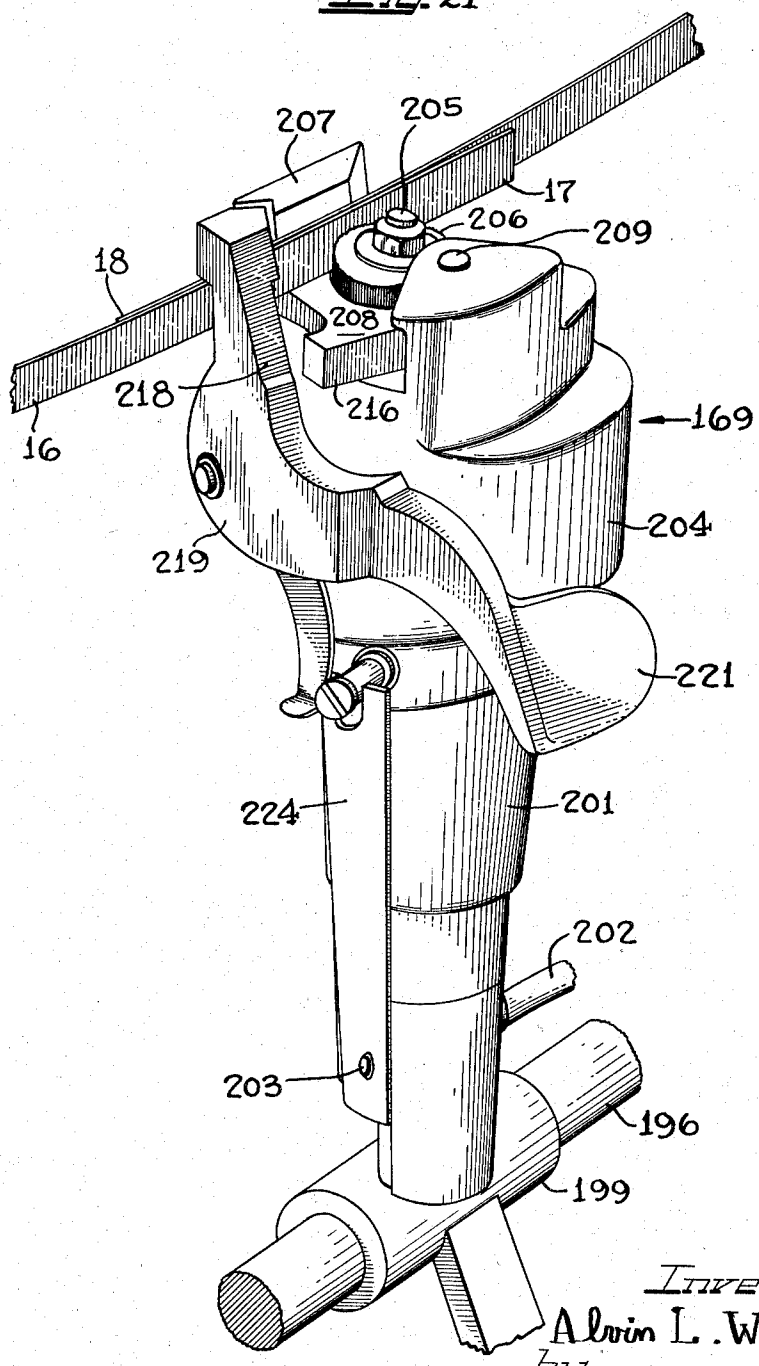
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LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

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Fig. 21



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United States Patent Office 2,905,066
Patented Sept. 22, 1959

2,905,066

LOCK FLAP CARTON FOLDING AND STRAPPING MACHINE

Alvin L. Winkler, Chicago, Ill., assignor to Acme Steel Company, Chicago, Ill., a corporation of Illinois

Application May 16, 1955, Serial No. 508,585

17 Claims. (Cl. 93—55.1)

This invention relates to improvements in carton flap folding and strapping machines and its purpose is to provide an improved machine for closing a carton by providing mechanisms for folding the end flaps of a carton and the side flaps of an end cap into interlocking engagement with each other and then encircling them with metal binding straps which are drawn taut with overlapped ends sealed together to retain the flaps in their interlocked relationship.

In the field of packaging such articles as refrigerators, water heaters and other relatively large articles, fiberboard containers have come into rather wide use. Particularly, containers comprising square cross-section tubes provided with end caps having flaps folded and strapped into interlocking engagement with flaps on the ends of the tubes have been frequently used. Containers of this type are commonly referred to as "lock flap" cartons. Ordinarily, workmen are employed to manually fold the flaps into interlocking engagement and strap them. This practice is difficult and cumbersome and usually requires several workmen due to the need to fold and hold flaps interlocked on four sides of the containers while at the same time applying binding straps. Because of these labor requirements, the practice has been very costly and the rate of production has been extremely low.

The principal object of the present invention is to provide an improved carton flap folding and strapping machine in which the operations of folding the flaps on the tube ends and the end caps of "lock flap" carton into interlocking engagement and encircling them with metal binding straps are performed automatically under the control of a single operator who then causes the binding straps to be drawn taut and to be joined together at their ends to thus minimize the amount of manual labor required.

Another object of the invention is to provide a carton flap folding and strapping machine comprising means for folding the flaps on the carton and its end caps into interlocking engagement and means for encircling these interlocked flaps with a loop of strap, both means being arranged for movement to and from the carton while the carton remains in a fixed position.

Another object is the provision of a carton flap folding and strapping machine comprising strap loop encircling means having magnetic holding devices for retaining a strap in a loop encircling the carton preparatory to drawing the strap taut and joining together its ends.

It is another object of the invention to provide a carton flap folding and strapping machine comprising means for folding the flaps on the carton and its end caps into interlocking engagement on all sides of the carton simultaneously and means for encircling these interlocked flaps with a loop of strap, both means being operated by means of cams on interconnected camshafts operated by a single motor.

It is another object to provide a carton flap folding and strapping machine comprising means for folding the flaps on the carton and its end caps into interlocking engagement comprising safety means for preventing the machine operator from getting his hands caught in the flap folding and strap encircling mechanisms while the machine is operating.

Other objects relate to various features of construction and arrangement which appear more completely hereinafter and will be apparent to persons skilled in the art from a study of the following description and accompanying drawings, in which:

Fig. 1 shows a perspective view of a preferred embodiment of the carton flap folding and strapping machine with a strapped carton in position on the machine and associated with a conveyor line;

Fig. 2 shows a perspective view of the bottom portions of a container comprising a fiberboard tube positioned above an end cap which is used to close this lower end of the tube by means of an interlocking flap arrangement;

Fig. 3 shows a cutaway and partial cross-sectional view of a lower corner of a carton similar to that as shown in Fig. 2 except that the flaps are shown in interlocked relationship and bound with a metal strap;

Fig. 4 shows a joint which may be formed for joining together the overlapped strap ends of a loop of strap encircling a carton;

Fig. 5 shows a front elevation of the machine shown in Fig. 1, but with the front sheet metal shroud removed;

Fig. 6 shows a right side view of the machine shown in Fig. 5, likewise with the sheet metal shroud removed;

Fig. 7 shows an enlarged view in partial section of a portion of the right-hand side of the machine viewed toward the right in Fig. 5;

Fig. 8 is a sectional view along the line 8—8 of Fig. 5;

Fig. 9 is a sectional view taken along the line 9—9 of Fig. 6;

Fig. 10 is a sectional plan view taken approximately along the line 10—10 of Fig. 6;

Fig. 11 shows a top plan view of the corner portion of the machine shown in the upper left-hand corner of Fig. 5;

Fig. 12 shows a sectional view along the line 12—12 of Fig. 11;

Figs. 13 through 18 show views of the flap folding and strap positioning members in successive positions during the operations of folding the flaps and positioning a strap around the folded and interlocked flaps;

Fig. 19 shows a partial sectional view of the magnetic clutch and brake assembly which is used to alternately start and stop the operations of the machine;

Fig. 20 shows a simplified schematic diagram of the electrical system for controlling the operations of the machine;

Fig. 21 shows a perspective view of a strap stretching tool in operating position as used in this invention;

Fig. 22 shows an end view of the tool shown in Fig. 21;

Fig. 23 shows a side view of a strap joint sealer tool in sealing position.

A preferred form of the machine 1, as shown in Fig. 1, has approximately a square shape in its plan view and is provided with a table 2 having rollers on which a carton can be easily moved into position. The machine 1 is preferably placed between two conveyor tables 4 and 5, both tables being provided with rollers for easy movement of containers over them and table 4 being positioned to lead cartons which are to be folded and strapped to the machine while table 5 is used to carry the folded and strapped cartons away from the machine. The side portions of the machine are covered with a sheet metal shroud 6 to conceal most of its internal mechanism to provide a more pleasant appearance and at the same time act as a safety measure, covering up moving mechanisms which might otherwise harm an operator. Attached to the front side of the machine are two control boxes 8

and 9 provided with push buttons 249*a* and 250*a* for operating the electrical control components of the machine.

The particular "lock flap" container 3 to be closed by this machine 1 is particularly shown in Figs. 1, 2 and 3 and comprises a hollow square or rectangular cross-section tube 10 which is the main portion of the container and which is provided with four flaps 12 extending both from its lower marginal edges and its upper marginal edges, thus providing a symmetrical tube having identical end portions. The flaps 12 are connected at corners provided with score lines 12*a*. The end cap 13 which covers an end of the tube 10 consists of a flat square body portion 14 provided with four flaps 15 extending outwardly from its margins approximately twice as far as the flaps 12 on the tube 10. These flaps 15 are provided with score lines 15*a* midway of their length and score lines 15*b* where they are connected to the body portion 14.

In order to close the end of a tube 10 with an end cap 13, the flaps 12 and 15 are folded around each other in a manner as shown in Fig. 3 and are retained in place by means of a strap 16. A flap 12 is folded back toward an outside wall of the tube 10 with a flap 15 extended into a space between the flap 12 and the side wall of the tube 10. Flap 15 then passes around the outside of the flap 12 and downwardly to where it is connected to the flat body portion 14 of the end cap 13. The strap 16 is in the form of a continuous loop having two overlapping strap ends 17 and 18 joined together by means of a tubular metal seal 19 encircling the strap ends and deformed to be interlocked therewith. A preferred seal joint is shown particularly in Fig. 4. It is a conventional type of seal joint which is made with a standard sealing tool which cuts through the combined seal and strap ends to provide depressed tabs 20 for an interlocking fastening arrangement preventing the metal strap ends 17 and 18 from pulling apart.

Having described the machine generally and the particular carton upon which it acts specifically, the machine will now be discussed in greater detail.

All of the mechanisms associated with the machine 1 are supported in some manner on a frame 21 comprising four vertical support legs 22, 23, 24 and 25 which rest on the floor or ground. As shown in Fig. 10, these legs are joined together by means of inverted T-shaped braces 26, 27 and 28. Brace 26 extends between legs 22 and 24 diagonally of the machine. Brace 27 extends between leg 23 and brace 26. Brace 28 extends between leg 25 and the brace 26. Braces 27 and 28 are in alignment with each other and also extend diagonally of the machine. In the area of the intersection of these braces 26, 27 and 28, at the center of the machine, is a flat square gusset plate 29 welded to the bottom surfaces of the braces. This gusset plate 29 supports blocks 30, 31, 32 and 33 on its upper marginal surface and these blocks are each provided with three upstanding yokes 34, 35 and 36. Each of these yokes is provided with pivot pins 37, 38 and 39 which pivotally support the inner ends of arms 40, 41 and 42, respectively. Each of these blocks 30, 31, 32 and 33 are identical and they carry identical arms which are used for identical purposes even though they act on four different sides of the machine. These arms 40, 41 and 42 are provided with roller type cam followers 43, 44 and 45 which engage irregular shaped cam grooves 46, 47 and 48 cut in the faces of cams 49, 50 and 51. When the machine operates, these cams rotate to cause pivotal movement of these arms 40, 41 and 42 to perform functions which will be described.

Considering the front side of the machine corresponding to the position of block 30 on the gusset plate 29, the three cams 49, 50 and 51 are mounted on a camshaft 52 which is provided at its very ends with two additional cams 53 and 54. These cams are provided with grooves 55 and 56 which engage roller type cam followers 57 and 58, respectively. These followers are mounted on arms 59 and 60 which have their inner ends pivoted on pins 61 and 62 which are mounted on the outside of plates 63 and 64. These plates are in turn fastened to the legs 25 and 22, respectively. The camshaft 52 is mounted in bearings 65 and 66 which are also mounted on these plates 63 and 64. A short distance inward of these plates 63 and 64 the camshaft 52 is provided with bevel gears 67 which in turn mesh with other bevel gears 68. These bevel gears are mounted at the ends of other camshafts 69 and 70. Both of the camshafts 69 and 70 are provided with cams 49, 50 and 51 which are identical to those on the front of the machine and similarly positioned relative to the camshafts 69 and 70. Also, as just mentioned, they actuate identical cam follower arms 40, 41 and 42 on two sides of the machine. The opposite ends of these camshafts 69 and 70 are provided with additional bevel gears 71 which engage bevel gears 67 on the rear camshaft 72 which is identical to the front camshaft 52. The camshaft 72 is provided with identical parts as on camshaft 52 such as cams 49, 50, 51, 53 and 54 which actuate similar cam follower arms 40, 41, 42, 59 and 60 to cause them to perform identical functions at the rear of the machine. The camshafts 69 and 70 are mounted for support in bearings 73 which are fastened by means of bolts to the plates 63*a* and 64*a* which are in turn fastened to legs 23 and 24, respectively. All of the camshafts 52, 69, 70 and 72, because their respective bevel gears are meshed with each other, rotate together. And, because all eight of the bevel gears are identical in diameter and number of teeth, these camshafts all rotate at the same speed. Also, since similarly numbered cams are provided with identical grooves, the cam follower arms actuate through similar paths of travel.

In order to rotate these camshafts, the camshaft 52 is provided with a triple chain type sprocket 74 adjacent the cam 51. As particularly shown in Figs. 8, 9 and 19, this sprocket 74 is driven by a triple row chain 75 by means of a pinion 76 which is mounted at the end of a shaft 77. This shaft 77 is mounted in two bearings 78 and 79. Bearing 78 is mounted in a support 80 which in turn is fastened to a plate 81 by means of screws 82. Bearing 79 is mounted on a channel beam 83 which in turn is welded to the plate 81. Plate 81 is supported between and fastened to two channel beams 84 and 85. These beams 84 and 85 are in turn mounted between two other channel beams 86 and 87 which are secured by welding between the legs 22, 23, 24 and 25 of the frame 21. Beam 86 is connected between legs 24 and 87 while beam 85 is connected between legs 23 and 22. In addition to the cam follower arms 41 actuated by the four cams 50, four additional arms 88 are actuated through an additional roller type cam follower 89 which rolls around in a groove cut in the face of the cam 50 on the side opposite to that in which the groove 47 is cut. As shown best in Figs. 5, 6, 7 and 9, these arms 88 are pivoted at their ends to pins 90 which are mounted in brackets 91 welded to the underside of channel shaped members 92, 93, 84 and 85. Members 84 and 85 have already been described, but members 92 and 93 (Fig. 9) are suspended from and welded to the lower surface of the square plate 81 which, as already described, is part of the main frame 21 of the machine.

So far, then, all of the main cams and the arms which they directly actuate have been described.

As particularly shown in Fig. 19 there are a brake 94 and a clutch 95. Both the brake and the clutch are conventional purchased parts. The brake 94 consists of an annular coil 96 surrounded by a housing 97 which is secured to the support bracket 80 by means of screws 98. Forward of the coil 96 is a braking material 99 which provides a friction surface when the brake is operated. Contacting, when the brake is energized, with the wearing surface 99 is an annular brake disc 100. This disc is slidably supported on shafts 101 which in turn are screwed into an annular drum 102. This drum 102 is fixed relative to

the shaft 77 by means of a key 103. Surrounding the drum 102 is a commutator ring 104 composed of electrical insulating material and provided with two brass rings 105 and 106. These brass rings are connected to wires 107 and 107*a* which connect to a coil 108 housed in the clutch 95. The clutch is identical in construction to the brake 94. It has an annular clutching surface 99*a* and a clutch disc 100*a*. It also has a housing 97*a*. However, this housing 97*a* is directly fastened to the drum 102 rather than to a support bracket. The clutch disc 100*a* of the clutch 95 is slidably mounted on shafts 101 which are screwed into a sprocket 109 rotatably mounted on the shaft 77 by means of two bearings 110.

To provide electrical current to the brake coil 96, it is supplied through two wires 111 and 112 leading into the coil. The clutch coil 108 is provided with current through the two wires 107 and 107*a* connected to the brass rings 105 and 106 by way of brushes 113 and 114 mounted in a fixed brush housing 115.

In operation, when the brake is energized, the clutch is deenergized and when the brake is deenergized the clutch is energized. Such an arrangement provides instant starting and instant stopping. In order to rotate the shaft 77, a motor 116, shown in Figs. 6 and 8, is provided with a sprocket 117 which drives a double chain 118 which in turn drives the sprocket 109. With the clutch coil 108 energized and the brake coil 96 deenergized, this sprocket 109 rotates the clutch 95 through the clutch disc 100*a* which now contacts the clutching surface 99*a* because of the magnetic field induced by the current in the clutch coil 108. The clutch disc is actually driven by the shafts 101 which in turn are driven by the sprocket 109 to which they are attached. Since the brake coil 96 is deenergized at this time, the brake 100 is free to rotate with the clutch assembly as it is turned by means of the shafts 101 fastened to the clutch drum 102. Since the drum 102 is keyed to the shaft 77, the shaft 77 is thus caused to rotate. When it is desired to stop rotation of the shaft 77, the brake 94 is energized and the clutch 95 is deenergized. When this occurs, the clutch disc 100*a* is no longer urged into contact with the annular clutching surface 99*a* on the clutch and, consequently, the clutch disc 100*a* continues to rotate freely with the sprocket 109 along with the motor 116. With the brake energized, the brake disc 100 is forced into contact with the braking surface 99 on the brake to thereby stop rotation of the drum 102 and the clutch housing 97*a*. Since the drum 102 is prevented from further rotation, likewise, the shaft 77 to which it is keyed is stopped. Stopping shaft 77 stops rotation of the pinion 76 which in turn stops rotation of all of the camshafts 52, 69, 70 and 72. By alternately energizing and deenergizing the clutch and the brake in this manner, the camshafts are rotated or stopped in relatively short time intervals even though the motor 116 continues to rotate.

As shown in Figs. 5, 6, 7, 8, 9, 11 and 12, four shafts 119 are provided. Each of these shafts 119 is journalled in two bearings 120 mounted in corner castings 121 secured to the upper portions of the frame legs 22, 23, 24 and 25. Each of these shafts 119 is provided at its mid-portion with a block 122 fixed at its one end to the shaft. Its other end is pivoted by a pin 123 to the upper end of a link 124 whose lower end is hinged by a pin 125 to the lever arm 88. At the outer ends of each of these shafts 119 are provided two spur gears 126 which are keyed in position. Mounted in bearings 127 and 128, one directly above and the other directly below the bearing 120 in the corner casting 121, are shafts 129 and 130 provided with small gears 131 and 132. The outer hubs of these gears are fastened to the inner ends of links 133 and 134 whose outer ends are pivoted on pins 135 and 136 to a holding bar arm 137. The links 133 and 134 are mounted parallel to each other and retain a parallel relationship at all times. The two holding bar arms 137 along one side of the machine are fastened to opposite ends of a holding bar 138. During its operation, a cam 50 causes its lever arm 88 to pivotally reciprocate up and down to cause alternate clockwise and then counterclockwise rotation of the spur gear 126 to cause the holding bar arms 137 to be raised and lowered in an arcuate path, as will be described, to move the holding bar through a similar path. This holding bar is used to hold certain carton flap portions down while another is folded around it as will later be explained.

In order to fold certain flaps in cooperation with the holding bar 138, additional folding means are required. On each of the three sides of the machine except the front side, an additional shaft 139 is provided and it is mounted in bearings 140 mounted in the corner castings 121. As best shown in Figs. 6 and 9, each shaft 139 is provided with two curved arms 141 adjacent its ends. These arms are of an approximate C-shape and their extremities 142 support a flat folding bar 143 between them. Pivotally mounted by pins 144 on an inside portion of each arm 141 is a J-shaped arm 145 whose free ends 146 support an auxiliary holding bar 147. About midway between the ends of each of these members 145 is provided a laterally extending bar 148. This bar rests against the upper end of a flat spring 149 whose lower end is fastened by screws 150 to a block 151 fastened at its inner end to the arm 141. The effect of this arrangement with the spring 149 is to urge bar 147 away from the folding bar 143.

In order to cause the folding arms 141 to be rotated to fold carton flaps, the shafts 139 must be rotated. As best shown in Figs. 11 and 12, each of the shafts 139 is journalled between two blocks 152 which are slidably mounted in vertical guideways 153 formed in the corner castings 121. Immediately inside these sliding blocks 152, the ends of the shafts 139 are provided with pinions 154 which engage teeth in a vertically sliding rack 155. Movement of the rack relative to the block 152 causes rotation of pinions 154 to thereby cause rotation of the folding arms 141. The lower end of each rack 155 is pivotally connected by a pin 156 to the upper end of a link 157 whose lower end is connected to a horizontal bar 158. This horizontal bar 158 is provided with two depending yokes 159 which pivotally connect to the outer ends of arms 40 and 42. Thus, when the camshafts are rotated, the cams 49 and 51 cause the arms 40 and 42 to a pivotally reciprocate up and down and cause the folding arms 141 to rotate first in one direction and then the other.

Again, as viewed in Fig. 12, since it is necessary to raise the folding arms 141 to their folding positions before rotating them to fold carton flaps, additional shafts 160 are provided on all four sides of the machine. These shafts 160 are mounted in bearings 161 in the corner castings 121. They are provided adjacent their ends with pinions 162 which engage racks 163 fastened to the sliding blocks 152. Rotation of these pinions 162 occurs during vertical upward and downward movement of these sliding blocks 152. The lower ends of each of these blocks 152 are pivoted by pins 164 to the upper ends of adjustable links 165 whose lower ends are fastened to ends of the horizontal arms 166. At the mid point of each of these arms 166 is provided a depending yoke 167 pivotally connected to the outer end of a lever arm 41. Thus, when the camshafts are rotated, the cams 50 cause vertical reciprocation of these lever arms 41 and thus cause rotation of the pinions 162. The purpose of these pinions 162 which act as idlers, is to compensate for any tendency to bind which would otherwise be present, between the walls of the vertical guideways 153 and those of the blocks 152 which slide therein. These pinions, then, overcome what might be termed a "transom latch" effect due to the relative shortness of the vertical guideways 153.

On the front side of the machine, as particularly viewed in Figs. 5 and 11, the flap folding members are different

than those associated with folding bars 143 on the other three sides of the machine. Instead of a long folding bar 143, two short folding bars 143*a* are provided between the extremities of spaced apart C-shaped folding arms 141*a* which are identical in shape to arms 141. These arms 141*a* are mounted on short shafts 139*a* which are in turn mounted between two sliding blocks 152 slidably mounted in vertical guideways 153 attached to the machine frame 21. Because of the use of two short shafts 139*a* rather than a long one on this front side of the machine, there are four sliding blocks 152 and four guideways 153 rather than two each as on the other three sides of the machine. Also, because of this, there are a total of four of the racks 155 and 163, the pinions 154 and 162, and the links 157 and 165 and their related parts. Likewise, these arms 141*a* are provided with short auxiliary holding bars 147*a* which connect between two J-shaped arms 145*a* which are pivoted on the arms 141*a* in the same manner as arms 145 are pivoted on arms 141. Similarly flat springs 149*a* react against bars 148*a* connected between the two arms 145*a*. These springs 149*a* are connected to blocks 151*a* which are in turn connected to the arms 141*a*. Thus, the front of the machine is provided with two short folding bars 143*a*, one on either side of the machine. As viewed in Fig. 5, this leaves a space 168 clear at the front of the machine where a strap stretching tool 169 and a sealing tool 170 can be manually operated after a strap loop has been positioned around the carton.

After the holding bars 138 and the folding bars 143 and 143*a* are actuated, the L-shaped strap retaining members 171 are raised into position to complete the flap folding and to position a strap loop around the interlocked flaps. On all three sides of the machine, except its front, these strap retaining members consist of end blocks 172 which are fastened by means of screws 173 to a plate 174 and these blocks 172 support three identical rollers 175 which are mounted between two of them on each side of the machine. Each of these plates 174 are fastened to the upper end 176 of a round plunger 177. Each of these plungers 177 is slidably mounted through holes in pads 178 which are a part of the corner castings 121. These pads are particularly shown in Figs. 5, 6 and 7. The lower end of each of these plungers 177 is pivotally connected to the end of one of the arms 59 or 60. Thus, when all of the main cams are rotated, cams 53 and 54 cause pivotal reciprocating motion of the levers 59 and 60 to cause the strap retaining members 171 to be raised and lowered.

On the front of the machine, as particularly viewed in Fig. 11, the strap retaining members 171*a* are shorter than the corresponding members 171 positioned along the other three sides of the machine. But, they are of similar construction. These strap retaining members 171*a* have end plates 172*a* and 172*b*. The end plates 172*a* are mounted on the plates 174 in the same manner as the end plates 172, but the end plates 172*b* are mounted on inner ends 174*a* of these plates 174. Mounted between the end plates 172*a* and 172*b* are short rollers 175*a* whose length corresponds to the spacing of these end plates 172*a* and 172*b*. The reason that these strap retaining members 171*a* are short and provided one on either side of the front of the machine is to leave the space 168 available for hand manipulation of the strapping tools 169 and 170 as previously mentioned.

As shown in Figs. 8 and 9, to provide additional support for the three shafts 119 on the three sides of the machine except the front, brackets 179, 180 and 181 are provided. They extend angularly upward to the region of the shafts 119 and their lower ends are fastened by bolts 182 to frame members 86, 87 and 183. Frame members 86 and 87 have already been described, but frame member 183 is mounted between legs 23 and 24. The upper ends of these brackets 179, 180 and 181 are provided with journals 184 which fit around the shafts 119.

Additional support is also given to the two camshafts 52 and 72. The lower extension of the bracket 181 is provided with a bearing 185 which surrounds and supports the center of the shaft 72 while an additional bracket 186 is fastened to the frame 21 by means of screws 187 and extends downwardly to support the central portion of the shaft 52 by means of a bearing or journal 188.

The table 2 on which a carton is supported is provided with rollers 189 which are journalled in the side members of the table 2 between the front and rear of the machine. As shown particularly in Figs. 6, 9 and 11, additional rollers 190 and 191 are provided at both ends of the machine. The rollers 190 are divided into groups of two each at the four corners of the machine and are journalled in brackets 192 which are fastened to the vertical guideways 153. The rollers 191 are divided into two groups of four each with a group at each end of the machine and centrally located laterally. These rollers 191 are journalled on a shaft 193 which is mounted on a bracket 194 fastened to the upper end of each of the brackets 179 and 180. These rollers 190 and 191 provide additional free rolling support for a carton being moved over the machine from a conveyor 4 leading to the machine and to a conveyor 5 at the exit of the machine.

The functional operations of the machine are shown in their sequence of movement in Figs. 13 through 18 where the basic flap folding and strap positioning members are somewhat diagrammatically shown. When the machine is at rest, all parts are in the positions as shown in Figs. 5 through 12. The main holding bars 138, the folding bars 143, the auxiliary holding bars 147 and the strap retaining members 171 are all below the upper surface of the table 2. At this time, a carton end cap 13 is placed on the table with its end marginal flaps 15 positioned as shown in Fig. 13. Upon this end cap is placed the carton tube 10 with its end flaps 12 aligned as shown in Fig. 13. With the carton parts in place, a holding bar 138 is rotated from its position as shown in dotted lines in the direction of the arrow 195 to its position as shown in bold outline in Fig. 13 where it rests against a score line 15*a* of the end cap flap 15 and also upon the outer edge of a flap 12. At this time, this holding bar 138 retains the flaps 12 and 15 clamped against the upper roller 175 of a strap retaining member 171. As shown in Fig. 14 a sliding block 152 is raised slightly as the rack 155 causes an arm 141 to rotate in a counterclockwise direction. This rotation causes the folding bar 143 to push the outer half of a flap 15 to a vertical position around the holding bar 138 to position it at a right angle to the remaining half of the flap. As shown in Fig. 15, after the outer half of the flap 15 is folded beyond the vertical to thereby interlockingly confine the flap 12, the holding bar 138 is then retracted through an arc to a higher position clear of the folding arm 141 which is then rotated further counterclockwise to a position where the holding bar 143 contacts a corner between the carton tube 10 and the flap 15. At this time, the auxiliary holding bar 147 holds the outer half of a flap 15 in a position where this outer half is folded back upon its inner half. Next, as shown in Fig. 16, the strap retaining member 171 is raised to fold the now folded flap 15 up against the side of the carton tube 10. At this time, the auxiliary holding bar 147 is deflected against the force of its leaf spring 149 toward the folding bar 143. After the folded flap 15 is once removed angularly well beyond its horizontal position, this bar 147 is no longer needed for retaining the flap 15 folded since the flap is now prevented from unfolding as its outer edge contacts the outer wall of the carton tube 10. Then, as shown in Fig. 17, when the folded flap 15 is angularly far beyond its horizontal

position, as the strap retaining member continues to urge it angularly, the folding arm **141** is rapidly rotated out of the way in a clockwise direction. The strap retaining member **171** continues upwardly until the flaps have achieved their final folded and interlocked positions as shown in Fig. 18. At this time, the strap loop **16** which had previously been positioned in the strap retaining members **171** is drawn taut and fastened by means of the hand tools **169** and **170** manipulated by the machine operator.

The strap loop **16** is positioned along the face **171***c* of these strap retaining members prior to the positioning of a carton. The strap loop is held in place by means of U-shaped magnets **171***b* positioned adjacent the ends of these strap retaining members **171** and also **171***a*. These magnets are particularly shown in Figs. 11 and 12. It has been found that magnets **171***b* are necessary only in the two front members **171***a* since the resilience of the strap itself holds the strap loop against the members **171**. But, for additional holding ability, magnets can be provided in the members **171** also, as described.

After all of the folding is completed and the strap is in place, the parts are all returned to their original positions as shown in Figs. 5 through 12. Another strap loop is then placed in the strap retaining members **171** in preparation for the next operating cycle.

Even though I have just described the operations of the folding bars **138** on all four sides of the machine and the operations of the members **143**, **147** and **171** which are on only three sides of the machine except the front, the shorter members **143***a*, **147***a* and **171***a* on the front side of the machine operate in an identical manner.

As shown in Figs. 5 and 8, the strap stretching tool **169** and the sealer tool **170** are both mounted on a shaft **196** which is mounted at its ends in two brackets **197** mounted to depend from the inner ends of the strap retaining members **171***a* on the front side of the machine. A bracket **198** below the shaft **196** is connected between these two members **197**. The lower ends of each of these tools **169** and **170** are pivoted by means of sleeves **199** and **200** on the shaft **196** so that the upper ends of the tools can be placed at or removed from strapping position. With this arrangement, the shaft **196** is raised and lowered along with the strap retaining members **171** and **171***a* and, thus, the tools are raised or lowered accordingly. Since the upper ends of the strapping tools are in alignment with the level of the plane of the strap loop **16** when one is placed in the strap retaining members, these tools remain in alignment because they move with the strap retaining members.

Even though many different varieties of strap stretching and sealing tools are available and could be used with this machine, a preferred air operated strap stretcher **169** is shown in Figs. 21 and 22 while one form of a sealer **170** is shown in Fig. 23.

The particular air operated strap stretcher comprises a conventional rotary type air motor **201** which is provided with an inlet of high pressure air through conduit **202**. An air valve **203** is provided for permitting air to enter through conduit **202** to operate the air motor or to shut off the air supply from the air motor. The upper end of the air motor **201** is connected to a housing **204** which contains a gear reducing mechanism. This gear reducing mechanism is connected to the shaft **205** which carries a wheel **206** which rotates with the shaft **205**. The wheel **206** is provided with serrated teeth **215** on its periphery. The shaft **205** is fixed, except for rotation, relative to the housing **204**. A strap rest plate **207** is provided at right angles to and at the lower end of an arm **208** which is pivoted on a pin **209** to the gear housing **204**. The strap rest plate **207** is provided with a strap seat **210** which is threaded into the strap rest plate **207** and is provided on its upper surface with sharp teeth **211**. A spring **212** reacts between a surface **213** on the gear housing and the bottom of a hole **214** in the arm **208** to cause the strap seat **210** to be urged into contact with the wheel **206**. At the outer end of the arm **208** is provided a projection **216** whose lower surface **217** is opposite a surface **218** on a release lever **219** pivoted on a pin **220** to the gear housing **204**. When the upper portion **221** of the lever **219** is depressed, it is pivoted against the action of a spring **222** and causes the strap seat **210** to be separated from the wheel **206** as surface **218** contacts surface **217** and moves plate **208** against the pressure of spring **212**. Such a release movement is necessary to provide for the insertion of the two strap ends **17** and **18** which are placed one above the other between these members. When the strap ends have been positioned properly, the lever **219** is released and strap seat **210** again is urged toward the wheel **206**. This time, however, the strap seat **210** rests against the lower surface of the strap end **18** while the teeth of the wheel **206** press against the upper surface of the strap end **17**. The extreme end **223** of the lever **219** is hooked over to provide a strap guide. It is retracted when the lever **219** is depressed. With the strap ends in place, the air valve **203** is operated by depressing an arm **224**, permitting air to enter the air motor **201** through conduit **202** to in turn cause rotation of the motor. This causes rotation of the gears within the gear housing **204** and causes the wheel **206** to be rotated. Rotating this wheel **206** causes strap end **17** to slide across strap end **18** which remains fixed relative to the strap seat **210**. In this manner, the strap loop is shrunk in size and tensioned around the interlocked flaps **12** and **15** of the container. Because the pivot pin **209** is angularly displaced from the plane of the strap seat **210**, as the strap loop tension is built up, the strap seat **210** is urged more strongly into contact with the wheel **206** to prevent slippage of the upper strap end **17** relative to the wheel **206** and the lower strap end **18** relative to the strap seat **210**.

As shown in Fig. 23, the conventional sealer tool used has a sealer head **225** with two operating arms **226** and **227** which are used to operate the linkages contained in the sealer head **225** for sealing together the strap ends **17** and **18**. The particular strapping tool shown in this Fig. 23 is one which is identical to that which is shown and claimed in U.S. Patent 1,974,913, issued September 25, 1934, to William C. Childress. Of course, as already mentioned, other sealing tools may be used depending upon the type of leverage required and the type of joint preferred.

The electrical control circuits for the machine are shown schematically in Fig. 20. Two wires **228** and **229** are connected to a source of alternating voltage. A master switch **230** connects these wires **228** and **229** to two fuses **231** which in turn are connected to two wires **232** and **233**. These wires connect to two wires **234** and **235** which lead into wires **236** and **237** connected to the electric motor **116**. At the lower end of these wires **234** and **235** are two wires **238** and **239** which provide voltage to a rectifier **240** to provide a direct current voltage across wires **241** and **242**. When the master switch **230** is closed, alternating current is supplied to both a motor **116** and the rectifier **240** to start rotation of the motor and also supply direct current between the wires **241** and **242**. Connected to the wires **241** and **242** are two short wires **107** and **243**. Wire **107** connects with a wire **112** while a wire **243** connects to a wire **244**. A branch circuit connects between the intersections of wires **107**, **112** and **243**, **244** and comprises a clutch coil **108**, the wire **107***a*, a rheostat **245** and a switch **246**. The lower ends of wires **112** and **244** connect to another branch circuit comprising a brake coil **96**, a wire **111**, a rheostat **247** and a switch **248**. Both of these branch circuits including a clutch coil and a brake coil are those provided with direct current from the rectifier **240**. Connected between the wires **234** and **235** is a branch circuit consisting of two switches **249**, **250**, switch **251** and a relay **252**. In parallel with portions of this branch

circuit are two other circuits comprising a switch **253** and a relay **254** in one circuit and a switch **255** and a relay **256** in the second circuit. A holding switch **257** is provided in parallel with the switch **255**. Still another switch **258** is connected from a point between switch **253** and relay **254** to a point between switch **251** and a relay **252**. Switches **246** and **248** are contact switches actuated by relay **252**, while switches **255** and **258** are contact switches actuated by relay **254**. Switches **251** and **257** are contact switches actuated by relay **256**.

When the master switch **230** is closed and the motor **116** is started and direct current is made available between the wires **241** and **242**, the switch **248** being already closed causes the brake coil **96** to be energized. This keeps the shaft **77** idle and, likewise, all of the camshafts **52**, **69**, **70** and **72**. Further, at this time, the clutch coil **108** is deenergized since the switch **246** is then open.

When it is desired to start rotation of the camshafts and begin the folding of the carton flaps, the two switches **249** and **250** are closed simultaneously by pressing their switch buttons **294***a* and **250***a* which are shown on the front of the machine in Fig. 1. They are purposely positioned at a distance from each other so that the machine operator is required to use both hands when pressing these buttons. This keeps his hands occupied and prevents them from becoming caught in the machine mechanisms. Further, since these switch buttons are spring returned, the operator must keep them depressed, otherwise the machine will stop. Upon actuating these switches **249** and **250**, the relay **252** is energized through the switch **251**. Energizing this relay **252** closes switch **246** and opens **248**. Doing so, de-energizes the brake coil **96** and energizes the clutch coil **108** with a consequent rotation of the camshafts **52**, **69**, **70** and **72** to start the operations of the machine. As shown in Fig. 6, switch **253** is mounted on the frame **21** of the machine and is provided with an arm having a roller **253***a* for actuating it. When the machine starts up, the roller **253***a* rests on a raised portion **259** of the cam **53**. As the cam **53** rotates, the roller falls off of this raised portion **259** and closes the switch **253**. This energizes the relay **254** which in turn closes the switches **255** and **258**. Switch **258** acts as a holding switch to then keep relay **254** energized. Closing switch **255** energizes relay **256**. Energizing relay **256** closes switch **257** which acts as a holding switch to keep relay **256** energized and also opens switch **251**. Opening switch **251** prevents continued rotation of the camshaft when switch **253** is later opened. The camshafts continue to rotate to approximately 270 degrees of rotation, at which time all of the folding has been completed and all parts of the machine are in positions corresponding to those of Fig. 18. At this time the roller **253***a* rides up onto a raised portion **260** on the cam **53** and this causes switch **253** to be opened again. Opening this switch deenergizes relay **254** to again open switches **255** and **258**. Opening switch **255** has no effect at this time since holding switch **257** is still closed to keep relay **256** energized. Opening switch **258** prevents continued energization of relay **254** when switch **251** is again closed. Also, opening switch **253** deenergizes relay **252** which in turn opens switch **246** to free the clutch and closes switch **248** to apply the brake and thereby stop rotation of the camshafts. At this time when all of the mechanized parts of the machine are stopped, switches **249** and **250** are opened to deenergize relay **256**. Deenergizing relay **256** opens up switch **257** and closes switch **251**. At this time all of the electrical components are returned to their original opsitions, as shown in Fig. 20, even though all of the mechanical parts of the machine are in stationary positions corresponding to those of Fig. 18.

In order to return the parts from their opsitions corresponding to Fig. 18 to their original positions indicated by Figs. 5 through 12, the switches **249** and **250** are again closed. The entire electrical cycle of operation is repeated for the last ninety degrees of rotation of the camshafts which corresponds to the smaller angular distance between the raised portions **260** and **259** on the cam **53**. Such an operation returns all of the parts to their original positions ready to begin a complete new operating cycle. To emphasize the relationship between the electrical and mechanical portions of the machine, the electrical cycle operates twice for each single complete mechanical cycle of the machine.

From this description it should be apparent that a machine has been provided which can quickly and efficiently fold together the flaps on an end cap with those of the main body tube of a "lock flap" carton and position a strap loop about them to provide an economical means of end closure. As shown in Fig. 1, the container **3** can first be closed on one end and then inverted and closed on its other end with one machine. Otherwise, one end cap can be applied by another machine at a different station and the second one applied at a first station. Although one form of the machine has been shown in a particular manner, it will be obvious to persons skilled in the art that it may be constructed in different ways with slight modifications without departing from the true scope of the appended claims defining the invention.

I claim:

1. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and inner portions of the marginal flaps against the support means, and means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them.

2. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, and means for folding the interlocked marginal flaps and end flaps against the body tube.

3. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, means for folding the interlocked marginal flaps and end flaps against the body tube including means for encircling the interlocked flaps with a strap loop.

4. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding

the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, means for folding the interlocked marginal flaps and end flaps against the body tube including means for encircling the interlocked flaps with a strap loop, said last means releasably retaining the strap loop.

5. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, means for folding the interlocked marginal flaps and end flaps against the body tube including means for encircling the interlocked flaps with a strap loop, said last means releasably retaining the strap loop by means of magnets.

6. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising means for holding the end flaps in contact with the marginal flaps, means for folding the marginal flaps around the end flaps into interlocked position with them, and means for encircling the interlocked flaps with a strap loop, said last means releasably retaining the strap loop.

7. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, means for holding the end flaps in contact with the marginal flaps, means for folding the marginal flaps around the end flaps into interlocked engagement with them, and means for encircling the interlocked flaps with a strap loop, said last means releasably retaining the strap loop by means of magnets.

8. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, means for folding the interlocked marginal flaps and end flaps against the body tube including means for encircling the interlocked flaps with a strap loop, all of said holding and folding means being operated by cam actuated levers.

9. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, means for folding the interlocked marginal flaps and end flaps against the body tube including means for encircling the interlocked flaps with a strap loop, all of said holding and folding means being operated by levers actuated from power driven cams.

10. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, means for folding together the end flaps of the body tube and the marginal flaps of the end cap into interlocked engagement, and means for folding the interlocked end flaps and marginal flaps against the body tube and encircling the interlocked flaps with a strap loop, all of said means being actuated by a power means.

11. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, means for folding together the end flaps of the body tube into interlocked engagement with the marginal flaps of the end cap, and means for folding the interlocked end flaps and marginal flaps against the body tube and encircling the interlocked flaps with a strap loop, said last means carrying a strapping tool into operating position.

12. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, means for folding together the end flaps of the body tube into interlocked engagement with the marginal flaps of the end cap and means for folding the interlocked end flaps and marginal flaps against the body tube and encircling the interlocked flaps with a strap loop, said last means pivotally supporting a strap tensioning tool and a strap joint forming tool which are moved into operating position by this last means.

13. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, means for folding together the end flaps of the body tube with the marginal flaps of the end cap, said means being operated by levers actuated for rotating cams, said cams being mounted on a shaft connected to be driven through an electro-magnetic clutch by a power means and to be stopped by an electro-magnetic brake, said clutch and brake being electrically connected for alternate energization and deenergization to provide incremental movements of the shaft for one entire revolution of the shaft.

14. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, folding means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, auxiliary holding means pivoted on said folding means for holding the outer portions of the marginal flaps in engagement with the end flaps, and means for folding the interlocked marginal flaps and end flaps against the body tube.

15. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, means for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, folding means for folding the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, auxiliary holding means pivoted on said folding means for holding the outer portions of the marginal flaps in engagement with the end flaps, means for folding the interlocked marginal flaps and end flaps against the body tube including means

for encircling the interlocked flaps with a strap loop.

16. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, a power driven camshaft supporting cams thereon for actuating levers pivoted to the machine frame, one of said levers actuating a holding bar for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, a second of said levers actuating to operate a folding bar which folds the outer portions of the marginal flaps around the end flaps into interlocking engagement with them, an auxiliary holding bar pivoted on said folding bar for holding the outer portions of the marginal flaps in engagement with the end flaps, and a third of said levers actuating to operate an arm for folding the interlocked marginal flaps and end flaps against the body tube and position a strap loop about the interlocked flaps.

17. A machine for end closure of containers wherein each container is characterized by a body tube having end flaps folded into interlocking engagement with marginal flaps on an end cap comprising, support means for supporting the unfolded end cap beneath the body tube with the end flaps resting flatly on the marginal flaps, a power driven camshaft supporting cams thereon for actuating levers pivoted to the machine frame, one of said levers actuating a bell crank lever for rotating

a shaft mounted on the frame, said shaft being connected to a parallel motion linkage for actuating a holding bar for holding the end flaps in contact with the inner portions of the marginal flaps and the inner portions of the marginal flaps against the support means, a second of said levers being provided with a rack engaged to position a folding arm, a third of said levers engaged to rotate a pinion attached to the folding arm which carries a folding bar for folding the outer portions of the marginal flaps into interlocking engagement around the end flaps, an auxiliary holding bar resiliently pivoted on said folding arm for holding the outer portions of the marginal flaps in engagement with the end flaps after the outer portions of the marginal flaps are folded around the end flaps, and a fourth of said levers actuating to operate an arm slidably mounted in the frame, said arm supporting a strap loop and operated to fold the interlocked marginal flaps and end flaps against the body tube and position the strap loop about them, said arm also pivotally supporting mechanism for tensioning the strap loop and joining together the ends of the strap loop.

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