United States Patent [19]

Lemmond et al.

[11] **3,810,345**

[45] **May 14, 1974**

[54] **BOX CAPPING MACHINE**

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[52] **U.S. Cl.** **53/306**, 53/367

[51] **Int. Cl.** **B65b 7/28**

[58] **Field of Search** 53/306, 310, 389, 282, 53/283, 285, 183, 287, 367

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Primary Examiner—Travis S. McGehee
Assistant Examiner—Horace M. Culver
Attorney, Agent, or Firm—A. Yates Dowell, Jr.

[57] **ABSTRACT**

Apparatus for automatically removing box lids from a first conveyor and placing such lids on boxes carried by a second conveyor. The apparatus includes a carriage having first and second lid pickup devices in which the first lid pickup device removes a box lid from a lid holding station on the first conveyor and transfers the lid to a ready pickup station. Simultaneously the second pickup mechanism removes a box lid from the ready pickup station and places such lid on a box located at a box holding station on the second conveyor. The apparatus includes electrical and fluid systems arranged in a manner that the lids will be placed on the boxes or containers automatically without an operator being present after the apparatus has been started.

15 Claims, 22 Drawing Figures

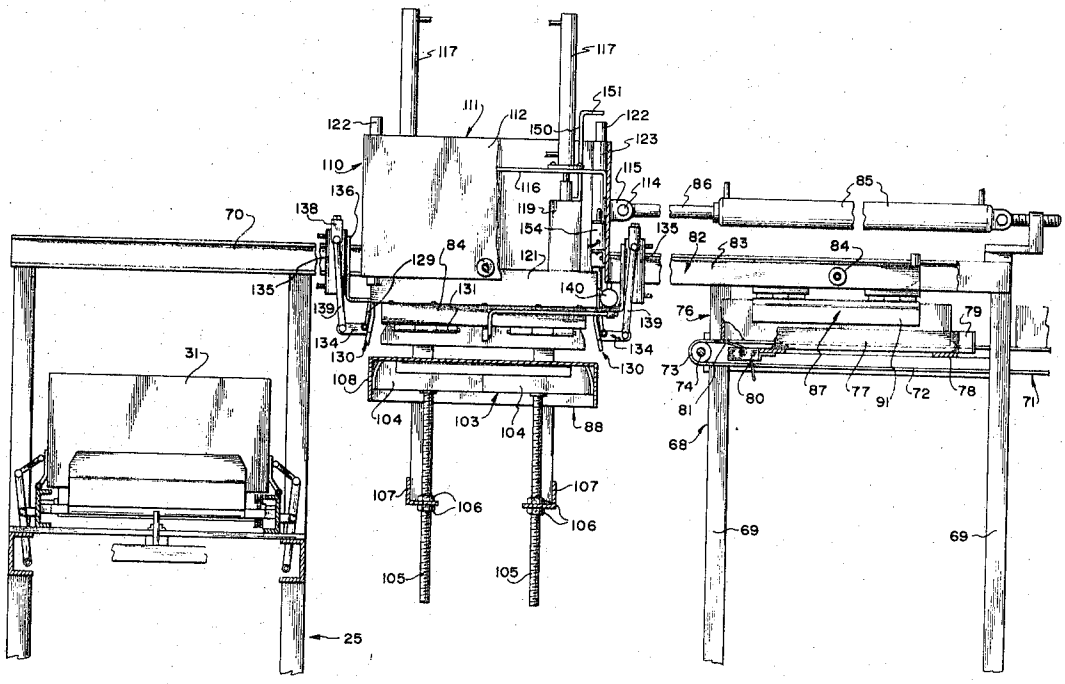


FIG. 1

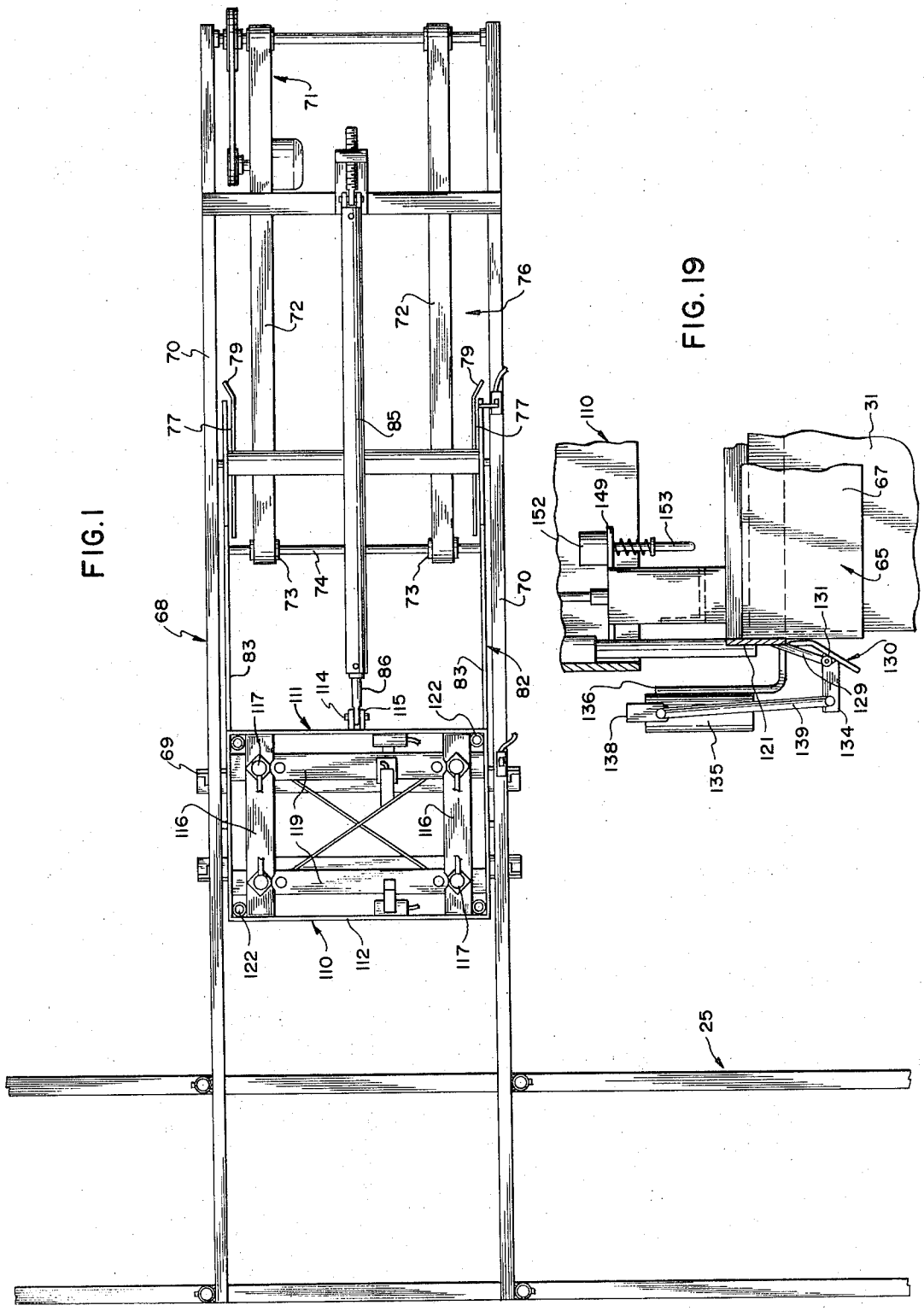

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FIG. 19

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FIG. 2

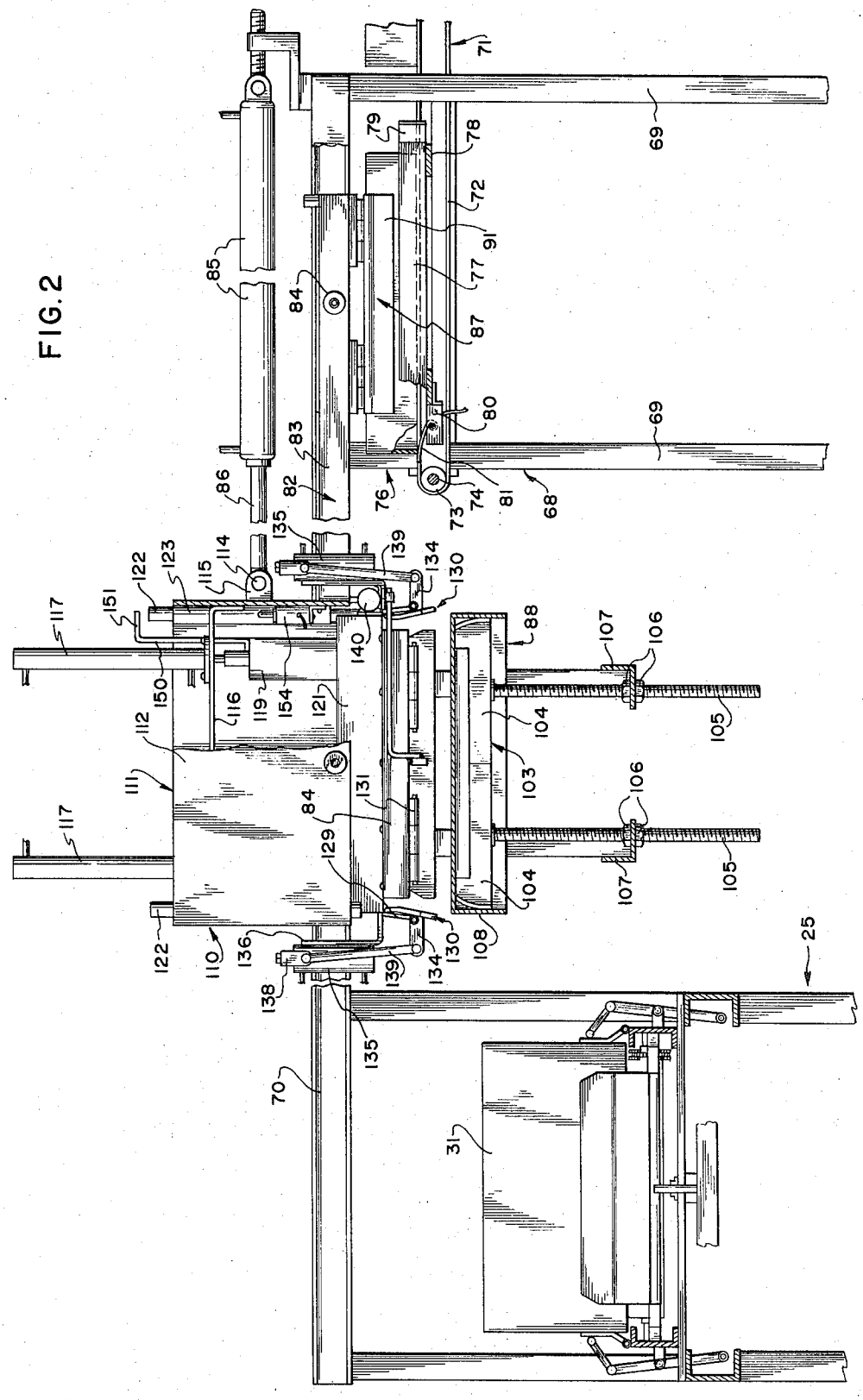

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FIG. 3

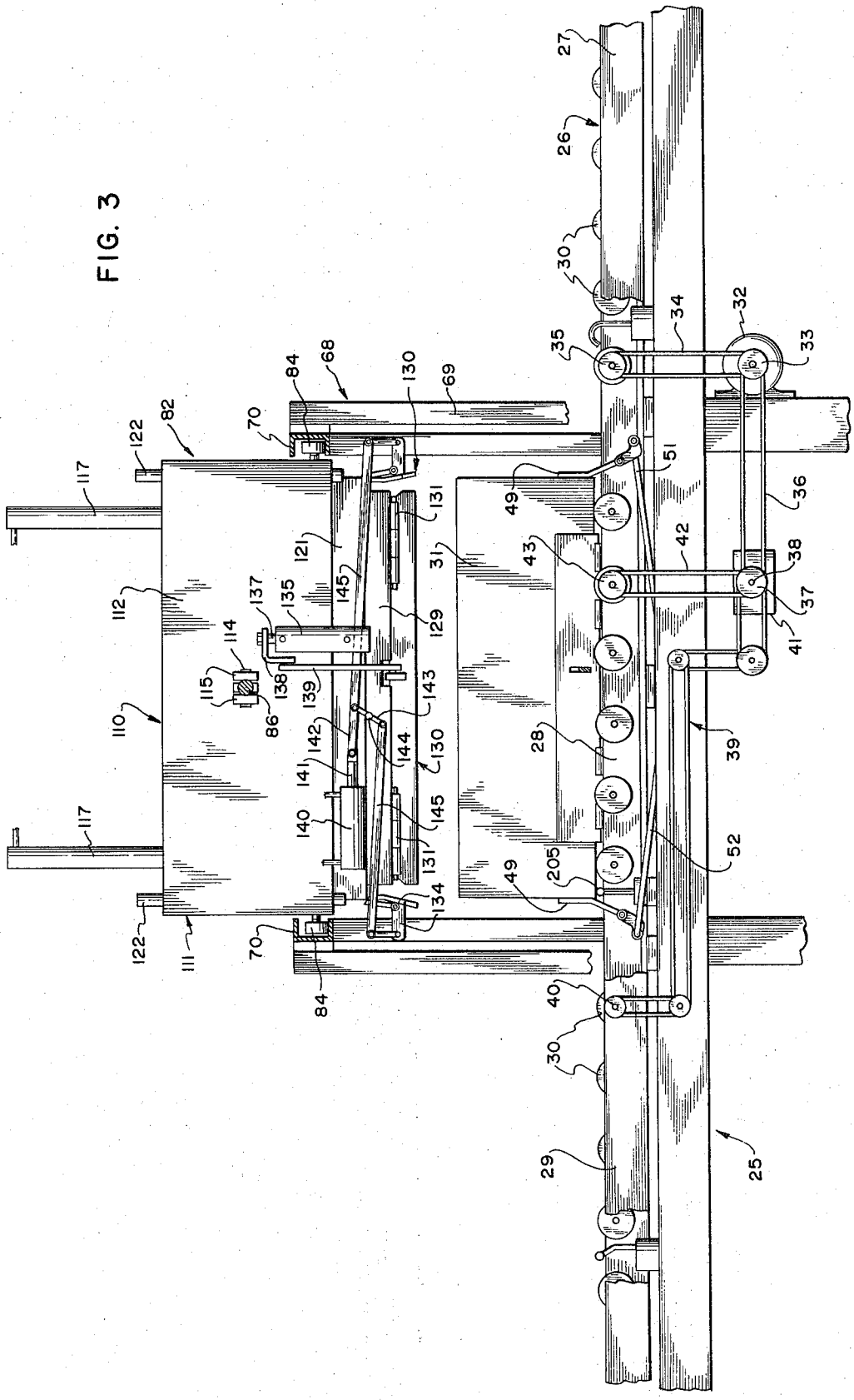

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FIG. 4

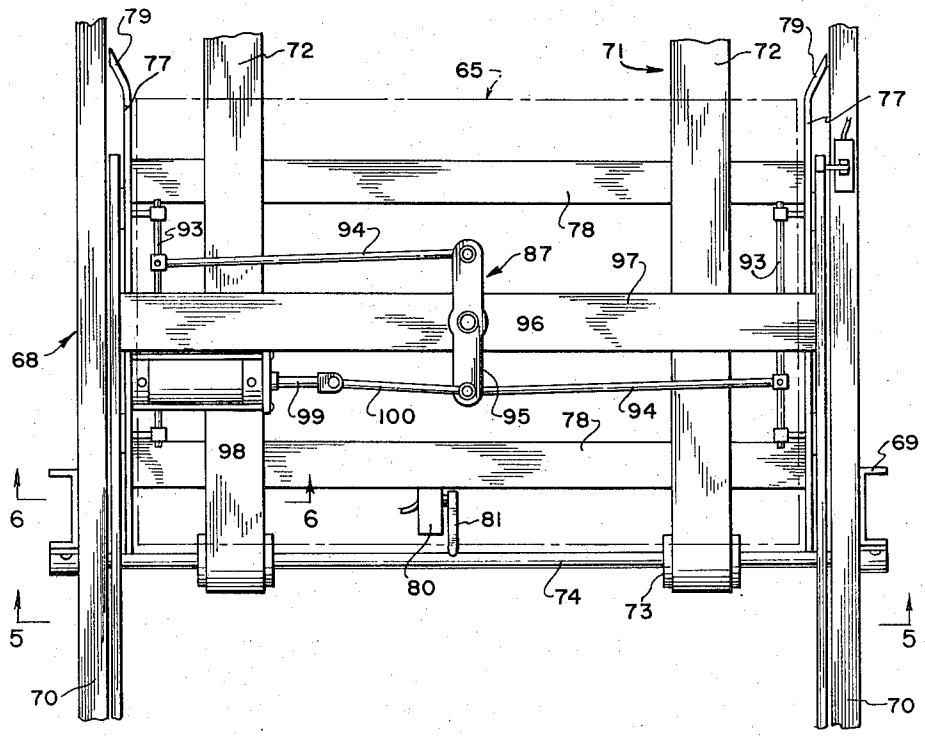


FIG. 5

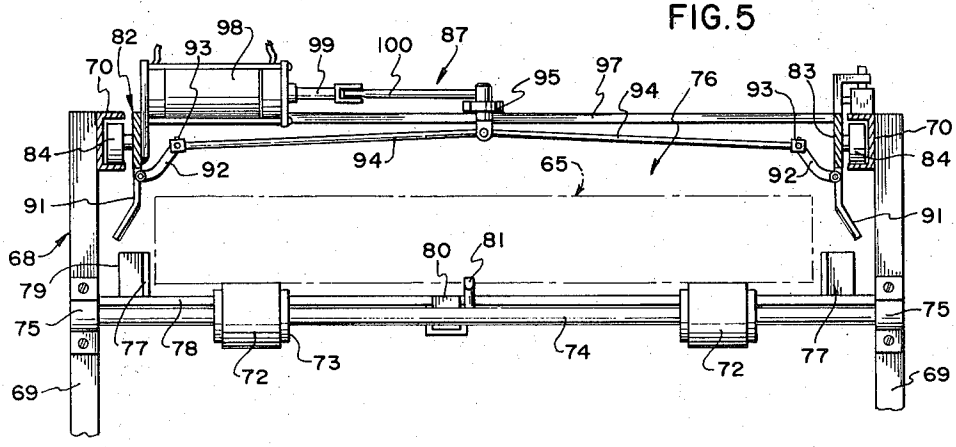


FIG. 6

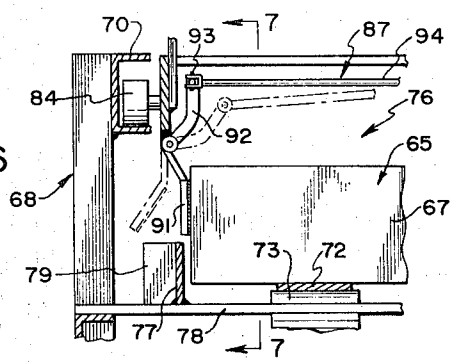


FIG. 7

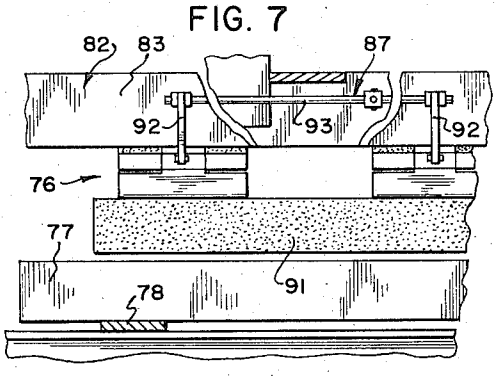


FIG. 8

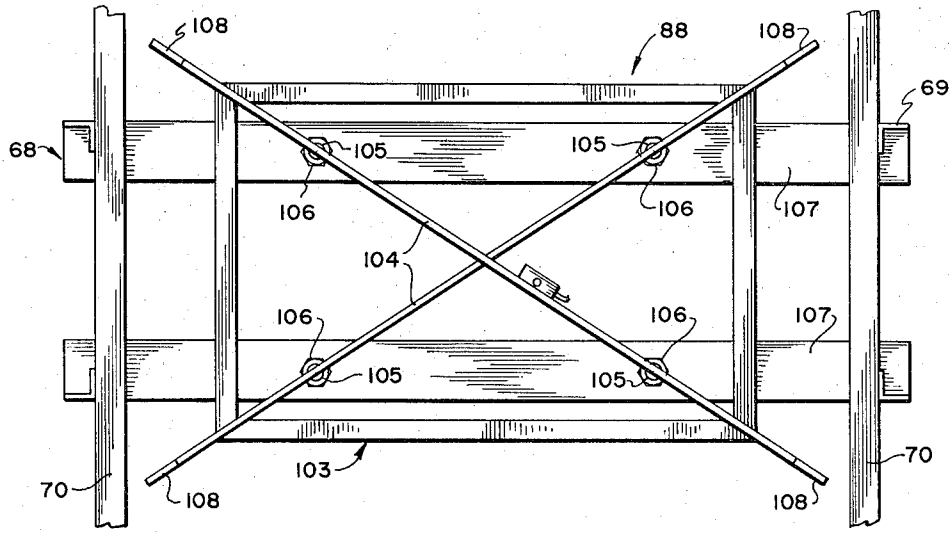
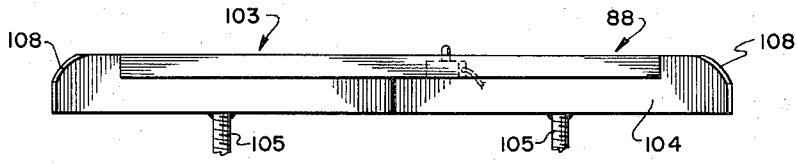


FIG. 9



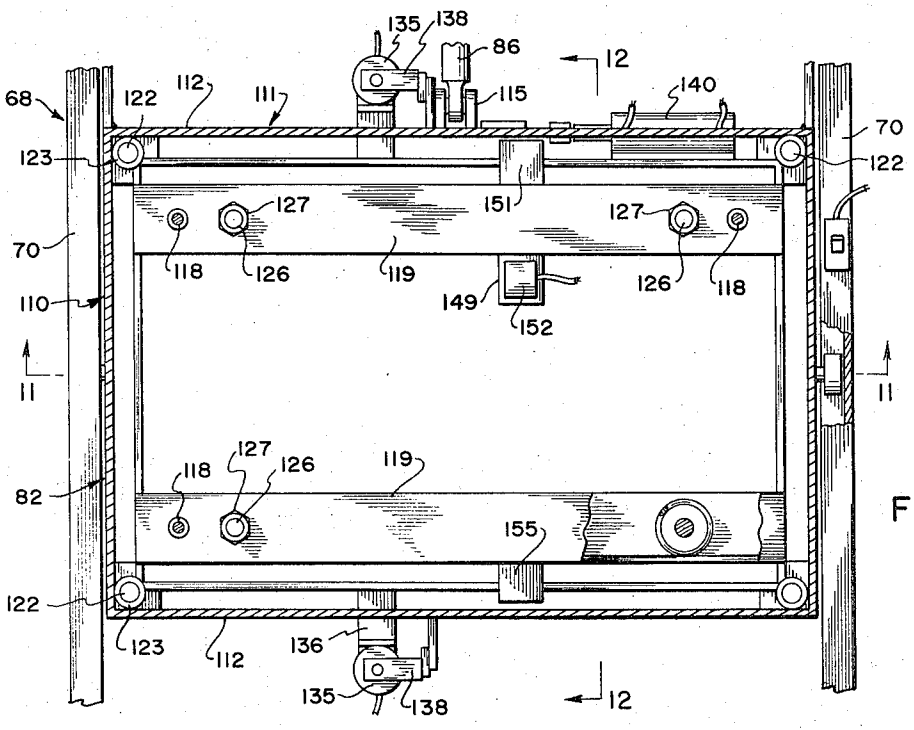


FIG. 10

FIG. 11

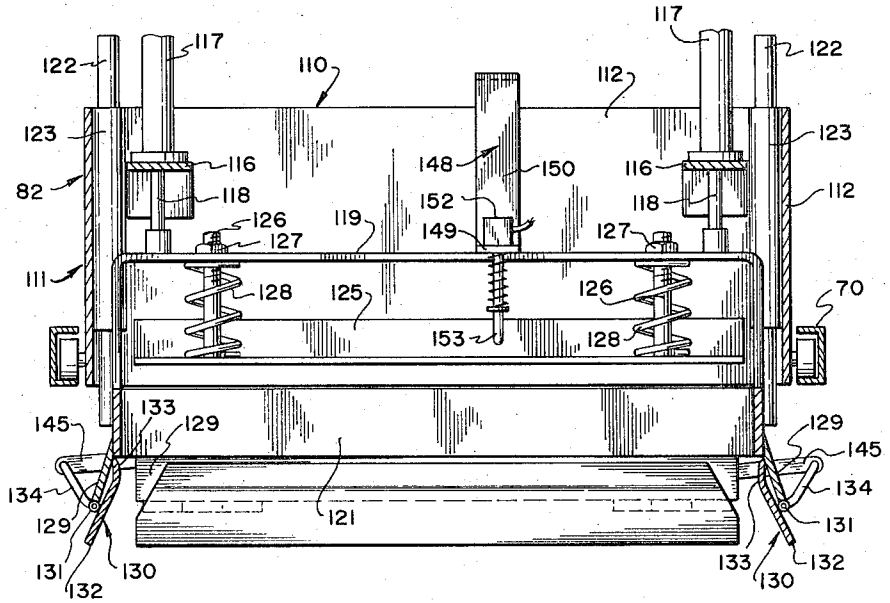

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FIG. 12

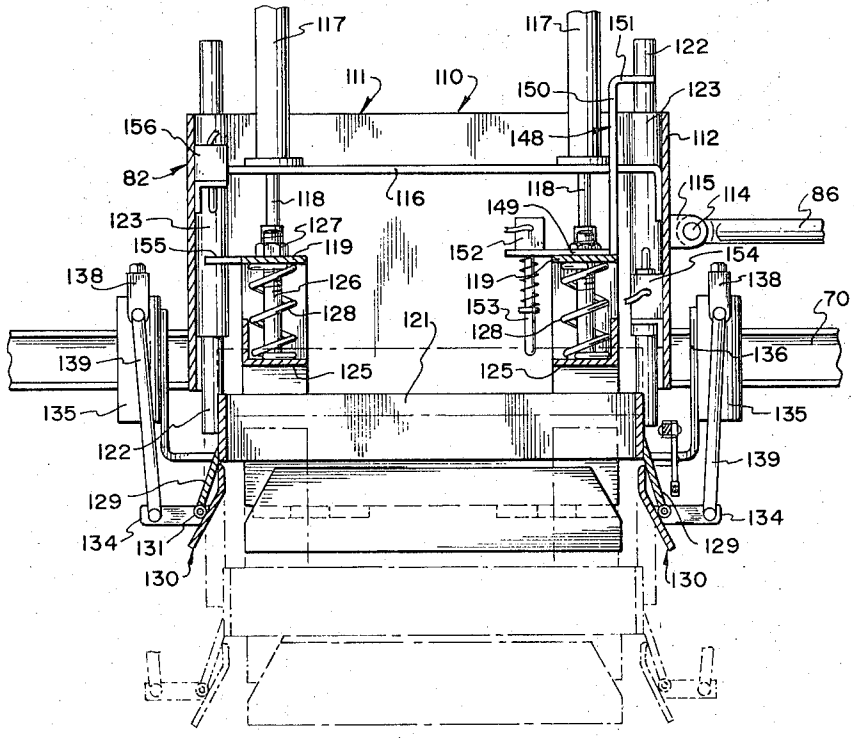

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FIG. 13

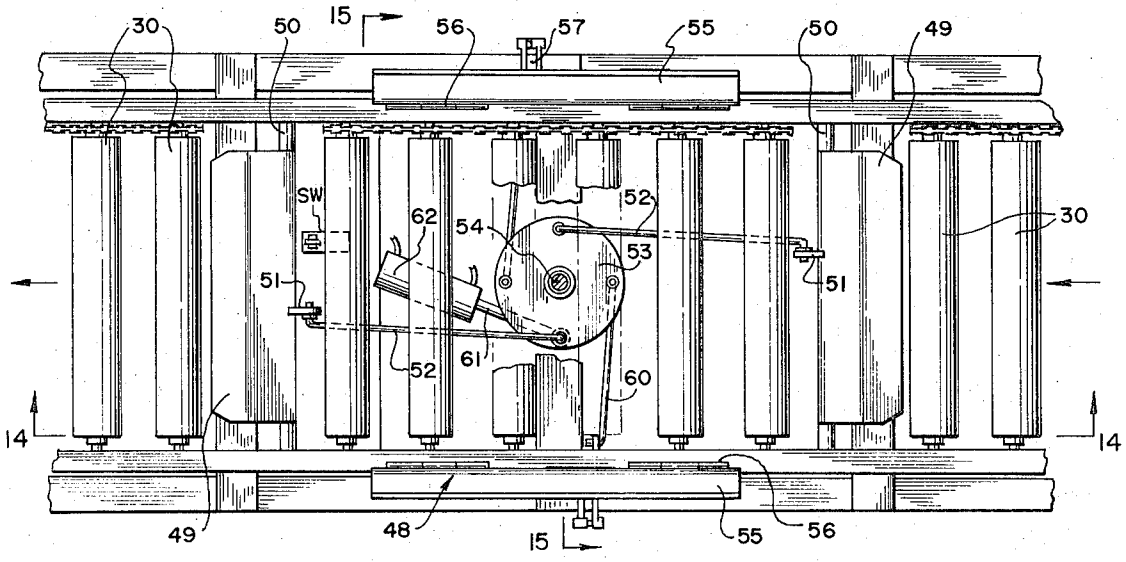


FIG. 14

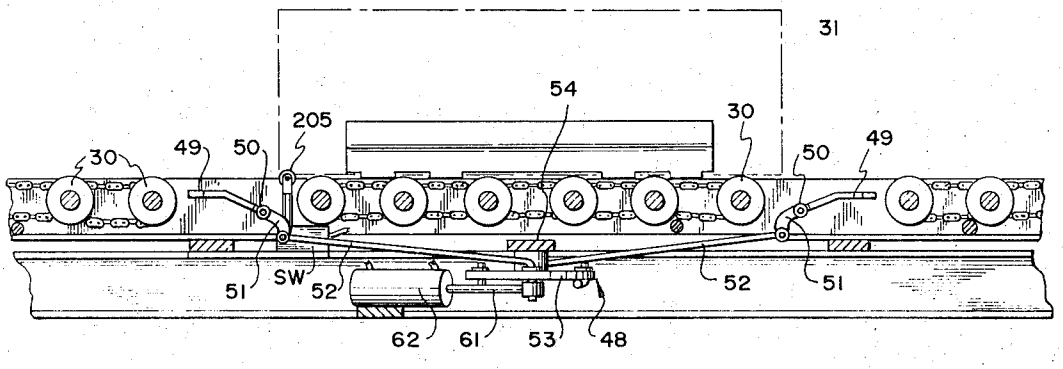


FIG. 15

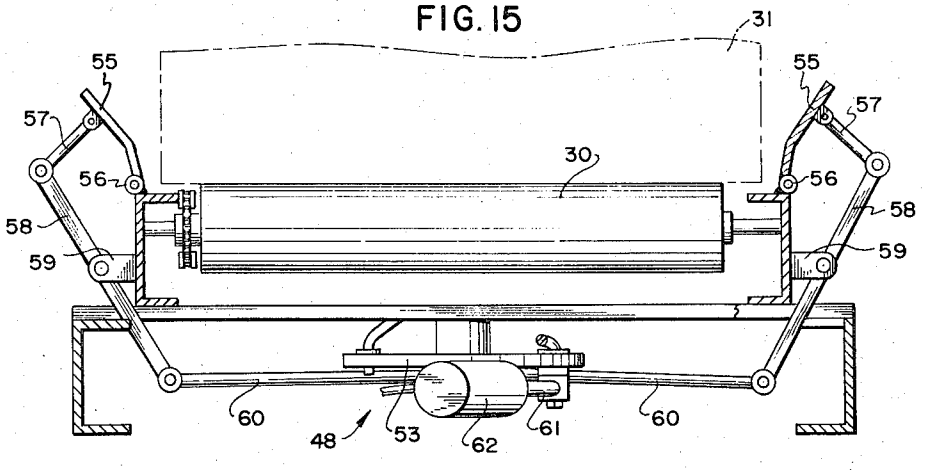


FIG. 16

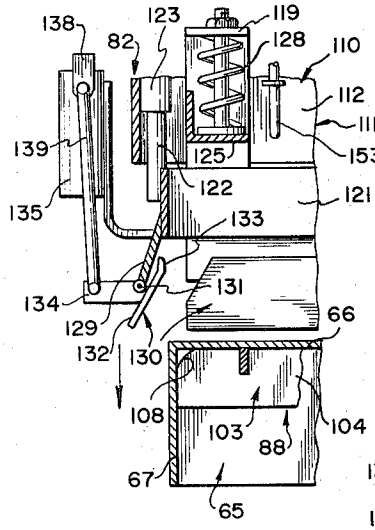


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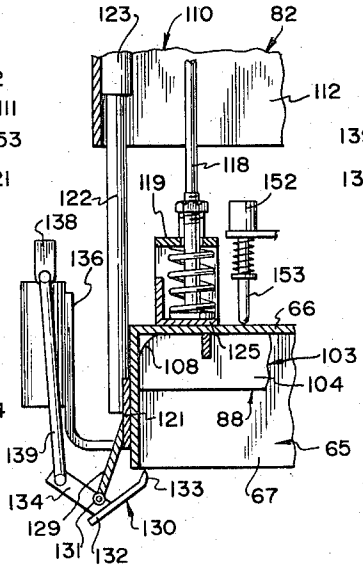
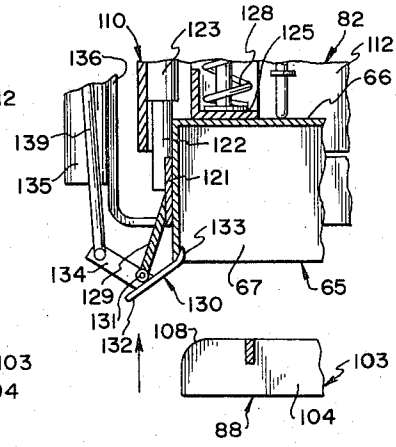


FIG. 18



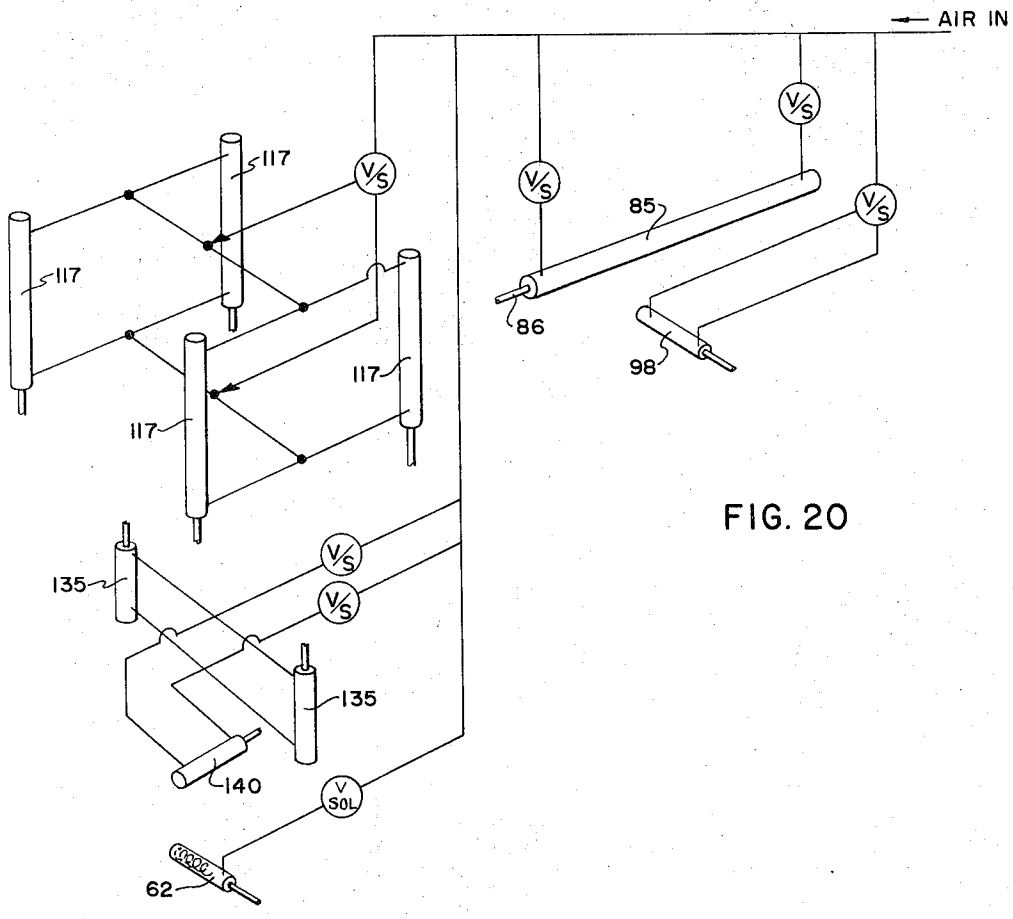


FIG. 20

FIG. 21

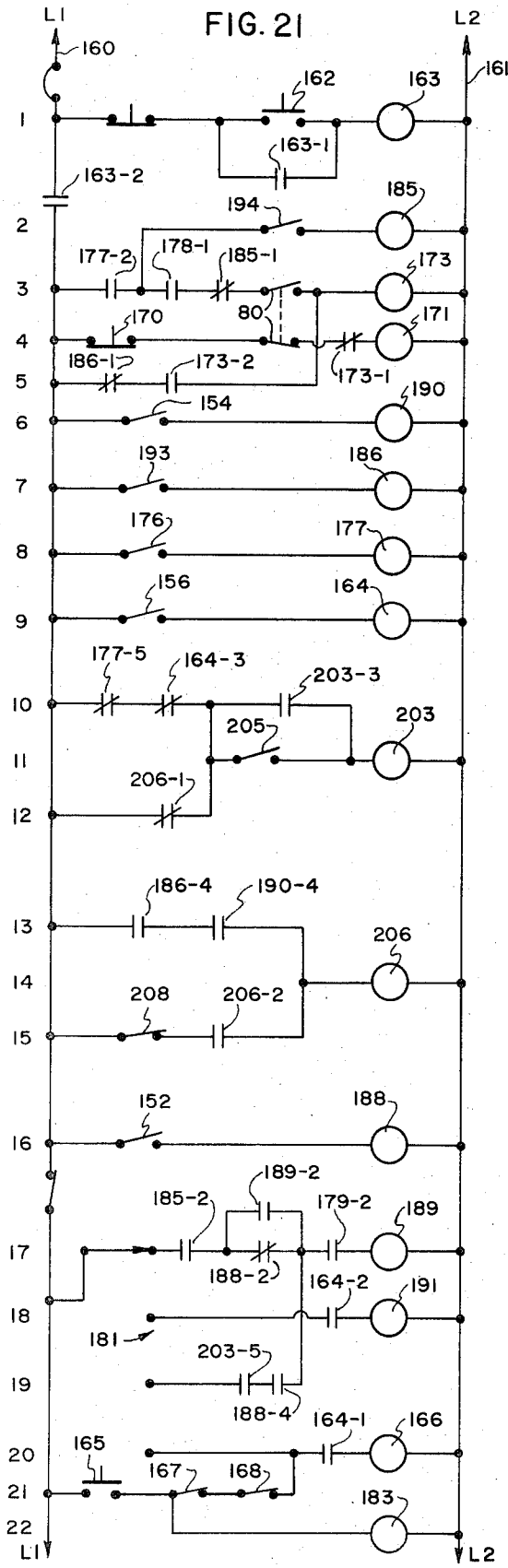
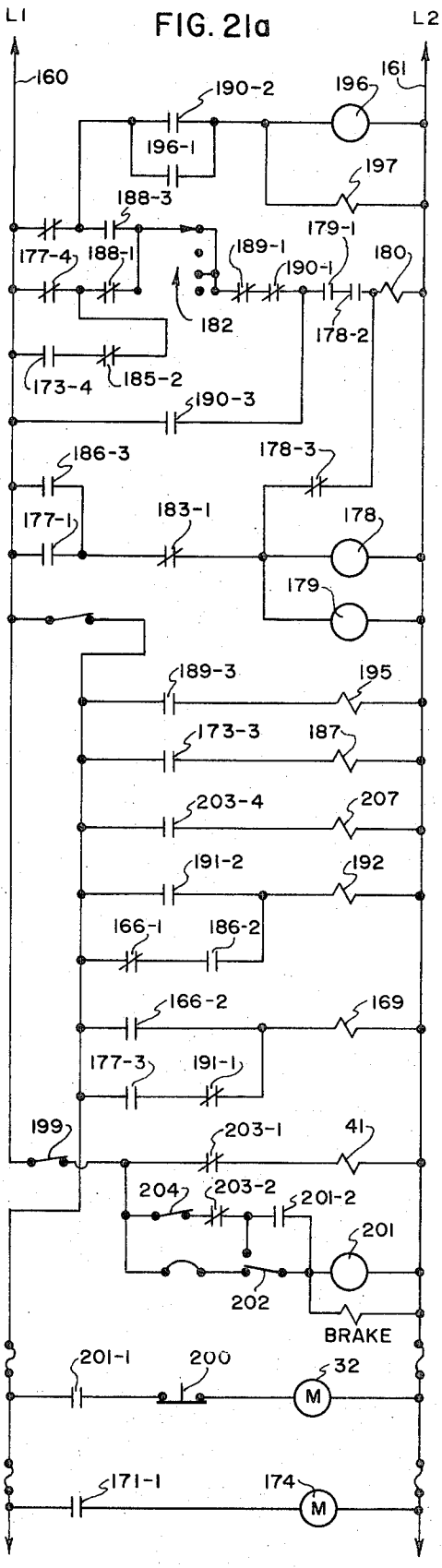


FIG. 21a



BOX CAPPING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to containers of various kinds and relates particularly to apparatus for automatically placing a lid or cap on a container after the container has been filled.

2. Description of the Prior Art

In the past, containers have been filled with articles to be stored or shipped and after the articles were placed within the containers, either the top of the container was folded and sealed by tape, adhesive, or the like, or a separate lid was placed on the container. Containers which are sealed normally are used one time only, while containers having an independent lid normally can be used repeatedly since the lids can be easily removed to permit access to the contents of the container and after the contents have been removed, the lid can be reapplied.

Normally containers having lids have required that the lids be applied manually after the containers have been filled due to the difficulty in placing the containers in an exact position and then mechanically placing a removable lid on the container. Prior attempts to automatically place lids on containers have resulted in the lid either being dropped accidentally or removed from the container when the lid applying mechanism is retracted. Some examples of the prior art are U.S. Pat. Nos. 1,809,842 Goodwin; 1,989,039 J. R. Geyer; 2,919,532 Earnheart; and 3,501,895 R. L. Geyer.

SUMMARY OF THE INVENTION

The present invention is a box capping machine including a carriage having a first pickup device which automatically removes a box cap or lid from a lid holding station and transfers such lid to a ready pickup station when the carriage is moved. Such carriage includes a second lid pickup device which removes a lid from the ready pickup station and transfers such lid horizontally and vertically to place the lid on a container located in the fixed predetermined position at a container holding station. Thereafter the second lid pickup mechanism is retracted while the lid remains on the box or container. Preferably a first conveyor is provided for supplying lids to the lid holding station and a second conveyor is provided for moving filled boxes to the box holding station.

It is an object of the invention to provide a box capping machine including apparatus which removes a lid from one location and automatically places such lid on a box or container in a remote position.

Another object of the invention is to provide a lid holding mechanism having portions which positively engage the lid while the lid is being transferred and placed on a container but which releases the lid after the lid has been placed on the container so that the lid remains thereon.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of the apparatus of the present invention.

FIG. 2 is a side elevation thereof.

FIG. 3 is an end elevation.

FIG. 4 is a top plan view of the lid holding station with the first lid pickup mechanism in non-clamping position.

FIG. 5 is a section on the line 5—5 of FIG. 4.

FIG. 6 is an enlarged fragmentary detailed section on the line 6—6 of FIG. 4 with the lid holding mechanism in clamping position.

FIG. 7 is a section on the line 7—7 of FIG. 6.

FIG. 8 is a top plan view of the ready pickup station.

FIG. 9 is a side elevation thereof.

FIG. 10 is a top plan view of the lid holding and depositing mechanism with portions broken away for clarity.

FIG. 11 is a section on the line 11—11 of FIG. 10.

FIG. 12 is a section on the line 12—12 of FIG. 10.

FIG. 13 is a top plan view of the box positioning and holding station.

FIG. 14 is a section on the line 14—14 of FIG. 13.

FIG. 15 is an enlarged fragmentary vertical section on the line 15—15 of FIG. 13.

FIG. 16 is a fragmentary section of the lid ready pickup station illustrating the lid pickup mechanism moving downwardly to pick up a lid.

FIG. 17 is a fragmentary section similar to FIG. 16 and illustrating the pickup mechanism in fully extended position.

FIG. 18 is a fragmentary section similar to FIG. 16 and illustrating the pickup mechanism in retracted position and carrying a lid.

FIG. 19 is a fragmentary section illustrating the lid being applied to a box.

FIG. 20 is a schematic perspective of the hydraulic system.

FIGS. 21 and 21*a* are schematic diagrams of the electrical system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With continued reference to the drawings, a base frame **25** is provided on which a box conveyor **26** is mounted. The conveyor **26** includes an in-feed section **27**, a box positioning section **28**, and an out-feed section **29**. As illustrated, each of the sections of the conveyor **26** includes a plurality of rollers **30**. It is recognized that substantially any other conventional type of conveyor could be mounted on the frame **25** for moving boxes **31** or other containers from one position to another. Also the rollers of each section can be freely rotatably mounted so that the boxes move lengthwise of the conveyor by gravity, or as illustrated, one or more of the rollers of each section can be driven by a source of power.

With particular reference to FIG. **3**, a power plant **32** is mounted on the base frame **25** and drives a multiple sheave drive pulley or sprocket **33** drivingly connected by a belt or chain **34** to a driven pulley or sprocket **35** carried by at least one of the rollers of the in-feed section **27**. A second belt or chain **36** drivingly connects the pulley or sprocket **33** to a multi-sheave pulley or sprocket **37** mounted on an intermediate shaft **38**. A drive belt or chain assembly **39** connects the multi-sheave member **37** with a driven pulley or sprocket **40** carried by at least one of the rollers of the out-feed section **29** of the conveyor. In this manner at least one of the rollers of the in-feed section **27** and the out-feed

section 29 is driven when the power plant 32 is in operation.

It is desirable to operate the rollers of the box positioning section 28 of the conveyor independently of the in-feed and out-feed sections and, therefore, the intermediate shaft 38 is connected to a clutch 41 and the opposite side of such clutch is provided with a drive pulley or sprocket (not shown), connected by a belt or chain 42 to a pulley or sprocket 43 carried by at least one of the rollers 30 of the box positioning section 28.

Normally the boxes 31 are filled with articles as the boxes travel along the in-feed section 27 of the conveyor 26 and in some cases in which the boxes contain perishable goods, such as dressed chickens, fish, certain vegetables and the like, a refrigerant medium such as ice or solidified carbon dioxide is added to the contents of the boxes as the boxes travel along the in-feed section 27 of the conveyor.

When the filled boxes 31 are transferred from the in-feed section 27 to the box positioning section 28, it is important that the boxes be disposed in a fixed predetermined position. In order to do this, a box positioning apparatus 48 is mounted on the box positioning section 28 of the conveyor. The positioning apparatus 48 includes a pair of box end engaging pads 49 swingably mounted on shafts 50 carried by the support structure for the conveyor 26. Each of the pads 49 includes an operating lever 51 which pivotally receives one end of a link 52 and the opposite end of each of the links is pivotally connected to opposite sides of a disk 53. Such disk is rotatably supported on a post 54 carried by the support structure of the conveyor 26.

A pair of box side engaging pads 55 are swingably mounted on hinges 56 mounted on the conveyor support structure. Each of the side engaging pads 55 is swingably connected to one end of a link 57 and the opposite end of such link is swingably connected to one end of a lever 58. Such lever is swingably mounted intermediate its ends between a pair of lugs 59 welded or otherwise attached to the conveyor support structure. The opposite end of each of the levers 58 is pivotally connected to one end of a link 60 and the opposite end of each of the links 60 is pivotally connected to opposite sides of the disk 53 and substantially 90° from the ends of the links 52.

In order to operate the end engaging pads 49 and the side engaging pads 55 simultaneously and cause such pads to clampingly engage all four sides of a box 31, the disk 53 is eccentrically connected to one end of a piston rod 61 carried by a fluid cylinder 62 which is swingably supported on the conveyor support structure. When the piston rod 61 is extended, the disk 53 is rotated in a counterclockwise direction, as seen in FIG. 13, and the pads 49 and 55 are retracted from the box. When the piston rod 61 is retracted within the cylinder 62, the disk 53 is rotated in a clockwise direction and the pads 49 and 55 are moved into engagement with the ends and sides of the box. If one of the end or side pads engages the box before the cooperating end or side pad, such box is moved slightly toward the non-engaged pad until the pressure on all four pads is substantially equal at which time the box is located in a predetermined position.

After the box 31 has been located in a predetermined position on the box positioning section 28 of the conveyor 26, it is necessary to place a cap or lid 65 on the box 31 to cover the contents therein. Preferably the lid includes an upper substantially flat portion 66 having a downwardly extending flange 67 disposed entirely around the periphery thereof. Normally the inner surface of the flange 67 snugly engages the outer surface of the side walls of the box while the bottom surface of the upper portion 66 engages the upper edge of the open top of such box when the box and top are in assembled relationship.

In order to automatically place a lid 65 on the box 31, a main frame 68 is located above and generally at an angle to the base frame 25 and such main frame includes a plurality of upright posts 69 welded or otherwise attached to a pair of generally parallel carriage supporting tracks 70. A lid conveyor 71 is provided adjacent to the main frame 68 and such lid conveyor has one end located below one end of the tracks 70 and the opposite end extending outwardly from the tracks and terminates at a source of supply (not shown) of preassembled lids.

The lid conveyor 71 can be of any desired construction including perforated or non-perforated belts, chains, rollers, or the like; however, for purposes of illustration, a pair of substantially parallel belts 72 have been provided which extend around drums 73 supported by a shaft 74 and such shaft is channeled in bearings 75 carried by the main frame 68. The belts 72 are driven from any convenient power plant 174.

The area at the end of the belts 72 adjacent to the tracks 70 constitutes a lid holding station indicated generally at 76. A pair of spaced generally parallel guides 77 are mounted on cross bars 78 connected to the main frame 68 and if desired one end 79 of each of the guides is flared outwardly to direct lids 65 into the lid holding station 76. A limit switch 80 having an upwardly extending trigger 81 is disposed at one end of the lid holding station 76. The switch 80 controls the power plant which drives the lid conveyor 71 so that when a lid being carried by the conveyor engages the trigger 81, power will be interrupted to the lid conveyor power plant and such lid will remain at the lid holding station.

To remove the lid from the lid holding station 76 and place such lid on a box 31, an elongated carriage 82 is provided having a frame 83 which is supported by a plurality of rollers 84 located within the tracks 70. The carriage 82 is reciprocated back and forth within the tracks 70 in any desired manner, as by a fluid cylinder 85 having one end connected to the main frame 68 and having an extendable and retractable piston rod 86. At one end of the carriage frame 83, a lid pickup mechanism 87 is provided for removing a lid 65 from the lid holding station 76 and transferring such lid to a ready pickup station 88 which will be described later.

The lid pickup mechanism includes a pair of clamping members 91 hingedly connected to opposite sides of the carriage frame 83. Each of the members 91 includes a pair of angularly disposed arms 92 spaced apart along the length of the members 91 and such arms are connected together by a rod 93. Each of the rods rotatably receives one end of a link 94 and the opposite ends of such links are pivotally connected to opposite ends of a lever 95. The lever 95 is swingably mounted about a central pivot 96 carried by a brace 97 fixed to the carriage frame 83.

In order to oscillate the lever 95 and move the clamping members 91 into and out of engagement with a lid

65, a fluid cylinder 98 is supported on the carriage frame 83 and such cylinder includes a piston rod 99 the free end of which is swingably connected to one end of a link 100 the opposite end of which is swingably connected to the lever 95. With particular reference to FIGS. 4–7, it will be seen that extension of the piston rod 99 causes the members 91 to swing away from the lid 65 and retracting the piston rod causes the members 91 to clampingly engage the lid 65.

When the lid at the lid holding station 76 is clamped by the members 91, the carriage 82 is moved in a forward direction until the lid is disposed above the ready pickup station 88 at which time the piston rod 99 is extended to permit the lid to fall by gravity onto the ready pickup station.

The ready pickup station 88 includes a frame 103 having a pair of cross bars 104 supported by threaded rods 105 and such rods are adjustably mounted by nuts 106 on braces 107 carried by the main frame 58. The cross bars 104 are located in a position to extend into the corners of a lid 65 and preferably the upper ends of such cross bars are provided with a downwardly curved portion 108 to cause the lid 65 to slide down the curved portion 108 in case the lid does not fall straight when released by the clamping members 91. The frame 103 is adjustable to any desired elevation merely be adjusting the nuts 106 on the rods 105. When a lid 65 is supported by the frame 103, substantially the entire length of the downwardly extending flanges 67 of such lid are free of obstructions.

In order to remove a lid 65 from the ready pickup station 88 and positively place such lid on a box 31, the carriage 82 is provided with a lid holding mechanism 110 at the end remote from the lid pickup mechanism 87. Such lid holding mechanism includes a supporting frame 11 having a generally rectangular wall structure 112 defining a hollow substantially rectangular housing which is open at the top and bottom. The free end of the piston rod 86 is swingably mounted to a pivot 114 carried by lugs 115 mounted on one side of the wall structure 112.

A pair of longitudinal bridges 116 span the hollow frame 111 and are welded or otherwise fixed to the wall structure 112 at opposite sides of such frame. To each of the bridges 116 are mounted a pair of generally parallel vertically disposed fluid cylinders 117 each of which includes a downwardly extending piston rod 118. A pair of inverted U-shaped support members 119 are fixed to the lower ends of the piston rods 118 and extend generally transversely of the frame 111. The support members are disposed generally normal to the bridges 116 in such a manner that the intermediate portion of one of the support members is connected to the two forward cylinders 117 and the intermediate portion of the other support member is connected to the two rear cylinders. Opposite downwardly extending ends of each of the U-shaped support members 119 are welded or otherwise attached to a substantially rectangular ring 121. Operation of the cylinders 117 raises and lowers the ring 121 in a substantially vertical direction and in order to guide the ring 121 during the vertical movement, a post 122 is welded or otherwise attached to each corner of the ring and each of such posts is slidably mounted in a sleeve 123 carried by the wall structure 112.

A pressure plate 125 is located below each of the support members 119 and each of such pressure plates includes a pair of upwardly extending threaded posts or stanchions 126 which extend through openings in the support members 119 and are adjustably connected thereto by nuts 127. A spring or other resilient member 128 is disposed between the pressure plates 125 and the support members 119 to permit limited movement of the pressure plates in a generally vertical direction. The springs 128 urge the pressure plates 125 downwardly until the nuts 127 engage the support members 119 and form a stop.

At the lower end of the ring 121, a skirt 129 is welded or otherwise attached to each side and such skirts extend downwardly and outwardly from the ring. A lid engaging finger 130 is swingably connected by a hinge 131 to the lower extremity of each of the skirts 129 and each of such fingers has a lower portion 132 on which the hinge is mounted and an upper portion 133 disposed at an angle to the lower portion. Each of the fingers 130 is provided with an outwardly extending lug 134 by means of which such fingers are selectively operated.

With particular reference to FIGS. 2, 3 and 12, the fingers 130 at the front and rear of the lid holding mechanism 110 are adapted to be operated independently and simultaneously by fluid cylinders 135 mounted on braces 136 and such braces in turn are supported by the ring 121. Each of the cylinders 135 has a piston rod 137 the free end of which is connected to a bracket 138. A link 139 is swingably connected at one end to the bracket 138 and the opposite end of such link is swingably connected to the lug 134 of the front and rear fingers.

With particular reference to FIG. 3, the fingers 130 on opposite sides of the frame 111 are operated together by a fluid cylinder 140 having a piston rod 141 and such fluid cylinder is mounted on the ring 121. The free end of the piston rod 141 is swingably connected to one end of an operating link 142 the opposite end of each is swingably connected to one end of a lever 143. Such lever is swingably mounted about a pivot 144 located intermediate its ends and such pivot is fixed to one of the skirts 129. Each end of the lever 143 is swingably connected to one end of a link 145 and the opposite ends of such links are swingably connected to the lugs 134 carried by the fingers 130 at opposite sides of the frame 111. In and out movement of the piston rod 141 causes the lever 143 to swing about the pivot 144 and cause the links 145 to move inwardly and outwardly simultaneously depending upon the direction of movement of the piston rod. Preferably the fluid cylinders 135 and 140 are operated simultaneously so that all of the fingers 130 operate together.

As illustrated best in FIG. 12, a trigger 148 is mounted on one of the support members 119 and such trigger includes an inwardly extending portion 149, an upwardly extending portion 150, and an outwardly extending portion 151. The inwardly extending portion has a lid sensing switch 152 with a downwardly extending spring loaded probe 153 associated therewith. The outwardly extending portion 151 is adapted to engage a limit switch 154 when the ring 121 is lowered to its extreme position. The other support member 119 is provided with an outwardly extending trigger 155 which is adapted to engage a limit switch 156 when the ring 121 reaches its upper extreme position.

With particular reference to FIGS. 21 and 21*a*, a pair of electric supply lines **160** and **161** are connected to any desired source of electrical energy. At the beginning of operation with no lids **65** or boxes **31** in the machine, a start switch **162** (line 1) is provided and operation of such start switch energizes an emergency stop relay **163** (line 1) which seals itself in through stop relay contact **163-1** (line 1 bypass) and energizes the machine control circuit through stop relay contact **163-2** (line 2). Fluid under pressure from any conventional source is introduced into the machine and such fluid flows into the cylinders **117** and causes the ring **121** to be raised until the trigger **155** engages the upper limit switch **156** (line 9) which in turn energizes an upper limit control relay **164** (line 9). A reset switch **165** (line 21) is then operated to energize a carriage reverse control relay **166** (line 20) through normally closed reverse limit switch **167** (line 21), normally closed forward limit switch **168** (line 21), and upper limit control relay contact **164-1** (line 20).

When the carriage reverse control relay **166** is energized, normally closed contact **166-1** (line 36) opens and normally open contact **166-2** (line 37) closes and energizes solenoid valve **169** to introduce fluid into cylinder **85** and move the carriage to the reverse position where it is ready to pick up the first lid. A lid feed conveyor switch **170** (line 4) is moved to the On position. This energizes lid conveyor control relay **171** (line 4) through normally closed limit switch **80** (line 4) and the normally closed contact **173-1** (line 4) of lid pickup mechanism control relay **173** (line 3). Energizing lid conveyor control relay **171** operates the drive motor **174** (line 44) of the lid conveyor **71** through normally open relay contact **171-1** (line 44) of the lid conveyor control relay **171** (line 4). Motor **174** drives the lid conveyor **71** to move a lid to the lid holding station **76.** When the lid **65** is in position, such lid engages limit switch **80** (line 4) and opens the same to de-energize lid conveyor control relay **171** and stop the conveyor.

When the carriage reaches the reverse position, such carriage engages and closes a reverse limit switch **176** (line 8) and energizes a reverse limit control relay **177** (line 8). When the reverse limit control relay **177** is energized, normally open contacts **177-1** (line 30), **177-2** (line 3) and **177-3** (line 38) close and normally closed contacts **177-4** (line 26) and **177-5** (line 10) open. When reverse limit control contact **177-1** (line 30) closes, electrical energy flows to first and second timing relays **178** and **179** (lines 30 and 31 respectively) and a stepper relay **180** through a normally closed contact **183-1** (line 30) of reset control relay **183** (line 22). The stepper relay **180** has a first wafer **181** (lines 17-20) and a second wafer **181** (lines 25 & 26). Energizing the stepper relay **180** causes wafers **181** and **182** to move to the first position.

After a one-tenth second delay, normally open timing relay contact **178-1** (line 3) closes and energizes the lid pickup mechanism control relay **173** (line 3) through limit switch **80** (line 3), which closes when a lid is in position, as well as reverse limit control relay contact **177-2** (line 3) and control relay contact **185-1** (line 3) of a lid position control relay **185** (line 2). Normally open lid pickup mechanism contact **173-2** (line 5) closes and seals in the lid pickup mechanism control relay **173** through normally closed control relay contact **186-1** (line 5) of forward limit control relay **186** (line 7). Normally open lid pickup mechanism contact **173-3** (line 33) closes energizing solenoid valve **187** (line 33) and such solenoid valve introduces fluid under pressure into cylinder **98** to operate the lid pickup mechanism **87.** Normally open lid pickup mechanism contact **173-4** (line 27) closes to energize the stepper relay **180** through lid position control relay contact **185-2** (line 27), lid sensor contact **188-1** (line 26) of lid sensor control relay **188** (line 16), the second stepper wafer **182,** down control relay contact **189-1** (line 26) of a down control relay **189** (line 17), down limit control relay contact **190-1** (line 26) of down limit control relay **190** (line 6), timing relay contact **179-1** (line 26) and normally open timing relay contact **178-2** (line 26). The stepper relay **180** then moves wafers **181** and **182** to the second position.

In this position the first wafer **181** energizes a carriage forward control relay **191** (line 18) through normally open upper limit control relay contact **164-2** (line 18). Normally closed carriage forward relay contact **191-1** (line 38) opens and de-energizes the carriage reverse solenoid valve **169** (line 37). At the same time, normally open carriage forward relay contact **191-2** (line 35) closes energizing carriage forward solenoid valve **192** (line 35). This causes fluid to be introduced into the cylinder **85** to move the carriage to the forward position where the lid pickup mechanism **87** is located above the ready pickup station **88.**

As the carriage leaves the reverse position, the reverse limit switch **176** (line 8) opens de-energizing reverse limit control relay **177** which in turn de-energizes timing relays **178** and **179** (lines 30 and 31 respectively). When the carriage reaches the forward position, forward limit switch **193** (line 7) is closed by the carriage **82** so that the forward limit control relay **186** is energized. Normally open forward limit control relay contact **186-2** (line 36) closes sealing in solenoid valve **192** (line 35) which controls the movement of the carriage **82.** Normally closed forward limit relay contact **186-1** (line 5) opens and de-energizes lid pickup mechanism control relay **173** (line 3) which in turn opens lid pickup mechanism relay contact **173-3** (line 33) and opens solenoid valve **187** (line 33). This releases the lid from the clamping members **91** and permits the lid to drop by gravity onto the ready pickup station **88.**

When the lid falls onto the ready pickup station, it engages and closes ready pickup station limit switch **194** (line 2). Normally open forward limit relay contact **816-3** (line 29) closes and energizes timing relays **178** and **179** and the stepper relay **180** through normally closed reset control relay contact **183-1** (line 30) and causes the stepper relay wafers **181** and **182** to move to the third position. After a 1/10 second delay, normally closed timing relay contact **178-3** (line 29) opens and de-energizes the stepper relay **180** and closes normally open timing relay contact **178-2** (line 26). After another 1/10 second delay, normally open timing relay contact **179-1** (line 26) closes and energizes stepper relay **180** through normally closed reverse limit control relay contact **177-4** (line 26), normally closed lid sensor control relay contact **188-1,** the third stepper contact, normally closed down control relay contact **189-1,** normally closed down limit control relay contact **190-1** (line 26), and timing relay contact **178-2** which closed previously. It is noted that lid sensor control relay contact **188-1** is closed because there is no lid

in the lid holding mechanism 110. The stepper relay 180 then moves to a fourth position.

In the fourth position of the stepper relay, carriage reverse control relay 166 (line 20) is energized through upper limit control relay contact 164-1 and the carriage moves to the reverse position, as previously described. As the carriage moves from the forward position, forward limit switch 193 (line 7) opens and de-energizes forward limit control relay 186. When the carriage reaches the reverse position, reverse limit switch 176 (line 8) closes and energizes reverse limit control relay 177.

When reverse limit control relay 177 is energized, reverse limit relay contact 177-2 (line 3) closes and energizes lid position control relay 185 through ready pickup station limit switch 194 which closed when the lid dropped onto the ready pickup station 88. Normally open reverse limit control relay contact 177-1 (line 30) closes and moves the stepper relay 180 to the first position. After a two-tenths second delay, timing relay contact 179-2 (line 17) closes and energizes down control relay 189 (line 17) through the first wafer 181, lid position control relay contact 185-2 (line 17), which closed when the carriage returned to the reverse position, and lid sensor control relay 188-2 (line 17). Normally open down control relay contact 189-2 (line 17) closes and seals in down control relay 189 (line 17). Normally open down control relay contact 189-3 (line 32) closes energizing the down solenoid valve 195 (line 32). This causes the lid holding mechanism 110 to move down to pick up the lid 65 from the ready pickup station 88.

When the lid holding mechanism 110 reaches the extreme Down position, the trigger 148 closes down limit switch 154 (line 6) energizing down limit control relay 190 (line 6). When down limit relay 190 is energized, normally open down limit relay contact 190-2 (line 23) closes energizing a lid pickup control relay 196 (line 23) and the lid pickup solenoid valve 197 (line 24). Solenoid valve 197 introduces fluid under pressure into fluid cylinders 135 and 140 to pivot the fingers 130 about the end of the skirt 129 so that the fingers are disposed below the lid 65 on the ready pickup station. Lid pickup control relay contact 196-1 (line 24) closes and seals in the lid pickup solenoid valve 197.

When a lid 65 is in the lid holding mechanism 110, the probe 153 closes the limit switch 152 (line 16) and energizes lid sensor control relay 188 (line 16). Normally closed down limit control relay contact 190-1 (line 26) opens and normally open down limit control relay contact 190-3 (line 28) closes energizing the stepper relay 180 through normally open timing relay contacts 179-1 and 178-2 (line 26) so that the stepper relay moves to the second position.

In this position, normally closed lid sensor contacts 188-1 (line 26) and 188-2 (line 17) open, and normally open lid sensor contacts 188-3 (line 25) and 188-4 (line 19) close. When the stepper relay 180 moves from the first position, it de-energizes down control relay 189 (line 17) which in turn de-energizes solenoid valve 195 so that the lid holding mechanism 110 returns to the Up position.

When the lid holding mechanism 110 returns to the Up position, trigger 155 closes the up limit switch 156 (line 9) and energizes upper limit control relay 164. This causes the carriage 82 to move to the forward position by energizing carriage forward control relay 191 (line 18) which de-energizes solenoid valve 169 (line 37) and energizes solenoid valve 192, as previously described.

When the carriage 82 again leaves the reverse position, it opens reverse limit switch 176 (line 8) de-energizing control reverse limit relay 177 and resetting timing relays 178 (line 30) and 179 (line 31). Upon reaching the forward position, the carriage actuates forward limit switch 193 (line 7) energizing forward limit control relay 186 causing the stepper relay 180 to move to the third position. At this time lid sensor control relay 188 (line 16) is still energized by a lid 65 in the lid holding mechanism 110 and the stepper relay 180 will not be energized again until a box 31 is located in the box positioning section 28 of the box conveyor 26.

To energize the box conveyor 26, the box feed control switch 199 (line 39) is moved to the automatic position and the box conveyor switch 200 (line 43) is moved to the On position. If there is no box located in the in-feed section 27, or the box positioning section 28 of the box conveyor, box conveyor control relay 201 (line 41) is energized through the normally closed in-feed conveyor limit switch 202 (line 41) and the box positioning section clutch 41 (line 39) is energized through box hold control relay contact 203-1 (line 39) of box hold control relay 203 (line 11) which is normally closed. Normally open box conveyor control relay contact 201-1 (line 43) closes and energizes the box conveyor motor 32 starting the box conveyor 26. Box conveyor control relay 201 (line 41) is sealed in by a box in-feed limit switch 204 (line 40), normally closed box hold control relay contact 203-2 (line 40) and normally open box conveyor control relay contact 201-2 (line 40).

When the box conveyor 26 is in operation, a box moves through the in-feed section 27 and onto the box positioning section 28 until it closes normally open box positioning limit switch 205 (line 11). When box positioning limit switch 205 closes, it energizes box hold control relay 203 (line 11) through normally closed box out-feed reset control contact 206-1 (line 12) of box out-feed reset control relay 206 (line 14). When box hold control relay 203 (line 11) is operated, normally closed box hold relay contact 203-1 (line 39) opens de-energizing the clutch 41 and stopping the box positioning section 28. Normally closed box hold control relay contact 203-2 (line 40) and box limit switch 204 (line 40) both open clearing the seal in the circuit to box conveyor control relay 201, however, the relay remains energized and the in-feed section 27 of the box conveyor continues to run until another box actuates in-feed conveyor limit switch 202 (line 41) at which time the box conveyor motor 32 stops.

When a box 31 is located on the box positioning section 28 and the box positioning limit switch 205 is energized, normally open box hold control relay contact 203-3 (line 10) closes and seals in box hold control relay 203. Normally open box hold relay contact 203-4 (line 34) closes and energizes solenoid valve 207 (line 34). Operation of the solenoid valve 207 causes fluid under pressure to be introduced into the fluid cylinder 62 to operate the end-engaging pads 49 and side-engaging pads 55 to locate the box in a predetermined position. Normally open box hold control relay contact 203-5 (line 19) closes energizing down control relay 189 (line 17) through the first wafer 181 of the stepper

relay, normally open lid sensor control relay contact **188-4** (line **19**) and timing relay contact **179-2** (line **17**). Normally open down control relay contact **189-3** (line **32**) closes energizing the down solenoid valve **195** and causes the lid holding mechanism **110** to move down and place a lid on the box.

When the lid holding mechanism **110** reaches the Down position, the trigger **148** closes down limit switch **154** (line **6**) and energizes down limit control relay **190** (line **6**). Normally open down limit control relay contact **190-4** (line **13**) closes and energizes box out-feed reset control relay **206** (line **14**) through normally open forward limit control relay contact **188-4** (line **13**) which closed when the carriage reached the forward limit switch **193** (line **7**). Normally open down limit control relay contact **190-3** (line **28**) closes and energizes stepper relay **180** (line **26**) causing it to move to the fourth position. Normally open box out-feed reset control relay contact **206-2** (line **15**) closes and seals in relay **206** through the box out-feed limit switch **208**.

When the stepper relay **180** moves the wafers **181** and **182** to the fourth position, down control relay **189** (line **17**) is de-energized. Normally open down control relay contact **189-3** (line **32**) opens de-energizing solenoid valve **195** (line **32**) and cap holding mechanism **110** goes to the Up position.

When the lid holding mechanism **110** reaches the Up position, the trigger **155** closes up limit switch **156** and energizes upper limit control relay **164**. Normally closed upper limit control relay contact **164-3** (line **10**) opens and de-energizes box hold control relay **203** (line **11**) which in turn de-energizes solenoid valve **207** (line **34**) which releases the box.

When the box is released, limit switch **204** (line **40**) closes and energizes box conveyor control relay **201** (line **41**) through normally closed contact **203-2** (line **40**) and normally open in-feed conveyor limit switch **202**. This causes the conveyor motor **32** to start and drive the box onto the out-feed conveyor section **29**. As the box moves clear of the box positioning section **28**, it strikes the box-out limit switch **208** (line **15**) which opens and de-energizes box out-feed reset control relay **206** (line **14**).

When the lid holding mechanism **110** reaches the Up position and energizes upper limit control relay **164** (line **9**) it energizes carriage reverse control relay **166** (line **20**) through normally open upper limit relay contact **164-1** (line **20**) and the carriage reverse control relay **166** in turn energizes solenoid valve **169** (line **37**) and causes the carriage to move to the reverse position. Upon reaching the reverse position, the carriage closes reverse limit switch **176** (line **8**) and energizes reverse limit control relay **177** (line **8**). Reverse limit relay contact **177-1** (line **30**) closes and causes the stepper relay **180** to move the wafers **181** and **182** to the first position ready to repeat another cycle.

The carriage **82** remains in the reverse position until a lid actuates limit switch **80** (line **4**) at which time the operation is repeated. Sequency interlocking is provided so that the mechanism cannot attempt to place a lid on a box if there is no box at the box positioning section. Also the lid holding mechanism **110** cannot pick up another lid from the ready pickup station until a lid within the lid holding mechanism has been placed on a box.

In the operation of the device, one or more filled boxes **31** are moved along the box conveyor **26** until the first box is located on the box positioning section **28** at which time the fluid cylinder **62** is operated to rotate the disk **53** and move the box-engaging pads **49** and **55** into engagement with the box. Pads **49** and **55** move the box to a predetermined position.

The carriage **82** is retracted to a reverse position along the tracks **70** until the lid pickup mechanism **87** at the rear of the carriage is located above the lid holding station **76** and the lid holding mechanism **110** at the front of the carriage is located above the ready pickup station **88**. In this position, the fluid cylinder **98** at the lid pickup station **87** is operated to move the members **91** into clamping engagement with a lid at the lid holding station. Simultaneously the cylinders **117** are operated to lower the lid holding mechanism **110** until the outwardly extending portion **151** of the trigger **148** engages the lower limit switch **154**. During the descent of the lid holding mechanism, the pressure plates **125** engage the upper flat surface **66** of the lid **65** at the ready pickup station **88**. Continued downward movement of the lid holding mechanism **110** causes the springs **128** to be compressed and causes the probe **153** to engage the lid and close the lid sensor switch **152**. When the lower limit switch **154** is closed, fluid under pressure is introduced into the cylinders **135** and **140** to pivot the fingers **130** inwardly about the lower extremity of the skirt **129** so that such fingers are located below the flange **67** at all four sides of the lid **65**.

After the fingers are extended, the direction of movement of the cylinders **177** is reversed so that the lid holding mechanism **110** travels upwardly and the fingers **130** engage the bottom edge of the lid flange **67** and remove the lid from the ready pickup station. In this position, the pressure plates **125** are still in engagement with the top of the lid so that such lid is clamped between the fingers **130** and the pressure plates **125**. The carriage **82** then is moved to its forward position at which time the fluid cylinder **85** of the lid pickup mechanism **87** at the rear end of the carriage is operated in a reverse direction to release the lid from the clamping plates **91** and permit such lid to fall by gravity onto the ready pickup station **88**. Simultaneously the fluid cylinders **117** are supplied with fluid under pressure to lower the lid holding mechanism **110** and the lid **65** carried thereby until the trigger **148** engages the lower limit switch **154** to stop downward travel of the lid holding mechanism.

During the downward movement of the lid holding mechanism **110**, the fingers **130** engage the top of the box **31** which is held in position by the box positioning apparatus **48** and guide the lid **65** onto the box. Just before the trigger **148** engages the lower limit switch **154**, the lower surface of the flat upper portion **66** of the lid engages the upper edge of the box. Continued downward movement of the lid holding mechanism **110** further compresses the springs **128** since the pressure plates **125** are stopped. The lid holding mechanism **110** continues downward movement until the fingers **130** are clear of the lower edge of the flange **67**. When the lower limit switch **154** is closed, fluid cylinders **135** and **140** are energized to retract the fingers **130** so that the inner ends of the fingers are located below and generally in alignment with the ring **121**. The flow of fluid to the cylinders **117** is reversed to raise the lid holding mechanism **110**. During the initial upward movement,

the pressure plates 125 are urged downwardly by the springs 128 so that the pressure plates hold the lid on the box while the lid holding mechanism 110 is moving upwardly. After short upward movement of the lid holding mechanism, the stops 127 of the pressure plates engage the support members 119 so that the pressure plates are raised with the lid holding mechanism. When the lid holding mechanism reaches its upper extremity, the upper limit switch 156 is closed by the trigger 155 which interrupts the flow of fluid to the cylinders 117 and introduces fluid into the cylinder 85 to move the carriage 82 rearwardly to its rearmost position, and the process is repeated.

We claim:

1. Apparatus for automatically placing a lid on a box, said apparatus comprising a frame, means for intermittently moving a box to a box positioning station associated with said frame, means for positioning and holding the box in a fixed predetermined position at said box positioning station, a lid pickup station located adjacent to said frame, means for supplying a preformed lid having an uppper portion and a downwardly extending lower portion to said lid pickup station, carriage means movably mounted on said frame, lid holding mechanism carried by said carriage means, means for raising and lowering said lid holding mechanism relative to said carriage means, means on said lid holding mechanism for positively engaging the upper and lower portions of said lid, and means on said frame for moving said carriage means so that the lid carried by said lid holding mechanism overlies and is in alignment with the box at said box positioning station, whereby said lid holding mechanism is operated to remove a lid from said lid pickup station, said carriage means is moved along said frame until the lid is disposed above said box, and thereafter said lid holding mechanism is lowered to place the lid on the box while the box is in fixed position.

2. The structure of claim 1 in which said means for positively engaging said lid includes pressure plate means resiliently engaging the upper portion of the lid, and a plurality of movable finger means for engaging the lower portion of the lid selectively.

3. The structure of claim 1 including a lid holding station located adjacent to said frame, means for supplying lids to said lid holding station, a lid pickup mechanism carried by said carriage means in a position remote from said lid holding mechanism, and means on said lid pickup mechanism for selectively engaging a lid at said lid holding station, whereby when said carriage means is moved along said frame said lid pickup mechanism places the lid from said lid holding station onto said lid pickup station.

4. The structure of claim 3 in which said means for selectively engaging the lid at said lid holding station includes a pair of clamping members hingedly mounted on opposite sides of said carriage means, and fluid cylinder means for operating said clamping members simultaneously.

5. The structure of claim 4 in which said means for supplying lids to said lid holding station includes conveyor means, and means for interrupting movement of said conveyor means when a lid is located at said lid holding station and operating said conveyor means after a lid has been removed from said lid holding station.

6. The structure of claim 1 in which said means for positioning and holding the box at said box positioning station includes a plurality of pad means, and means for selectively moving said pad means into engagement with the sides of said box to move the box to a predetermined position.

7. The structure of claim 6 in which said means for intermittently moving a box includes a conveyor for boxes, a frame supporting said box conveyor, said pad means being hingedly mounted on said conveyor frame, a disk rotatably mounted on said conveyor frame, link means connecting each of said pads to said disk, and means for rotating said disk selectively, whereby said pad means are operated simultaneously to move a box to a predetermined position.

8. The structure of claim 7 in which said box conveyor includes an in-feed section for supplying boxes to said box positioning station, and an out-feed section for removing boxes from said box positioning station after a lid has been placed on the box.

9. The structure of claim 8 including switch means on said in-feed section for operating said conveyor after a box has been moved to said box positioning station.

10. The structure of claim 1 in which said lid holding mechanism includes a housing, ring means adjustably supported by said housing, operating means carried by said housing for moving said ring means relative to said housing, pressure plate means carried by said ring means, said pressure plate means being resiliently mounted for limited movement, a plurality of finger means swingably carried by said ring means, and means on said ring means for selectively moving said finger means to engage a lid.

11. The structure of claim 10 in which said ring means includes a downwardly and outwardly extending skirt for supporting said plurality of fingers, said fingers being located outwardly of the inner surface of said ring means in retracted position and having portions which extend inwardly of the inner surface of said ring means to a position to engage the lower portion of a lid when the fingers are operated.

12. Apparatus for automatically placing a lid on a box, said apparatus comprising a frame, first conveyor means for moving a box to a box positioning station adjacent to said frame, means for positioning and holding the box in a fixed predetermined position at said box positioning station, a lid ready pickup station mounted on said frame, a lid holding station located adjacent to one end of said frame, second conveyor means for supplying preformed lids having an upper portion and a downwardly extending lower portion to said lid holding station, a carriage movably mounted on said frame, said carriage having a lid holding mechanism at one end and a lid pickup mechanism at the opposite end, said lid pickup mechanism including selectively operable clamping means for engaging a lid at said lid holding station and placing said lid on said ready pickup station when the carriage is moved, means for selectively raising and lowering said lid holding mechanism, said lid holding mechanism including means for positively engaging the upper and lower portions of a lid at said ready pickup station, means for moving said carriage so that the lid carried by said lid holding mechanism is in alignment with the box at said box positioning station and can be placed thereon by said raising and lowering means, and means for temporarily holding the lid on

the box while said means for positively engaging the lid is released.

13. The structure of claim 12 including means for operating said first conveyor means to move a box adjacent to said box positioning station, limit switch means for interrupting operation of said first conveyor when a box is located adjacent to said box positioning station and energizing said operating means when the box on said conveyor means has been moved to said box positioning station.

14. The structure of claim 12 including means for operating said second conveyor means, limit switch means for interrupting operation of said second conveyor when a lid is located at said lid holding station and energizing said operating means when the lid has been removed from said lid holding station by said lid pickup mechanism.

15. The structure of claim 12 including guide means at said lid holding station for locating lids on said second conveyor means in a predetermined position.

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