

Nov. 13, 1956

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2,770,373

MACHINE FOR STACKING BOXES, CASES, AND THE LIKE

Filed Dec. 29, 1952

11 Sheets-Sheet 1

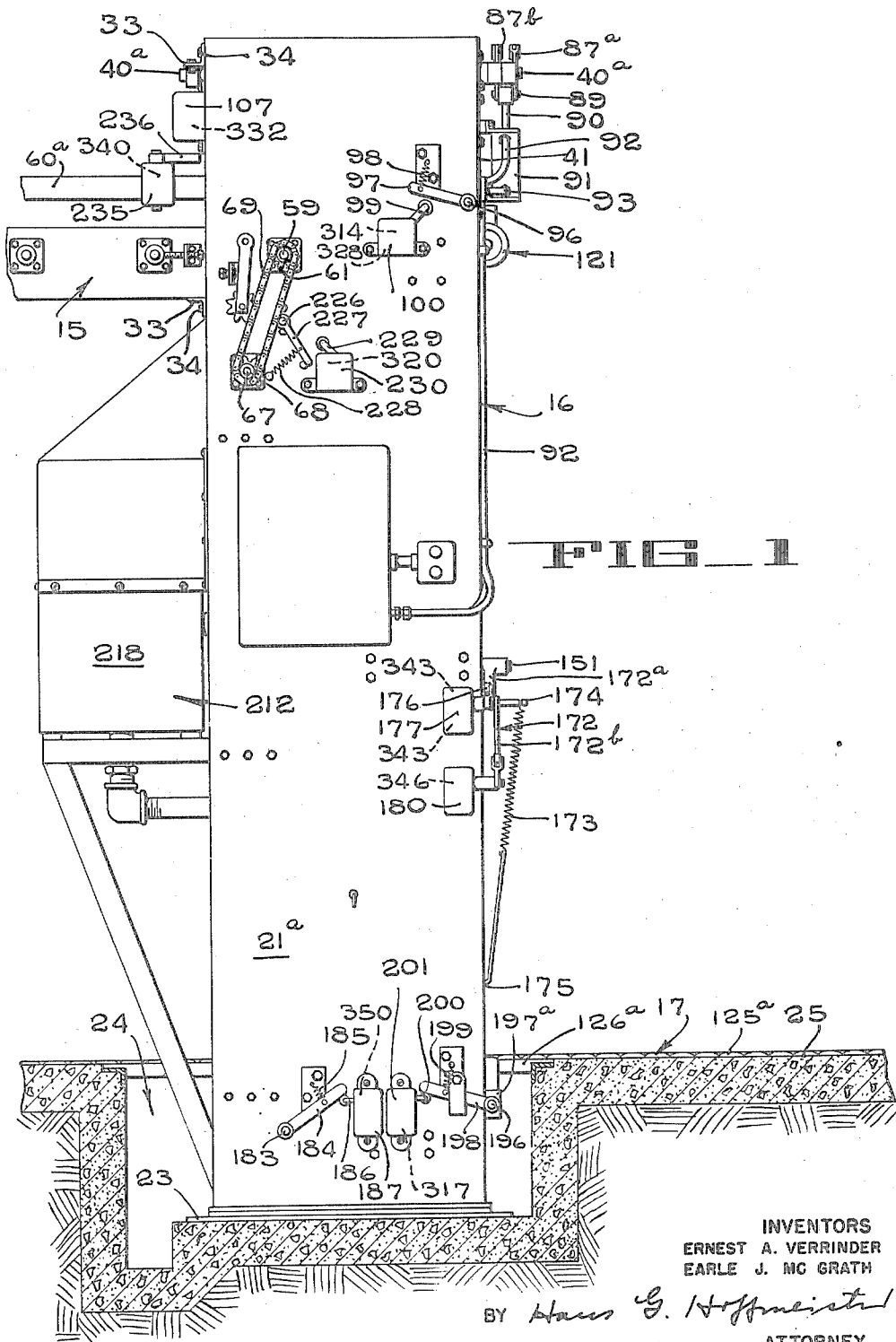


FIG. 1

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11 Sheets-Sheet 2

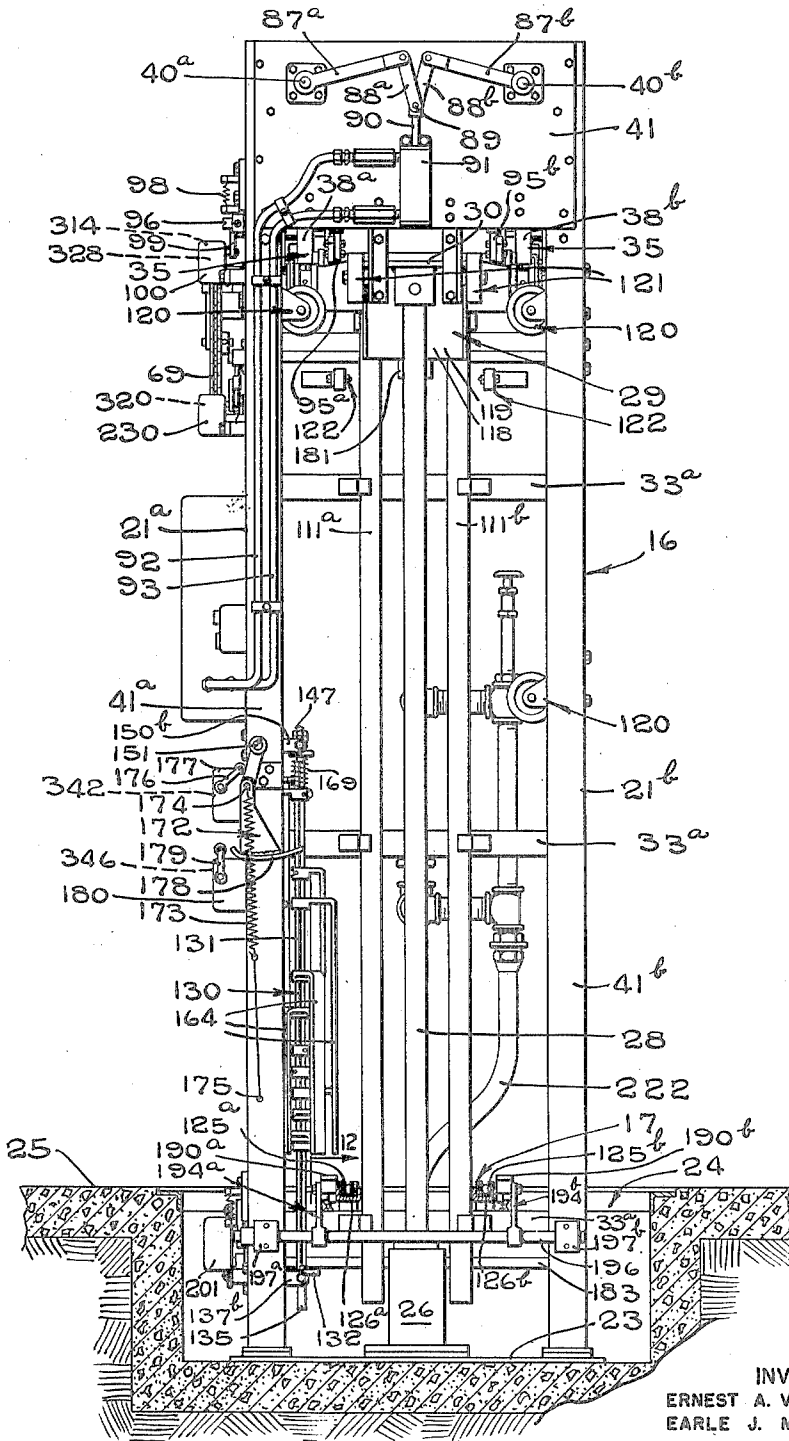


FIG. 2

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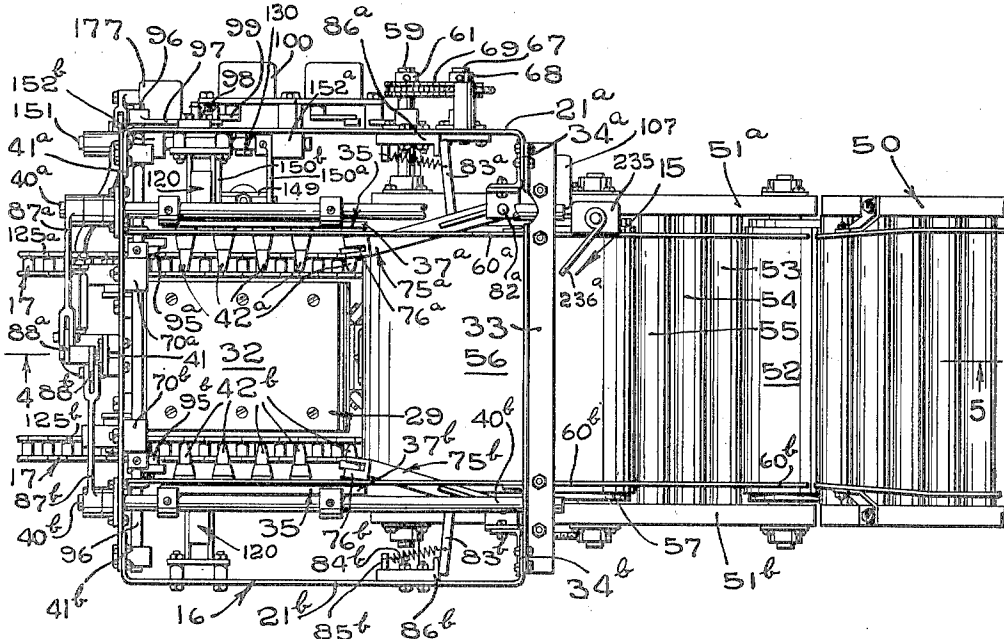


FIG. 3

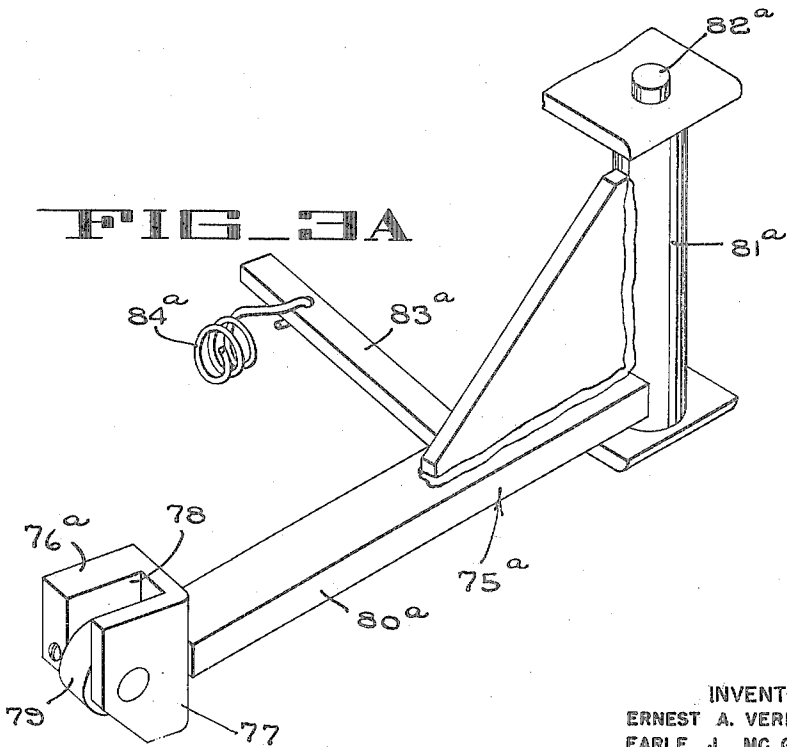


FIG. 3A

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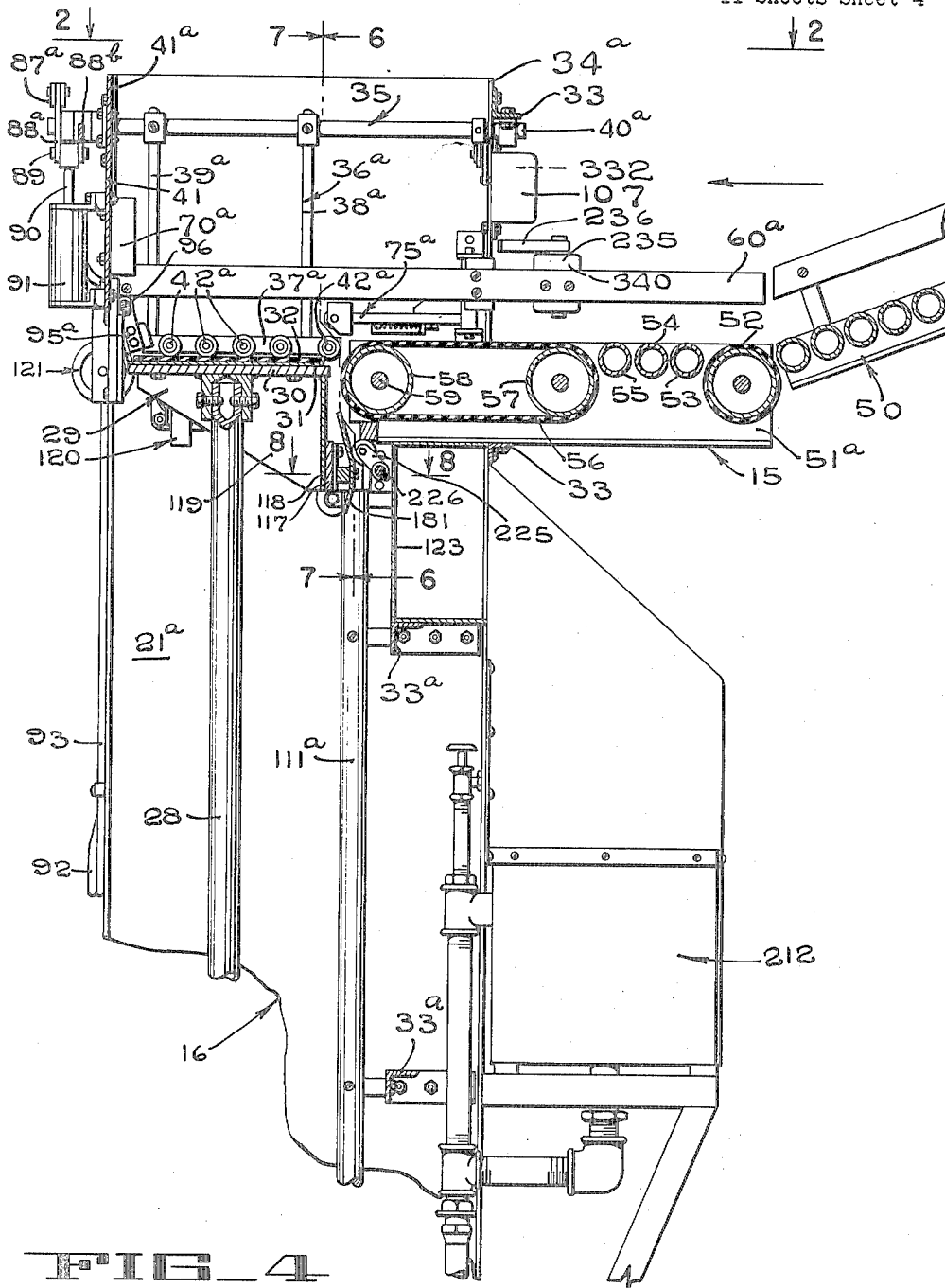


FIG. 4

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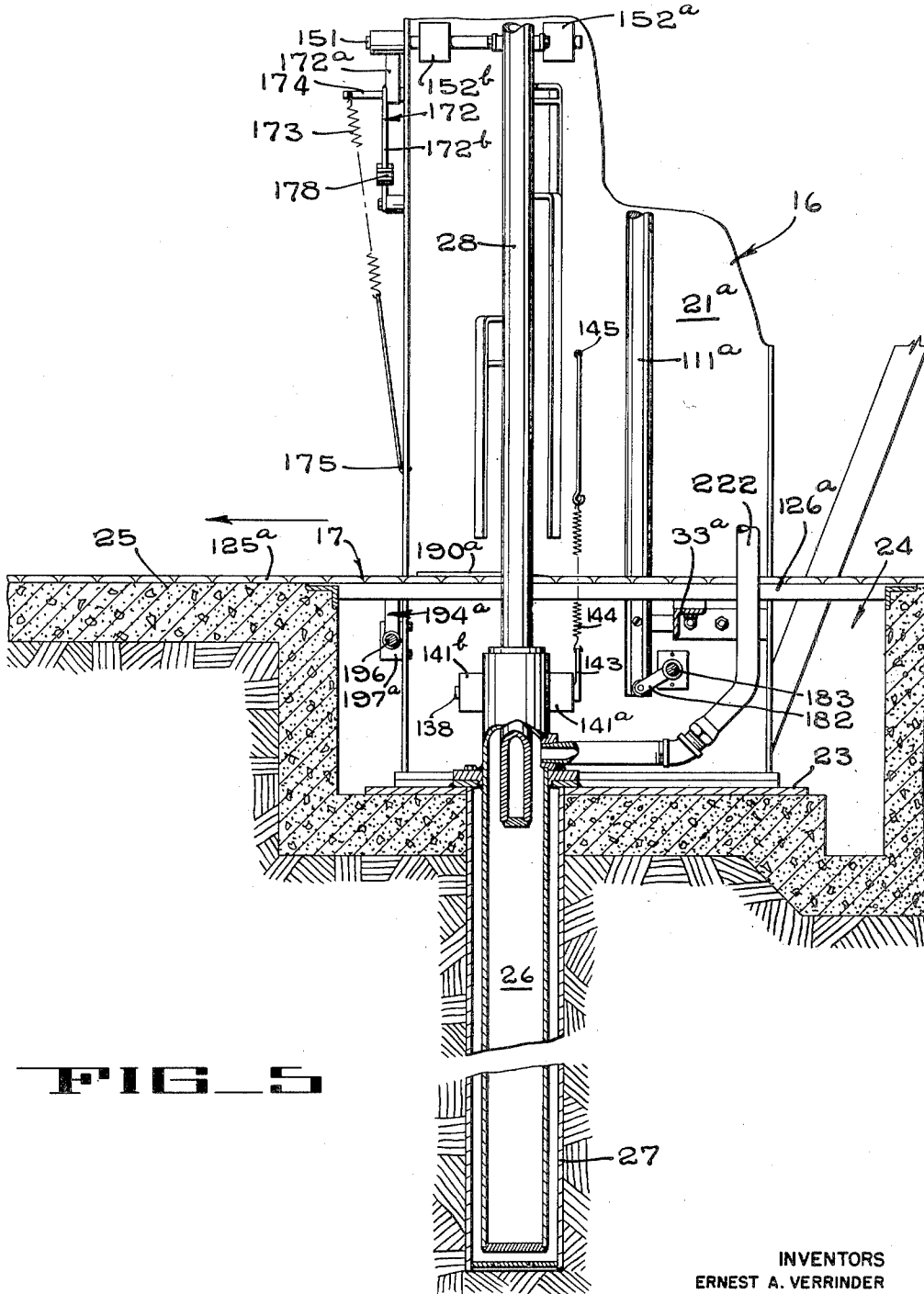


FIG 5

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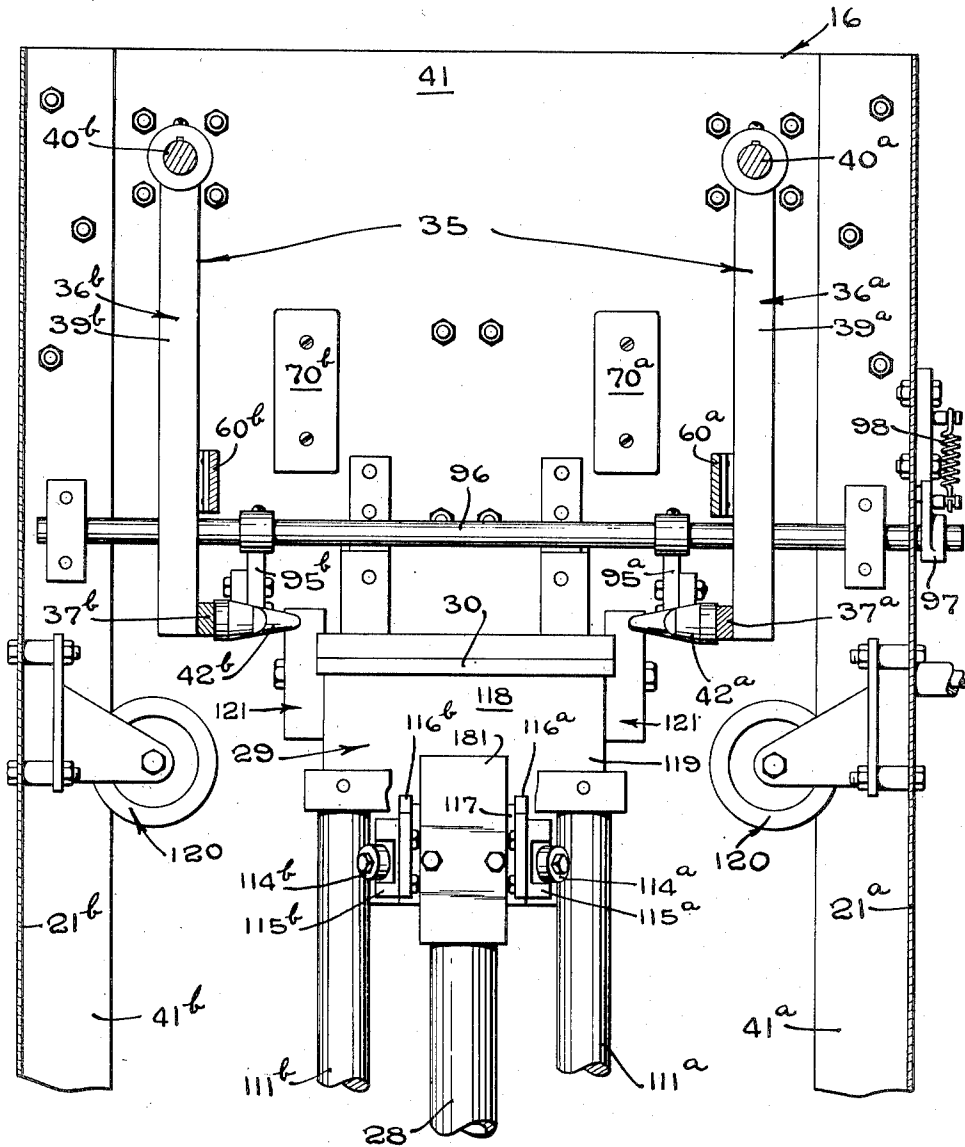
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FIG. 6



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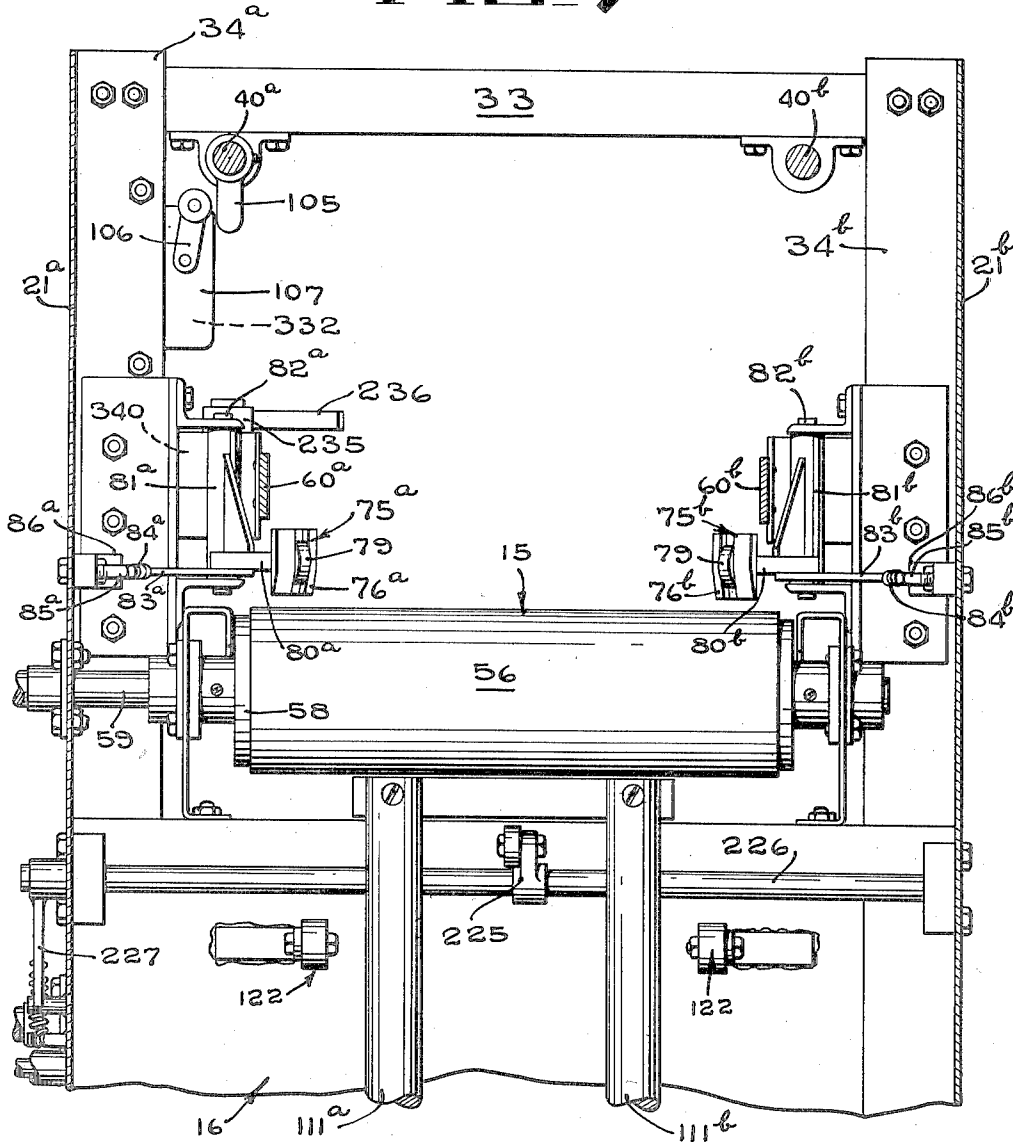
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FIG. 7



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FIG 8

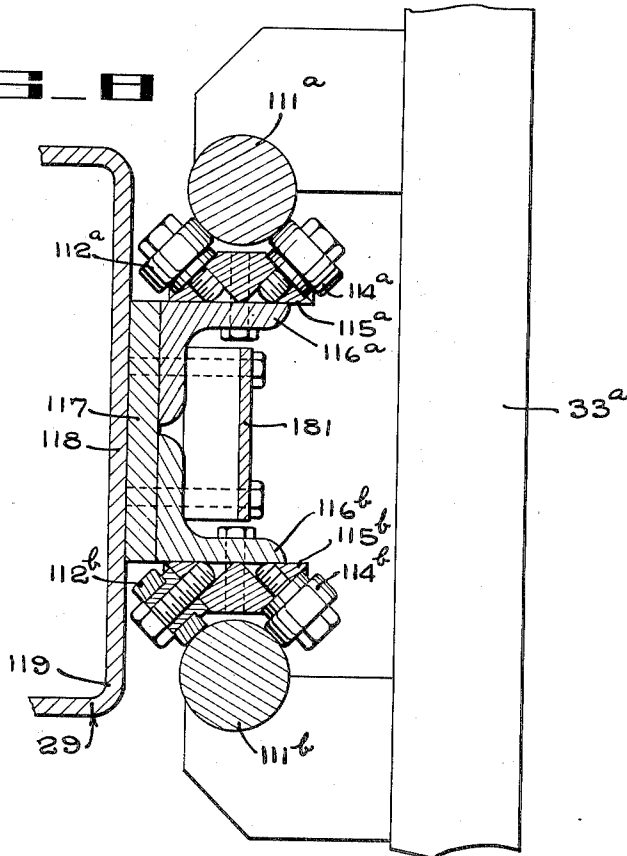
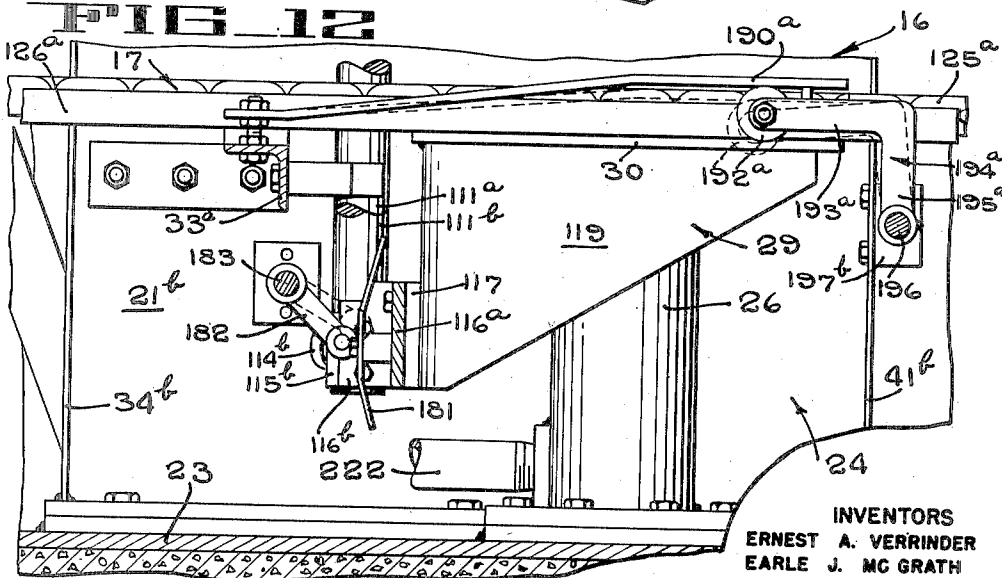


FIG 12



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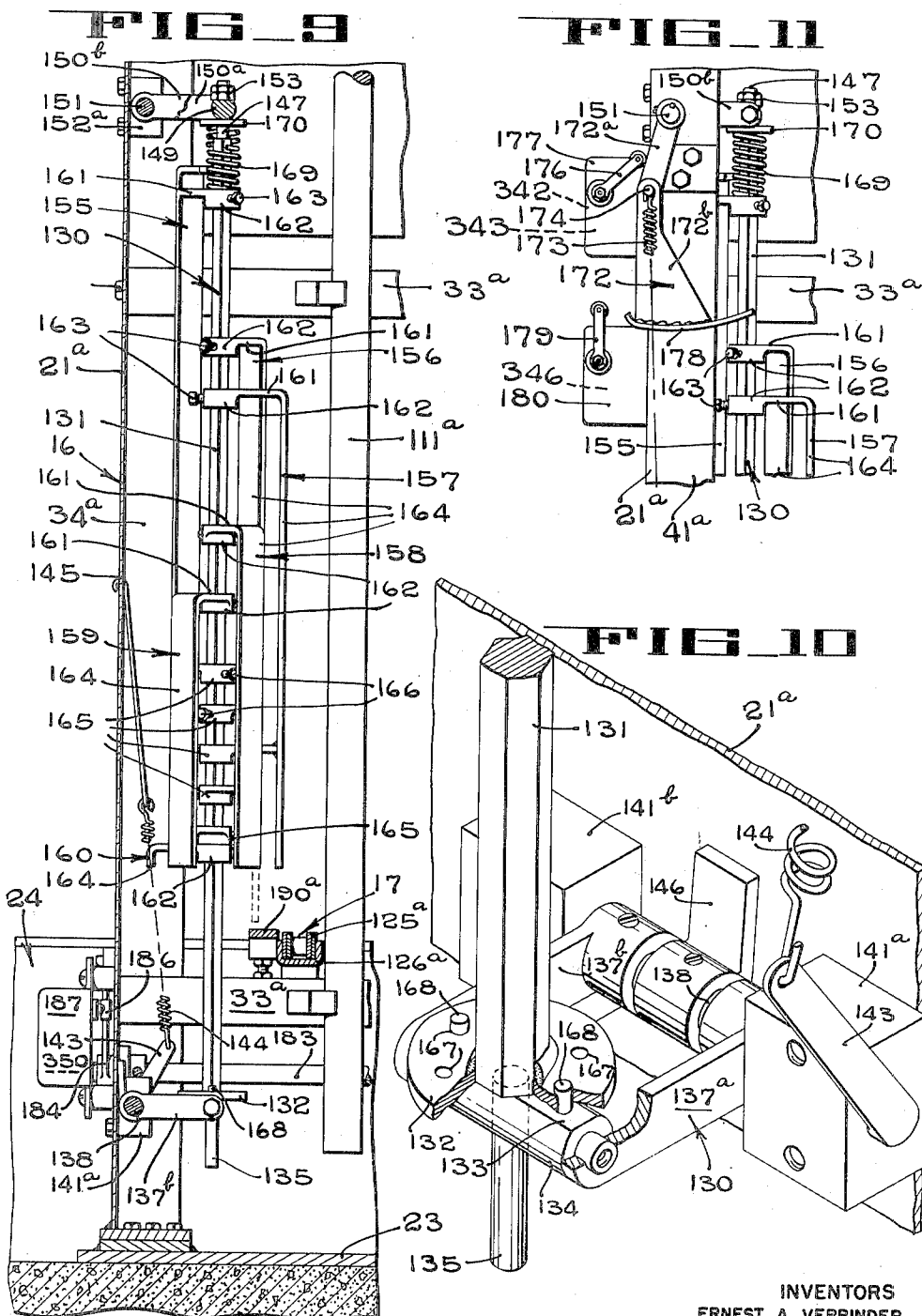
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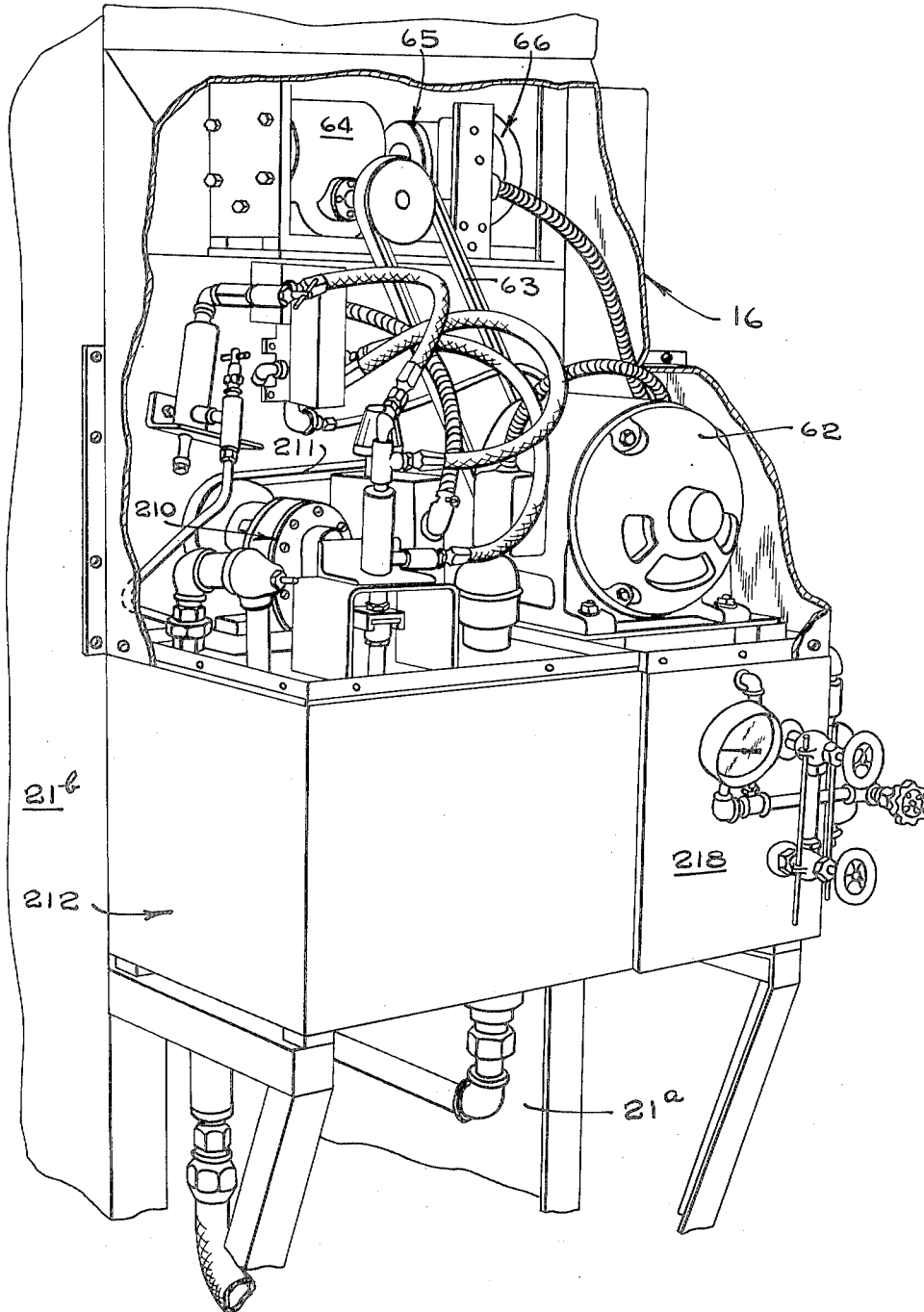


FIG. 13

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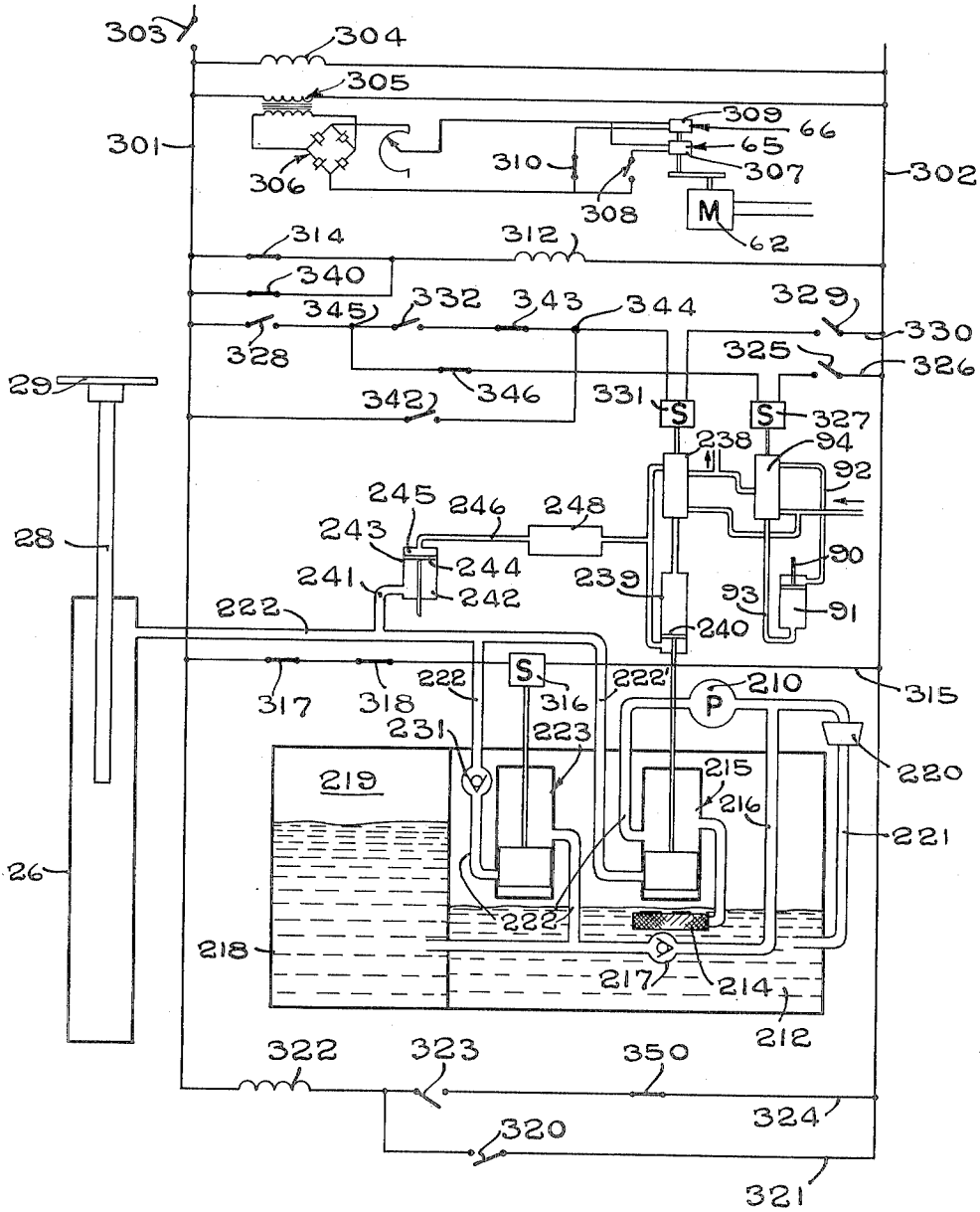


FIG. 14

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**MACHINE FOR STACKING BOXES, CASES,
AND THE LIKE**

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Nuevo, Calif., assignors to Food Machinery and Chemical Corporation, San Jose, Calif., a corporation of Delaware**

Application December 29, 1952, Serial No. 328,445

18 Claims. (Cl. 214-6)

The present invention relates to machines for stacking boxes, cases and the like.

It is an object of the present invention to provide a stacking machine which is simple in construction and fast and dependable in operation.

Another object is to provide a stacking machine, of the type referred to, that is adapted to form a stack of predetermined height.

Another object is to provide a stacking machine, of the type referred to, that performs all the necessary stacking operations automatically.

Another object is to provide a stacking machine, of the type referred to, that may readily be adjusted to handle boxes and cases of different height.

A further object is to provide a box stacking machine adapted to form stacks having a predetermined number of boxes, and which may readily be adjusted to handle boxes of different height.

Still another object is to provide a box stacking machine, of the type referred to, that will so accurately align the stacked boxes in a vertical direction that it may be used to stack open boxes, such as milk boxes, beer boxes and the like.

Another object is to provide a hydraulic system operable to rapidly raise or lower a table such as may form part of the present box stacking machine.

These and other objects of the present invention will readily be apparent from the following description of the accompanying drawings in which:

Fig. 1 is a side elevation of a box stacking machine embodying the invention.

Fig. 2 is a rear elevation of the box stacking machine shown in Fig. 1.

Fig. 3 is a plan view of the same box stacking machine.

Fig. 3A is a perspective of one of the component parts shown in Fig. 3.

Fig. 4 is a fragmentary vertical section through the upper half of the box stacking machine taken along line 4-5 of Fig. 3 and viewed in the direction of the arrows associated with said line.

Fig. 5 is a fragmentary vertical section through the lower half of the box stacking machine taken along line 4-5 of Fig. 3 and viewed in the direction of the arrows associated with said line.

Fig. 6 is an enlarged vertical section through the upper end of the box stacking machine taken along line 6-6 of Fig. 4 and viewed in the direction of the arrows associated with said line.

Fig. 7, like Fig. 6, is an enlarged vertical section through the upper end of the box stacking machine taken along line 7-7 of Fig. 4 and viewed in the direction of the arrows associated with said line.

Fig. 8 is an enlarged fragmentary horizontal section taken along line 8-8 of Fig. 4.

Fig. 9 is a fragmentary vertical section through the lower portion of the left side of the machine, as viewed from the stack discharge end thereof.

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Fig. 10 is an enlarged fragmentary perspective illustrating part of the mechanism shown in Fig. 9.

Fig. 11 is a rear elevation similar to Fig. 2 showing, on an enlarged scale, part of the mechanism illustrated in said Fig. 2.

Fig. 12 is an enlarged fragmentary vertical section through the lower portion of the box stacking machine taken along line 12-12 of Fig. 2 and viewed in the direction of the arrows associated with said line.

Fig. 13 is a fragmentary perspective of the power train and the hydraulic system forming part of the machine illustrated in Fig. 1.

Fig. 14 is a combined diagram of the electric, hydraulic and pneumatic circuits comprised in the machine.

Having first reference to Fig. 1, the stacking machine illustrated therein comprises a box feed ramp 15, an elevator structure 16 and a discharge conveyor 17. The elevator structure 16 is formed by two side frames 21a and 21b in the form of two transversely spaced upright channels that rise from a base plate 23 which is located in a shallow recess 24 in the floor 25 of the establishment where the stacking machine is set up (Fig. 2). A hydraulic cylinder 26 suitably secured at its upper end to said base plate 23 depends from said base plate into a tubular pit 27 located in the center of said recess intermediately of the side frames 21a and 21b (Fig. 5). The plunger 28 of the hydraulic cylinder 26 carries at its upper end a table 29 in the form of a horizontal plate 30 that is narrower in transverse width than the boxes or crates which the machine is to handle. Bolted to said plate is a shallow tray 31 containing a pad 32 of elastic material, such as rubber (Fig. 4). The side frames 21a and 21b may be connected at the feed side of the machine by a series of vertically spaced transverse braces 33 that are bolted to the inwardly turned front flanges 34a and 34b of said side frames to impart sturdiness to the structure (Fig. 2).

At a level slightly above the hydraulic table 29 in its uppermost position the side frames 21a and 21b support a gate or trap door 35 upon which the boxes or crates to be stacked are successively received from the feed ramp 15. Having reference to Figs. 4 and 6, said trap door 35 is formed by two symmetrically arranged gates 36a and 36b comprising horizontal bars 37a and 37b, respectively, that extend in a direction longitudinally of the machine along but vertically clear of the side edges of the table plate 30. Each of said bars is firmly attached to the lower ends of a pair of arms 38a, 39a and 38b, 39b, respectively, depending from and firmly secured to a pair of longitudinal shafts 40a and 40b. At the feed side of the machine, the shafts 40a and 40b are rotatably supported in any suitable manner from the uppermost cross brace 33 of the side frames 21a and 21b (Fig. 7), and their opposite ends are rotatably received in a brace plate 41 that connects said side frames at the discharge side of the machine above the level of the hydraulic table in its uppermost position and is bolted to the rear edge flanges 41a and 41b of said side frames as best shown in Figs. 2 and 6. Pivoted to the bars 37a, 37b at their inwardly directed faces are rows of conically shaped rollers 42a and 42b, respectively, extending with their points close to, but vertically clear of, the side edges of the hydraulic table 29 in its uppermost position.

During practical performance of the stacking machine, the boxes or crates to be stacked are consecutively delivered from a suitable conveyor, such as the gravity chute 50 shown in Fig. 4, onto the feed ramp 15 which passes them in proper intervals onto the trap door 35. The feed ramp 15 may be formed by a pair of transversely spaced, horizontally disposed channels 51a and 51b that rest upon and are bolted to the second cross brace 33 and which carry a first roller 52, that may

be continuously rotated in a counterclockwise direction, a sequence of three rotatably mounted idler rollers 53, 54 and 55 that may be of smaller diameters than rollers 52, as shown, and an endless conveyor belt 56 whose upper run extends from the last one 55 of said idler rollers to a point closely adjacent to and about level with the conical rollers 42a and 42b of the trap door 35. Said endless conveyor belt 56 is trained around a first idler roller 57 that is rotatably supported in the channels 51a and 51b and a second drive roller 58 that is firmly mounted upon a transverse shaft 59 which is rotatably supported in the channels 51a and 51b. The feed ramp 15 is flanked at either side by horizontal guide rails 60a and 60b that may be suitably supported from the side frames 21a and 21b of the machine and which extend through the elevator structure 16 to a point closely adjacent to the aforementioned brace plate 41 at the discharge side thereof.

During practical performance of the machine, the endless belt 56 is turned in a counterclockwise direction as viewed in Fig. 4 to deliver boxes arriving through the gravity chute 50 and over the rollers 52 to 55 onto the conical rollers 42a and 42b of the trap door 35. For this purpose one end of the drive shaft 59 extends through the side frame 21a and carries on its protruding end a sprocket 61 (Fig. 1). An electric motor 62 suitably supported from the side frames 21a and 21b below the ramp 15 is arranged to transmit its rotary power by means of a drive belt 63 through a speed reducer unit 64 (Fig. 13) and an electrically controlled clutch 65 provided with an automatic braking mechanism 66 to a driven shaft 67. Said driven shaft extends through the side frame 21a of the machine (Fig. 1) and carries on its protruding end a sprocket 68 which is operatively connected through a sprocket chain 69 with the sprocket 61 on the protruding end of the conveyor belt drive shaft 59.

To cushion the impact of filled boxes or crates delivered from the ramp 15 onto the trap door 35 against the transverse brace plate 41, suitable rubber pads 70a and 70b may be mounted upon the inner surface of said brace plate as shown in Fig. 6. Additionally, means may be provided to prevent a case or crate delivered onto the trap door against said rubber pads from bouncing back onto the ramp. For this purpose, forwardly directed buffers 75a and 75b, respectively, extend yieldably from below the guide rails 60a and 60b into the path of the boxes traveling along the ramp, with their heads 76a and 76b located approximately above the first of the conical rollers 42a and 42b of the trap door gates 36a and 36b. Having specific reference to Figs. 3, 3a, 4 and 7, said buffer heads may be formed by blocks 77 provided at their forwardly directed faces with vertical grooves 78 within which are pivoted for rotation about horizontal axes rollers 79 that protrude slightly beyond the forwardly directed faces of said blocks. Said blocks are secured to the front ends of rods 80a and 80b which are firmly mounted upon sleeves 81a and 81b. Said sleeves turn on vertical pivots 82a and 82b that are rigidly supported from the front edge flanges 34a and 34b of the side frames 21a and 21b, respectively, adjacent to, but exteriorly of, the guide rails 60a and 60b (Figs. 3 and 7). Rigidly secured to the buffer rods 80a and 80b at points intermediately of their ends are outwardly directed arms 83a and 83b, and spring means 84a and 84b tensioned between the ends of said arms and suitable points 85a and 85b of the side frames 21a and 21b, respectively, urge the buffer rods in a direction inwardly of the feed ramp to positions determined by engagement of said arms with stop ledges 86a and 86b secured to said side frames 21a and 21b. In said position, the buffer rods protrude in a forward direction into the box path as determined by the guide rails 60a and 60b, and the buffer heads are located above the first set of the conical rollers 42a and 42b of the trap door gate as mentioned hereinbefore. Whenever a box slides along the ramp 15 and onto the trap door 35, the buffers 75a and 75b will readily yield

in an outward direction so that the box may pass, but once the box has passed, they return under the urgency of their restore springs 84a and 84b into their initial inwardly directed positions as illustrated in Fig. 3 wherein they positively block, by engagement of their arms 83a and 83b with the stop ledges 86a and 86b, respectively, any return movement of the box from the trap door 35 back to the supply ramp 15. Thus, a box once delivered onto the trap door 35 remains dependably in its proper position vertically above the hydraulic table 29.

Means are provided in accordance with the invention that are effective to open the trap door 35, as soon as a box has been properly positioned thereon, so as to drop said box onto the hydraulic table underneath. For this purpose, the rotatable shafts 40a and 40b from which the roller-carrying bars 37a and 37b of the trap door are supported, extend through the brace plate 41 at the discharge side of the side frames, and firmly mounted upon the outwardly protruding ends of said shafts are arms 87a and 87b which extend toward each other (Fig. 2) and which are pivotally connected by links 88a and 88b to a common pivot point 89 on the vertically disposed piston rod 90 of a pneumatic cylinder 91 that is supported in vertical position from the outer surface of said brace plate 41. Air supply conduits 92 and 93 are arranged to deliver compressed air from a suitable source (not shown) to the upper and lower ends, respectively, of said cylinder depending upon the position of a pneumatic control valve 94 (Fig. 14). Normally the air flow control valve 94 is in such a position as to deliver compressed air through the air supply conduit 93 to the lower end of the cylinder 91 while connecting the conduit 92 at the upper end of said cylinder to the outside atmosphere. This is effective to project the piston rod 90 and hold the gates 36a and 36b of the trap door in the horizontal position illustrated in Fig. 6 in which said trap door is adapted to support a box. However, when a box is delivered onto said trap door and strikes against the rubber pads 70a and 70b on the brace plate 41, it depresses a pair of arms 95a and 95b that are firmly mounted upon a common horizontal shaft 96 which is rotatably supported from the rear edge flanges 41a and 41b of the side frames 21a and 21b, respectively. Said shaft 96 protrudes through the right side frame 21a and carries on its outwardly projecting end an actuating bar 97 (Fig. 1). Upon engagement of the aforementioned arms 95a and 95b by a box delivered onto the trap door, the bar 97 swings in a counterclockwise direction as viewed in Fig. 1 against the urgency of a restore spring 98 and engages the actuating arm 99 of a switch 328 (Fig. 14) that is located in a switch box 100 which is bolted to the outer surface of the side frame 21a. Under proper conditions, i. e., with the hydraulic table at the proper elevation, actuation of switch 328 is effective to energize a solenoid 327 that sets the air flow control valve 94 into a position in which it delivers the compressed air through the conduit 92 to the upper end of the pneumatic cylinder 91 while connecting its lower end to the outside atmosphere. As a result thereof, the piston rod 90 of the pneumatic cylinder is retracted which is effective to swing the gates 36a and 36b of the trap door 35 laterally away from underneath the box so that the box is deposited onto the hydraulic table underneath or upon a box previously deposited upon said table.

As the gates of the trap door 35 swing open, a bar 105 firmly mounted upon the shaft 40a of trap door gate 36a (Fig. 7) engages the actuating arm 106 of another switch 332 located in a suitable switch box 107 that is bolted to the flange 34a of side frame 21a of the machine. Under proper conditions to be described in greater detail hereinafter, the described actuation of the switch 332 is effective to drop the hydraulic table to a lower level by a distance about equal to the depth of the box which the machine may handle at the moment.

To prevent wobbling of the table 29 during its descent in loaded condition, suitable guide means may be pro-

vided that engage the table at the feed side thereof. Having reference to Figs. 2, 6 and 8, two vertical guide posts **111a** and **111b** are suitably supported from cross braces **33a** that connect the side frames **21a** and **21b** at the feed end of the machine. Said guide posts extend all the way from a point somewhat below the trap door down into the recess **24** of floor **25**. The inner quadrants of said guide posts are each embraced by pairs of rollers **112a**, **114a** and **112b**, **114b**, respectively, that are mounted in blocks **115a** and **115b** for rotation about horizontal axes disposed at right angles to each other. Each of said blocks **115a** and **115b** is bolted to a bracket **116a** and **116b**, respectively, which in turn is bolted to a vertically disposed plate **117**. Said plate **117** is firmly secured to the center wall **118** of a hood-shaped gusset structure **119** that depends from and is rigidly secured to the table plate **30** along the feed and side edges thereof. To give lateral support to the boxes on the hydraulic table **29**, as said table drops to lower levels, suitable casters **120** may be pivotally supported from the side frames **21a** and **21b** at different levels vertically of the machine, as best shown in Fig. 2. Additionally, pairs of guide rollers **121** and **122** may be pivotally supported from the brace plate **41** and a vertical mounting plate **123**, respectively, that is mounted upon the upper brace bar **33a**.

As box after box is delivered onto the trap door **35** and is deposited from said trap door upon the hydraulic table underneath or upon the box or boxes previously deposited thereon, and as the table drops with the arrival of each new box progressively to lower levels, a stack of vertically superposed boxes is formed on said table; and after a full stack of boxes has accumulated upon the table, said table is arranged to descend to the level of the shop floor to effect discharge of the completed stack while the trap door is locked in closed position to prevent newly arriving boxes from dropping onto the descending stack. Upon arrival of the descending table at the level of the floor, the table deposits the completed stack upon the previously mentioned discharge conveyor **17** that extends through the elevator structure at the level of the shop floor and which moves in a direction from the feed to the discharge side of the machine. As best shown in Figs. 1 and 2, said discharge conveyor may be formed by a pair of parallel chains **125a** and **125b** which run in U-shaped channels **126a** and **126b**, respectively, and extend through the space defined by the side frames **21a** and **21b** at either side of the hydraulic plunger **23** at a distance sufficiently far apart to permit the relatively narrow hydraulic table **29** to pass intermediately thereof. Thus, as the hydraulic table drops below the level of said conveyor chains, the laterally projecting floor portions of the lowermost box come to rest upon and are engaged by said chains which carry the whole stack immediately away from the machine through the open discharge side thereof.

According to the height of the boxes to be stacked and also according to the number of boxes which a stack is to comprise, the complete stack to be formed will be of different over-all height and accordingly the trap door **35** of the machine will have to be blocked and descent of the hydraulic table to its stack-discharging position initiated at different levels vertically of the elevator structure. According to the invention, a switch-actuating mechanism **130** is provided that may be adjusted to initiate the above described stack discharge operations at predetermined different levels corresponding to the different over-all heights of the stacks resulting from the different numbers of boxes to be comprised in a stack and/or the different individual heights of the boxes to be stacked.

Having reference to Figs. 2 and 9, the adjustable switch actuating mechanism of the invention comprises a vertical control rod **131** of, for example, hexagonal cross section which is supported for rotary adjustment and for limited vertical movement from, and adjacent to, the lower half of side frame **21a** of the machine. For this purpose, the lower end of the control rod **131** is provided with a

circular flange **132** that rests upon the flattened side face **133** of a horizontally positioned roller **134**, and forms a tenon **135** that projects downwardly from said flange, and is rotatably received in, and protrudes downwardly through, a suitable opening extending diametrically through the roller **134**. At its opposite ends, said roller **134** is rotatably supported in two arms **137a** and **137b** that are firmly mounted upon a horizontal shaft **138** which extends parallel of, and adjacent to, the inner surface of the side frame **21a**. Said shaft **138** is rotatably supported in two bearing blocks **141a** and **141b** that are suitably secured to said side frame, and one of its ends projects through its respective bearing block **141a** and carries on its projecting end an arm **143**. A spring **144** tensioned between the free end of said arm **143** and a suitable point **145** of the side frame **21a** above the shaft **138** urges said shaft into an extreme clockwise position (as viewed in Fig. 10) that is determined by engagement of a stop lug **146** fixedly secured to the shaft **138** at a point intermediately of the arms **137a** and **137b**, with the inner surface of the side frame **21a**. In said extreme clockwise position, the arms **137a** and **137b** assume a substantially horizontal position as illustrated in Fig. 10, from which they may yield downwardly as soon as downward pressure is applied upon the control rod **131** against the urgency of the spring **144**. At its upper end, the control rod **131** forms another tenon **147** that is slidably received in and projects upwardly through a diametrical bore in another horizontal roller **149** (Fig. 9) rotatably supported in the ends of two arms **150a** and **150b**. Said arms **150a** and **150b** are again firmly mounted upon a horizontal shaft **151** that is rotatably supported in bearing blocks **152a** and **152b** which are bolted to the side frame **21a** of the machine. The upper projecting end of the tenon **147** is engaged by screw nuts **153** to prevent disengagement of the control rod **131** from the roller **149**.

The control rod **131** carries at different levels vertically thereof and at different angular points in the plane of rotation thereof, six camming members **155**, **156**, **157**, **158**, **159** and **160** having somewhat the shape of upwardly directed sleigh runners. Each of said sleigh runners has a radially extending run **161** the inner end of which is formed into a collar **162** that is engaged over and adjustably secured to, the control rod at a predetermined level by means of a set screw **163**. At its outer end each of the radially directed runs of the camming members comprised in the actuating mechanism, bends smoothly downwards into a vertical run **164** and the vertical runs of all but the lowermost camming member carry another collar **165** supported from their inner faces, which are engaged over and may be adjustably secured to the control **131** by means of set screws **166**. The described arrangement is preferably such that at their lower ends all the vertical runs of the camming members comprised in the actuating mechanism terminate at a common level vertically of the machine.

The radial runs of the camming members **155** to **160** are of equal length, and said length is so chosen that whichever camming member is in a position projecting inwardly from the control rod **131** in a direction transversely of the machine, protrudes into the path of the oppositely projecting end portion of the lowest box upon the hydraulic table, but remains clear of the table plate **30** itself. By rotary adjustment of the center rod **131** different ones of the six camming members **155-160** may selectively be placed into the path of the descending box stack depending upon the total height of the box stack to be assembled in a particular box stacking operation.

Means are provided in accordance with the invention to dependably maintain the described actuating mechanism **130** in its adjusted position during the box stacking operation. Having again reference to Fig. 10, the annular flange **132** at the bottom of the rod **131** is provided with six angularly equi-spaced apertures **167**, and each two diametrically opposite apertures **167** are adapted to be engaged by two studs **168a** and **168b** projecting up-

wardly from the flattened side face 133 of the roller 134. When two oppositely positioned apertures 167 in the flange 132 are engaged by said studs, the control rod 131 is locked against rotary displacement. To dependably maintain the studs 168a and 168b in engagement with the apertures 167, a spring 169 coiled about the upper end of the control rod 131 between the collar 162 of the highest camming member 155 and a disc 170 loosely engaged over the upper tenon 147 of said rod and located below the upper roller 149 urges the rod 131 in downward direction and in this manner keeps the flange 132 yieldably engaged over the studs 168a and 168b. If it is desired to change the adjustment of the described actuating mechanism, the operator merely grips the hexagonal control rod 131 at a convenient place, such as in the area between the collars 162 of the two highest camming members 155 and 156, and lifts the rod against the urgency of the spring 169 until the flange 132 is disengaged from the studs 168a and 168b. Thereupon, he turns the rod 131 until the camming member, that he has selected, projects transversely into the path of the stack to be formed and then permits re-engagement of the corresponding apertures 167 in flange 132 with the studs 168a and 168b under the urgency of said spring 169 and the weight of the actuating mechanism itself.

Whenever the lowermost box upon the descending table 29 comes against the radial run of the camming member adjusted to project into the path of the descending stack, it depresses said camming member and hence the control rod 131 to which it is secured, against the urgency of the restore spring 144. This depresses the arms 156a and 156b at the upper end of the control rod and swings their shaft 151 in clockwise direction, as viewed in Figs. 2 and 11. The rearwardly extending end of said shaft projects through the rear edge flange 41a of the side frame 21a, and firmly mounted upon said rearwardly projecting end is a downwardly directed bar 172 which is yieldably held in an ineffective position by a spring 173 tensioned between a mid-point 174 thereof and a point 175 on the rear edge flange 41a of the side frame 21a near the floor level. Said bar 172 is composed of an upper slightly slanted portion 172a and a vertical lower portion 172b, and upon clockwise rotation of shaft 151, the upper portion 172a of said bar comes against the actuating arm 176 of a switch 342 (Fig. 14) located in a switch box 177 which is bolted to the outer surface of the side frame 21a. Actuation of the switch 342 is effective to cause the hydraulic table to continue its downward travel beyond a distance equal to the height of a single box as will be explained in greater detail hereinafter.

As the hydraulic table continues its descent due to the described switch actuation, the stack of boxes situated upon said table depresses the switch actuating mechanism 130 still more which turns the shaft 151 further in clockwise direction. This brings a camming arch 178 secured to the lower end of the vertical portion 172b of bar 172 against the actuating arm 179 of another switch 346 located in a switch box 180 that is bolted to the outer surface of the side frame 21a. Actuation of said switch 346 is effective to maintain the pneumatic control valve 94 in a position wherein the pneumatic cylinder 91 keeps the gates of the trap door 35 closed, even though a new box may position itself thereon and operate the actuating arms 95a and 95b of the gate control switch 328.

As the hydraulic table and the completed stack of boxes situated thereon continue to drop, the arms 150a and 150b which support the upper end of the control rod 131 and the arms 137a and 137b which support its lower end swing all in clockwise direction as viewed in Figs. 2 and 9. As a result thereof the control rod 131 and hence the engaged camming member yield laterally away from the box stack and free said box stack for unimpeded further descent. The vertical run of the engaged camming member, however, remains in contact with the adjacent side of the descending box stack and, as a result thereof, the

actuating arms 176 and 179 of switches 342 and 346, respectively, remain in actuated condition until the box stack is rearwardly removed from the elevator structure of the machine.

Eventually the descending table 29 drops below the level of the discharge conveyor chains and deposits the box stack on said chains, and since during practical performance of the described machine said chains move continuously in the direction rearwardly out of and away from the elevator structure as pointed out hereinbefore said chains take hold of the box stack and remove it rearwardly from the hydraulic table. When this occurs, the switch actuating mechanism 130 is permitted to return to its normal position under the force of restore springs 144 and 173 and the switches 342 and 346 are, therefore, permitted to return to their normal position.

As the hydraulic table drops below the level of the discharge conveyor, an arched camming plate 181 suitably bolted to the hereinbefore mentioned plate 117 below the feed edge of the hydraulic table (Figs. 4 and 12), engages an arm 182 that is firmly mounted upon a transverse shaft 183 which is rotatably supported in the side frames of the machine near the bottom end thereof and which carries on one of its outwardly projecting ends a bar 184 (Fig. 1) that is yieldably held in a counterclockwise position by suitable spring means 185. Upon depression of the arm 182 by the descending table, the bar 184 depresses the actuating arm 186 of a normally closed switch 350 housed in a box 187 that is bolted to the outer surface of the side frame 21a. Actuation of said switch 350 is arranged to condition the table for return movement to its uppermost position in a manner to be described in greater detail hereinafter. Means are provided, however, to prevent such operation until the stack of boxes deposited upon the chains has been completely removed from above the hydraulic table. For this purpose, a pair of spring bars 190a and 190b (Fig. 12) are arranged to extend longitudinally of the conveyor chains adjacent the outer sides thereof. At the feed side of the hydraulic elevator structure, said bars are bolted to the lowest of the hereinbefore mentioned transverse brace bars 33a that extends at a level below the level of the conveyor chains. From said transverse angle bar, the spring bars 190a and 190b rise gently to a level slightly above the level of the conveyor chains with their free ends reaching beyond the discharge edge of the hydraulic table in a direction longitudinally of the machine. The free ends of said bars 190a and 190b are arranged to overlie rollers 192a and 192b pivoted to the upper inwardly directed runs 193a and 193b, respectively, of angular arms 194a and 194b, whose vertically disposed lower runs 195a and 195b are firmly mounted upon a transverse shaft 196. Said shaft is rotatably supported in bearing blocks 197a and 197b which are bolted to the discharge edge flanges 41a and 41b of the side frames 21a and 21b at a level below the conveyor chains (Fig. 2). Firmly mounted upon a laterally projecting end of said shaft 196 is a bar 198 (Fig. 1) that is yieldably held in clockwise position by suitable spring means 199. When in said position, the angular arms 194a and 194b yieldably maintain the rollers 192a and 192b against the ends of the spring bars 190a and 190b. Upon counterclockwise movement of bar 198, however, against the urgency of spring means 199 as effected by depression by the spring bars 190a and 190b under the weight of a box stack resting thereon, said bar 198 is arranged to operate the actuating arm 200 of a switch 317 (Fig. 13) that is housed in a switch box 201 which is bolted to the outer surface of the side frame 21a near the lower end thereof. Upon actuation, said switch 317 is arranged to prevent elevation of the hydraulic table in a manner to be described in greater detail hereinafter. Hence, the hydraulic table cannot commence its return journey to its uppermost position, even though its camming arch 181 may have actuated the hereinbefore mentioned switch 350 in switch

box 187, until the conveyor 17 has completely removed the stack from above the resilient bars 190a and 190b whereupon return of said bars to their normal position above the level of the conveyor chains will permit bar 198 to disengage the actuating arm 200 of switch 317 under the urgency of spring 199. Only then will the hydraulic table commence to return to its position of maximum elevation.

The electric, hydraulic and pneumatic circuits comprised in the machine of the invention are illustrated in Fig. 14 wherein the numerals 301 and 302 represent the main leads of the electric circuit across which the individual control circuits are connected. In practical use of the machine, the attendant starts operation of the discharge conveyor 17 which may be a unit entirely separate from the machine. At the same time, he closes the master switch 303 of the electrical circuit to energize the control relay 304 of the electric motor 62 and as a result thereof, said motor commences operation. Closure of the master switch 303 also feeds power through a suitable transformer 305 to a rectifier 306. Connected across the output terminals of said rectifier is the actuating solenoid 307 of the hereinbefore described motor clutch 65. In series with the clutch control solenoid 307 is a normally open control switch 308, hence the motor clutch 65 remains disengaged until the switch 308 is closed. Also connected across the output terminals of the rectifier 306 is the control solenoid 309 of the hereinbefore described braking mechanism 66 in the power train from the motor 62 to the feed belt 56. In series with said brake control solenoid 309 is a normally closed control switch 310. Hence, as soon as the master switch 303 is closed the control solenoid 309 of the braking mechanism may be energized which maintains the feed belt at a standstill. However, likewise connected across the main leads 301 and 302 is a control relay 312 in series with a normally closed switch 314. Said switch 314 is housed in the same switch box 100 and is operated by the same actuating mechanism as the hereinbefore described trap door opening switch 328, but while the switch 328 is closed by the arrival of a box on the trap door 35, the switch 314 is opened by the pressure of a box on trap door 35 against the actuating arms 95a and 95b. Hence, with no box upon the trap door, the control relay 312 is energized as soon as the master switch 303 is closed. Said control relay 312 is arranged, upon energization, to open the normally closed switch 310 in series with the brake control solenoid 309 and to close the normally opened switch 308 in series with the clutch control solenoid 307. As a result thereof, the brake mechanism 66 is released and the clutch 65 is engaged. Hence, as long as the relay 312 remains energized, the motor 62 will drive the feed belt 56 in the feed ramp 15 through the previously described power train so that said belt may deliver boxes arriving through the feed chute onto the trap door 35.

Closing of the master switch 303 also causes current to flow through a circuit 315 formed by a solenoid 316 and two normally closed switches 317 and 318 in series. When the solenoid 316 is energized, it sets the hydraulic control system of the table 29 into a position wherein liquid is delivered into the hydraulic cylinder 26 causing the table 29 to rise.

The hydraulic system comprises a pump 210 operatively connected by means of a suitable drive belt 211 with the hereinbefore mentioned motor 62 (Fig. 13). Said pump is arranged to draw hydraulic liquid from a reservoir 212 through a suitable filtering screen 214 and a normally open valve 215 and deliver it through a suitable conduit 216 provided with a check valve 217 into a closed tank 218 containing a cushion 219 of a gaseous fluid, such as air, above the liquid accumulated therein. The pump will continue to deliver liquid in the described manner into the tank 218 until the pressure developed in said tank by compression of the enclosed air cushion above the rising liquid exceeds the pressure setting of a relief valve 220 provided in a branch line 221 of conduit 216, whereupon

said branch line 221 returns the output of the pump to the reservoir 212. A conduit 222 leads from a point of conduit 216 on the down stream side of the check valve 217 through a normally closed hydraulic control valve 223 to the upper end of the hydraulic cylinder 26. When the hereinbefore mentioned solenoid 316 in circuit 315 is energized by closure of the master switch 303, said solenoid 316 sets the control valve 223 to a position wherein it opens conduit 222. As a result, hydraulic liquid rushes under the pressure developed in the tank into the hydraulic cylinder and rapidly raises its plunger 28 from whatever level it may have occupied at the moment until the hereinbefore described arched camming plate 181 supported from the hydraulic table 29 engages an arm 225 that is firmly mounted upon a transverse shaft 226 which is rotatably supported in the side frames 21a and 21b of the machine at a level slightly below and adjacent to the feed ramp 15 (Fig. 4). One end of said shaft 226 projects through the side frame 21a and carries firmly mounted upon its projecting end, a bar 227 (Fig. 1) that is normally held in a clockwise position as viewed in Fig. 1, by suitable spring means 228. Said bar is turned in counterclockwise direction, however, when the arched camming member 181 engages the arm 225, and contacts the actuating arm 229 of a switch 320 located in a box 230 bolted to the outer surface of the side frame 21a. Said switch 320 is normally open and lies in the power circuit 321 (Fig. 14) of a multi-action relay 322. Hence, whenever the rising table actuates the arm 225, the relay 322 is energized. Said relay 322 is arranged, upon energization, to open the hereinbefore mentioned normally closed switch 318 in the power circuit 315 of the table raising solenoid 316 so that said solenoid is de-energized. With the solenoid 316 is disabled, the hydraulic control valve 223 returns to its normal position wherein it blocks further flow of liquid to the hydraulic cylinder 26. As a result, the table comes to a halt in a position directly below the gates of the trap door 35 as best illustrated in Fig. 4, and is dependably maintained in said position by virtue of a suitable check valve 231 provided in conduit 222 at a point intermediately of the hydraulic table raising valve 223 and the cylinder 26, while the continuously operating pump commences to deliver fresh amounts of liquid into the tank 218 to replace the amount of liquid supplied to the hydraulic cylinder and re-establish in said tank the pressure level determined by the setting of relief valve 220.

Reverting to the electric circuit arrangement, it should be noted that energization of the multi-action relay 322 by closure of switch 320 at the upper end of the hydraulic elevator structure is also effective to close a normally open switch 323 in series with said relay 322 and in parallel with the switch 320. Said switch 323, upon closure, completes a holding circuit 324 for the relay 322 across the leads 301 and 302 so that said relay 322 may remain energized even after the hydraulic table drops with its arched camming plate 181 out of engagement with the actuating arm 225 of the switch 320 and permits said switch to return to its normal open position. In addition, energization of the multi-action relay 322 is effective to close a normally open switch 325 in the power circuit 326 of a solenoid 327 that operates the hereinbefore mentioned pneumatic valve 94 which controls the air supply to the trap door actuating air cylinder 91 and which is normally set to keep the trap door closed as explained hereinbefore. However, in spite of the closure of switch 325 the solenoid 327 remains inactive for the moment because of the presence of a normally open switch 328 in circuit 326. Energization of relay 322 further closes a normally open switch 329 in the power circuit 330 of a solenoid 331 which is effective, upon energization, to move the hereinbefore mentioned hydraulic valve 215 in a manner to be presently described in greater detail into a position wherein the input end of the continuously operating pump 210 is connected

through a conduit 222' and a portion of conduit 222 to the hydraulic cylinder 26 instead of the reservoir 212 to draw liquid from said cylinder and effect lowering of the table 29. In spite of the closure of switch 329, said table lowering solenoid 331 remains inactive, however, due to the location of the hereinbefore mentioned normally open switch 328 in a common branch of the circuits 330 and 326 and also due to the presence in circuit 330 of an additional normally open switch 332.

Let it now be assumed that a box passes from the inclined gravity chute 50 onto the feed ramp 15 from where the continuously turning belt 56 delivers it past the buffers 75a and 75b onto the trap door 35 and against the actuating arms 95a and 95b of switch 314 so that said switch is opened. This would normally interrupt the power circuit of control relay 312 and de-energize said relay with the result that the clutch 63 is disengaged and the braking mechanism 66 effects instantaneous halt of the belt 56. However, to make sure that the trap door will always promptly be supplied with another box as soon as it has deposited a box onto the hydraulic table underneath, the control switch 314 is shunted by another normally closed switch 340 that is effective to keep the feed belt in operation, although a box may have been delivered onto the trap door and keep the switch 314 open. Said normally closed switch 340 may be housed in a box 235 supported from the guide rail 60a of the feed ramp (Figs. 1 and 4) and has an actuating arm 236 that extends resiliently into the path of the boxes passing along the ramp at a point in front of buffer 75a. Whenever a box passes along the ramp, therefore, while the trap door 35 is unoccupied and the switch 314 is thus in closed condition, said box opens the switch 340 briefly which remains without effect because at the moment the switch 340 is opened the switch 314 still closes the power circuit though the relay 312, and the switch 340 will have closed behind the box before the box reaches and bears against the arms 95a and 95b that open the switch 314. However, if a box should enter the ramp and slide onto the moving belt 56 thereof, while the trap door 35 is occupied by a preceding box which keeps the switch 314 open, actuation of the switch arm 236 throws the switch 340 open, and with both power paths to the control relay 312 thus interrupted, the feed belt 56 comes instantaneously to a halt and prevents the second box from crowding upon the occupied trap door and from hitting the box situated thereon.

Reverting now to the box situated upon the trap door 35, the switch arms 95a and 95b which are depressed by the box as it comes against the rubber pads 70a and 70b on the brace plate 41, are not only arranged to open the switch 314, they are also arranged to close the hereinbefore mentioned normally open switch 328 (Fig. 14) which is located in the same switch box 100 as the switch 314 (Fig. 1). As previously described, said normally open switch 328 lies in the power circuit 326 of the solenoid 327 and said power circuit contains an additional normally open switch 325 that was closed by energization of the multi-action relay 322 as explained hereinbefore. Thus, when switch 328 is closed, the trap door controlling solenoid 327 is energized and sets the pneumatic valve 94 into a position wherein it applies compressed air to the upper end of the pneumatic cylinder 91 while connecting the lower end of the cylinder to the outside atmosphere. As a result thereof, the piston rod 90 of said cylinder is retracted which is effective to swing the gates 36a and 36b of the trap door downwardly. Thus, the box is released from the conical rollers 42a and 42b and drops upon the hydraulic table 29 in its uppermost position.

The normally open switch 328, however, does not only lie in the power circuit 326 of the trap door opening solenoid 327. As previously described, it lies also in the power circuit 330 of the solenoid 331. Said power

circuit 330 contains two additional normally open switches 332 and 329. Normally open switch 329 was closed by energization of the control relay 322 as explained hereinbefore, and whenever the gates of the trap door have swung fully into their open position, the switch 332 is closed by engagement of the previously described arm 105 on shaft 40a of gate trap door 36a with the actuating arm 106 of said switch 332 which is housed within the switch box 107 as mentioned hereinbefore (Fig. 7). Thus, when the trap door gates have fully opened and the box is properly positioned upon the hydraulic table underneath, the solenoid 331 is energized. Energization of said solenoid sets another pneumatic valve 238 (Fig. 14) into a position wherein it delivers compressed air into the bottom end of another pneumatic cylinder 239 while connecting its upper end to the outside atmosphere. The resultant movement of its piston 240 moves the hereinbefore mentioned hydraulic valve 215 into a position wherein it connects the hydraulic cylinder 26 to the input end of the continuously operating pump 210. As a result, liquid is quickly drawn from the hydraulic cylinder 26 and the table 29 begins to drop and will continue to drop, even though its arched camming plate 181 may release the arm 225 and cause the switch 320 to open, because the multi-action relay 322 continues to receive power through its holding circuit 324.

However, as soon as the hydraulic table has dropped to a level at which the box situated thereon releases the actuating arms 95a and 95b upon shaft 96, the switch 328 returns to open position. This has the double effect of (1) de-energizing the table lowering solenoid 331 causing the hydraulic table 29 to come to a standstill and (2) of de-energizing the trap door opening solenoid 327 which permits the pneumatic control valve 94 to return to its initial position wherein it delivers the compressed air into the lower end of the pneumatic cylinder 91 while connecting its upper end to the outside atmosphere. As a result thereof, the piston rod 90 of the hydraulic cylinder 91 is again projected and causes the gates of the trap door to close above the box on the lowered hydraulic table while the arm 105 on the shaft 40a of the trap door gate 36a releases the actuating arm 106 of switch 332, permitting said switch to return to its normally open position.

Release of the actuating arms 95a and 95b by the descending box has the additional effect of permitting switch 314 in the power circuit of the control relay 312 to close. As a result thereof, the relay 312 is re-energized, although a succeeding box may maintain the switch 340 open, and the feed belt 56 commences to operate again and delivers any such succeeding box quickly onto the trap door, while the shunt switch 340 in the power circuit of the belt control relay 312 is permitted to close. Arrival of the box on the trap door will then initiate the same trap door opening and table lowering operations as described hereinbefore so that the second box will drop on top of the box previously deposited onto the hydraulic table.

To cushion the shock of the dropping hydraulic table, that may be loaded with heavy, product-filled boxes, as it comes to a sudden halt when de-energization of the solenoid 331 causes the hydraulic valve 215 to block the passage 222' from the hydraulic cylinder 26 to the input end of the pump 210, the conduit through which the hydraulic liquid may flow into and out of the hydraulic cylinder may be provided with a branch line 241 (Fig. 14) that leads into the lower end 242 of a dash pot 243 having a piston 244 that operates against an air cushion which is enclosed in the opposite end 245 of the dash pot. Hence, when further escape of the hydraulic fluid from the cylinder 26 to the pump 210 is suddenly blocked, some of the liquid forced from the cylinder under the momentum of the dropping table may escape through the branch line 241 into the dash pot 243 since the piston 244 will yield because the air cushion in its upper end is com-

pressible. In the preferred embodiment of the invention illustrated in the accompanying drawings, the arrangement is such that return of the pneumatic control valve 238 to its initial position, as caused by de-energization of the table lowering solenoid 331, connects the air chamber 245 of the dash pot through a narrow discharge conduit 246 to the outside atmosphere so that part of the air cushion contained in the upper end of the dash pot may bleed off. To restore the effectiveness of the dash pot for the next operational phase in the performance of the hydraulic table, said pneumatic control valve 238 may be arranged, upon energization of the table lowering solenoid 331, to deliver compressed air, not only into the lower end of the pneumatic piston 239 that controls the setting of the table lowering hydraulic valve 215, but also through the narrow conduit 246 into the air chamber 245 of the dash pot 243 to depress the piston and eject some of the hydraulic liquid of the other side thereof. To increase the effectiveness from the described arrangement, a directional flow control valve 248 may be interposed in the narrow conduit 246 to restrict the flow of air from the dash pot to the outside atmosphere, while permitting free flow of air through the conduit in the reverse direction, i. e., into the dash pot.

As box after box is stacked upon the hydraulic table, said table drops with the arrival of each new box to a lower level in the manner described hereinbefore. Eventually, as the table receives the last box to be comprised in a particular stack and commences to descend again, it reaches, and drops below, the level of the radial run 161 of whatever camming member 155, 156, 157, 158, 159 or 160 of the actuating mechanism 130 was set to project into the path of the descending boxes to limit the height of the box stack to be formed on the table. Then, as the adjacent laterally projecting end of the lowest box on the table 29 bears down upon the radial run of said particular camming member and depresses the total actuating mechanism 130, the upper portion 172a of the bar 172 (Figs. 9 and 11) actuates the switch arm 176 as previously described which is effective to close the normally open switch 342 that shunts the previously described switches 332 and 328 in the power circuit 330 of the table lowering solenoid 331. Said switches 332 and 328 are normally open, as previously explained, but were closed during the preceding phases in the operation of the machine by energization of the master relay 322 and the pressure of a box against the switch arms 95a and 95b at the upper end of the hydraulic elevator structure. With the shunt switch 342 closed, therefore, the table lowering solenoid 331 will remain energized and the hydraulic table will continue to drop, even though the switch 328 will eventually open as the uppermost box in the stack drops below the level of said switch arms 95a and 95b. The opening of said switch 328, however, will interrupt the power circuit 326 of the trap door control solenoid 327 and in consequence thereof, the gates of the trap door will close as soon as the uppermost box in the stack drops below the level of the switch arms 95a and 95b. In addition to closing the shunt switch 342 in the power circuit 330 of the table lowering solenoid 331, actuation of switch arm 176 in response to the depression of actuating mechanism 130 by the descending stack of boxes is effective to open a normally closed switch 343 located between the juncture point 344 of shunt switch 342 and circuit 330 and the juncture point 345 of circuits 330 and 326. Opening said switch 343 is effective to prevent accidental energization of the trap door control solenoid 327 through a shunt path that might otherwise form through the closed switches 342 and 332. Thus, the trap door will not accidentally open when closure of the shunt switch 342 maintains the table lowering solenoid 331 in energized condition.

As the hydraulic table descends further and the actuating mechanism 130 is further depressed, the camming arch 178 at the lower end 172b of bar 172 engages the

actuating arm 179 of a switch 346 as previously described (Fig. 11). Said switch 346 is normally closed and lies in circuit 326 in series with the trap door control solenoid 327. The described actuation of the switch arm 179 is effective to open the switch 346 as an added assurance that the solenoid 327 cannot be energized and that the trap door will, therefore, dependably remain closed as the hydraulic table lowers the completed stack onto the discharge conveyor C, whether a new box may be delivered onto the trap door or not.

As the dropping table is about to reach the level of the discharge conveyor chains 125a and 125b, the laterally projecting ends of the lowermost box on the table 29 engage and depress the bars 190a and 190b (Fig. 12). As previously described, this is effective to actuate the switch arm 200 of a switch 317 located in the switch box 201. Said switch 317 is normally closed and lies in the power circuit 315 of the table raising solenoid 316 and when the bars 190a and 190b are depressed, said switch 317 is opened as a precaution that the table raising solenoid 316 may not be energized and hence the table not be allowed to rise until the conveyor chains 125a and 125b have removed the complete stack from above said table. It is only then that the resilient arms 190a and 190b may rise again and that the actuating bar 198 may release the switch arm 200 permitting switch 317 to close.

After depositing the box stack upon the conveyor chain, the hydraulic table continues its descent until the hereinbefore described camming arch 181 supported from said table depresses the arm 182 (Fig. 12) of transverse shaft 183. This is effective to actuate the arm 186 of a normally closed switch 350 that is located in the switch box 187 as previously described. Said normally closed switch 350 lies in the holding circuit of the multi-action relay 322 (Fig. 14) and, upon opening, causes de-energization of said relay. In consequence thereof the holding switch 323 of said relay 322 returns to open position so that the relay 322 cannot again be energized until arrival of the table at its highest elevation, closes the normally open switch 320 in the manner previously described. With the multi-action relay 322 de-energized, switch 329 in the power circuit 330 of the table lowering solenoid 331 is opened and as a result thereof, the downward travel of the hydraulic table comes to a halt. At the same time, the switch 318 in the power circuit 315 of the table raising solenoid 316 is allowed to return to its normally closed position which causes the table to rise as soon as the conveyor has cleared the stack out of its vertical path and the switch 318 in the power circuit of the table raising solenoid 316 has therefore returned to its normally closed position. De-energization of the multi-action relay 322 also permits switch 325 in the power circuit 326 of the trap door opening solenoid 327 to return to its normally open position so that said solenoid remains dependably de-energized and the trap door cannot open, even though a newly arrived box may actuate the switch 328, until the table has reached its highest elevation wherein it is situated directly below the trap door.

As the conveyor chains 125a and 125b remove the stack through the open discharge side of the hydraulic elevator structure, said stack releases the previously engaged camming member of switch actuating mechanism 130. As a result thereof, the various switches which were held in actuated condition by said mechanism are allowed to return to their normal positions to condition the machine for the next operational cycle. Thus, the shunt switch 342 in the power circuit 330 of the table lowering solenoid 331 is allowed to return to its normally open position. Also, the shunt-path-preventing switch 343 in said circuit 330 is allowed to return to its normally closed position and switch 346 in the power circuit 326 of the trap door opening solenoid 325 is per-

mitted to close. With both the switches 317 and 318 in the power circuit of the table raising solenoid 316 returned to their normally closed positions, the hydraulic table 29 continues to rise in the manner previously described until it reaches its uppermost position when its camming arch 181 closes again the normally open switch 320 in the power circuit of the multi-action relay 322 causing energization of said relay which conditions the machine for another box stacking operation in the manner previously described.

While we have described a particular embodiment of the present invention, we do not wish to be limited to the constructional details shown and described which may be departed from without departing from the scope and spirit of the invention.

Having thus described our invention what we claim as new and desire to protect by Letters Patent is:

1. A box stacking machine comprising normally closed gate means adapted when in closed position to support a box thereon, a normally stationary table arranged for movement from a top position directly below said gate means to a bottom position a predetermined distance below said gate means, means effective in the presence of a box on said gate means to open said gate means so as to drop the box onto said table and to lower said table until the box has dropped below the level of said gate means, and stack limiting means adjustable to protrude into the path of a box on said table at selected levels between said top and bottom positions and effective upon engagement with the lowermost box on said table to hold said gate means in closed position.

2. A box stacking machine comprising normally closed gate means adapted when in closed position to support a box thereon, a normally stationary table arranged for movement from a top position directly below said gate means to a bottom position a distance below said gate means larger than the tallest stack to be formed, means temporarily effective in the presence of a box on said gate means to open said gate means so as to drop the box onto said table and to lower said table until the box has dropped below the level of said gate means, and stack limiting means adjustable to protrude into the path of a box on said table at selected levels between said top and bottom positions and effective upon engagement with the lowermost box on said table to cause continuous lowering movement of said table to said bottom position while simultaneously holding said gate means in closed position.

3. A box stacking machine comprising normally closed gate means adapted when in closed position to support a box thereon, a normally stationary table arranged for movement from a top position directly below said gate means to a bottom position a predetermined distance below said gate means, means temporarily effective in the presence of a box on said gate means to open said gate means so as to drop the box onto said table and to lower said table until the box on said table has dropped below the level of said gate means, and stack limiting means adjustable to protrude into the path of a box on said table at selected levels corresponding to different overall heights of the stacks to be formed and effective upon engagement with the lowermost box on said table to lower said table continuously to its bottom position and to simultaneously hold said gate means in closed position irrespective of the presence of a box thereon.

4. A box stacking machine comprising normally closed gate means adapted to support a box thereon, a discharge conveyor disposed a distance below said gate means larger than the overall height of the tallest box stack to be formed, a normally stationary table arranged for movement from a top position directly below said gate means to a bottom position below the level of said discharge conveyor, means temporarily effective in response to the presence of a box on said gate means to open said

gate means so as to drop the box onto said table and to lower said table until the box dropped from said gate means descends below the level of said gate means, and stack limiting means protruding at a predetermined level into the path of a box on said table, as said box descends intermittently in response to repeated activations of said temporarily effective means by the arrival of new boxes, and effective upon engagement with the lowermost box on said table to cause continuous lowering movement of said table to said bottom position and to simultaneously hold said gate means in closed position irrespective of the arrival of a new box thereon.

5. A box stacking machine comprising normally closed gate means adapted to support a box thereon, means operable to feed boxes individually onto said gate means, a discharge conveyor having two horizontally spaced conveyor chains disposed a distance below said gate means larger than the overall height of the tallest box stack to be formed, a normally stationary table arranged for movement from a top position directly below said gate means to a bottom position below the level and intermediately of the chains of said discharge conveyor, first means effective in the presence of a box on said gate means to disable said box feed means, second means likewise effective in response to the presence of a box on said gate means to open said gate means so as to drop the box onto said table and to lower said table until the box dropped from said gate means descends below the level of said gate means, and stack limiting means adjustable to protrude into the path of a box on and descending with said table at different levels corresponding to different overall heights of the stacks to be formed, and effective upon engagement with the lowermost box on said table to cause continuous lowering movement of said table to said bottom position and to simultaneously lock said gate means in closed position regardless of the arrival of a new box thereon.

6. A box stacking machine comprising a normally closed gate means adapted to support a box thereon, a discharge conveyor comprising two chains spaced transversely apart by a distance less than the width of the boxes to be stacked disposed below said gate means at a distance larger than the overall height of the tallest box stack to be formed, a normally stationary table of a transverse width less than the space between said chains arranged for movement from a top position directly below said gate means to a bottom position intermediately of and below the level of said conveyor chains, means temporarily effective in response to the presence of a box on said gate means to open said gate means so as to drop the box onto said table and to lower said table until the box dropped from said gate means descends below the level of said gate means, stack limiting means adjustable to protrude into the path of a box on and descending with said table at different levels corresponding to the different overall heights of the stacks to be formed and effective upon engagement with the lowermost box on the table to cause continuous lowering movement of said table to said bottom position, while simultaneously locking said gate means in its closed position regardless of the arrival of a new box thereon, and means operative in response to removal of the box stack accumulated upon said table from the space above said table to return said table to its top position while still maintaining said gate means in locked condition, and means for unlocking said gate means when said table reaches its uppermost position.

7. A box stacking arrangement including an elevator structure having a vertically movable table; normally closed gate means at the upper end of said elevator structure adapted to support a box; means effective in response to the presence of a box on said gate means to open said gate means and drop the box onto the table underneath and to lower the table until the box dropped thereon descends below the level of said gate means; a stack

limiting mechanism adjacent the lower end of said elevator structure comprising a plurality of camming members extending radially from a common vertical axis at different vertical and angular points thereof; and means effective in response to engagement of a selected one of said camming members with a box on said table to lock said gate means in closed position.

8. A box stacking arrangement including an elevator structure having a vertically movable table; normally closed gate means at the upper end of said elevator structure adapted to support a box; means operable in response to the presence of a box on said gate means to open said gate means and drop the box upon the table underneath and to lower the table until the box dropped thereon descends below the level of said gate means; a stack limiting mechanism comprising a vertical rod mounted for rotation about its axis and for downward movement adjacent the lower end of said elevator structure and a plurality of camming members extending radially from said rod at different vertical and angular points thereof; and means effective in response to depression of said rod by engagement of a selected one of said camming members with a box on said table to lock said gate means in closed position.

9. A box stacking arrangement including an elevator structure having a vertically movable table; normally closed gate means at the upper end of said elevator structure adapted to support a box, a discharge conveyor passing through the lower end of said elevator structure, means operable in response to the presence of a box on said gate means to open said gate means and drop the box upon the table underneath and to lower the table until the box dropped thereon descends below the level of said gate means; a stack limiting mechanism comprising a vertical rod mounted for rotation about its axis and for downward movement adjacent the lower end of said elevator structure and a plurality of camming members extending radially from said rod at different vertical and angular points thereof; and means effective in response to depression of said rod by engagement of a box on said table with a selected one of said camming members to lock said gate means in closed position and lower the table continuously to the level of said discharge conveyor.

10. A box stacking machine comprising a table movable along a vertical path between a top and a bottom position, a discharge conveyor disposed adjacent the path of said table near the bottom position thereof and effective to remove boxes from said table when said table approaches said bottom position, means operable by said table at the bottom position thereof to initiate upward movement thereof, and means depressible by said boxes and effective to disable said upward movement initiating means until said discharge conveyor has removed any box on said table out of the vertical path of said table.

11. A box stacking machine comprising a table of lesser width than the boxes to be stacked and movable along a vertical path between a top and a bottom position, a discharge conveyor having chains disposed at either side of said table near the bottom position thereof and operable to move continuously in a predetermined direction, said chains being spaced apart by a distance larger than the width of said table but smaller than the width of the boxes to be stacked, means operable by said table in response to descent of the table below the level of said chains to initiate upward movement of said table, a depressible member positioned adjacent to and normally slightly above the level of said chains in the path of the vertical movement of said boxes, and means effective in response to depression of said member to disable said means for initiating upward movement of said table until said boxes are removed from said depressible member by said chains.

12. In a box stacking machine of the type having a

table adapted to support a stack of boxes and movable along a vertical path between a top and bottom position, a stack discharge arrangement comprising conveyor chains disposed at either side of said table above the level of its bottom position and operable to move continuously in a direction away from the table path, means operable by said table in response to descent of the table below the level of said chains to initiate upward movement thereof, and means adjacent to said chains and adapted to be contacted by the boxes on said table to disable said means for initiating upward movement until released by movement of said stack of boxes from the vertical path of said table.

13. A box stacking machine comprising a table of lesser width than the boxes to be stacked and movable along a vertical path between a top and a bottom position, conveyor chains disposed at either side of said table above the bottom position thereof and operable to move continuously in a direction away from the table path, said chains being spaced apart by a distance larger than the width of said table but smaller than the width of the boxes to be stacked, means effective in response to descent of the table to its bottom position to reverse its movement, an arm extending adjacent said chains to a point in transverse alignment with the discharge edge of said table, means holding said bar yieldably above the level of said chains, and means effective in response to depression of said bar to disable said table reversing means.

14. In a box stacking machine of the type having a table adapted to descend along a vertical path for the accumulation of a stack of boxes thereon, a stack limiting mechanism comprising a vertical rod, means mounting said rod for rotation about its vertical axis in a manner permitting it to yield downwardly, and a plurality of camming members projecting radially from different points vertically and angularly of said rod in the plane of rotation thereof.

15. In a box stacking machine of the type having a table adapted to descend along a vertical path for the accumulation of a stack of boxes thereon, a stack limiting switch actuating mechanism comprising a vertical rod, means mounting said rod for rotation about its vertical axis in a manner permitting it to yield downwardly and laterally from a predetermined position of rest, a plurality of camming members projecting radially from different points vertically and angularly of said rod in the plane of rotation thereof and having downwardly directed vertical portions, and means yieldably maintaining said rod in a selected rotary position.

16. In a box stacking machine of the type having a table adapted to descend along a vertical path for the accumulation of a stack of boxes thereon, a stack limiting switch actuating mechanism comprising a vertical rod, means mounting said rod for rotation about its vertical axis in a manner permitting it to yield downwardly and laterally from a predetermined position of rest, a plurality of camming members projecting radially an equal distance from different points vertically and angularly of said rod in the plane of rotation thereof and having downwardly directed vertical portions terminating at the same lower level, and means yieldably maintaining said rod in a selected rotary position.

17. A box stacking machine comprising a vertically movable table, normally closed gate means adapted when in closed condition to convey a box to, and to support the box in, a position above said table, means operable by a box arriving at said position to actuate said gate to an open position to release the box for gravitation of the same onto said table, and means operable by said gate in moving to box releasing position to lower said table.

18. In a box stacking machine a table mounted for vertical movement, means for lowering the table from an upper to a lower position, opposed gates arranged at a higher elevation than said upper position of said table and

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on opposite sides of said table's path, each of said gates including a support structure and a plurality of box conveying rollers rotatably mounted thereon, said rollers being movable from a box conveying and supporting position wherein the axes of the rollers extend inward from said support structures to a box releasing position wherein the axes of the rollers extend downward, means for effecting movement of said rollers from said box conveying and supporting position to said box releasing position, control means operable by a box moving on said rollers for actuating said roller moving means, and control means operatively connected to said rollers to remain effective while the rollers occupy said box-releasing position to energize said table lowering means.

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