Dec. 10, 1963 G. E. VON GAL, JR 3,113,683

UNSTACKING MACHINE

Filed April 10, 1959 6 Sheets-Sheet 1

FIG. 1

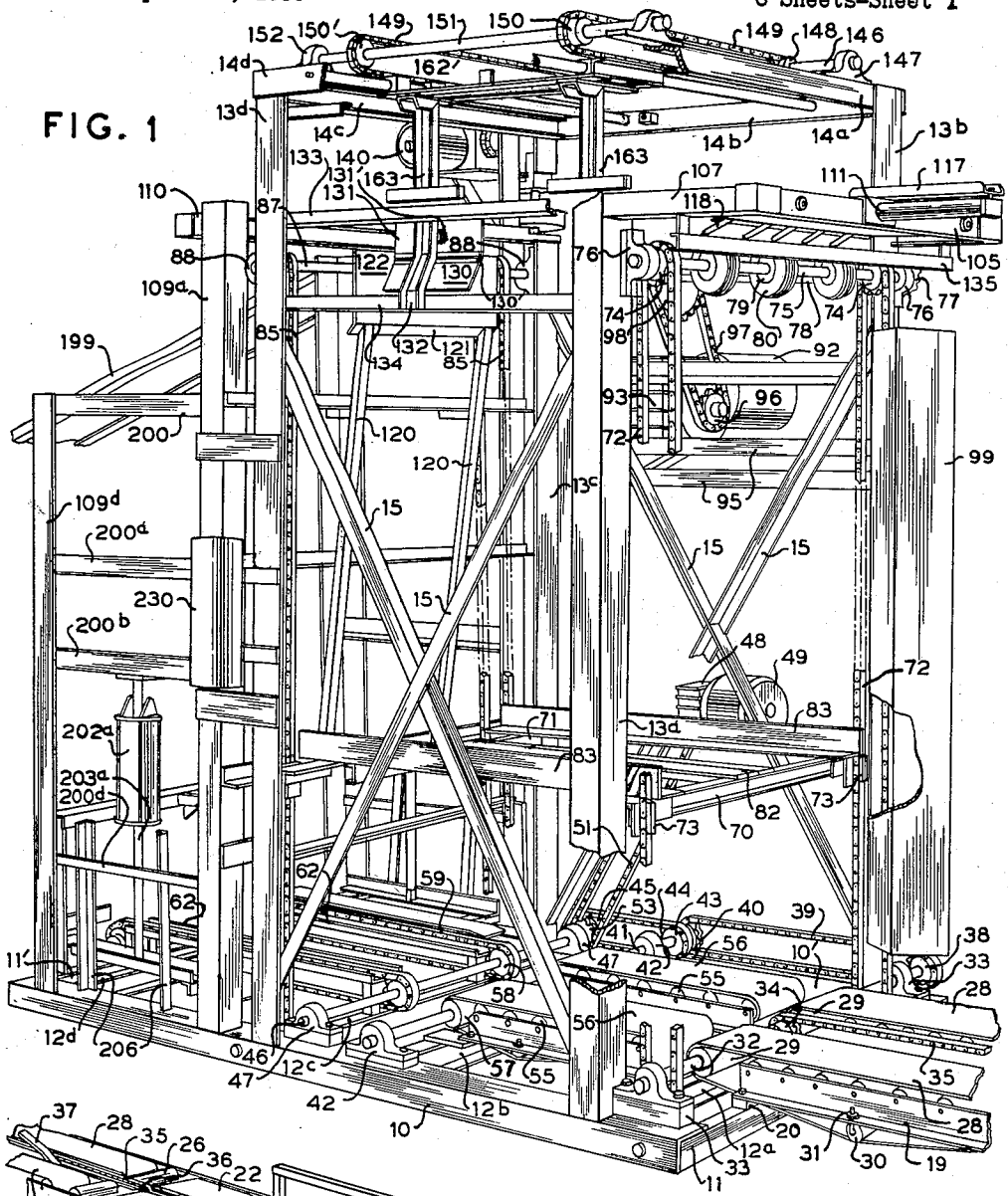
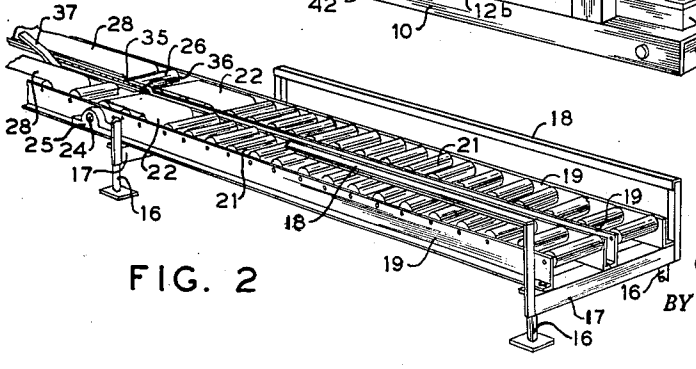


FIG. 2



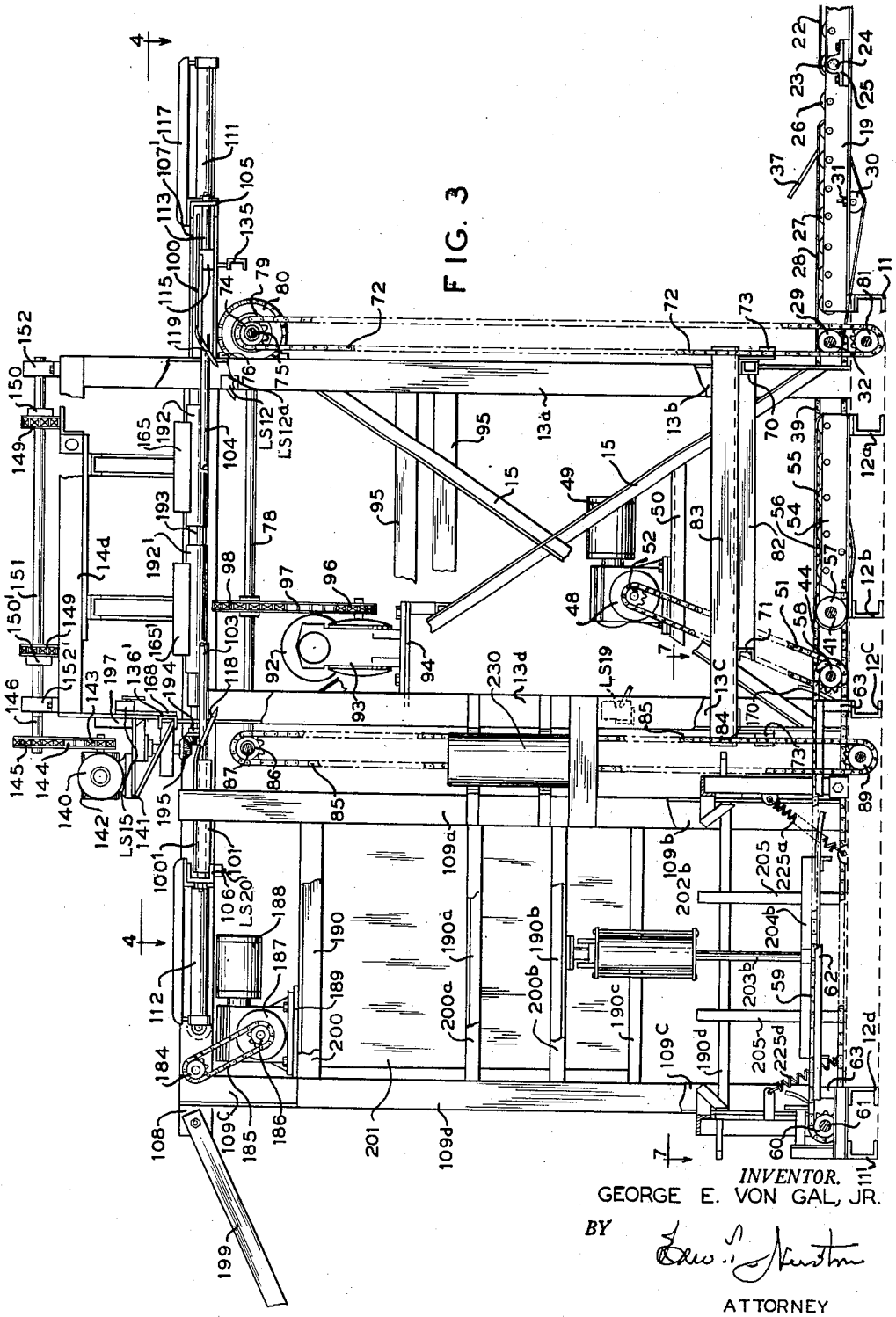
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UNSTACKING MACHINE

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FIG. 3



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UNSTACKING MACHINE

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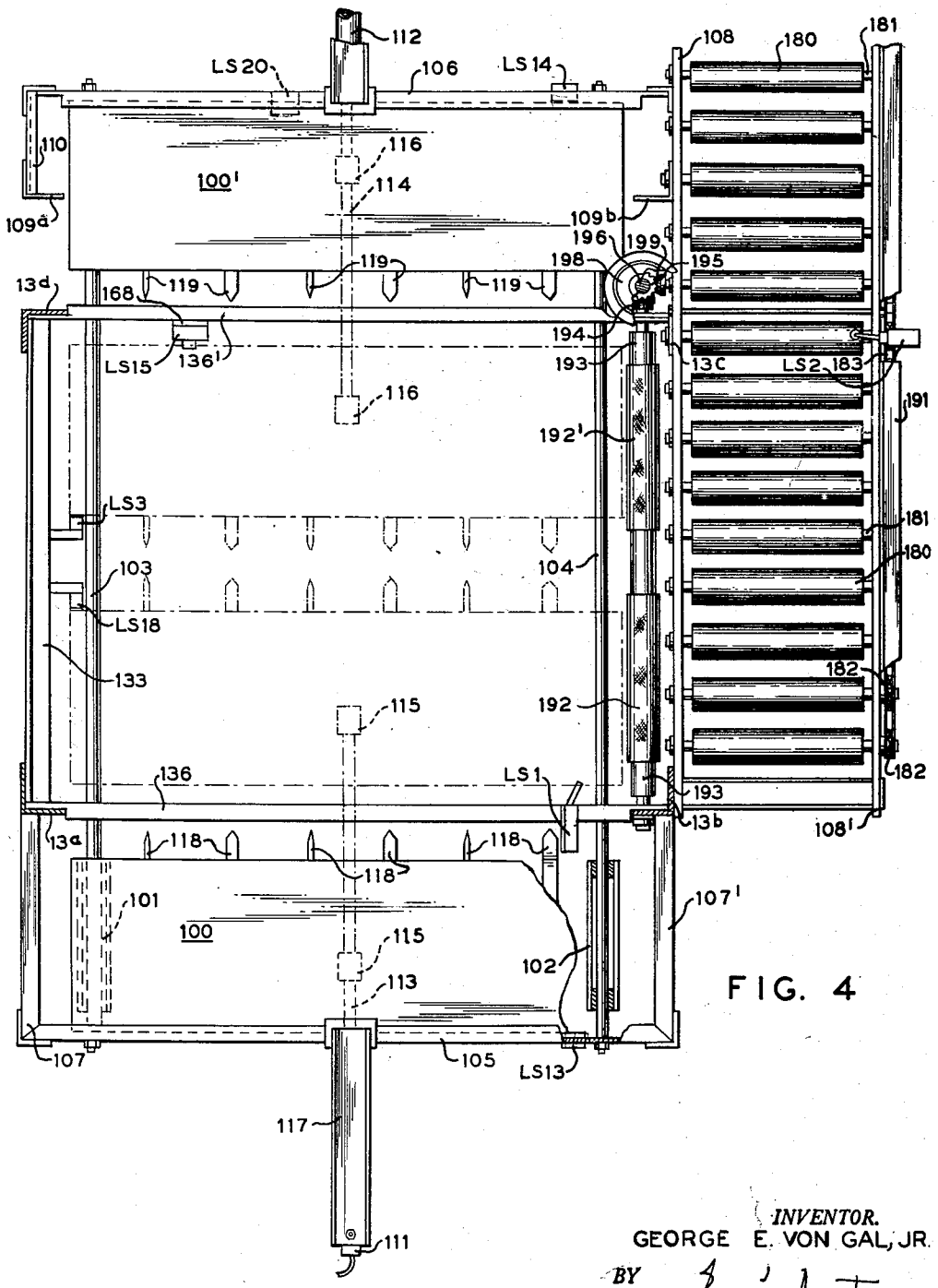


FIG. 4

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UNSTACKING MACHINE

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FIG. 5

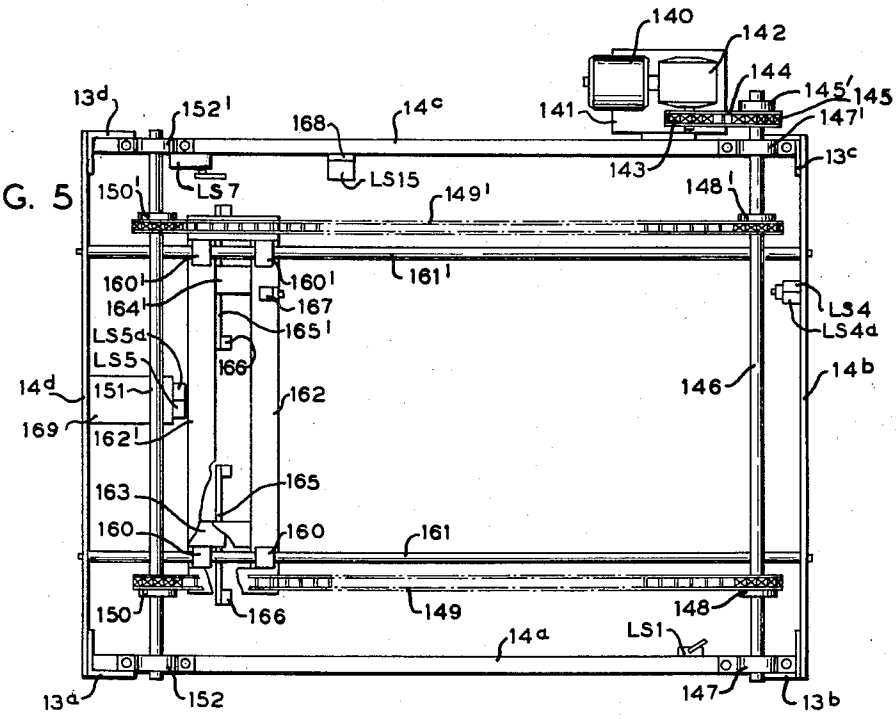
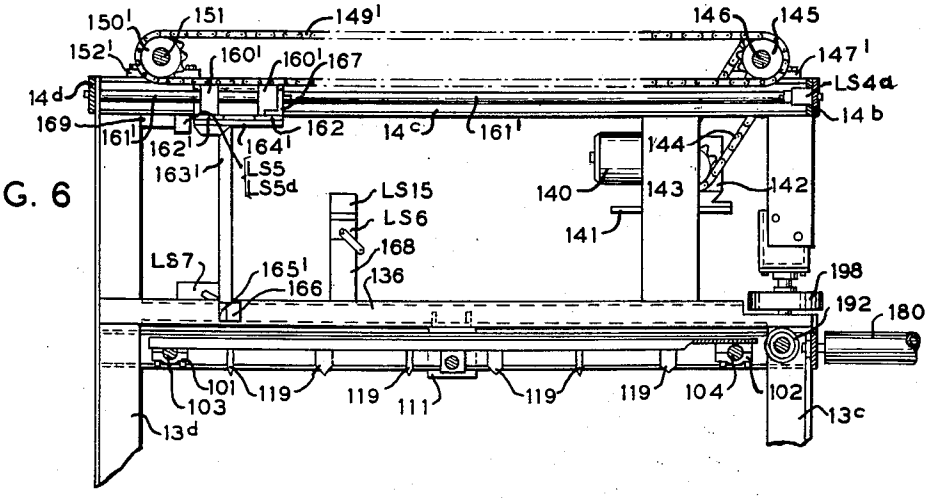


FIG. 6



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FIG. 7

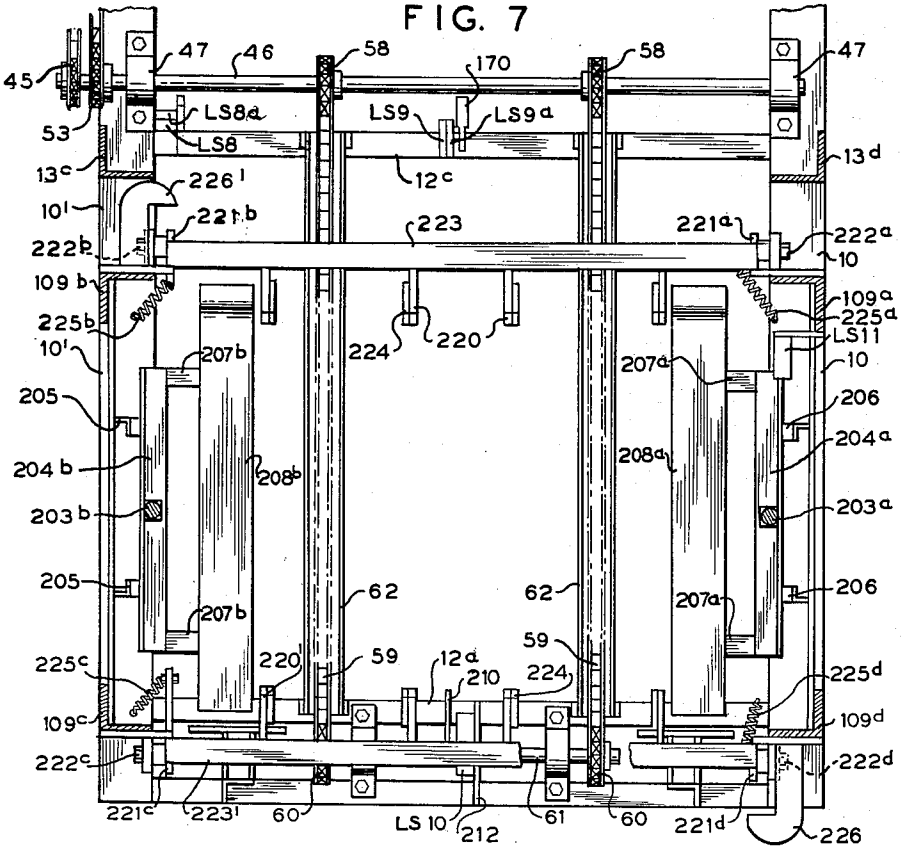
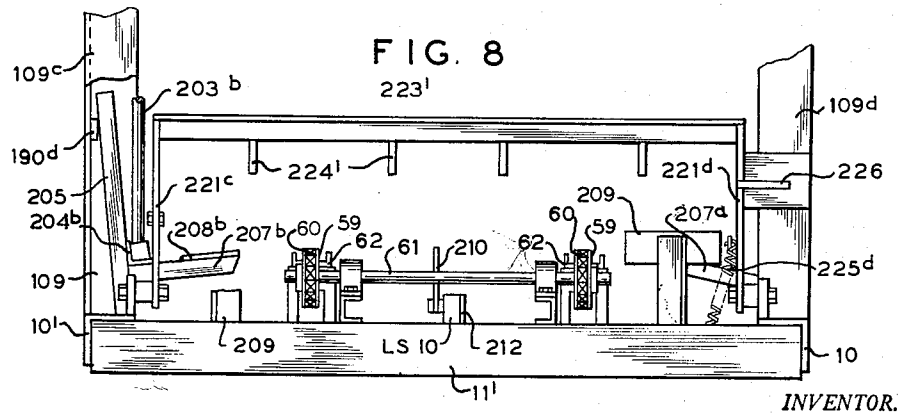


FIG. 8



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UNSTACKING MACHINE

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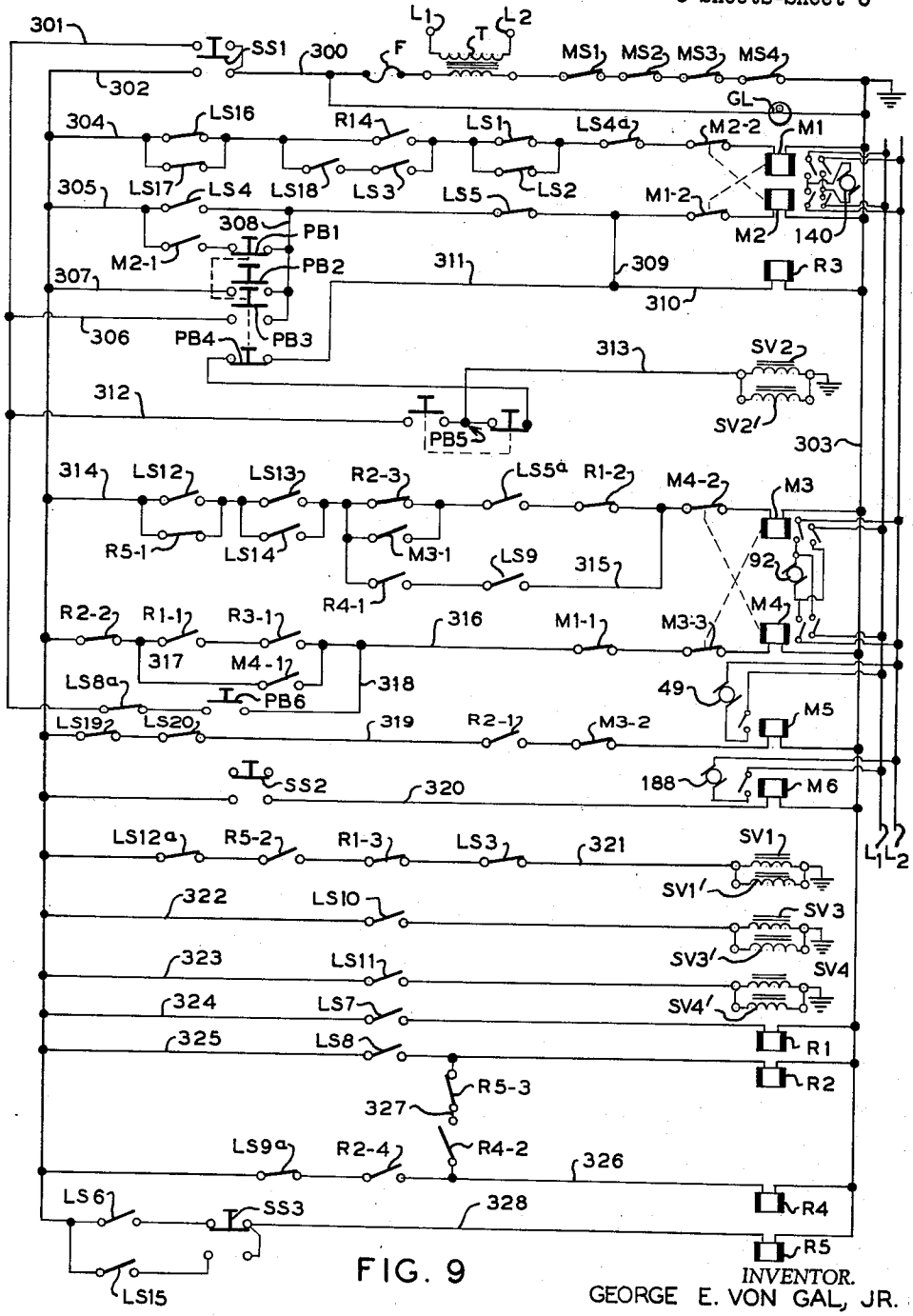


FIG. 9

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United States Patent Office 3,113,683 Patented Dec. 10, 1963

3,113,683

UNSTACKING MACHINE

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Filed Apr. 10, 1959, Ser. No. 805,412
9 Claims. (Cl. 214—8.5)

This invention relates to an unstacking machine and is more particularly concerned with a machine which will automatically and continuously receive consecutive pallets each containing a stack of articles, unload these articles, and pass the unloaded articles in single file from the machine.

This invention is a continuation-in-part of my copending application Serial No. 665,334, filed June 12, 1957, entitled "Stacking Machine."

In the past, a few devices have been proposed and built for purpose of unstacking articles. These prior art devices have usually been extremely expensive and complicated, thus precluding small manufacturers, such as local soft drink bottling plants, from utilizing the same. Further, such prior art devices are not well suited for unstacking crates of bottles and operate at such a low rate as to be impractical for high speed synchronized assembly line use.

In the bottling industries which may utilize unstacking machines, most articles, such as soft drink crates or cases, are reuseable and since such crates do not come in actual contact with the food or liquid to be consumed, they are seldom cleaned prior to being filled, except that such crates are usually inverted to dump the loose dirt and trash therefrom. Therefore, a major problem in the bottling industries is that dirt and other foreign matter from the articles being handled will become lodged in the cogs, gears or other mechanisms of a machine and thereby prevent the proper functioning of the machine or cause the machine to break down.

Briefly, in an attempt to obviate this problem in the prior art and provide an inexpensive yet efficient unstacking machine, I have devised an unstacking machine which includes an elevator adapted to receive successive pallets having bottles in crates in stacked, side by side, relationship. This elevator mechanism lifts the stack of articles in step by step fashion as the opposed slide plates of the unstacking mechanism move toward each other to, in effect, scoop the top layer of articles therefrom. When this top layer is removed by the slide plates, a ram or rake mechanism feeds these articles, still in side by side relationship, to a live conveyor mechanism where the front group of articles are actuated in a path normal to the path of movement of the ram or rake mechanism. This aligns the articles single file in succession along a conveyor, whence the articles proceed to the assembly line for such treatment as desired. As the last layer of articles is removed from the pallet on the elevator mechanism, the elevator mechanism is actuated to lower the empty pallet to its original level where this pallet is removed as a loaded pallet is transferred to take its place. The cycle is then repeated. The unloaded pallet, discharged from the elevator, travels to a magazine assembly where it is lifted into the magazine to form the lowermost pallet in a stack of pallets.

It will be readily seen that the present unstacking machine is particularly adapted for construction with and operation in conjunction with my stacking machine disclosed in application Serial No. 665,334, filed June 12, 1957, now Patent No. 3,056,513, since they are very similar machines and the stacked pallets may be transferred to the stacking machine for use in receiving crates of filled bottles.

Accordingly, it is a primary object of my invention to provide an inexpensive, durable and efficient unstacking machine which is easily manufactured, operated and maintained.

Another object of my invention is to provide an unstacking machine which is well adapted to handle articles, such as crates of empty soft drink bottles, and to unstack these crates from the pallet on which the crates are carried.

Another object of my invention is to provide an unstacking machine in which the stacks of articles to be unstacked need not be uniform in height between respective layers.

Another object of my invention is to provide an unstacking machine having relatively few moving parts to wear out or become out of adjustment.

Another object of my invention is to provide an unstacking machine which is well adapted to operate in conjunction with an assembly line to discharge articles to the assembly line at a substantially constant rate and automatically unstack a succession of pallets in automatic sequence.

Another object of my invention is to provide an unstacking machine which will operate substantially automatically and requires little attention from an operator during this operation.

Another object of my invention is to provide an unstacking machine which will occupy little floor space and which may be installed in processing plants without material alteration to the plant.

Another object of my invention is to provide an automatic stacking machine which will utilize conventional power sources such as compressed air and electricity which are found in most processing plants.

Other and further objects, features and advantages of my invention will become apparent from the following description when taken in conjunction with the accompanying drawings wherein like characters of reference designate corresponding parts throughout the several views and wherein:

FIG. 1 is a perspective view of a portion of an unstacking machine constructed in accordance with the present invention, parts thereof being broken away to disclose more clearly pertinent parts of the machine.

FIG. 2 is a fragmentary perspective view of the remaining portion of the unstacking machine of FIG. 1 and showing the infeed conveyor which feeds stacked articles on pallets to my unstacking machine.

FIG. 3 is a partially broken away side elevational view of the unstacking machine disclosed in FIG. 1.

FIG. 4 is a partially broken away horizontal sectional view taken along lines 4—4 in FIG. 3.

FIG. 5 is a plan view of a detail of my machine, showing the upper end of the unstacking frame.

FIG. 6 is a fragmentary vertical sectional view of the mechanism shown in FIG. 5.

FIG. 7 is a horizontal sectional view taken along lines 7—7 in FIG. 3.

FIG. 8 is a fragmentary end view of the mechanism shown in FIG. 7.

FIG. 9 is a wiring diagram of the electrical circuit of my unstacking machine.

Referring now in detail to the embodiment chosen for purpose of illustrating the present invention, it will be seen that the frame structure of my unstacking machine is made from a plurality of "L-beams" or "angle irons" which are welded or otherwise secured together. This frame comprises a pair of spaced longitudinal base members **10, 10'** extending along the floor of a plant and connected at their ends by transverse base members **11, 11'** to provide a rectangular base which supports the entire remaining structure. Within this base and running transversely thereof are a plurality of reinforcing ribs **12***a*, **12***b*, **12***c* and **12***d* which provide support for the various pallet infeed and discharge rollers and belts to be described hereinafter.

On the right portion of the base, as viewed in FIG. 3, and extending upwardly from longitudinal base members **10, 10'** are four spaced upstanding standards **13***a*, **13***b*, **13***c* and **13***d*, which define an elevator chute, the upper portion of which is adapted to support the slide plates and the rake or ram mechanism for unloading the stack of articles. For reinforcement, the ends of standards **13***a*, **13***b*, **13***c* and **13***d* are joined by an upper rectangular frame comprising top struts **14***a*, **14***b*, **14***c* and **14***d*.

For reinforcing the frame structure, I have provided criss-crossed straps **15** on the sides, the straps extending between standards **13***a* and **13***d* and between standards **13***b* and **13***c*, as shown in FIG. 1. This leaves an open front between standards **13***a* and **13***b*, between which the loaded pallets are fed to the elevator mechanism.

Pallet Conveying Mechanism

Along the lower portion of my unstacking machine is the pallet conveying mechanism, the purpose of which is to convey the loaded pallets to the elevator mechanism and, after the articles have been removed from the pallet, to convey the empty pallet to the magazine mechanism while at the same time feeding another loaded pallet to the elevator mechanism. To accomplish this function, I have provided an infeed conveyor, best seen in FIG. 2, which includes a plurality of stanchions **16** mounted in front of the base, which stanchions support transverse beams **17** and pallet guide rails **18**. Between the pallet guide rails **18** and on the transverse beams **17** are two pairs of opposed roller supporting girders **19** which run parallel to each other toward the base of my machine. The inner end of girders **19** are supported from transverse base member **11** by means of block **20**. Between each pair of girders **19** there are provided a plurality of parallel successive infeed rollers **21** which are inclined toward the base of my machine. Several of the transversely aligned rollers **21** at the central portion of the conveyor mechanism are provided with a pair of side-by-side feed regulating belts **22** which loop around a pair of feed regulating, belt drive rollers **23** which are carried on a common axle **24** journalled by pillow blocks **25**.

Inwardly of belts **22** are a pair of aligned idler rollers **26** and inwardly of the idler rollers **26** are a plurality of elevator feeding rollers **27**. The elevator feeding rollers **27** are provided with a pair of elevator feeding belts **28** which extend over these rollers and are driven by a pair of drive rollers **29**. The tension of belts **28** is regulated by a pair of tensioning rollers, such as roller **30**, which are mounted by means of adjustable brackets **31** on the lower side of girders **19**.

The rollers **29** are mounted beyond the inner end of girders **19**, on a common transverse shaft **32** which is supported for rotation by spaced pillow blocks **33** mounted at the ends of longitudinal base members **10, 10'**. Between the rollers **29** and on shaft **32** is a sprocket **34** driving a chain **35**, which, in turn, drives a sprocket of a clutch mechanism **36** on shaft **24**. An upwardly and inwardly projecting clutch lever **37** between the belts **28** controls the engaging and disengaging of the clutch **36** so that when the lever **37** is urged down to a position parallel to the top flights of belts **28**, the clutch **36** will be disengaged such that chain **35** will not rotate axle **24**. When lever **37**, however, is in the position shown in FIGS. 2 and 3, the clutch **36** is engaged to drive axle **24** and hence to drive through rollers **23**, the belts **22**.

As best seen in FIG. 1, the end of shaft **32** is provided with a drive sprocket **38** which is connected by means of a continuous chain **39** to a sprocket **40** on the end of elevator discharge shaft **41** supported for rotation by pillow blocks **42** on longitudinal base members **10, 10'**. The elevator discharge shaft **41** is provided with a driven sprocket **43** which is driven by means of continuous chain **44**, from a drive sprocket **45** on the end of the unloaded pallet positioning shaft **46**. Pillow blocks **47** on longitudinal base members **10, 10'** support the unloaded pallet positioning shaft **46** adjacent standards **13***c* and **13***d*.

The driving mechanism for shaft **46** includes an electric infeed conveyor motor **49** which drives a gear reducer **48** mounted on a platform **50** carried by straps **15**. A chain **51**, driven from a sprocket **52** on the gear reducer **48**, drives a sprocket **53** on shaft **46**. Thus it is seen that upon rotation of motor **49**, shafts **46**, **41** and **32**, respectively, will be rotated synchronously and in the event lever **37** is up, as shown in FIG. 2, axle **24** will also be rotated in synchronization with shafts **46**, **41** and **32**, all being powered from motor **49** by the train of gears, sprockets and chains previously described.

Between shafts **32** and **41** are two pairs of girders **54** which are aligned with girders **19** and are entirely within the space defined by standards **13***a*, **13***b*, **13***c* and **13***d*, being supported by their ends from ribs **12***a* and **12***b*, as best seen in FIG. 3. Between each pair of girders **54** are a plurality of parallel rollers **55** around which are disposed the elevator discharge belts **56**, the top flights of which are in alignment with elevator feeding belts **28**. The rear extreme of belts **56** loop around drive rollers **57** on shaft **41** and thus the belts **56** are driven in synchronization with belts **28**.

The present embodiment of my machine is particularly adapted to discharge from pallets, layers consisting of six crates of bottles, the crates being arranged two crates wide and three crates deep, the two crate rows being end to end. The pallets are fed to the infeed conveyor with the three crate row forward so that when received in the frame of my machine there are three crates between the straps **15** and two crates between the front and back of the elevator chute.

The purpose of the two lines of infeed rollers **21** is to facilitate alignment of the pallet by the guide rails **18**. The purpose of the spacing between belts **28** is to provide room for the clutch lever **37**. The purpose of the spacing between the belts **28** and **56**, between respective belts **56** and between belts **28** and shaft **46** is to provide sufficient space to permit the various members of the elevator to be described hereinafter, to be positioned below the top flights of belts **56** for receiving and discharging pallets.

The mechanism for feeding the unloaded pallets from the elevator chute to the magazine chute, where each successive pallet becomes the lowermost pallet of the stack, includes a pair of spaced sprockets **58** fixed to shaft **46** and aligned respectively with belts **56**. A pair of spaced pallet positioning chains **59** extend around these sprockets **58** and around sprockets **60** on an idler shaft **61**, shaft **61** being arranged above transverse base member **11'**. The top flights of chain **59** are slidably carried in channel members **62** appropriately supported by blocks **63** from ribs **12***c* and **12***d*.

Centrally of the base and projecting upwardly within the rear part of the bottom portion of the elevator chute is the lever 170 of limit switches LS9, LS9*a*. Adjacent switch LS9, LS9*a* is switch LS8.

Elevator Mechanism

For lifting each loaded pallet in step-by-step fashion so that the layer removing mechanism to be described hereinafter may remove the topmost layer of crates, I have provided an elevator frame comprising a pair of spaced parallel transversely extending channel members 70 and 71. The channel member 70 rides between the inner surfaces of standards 13*a* and 13*b* and inwardly of its ends, channel member 70 is fixed to a pair of vertical front elevator chains 72 by means of connector plates 73.

The chains 72 are looped around spaced sprockets 74 which are fixed on shaft 75, the shaft being supported for rotation by pillow blocks 76 fixed to the upper portion of standards 13*a* and 13*b*. The end of shaft 75 is provided with a beveled gear 77 which meshes with a complementary beveled gear (not shown) connected to the end of a power transmission shaft 78, appropriately supported between standards 13*b* and 13*c*. As best seen in FIGS. 1 and 3, a plurality of alignment wheels 79 are provided between sprockets 74 on shaft 75. These alignment wheels 79 are provided with yieldable pneumatic tires 80 around their peripheries. The lower portion of chains 72 loop around idler sprockets, such as sprocket 81, seen in FIG. 3, so that the inner flights of chains 72 remain adjacent and in a parallel veritcal plane with respect to the elevator chute.

Returning now to the elevator platform or frame, between the central portions of the channel members 70 and 71 is a central rib 82 which spaces the channel members 70 and 71 apart sufficiently that when the elevator frame is in its lowermost position, the channel member 70 passes between belts 28 and belts 56 and the channel member 71 passes between belts 56 and chains 59 so as to be below the upper flights of these belts and chains, the rib 82 resting between the inner girders 54.

Guide brackets 83 formed from angle irons extend longitudinally between the channel members 70 and 71, these brackets 83 projecting beyond the rear channel member 71 to terminate adjacent standards 13*c* and 13*d* respectively. Connectors 84 join the guide brackets 83 to the rear vertical elevator chains 85 so that at all times the elevator frame is in a horizontal position. Chains 85 loop around upper sprockets 86 which are fixed to shaft 87, supported for rotation by pillow blocks 88 on standards 13*c* and 13*d*. The end of shaft 87 is provided with a beveled gear (not shown) which meshes with a beveled gear (not shown) on the end of shaft 78. Thus, shafts 75 and 87 rotate together in opposite directions upon rotation of shaft 78. The lower portion of chains 85 loop around idler sprockets, such as idler sprocket 89 as shown in FIG. 3.

To actuate the elevator mechanism, I have provided an elevator motor 92 having a gear reducer 93 on a platform 94 supported by straps 95 between standards 13*b* and 13*c*. A sprocket 96 driven from gear reducer 93 drives through chain 97 a sprocket 98 on drive shaft 78. Thus, upon rotation of motor 92 in one direction, the elevator frame will be lifted by chains 72 and 85 and upon rotation of motor 92 in the other direction, the elevator frame will be lowered.

To guide the cases on each incoming pallet between standards 13*a* and 13*b*, I have provided guards 99 which are secured to standards 13*a* and 13*b*. These guards 99 are formed of long flat sheets of metal which extend forwardly then outwardly around the inner and front sides of chains 72.

Top Layer Removing Mechanism

For removing the top layer of crates, I have provided a top layer removing mechanism at the upper portion of

standards 13*a*, 13*b*, 13*c* and 13*d*, this mechanism being best seen in FIGS. 4, 5 and 6. The function of the top layer removing mechanism is to scoop the top layer of crates by means of the tines from the layers therebelow and support this layer in its assembled fashion on plates so that the rake mechanism urges the layer from the plates to a live conveyor whence the forward crates are urged in a path normal to the path of travel of the rams or rakes. To accomplish this function, I have provided a pair of opposed rectangular slide plates 100 and 100′ which are movable toward and away from each other in a horizontal plane in the upper part of the frame structure. Each of the plates 100 and 100′ is provided with a pair of parallel sleeves 101 and 102 secured to the lower surface thereof, so as to be aligned longitudinally with their complementary sleeves. A pair of spaced parallel longitudinally extending rods 103 and 104 which pass adjacent standards 13*d* and 13*a* and adjacent standards 13*c* and 13*b*, respectively, receive the sleeves 101 and 102. These rods 103 and 104 are fixed at their ends, outwardly of the elevator chute, to transverse rod supporting struts 105 and 106. The forward strut 105 is, in turn, supported by its ends, by means of a pair of spaced brackets 107, 107′ projecting forwardly from the standards 13*a* and 13*b*. Thus is formed a U-shaped plate supporting frame, the brackets 107 and 107′ which are of sufficient length that the forward plate 100 may be retracted along rods 103 and 104 to lie completely outside the chute formed by standards 13*a*, 13*b*, 13*c* and 13*d*.

At the rear of my machine, as viewed in FIG. 4, the rear strut 106 is supported in spaced relationship to the elevator frame by a discharge roller supporting girder 108 to which one end of strut 106 is connected and a standard 109*a* of the pallet magazine, there being a short bracket 110 extending from the standard 109*a* to the end of strut 106.

It is now seen that both slide plates 100 and 100′ are slidably supported in a horizontal plane for movement toward and away from each other. As viewed in FIG. 4, the solid line representation indicates the plates 100 and 100′ in the open position and the broken line representation indicates the plates 100 and 100′ in the closed position.

For moving plates 100 and 100′ from the opened to the closed position, I have provided a pair of double acting air cylinders 111 and 112 connected respectively to the struts 105 and 106. The cylinders 111 and 112 are provided with the usual pistons (not shown) from which project piston rods 113 and 114, the rods being secured to the bottom surfaces of plates 100 and 100′ by blocks 115 and 116 so that when air acts against the outer surfaces of the pistons (not shown), the plates 100 and 100′ will be urged to their closed position and when air acts upon the inner surface of these pistons, the plates 100 and 100′ will be urged to their open position. As is seen in FIGS. 3 and 4, the cylinder 111 is supported by a brace 117 extending from strut 105.

The valves of air cylinders 111 and 112 are operated by solenoids SV1, SV1′ and SV2, SV2′; the solenoids SV1, SV1′ being for operating the valves to admit air to both cylinders 111, 112 for opening slide plates 100, 100′ and the solenoids SV2, SV2′ being for operating the valves to admit air to both cylinders 111, 112 for closing the slide plates 100, 100′.

Along the inner edges of the plates 100 and 100′ are respectively a plurality of opposed and aligned, inwardly and downwardly projecting tines 118 and 119, the points of which are in close proximity when the slide plates 100 and 100′ are in their closed position. The spaces between adjacent tines 118 and 119 are such that upon closing of slide plates 100 and 100′, the tines 118 and 119 will pass between adjacent bottles in the crates of the second uppermost layer of crates, as will be described more fully hereinafter.

For acting in conjunction with the tires 80 in urging the upper layer of crates into a compact group, the sides

of the crates abutting each other, I have provided along the rear portion of the elevator chute, upwardly and inwardly inclined guide struts 120, 120' terminating opposite tires 80 with a guide plate member having an inclined section 121 and a vertical section 122.

In the same horizontal plane with the tires 80 and the guide plate member are additional opposed complementary guide plate members at the opposite sides of the elevator chute. The construction of each of the opposed guide plate member is identical and hence only one is illustrated in FIG. 1. This guide plate member includes a vertical plate section 131 which is supported inwardly of the plane of standards 13*a* and 13*d* by a coiled spring 131'. A strap 132 located centrally between two parallel horizontal beams 133 and 134 extending between standards 13*a* and 13*d* supports spring 131'. Connected from the bottom edge of plate 131 by a piano hinge 130' is an inclined plate which is normally inclined slightly downwardly and outwardly. The complementary guide members urge each layer of crates transversely into a compact layer as the layer is raised therebetween by the elevator.

The channel 135 illustrated in the drawings is for the purpose of supporting appropriate electrical cables and air conduits which are not illustrated.

Mounted slightly above the plane of slide plates 100 and 100' at the front and rear of the elevator chute are the alignment bars 136 and 136' extending respectively between standards 13*a* and 13*b* and between standards 13*c* and 13*d*. The purpose of the alignment bars 136 and 136' is to retain a layer of crates on the slide plates 100 and 100' within the confines of the elevator chute.

Ram Mechanism

Above the slide plates 100 and 100' is a ram mechanism, the function of which is to urge the layer of crates on the slide plates 100 and 100' from the chute defined by standards 13*a*, 13*b*, 13*c* and 13*d* to the discharge conveyor. This ram mechanism is best seen in FIGS. 5 and 6.

In more detail, the ram mechanism includes a reversible rake motor 140 which drives a gear reducer 142 mounted on platform 141. The gear reducer 142, in turn, drives by means of sprocket 143 a continuous chain 144 arranged over a sprocket 145 driving through slip clutch 145' a power shaft 146.

Power shaft 146 is journalled for rotation by a pair of spaced pillow blocks 147 and 147' mounted respectively on top struts 14*a* and 14*c* above standards 13*b* and 13*c*. Between the pillow blocks 147 and 147' fixed on shaft 146 are a pair of spaced sprockets 148 and 148' which are provided with continuous chains 149 and 149' driving sprockets 150 and 150' on an idler shaft 151 carried by pillow blocks 152 and 152'. The pillow blocks 152, 152' are mounted at the opposite ends of top struts 14*a* and 14*c* from pillow blocks 147 and 147' so that the chains 149 and 149' extend across the upper end of the elevator chute.

The rake supporting structure comprises a pair of slide blocks 160 and 160' connected respectively to chains 149 and 149'. The slide blocks 160 and 160' are slidably carried by a pair of transverse rods 161 and 161' which respectively lie beneath and parallel to the lower flights of chains 149 and 149', the transverse rods 161 and 161' being supported by their ends by top struts 14*b* and 14*d*. Extending between the slide blocks 160 and 160' is a traveler frame having travelers 162, 162'. A pair of spaced rake arms 163, 163' are suspended from spaced tie rods 164 and 164' fixed to the travelers 162 and 162', the rake arms 163 and 163' extending down therefrom to terminate above the plane of slide plates 100 and 100' so as to be respectively on about a transverse center line of plates 100 and 100' when the plates 100 and 100' are closed. At the ends of rake arms 163 and 163' the rakes 165 and 165' extend longitudinally of the machine across the closed slide plates 100 and 100' so as to engage the side of crates of bottles on the slide plates 100 and 100'. Usually the rakes 165 and 165' are slightly less wide than a crate of bottles so that the spaced pair of pusher fingers 166 on each of the rakes 165 and 165' will engage the crate at one side thereof and adjacent the corners of the crate to thereby compensate for irregularities in the surface of the side of the crate and affording an even push.

Mounted on the top of the front traveler 162 is a switch engaging lug 167 which, when the rake assembly traverses the slide plates 100 and 100', engages switches LS4, LS4*a* mounted, as shown in FIGS. 5 and 6, on the inside of top strut 14*b*. The switch LS4 is electrically connected to the motor 140 for reversing the same, as will be pointed out hereinafter. Mounted on alignment bar 136, adjacent standard 13*b* is switch LS1 for detecting the presence of the crates on the slide plates 100, 100'.

Discharge Conveyor

The purpose of the discharge conveyor is to receive successive pairs of crates urged by the rake mechanism from the slide plates 100 and 100' and to feed these crated longitudinally in single file out of my machine.

As best seen in FIG. 4, the discharge rollers 180 are carried by axles 181 which are journalled by roller supporting girder 108 and a second roller supporting girder 108' outwardly and parallel to girder 108. Each of rollers 180 is a live roller, being actuated by sprockets 182 on the outer ends of axles 181. The sprockets 182 are driven by a continuous chain 183 looped around the outermost sprockets 182 so that the top flight of chain 183 engages all sprockets 182.

As seen in FIG. 3, the endmost axle 181 protrudes beyond girder 108 and is provided with a second sprocket 184 which is driven by chain 185 from sprocket 186 on gear reducer 187. The discharge motor 188 actuates gear reducer 187, the gear reducer being mounted on platform 189 on a longitudinally extending reinforcing runner 190 which extends between standards 109*b* and 109*c* of the magazine chute.

A suitable cover 191 may be provided over chain 183 and sprockets 182.

As best seen in FIGS. 3 and 4, a pair of coaxially aligned discharge rollers 192 and 192' are provided between the side edges of the closed slide plates 100 and 100' respectively and the girder 108. These rollers 192 and 192' are fixed on a longitudinally extending drive shaft 193 journalled by standards 13*b* and 13*c*. The peripheries of rollers 192 and 192' have a rough surface, such as splined rubber, the upper extremities of which are slightly above the plane of the slide plates 100 and 100' and rollers 180 so that as the crates are urged outwardly onto the discharge rollers 180, the crates will ride over the upper peripheries of rollers 192 and 192' and will thereby be fed at an accelerated rate to the discharge rollers 108. The end of shaft 193 is provided with a beveled gear 194 meshing with a beveled gear 195 on a vertically disposed shaft 196. The shaft 196 is journalled by a bracket 197 in a cut away portion of standard 13*c*. Fixed on shaft 196 is a wheel 198 having a rubber periphery protruding inwardly beyond the end of alignment bar 136', and outwardly over a portion of rollers 180, so as to contact the rearmost side of the crates as they are discharged by the rake mechanism and a side of each crate as it is discharged by rollers 180. It is now seen that the wheel 198 and rollers 192, 192' are so geared together as to rotate in unison, each acting against a portion of the crates being discharged onto rollers 180.

In FIG. 4 it will be seen that wheel 198 and rollers 192, 192' are driven at a higher peripheral speed than the speed of travel of rakes 165, 165' by means of a bevel gear 199 on the end of one of shafts 181, the bevel gear 199 meshing with bevel gear 195. About opposite wheel

198 is switch LS2 which indicates when the discharge conveyor is free to receive additional crates.

At the end of girders 108 and 108' is an inclined discharge ramp denoted generally by numeral 199. The single file crates are fed by rollers 180 to this ramp which feeds the crates from my machine.

Pallet Stacking Mechanism

At the rear of my machine is a pallet stacking magazine mechanism, the function of which is to receive and store the unloaded pallets discharged from the elevator frame. To accomplish this function, I have provided a vertical pallet magazine parallel to and spaced from the elevator chute. This pallet magazine is defined by four upright standards 109*a*, 109*b*, 109*c* and 109*d*, the standards 109*c* and 109*d* being at the rear corners of the base and standards 109*a* and 109*b* being adjacent standards 13*d* and 13*c* on longitudinal base members 10 and 10'. The standard 109*d* is shorter than the other standards.

Below the reinforcing runner 190 there are a plurality of additional parallel reinforcing runners, including runner 190*a*, 190*b*, 190*c* and 190*d* spaced parallel one below the other between an intermediate portion of standard 109*a* and the upper end of standard 109*d*. Reinforcing runners 200*a*, 200*b* and 200*d* extend between standards 109*a* and 109*d* and are parallel to the reinforcing runners of standards 109*b* and 109*c*. Mounted outwardly to the runners 190 and 190*c* is a panel 201 which projects from the frame structure and contains the electrical equipment such as relays and the like.

Depending from the central portions of runners 190*b* and 200*b* respectively are a pair of air cylinders 202*a* and 202*b* which contain the usual pistons for actuating the downwardly projecting piston rods 203*a* and 203*b*. Carried by the lower ends of these piston rods 203*a* and 203*b* are a pair of opposed horizontal lift beams 204*a* and 204*b* which slide along the inner surfaces of upstanding slide bars 205 and 206, the slide bars 206 extending from longitudinal base member 10 upwardly and outwardly in spaced parallel relationship and being supported at intermediate points by runner 200*d*. Similarly, slide bars 205 are carried by longitudinal base member 10 and runner 190*d* and extend upwardly and outwardly.

As best seen in FIG. 7 and 8, lift arms 207*a* and 207*b* project inwardly and slightly upwardly from lift beams 204*a* and 204*b*, respectively. The ends of these lift arms 207*a* and 207*b* carry the lift plates 208*a* and 208*b*, best seen in FIG. 7. The lift plates 208*a*, 208*b* are arranged in about a horizontal plane normally below the plane of the upper flights of chains 59 and spaced apart sufficiently that the edges of a pallet carried by chains 59 into the pallet magazine will overlie plates 208*a* and 208*b*. Thus, upon the simultaneous actuation of cylinders 202*a* and 202*b*, and the resulting upward movement of rods 203*a* and 203*b*, the plates 208*a* and 208*b* will lift the pallet from chains 59 upwardly by a distance equal to the distance of travel of rods 203*a* and 203*b*.

On transverse base member 11' are a pair of stop members denoted generally by numeral 209 which stand above the plane of the upper flights of chain 59 and limit the inward movement of a pallet carried on chains 59. Immediately ahead of the stop members 209 in the path of travel of the pallet is a switch arm 210 which actuates a swtich LS10 on a cross member 212 centrally between base member 11' and rib 12*d*. The purpose of switch LS10 is to actuate the air cylinders 202*a* and 202*b*. The valves of air cylinders 202*a*, 202*b* are provided with solenoids SV3, SV3' and SV4, SV4'. Solenoids SV3, SV3' position the valves for retracting piston rods 203*a*, 203*b* and solenoids SV4, SV4' position the valves for extending piston rods 203*a*, 203*b*.

For supporting the stack of pallets to be stacked in the pallet magazine, I have provided a pallet engaging mechanism having fingers 220 and 220' which project between the upper and lower boards of the lowermost pallet, the fingers 220 and 220' being adapted to be urged outwardly as each additional pallet is thrust upwardly and thereafter to spring inwardly beneath the edges of that additional pallet. The pallet engaging mechanism, as best seen in FIGS. 7 and 8, includes pairs of opposed rocker arms 221*a*, 221*b*, 221*c* and 221*d* pivotally mounted by pivot pins 222*a*, 222*b*, 222*c* and 222*d* to the lower portion of standards 109*a*, 109*b*, 109*c* and 109*d* respectively. These rocker arms project upwardly, outwardly adjacent standards 109*c* and 109*d*, the upper ends of rocker arms 221*a* and 221*b* being joined by a finger carrying bar 223 and the upper ends of rocker arms 221*c* and 221*d* being joined by finger carrying bar 223'. The fingers 220 and 220' project horizontally inwardly from bars 223 and 223' respectively, terminating within the pallet magazine. Angling downwardly and outwardly from the ends of fingers 220 and 220' respectively are the camming bars 224 and 224' against which the front and back edges of the pallet, as it is lifted by plates 208*a* and 208*b*, act to pivot the pallet engaging mechanism outwardly.

Springs 225*a*, 225*b*, 225*c* and 225*d* connected respectively from intermediate portions of rocker arms 221*a*, 221*b*, 221*c* and 221*d* to the base members 10 and 10' resiliently resist outward movement and urge the rocker arms inwardly; the inward movement of the rocker arms, however, is limited by standards 109*a*, 109*b*, 109*c* and 109*d*. The outward movement of the rocker arms is limited by the diagonally opposed hook members 226 and 226' which are supported by standards 109*b* and 109*d* and pass outwardly and behind rocker arms 221*b* and 221*d*.

As best seen in FIGS. 1 and 2, an accumulator tank 230 is provided to supply fluid, preferably air under pressure, to the various pneumatic cylinders such as cylinders 111, 112 and cylinders 202*a* and 202*b*. The tubing to and from the accumulator tank is not shown for purpose of clarity. It will be understood, however, that cylinders 111 and 112 are double acting and that appropriate electrically controlled valves regulate the actuation of the piston of these cylinders. The cylinders 202*a* and 202*b* may have single acting, spring return pistons since positive actuation of piston rods 203*a* and 203*b* is not required. Appropriate electrical valves control the flow of fluid from the accumulator tank 230 to the cylinders 202*a* and 202*b*.

Electrical Circuits

In FIG. 9 the wiring diagram of the present invention is illustrated. Here, line current either 110 volts or 220 volts is supplied from lines L_1, L_2 to motors 140, 92, 49 and 188, relays M1 and M2 controlling motor 140, relays M3 and M4 controlling motor 92, relay M5 controlling motor 49 and relay M6 controlling motor 188. Line current is also supplied to transformer T where it is converted to 12 volts, one lead from the secondary coil of transformer T being grounded through several series connected normally closed switches MS1, MS2, MS3 and MS4. Switches MS1, MS2, MS3 and MS4 are motor heater circuit breakers connected respectively to motors 140, 92, 49 and 188. From the hot side of the transformer T, conductor 300 leads through fuse F to a three position main switch SS1 which is adapted to throw current selectively to auxiliary bus 301 or main bus 302 or to be positioned in the off position, as shown in FIG. 9.

Incidental to the circuit is a glow light GL which leads from conductor 300 to the ground bus 303 which thence leads to ground. With current being supplied through transformer T and provided switches MS1, MS2, MS3 and MS4 are closed and the fuse F is good, glow light GL will light indicating power to the electrical system.

Between buses 302 and 303 are the "rake forward" controls consisting of wire 304 leading from bus 302 through switches LS16 and LS17 in parallel and thence through switches R1–4, LS1, LS4*a* and M2–2 in series, through relay M1 to ground bus 303. Switch R1–4 is normally open and the other switches in series therewith

are normally closed. Switch LS3 and LS18, in series with each other, are in parallel with switch R1–4 and switch LS2 is an parallel with switch LS1. When a circuit is made to relay M1, motor 140 rotates in a direction to drive the rakes 165, 165' across the elevator chute.

Below wire 304 in FIG. 9 are the "rake return" controls, comprising wire 305 which supplies current from bus 302 through switches LS4, LS5 and M1–2 to relay M2 and thence to ground bus 303. Switches LS5 and M1–2 are normally closed and switch LS4 is normally open. In series with each other are a normally open switch M2–1 and a normally closed switch PB1 which are in parallel with switch LS4.

For independent return of the rake, switches PB1, PB2 and PB3 are provided. Switches PB1 and PB3 operate together so that when switch PB1 is closed, switch PB3 is open and vice versa. Wires 306 and 307 lead from buses 301 and 302 respectively to switches PB3 and PB2 and from switches PB2 and PB3 wire 308 leads to wire 305 between switch LS4 and LS5.

A cross connect wire 309 leading from wire 305 between switches LS5 and M1–2 and is connected to wires 310 and 311, wire 310 leading through relay R3 to ground bus 303. Wire 311 is connected through normally closed switch PB4 to one external terminal of a selector switch PB5, the other external terminal of which is connected through wire 312 to bus 301. The central terminal of switch PB5 is connected via wire 313 through parallel connected valve control solenoids SV2 and SV2' to ground. Solenoids SV2 and SV2' control the actuation of air cylinders 201 and 202 respectively.

Switch PB4 is normally closed and is operated in conjunction with switches PB1 and PB3 so that switch PB4 is closed when switch PB1 is closed and switch PB3 is opened; conversely switch PB3 is closed and switch PB1 is open.

The next two circuit include the "elevator up" controls and the "elevator down" controls. In the elevator up circuit, wire 314 leads from bus 302 through a pair of parallel switches LS12 and R5–1, through a pair of parallel switches LS13 and LS14, through a pair of parallel switches R2–3 and M3–1 to switch LS5*a*. Switch LS5*a* is connected in series through switches R1–2 and M4–2, and through relay M3 to ground. Switches LS12, LS13, LS14, M3–1 and LS5*a* are normally open and switches R5–1, R2–3, R1–2 and M4–2 are normally closed. Jumping the switches R2–3, M3–1, LS5*a* and R1–2 is a bypass wire 315 which has series connected normally open switches R4–1 and LS9.

The elevator down circuit includes wire 316 connected through relay M4 from bus 302 to bus 303. Switches R2–2, R1–1, R3–1, M1–1 and M3–3 are in series along wire 316. Switches R2–2, M1–1 and M3–3 are normally closed and switches R1–1 and R3–1 are normally open. Jumping switches R1–1 and R3–1 is a wire 317 having therein a normally opened switch M4–1. Leading from wire 301 and connecting to wire 316 between switches M1–1 and the other switches of that circuit is wire 318 having two series connected switches LS8*a* and PB6. Switch LS8*a* is normally closed and switch PB6 is normally opened. Relays M3 and M4 are connected to motor 92. When relay M3 is energized, current is supplied to actuate motor 92 to raise the elevator and when relay M4 is energized current is supplied to motor 92 to lower the elevator.

The next circuit includes the "infeed conveyor" thereof. Relay M5 thereof actuates motor 49 which is adapted to rotate in only one direction. A wire 319 leads from bus 302 to ground bus 303, through relay M5, the wire 319 having in series therein switches LS19, LS20, R2–1 and M3–2. Switches LS19, LS20 and M3–2 are normally closed and switch R2–1 is normally opened.

In the next circuit are the "discharge conveyor" controls. Motor 188 is controlled by relay M6 which is connected by wire 320 between buses 302 and 303, the wire 320 having therein an on-off push button switch SS2.

In the next circuit are the "slide plate closed" controls, including wire 321 which connects solenoids SV1, SV1' to bus 302 through series connected switches LS12, R5–2, R1–3 and LS3. Switches LS12, R1–3 and LS3 are normally closed and switch R5–2 is normally open. Solenoids SV1 and SV1' operate the valves of air cylinders 111, 112 for opening slide plates 100, 100'.

In the circuit of wire 322 are the "pallet up" controls, wherein normally opened switch LS10 and solenoids SV3, SV3' are connected in series between bus 302 and ground. As pointed out above, solenoids SV3, SV3', when energized, actuate the valves of air cylinders 202*a*, 202*b* to cause retraction of piston rods 203*a*, 203*b*. To return the retracted piston rods 203*a*, 203*b*, solenoids SV4 and SV4' are provided in connection with the valves of air cylinders 202*a* and 202*b*. Solenoids SV4 and SV4' are connected between bus 302 and ground by wire 323, having normally opened switch LS11 in series therein. Several relays are provided in any event. The coil of relay R1 is energized by the closing of normally open switch LS7 which supplies, via wire 324, current from bus 302 through relay R1 to ground bus 303. Relay R1 controls switches R1–1, R1–2, R1–3 and R1–4.

The coil of relay R2 is energized by the closing of switch LS8, connected in series with relay R2 by wire 325 leading from bus 302 to bus 303. Relay R2 controls switches R2–1, R2–2, R2–3 and R2–4.

The coil of relay R4 is connected through wire 326 between buses 302 and 303, having series connected switches LS9 and R2–4 therein. Switch LS9 is normally closed and switch R2–4 is normally opened. Between wires 325 and 326 is a cross-connect wire 327 having series switches R5–3 and R4–2. Wire 327 connects to wire 325 between switch LS8 and relay R2 and connects to wire 326 between R2–4 and relay R4. Switch R5–3 is normally closed and switch R4–2 is normally opened.

Relay R5 is connected by wire 328 to a selector switch SS3 which is adapted to selectively connect relay R5 between buses 302 and 303 through switches LS6 and LS15 respectively.

Relay R4 controls switches R4–1 and R4–2; relay R5 controls switches R5–1, R5–2 and R5–3.

Referring again to the relays R3, M1, M2, M3 and M4, it will be understood that relay R3 controls switch R3–1; relay M1 controls switches M1–1 and M1–2; relay M2 controls switches M2–1 and M2–2; relay M3 controls switches M3–1, M3–2 and M3–3; and relay M4 controls switches M4–1 and M4–2.

It will also be understood that the term "LS" applied to the various switches means limit switch; the term "SS" means selector switch and the term "R" refers to relays, while the term "M" refers to motor control relays.

Limit Switch Location

In the drawings it will be seen that switch LS1 is positioned on alignment bar 136' to detect the presence of crates on the side plates 100, 100' at a position adjacent rollers 192, 192'. Switch LS2 is positioned on girder 108' in alignment with standards 13*c* and 13*d* so as to indicate when the rollers 180 adjacent rollers 192, 192' are free of crates and may receive additional crates.

Switches LS3 and LS18 are positioned on the beam 133 so as to be engaged respectively by the slide plates 100, 100' when they are completely closed.

As seen in FIG. 5, switches LS4, LS4*a* are mounted on top strut 14*b* for engagement by switch engaging lug 167 on traveler 162 when the rakes 165, 165' are completely forward. Switch LS5, LS5*a* are carried by a brace 169 extending inwardly from top strut 14*d* for engagement by traveler 162' when the rakes 165, 165' are completely returned.

Switches LS6 and LS15 are mounted on an upstanding brace 168 which is secured to an intermediate portion of alignment bar 136', the switch LS15 being mount-

ed above switch LS6. The switches LS6 and LS15 have switch arms which extend into the elevator chute at preselected heights so as to be engaged by the tops of the bottles in the uppermost crate or the top of the uppermost crate itself.

Switch LS7 is mounted on alignment bar 136' so as to be engaged by channel member 71 on the elevator but not by any crates or the pallet, the switch arm of switch LS7 terminating slightly above the upper plane of the slide plates 100, 100'.

Switches LS8, LS8*a*, LS9, LS9*a*, LS10 and LS11 are best seen in FIGS. 7 and 8. Switches LS8, LS8*a* are carried by rib 12*c* in a position to be engaged by the elevator when it is in its lowermost position. Switches LS9, LS9*a* are centrally of the base adjacent the center of rib LS12*c*. The switch arm 170 operating switches LS9, LS9*a* projects upwardly and forwardly into the bottom portion of the elevator chute so as to be engaged by each loaded pallet as it is about properly positioned on the elevator.

Switch LS10 is centrally on cross member 212 and its switch arm 210 is in a position to be engaged by an unloaded pallet as it is about properly positioned for lifting by lift plates 208*a*, 208*b*. Switch LS11 is located on standard 109*a* and has an arm adapted to be engaged by lift beam 204*a* when piston rod 203*a* completes its upward travel.

Switches LS12, LS12*a*, as seen in FIG. 3, are carried by standard 13*b* with their common switch arm extending into the path of travel of the pallet in the chute so as to be engaged by the pallet in a plane immediately below the plane of slide plates 100, 100'.

Switches LS13 and LS14, as seen in FIG. 4, are carried on the inner surfaces of struts 105 and 106 respectively. These switches LS13 and LS14 are in position to be engaged by slide plates 100, 100' respectively when they are completely opened.

Switches LS16 and LS17 are positioned at any convenient place along the path of discharge of the crates to indicate when additional crates are needed in the production line.

Switch LS19 is positioned as shown in FIG. 3 to be engaged by the crates on a loaded pallet as the pallet is positioned on the elevator.

Switch LS20 is carried centrally on the bottom edge of strut 106 so as to be engaged by the top pallet in the pallet magazine when the magazine is filled.

Operation

From the foregoing description the operation of my unloading machine is apparent. The pallet which the present embodiment is adapted to unload is a pallet having a plurality of layers of crates of bottles, six crates to the layer. The pallet is of a size to provide space for a layer two crates deep and three crates across.

The pallets so loaded are fed one after another down the rollers 21 in FIG. 2. Since rollers 21 are free rolling, the loaded pallets pass therealong until the first pallet reaches feed regulating belt 22. It is important that the pallets be fed with a three crate side first into my machine. Prior to automatic operation, the elevator must be arranged in the down position, the rakes 165, 165' in the completely returned position, and the slide plates 100, 100' in their opened position. To accomplish this in the event the elements are not positioned, switch SS1 of FIG. 9 is thrown from its off position to its auxiliary position, supplying current from wire 300 to the auxiliary bus 301.

To return the elevator to the bottom independently, the operator depresses switch PB6 which supplies current from auxiliary bus 301 through limit switch LS8*a*, wire 318, wire 316, switch M1–1 and switch M3–3 to relay M4. Upon the energization of relay M4, motor 92 is actuated to bring the elevator down until it strikes limit switch LS8*a* (seen in FIG. 7), opening it and thereby deenergizing the circuit. The elevator fully down, closes switch LS8 for automatic operation.

To open the slide plates 100, 100', the operator depresses switch PB5 which supplies current from bus 301 through wires 312 and 313 to solenoids SV2 and SV2'. It will be understood that while one side of switch PB5 is closed the other side is opened and hence no current will be supplied through wire 311 at this time. With the slide plates 100, 100' open, switches LS13 and LS14 (seen in FIG. 4) are closed.

To return the rakes 165, 165' to the position shown in FIG. 1, the operator depresses the push button, closing switch PB3 which supplies current from auxiliary bus 301, through wire 306, wire 308, wire 305, switch LS5 and M1–2 to energize relay M2 and thus energize motor 140 for rotation in the proper direction. Since push buttons PB1, PB3 and PB4 are operated simultaneously, no current will be supplied the main bus 302 via the hold-down switch M2–1 since switch PB1 is open. Further, no current will be supplied to actuate the slide plates 100, 100' since switch PB4 is open. When the rakes are in the completely returned position, traveler 162' strikes and opens switch LS5, thereby breaking the circuit to relay M2 which results in deenergizing motor 140.

For automatic operation, first, selector switch SS3 is positioned either in the up or down position according to the size of bottles in the crates. In the present embodiment, if the crates on the pallets contain 6 ounce bottles, the selector switch SS3 is positioned up, activating switch LS6 (seen in FIGS. 5 and 6). If, on the other hand, the crates contain larger bottles, such as 12 ounce bottles, selector switch SS3 is positioned down so as to activate switch LS15 (seen in FIGS. 5 and 6). Assume for the purpose of this description that the standard 6 ounce soft drink bottle is contained in the crates on the pallet; in such case, selector switch SS3 is placed in the position shown in FIG. 9. Next, the switch SS1 is depressed past the off position as shown in FIG. 1 to the automatic position supplying current from wire 300 to the main bus 302.

Next the selector switch SS2 is placed in the depressed position thereby supplying current from bus 302, via wire 320 to energize relay M6 which in turn energizes motor 188 to cause rotation of rollers 180.

With the elevator down, limit switch LS8 is closed and hence relay R2 is energized. Relay R2, in turn, closes switch R2–1 of wire 319, opens switch R2–2 of wire 316, opens R2–3 of wire 314 and closes R2–4 of wire 326. The closing of switch R2–1 supplies current via switches LS19, LS20, M3–2 (which are normally closed) to relay M5 which energizes motor 49 and drives the infeed conveyors, namely belts 23, 28 and 56 as well as chains 59.

With the closing of switch R2–4, current is supplied through switch LS9*a* and wire 326 to relay R4. The energization of relay R4 closes switches R4–1 of wire 315 and R4–2 of wire 327. Thus, regardless of the position of switch LS9*a* and R2–4, current will be supplied to relay R4 via wires 325 and 327 so long as the elevator is down, closing switch LS8 and provided switch LS6 is not closed.

As the first pallet is fed toward the elevator chute, it trips clutch lever 37, thereby disengaging rollers 23 and momentarily stopping the movement of all except the first evaded pallet toward the elevator chute. This provides a space between each successive pallet.

As the first pallet enters the elevator chute, and is positioned over the elevator, it engages switches LS9, LS9*a*, closing switch LS9 and opening switch LS9*a*. Switch LS9*a* is operably connected to switch LS9 and hence is opened upon the closing of switch LS9.

It is to be remembered that switches LS13 and LS14 are closed. Thus, upon the closing of switch LS9, current is supplied from bus 302 via wire 314, switch R5–1,

switches LS13 or LS14, switch R4–1, LS9, wire 315 and switch M4–2 to relay M3 which energized motor 92 to lift the loaded pallet. The energization of relay M3 opens switch M3–2 and thereby deenergizes relay M5 and turns off infeed conveyor motor 49. Thus, no additional pallets will feed to the elevator.

When the top layer of crates is carried upwardly by the elevator, it engages and closes switch LS6 (if the taller 12 ounce bottle crates were being unstacked, switch LS15 would be the switch to be engaged). This energizes relay R5–1, R5–3 and closes switch R5–2. The opening of switch R5–1 opens the circuit to relay M3 and thus stops motor 92 from lifting the elevator. At this stage, the base of first or top layer of crates is about parallel to the slide plates 100, 100'.

The closing of switch R5–2 closes the circuit via wire 321, switches LS12*a*, R1–3 and LS3 to energize valve solenoids SV1, SV1'. These solenoids SV1, SV1' open the valves of cylinders 111, 112 admitting air under pressure to drive piston rods 113, 114 toward each other, closing the slide plates 100, 100'.

As the slide plates 100, 100' close, the tines 118 and 119 pass between adjacent bottles of the second topmost layer and engage the outer bottom edges of all crates in the top layer, urging these two lines of crates in the top layer together and upon further inward movement, lift the top layer of crates sufficiently that the slide plates 100, 100' slide therebenath.

Upon the closing of both slide plates 100, 100' switches LS13 and LS14 spring open, thereby preventing the energization of relay M3 when the slide plates 100, 100' are closed.

When the slide plates 100, 100' are completely closed, they strike and close switches LS3 and LS18, thereby making a circuit via wire 304 to energize relay M1 and thus actuate motor 140 to move the rakes 165, 165' across the closed slide plates 100, 100' urging the crates thereon, two at a time, over rollers 192, 192'. As each pair of crates engages rollers 192, 192' they are rapidly transferred by rollers 192, 192' to rollers 180. Thus, in normal operation, there is no need for the movement of rakes 165, 165' to be interrupted. The crates are deposited two at a time on the live rollers 180 and are thence moved normal to their path of discharge from the elevator chute, along rollers 180 and down the inclined ramp 199.

In FIG. 4 it will be seen that the switch LS2 is in a position to be engaged by the crates on the rollers 180. Since switch LS2 is essentially in alignment with standards 13*c* and 13*d*, the switch LS2 will be held open so long as crates on rollers 180 block the discharge of additional crates by the rakes 165, 165'. Switch LS1 is in a position to be engaged and opened by crates being urged outwardly from the slide plates 100, 100' onto the rollers 180. Thus, whenever there are crates in position to be acted upon by the rakes 165, 165' but there is no room on rollers 180 for further discharge, switches LS1 and LS2 will be in open position, thereby interrupting current to relay M1 via wire 304.

It will be seen, therefore, that under normal conditions the rakes 165, 165' will be moved continuously because the forward crates will be rapidly removed by rollers 192, 192' as they are engaged. The rakes 165, 165' will, however, be intermittently motivated by motor 140 in accordance with the availability of space on rollers 180 for the discharge of crates thereto.

When the last pair of crates is discharged by the rakes 165, 165', switch LS1 will no longer be held open and hence closes. Thus the rake motor 140 will continue to rotate until the rake assembly completes its travel in a discharging direction. As the rake assembly reaches its extreme travel, lug 167 engages switches LS4, LS4*a*, opening switch LS4*a* and closing switch LS4. This breaks the circuit to relay M1 via wire 304 and makes the circuit via wire 305, switch LS4, switch LS5, switch M1–2 to relay M2, thereby reversing the rotation of motor 140. With the energization of relay M2, the hold-down switch M2–1 is closed, thereby permitting current to flow through the circuit to relay M2 even though switch LS4 be subsequently opened. Thus the rakes 165, 165' continue their return travel until traveler 162' of the rake assembly engages switches LS5 and LS5*a* (mounted on brace 168 in FIGS. 5 and 6), opening switch LS5 and closing switch LS5*a* and thereby interrupting current via wire 305 and switch LS5. Thus, current to rake motor 140 is interrupted and the motor 140 stops.

It will be observed that during the time current is supplied via wire 305 past switch LS5 for the energization of relay M2 to return the rakes 165, 165', current is simultaneously supplied via wires 309 and 310 to relay R3 and via wire 311, switches PB4, PB5 and wire 313 to solenoids SV2, SV2'. The energization of solenoids SV2, SV2' actuates the valves of air cylinders 111, 112 and causes retraction of piston rods 113, 114, thereby again opening the slide plates 100, 100'.

At this stage of the cycle of my machine, the elevator has moved up sufficiently to clear switches LS9, LS9*a* and LS8. Relays R2 and R4 thus drop out since switch LS9*a* closes after switch LS8 opens, and thus the hold-down switches R4–2 and R2–4 again open. Further, the deenergization of relay R2 closes relay switch R2–3. Therefore, when the rake assembly closes switch LS5*a* and provided switches LS13 and LS14 have been closed by the slide plates 100, 100' respectively, current is supplied to relay M3 and the hold-down switch M3–1 closes to shunt relay switch R2–3. Thus, motor 92 is again started to raise the elevator until the top layer of crates engages and closes switch LS6 which energizes relay R5 and opens relay switch R5–1. The cycle, after the closing of switch LS6, is therefore repeated for as many layers of crates as are stacked on the bottommost layer of crates.

It will be observed at this time that switch LS8 is again open and relay R2 deenergized, switch R2–1 is open and the elevator may pass switch LS19 without danger of motor 49 being energized.

Since the tines 118, 119 cannot pass beneath the lowermost layer of crates without digging into the pallet itself, the removal of the last or bottommost layer is different from the preceding layers of crates. As the slide plates 100, 100' are opened, the rake assembly returns, and the elevator is moved upwardly containing only the bottommost layer of crates, the pallet engages switches LS12, LS12*a*, closing switch LS12 and opening switch LS12*a*. Thus, when the bottommost crates of bottles close switch LS6 energizing relay R5, which closes switch R5–2, no current is supplied through wire 321 and the slide plates 100, 100' remain open. Since the closing of switch LS12 renders relay switch R5–1 ineffective, the elevator continues to travel upwardly until the pallet engages switch LS7, thereby energizing relay R1 via wire 224.

The energizing of relay R1 closes switch R1–1 of wire 316, opens switches R1–2 and R1–3 and closes switch R1–4. Thus, the circuit to relay M3 is broken stopping motor 92 from lifting the elevator and the circuit to relay M1 is made energizing the motor 140 which moves rakes 165, 165' across the pallet, discharging the bottommost layer from the pallet. Further, the circuit to solenoids SV1, SV1' is rendered inoperative by the opening of switch R1–3 and the circuit to relay M4 is rendered operative by closing of switch R1–1.

When the rakes 165, 165' begin their return travel, as a result of the closing of switch LS4, current is also supplied via wires 309, 310 to relay R3. The energization of relay R3 closes switch R3–1 and hence a circuit is made from bus 302 through switches R2–2, R1–1, R3–1, via wire 316 and switch M1–1 to energize relay M4. Thus, motor 92 is energized to move the elevator down-

wardly. Upon the energization of relay M4, switch M4–1 closes, thereby by-passing switches R1–1 and R3–1 and the elevator continues its downward travel until it reaches the bottom and engages and closes switch LS8. Relay R2 is thereby again energized, closing switches R2–1, R2–3 and R2–4 and opening switch R2–2. The opening of switch R2–2 deenergizes relay M4 and stops motor 92. The closing of switch R2–1 energizes relay M5 and starts motor 49 to drive again the infeed belts 22, 23 and 56 and chain 59. The closing of switch R2–4 energizes relay R4. Thus, the cycle, receiving and unloading the next loaded pallet, as hereinbefore described, is repeated.

As the next pallet is fed into the elevator chute, belts 56 discharge the unloaded pallet to chains 59 whence the unloaded pallet is carried into the pallet magazine where lever 210 is engaged by the unloaded pallet and switch LS10 is closed. The closing of switch LS10 energizes via wire 322 the solenoids SV3, SV3' which actuate the valves of air cylinders 202*a*, 202*b* and thereby retract piston rods 203*a*, 203*b*.

The retracting of piston rods 203*a*, 203*b* causes skid plates 208*a*, 208*b* to lift the unloaded pallet by its sides upwardly. The pallet moving upwardly acts against the camming members 224, 224' and continued upward travel of the pallet urges the rocker arms 221*a*, 221*b*, 221*c* and 221*d* outwardly until the pallet passes above the pallet engaging fingers 220, 220' and the rocker arms 221*a*, 221*b*, 221*c* and 21*d* pivot inwardly. When the piston rods 203*a*, 203*b* complete their upward travel delivering the unloaded pallet above fingers 220, 220', lift beam 204*a* strikes and closes switch LS11 (of FIG. 7) and this energizes via wire 323, the solenoids SV4, SV4' which change the valves of the air cylinders 202*a*, 202*b* to return the piston rods 203*a*, 203*b* to their original extended positions.

It will now be seen that the operation, above described, continues with an additional loaded pallet being fed to the elevator as the preceding pallet is simultaneously fed to the pallet magazine from the elevator. The unloaded pallet is thereafter lifted beyond the fingers 220, 220' to become the bottommost pallet in the pallet magazine and support the pallets in the pallet magazine thereabove.

When the pallet magazine is filled, the uppermost pallet engages switch LS20 which opens the circuit to relay M5 and prevents the energizing of motor 49 for the feeding of additional pallets to either the elevator or the pallet magazine. Thereafter a lift truck may remove the stacked pallets from the pallet magazine.

It will be observed that I have provided a number of safety features in my machine. For example, the overheating of any of the motors will cause the interruption of current to all circuits through the opening of any one of switches MS1, MS2, MS3 or MS4. The interruption of current either by the blowing of fuse F or the opening of one of switches MS1, MS2, MS3 or MS4 will be indicated by light GL going out. Further, current cannot be supplied to relays M1 and M2 simultaneously since the energization of relay M2 will open switch M2–2. Also, relays M3 and M4 cannot be energized simultaneously since the energization of relay M3 opens switch M3–3 and the energization of relay M4 opens switch M4–2. Switch LS19 is placed within the elevator chute to detect the presence of a loaded pallet and prevents actuation of motor 49.

In the event the rakes 165, 165' do not completely return, the depressing of switch PB2 will supply current to energize relay M2 and start motor 140 to cause travel of the rakes 165, 165' in a return direction until the rake assembly opens switch LS5.

A better understanding of my invention may be had by reference to the table below which outlines the function of the various switches:

Unloader Control System

Symbol	Function
LS-1	In parallel with LS-2 stops rake if cases in both positions.
LS-2	In parallel with LS-1 stops rake if cases in both positions.
LS-3	(1) Starts rake forward when plates are closed. (2) Shuts off power to plate forward circuit.
LS-4, LS-4a	(1) Stops rake forward circuit. (2) (a) starts rake return; (b) starts plate return circuit; (c) energizes R-3 relay which starts elevator down when pallet is empty.
LS-5, LS-5a	(1) Stops rake on return. (2) Stops elevator up circuit until rake is returned.
LS-6	(1) Operates R-5 which (a) stops elevator up circuit in parallel with LS-12 for 6½ ox. bottles; (b) starts plate forward circuit for 6½ ox. bottles. (2) Shuts off power to relay R-2.
LS-7	Energizes R-1 Relay. (1) Stops elevator up. (2) Makes part of elevator down circuit. (3) Stops plate forward circuit when elevator all the way up. (4) Starts rake forward circuit.
LS-8, LS-8a	Energizes R-2 Relay. (1) Starts ramp motor. (2) Stops elevator down. (3) Holds elevator up circuit closed when elevator off LS-8.
LS-9, LS-9a	Starts elevator up.
LS-10	Starts pallet magazine Air Cylinder.
LS-11	Pallet air cylinder retract.
LS-12, LS-12a	Holds elevator up Circuit in parallel with relay R-5 to raise last layer of cases high enough to rake directly from pallet.
LS-13, LS-14	Stops elevator from coming up when plates are not fully returned.
LS-15	Positions elevator and starts plate forward circuit for 10 and 12 oz. bottles (Same as LS-6).
LS-16	In parallel with LS-17 and stops rake if cases open switch LS-16 and LS-17.
LS-17	In parallel with LS-16 and stops rake if cases open switches LS-16 and LS-17.
LS-18	Starts rake forward when plates are closed.
LS-19	Pallet infeed safety.
LS-20	Turns off machine when pallet magazine is full.

It will be obvious to those skilled in the art that many variations may be made in the embodiment chosen for the purpose of illustrating the present invention, elements may be combined as separated into several parts and full resort may be had to the use of equivalents without departing from the scope of my invention as defined by the appended claims.

I claim:

1. An unstacking machine comprising an elevator chute, an elevator vertically moveable in said chute, infeed conveyor means for feeding pallets loaded with layers of articles thereon successively to said elevator chute and over said elevator, means for preventing the travel of said pallets to said elevator chute when said elevator has received a loaded pallet, means for preventing the travel of said pallets to said elevator until said elevator is positioned in its lowermost position, means for spacing said pallets on said infeed conveyor, a pair of opposed horizontally disposed slide plates operably associated with said elevator chute and moveable toward each other across said elevator chute, downwardly and inwardly projecting tines at the iner edges of said slide plates for urging the topmost layer of articles upwardly as said slide plates move toward each other, means for reciprocating said slide plates in timed relationship to the movement of said elevator, reciprocatable rake means moveable across said slide plates for pushing articles from said slide plates, and a discharge conveyor opposite said rake means for receiving articles pushed by said rake means and for arranging said articles in single file fashion upon being received thereon.

2. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet from said conveyor and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, slide plate means disposed at said unloading station and above said elevator for move-

ment between the uppermost layer and the layer therebeneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, article engaging means on said slide plate means and moveable therewith for progressively engaging the sides of the articles in said uppermost layer and for urging said articles in said uppermost layer upwardly away from the layer of articles therebelow and onto said slide plate means as said slide plate means is moved between said uppermost layer and the layer therebeneath, means disposed at said unloading station for discharging row by row the layer of articles from said slide plate means, and conveyor means positioned adjacent said slide plate means for receiving each row of articles as it is discharged from said slide plate means and for arranging and discharging the articles in single file fashion.

3. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the sheight of said layers, slide plate means disposed at said unloading station and above said elevator for movement between the uppermost layer and the layer therebeneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, article engaging means on the end of said slide plate means for engaging the articles in said uppermost layer as said slide plate means is moved and for urging said articles onto said slide plate means, means disposed at said unloading station for discharging row by row the layer of articles from said slide plate means, and a conveyor positioned adjacent said slide plate means for receiving each row of articles as it is discharged from said slide plate means and for arranging and conveying the articles in single file fashion.

4. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, slide plate means disposed at said unloading station and above said elevator for movement between the uppermost layer and the layer therebeneath to remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, rake means disposed at said unloading station and above said slide plate means, means for moving the rake means across the slide plate means for discharging row by row the layer of articles from said slide plate means, and a conveyor positioned adjacent said slide plate means for receiving each row of articles as it is discharged from said slide plate means and for arranging and conveying the articles in single file fashion.

5. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, a pair of opposed slide plates disposed at said unloading station and above said elevator for movement toward each other and away from each other, said slide plates when moved toward each other extending between the uppermost layer and the layer therebeneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, rake means disposed at said unloading station and above said slide plates, means for moving the rake means across the slide plates for discharging row by row the layer of articles from said slide plates, and a means positioned adjacent said slide plates for receiving each row of articles as it is discharged from said slide plates and for arranging and discharging the articles in single file fashion.

6. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, a pair of opposed slide plates disposed in a common transverse plane at said unloading station and above said elevator for movement toward each other and between the uppermost layer and the layer therebeneath to remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, article engaging means on said slide plates for engaging the articles in said uppermost layer as said slide plates are moved and for urging said articles onto said slide plates, rake means disposed at said unloading station and above said slide plates, means for moving the rake means across the slide plates after said slide plates have been moved toward each other for discharging row by row the layer of articles from said slide plates, and a conveyor positioned adjacent said slide plates for receiving each row of articles as it is discharged from said slide plates and for arranging and conveying the articles in single file fashion.

7. In a machine of the class having an upright frame defining an upright unloading station wherein a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet are unloaded, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into said unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, a pair of opposed slide plates carried by said frame in a common transverse plane above said elevator for movement between the uppermost layer and the layer beneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, rake means disposed at said unloading station and above said slide plates, means for moving the rake means across the slide plates for discharging row by row the layer of articles from said slide plates, and a conveyor positioned adjacent said slide plates for receiving each row of articles as is is discharged from said slide plates and for arranging and conveying the articles in single file fashion.

8. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, slide plate means disposed at said unloading station and above said elevator for movement between the uppermost layer and the layer beneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, control means for detecting when said slide plate means has been moved beneath said uppermost layer, rake means disposed at said unloading station and above said slide plate means, drive means controlled by said control

means for moving the rake means across the slide plate means for discharging row by row the layer of articles from said slide plate means, a conveyor positioned adjacent said slide plate means for receiving each row of articles as it is discharged from said slide plate means and for arranging and conveying the articles in single file fashion and means for detecting when articles are received on said last mentioned conveyor for interrupting the action of said drive means until the articles have been conveyed by said last mentioned conveyor.

9. In a machine for unloading a plurality of horizontal layers of articles arranged in stacked layer formation on a pallet, each layer being formed of a plurality of side-by-side rows of articles, a conveyor extending into an unloading station for receiving and carrying a pallet loaded with the stacked layers of articles, an elevator within said unloading station for receiving said loaded pallet and for raising said pallet step-by-step upwardly by distances approximately equal to the height of said layers, slide plate means disposed at said unloading station and above said elevator for movement between the uppermost layer and the layer therebeneath to successively remove and receive thereon the uppermost layer after each step of movement upwardly of said elevator, article engaging means protruding inwardly from the end of said slide plate means and extending below the upper surface of said slide plate means for progressively engaging the articles in said uppermost layer as said slide plate means is moved and for urging said articles upwardly onto the upper surface of said slide plate means, means disposed at said unloading station for discharging row by row the layer of articles from said slide plate means, and a conveyor positioned adjacent said slide plate means for receiving each row of articles as it is discharged from said slide plate means and for arranging and conveying the articles in single file fashion.

References Cited in the file of this patent

UNITED STATES PATENTS

1,464,513	Sutherland	Aug. 14, 1923
1,772,734	Romine	Aug. 12, 1930
2,609,109	Ardell	Sept. 2, 1952
2,643,009	Kenyon	June 23, 1953
2,727,642	Haycock	Dec. 20, 1955
2,729,344	Birchall	Jan. 3, 1956
2,741,379	Stryker	Apr. 10, 1956
2,774,489	Guigas	Dec. 18, 1956
2,792,950	Fenton	May 21, 1957
2,815,870	Laub	Dec. 10, 1957
2,902,182	Thomas	Sept. 1, 1959
2,956,697	Madden	Oct. 18, 1960
2,994,444	Peterson	Aug. 1, 1961