

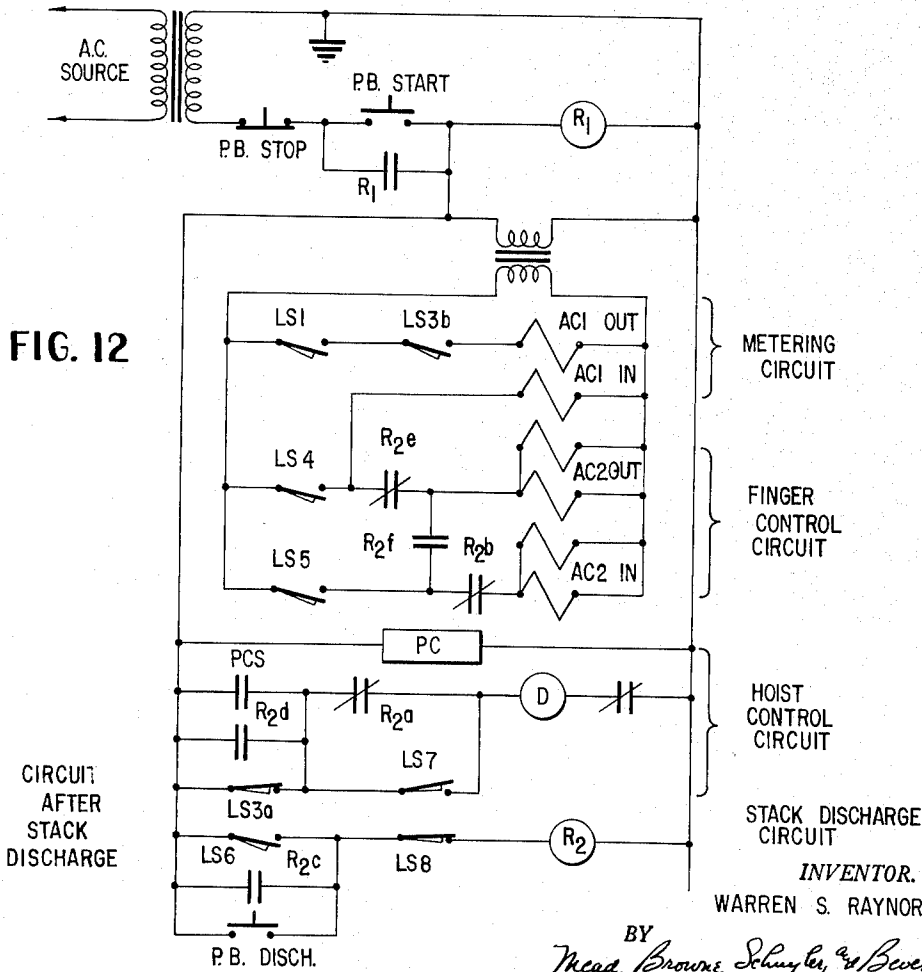
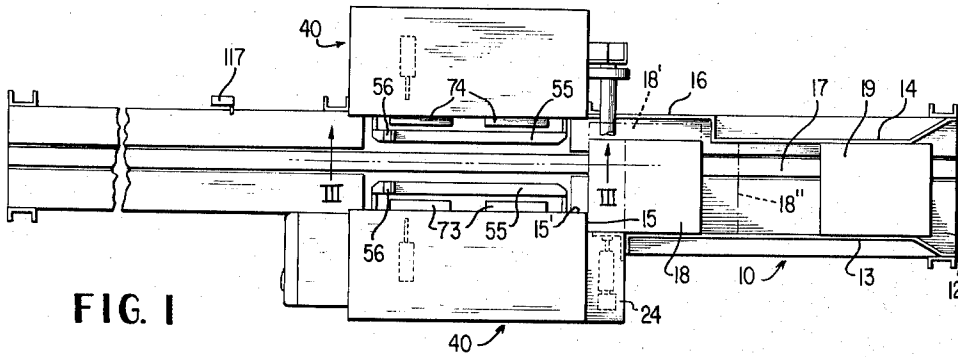
Feb. 15, 1966

W. S. RAYNOR  
AUTOMATIC CASE STACKER

3,235,100

Filed Nov. 9, 1961

6 Sheets-Sheet 1



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**Feb. 15, 1966**

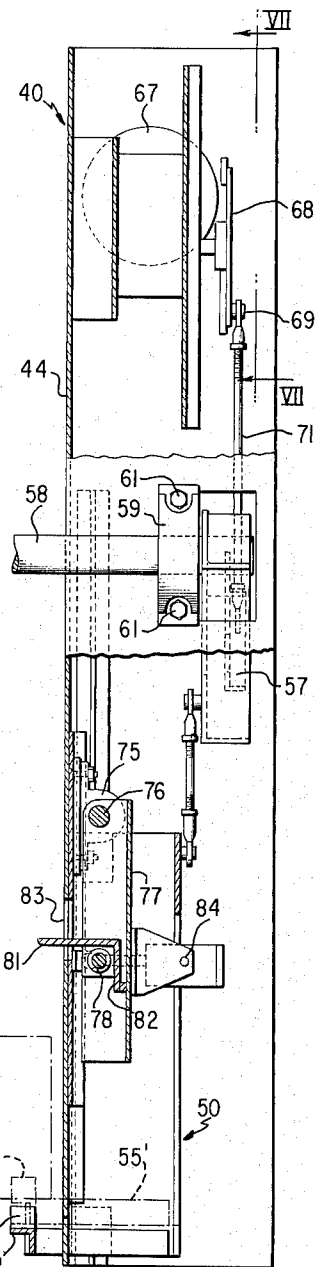
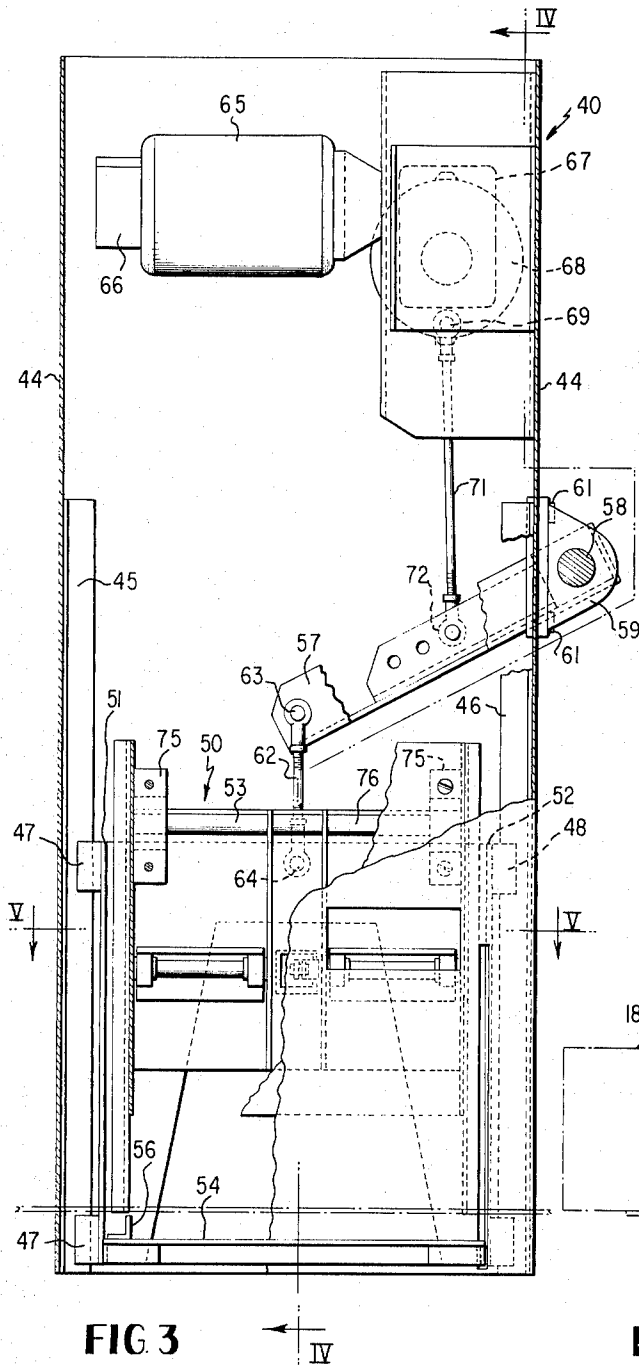
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# AUTOMATIC CASE STACKER

Filed Nov. 9, 1961

6 Sheets-Sheet 3



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AUTOMATIC CASE STACKER

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6 Sheets-Sheet 5

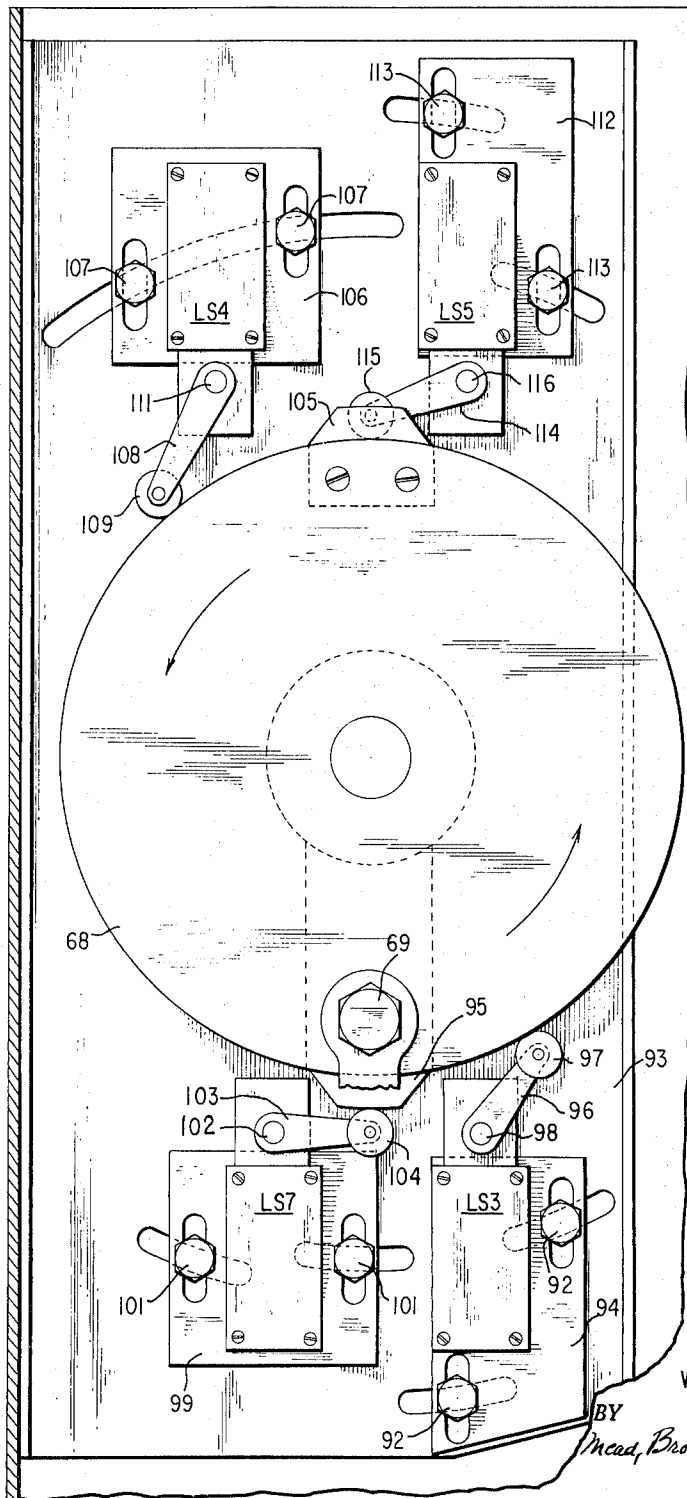


FIG 7

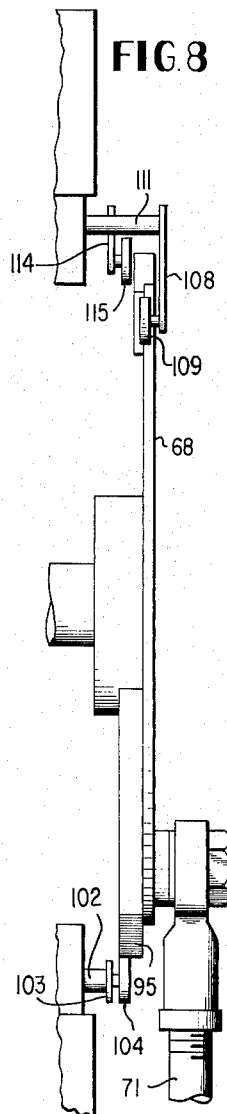


FIG 8

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3,235,100

## AUTOMATIC CASE STACKER

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9 Claims. (Cl. 214—6)

This invention relates to a carton, box or case stacking device adapted to be used with a linear conveyor for the placement of individually received cartons in stacked tiers and for the release of these stacked cartons to pass via the conveyor to a loading station or other means for storage or transport.

More particularly the invention relates to an under-stacking device with means for controlling automatically the infeed of cartons, the stacking operation, the limiting height, and the discharge of the stacked cartons automatically in a device which is adaptable to use with a linear conveyor already installed and without the use of a pit or other special equipment arrangements. The device of this invention is essentially a self-contained unit which is separable from the conveyor and is portable. At the same time it is adaptable for use with an automatic palletizer or load distribution control mechanism such that the stacking operation automatically terminates if stacked cartons do not pass from the stacker.

Previous devices for the general purpose of this invention have been generally quite complicated and expensive to manufacture and to maintain. They have generally occupied considerably more space than is desirable and have required permanent installation either with a pit, an overhead line or other permanent structure in the platform area where the operation takes place. Likewise, adjustments for different size packages or cartons have been difficult or impossible with prior devices for this purpose. It has generally not been possible to move such a stacker from one location to another or from one conveyor to another, whereas the present invention is intended to permit this flexibility of use. Likewise, most such devices have not been entirely automatic in their operation or have been subject to clogging or malfunctioning in the absence of an attendant. The disadvantages of prior devices include the rather large amount of machinery necessary to accomplish the purpose with a consequently high cost for such devices and the necessity for large operating space to permit their use.

It is an object of this invention to provide a conveyor stacker mechanism completely automatic in operation, so long as cartons are supplied thereto and stacked cartons are removed from its delivery area.

Another object of the invention is to provide a stacker which may be employed with already existing conveyers which is movable from one location to another.

A further object is to provide a stacking mechanism which is simple in operation, requiring few parts to wear or become maladjusted and to nevertheless supply accurately stacked cartons at a high rate of stacking.

A still further object of the invention is to provide a case stacker suitable for use with cases of cardboard material wherein the operating fingers and arms are prevented from damaging the cartons inasmuch as heavy arms need not be ratchet operated by, or rubbed against, the cartons during stacking.

A still further object of the invention is to provide a stacking mechanism which is cheaper to manufacture and maintain and which provides a more accurate vertical alignment of cartons stacked in tiers.

Other objects and contemplated advantages will be evident as the description proceeds by reference to the drawings in which:

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FIG. 1 is a diagrammatic plan view of the stacking mechanism together with a portion of the infeed and outfeed conveyor showing infeed control;

FIG. 2 is a diagrammatic elevational view taken laterally of the conveyor and showing infeed of a carton and outfeed of a stack of cartons;

FIG. 3 is a fragmentary sectional view taken as indicated by the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary vertical sectional view taken in the plane indicated by line 4—4 of FIG. 3;

FIG. 5 is a fragmentary sectional view taken in the transverse horizontal plane at line 5—5 of FIG. 3;

FIG. 6 is a generally sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is a fragmentary sectional view showing an inside elevation taken along line 7—7 of FIG. 4 to illustrate sequence control elements of the operation;

FIG. 8 is an elevational view of the sequence control and driving mechanism taken in the direction of line 8—8 of FIG. 7;

FIG. 9 is a plan view partly in section showing the infeed control mechanism in relation to a carton passing along the conveyers;

FIG. 10 is an elevation largely in section taken along line 10—10 of FIG. 9;

FIG. 11 is a pictorial perspective view showing positional locations of switches adapted to control and actuate a sequence of events producing finished stacks of cartons; and

FIG. 12 is a schematic electrical control diagram showing the operation of the mechanisms and switches.

There is shown generally in FIGS. 1 and 2 a linear conveyor 10 supported in any convenient way as by posts 11 resting on the floor or other supporting structure. A conveyor consists of a horizontally bottomed channel 12 extending generally through the stacker and into a loading or palletizing area not shown in detail. This channel will normally be supplied with side panels 13 which are adjustable to accommodate packages of different widths. These panels may be employed both at the infeed and exit ends of the conveyor, but are not shown except as modified for the purpose of this invention which employs one such panel 13 at one side of the conveyor, and at the other side of the conveyor there is an offset panel 14 adjustable to accept between it and panel 13 a carton of the desired width. The panel 14 overrides a portion of the channel 12 and forces cartons moving therealong laterally into contact or near contact with panel 13. Panel 13 terminates at or near a transverse abutment 15, having parallel portion 15' therebeyond, later to be described. Panel 14 terminates one carton length toward the infeed end of the conveyor from the position of the abutment 15 such that a carton passing along the channel and striking the abutment 15 can be offset by means later to be described into the channel beyond the termination of the panel 14 and is there held in the channel by means of a further panel portion 16 which may extend on the same side of the conveyor beyond the stacking mechanism. Any carton or case inserted in the infeed section of the channel 12 from other conveyor sections, or otherwise deposited therein by an operator, is fed along the channel by means of a belt or chain arrangement shown at 17 which is supported slightly above the level of the channel bottom so as to contact each carton placed thereon. The bearing surface of the chain or belt 17 is preferably slightly elevated from the channel, or of moderately high friction material to assure positive transport of the cartons, yet permitting cartons to be temporarily arrested thereon. It may, of course, be a continuous moving belt or a chain structure with segmented blocks serving as the bearing surface. In either case this belt travels

through substantially the center line of the channel, particularly at the position beyond the stacker mechanism. At the infeed end of the conveyer ahead of the stacking mechanism the conveyer belt is shown closer to one edge of a carton carried therealong than to the other edge by virtue of the fact that the panel 14 is inserted and adjusted part way across the channel 12 so as to form an offset portion of the channel between members 14 and 13, and there is at the entrance to the stacker mechanism a broadened portion of the channel between the abutment 15' and side panel 16 of the channel. Any carton traveling along the channel, therefore, comes against the abutment 15, and the opposite rear corner thereof, as shown in FIG. 1, is free to rotate about the abutment 15 only until it contacts wall 16. The forward corner of the carton is stopped against the abutment and cannot proceed therebeyond until further controls are operated, as will later be described. The space between panel 16 and the abutment 15' is adjusted to just exceed the width of a carton such that an arrested carton cannot pass the barrier 15 into the stacking mechanism. A displaced carton, shown at 18 in FIGS. 1 and 9, is shown repositioned for transport at 18' in FIG. 9 by dotted outline. A further arriving carton is shown at 19 in FIG. 1.

Means for operating and controlling the conveyer belt do not form a part of this invention and are not shown, except that drive rollers are shown at 21 and 22. It will be unnecessary to further describe the conveyer since this may be of any well-known type having a moving belt centrally extending therealong. Likewise not shown, there is normally some suitable delivery facility for handling the stacked cartons which are dispatched from the stacker mechanism. One suitable form for such apparatus would be a palletizing structure in which the tiers of cartons are successively positioned adjacently to each other in linear rows and laterally displaced by some suitable ram mechanism into groups of rows on a pallet for picking up or depositing in a truck or other device either for storage or transport. Since these mechanisms do not form a part of the present invention, further description is here omitted. The present invention relates instead to the stacking mechanism and the means of control for the infeed such that no two cartons are in a position to be handled at the same time or to interfere with each other or with the operation of the stacking mechanism. There is illustrated, however, a control switch or equivalent device arranged along the conveyer beyond the stacker for the purpose of restoring operation of the stacker as a stack is discharged from the machine.

While the present invention consists of a very compact and simple mechanism for stacking cartons, it achieves its simplicity by means of a reciprocating hoist within the stacking mechanism; and in such a hoist mechanism, to be operative without jamming or clogging, a control is necessary limiting the arrival of packages into the machine to those intervals when the machine is ready to receive additional cartons for stacking. There is provided for this purpose a metering device and actuating means therefor which releases cartons from the abutment 15 upon the occurrence of conditions within the stacker which permit the stacker hoist to operate in the normal fashion.

The operation of the infeed control device according to a preferred form of this invention may be understood best by reference to FIGS. 1, 9 and 10. There is shown an air cylinder designated AC1 mounted in any suitable fashion as by base 23 mounted on the stacker housing adjacent the conveyer channel. The air cylinder has a piston shaft 25 extending from the forward end of the cylinder through a fitting such as 26 enabling it to be stroked out toward the right, as shown in FIG. 10. Secured to the shaft end by threaded receiver 27 is a thrust plate 28 parallel to channel 12 and vertically disposed with a right angled portion 29 forming a vertical transverse arresting face in channel 12.

As illustrated in FIGS. 9 and 10, the plate member 28 and 29 is adapted to be moved laterally across the conveyer upon the actuating of AC1; and when AC1 is not actuated, the rest position places the face 28 in line with the conveyer panel 13 so that a carton may come directly against the leading face of pedestal 40 at the position indicated as abutment 15. The outstroke of AC1 is sufficient, when properly adjusted, to advance thrust plate 28 to alignment with the pedestal portion 15' from which position conveyer belt 17 can transport the carton into the stacking well. A carton disposed against the abutment 15 is indicated by the numeral 18 in its "ready" position. When AC1 is actuated, the stacking mechanism "accepts" the carton for stacking, since it is displaced into a line of movement directly into the well as shown at 18'. Any further arriving carton, when it reaches a position to contact arresting face 29, will be there held and may be referred to as a "waiting" carton 18', in which position it remains until AC1 is stroked in, thus permitting the carton to move into the position ready for release.

The release of a carton from its position 18 to position 18' is controlled by the air cylinder AC1, which may generally be operated by a conventional solenoid control on an air valve leading from a suitable air pressure supply, not here illustrated. This control is electrically operated in most cases as a matter of convenience, although other means of operating the cylinder may optionally be selected for the same purpose.

Control of AC1 is effected by means of switches LS1 and LS3b. LS1 is indicated at 31 as a conventional limit switch having normally open contacts arranged in series with LS3b for the actuation of the AC1 outstroking solenoid. Switch LS1 is mounted as by a raised flange fitted with slotted mounting holes and screws adjustably secured to the leading face of one pedestal 40, such that the switch is in its operated position whenever a carton 18 is urged into position against the abutment 15 by motion of the conveyer belt. The switch preferably is fitted with an operating spindle 33 bearing actuating arm 34 and a return spring 35, there being a suitable termination at the end of the actuating arm 34 such as roller 36 for engaging a carton as it approaches abutment 15. Rotation of spindle 33 actuates normally open contacts within the switch and provides for sufficient overtravel. Actuating arm 34 is fully displaced from the channel 13 contact upon the arrival of a carton but will not reopen the switch contacts until the carton has been laterally displaced into position 18' for acceptance in the stacking well.

Upon actuation of AC1 piston 25 and thrust plate 28 move the carton 18 beyond the range of arm 34. This, however, does not stroke the piston in for the reason that the air cylinder solenoid control is single acting and requires the closing of a further circuit to actuate the solenoid controlling AC1 (in) to retract piston 25. This is accomplished through the connection to a further limit switch LS4 later to be described in connection with the hoist cycle. Closing of LS4 and actuation of AC1 (in) again aligns the plate 28 with the conveyer wall 13, and waiting carton 18' advances to the ready position at 18, thereby reclosing the contacts of LS1. As will later be noted, the switch contacts LS3b are open during the cycling of the hoist, and AC1 is not stroked out by the closing of LS1 except when the hoist is at rest since the hoist must commence its upward stroke before LS4 is closed, at which time LS3b is already opened. LS3b remains open until the hoist returns to the receive position.

When a further "arriving" carton 19, which may be following closely behind carton 18, reaches arresting plate 29, the arriving carton is there arrested. It will be noted that this carton cannot actuate LS1 until AC1 is stroked in but is restrained against the arresting face 29. To support the arresting face against the forward urging of a carton on the conveyer, there is provided a

tracking roller 39 disposed to move along the face of the pedestal 40 in the vicinity of the abutment 15 supported by brackets 37 and 38, each attached to thrust plate 28. Tracking roller 39 maintains spacing between plate 28 and pedestal 40 for smooth operation.

The infeed control mechanism hereinbefore described operates to control the feeding of cartons into the stacker mechanism. The construction and operation of the stacker mechanism will thus be understood by reference first to FIGS. 3 and 4 in which are shown two views of like pedestals indicated generally at 40 placed on opposite sides of the conveyer 10 at the stacking position. Pedestals 40 contain like hoisting and holding means except that the controls and the motive power are normally disposed within one of the units 40. The pedestals each consist of floor based supports indicated generally at 30 with internal supporting structure not shown in detail and a surrounding housing formed, for example, of sheet metal or plastic as at 44 so as to entirely enclose the unit with the exception of ports as necessary for operations to be described. The companion pedestals thus have inwardly facing walls adjustably spaced to accommodate cases or cartons passing therebetween, disposed parallel and in a position to receive cartons substantially in contact with inward facing walls. The pedestals are preferably supported directly on the floor adjacent to the conveyer and are normally detachably secured to the conveyer therebeneath such that the pedestals may not move with respect to each other or the conveyer during operation. With each pedestal 40 and on opposite interior walls thereof are hoist guides 45 and 46 secured to the housing wall and supporting structure, conveniently formed of T-bar stock having the flat faces secured to these opposite walls of the housing, respectively, and having the flanges thereof inwardly extending in a position to receive hoist slides 47 and 48, preferably disposed in pairs of which the members are at upper and lower extremities of a reciprocating hoist structure generally indicated at 50.

Vertical hoist frame members 51 and 52, which bear hoist slides 47 and 48, are rigidly secured to cross members 53 and 54, providing a rigid structure for the hoist 50.

The hoist unit so constructed is arranged to be moved vertically by an amount which is adjustable according to the size of the carton to be hoisted. Accordingly, hoist guides 45 and 46 are sufficiently long to accommodate motion of the hoist and hoist slides 47 and 48 therealong for a distance substantially greater than the height of the largest carton which will be stacked by the mechanism.

As shown in FIGS. 3 and 4, the hoist is in its lowermost position at which member 54 barely clears the floor. The member 54 of each hoist supports a pair of transverse members which extend inwardly toward the companion pedestal and are joined by a rigidly secured bar at the extremities to form a lifting arm 55 arranged generally parallel to the inward facing walls and extending sufficiently into the channel 12 to underlie cartons moved along the conveyer belt 17. Arms 55 may conveniently be of angle iron with a flat surface upward. At this location the channel bottom is removed to accommodate the arms 55, and the wall 44 is slotted to permit vertical reciprocation of the supports therefor. The arms 55 extend sufficiently into channel 12 so that when moved vertically they pass by the holding fingers later to be described, which extend thereinto by a lesser amount. On each arm 55 is a rigidly attached stop 56 arranged to arrest the passage of a carton in channel 12 when arms 55 are in the receive position shown at 55' of FIGURE 4. The stops 56 are arranged on a line perpendicular to the direction of travel of the belt and constitute means for orienting packages exactly within the stacking channel or well.

Ordinarily the pedestals will be closely adjusted to the width of the cartons then being stacked, thereby to cause proper lateral placement on the belt 17 over arms 57. Close spacing of pedestals 40 assures angular orientation of adequate precision for most purposes. Nevertheless, there may be circumstances in which narrower cartons are stacked without readjusting lateral spacing of the pedestals, and some misalignment might thereby result. A further feature of construction avoids this result. In the event one edge of an arriving carton is ahead of the opposite leading edge it will first strike one stop 56 (which is in position 56' when a carton is received) after which the carton will be carried along until the opposite edge strikes the corresponding stop 56 at the other side of the channel, pivoting about its support point on the belt 17. By this means each arriving carton is exactly positioned above arms 55 and each succeeding carton thereafter arriving will be placed in identical stacking position. Since it is a function of the lifting arms to raise these cartons in succession placing each one beneath a previously elevated carton, except in the case of the first carton of a stack, all cartons so arranged have aligned leading edges and with the lateral edges correspondingly aligned.

The hoist 50, here generally referred to in the singular, consists of two like frames, one in each pedestal. These hoist members are caused to coact as a single hoist by means of simultaneous operation of a pair of lifting arms 57, each of which reciprocatingly rotates with a supporting shaft 58, journaled in a pair of bearings 59, one bearing being on each pedestal 40 and secured to the housing 44 thereof and to the reinforcing structure therein by means of bolts as at 61. Both arms 57 of the pair are keyed to shaft 58 such that they operate simultaneously through the same arc of rotation thereabout. Arms 57 are each connected to the corresponding hoist structure by means of connecting rods 62, each secured to an arm 57 and to the hoist member by bearings 63 and 64, respectively.

At the top of one of the pedestals 40 there is mounted a drive motor 65, preferably supplied with a magnetic brake 66 or other means for bringing the motor quickly to a stop at the termination of any phase of its operation. The motor operates through a gear box 67 to rotate a drive disc 68 suitably supported in the pedestal for rotation about an axis parallel to shaft 58 to operate the hoist mechanism and lift a stack of cartons. Drive disc 68 carries a crank pin 69 to which connecting rod 71 attaches for operation by crank pin 69. The opposite end of each connecting rod 71 connects to one of the arms 57 at bearing 72 which may be adjustably located along the arm 57 at a distance from shaft 58 to accommodate various heights of lift desired for the hoist. It is thus seen that when the motor 65 operates, disc 68 is driven in rotation and arm 57 is moved in arcuate reciprocation whereas the hoist 50 reciprocates vertically between two positions determined by the adjustment along arms 57 of the bearings 72.

By the structure provided the motor 65, operating drive disc 68, connecting rod 71, lifting arm 57, connecting rod 62 and hoist 50 elevates the pair of arms 55, whenever a carton is placed thereon, to a predetermined height. This elevation is sufficient to bring the arms 55 above the level of the top of a newly arriving carton coming into the stacking well. To hold the carton in the elevated position until a further carton is placed thereunder holding fingers 73 and 74 are arranged one pair in each pedestal. Each such pair of holding fingers is supported on the structure of the pedestal adjacent to the inward facing wall and extendable through ports cut therein under control of the cycling mechanism to withdraw the fingers as cartons are lifted and insert them at the top of the stroke so as to hold up each successively elevated carton. Thus, each successively arriving carton is stacked beneath the carton previously elevated.

In order to release a completed stack from the elevated position the supporting fingers must be prevented from re-entering the stacking well during the remainder of that lift cycle. The holding fingers are arranged and actuated so as to be positively inserted into the stacking well at the appropriate time, and to be positively withdrawn from the stacking well, both when a new carton is elevated and when it is desired to release a stack. The structure to provide this feature of the invention includes bearings mounted on the frame within the pedestals at the inward facing walls thereof, these bearings being designated 75 in FIG. 4, and supported in any convenient manner on the internal structure supporting the walls 44. Bearings 75 carry shafts 76 supported for rotation therein. It is convenient generally to arrange one member of a pair of bearings 75 in each pedestal at either end of a shaft 76. Rotatively attached to shaft 76 is a frame member 77 which may be formed of a pair of angle irons interconnected by a rigid plate serving as a movable base structure for mounting the finger mechanism. The frame member 77 has inwardly extending flanges carrying shafts 79 arranged along a common axis parallel to shaft 76 substantially therebelow on the frame 77 such that rotation of frame 77 about shaft 76 moves the frame member outwardly from its normal position next to the wall 44. Shafts 79 receive the holding fingers 73 and 74, as illustrated in FIG. 5. Each finger consists of an elongated member of substantially L-section having a horizontal portion 81 extending into the stacking well when in the normal rest position and having a vertical portion at right angles thereto extending downwardly from its junction with the horizontal portion 81 and into contact with the frame member 77 so as to maintain the horizontal portion perpendicular to frame member 77 when in the normal position. The shafts 79 support the fingers by bearings 78 attached thereto near the junction between the horizontal portions 81 and the vertical portions 82.

The holding fingers thus attached to the frame member 77 are actuatable from the normal position of the frame member 77 which is vertical and which extends the portions 81 into the stacking well with a horizontal attitude. The frame member is supported for arcuate reciprocating motion at shaft 76 whereby when the frame member 77 is displaced from its vertical position, finger portions 81 are withdrawn from the stacking well. Means for positively withdrawing or inserting each pair of fingers in the stacking well consists of an air cylinder designated AC2 which may be of the bellows type, one in each pedestal, attached to the frame 77 by means of trunnions 84 supported by ears 85 which are rigidly attached to the frame members 77 by bolts as at 86. A piston shaft 87, or other bellows actuated shaft for each air cylinder AC2, extends to a bearing 88 which is supported by ears 89 secured to the inner wall of the stacking mechanism, preferably at the center thereof between the ports 83 through which portions 81 of the holding fingers extend. The air cylinder is of conventional design and is supplied with conventional fittings at either end thereof for the admission of air pressure and its release under control of a suitable control mechanism. Electrical control mechanism for the cylinders AC2 is indicated generally at 80 and is of conventional design supplied as a part of the air cylinder assembly with separate connections for control of air pressure to stroke the piston out or in upon signal. Thus, each pedestal is identically supplied with an air cylinder AC2, and a control mechanism 80 supplies air pressure from a suitable source not here shown. Actuation of the air cylinders either to stroke them in or out is controlled by electrical limit switches LS4 and LS5 operated by the rotation of the drive disc 68, as later described. When the cylinder is stroked out by admission of air to the right end thereof, as shown in FIG. 6, the piston together with its mounting on frame 77 is arcuately moved

to the right by the thrust of the rod 87 through its bearing 88 and support 89 against an inner wall of the pedestal. When the air pressure is released from the right end of the cylinder and pressure is admitted to the left end of the cylinder, the piston is stroked in and frame member 77 is pivotally actuated to its normal position vertically depending from shaft 76. As each carton is elevated by the hoist past the fingers 73 and 74, the air cylinders AC2 are stroked in to insert the fingers beneath the elevated carton. Horizontal portions of the fingers shown at 81 then extend into the stacking well by a distance somewhat less than the lifting arms 55 and, since the fingers are shorter than the arm 55, do not interfere with the return stroke of the lifting arm as it moves downward to its original position, shown in FIG. 4. However, as a newly arriving carton is elevated beneath the carton then resting on the fingers, these fingers are withdrawn by positive outstroking of AC2.

In order to avoid need for a precise timing of the cylinder stroke to always release the supported cartons of varying sizes at the instant the newly hoisted carton comes into bottom contact therewith it is convenient to employ ratchet action inherent in the described mounting of the fingers by bearings 78 on shafts 79 on the frame 77. Thus, while the hoist is elevating a new carton beneath that already stacked above the fingers, these fingers may be pushed aside in the event that the newly hoisted carton contacts the lowermost stacked carton prior to the time the fingers are fully withdrawn. When this occurs, the horizontal portions 81 are permitted to rotate upwardly about the shaft 79 to the extent necessary to permit the upward movement of the newly elevated carton, the ports 83 through which the fingers extend being elongated upwardly by an amount sufficient to permit ratcheting retraction of the fingers therethrough. As illustrated in FIG. 6, the normal position of the vertical portion 82 of the fingers restrains rotation of the fingers about the shaft 79 only in one direction such that the horizontal portions 81 may not be pushed below their horizontal position. The dashed line showing of a finger upwardly rotated in FIG. 6 is illustrative of the ratcheting action permissible by rotation on shaft 79. Unless the newly elevated carton contacts portion 81 of the finger it will not be so rotated because of the distribution of weight on the finger about the shaft 79. The fingers may thus be actuated either to the inserted or to the withdrawn position, positively by AC2, but may also be retracted by virtue of the passage of a carton from beneath into contact with cartons held thereon to permit a ratcheting action for the elevation of the newly elevated carton.

The structure also accomplishes the essential purpose of positive retraction during the entire downstroke of the hoist whenever a stack is completed, to permit stack discharge since the circuit actuating AC2 to the instroke is prevented from operating by the operation of a relay as the stack is completed. Cylinder AC2 remains in its outward stroke position until operation of the instroke control.

As best shown in FIG. 7, drive disc 68 has a lower dead-center position for crank pin 69 for which the hoist is in its lowermost position as described in connection with FIG. 3. This is the stack discharge position of the hoist corresponding to the electrical diagram of FIG. 12 rather than the position in which the stacking mechanism is ready to receive an additional carton for stacking. It will be noted that limit switch LS3 has a pair of normally closed contacts LS3a and a pair of normally open contacts LS3b. It is mounted on a structural plate behind the drive disc by means of pins 92 extending both through the structural plate 93 and the mounting plate on the switch LS3, each being provided with slotted apertures for the pins such that LS3 may be adjusted in rotation and in radial position with respect to the axis of the drive disc 68. By this means fine adjustment for the operating position of LS3 may be provided even though

actuation therefor is by a cam or striker 95 which is secured at the lower dead-center position for the disc 68. Cam 95 serves as a striker for actuate lever 96 of LS3 which is preferably supplied with a roller 97 in order to secure long life and reliable operation of the switch. The roller 97 bears against the rim of the disc 68 to rotate post 98 when the striker 95 thereon engages the roller 97. Roller 97 is shown displaced approximately thirty degrees from the dead-center position, so that LS3 would be actuated substantially past the dead center at which the hoist is at its bottom position. The striker is of sufficient width to assure that the motor brake 66 brings the motor to a stop before roller 97 passes completely over striker 95. The normally closed contacts LS3a remain closed except when striker 95 actuates lever 96. Opening of LS3a contacts cuts off the motor unless a shunt circuit therefor is provided (PCS), which will be presently described.

The function of the normally open contacts LS3b was described in connection with AC1 and the infeed metering device. These contacts are closed by actuation of the lever 96, and when series contacts LS1 are closed, there is completed an actuation circuit from a power supply to AC1 to stroke it out, which outstroking thus cannot occur at any hoist position except that indicated for actuation of lever 96.

When a carton is released by simultaneous actuation of LS1 and LS3b, the carton moves into the stacking mechanism and approaches the stops at 56' and breaks a photocell beam to close a photocell control switch connected in shunt with contacts LS3a previously described. A photoelectric cell and actuating light beam may be arranged so that the light source is in one pedestal while the receiving cell is in the other pedestal. The pedestals thus may be moved apart or closer together without in any way affecting the functioning of the photocell control. This control is illustrated in FIGS. 1, 11 and 12 as consisting of the two parts designated PC and PCS whereof PC is a photo control unit of conventional design energized from a suitable power supply in parallel with other operative circuits, and includes a conventional light source and the circuitry for closing a pair of switch contacts PCS when the beam is interrupted. There being no other cycling control element in series with PC, it will operate to close the contacts PCS at any time when a carton is between the two pedestals at the level of the arriving carton. While this occurs during stack discharge cycles, LS3a is already closed and PCS does not start a new cycle. Photocell actuation to close normally open contacts PCS avoids the difficulties inherent in movement of cartons both horizontally along the channel 12 and vertically in the stacking well, since no actual contact need be made with cartons.

The normally open contacts PCS and LS3a are in parallel connection from the power supply through the contacts of relay R2a (normally closed) to an actuating control for the motor 65 designated in FIG. 12 as D, and closing either PCS or LS3a to operate the motor 65. LS7 is mounted in position to be opened at the time when the drive disc 68 is in its lower dead-center position whereby the circuit to the motor control D, normally completed through closed contacts LS3a, may be opened to stop the motor, even though relay R2 is still energized, before it cycles to a position where LS3a opens (receive position). For this purpose LS7 is mounted on plate 93 as by mounting plate 99 and clamping bolts 101 passing through adjusting slots, as in the case of LS3. It has actuating arm 103 and actuating roller 104 thereon mounted for rotation about actuating post 102. It is arranged for actuation of the contacts into their open position at the time striker 95 is in its lowermost position at lower dead center.

Also under control of the hoist cycle there are limit switches for electrical control for finger actuation frame 77 for stroking out or in, as shown in FIG. 7, by a striker

105 at the top of disc 68 when 69 is at bottom dead center. A limit switch LS4 is mounted on structural plate 93 by means of mounting plate 106 and clamping bolts 107 operating through crossed adjusting slots in plates 93 and 106. The switch LS4 is fixed to plate 106 and has actuating lever 108 and actuating roller 109 arranged to rotate switch post 111 whenever striker 105 contacts roller 109, after which it returns by spring action to its normally open position. It has contacts which are closed by operation of lever 108 as roller 109 rides over striker 105, to supply power to AC2 control 80 and apply air pressure to the outer end of AC2, stroking both cylinders out simultaneously. LS4 has normally open contacts which serve to release the next carton waiting as at 18'. By arranging the actuation of LS4 somewhat later in cycle than LS3, LS4 remains unactuated except for a short interval after de-actuation of LS3 as a carton begins to be hoisted in the stacking well.

A similar limit switch LS5 is fixed on mounting plate 112 and adjustably secured to plate 93 by bolts 113 as in the mounting of LS4. LS5 is actuated by lever 114, roller 115 and post 116, and is mounted to cause roller 115 to contact striker 95 as the hoist reaches top dead center, thereby operating control 80 to admit air to AC2 stroking them in at that time. Power is applied to control 80 through normally open contacts of LS5 when actuated except when further control contacts in series therewith are opened during the stack discharge cycle.

During each lifting cycle as the hoist reaches its lowest position after elevating a carton, or lowering a stack of cartons upon the conveyer, the motion of the hoist is terminated by the opening of LS7, except that this is permitted to happen only during lowering of the completed stack because normally closed contacts R2a are in shunt circuit across the LS7 contacts, and provides control by LS7 only when R2a is opened to cause stack discharge.

The discharge cycle is initiated by any hoist cycle which elevates a top carton of the stack to a level predetermined to limit the stack height. A limit switch LS6 is mounted at an adjustable position near the top of the stacker on one pedestal with an actuating lever, of any well-known type permitting a degree of overtravel, disposed within the well to be contacted as the hoist elevates a completed stack to the predetermined position. Normally open contacts LS6 are then closed and normally closed contacts R2a are opened to place LS7 in control of the hoist motor as previously described. To lower the stack the fingers 73, 74 are prevented from entering the well below a completed stack by breaking the circuit to AC2 (in). To keep the fingers retracted after LS6 is de-actuated, relay R2 is provided with connections to a power supply for actuation when LS6 closes. R2 has contacts R2a in shunt with LS7, as before noted, normally closed contacts R2b in series with LS5 and AC2 (in), and normally open contacts R2c shunting LS6 to form a keep-alive or lock-in circuit for R2, effective upon the opening of LS6 as the stack is lowered. Contacts R2b prevent insertion of the fingers by de-activating the LS5 control of AC2 (in) and R2a holds open the shunt for LS7 making the latter effective in stopping the motor at its lowermost position to allow the stack to pass from the machine over stops 56.

To re-establish control of the mechanism by the cycle controls a limit switch LS8 is disposed beside channel 12 at the outfeed section of the stacking well having an actuate lever indicated in FIG. 1 at 117 and normally closed contacts thereof interposed in the power circuit to R2 via LS6. Upon actuation of 117 as a stack passes from the well, LS8 opens to break the circuit to R2, thereby restoring normal cycling controls as before actuation of LS6, since control LS7 which stopped the motor at bottom dead center is then shunted by R2a to cycle the hoist motor on to the point of breaking its supply circuit as LS3a reopens. LS8 closes upon the passage of the stack there-

beyond and the mechanism is then ready for a new cycle conditioned upon the presence of a carton against stop 15.

It sometimes becomes desirable to terminate a stacking operation prior to the completion of the stack, and to discharge the partially formed stack. This is accomplished by means of the discharge button and contacts carried by R2. As previously noted, operation of the discharge button closes R2c to lock R2 in the operated condition. Further contacts R2d, are connected in parallel with PCS and LS3a and in series with either R2a or LS7 to maintain motion of the hoist mechanism through D. Contacts R2e are connected in series with LS4 and AC2 (out), and these contacts do not affect the operation of the mechanism previously described except that the fingers may not be inserted in the well to intercept a descending partial stack of cartons during a downstroke of the hoist, when R2 is actuated. R2b and R2e are normally closed contacts permitting operation of AC2 either out or in as LS4 or LS5 is actuated. Contacts R2c and R2d are normally open, and close only as R2 is actuated. A further set of normally open contacts R2f is connected, one contact to the junction of R2e and AC2 (out) at one end and the other to the junction of LS5 and R2b, to provide control of the holding fingers during a manual discharge cycle, causing the holding fingers to remain effective until the hoist reaches top dead-center position as in the normal stack discharge operation.

To briefly restate the automatic operation of the stacker, we may start with the stacker moved through a discharge cycle and returned to its receive position such that the stacking well is empty and the lifting arms are in position beneath the channel 12 but above their lowermost position such that the stop 56 on each arm extends upward into this channel. Switch LS3 is actuated by striker 95 to close LS3b and open LS3a. The parallel-connected switch contacts PCS are also open, thereby to cut off the motor actuator D. LS1 may then or thereafter be actuated by arrival of a carton against abutment 15, to close LS1. All other motion limiting switches are in their rest or normal condition. LS6 and LS7 are thus closed to complete the circuit through D whenever either LS3a or PCS is closed.

Starting with the machine at the receive position, a carton is placed in the infeed section, the conveyer transports it along the channel until it reaches the abutment 15 and is held there. Since LS1 contacts are arranged for actuation when the arm 34 is urged in the direction of motion of the cartons on the conveyer, they will be closed when the carton arrives at 15. Since LS3b is already closed, LS1 now completes the circuit from the power supply to the actuating solenoid for the air cylinder AC1, thereby causing the air cylinder to be stroked out. Plate 28 attached to AC1 is thrust against the forward portion of the carton urging it laterally into the channel to pass abutment 15, and the conveyer is enabled to carry the accepted carton into the stacker. Contacts LS1 open to break the circuit to the outstroke solenoid for AC1.

The first carton is then moved into the stacker sufficiently to operate photocell PC and close contacts PCS in shunt with open switch LS3a starting the hoist motor by operation of motor control D. Upon operation of the hoist motor the striker 95 leaves its engagement with the actuating arm for LS3, thereby closing LS3a to maintain operation of the motor and opening LS3b to prevent a new metering action at the infeed mechanism regardless of actuation of LS1. The positioning of the photocell is such that the hoist does not elevate the carton until such time as it has passed along the channel into contact with stops 56', one on each hoist arm. A second carton approaching the abutment is stopped by plate 29 before it reaches LS1 which cannot be actuated until LS4 returns AC1 to its position. Thereupon carton 18" moves to the position at 18.

The drive disc 68 attached to the hoist motor rotates to close limit switch LS4 to cause the hold fingers to be

withdrawn from the vertical channel in which the carton is moving, before the package has progressed much above the channel. This finger retraction is achieved by operation of AC2 (out). When the drive disc has reached its 180 degree rotation position, the striker 95 engages the actuator of the switch LS5, thereby energizing the in-stroke solenoid control for AC2. LS5 is actuated at about top dead center for the hoist, and the hold fingers are inserted beneath the carton to prevent its return to the conveyer channel. The motor continues lowering the lift arms until the drive disc is at the bottom dead-center position at which time LS7 is actuated, but the actuation of LS7 does not become effective to break the circuit to the motor control D because of the shunt path through R2a. The motor continues to operate until the striker 95 actuates LS3 to open LS3a, at which time it is again stopped in the receive position. This permits a further metering action to occur with the release of a second carton at the abutment and its transport along the conveyer into the stacker for re-actuation of the motor as PCS contacts close. A further lift cycle commences, as before, the second carton rising exactly beneath the first carton and thrusting thereagainst at approximately the time LS4 again operates to stroke the hold fingers out of their holding position. Thereafter the lifting arms raise both cartons until the lower one is in the position occupied by the previous one, and the hold fingers are again inserted, this time beneath the second carton. The hoist motor continues its operation as before, again picking up a carton as it is released thereto by the metering device. The third carton takes its position beneath the other two raising them thereabove in a stacked array.

When, for example, five cartons are to be stacked one above the other, the fifth carton is raised to the first elevated position of the first carton, and the first carton stacked thereabove extends to a position in the stacking well which is set as the limit of stack height, the carton striking the actuating lever for LS6. As the contacts of LS6 close, a circuit is made through normally closed LS8 to relay R2 which is locked in to hold open the circuit for air cylinders AC2 (in). In this way completion of the stack prevents the reinsertion of the holding fingers beneath the bottom member of the stack, and the entire stack is thereupon lowered to the conveyer. The lifting arms pass sufficiently beneath the horizontal channel so that the stops 56 permit passage of the stack along the conveyer to the exit opening of the stacker.

As the hoist reaches the bottom of its travel, LS7 opens to stop the motor which remains stopped until such time as R2a recloses. Switch LS8, mounted adjacent the exit of the stacker, is actuated as the cartons emerge from the stacker to open its contacts, thereby interrupting the circuit to R through its hold-in contacts R2c. R2 thereupon returns to normal condition, R2c being opened thereby and R2a and R2b being closed. LS8 recloses as the stack passes. The hoist motor cycles on to its receive position as R2a closes. A complete discharge cycle has now occurred, and all switches are in the same position as at the beginning of the operation described. It is noted that all switches are in their normal or un-actuated positions just prior to the reopening of LS3a when no carton is at abutment 15.

While additional circuits may be employed for further control of the stacker, they do not enter into the stacking operation as described except that this stacking operation may be interrupted automatically for such purposes as assuring that the exiting stacks are properly disposed of. The stacking mechanism described could, for example, be employed with a palletizing device having a further limit switch controlling the motor control device to prevent the operation of the hoist if the stack disposal area is filled. Since various auxiliary devices do not form a part of the present invention, they are not further described.

It will also be understood that while certain of the switch combinations are described as separate switches, they may cooperate in point of time and could be combined in a single unit when suitably actuated. It is likewise evident that the relay having thereon several sets of contacts could be replaced by an equivalent structure employing more than one relay, but with substantially the same switch closing and opening functions, suitably synchronized in time as indicated. Similarly LS3 controlling the instroke and the outstroke of AC2 could be replaced by separate switches actuated at substantially the same time so long as both the instroke and the outstroke solenoids were not simultaneously actuatable. R1 is shown in series with P.B. START and P.B. STOP to provide for locking-in power connections after P.B. START is released. A self-locking P.B. START button might be used in lieu of the arrangement shown.

It will also be understood that while limit switches have been described and illustrated as simple expedients for the closing of circuits in prescribed cycling relationship to each other, equivalent structure could be employed by anyone skilled in the art employing relays or other similar devices closing contacts according to the time relationship described. Similarly, it is a matter of choice whether air cylinders are actuated by solenoids as described or by some other suitable means under automatic control of the switching arrangement selected. Employment of the components and mechanism as illustrated and described provides a rugged unit which is highly reliable in operation and adaptable to ready adjustment for stacking of cartons of various sizes, either by simple adjustment of the channel width as the pedestals are positioned or by the changing of the position of such switches such as LS6 and of the stroke of the lifting lever 57 by adjustment of the position of attachment of the connecting rod 71 thereto. It will be observed that the driving disc carrying the rotary moving end of the connecting rod describes a constant circle, for example employing a circular diameter and stroke of eight inches, thus providing a motion of the lifting platform variable up to about eighteen inches.

It may also be observed that additional circuitry may be used such as a push-button mechanism for starting the operation under manual control with a further push-button for stopping the action until such time as it is manually re-started. Likewise, a push-button actuating device might be desired for by-passing the complete stacking of a stack of cartons. This might occur, for example, at the end of a day or when for some other reasons it might be desired to terminate the operation before a stack is completed. By this means a partial stack could be discharged without otherwise affecting the readiness of the mechanism to resume the automatic stacking operation. Such manual controls are diagrammatically illustrated in FIG. 12. In this way a completely versatile unit is provided which is adaptable for manual operation at critical points or under unusual circumstances with a return to automatic operation whenever desired. The structure described and illustrated is exceedingly compact and operates with a conveyor which need not extend more than four inches above the floor upon which it is mounted, and requires no operating pit. It is, therefore, transportable and may be set up at any place desired; either at the place where the cartons are loaded or at a storage facility where it is desired to stack cartons in a massive array. Since the two pedestals are floor mounted on either side of a conveyor and are connected together only by the shaft which interconnects the hoist arms to assure their simultaneous operation, the unit is readily assembled astride a suitable conveyor at which it is desired to employ stacking operations. The only other required connection between the two pedestals of the stacker is the air hose for the simultaneous operation of one of the two air cylinders AC2, and electrical controls for the air cylinder which is not at the pedestal having the motor

and other control circuits. An additional feature is the employment of an infeed metering mechanism which is easily and quickly attached to a channel merely by the placement in the channel infeed section both the offset channel guide and the abutment with the metering switch and actuating cylinder AC1 attached. Limit switch LS8 may be secured by an arm to one of the pedestals, being disposed for actuation as the stacks emerge from the machine.

While the invention has been described with respect to a particular embodiment, it will be understood that many modifications of the operative principles are contemplated within the scope of the appended claims.

What I claim is:

1. Box stacker mechanism comprising in combination: a pair of frame members defining a stacking well, a through-feeding conveyer having a load transporting belt moving through said well from an infeed station to a loading station therebeyond, means at said infeed station preventing boxes transported by said belt from entering said well until individually released, reciprocatingly cycled means supported by said frame members for elevating each box entering said well sufficiently to clear the next entering box, paired finger means one in each said member controllably insertable in said well to restrain downward motion of elevated boxes, control means actuated by the lift means to positively retract said finger means during elevation of boxes and to reinsert said finger means prior to a return stroke thereof for causing successively elevated boxes to be bottom-stacked on the finger means, second control means actuated by a predetermined stack elevation to prevent the next succeeding said reinsertion of the fingers for causing stacked boxes in said well to be returned to said belt for movement to said loading station, third control means responsive to completion of each reciprocating cycle for releasing a box in said infeed station, fourth control means delaying completion of a cycle during which said second control means is actuated until said stacked boxes have reached said loading station, and stop means attached to said elevating means for arresting boxes on said conveyer belt when said cycle is completed, said stop means being retracted below said conveyer during said delay of a cycle.

2. In the stacker mechanism of claim 1, first said means including a fixed transverse abutment and conveyer guide means directing each box transported therealong into arrested position against said abutment.

3. In the stacker mechanism of claim 2, said third control means including a powered transverse thrust arm laterally disposed before said abutment and actuated in response to presence of a box against said abutment when said cycle is completed.

4. In the stacker mechanism of claim 1, said stop means comprising a pair of stops disposed on either side of said conveyer belt perpendicular to the line of motion thereof whereby transported boxes are individually re-oriented in fixed position.

5. In a carton stacking device including a through-feeding conveyer and an elevator structure straddling said conveyer and having lift arms normally at the conveyer level reciprocatingly cycled above and below said level from the elevator to elevate above said conveyer each carton entering the structure, a lateral offset in said conveyer adjacent the entrance of said elevator disposed to stop cartons passing therealong, means electrically actuated when said lift arms are at said level to mechanically release a carton at said offset being electrically de-actuated upon said release, object sensing means electrically initiating a reciprocating lift cycle of the arms upon entrance of a released carton into the elevator, control means on said arms stopping each entering carton in predetermined orientation thereon, means actuated at the top of each lifting cycle to insert retaining fingers beneath the carton last elevated, means actuated during the first of each succeeding lifting cycle withdrawing said fingers

from the elevation path and causing any cartons already supported in elevation to be stacked upon the carton then in the lifting cycle, control means operative at predetermined stack height to prevent said insertion of the fingers during the instant cycle to cause the stacked cartons to be lowered upon said conveyer, means interrupting the cycle while said arms are below said level after lowering said stacked cartons, and means responsive to exit passage of said stacked cartons for completing said cycle.

6. A carton stacking machine comprising, spaced vertical support members defining lateral stacking well limits, a horizontal conveyer operative between said members forming infeed and outfeed sections, paired elevator arms one carried by each of said support members, hoist means for cycling said arms from a receiving position to upper and lower limit positions, paired holding supports one carried by each said support member exteriorly of said elevator means and within said well limits, closed gate means stopping cartons in said infeed section, means operative while said elevator means are in said receiving position for releasing one carton at said gate means, means operative upon said release reclosing said gate means, means operative as said carton arrives between said members to actuate a cycle of said hoist means, means actuated by operation of the hoist means withdrawing said holding supports from said well during upward motion of said arms, means operative at said upper limit position reinserting said holding supports in the stacking well below last said limit position, stack release means operative during a selected downward motion of said arms preventing operation of last said means, thereby to lower stacked cartons upon said conveyer, means on said arms for preventing passage of a carton while in said receiving position and permitting passage thereof while in said lower limit position, means arresting said cycle in said lower limit position on operation of said stack release, and means operative when said stack release means is not operated for returning said arms to said receiving position.

7. In a stacker mechanism having a vertical stacking well above a continuously moving conveyer, driven rotary cam means, elevator means reciprocatingly operated by said cam means operative in said well to elevate each carton received therein, means controlled by said cam means for holding each last elevated carton at the upper limit of elevator operation, means controlled by said cam means for withdrawing from said well the holding means as successive cartons are raised therein, means releasing cartons when stacked to predetermined height being operative to withdraw until the stack is released the holding means from the well when said height of stack is reached, and gate means admitting one carton to the stacker at the end of each elevator reciprocation, comprising an infeed channel section offset from said well to arrest cartons arriving thereat and means for laterally displacing cartons in said channel section to alignment with said well.

8. In a carton stacker including a conveyer having infeed and outfeed sections adapted to transport single cartons thereto and stacked cartons therefrom, having hoist means including arms continuously cycleable from a position for receiving a carton thereon to an elevated position above the next entering carton, thence to a position below said receiving position and finally to said receiving position for elevating to uniform height each carton upon passage from the infeed section, optical sensing means for detecting the passage of the carton from said infeed section, powered shaft means operatively supporting crank means for driving said arms and opera-

tive in response to actuation of said optical means, cam means synchronously rotatable with said shaft means to actuate a power circuit only when said arms are in said receiving position, a metering device in said infeed section comprising offset means on said conveyer arranged to displace cartons to one side of the conveyer, an abutment at said side constructed to engage and hold a first corner of a transported carton and arranged at least one carton length toward said stacker from the termination of said displacing means, whereby a carton may be repositioned to pass said abutment, a control switch having actuate means arranged for actuation by a carton contacting said abutment whenever said power circuit is actuated, electro-mechanically operated pusher means responsive to the presence of said hoist means in its receive position and to the actuation of said actuate means extendable to reposition said corner of said carton, and means controlled by rotation of said cam device for retracting said pusher means at a delayed position in each said cycle, said pusher means being effective when extended to prevent further operation of said switch until the hoist has been operated.

9. In a carton stacking machine, a continuously operating conveyer means defining a horizontal pathway through said machine, a frame defining a vertical stacking channel above said means, paired vertical lifting arms disposed one at each side of said channel, paired arresting stops one on each said arm arranged when in said pathway to define a stacking position for a carton transported by the conveyer means, lift cycling means responsive to arrival of each carton at said stops for elevating said arms to a height exceeding one carton height and return through a bottom position to an initial position with said stops in said pathway, means operatively responsive to completion of the lifting portion of said cycle for inserting holding fingers beneath said carton in its lifted position, metering means at said horizontal pathway preventing cartons from entering said machine during said cycle and releasing one carton upon completion of said cycle, means operative upon successive elevations of cartons to withdraw said holding fingers from said channel thereby depositing previously lifted cartons upon the carton lifted by said arms during instant said cycle, control means operatively responsive to accumulation of a predetermined stack elevation for interrupting during instant said cycle the operation of said inserting means thereby to lower the stack to the conveyer, means interrupting said cycle at said bottom position sufficiently beneath said initial position to maintain said stops below said pathway thereby to permit exit of cartons lowered on the conveyer means, and means thereupon causing completion of said cycle.

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