

July 15, 1958

A. H. MERKNER ET AL
ARTICLE PACKING APPARATUS

2,842,912

Filed April 15, 1953

5 Sheets-Sheet 1

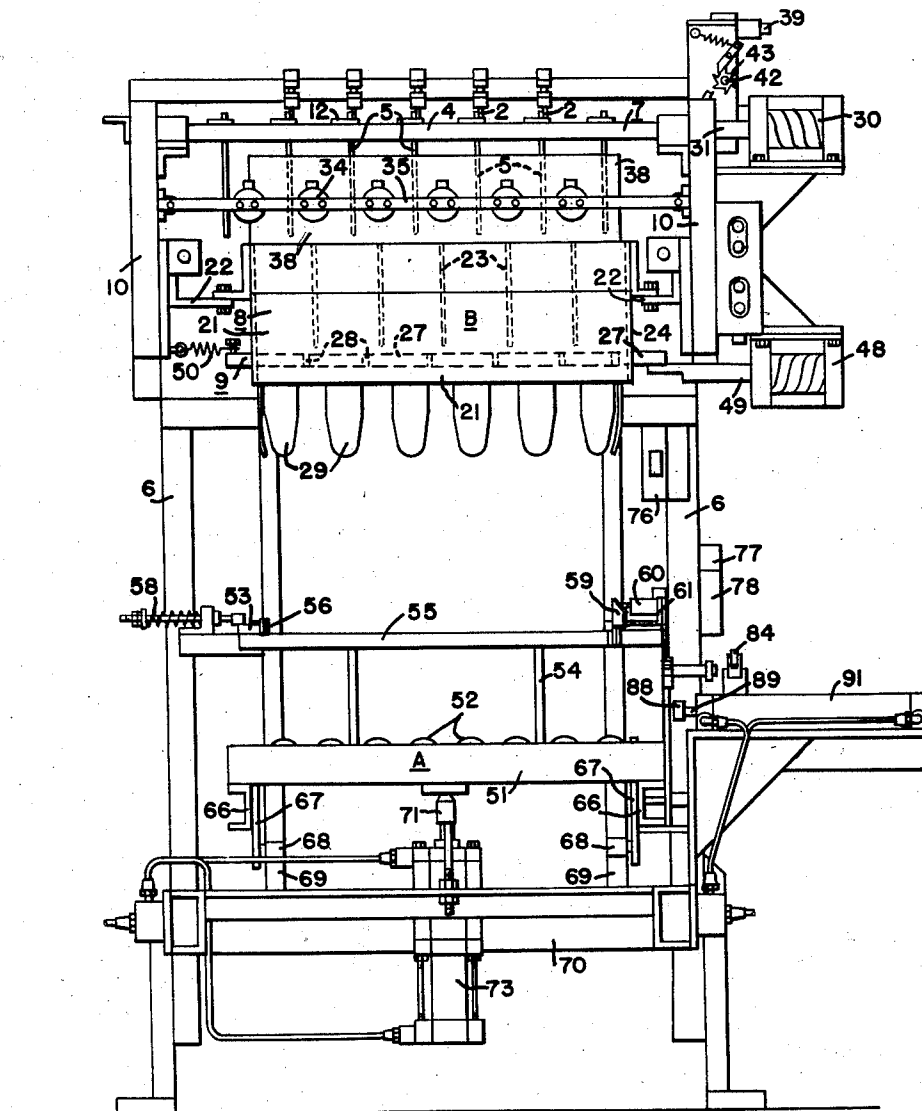


Fig. 1.

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5 Sheets-Sheet 2

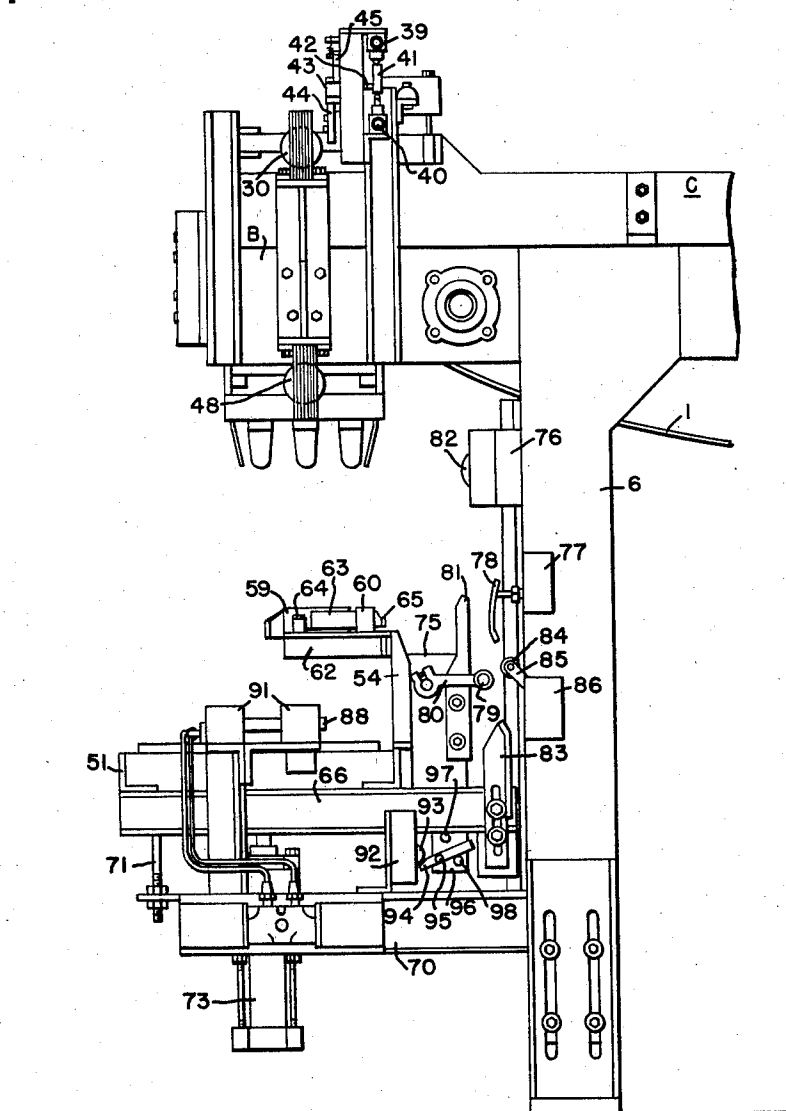


Fig. 2.

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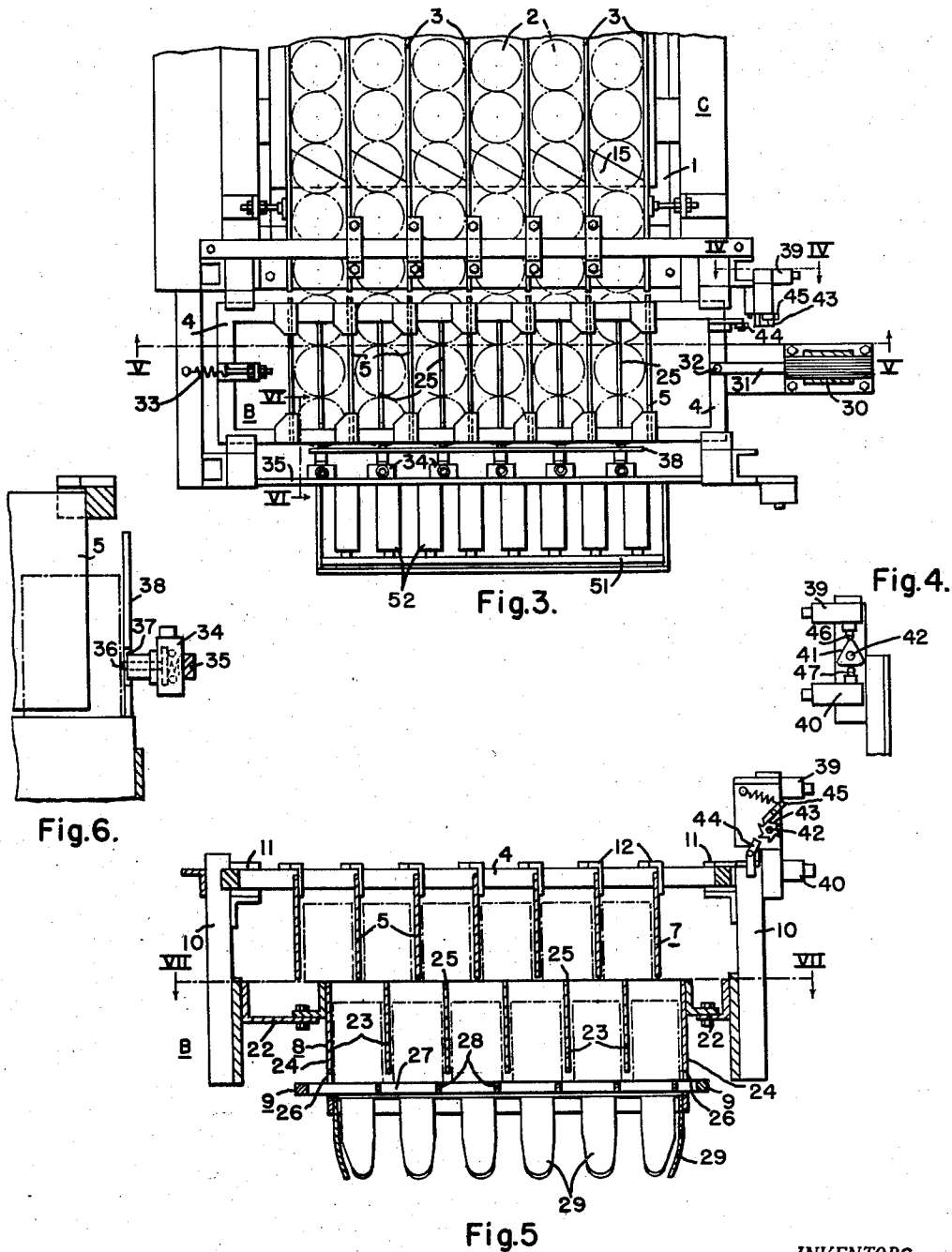
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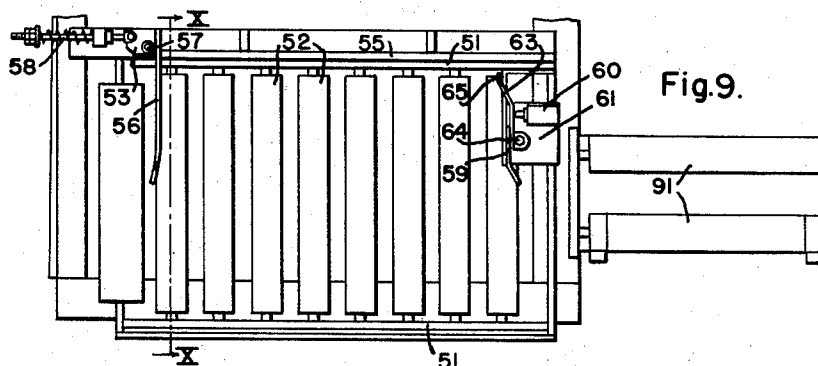


Fig.9.

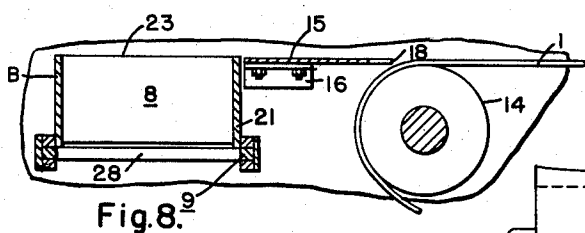


Fig. 8.5

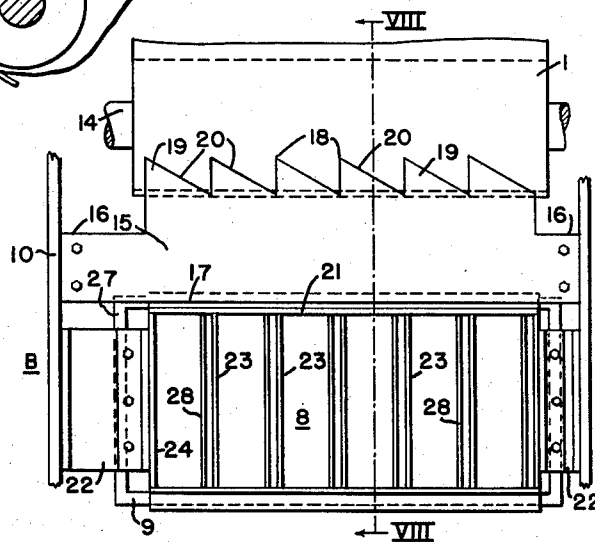


Fig.7.

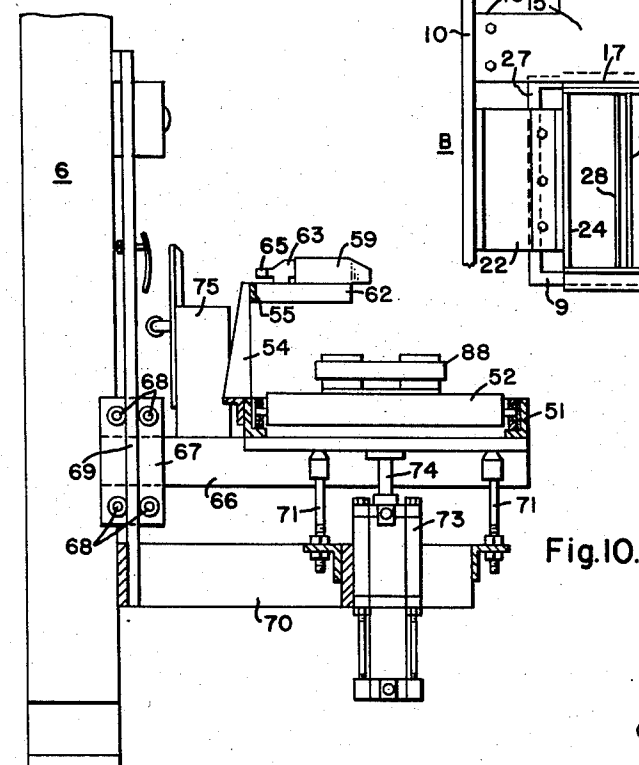


Fig.10.

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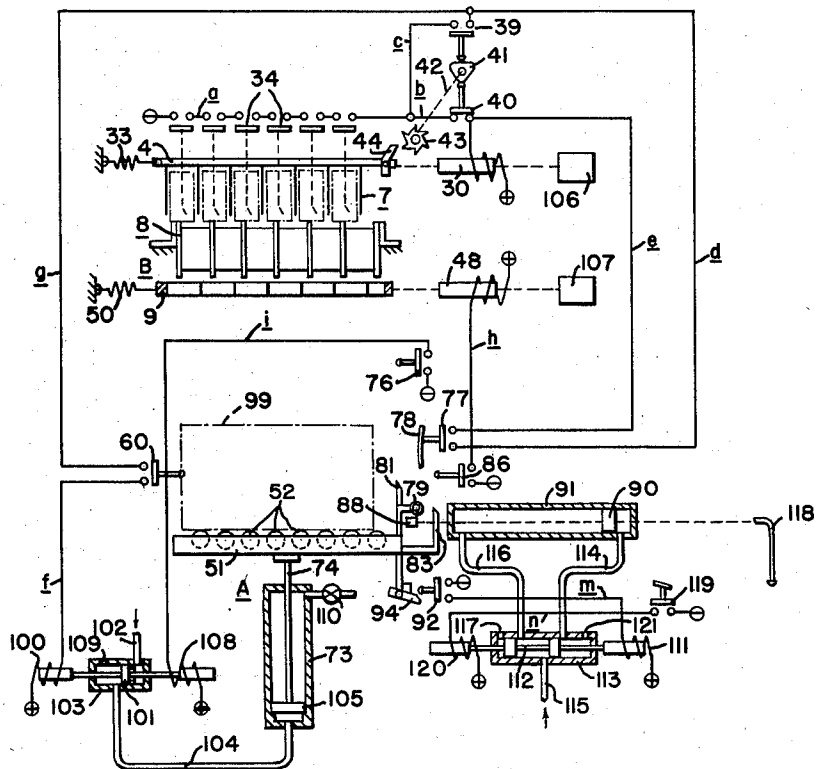


Fig.II.

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ARTICLE PACKING APPARATUS

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Application April 15, 1953, Serial No. 349,018

27 Claims. (Cl. 53—61)

This invention relates to an apparatus for packing plural layers of articles and more particularly for packing plural layers of cans in container boxes such as are customarily provided for shipment and storage.

While the article packing apparatus of this invention is primarily for the purpose of packing cans in cardboard boxes or cartons, it is to be understood that its principles are applicable equally well to the problem of packing other types of articles. Cans such as those commonly employed in the food industry are generally cylindrical in shape and must be packed after filling in boxes for storage and shipment, two layers of cans being usually packed in each case. The conventional packing apparatus for this purpose comprises an inclined track down which the cans are rolled on their sides to an assembling mechanism composed of tiers corresponding in number to the number of rows of cans to be packed where a single layer of cans is assembled. At the assembling mechanism, the operator places a box on its side with its open end facing the assembling mechanism and operates a pusher mechanism which moves the assembled layer of cans into the box. To insert a second layer of cans in the box, the pusher mechanism must be retracted in order that another layer may be assembled in the tiers of the assembling mechanism, and then the pusher mechanism must be operated a second time to move the second layer into the box. The number of operations required of the operator and the inherent time delay between the various operations act to limit the production of this type of apparatus. In addition, this type of apparatus results in frequent damage to the cans by reason of rolling on their sides, and the rolling movement of the cans to the assembly mechanism too often results in a stoppage of the can supply along the supply conveyor which further cuts down production.

To the end of reducing the time required for packing, this invention contemplates an apparatus in the form of a unit which will accept a box or receptacle in which cans are to be packed, assemble the cans in layers, pack the layers of cans in the receptacle, and eject the case properly packed, all of these operations being performed in a manner which is not dependent upon the constant attention of an operator. Generally stated, the apparatus of this invention comprises a novel form of can collecting mechanism in which the cans are assembled in superimposed layers and dropped into an underlying box or receptacle. The box to be filled is delivered to the collecting mechanism by an elevator on which it is placed by an operator or by a box conveyor, and after filling of the box, the elevator returns it to a discharge station where it is automatically ejected. In a manner to be described, the various can assembling and charging operations incident to filling a box with two layers of cans are accomplished automatically in a cyclic manner initiated by emplacement of the box on the elevator.

The specific structure of the apparatus, its operation and advantages, will become apparent from the following description.

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In the drawings, there is shown a preferred embodiment of the invention. In this showing:

Fig. 1 is a front elevational view of an apparatus constructed in accordance with the principles of this invention;

Fig. 2 is a side elevational view with the can delivery conveying mechanism broken away;

Fig. 3 is a plan view of the apparatus shown in Figs. 1 and 2;

Fig. 4 is a fragmentary and detailed sectional view taken substantially along the line IV—IV of Fig. 3;

Fig. 5 is a sectional view taken substantially along the line V—V of Fig. 3;

Fig. 6 is a sectional view taken substantially along the line VI—VI of Fig. 3;

Fig. 7 is a plan view taken substantially along the line VII—VII of Fig. 5;

Fig. 8 is a sectional view taken substantially along the line VIII—VIII of Fig. 7;

Fig. 9 is a plan view of the elevator which is employed for elevating cartons to a can receiving position;

Fig. 10 is a sectional view taken substantially along the line X—X of Fig. 9 showing the essential parts of the elevator mechanism in side elevation; and

Fig. 11 is a schematic view illustrating the essential parts of the apparatus diagrammatically and showing a control circuit in connection therewith.

In the drawings, the latter A designates an elevator mechanism which receives the cartons or boxes to be filled with cans for elevation to a can receiving or charging position immediately underneath a can collecting and assembly mechanism B. In a manner to be described, the mechanism B collects the cans in two layers which respectively contain several parallel rows, and feeds such layers at the proper time into a carton which is supported below on the elevator mechanism A. Thereafter, the elevator mechanism A is lowered to its starting position where the filled carton is automatically ejected from the elevator. The cans are fed to the assembly mechanism B in parallel rows by a conveyor assembly C which, per se, forms no part of this invention. As will become apparent, the cycle of operations required for filling a carton with two or more layers of cans begins with the emplacement of the can-receiving carton on the elevator mechanism A, the subsequent operations all being performed automatically.

As indicated above, the conveyor mechanism C forms no part, per se, of this invention, and only a part thereof has been illustrated somewhat diagrammatically in Figs. 2 and 3. It comprises a conveyor belt 1 on which cans 2 are supported in endwise position for delivery to the assembly mechanism B. While the belt 1 has been indicated diagrammatically as a flexible belt, it will be formed in actual practice of transversely extending slats connected together in conventional manner to provide the required flexibility. Guides in the form of laterally spaced vertical plates 3 which extend longitudinally of the belt 1 provide parallel spaces through which the cans are delivered in parallel rows, as best illustrated in Fig. 3, to the assembly mechanism B. The assembly mechanism B includes a transversely shiftable frame 4 carrying vertically extending and laterally spaced plates 5 which, in the position illustrated in Fig. 3, provide parallel spaces in which the cans are received in parallel rows. A suitable form of mechanism C for conveying the cans to the assembly mechanism B is illustrated in Patent No. 2,219,817, issued October 29, 1940, to W. D. Kimball et al., which is referred to for a more detailed showing.

Can-assembling mechanism

The can assembling mechanism B of this invention is mounted on vertical uprights 6 forming part of a sup-

porting framework. The preferred embodiment of the mechanism B comprises three vertically spaced grids 7, 8 and 9 which are arranged in a manner best shown in Fig. 5. The top grid 7 includes the transversely shiftable frame 4 and plates 5 mentioned above. The frame 4 is supported on vertical supports 10 by brackets 11 which provide a sliding support therefor enabling its position to be shifted transversely relative to the supports 10. The plates are mounted on the frame 4 by brackets 12 and depend from the frame 4 whereby the plates 5 may be shifted to the right of the position shown in the various figures. In the position of the frame 4 shown in the drawings, the plates 5 are aligned with the conveyor guide plates 3 so that the cans may move from the conveyor C by a sliding movement into the spaces between the plates 5.

Referring now to Figs. 7 and 8, it will be noted that the belt 1 is trained over a reel 14 and thus terminates short of the assembly mechanism B. To transfer the cans over the interval between the reel and assembly mechanism there is provided a thin sheet metal plate 15 which is mounted on the supporting framework by brackets 16 at its transverse ends. The plate 15 has one transversely extending edge 17 positioned adjacent the assembly B so that cans sliding over the upper surface of the plate 15 may be easily transferred to the assembly B. An opposite edge 18 is positioned adjacent the end of the belt 1 at the point where it starts to move downwardly over its reel 14 for accepting cans from the belt 1. The edge 18 is provided with a plurality of laterally spaced fingers 19 which respectively project underneath one of the spaces between adjacent conveyor guides 3. The fingers 19 are triangular in shape and have edges 20 which slope diagonally relative to the path of can movement so that the plate edge 18 has essentially a saw-tooth configuration to facilitate sliding movement of the cans onto the upper surface of the plate 15. As the cans move to the end of the belt 1, they tend to follow the movement of the belt downwardly over the reel 14 and thus tilt. The fingers 19 engage under the tilted lower ends of the cans so that the cans slide on to the upper surface of the plate 15. By reason of the sloping edges 20 of the fingers 19, there is no abrupt edge presented to the cans during their forward movement which might otherwise act as an abutment and impede such forward movement.

The intermediate grid 8 comprises a hollow rectangular housing 21 which is stationary and is mounted by brackets 22 on the supporting standards 10. The housing 21 mounts a plurality of parallel plates 23 which have a spacing corresponding to the spacing of the spaced plates 5 of the movable grid 7. The plates 23 define spaces therebetween for the reception of cans. The sides 24 of the housing 21 provide the end plates 23 and are extended below the level of the intermediate plates 23 as best shown in Figs. 1 and 5. In the position illustrated in the drawings, the upper edges 25 of the plates 23 are positioned centrally of the spaced plates 5 of the movable grid 7 to form a support for the cans delivered to the movable grid 5 from the conveyor C. As the cans move in parallel rows from the forward edge 17 of the supporting plate 15, they slide over and are supported by the upper edges 25 of the stationary grid 8.

The extended lower portions of the sides 24 are slotted as at 26 to provide a sliding support for the movable grid 9 which is a restraining grid. The movable grid 9 comprises a rectangular frame 27 having plural and spaced parallel restraining members 28. In the position illustrated in the drawings, the restraining members 28 are positioned intermediate the plates 23 of the stationary grid 8 to provide a restraining support engageable with cans in the stationary grid 8 for preventing downward gravitational movement of the cans. The restraining grid 9 is shiftable to the right as viewed in the drawings to a position in which the restraining members 28 are aligned with the plates 23. Such shifting movement moves the restraining members 28 out of engagement with the bot-

toms of the cans positioned in the stationary grid 8 and releases the cans for downward gravitational movement through the restraining grid.

The lower edge of the housing 21 has plural spring leaves 29 depending therefrom for holding open the closure flaps of a carton which is elevated to receive a filling of cans from the assembly mechanism.

The structure of the can collecting and charging mechanism B will be better understood by referring briefly to the operation of the three superimposed grids 7, 8 and 9. When the spaces between the plates 5 of the movable grid are filled with cans, the frame 4 is shifted to the right as viewed in the drawings to a position in which the plates 5 are aligned with the plates 23 of the stationary grid 8. This action moves the cans out of supporting engagement with the top edges 25 of the plates 23, and the cans are thus released for gravitational movement into the stationary grid 8. Downward gravitational movement of the cans through the movable grid is stopped by engagement of the bottoms of the cans with the restraining members 28. Movement of the frame 4 to the right in this manner moves the plates 5 of the movable grid 7 out of their aligned position with the conveyor guide plates 3 and to a position in the path of movement of the cans from the conveyor C. The plates 5 thus become effective to stop the forward movement of the cans by the conveyor C and the supporting belt 1 slides under the cans while their forward movement is restrained in this manner. After the movable grid 7 drops its charge of cans into the stationary grid 8, it is returned to the position illustrated in the drawings to collect another layer of cans. When the second layer of cans is collected by the movable grid 7, the frame 4 is again shifted to the right to drop the second layer of cans into the stationary grid 8. Just before the second layer of cans are dropped into the stationary grid 8, the restraining grid 9, in a manner to be described, is shifted to the right to move the restraining members 28 out of supporting engagement with the cans in the stationary grid 8, as described above, to release the first layer of cans for movement downwardly into a packing case on the elevator underneath the charging mechanism B. The restraining grid 9 is maintained in its shifted position until after the second layer of cans are dropped into the stationary grid 8 so that the second layer of cans will gravitate through both the stationary grid 8 and the restraining grid 9 without stoppage of downward movement by the restraining grid 9.

While the particular arrangement of superimposed grids 7, 8 and 9 as shown in the drawings and described above will charge a case with two layers of cans, it will be understood that modifications permitting charging a case with three or more layers are contemplated. For example, to charge a case with three layers of cans, it will only be necessary to increase the depth of the stationary grid 8 so that it will accommodate two layers of cans therein. In such case, the restraining grid would be shifted once for every three shifting movements of the top grid 7 instead of once for every two shifting movements as described above. While the top and bottom grids 7 and 9 have been described as being shiftable and the intermediate grid 8 as stationary, it will be further understood that modified grid shifting arrangements may be employed without departing from the principles of this invention.

To shift the top grid 7 to the right as described above, a solenoid 30 is provided. The solenoid 30 has an armature 31 which is connected at 32 to one side of the frame 4. Upon energization of the solenoid, its armature 31 will be attracted to the right as viewed in Fig. 3 and carry with it the frame 4. The other end of the frame 4 is connected with a spring 33 which is placed under tension by shifting movement of the frame 4 to the right and is effective to return the frame 4 to the position illustrated in the drawings when the solenoid 30 is deenergized.

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In order to prevent energization of the solenoid 30 when any of the spaces between the plates 5 may not be filled with cans, a plurality of limit switches 34 are provided. The limit switches 34 are mounted on a supporting bar 35 extended transversely of the apparatus, and have operating members 36 which project through openings 37 in a stationary plate 38 at the front of the grid 7. As best shown in Fig. 6, the forward movement of the cans between the plates 5 is limited by engagement of the foremost can in each row with the plate 38. As forward movement of the rows of cans is stopped by the plate 38 in this manner, the operating member 36 will be engaged by the leading can in each row to close the associated limit switch 34. In a manner to be described, the limit switches 34 are connected in series with a pair of energizing circuits for the solenoid 30 so that the solenoid will not be energized unless the top grid 7 has a full charge of cans therein.

The charging of a container with two layers of cans as described above requires a double operation of the solenoid 30. These two solenoid operations are effected through a pair of limit switches 39 and 40 which are positioned vertically above each other as best shown in Fig. 4. The limit switches 39 and 40 are operated by a triangularly shaped cam 41 mounted on a rotatable shaft 42 which also carries a ratchet wheel 43 (see Fig. 5). The ratchet wheel 43 has six teeth which are arranged in the path of an actuating member 44 carried by the shifting frame 4 of the movable grid 7. When the grid 7 is shifted to the right, the member 44 engages one of the ratchet teeth on the wheel 43 and rotates the wheel 43 and shaft 42 one-sixth ($\frac{1}{6}$) of a revolution. The operating member 44 is pivoted so that return movement of the frame 4 will not change the position of the ratchet wheel 43. A pivoted pawl 45 is provided to additionally prevent rotation of the wheel 43 in a clockwise direction opposite to that in which it is moved by the member 44. Operation of the ratchet wheel 43 in this manner rotates the triangular cam 41 through one-sixth ($\frac{1}{6}$) of a revolution and moves one of its cam points out of engagement with the operating member 46 for the limit switch 39 and another of its cam points into engagement with an operating member 47 for the limit switch 40. In the next operation of the ratchet wheel 43 and cam 41, a high point on the cam 41 is moved out of engagement with the operating member 47 for the limit switch 40 and into engagement with the operating member 46 for the limit switch 39. In this manner, the limit switches 39 and 40 are opened and closed alternately at each operation of the movable grid 7, one of such limit switches being closed at all times. The manner in which the limit switches 39 and 40 cooperate in a control circuit for the apparatus will be explained below.

Shifting movement of the restraining grid 9 to the right is effected by a solenoid 48 having an armature 49 which is connected to the frame 27 of the movable grid 9. When the solenoid 48 is energized, its armature 49 is attracted to the right as viewed in the drawings and carries with it the restraining grid 9. A spring 50 is connected to the other end of the frame 27 which is placed under tension when the grid 9 is moved to the right and is effective to return the frame 9 to the position shown in the drawings when the solenoid 48 is de-energized. In a manner to be described, energization of the solenoid 48 is made dependent upon the movable grid 7 operating to collect two layers of cans. In other words, the solenoid 48 cannot be energized unless all of the limit switches 34 have been actuated twice thereby insuring a double operation of the solenoid 30 for each operation of the solenoid 48.

Elevator mechanism

The elevator mechanism A, as indicated above, is provided for elevating boxes or cartons to a position underneath the charging mechanism B for the reception of a

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charge of cans. The elevator mechanism in the various figures of the drawings is shown in its lowered position. It includes a vertically movable frame 51 carrying a plurality of roller supports 52 which have their axes extending from front to rear of the frame 51. As has been further indicated above, the various operations incident to the filling of a carton with plural layers of cans are made dependent upon the emplacement of a box in position on the roller supports 52. To properly position a box on the roller supports 52, there is provided a centering mechanism which includes the horizontal stop bar 55 supported at the back of the elevator by supporting bars 54 at a point above the level of the rollers 52 and which provides a rear stop for limiting rearward movement of a box on the rollers 52. As shown in Fig. 9, there is provided an arm 56 connected to a plate 53 having a pivot connection 57 to one end of the stop 55 for engagement with one side of the box. A biasing spring 58 is provided for biasing the arm 56 to the position shown in Fig. 9 in which it will engage with one side of the box on the rollers 52. The other edge of the frame 51 is provided with a stationary guide plate 59 which is secured to the other end of the stop 55. Boxes or cartons to be filled are placed on the elevator by a sliding movement endwise over the roller supports 52 until they engage with the rear stop 55. If the box is not centered properly on the rollers 52, the arm 56 engaging with one side of the box will move it laterally to a position in which its other side engages with the guide plate 59.

Elevating movement of the platform 51 is controlled by a limit switch 60 which is positioned at the right of the frame 51 as viewed in Fig. 9. The limit switch 60 is mounted on a plate 61 carried by an arm 62 (see Fig. 10) which extends forwardly from the stop bar 55 and carries the side guide plate 59. The limit switch 60 is operated by an arm 63 having a pivotal connection at 64 to the switch mounting plate 61. As shown in Fig. 9, the switch operating arm 63 has its outer end 65 inclined and projecting forwardly through a space between the rear of the guide plate 59 and the rear stop 55 so that it will be pivoted in a clockwise direction to operate the switch 60 when a box is moved into position against the back stop 55 and the side stop 59. It will be noted that the end 65 of the switch operating lever 63 is positioned adjacent the back stop 55 to prevent operation of the switch 60 unless the box is properly positioned on the rollers 52. It is not essential that the box be precisely centered since the spring leaves 29 projecting downwardly from the charging mechanism B will center the box when it is raised to receive a charge of cans. The switch operating arm 63 has a spring bias (not shown) for maintaining it in its unoperated position as illustrated in Fig. 9. In a manner to be described, operation of the switch 60 by the arm 63 is necessary to initiate elevation of the elevator to thereby initiate the cycle of operations required to fill the box.

Upward vertical movement of the elevator is guided by guide plates 67 which mount spaced pairs of rollers 68 having guiding engagement with a vertically extending trackway 69 secured to the stationary standards 6. The guide plates 67 are secured to channels 66 which are in turn attached to the under side of the vertically movable frame 51.

A stationary supporting frame-work 70 is attached to the stationary standard 6 and carries stop members 71 which engage with the under side of the frame 51 to limit downward movement of the elevator. Upward movement is effected by an air or hydraulically operated cylinder 73 mounted on the supporting frame-work 70. The cylinder 73 has a piston rod 74 projecting therefrom for imparting upward movement to the elevator frame 51. The details of the cylinder 73 including its operating valves will be described in connection with the operation of the apparatus upon reference to the schematic showing of Fig. 11.

One of the channels 66 secured to the under side of the frame 51 carries a switch operating element 75 for operating control switches 76 and 77. The control switch 77 has an operating arm 78, as best shown in Fig. 2, positioned in the path of a roller 79 at the end of an arm 80 secured to the member 75 so that upward movement of the roller 79 will actuate the switch 77. As will be explained in connection with the showing of Fig. 11, closure of the switch 77 is essential in order to effect the second transfer shifting operation of the top grid 7.

The switch operating member 75 also mounts an operating member 81 which will engage and actuate an operating button 82 for the limit switch 76 upon movement of the elevator to its uppermost position. As will be explained in connection with the showing of Fig. 11, closure of the switch 76 energizes a circuit for effecting lowering movement of the elevator.

The channel 66 mounts a second switch actuating member 83 for engagement with a roller 84 at the end of a switch operating arm 85 for a switch 86. Closure of the switch 86 is effected by upward movement of the actuating member 83 and is effective to energize a circuit to the solenoid 48 for effecting shifting movement of the restraining grid 9.

Case ejecting mechanism

To eject a filled case upon return of the elevator 51 to its lowered position, there is provided an ejecting bar 88 which is secured to the outer ends of two piston rods 89 respectively having their inner ends connected to pistons 90 within air cylinders 91. The details of the cylinders 91 including the operating valve mechanism therefor will be described in connection with the schematic view of Fig. 11. At this point, it will be sufficient to indicate that admission of air under pressure to the cylinder 91 will be effective to move the ejecting bar 88 to the left as viewed in Fig. 1. Movement of the ejecting bar 88 to the left in this manner causes it to strike the filled case supported on the rollers 52 and the momentum imparted to the case will cause it to roll over the rollers 52 and off of the elevator. Suitable conveyor mechanism (not shown) may be provided at the end of the frame 51 for receiving and carrying away the ejected case.

In connection with the ejection of a filled case from the elevator, attention is directed to the fact that the pivotal mounting of the case positioning bar 56 as shown in Fig. 9 provides for the ejecting movement. As the case is ejected, the bar 56 is pivoted in a counter-clockwise direction through an angle of 90° so that it will not interfere with movement of the filled case from the elevator mechanism. As soon as the case has moved off the elevator, the biasing spring 58 will return the centering bar 56 to the position shown in Fig. 9 where it will be effective again to center the next box placed on the elevator for a filling operation.

The ejecting operation of the bar 88 is initiated by a limit switch 92 mounted on the supporting frame 70 as shown in Fig. 2. The limit switch 92 has an operating button 93 which is actuated by a pawl 94 which is pivoted at 95 to a bracket 96 secured to one of the channels 66. The pawl 94 can pivot between stops 97 and 98 and has a gravity bias for engagement with the stop 98. Upon upward movement of the elevator, the pawl 94 is pivoted upon engagement with the switch operating button 93 without actuating the switch 92. When the elevator is returned to its lower position, the stop 98 prevents pivotal movement of the pawl 94 and the button 93 is actuated to close the switch 92. The stop 97 is provided only for limiting the free pivotal movement of the pawl 94 during upward movement of the elevator.

Operation

The operation of the apparatus will be best understood by referring to Fig. 11. In this showing, the essential structural elements of the apparatus have been shown

diagrammatically and are designed by the same numerals applied to Figs. 1 through 10. The control circuits are designated by letters to be referred to and are energized when any circuit portion is completed from a positive to a negative terminal, the positive and negative terminals being indicated diagrammatically by plus and minus signs.

The various parts illustrated in Fig. 11 are shown in the relative positions which they occupy prior to starting operation of the apparatus and before any cans have been delivered to the upper grid 7. The apparatus is placed in operation by starting up the conveyor C to deliver cans to the upper grid 7. When each of the spaces in the upper grid 7 is filled with cans, the limit switches 34 all close to complete a circuit *a* for energizing the solenoid 30 through a branch circuit *b* and the limit switch 40, the limit switch 40 being closed when the apparatus is started and the limit switch 39 being open. Energization of the solenoid 30 shifts the grid 7 to the right to drop the first layer of cans into the stationary grid 8 into a position supported on the restraining grid 9. Shifting movement of the frame 4 to the right actuates the ratchet wheel 43 through the operating dog 44 to rotate the shaft 42 and cam 41 one-sixth ($\frac{1}{6}$) of a revolution to open the limit switch 40 and close the limit switch 39. Opening the limit switch 40 deenergizes the solenoid 30 so that the spring 33 becomes effective to return the upper grid 7 to a position in which it is effective to collect another layer of cans.

Collection of the second layer of cans effects a second closure of the limit switches 34 thereby setting up a second circuit for energizing the solenoid 30 for shifting the upper grid 7 to the right a second time. This second circuit includes the branch circuit *c*, the limit switch 39 and the circuit elements *d* and *e*, the circuit element *e* being connected to the solenoid 30 through one terminal of the limit switch 40. At this time, the solenoid 30 is not energized due to the limit switch 77 between the circuit elements *d* and *e* being open. The solenoid 30 will not act a second time until after a box is placed on the elevator 51.

Emplacement of a box 99 on the elevator 51 initiates raising movement of the elevator. This is accomplished by the box closing the limit switch 60 through cooperation of the box centering elements 56 and 59 and the actuation of the limit switch operating lever 63 as described above in connection with Fig. 9. Closure of the limit switch 60 energizes a solenoid 100 through the circuit elements *f* and *g*, the limit switch 39 which was closed by the first shifting operation of the grid 7, branch circuit *c*, and circuit *a* which it will be recalled was closed by the second closure of the limit switches 34 when the upper grid 7 collected a second layer of cans. Energization of the solenoid 100 is essential for imparting a raising movement to the elevator and attention is directed at this point to the fact that closure of the limit switch 60 by emplacement of a box on the elevator will not cause the elevator to start up unless the second layer of cans has been collected in the upper grid 7.

Energization of the solenoid 100 moves a valve element 101 to the left as viewed in Fig. 11 to connect an air supply conduit 102 through a valve casing 103 to a conduit 104 for delivering air under pressure to the lower end of the elevator cylinder 73. The pressure so admitted to the cylinder 73 acts on the piston 105 to move the piston rod 74 and elevator 51 connected thereto upwardly.

As the elevator moves upwardly, limit switches 86 and 77 are closed, the limit switch 86 being closed by the operating element 83 and the limit switch 77 being closed by the roller 79 actuating its operating arm 78. Closure of the limit switch 86 closes a circuit *h* for energizing the solenoid 48 to shift the restraining grid 9 to the right so that two layers of cans may drop therethrough into the box on the elevator. Closure of the limit switch 77 connects the circuit elements *d* and *e* to provide a

second energizing circuit for the solenoid 30. This second energization of the solenoid 30 shifts the top grid 7 to the right to drop the second layer of cans into the stationary grid 8. In the preferred practice of the invention, closure of the limit switches 36 and 77 are timed in such manner that the limit switch 36 closes an instant ahead of closure of the limit switch 77. In this manner, downward movement of the first layer of cans into the box is started just prior to movement of the second layer of cans into the grid 8, and the second layer of cans gravitates through the grids 8 and 9 into the case without having their downward movement stopped either by the first layer of cans or by the restraining grid 9.

When the grid 7 is shifted to the right by energization of the solenoid 30 through closure of the switch 77, the ratchet wheel 43 is actuated to rotate the cam 41 another partial revolution to open the switch 39 and close the switch 40. Opening of the switch 39 deenergizes solenoid 100 and deenergizes the solenoid 30 so that the grid 7 is returned to the left to pick up another layer of cans. To prevent too rapid a return movement of the grid 7, a retarding device 106, which may be any suitable form of mechanical dash-pot connected directly with the solenoid armature, or a time delay relay in the energizing circuit for the solenoid 30, is provided. It is necessary to delay the return movement of the grid 7 at this time since its immediate return would otherwise result in a third energization of the solenoid 30 through closure of the limit switches 34 in the circuit *a* and the branch circuit *b* through the limit switch 40. Premature operation of the grid 7 in this manner would result in a third layer being dropped into the stationary grid 8 prior to return movement of the grid 9 to its restraining position. The delay in return movement of the grid 7 by the retarding device 106 is adjusted to insure return movement of the grid 9 before another layer of cans can be collected by the upper grid 7. After the retarding grid 9 returns to the position shown in Fig. 11, the top grid 7 may operate to drop a layer of cans into the stationary grid 8 where it will remain until another box is placed on the elevator.

The solenoid 48 is also provided with a retarding device 107, similar to the retarding device 106 for the solenoid 30, to prevent return of the restraining grid 9 to its restraining position before the second layer of cans has gravitated therethrough.

When the elevator moves to its uppermost limit of travel, the limit switch 76 is closed by the operating member 81 carried by the elevator. Closure of the switch 76 completes a circuit *i* for energizing a solenoid 108. The solenoid 108 returns the valve 101 to the position shown in Fig. 11 thereby interrupting the connection of the air supply line 102 to the elevating cylinder 73. At the same time, the conduit 104 connects the lower end of the cylinder 103 to the atmosphere through a port 109 in the valve casing 103. The elevator will then return to its lower position by gravity, and a manually adjustable valve 110 is provided for controlling the admission of air to the upper end of the cylinder to thereby control its speed of lowering movement. As the elevator moves to its lower position, the ejecting bar 88 is operated to eject the box 99 as described above. This is accomplished by the pawl 94 closing the limit switch 92 to complete an energizing circuit *m* for a solenoid 111. Energization of solenoid 111 moves valve element 112 in casing 113 to the right to connect the conduit 114 with an air supply conduit 115. At the same time, conduit 116 is connected to the atmosphere through a port 117 in the casing 113. Connection of the conduit 114 with the air supply conduit 115 in this manner supplies air under pressure to the cylinder 91 for moving the piston 90 and ejector bar 88 to the left as viewed in Fig. 11 to eject a filled case from the elevator.

Movement of the piston 90 to the left carries with it a switch operating member 118 which closes a switch 119

at the end of the ejecting movement of the piston 90. Closure of the switch 119 energizes a circuit *n* for a solenoid 120 which returns the valve 112 to the position shown in Fig. 11. In this position of the valve 112, the conduit 116 is connected with the air supply conduit for admitting pressure to the cylinder 91 to return the ejector bar 88 and piston 90 to the right and to the position shown in Fig. 11. During the return movement of the ejector bar, the conduit 114 is connected to the atmosphere through a port 121 in the valve casing 113.

The valves 103 and 113 are illustrated diagrammatically and may be any conventional type suitable to the operations described. As illustrated they are of the piston type and remain in the position to which they are moved by momentary energization of one of the solenoids until such time as the other of the solenoids is operated, it not being necessary to maintain energization of a solenoid to have the valve remain in any selected position.

From the foregoing, it will be apparent that the apparatus of this invention is effective to pack a box with plural layers of cans, it being only necessary to place an empty box on the elevator. Emplacement of the box on the elevator may be either a manual or automatic operation as the circumstances may require and is effective to initiate the various operations incidental to charging the box with a plural layer of cans. Emplacement of the box on the elevator is effective to initiate elevation of the elevator, and particular attention is directed to the fact that upward movement of the elevator will take place only if the can assembling mechanism B is in condition to charge the box with the required number of layers of cans. In other words, emplacement of the box on the elevator will not be effective to initiate its upward movement until the top layer of cans has been charged into the top grid 7. As upward movement of the elevator takes place, the controls for the charging operation of the assembly mechanism B are operated in timed sequence to fill the box with the proper number of layers of cans. Attention is also directed to the fact that the sequential operation of the charging assembly mechanism B is responsive to emplacement of a box on the elevator and to upward movement of the elevator. As this upward movement of the elevator takes place, closure of switch 77 results in the final shifting movement of the top grid 7 and in an operation of the cam 41 to transfer control from the switch 39 to the switch 40. Closure of switch 40 in effect takes control of the operation of the assembly mechanism B away from the elevator, but it will be noted that the next shifting movement of the top grid 7, through operation of cam 41 and the closure of switch 39 and opening of switch 40, returns control of the assembly mechanism B to the elevator mechanism. The operation of the apparatus is thus continuous and is dependent only upon the conveyor C operating to deliver cans and upon emplacement of empty boxes on the elevator.

While the above specification and accompanying drawings illustrate and describe one specific embodiment of the invention, it will be understood that this is merely by way of illustration, and that various changes and modifications may be made therein within the contemplation of the invention and under the scope of the following claims.

We claim:

1. In an article packing machine, the combination with a supply table for moving articles to be packed forwardly in plural parallel rows, of a packing mechanism comprising a transversely movable grid having spaced parallel members providing spaces therebetween in which the articles are received in rows from said table, a stationary grid underneath said movable grid formed of spaced parallel plates the upper edges of which provide a temporary support for the articles received in said spaces, and a transversely movable restraining grid formed of spaced parallel members normally occupying positions in-

intermediate and parallel to said plates for restraining gravitational movement of articles through said stationary grid but movable transversely into positions in alignment with said plates to allow articles to gravitate through both said stationary grid and restraining grid.

2. An article packing mechanism comprising a transversely movable grid having spaced parallel members providing spaces therebetween in which the articles to be packed are received in rows, a stationary grid underneath said movable grid formed of spaced parallel plates the upper edges of which provide a temporary support for the articles received in said spaces, and a transversely movable restraining grid formed of spaced parallel members normally occupying positions intermediate and parallel to said plates for restraining gravitational movement of articles through said stationary grid but movable transversely into positions in alignment with said plates to allow articles to gravitate through both said stationary grid and restraining grid.

3. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for receiving the articles to be packed in rows, one of said grids being stationary and the other two being movable transversely relative thereto, and means for actuating said movable grids in a sequential manner to provide for the gravitation of plural layers of articles through the bottom one of said grids.

4. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for receiving the articles to be packed in rows, the members of the intermediate and bottom grids respectively occupying positions intermediate the members of the overlying grid whereby they are effective to restrain gravitational movement of the articles out of the spaces between the members of the overlying grid, at least one of said grids being transversely movable relative with respect to one of the other of said grids whereby the members of two grids are moved relatively into positions of alignment with each other to allow gravitational movement of articles from the spaces between the members of an overlying grid into the spaces between the members of an underlying grid.

5. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for receiving the articles to be packed in rows, the members of the intermediate and bottom grids respectively occupying positions intermediate the members of the overlying grid whereby they are effective to restrain gravitational movement of the articles out of the spaces between the members of the overlying grid, two of said grids being transversely movable relative with respect to the other of said grids whereby the members of two grids are selectively moved relatively into positions of alignment with each other to allow gravitational movement of articles from the spaces between the members of an overlying grid into the spaces between the members of an underlying grid, and means for operating said transversely movable grids in a sequential manner to effect gravitation of said articles in plural layers through the bottom one of said grids.

6. In a machine for packing articles in superimposed layers, means for sequentially collecting layers of articles to be packed, means for receiving each said layer from said collecting means, and means sequentially operable to release said layer and a second collected layer for simultaneous gravitational movement into a packing case positioned underneath said receiving means.

7. In a machine for packing articles in superimposed layers, receiving means in which a layer of articles to be packed may be deposited and including means for restraining the articles against gravitational movement therefrom, means automatically operable for collecting the

articles in layers and depositing said layers in said receiving means, and means for operating said restraining means to release a plurality of layers of articles in said receiving means for gravitational movement into a packing case.

8. In a machine for packing articles in superimposed layers, receiving means in which a layer of articles to be packed may be deposited and including means for restraining the articles against gravitational movement therefrom, means for collecting and delivering the articles in layers by gravity to said receiving means, and means for sequentially operating said restraining means to release the plurality of layers of articles from said receiving means for gravitational movement into a packing case.

9. In a machine for packing articles in superimposed layers, receiving means in which a layer of articles to be packed may be deposited and including means for restraining the articles against gravitational movement therefrom, means operable in sequence for collecting and delivering a first layer and then a second layer of articles to said receiving means, means for operating said restraining means to release said first layer for gravitational movement into a packing case whereby the second layer deposited by said collecting means may gravitate into said case without being subjected to the restraining action of said receiving means.

10. In an article packing machine, the combination with a supply table for moving articles to be packed forwardly in plural parallel rows, of a packing mechanism comprising a transversely movable grid having spaced parallel members providing spaces therebetween in which the articles are received in rows from said table, a stationary grid underneath said movable grid formed of spaced parallel plates the upper edges of which provide a temporary support for the articles received in said spaces, means operated in response to filling of the spaces between said members with articles for shifting said movable grid to a position with said members in alignment with said plates to drop a first layer of articles into said stationary grid, a restraining grid positioned underneath said stationary grid and having spaced parallel restraining members normally occupying positions intermediate and parallel to said plates for engagement with the articles of said first layer to restrain gravitational movement of such articles through said stationary grid, and means responsive to a second operation of said shifting means for moving said restraining grid to a position with its restraining members aligned with said plates whereby said first layer of articles and a second layer of articles fed to said stationary grid by the second operation of said shifting means may gravitate through said restraining grid.

11. In an article packing machine, the combination with a supply table for moving articles to be packed forwardly in plural parallel rows, of a packing mechanism comprising a transversely movable grid having spaced parallel members providing spaces therebetween in which the articles are received in rows from said table, a stationary grid underneath said movable grid formed of spaced parallel plates the upper edges of which provide a temporary support for the articles received in said spaces, each of said spaces having a limit switch at one end thereof which is closed in response to such space being filled with a row of articles, a circuit in which said switches are connected in series, and an actuating device controlled by said circuit for shifting said movable grid to a position with said members in alignment with said plates to drop a first layer of articles into said stationary grid.

12. In an article packing machine, the combination with a supply table for moving articles to be packed forwardly in plural parallel rows, of a packing mechanism comprising a transversely movable grid having spaced parallel members providing spaces therebetween in which the articles are received in rows from said table, a stationary grid underneath said movable grid formed of

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spaced parallel plates the upper edges of which provide a temporary support for the articles received in said spaces, each of said spaces having a limit switch at one end thereof which is closed in response to such space being filled with a row of articles, a circuit in which said switches are connected in series, an actuating device controlled by said circuit for shifting said movable grid to a position with said members in alignment with said plates to drop a first layer of articles into said stationary grid, a restraining grid positioned underneath said stationary grid and having spaced parallel restraining members normally occupying positions intermediate and parallel to said plates for engagement with the articles of said first layer to restrain gravitational movement of such articles through said stationary grid, and actuating means for moving said restraining grid to a position with its restraining members aligned with said plates.

13. A machine as claimed in claim 12 characterized by the provision of means responsive to a second closure of said limit switches for rendering said actuating means operable.

14. A machine as claimed in claim 12 characterized by the provision of a control switch for operating said actuating means, and means operative in response to a second closure of said limit switches for closing said control switch.

15. A machine as claimed in claim 14 characterized by said last-named means including an elevator for raising a receptacle in which the articles are to be packed to a position underneath said restraining grid, and an operating member carried by said elevator for closing said control switch.

16. A machine as claimed in claim 12 characterized by the provision of a control switch for operating said actuating means, an elevator for raising a receptacle in which the articles are to be packed to a packing position under said restraining grid, means responsive to a second closure of said limit switches for operating said elevator, and an operating member carried by said elevator for closing said control switch.

17. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for receiving the articles to be packed in rows, the members of the intermediate and bottom grids respectively occupying positions intermediate the members of the overlying grid whereby they are effective to restrain gravitational movement of the articles out of the spaces between the members of the overlying grid, means for shifting the top and intermediate guides relative to each other to a position with their parallel members in vertical alignment with each other to drop the articles in the top grid into the intermediate grid, and means for shifting the intermediate and bottom grids relative to each other to a position with their parallel members in vertical alignment with each other to release the articles in the intermediate grid for gravitation through the bottom grid.

18. A packing mechanism as claimed in claim 17 characterized by the provision of a control means for effecting a single operation of the shifting means for the intermediate and bottom grids in response to a double operation of the shifting means for the top and intermediate grids whereby two layers of articles will gravitate through the bottom grid in response to said single operation of the shifting means for said intermediate and bottom grids.

19. A packing mechanism as claimed in claim 17 characterized by the provision of a control means including a first means for effecting a double operation of the shifting means for said top and intermediate grids, and a second means operated in response to said first means effecting said double operation for effecting a single operation of the shifting means for said intermediate and bottom grids.

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20. A packing mechanism as claimed in claim 19 characterized by said first means comprising a main control circuit having two branch circuits respectively having control switches therein, means alternatively operable in response to operation of the shifting means for the top and intermediate grids for opening one of said switches and closing the other of said switches whereby only one of said branch circuits is closed through its control switch at any given instant, and by said second means comprising a circuit including an operating switch and means responsive to closure of the control switch closed by the second operation of said alternatively operable means for actuating said operating switch.

21. A packing mechanism as claimed in claim 19 characterized by said first means comprising a main control circuit having two branch circuits respectively having control switches therein, means alternatively operable in response to operation of the shifting means for the top and intermediate grids for opening one of said switches and closing the other of said switches whereby only one of said branch circuits is closed through its control switch at any given instant, said main control circuit having a plurality of limit switches therein, each of said limit switches being respectively positioned at the end of one of the spaces of the top grid and being closable by articles filling the space in which it is positioned, said shifting means for the top and intermediate grids being operable only upon closure of all of said limit switches and one of said control switches, and by said second means comprising a circuit including an operating switch and means responsive to closure of the control switch closed by the second operation of said alternatively operable means for actuating said operating switch.

22. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for receiving the articles to be packed in rows, the members of the intermediate and bottom grids respectively occupying positions intermediate the members of the overlying grid whereby they are effective to restrain gravitational movement of the articles out of the spaces between the members of the overlying grid, a first actuator means for effecting relative shifting movement between said top and intermediate grids to a position in which articles in the top grid may gravitate into the intermediate grid, means controlling the operation of said first actuator means comprising a main control circuit having plural limit switches connected in series therein, each of said limit switches being respectively positioned at the end of one of the spaces in the top grid and being closable by articles filling the space in which it is positioned, and first and second branch circuits connected with said main control circuit and respectively having control switches therein, the control switch in said first branch circuit being closed whereby closure of said limit switches completes a circuit through said first branch circuit to effect a first operation of said actuator means, means alternately operable in response to each operation of said actuator means for opening the control switch in one of said branch circuits and closing of the control switch in the other of said branch circuits, closure of the control switch in said second branch circuit by said alternately operative means being effective to set up a second circuit including said main control circuit and second branch circuit for effecting a second operation of said actuator means, a second actuator means for effecting relative shifting movement between said intermediate and bottom grids to a position in which articles in said intermediate grid may gravitate through the bottom grid, and means responsive to closure of the control switch in said second branch circuit for effecting operation of said second actuator means.

23. An article packing mechanism comprising at least three superimposed grids respectively formed of spaced parallel members providing spaces therebetween for re-

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ceiving the articles to be packed in rows, the members of the intermediate and bottom grids respectively occupying positions intermediate the members of the overlying grid whereby they are effective to restrain gravitational movement of the articles out of the spaces between the members of the overlying grid, an elevator for raising a receptacle in which the articles are to be packed in layers to a filling position underneath said grids, a first actuator means for effecting relative shifting movement between said top and intermediate grids to a position in which articles in the top grid may gravitate into the intermediate grid, means controlling the operation of said first actuator means comprising a main control circuit having plural limit switches connected in series therein, each of said limit switches being respectively positioned at the end of one of the spaces in the top grid and being closable by articles filling the space in which it is positioned, and first and second branch circuits connected with said main control circuit and respectively having control switches therein, the control switch in said first branch circuit being closed whereby closure of said limit switches completes a circuit through said first branch circuit to effect a first operation of said actuator means, means alternately operable in response to each operation of said actuator means for opening the control switch in one of said branch circuits and closing of the control switch in the other of said branch circuits, circuit means responsive to closure of the control switch in said second branch circuit for effecting elevation of said elevator, closure of the control switch in said second branch circuit being effective to set up a second circuit for effecting a second operation of said actuator means, a switch closed in response to raising movement of said elevator for rendering said second circuit operative, a second actuator means for effecting relative shifting movement between said intermediate and bottom grids to a position in which articles in said intermediate grid may gravitate through the bottom grid into the receptacle on the elevator, and a control switch closed in response to elevating movement of said elevator for operating said second actuator means.

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24. A mechanism as claimed in claim 23 characterized by the provision of a switch which is closed by the emplacement of an empty receptacle on said elevator for rendering operative the circuit means for effecting elevation of the elevator.

25. A mechanism as claimed in claim 23 characterized by the provision of a limit switch which is closed in response to movement of the elevator to an elevated position in which the articles gravitating through said bottom grid are deposited in the receptacle carried thereby, and means responsive to closure of said limit switch for lowering the elevator to condition the mechanism for repeating its cycle of operations.

26. A mechanism as claimed in claim 23 characterized by the provision of a receptacle ejecting apparatus for ejecting a filled receptacle from said elevator, and means responsive to movement of the elevator to its lowered position for operating said ejecting apparatus.

27. A mechanism as claimed in claim 26 characterized by said ejecting mechanism comprising a cylinder having a piston therein, reversible valve means controlling the admission of fluid pressure to said cylinder for effecting ejecting and return movements thereof, said last named responsive means including a switch operated by the elevator for actuating said valve means to effect an ejecting movement of the piston, and a switch closed in response to movement of said piston for reversing said valve means for effecting a return movement of said piston.

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