

[54] **AUTOMATED SACK OPENING AND FEEDING APPARATUS**[75] Inventor: **Weg-Yuan Liou**, Chicago, Ill.[73] Assignee: **Vaclovas Plioplys**, Chicago, Ill.[22] Filed: **July 6, 1971**[21] Appl. No.: **159,687**[52] U.S. Cl. **53/188, 53/384, 53/390**[51] Int. Cl. **B65b 43/30**[58] Field of Search. **53/187, 188, 384, 53/390**[56] **References Cited****UNITED STATES PATENTS**

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Primary Examiner—Travis S. McGehee*Attorney*—James B. Kinzer et al.[57] **ABSTRACT**

An automated sack opening and feeding apparatus for use in a retail checkout counter, comprising a counter-height intake conveyor for conveying goods to a checking station, a recessed loading station, a bag feeder for feeding paper sacks one-by-one to the loading station, and an opening mechanism for opening each sack in the loading station, first at the sack bottom and then at its top. A filled sack ejector, synchronized with the bag feeder, moves each loaded bag to a continuously running output conveyor that moves the bags to an off-load station.

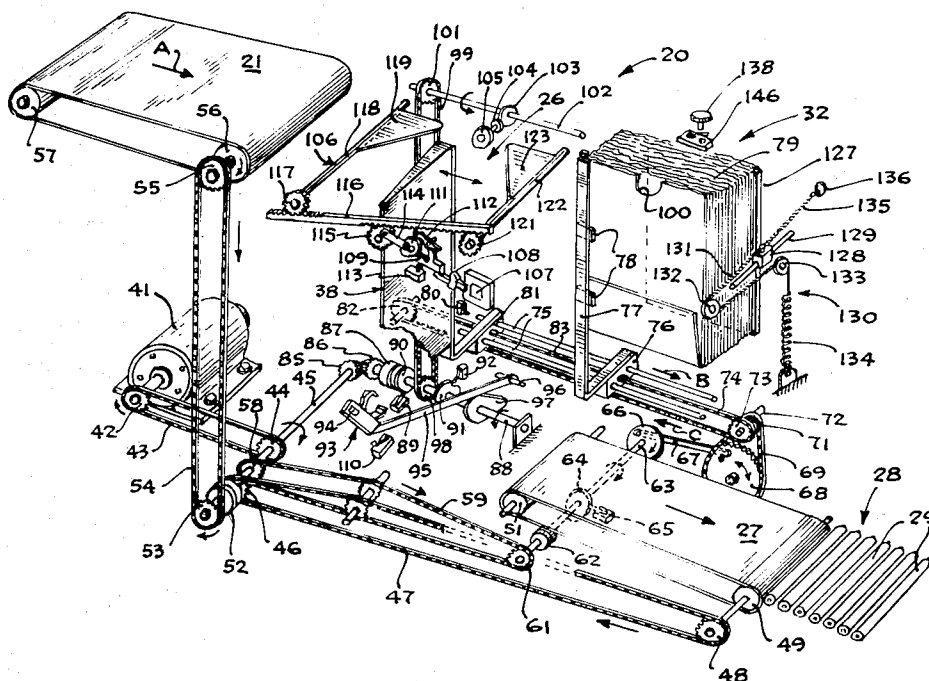
9 Claims, 11 Drawing Figures

Fig. 1

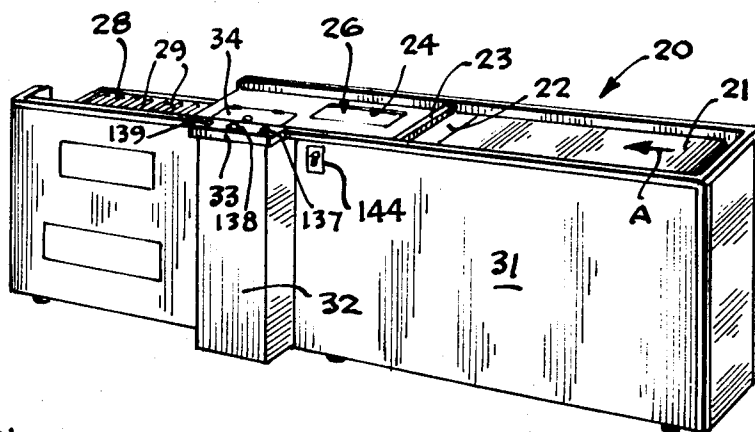
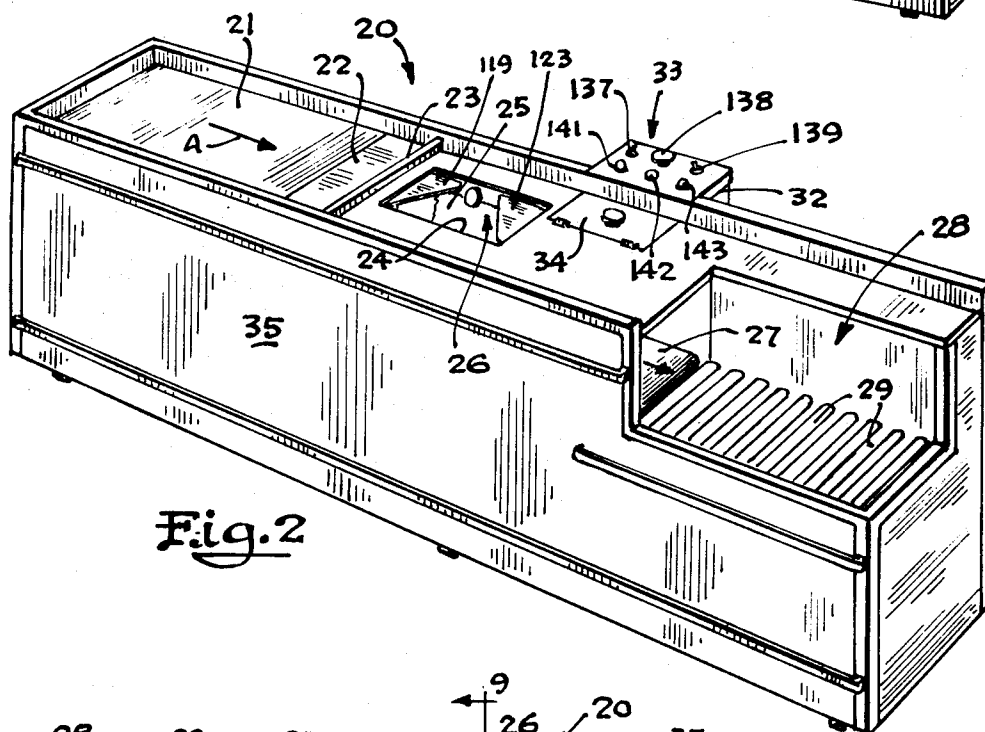


Fig. 2

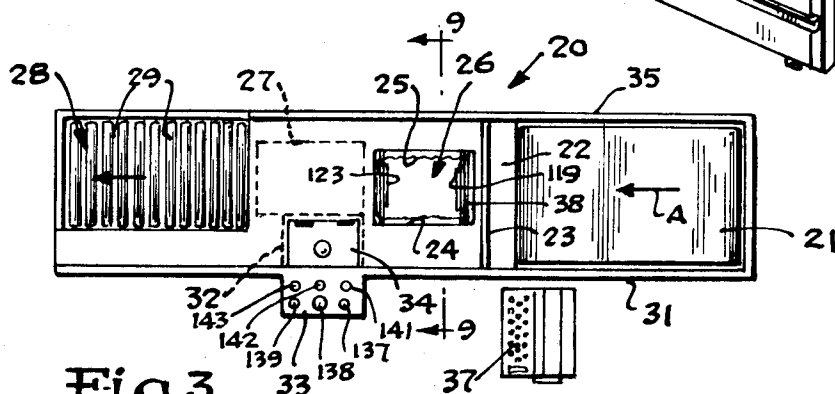
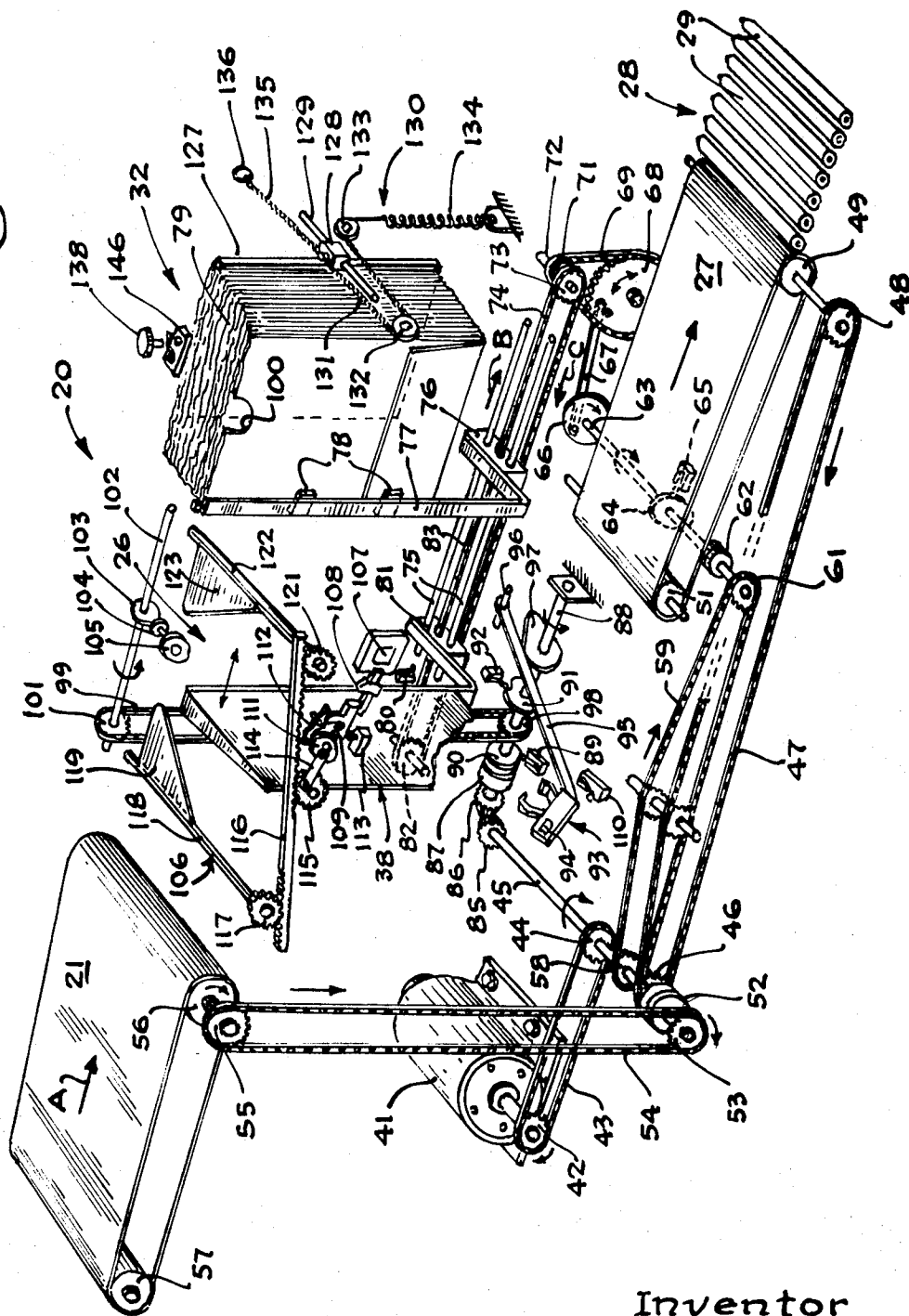


Fig. 3

Inventor
Weg-Yuan Liou
By Kinzer, Dorn and Zickert
Attorneys

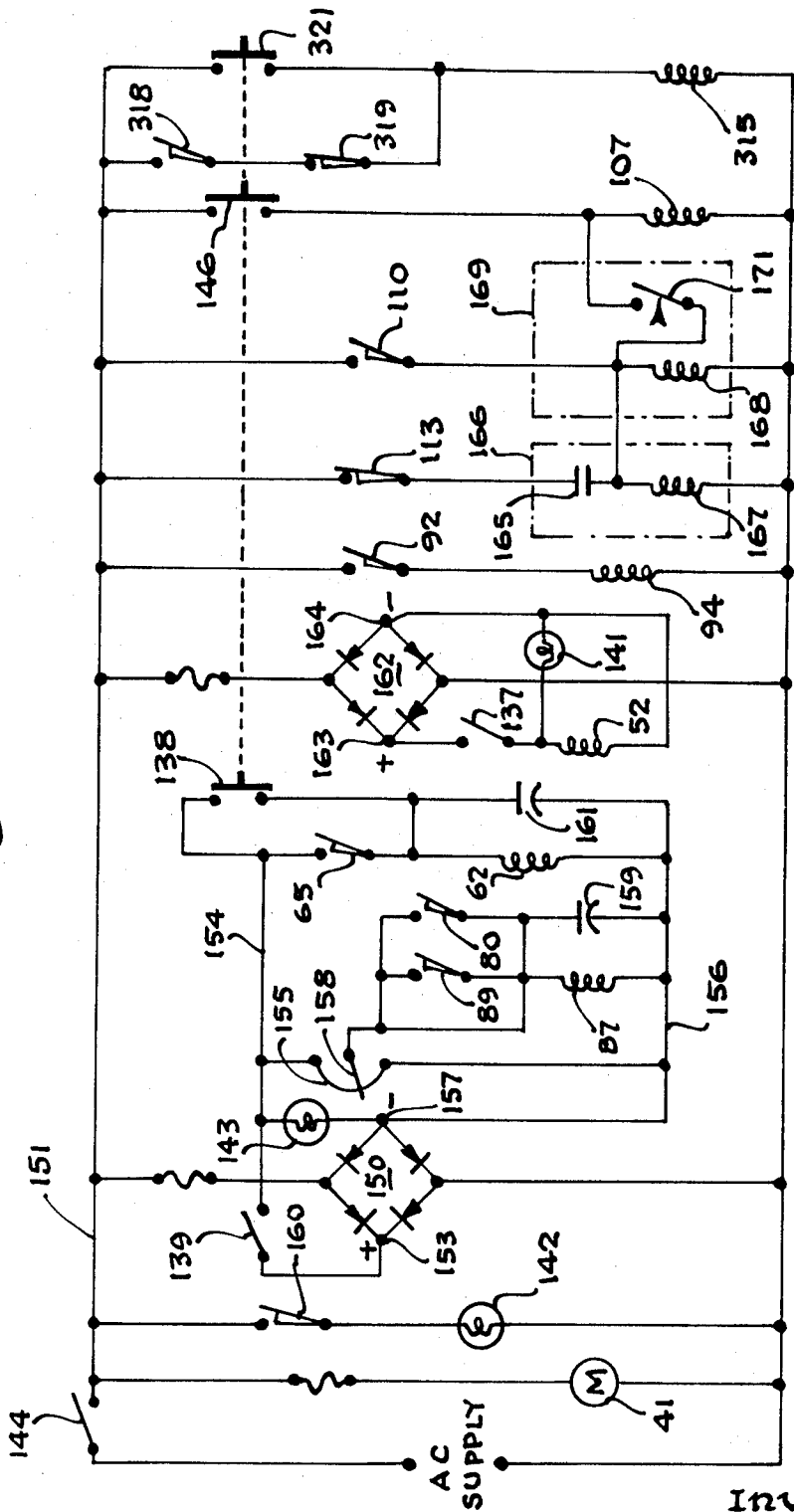
Fig. 4



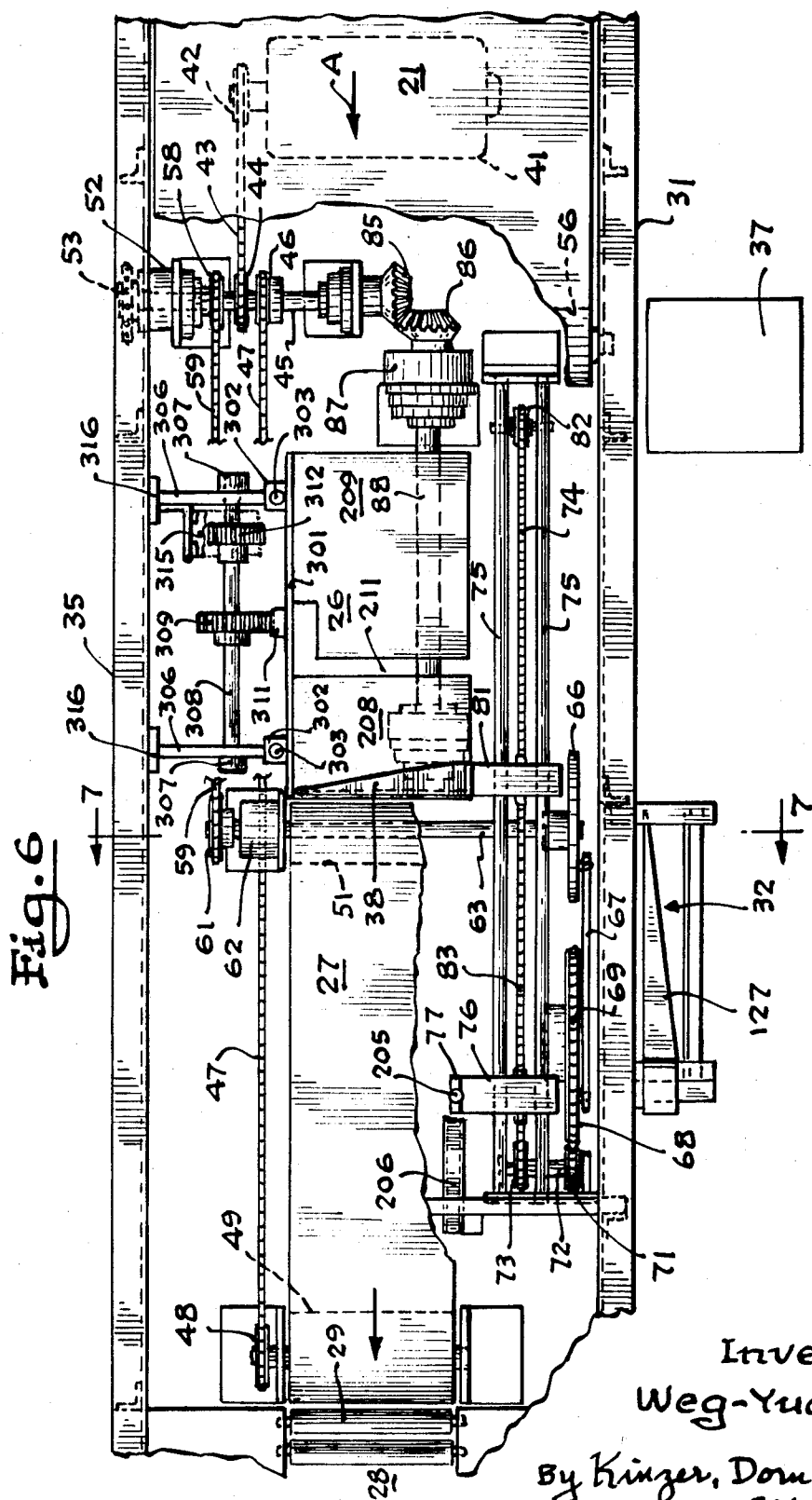
Inventor
Weg-Yuan Liou

By Kinger, Dorn and Zickert
Attorneys

Fig. 5

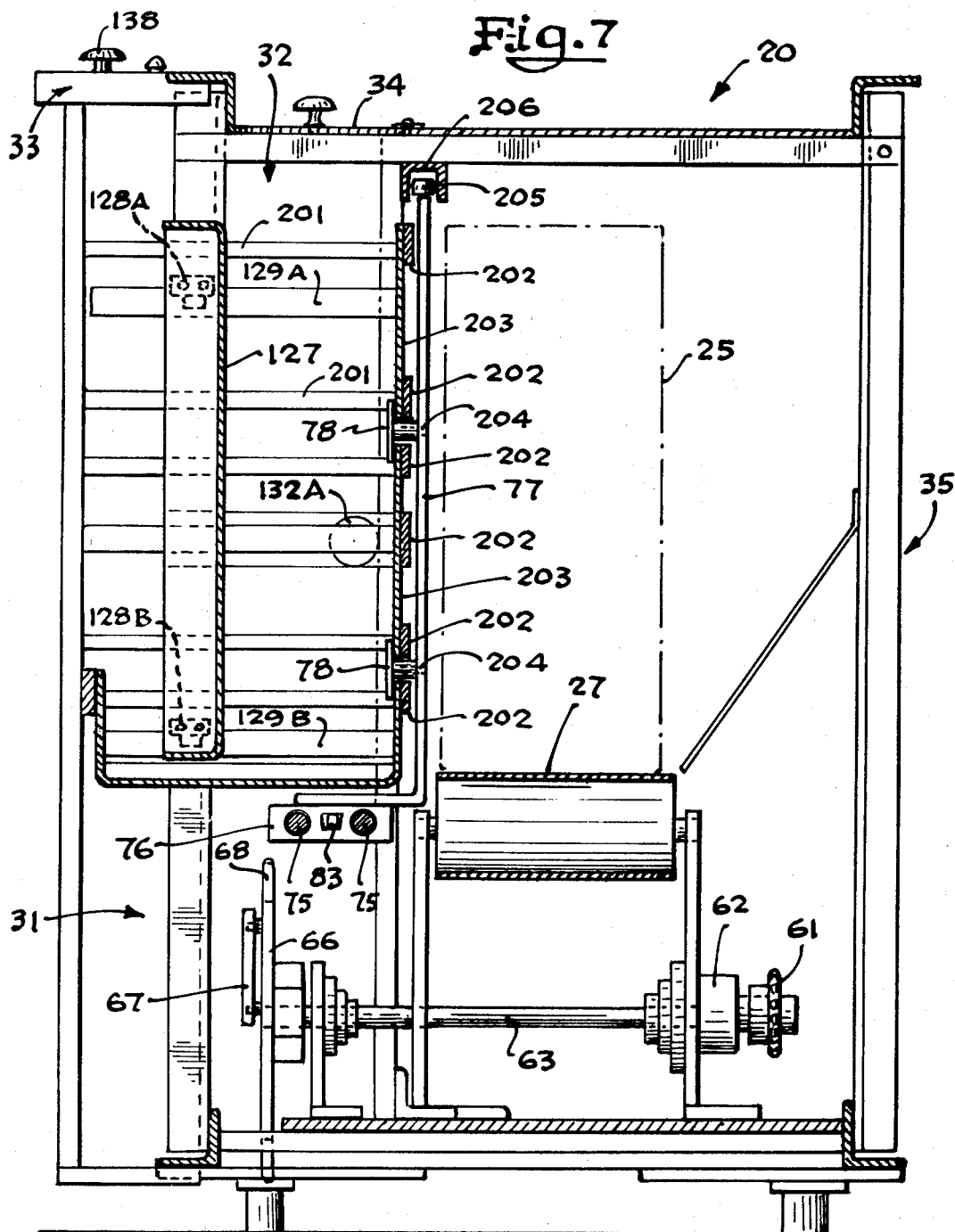


Inventor
Weg-Yuan Liou
By Kinger, Dorn and Zickert
Attorneys



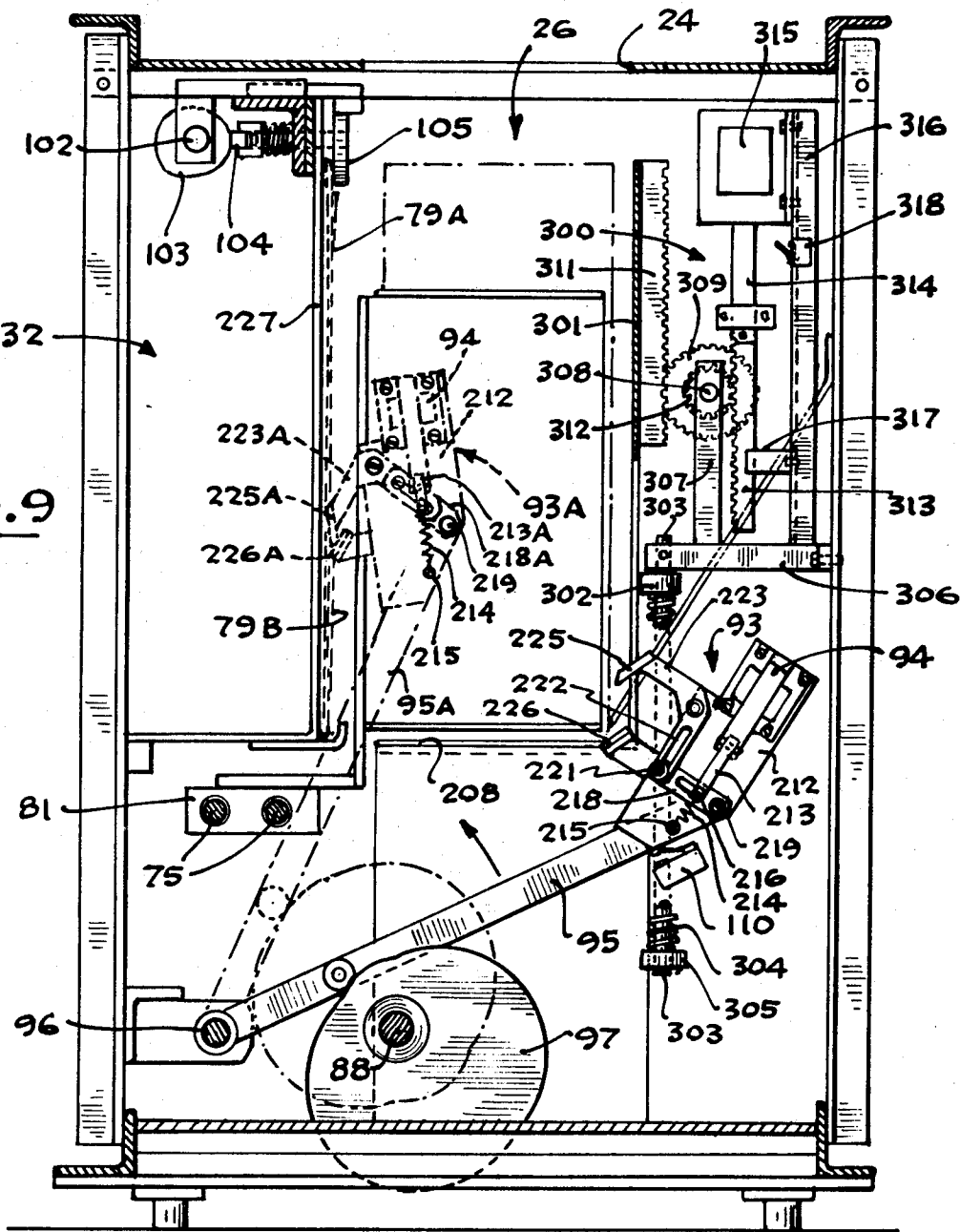
Inventor
Weg-Yuan Liou

By Kinger, Dom and Zickert
Attorneys



Inventor
Weg-Yuan Liou
By Kinger, Dom and Zickert
Attorneys

Fig. 9



Inventor
Weg-Yuan Liou
By Kinzer, Dorn and Zickert
Attorneys

AUTOMATED SACK OPENING AND FEEDING APPARATUS

BACKGROUND OF THE INVENTION

With the development of the modern supermarket, in which food and other items are displayed on open racks for selection by the individual customer and then taken by the customer to a checkout station, much of the labor required of store personnel in meeting the needs of the individual customers has been materially reduced or eliminated. Even in a supermarket, however, there is still a need for individual checking, by at least one clerk, of each item purchased by each customer. In most stores of this general kind, whether dealing in groceries or in other items susceptible to supermarket operation, such as hardware or other sundry products, the checkout operation is effected at an elongated counter. The customer unloads the purchased goods at one end of the counter in a position accessible to a clerk stationed on the opposite side of the counter. The counter may be equipped with a conveyor to move the items into easy reach of the clerk.

The clerk picks up each item, registers the purchase price on a cash register, and moves the purchased goods down the counter toward a loading station. The goods are collected at the loading station; they may be advanced to the far end of the counter by a second conveyor or may slide down a simple ramp. At the loading end of the counter, each item is again picked up, this time by an additional clerk if one is available, and loaded into paper sacks to be carried away by the customer.

The conventional technique for checkout of grocery or other goods in a supermarket operation is inherently time-consuming and labor-wasting. Each purchased item must be handled twice, once by the clerk at the cash register and the second time by the sacker at the end of the counter. If only one person is available, the checkout operation at the cash register must be interrupted each time an order is completed and the goods are ready for placing in sacks. The usual result, particularly during rush periods, is a substantial line-up of customers waiting to check out, with an inevitable and inherent loss of time on the part of the customers and a major labor expense to the store owner.

SUMMARY OF THE INVENTION

It is a principal object of the invention to provide a new and improved automated sack opening and feeding apparatus, incorporated in an automated checkout counter for supermarket operations, that allows a complete checkout function, with each item handled only once from the time it is deposited on the checkout counter by the customer to the time that it is sacked and ready for the customer to take away.

A specific object of the invention is to provide a new and improved sack opening mechanism, for use with conventional bottom-fold paper sacks, that assures rapid and efficient opening of each sack in a minimum of time.

Another object of the invention is to provide a new and improved automated sack opening and feeding mechanism synchronized with an ejector for loaded sacks; the mechanism moves a loaded sack from a loading position, feeds a new sack to the loading position, and opens the new sack, all in a single cycle requiring no more than a few seconds.

An additional object of the invention is to provide a new and improved automated checkout counter for supermarket operations that is relatively low in cost and efficient in operation and that materially reduces the personnel required for effective checkout work.

Accordingly, the invention relates to an automated sack opening and feeding apparatus for retail supermarkets and like applications in which objects are individually checked and loaded into paper sacks of the kind which, when folded, have a bottom fold extending parallel to the body of the sack. The apparatus of the invention comprises a magazine for storing a plurality of folded sacks and sack feed means for feeding a single sack, vertically oriented, from the magazine to an initial position at one side of a loading station, with the bottom fold of the sack facing the loading station. The apparatus further comprises retainer means for engaging and retaining the top edge of one side of the sack at the outer side of the loading station. Bottom opening means are provided for engaging and pulling the upper edge of the bottom fold of the sack outwardly and downwardly from its initial position into the base portion of the loading station, thus opening the bottom of the sack. The retainer means and the bottom opening means are both released by appropriate release means when the bottom of the sack has been opened. The apparatus further comprises top opening means for spreading the top of the sack, in the loading station, to full open position. In the preferred construction, the apparatus is incorporated in a checkout counter having a conveyor for moving the goods from one end of the counter to an intermediate checkout position immediately adjacent the loading station. An ejector mechanism, synchronized with the sack feed means, ejects each loaded sack immediately prior to the feeding of a new sack to the loading station. The counter can also include a conveyor for transporting the loaded sacks toward an outlet station located at the opposite end of the counter from the intake conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective side view of a checkout counter incorporating an automated sack opening and feeding apparatus constructed in accordance with one embodiment of the present invention, as seen from the clerk's side of the counter;

FIG. 2 is a perspective view of the checkout counter of FIG. 1 as seen from the customer's side;

FIG. 3 is a plan view of the checkout counter of FIG. 1 with a part of the counter top cut away to reveal some of the internal mechanism;

FIG. 4 is a schematic perspective view of the principal drive linkages and operating members of the automated sack opening and feeding apparatus and other components of the checkout counter;

FIG. 5 is a schematic diagram of the electrical control components of the apparatus;

FIG. 6 is a plan view of a sack feed mechanism and a conveyor incorporated in the checkout counter, with the counter covers removed to afford a better view of the mechanisms;

FIG. 7 is a sectional view of the checkout counter taken approximately along line 7—7 in FIG. 6;

FIG. 8 is a detail elevation view of the central portion of the checkout counter, taken from the customer's side, with the covers removed to reveal the sack feed and loaded sack ejector mechanisms;

FIG. 9 is a sectional elevation view taken approximately along line 9—9 in FIG. 3;

FIG. 10 is a detail plan view of the sack opening mechanism of the checkout counter; and

FIG. 11 is a detail view taken approximately along line 11—11 in FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The Complete Checkout Counter, FIGS. 1-3

FIGS. 1-3 afford general illustrations of a complete supermarket checkout counter incorporating an automated sack opening and feeding apparatus constructed in accordance with one embodiment of the present invention. The checkout counter 20, as shown in FIGS. 1-3, is preferably of normal counter height, about 36 inches. At one end of the counter, the upper counter surface comprises an input belt conveyor 21 for receiving a plurality of individual purchased items, which are unloaded onto the conveyor by the customer. The conveyor 21 moves in the direction of the arrows A under the control of a checkout clerk. At the end of conveyor 21 there is a fixed shelf 22 on which the clerk can allow a limited number of items to collect for momentary storage, the fixed counter top 22 ending at a barrier 23.

Beyond barrier 23, there is an aperture 24 in the top of counter 20. As shown in the plan view, FIG. 3, an open paper sack 25 is positioned immediately below aperture 24 at a location generally designated as the loading station 26 of counter 20. Sack 25 is positioned immediately adjacent an outlet belt conveyor 27 that leads to an outlet station 28. The lower surface of the outlet station 28 is afforded by a multiplicity of rollers 29 extending across the bottom of the outlet station.

The side 31 of counter 20 shown in FIG. 1 is the clerk's side of the counter. In the intermediate portion of the counter, just beyond loading station 26, a paper sack storage magazine 32 forms a small projection from side 31 of counter 20. A control panel 33 is mounted on the top of magazine 32. As best shown in FIG. 2, there is a loading door 34 in the top of counter 20 to provide for the deposit of a new supply of paper sacks in magazine 32.

The side 35 of counter 20 that is shown in FIG. 2 is the customer's side of the counter. The side 35 of counter 20 is of reduced height at the off-load end of the counter adjacent rollers 29, to allow the customer convenient removal of loaded sacks of goods at the outlet station 28.

In the operation of counter 20, the customer brings the goods to be checked out to the end of the counter at which conveyor 21 is located, approaching on side 35. The goods, usually brought to the counter in a grocery cart or the like, are unloaded by the customer onto conveyor 21. The checker or cashier actuates conveyor 21 on an intermittent basis, using one of the controls on panel 33 as described more fully hereinafter, and advancing the groceries or other goods to the counter shelf 22. At that point, each item is picked up by the clerk, the price is rung up on a cash register 37 (FIG. 3), and then the item is deposited directly in an open sack 25 at loading station 26. The goods pass through the opening 24 in the top of the counter.

When the sack 25 is loaded, the clerk actuates another of the controls in control unit 33 to initiate a sack replacement cycle for the automated sack opening and feeding apparatus incorporated in counter 20. At the

beginning of the cycle, an ejector 38 pushes the loaded sack into the internal conveyor 27 in counter 20. Conveyor 27, which preferably runs continuously, moves the loaded sack into the outlet station 28, where it rests on rollers 29. If another loaded sack is already present in outlet station 28, that sack simply moves further along, on rollers 29, toward the end of the outlet station.

When the loaded sack has cleared loading station 26, a new folded sack is fed from magazine 32, moving to the right as seen in FIGS. 1 and 3 and into loading station 26. When the folded sack reaches the loading station, it is opened automatically, so that the clerk can continue the checking of the groceries or other goods, loading them into the new open sack at the loading station. The entire sack exchange cycle is completed in only a few seconds, the cycle time being such that the clerk experiences little or no delay in the continuous checking of the goods.

Principal Mechanical and Electrical Systems — FIGS. 4 and 5

The principal operating systems of the automated check-out counter 20 are illustrated in schematic form in FIGS. 4 and 5; FIG. 4 shows the main mechanical components and drives and FIG. 5 is a complete electrical schematic of the control system.

Checkout counter 20, as shown in the schematic illustration of FIG. 4, includes an electrical motor 41 that is mounted in the base of the counter below conveyor 21. The output shaft of motor 41 carries a sprocket 42 engaged by a drive chain 43. Chain 43 engages a sprocket 44 mounted on a main drive shaft 45 which rotates continuously when the counter 20 is in operation.

The drive for the internal conveyor 27 in counter 20 comprises a sprocket 46 mounted on the main drive shaft 45 and engaged by a drive chain 47. The other end of chain 47 engages a sprocket 48 that is mounted on the shaft of a conveyor drive roller 49. Roller 49 is located at the output end of conveyor belt 27; an idler roller 51 engages the opposite end of this conveyor.

The drive for the intake conveyor belt 21 of counter 20 comprises a sprocket 53 that is connected to the main drive shaft 45 through an electrically actuated clutch 52. A chain 54 extends from sprocket 53 to a sprocket 55 that is mounted on the shaft of a drive roller 56 for conveyor belt 21. An idler roller 57 is located at the opposite end of the conveyor belt 21.

The drive for the paper sack feeding mechanism and the loaded sack ejector mechanism of counter 20 begins with a sprocket 58 mounted upon the main drive shaft 45. Sprocket 58 is engaged by a chain 59; the opposite end of chain 59 engages a sprocket 61. Sprocket 61 is connected through an electrically actuated clutch 62 to a sack feed and ejection cycling shaft 63. A cam 64 is mounted upon shaft 63 and actuates a sensing switch 65 located adjacent the cam.

The end of shaft 63 opposite clutch 62 carries a disc 66. A drive link 67 is pivotally connected at one end to the disc 66; the other end of link 67 is pivotally connected to a sprocket disc 68 that is somewhat larger than disc 66. The sprocket disc 68 is engaged by a chain 69 that also engages a sprocket 71 mounted on a short shaft 72.

Shaft 72 carries a sprocket 73 that is engaged by a sack feed and ejector drive chain 74. Chain 74 is con-

connected to a guide block 76 slidably mounted upon a pair of elongated guide members 75. A sack feed bar 77 is affixed to the guide block 76 and extends upwardly therefrom, parallel to the front end of the storage magazine 32 in which a plurality of folded paper sacks 79 are stored. A pair of sack feed fingers 78 are mounted on the sack feed bar 77.

The other end of chain 74 is connected to a second guide block 81 slidably mounted upon the two guide members 75, the chain extending around an idler sprocket 82. A short length of chain 83 affords a direct connection between the guide blocks 76 and 81; a rigid connection could be utilized if desired. The loaded sack ejector member 38 is mounted upon guide block 81. A sensing switch 80 is positioned at one end of the guide members 75 in position for engagement by the guide block 81.

One end of the main drive shaft 45 carries a 45° bevelled gear 85 that is disposed in meshing engagement with a second 45° bevelled gear 86. The gear 86 is connected, through an electrically actuated clutch 87, to a sack opener drive shaft 88. Shaft 88 carries two cams 90 and 91; cam 90 is aligned with a sensing switch 89, whereas cam 91 is aligned with another sensing switch 92.

The sack bottom opening mechanism of the automated checkout counter 20 comprises a gripper device 93, actuated by a solenoid 94, that is mounted upon a sack opener arm 95. Arm 95 is pivotally mounted upon a small shaft 96. The medial portion of arm 95 is engaged by a cam 97 that is mounted upon shaft 88.

A sprocket 98 mounted on shaft 88 engages a chain 99 that extends upwardly within counter 20 and into engagement with a sprocket 101 mounted on a shaft 102. A cam 103 mounted on shaft 102 engages a plunger 104 which carries a retainer disc 105. Plunger 104 is spring-biased into engagement with cam 103, as described more fully hereinafter. The retainer disc 105 is located at the top of loading station 26 in alignment with the side of the loading station to which paper sacks are fed during operation of counter 20.

The automated checkout counter 20 also includes a sack top opener mechanism 106 actuated by a solenoid 107. The armature 108 of solenoid 107 is connected to a rack member 109 that engages a combination gear and ratchet member 111. The gear-ratchet member 111, in turn, is engaged by a pawl 112 that is spring-biased toward the ratchet member. A sensing switch 113 is positioned to engage the end of the rack member 109.

A drive link 114 is pivotally connected, at one end, to the gear and ratchet member 111; the opposite end of link 114 is pivotally connected to a gear 115. Gear 115 is disposed in meshing engagement with an elongated double-sided rack 116. One end of rack 116 has gear teeth on the top surface, and these gear teeth engage a gear 117 mounted upon an opener shaft 118 to which a first sack top opener flap 119 is affixed. The opposite end of rack 116 has gear teeth on its lower surface that are disposed in meshing engagement with a gear 121 mounted on an opener shaft 122 that carries a second sack top opener flap 123.

FIG. 4 also illustrates a biasing apparatus 130 urging sacks 79 toward a feeding position in which they can be engaged by the sack feed bar 77. Mechanism 130 comprises a movable plate 127 located on the outer side of magazine 32. A guide block 128 is mounted upon plate

127; guide block 128 is in sliding engagement with a guide rod 129. A cord 131 connected to guide block 128 extends around a pair of pulleys 132 and 133 and is connected to a bias spring 134. An additional cord 135 extends from guide block 128 to the exterior of the counter, terminating in a ring 136.

The electrical circuits for the mechanism of FIG. 4 are shown in FIG. 5. As illustrated therein, motor 41 is connected directly across two A.C. power supply lines 151 and 152. A main power switch 144 is incorporated in power line 151. An indicator lamp 142 is connected in series with a sack supply sensing switch 160 across lines 151 and 152. A rectifier bridge 150 is connected across power lines 151 and 152. The positive terminal 153 of bridge 150 is connected through a manual control switch 139 to a D.C. supply line 154. A potentiometer 155 is connected from supply line 154 to a D.C. return line 156 that is connected back to the negative terminal 157 of bridge 150. An indicator lamp 143 is connected between lines 154 and 156.

The movable tap 158 on potentiometer 155 is connected to each of the two sensing switches 80 and 89 which, as shown in FIG. 5, are normally open switches. The two switches 80 and 89 are in parallel with each other and are connected to one terminal of the clutch solenoid 87, the other terminal of clutch solenoid 87 being returned to the D.C. return line 156. A manually actuated control switch 139 is connected in parallel with switches 80 and 89. A capacitor 159 may be connected in parallel with clutch solenoid 87. Line 154 is also connected to the sensing switch 65 and to a cycle control switch 138. Switches 65 and 138 are in parallel with each other and are each connected to one terminal of the operating solenoid for clutch 62. The other terminal of solenoid 62 is connected to the D.C. return line 156. A capacitor 161 may be connected in parallel with clutch solenoid 62.

A second rectifier bridge 162 is connected across the A.C. power lines 151 and 152. The positive terminal 163 of bridge 162 is connected to a manually operable control switch 137. Switch 137 is electrically connected to one terminal of the operating solenoid for clutch 52. The other terminal of solenoid 52 is connected to the negative terminal 164 of bridge 162. An indicator lamp 141 is connected in parallel with solenoid 52. Switches 137-139 and lamps 141-143 are on the operator's console (FIG. 2).

The gripper mechanism actuating solenoid 94 is an A.C. solenoid and has one terminal connected to the A.C. power line 152. The other terminal of solenoid 94 is connected to sensing switch 92, which is returned to the other A.C. power line 151. As shown in FIG. 5, the sensing switch 113 associated with rack member 109 (FIG. 4) is a normally closed switch. Switch 113 is connected from the A.C. power line 151 to a pair of normally open contacts 165 in a control relay 166 that includes an operating coil 167. The other contact in pair 165 is connected to coil 167, which is returned to the other A.C. line 152.

Coil 167 of control relay 166 is connected in parallel with the operating coil 168 of a time delay relay 169 having a pair of normally open contacts 171. Sensing switch 110 is connected to the relay coils 167 and 168, from A.C. supply line 151, in parallel with the circuit afforded by switch 113 and relay contacts 165. The pole of switch 110 that is connected to coils 167 and 168 is also connected to one side of the time delay relay

contacts 171. The other contact 171 is connected to one terminal of the solenoid 107, the other terminal of solenoid 107 being returned to the A.C. line 152. An alternate connection for solenoid 107, to the A.C. line 151, is provided through the switch 146, which is

When the automated checkout counter 20 is placed in operation, the clerk first actuates the main power switch 144 (FIGS. 1 and 5), providing a completed power supply for the control system of the counter mechanism. With switch 144 closed, motor 41 is continuously energized (FIG. 5). The drive connection afforded by chain 43 and sprockets 42 and 44 causes shaft 45 to rotate continuously (FIG. 4). The internal conveyor 27 of the checkout counter is also driven continuously through the drive connection afforded by sprockets 46 and 48 and drive chain 47.

Whenever goods requiring checkout are deposited upon conveyor 21 and the clerk desires to bring those goods forward to the access position on shelf 22 the clerk actuates the conveyor by means of control switch 137 (FIGS. 1-3 and 5). When switch 137 is closed, the operating coil of the electrically actuated clutch 52 is energized, completing a drive connection from the main shaft 45 to sprocket 53 (FIG. 4). The drive for conveyor belt 21 includes chain 54 and sprocket 55. Switch 137 is preferably a momentary contact switch so that, when it is released by the clerk, the movement of conveyor belt 21 is interrupted.

For automated operation, the clerk first closes switch 139. A sack feed and opening cycle is initiated by the clerk by actuating the main cycle control switch 138. Switch 146, which may be a separate miniature switch, is closed when switch 138 is actuated, completing an energizing circuit for solenoid 107. Solenoid 107, when energized, pulls rack 109 to the right, rotating the ratchet-gear member 111 in a counterclockwise direction to the position shown in FIG. 4. As member 111 rotates, gear 115 is rotated clockwise by the drive connection afforded by link 114. The rotation of gear 115 drives rack 116 to the right, rotating shaft 118 in a counterclockwise direction and rotating shaft 122 in a clockwise direction. The rotational movement of shafts 118 and 122 pivots the sack top opener flaps 119 and 123 upwardly and out of loading station 26 to the position shown in FIG. 4. Solenoid 107 (FIG. 5) is de-energized when the clerk releases the cycle control switch 138, allowing switch 146 to open; however, the bag top opener mechanism 106 remains in the position illustrated in FIG. 4, being held there by a latching mechanism, comprising pawl 112, described more fully hereinafter.

With switch 138 closed, the operating coil for clutch 62 is energized (FIG. 5), engaging the clutch and completing a driving connection from main shaft 45 to shaft 63 through the drive connection afforded by sprockets 58 and 61 and chain 59 (FIG. 4). The sack feed and ejector shaft 63 begins to rotate, closing sensing switch 65 almost immediately. Consequently, even though switch 138 opens when released by the clerk, clutch 62 remains energized, the circuit being kept complete through sensing switch 65 (FIG. 5). When one complete revolution of shaft 63 is completed, sensing switch 65 opens, de-energizing the operating coil of clutch 62 and terminating the sack feed and loaded bag ejection cycle.

During the operational cycle determined by one revolution of shaft 63, disc 66 also rotates through one complete revolution. As disc 66 begins its rotational movement from the position shown in FIG. 4, link 67 drives sprocket disc 68 in a clockwise direction, as viewed in FIG. 4. Accordingly, chain 69 causes sprocket 71 and shaft 72 to rotate in a clockwise direction. This rotational movement is also imparted to sprocket 73, driving chain 74 in the direction indicated by arrow B.

This movement of chain 74 moves both the sack feed bar 77 and the loaded sack ejector 38 in the direction of arrow B (FIG. 4). Ejector 38 moves through loading station 26 and pushes any loaded sack that may be present in the loading station onto the internal conveyor belt 27. In this manner, any loaded sack in the checkout counter is brought onto conveyor 27 and transported to the outlet station 28 of the counter, coming to rest on rollers 29. If another loaded sack has previously been deposited on the rollers 29, it is moved down the rollers further toward the outlet end of the counter.

The movement of the sack feed bar 77 in the direction of arrow B brings the sack feed bar to the extreme right hand end of magazine 32, as seen in FIG. 4, just beyond the edge of the front sack in the magazine. Subsequently, the continuing rotation of disc 66, acting through link 67, reverses the rotational movement of sprocket disc 68, which also reverses the movements of shaft 72 and chain 74. Chain 74 now moves back toward its original position, in the direction indicated by arrow C. During this return movement, the sack feed fingers 78 on bar 77 engage the front sack in magazine 32 and move that sack from the magazine to the far side of loading station 26. Of course, the return movement of chain 74 in the direction of arrow C causes a corresponding movement of ejector 38 back to the original position shown in FIG. 4. At the end of this return movement, guide block 81 engages and actuates sensing switch 80. The closing of switch 80 is momentary in nature; the final portion of the rotational cycle of shaft 63 again reverses the direction of rotation of disc 68 and moves chain 74 and guide block 81 a short distance in the direction of arrow B back to the initial position shown in FIG. 4, with block 81 clear of switch 80.

When the sack feed loaded bag ejection cycle is nearly completed and guide block 81 closes sensing switch 80, the operating coil of clutch 87 (FIGS. 4 and 5) is energized, through the D.C. circuit including rectifier 150 and potentiometer 155. Clutch 87 is engaged and completes a drive connection to shaft 88 from the main shaft 45, through the bevel gears 85 and 86 (FIG. 4). This initiates a sack opening cycle, during which shaft 88 rotates through one complete revolution. Sensing switch 89, connected in parallel with sensing switch 80, is closed by cam 90 almost immediately after shaft 88 starts to rotate, maintaining clutch solenoid 87 energized when switch 80 opens. Sensing switch 89 opens and interrupts the operating circuit for clutch 87 when one full revolution of shaft 88 is completed.

As shaft 88 rotates, cam 97 drives the sack bottom opener arm 95 upwardly, the arm pivoting in a counterclockwise direction about its pivot shaft 96. This pivotal movement of arm 95 beings the gripper device 93 into alignment with the upper edge of the folded bottom of the sack that has previously been moved to the

side of loading station 26 as described above. At the point at which the gripper contacts the sack, sensing switch 92 is closed by cam 91 (FIGS. 4 and 5), energizing solenoid 94 and actuating gripper mechanism 93 to grip the upper edge of the folded sack, at the center of the sack.

During the initial rotation of shaft 88, as described above, shaft 102 is driven through a corresponding angular movement by the drive connection afforded by sprockets 98 and 101 and chain 99 (FIG. 4). As shaft 102 starts to rotate, the reduced-diameter portion of cam 103 is brought into engagement with plunger 104, allowing retainer disc 105 to move into engagement with the upper edge of the paper sack positioned at the side of loading station 26. The paper sack 79, being of conventional construction, has a cut-away portion 100 on the top edge of the sack on only that side of the sack facing in the same direction as the folded bottom of the sack. Consequently, retainer 105 grips the upper edge of the outer wall of the sack without interfering with movement of the top of the inner wall of the sack. The cam arrangement is such that retainer 105 engages the sack at the side of loading station 26 before the gripper mechanism 93 is actuated to grip the bottom of the sack.

The continuing rotation of shaft 88, and the corresponding rotation of cam 97, now allows the sack bottom opener arm 95 to pivot in a clockwise direction back toward its original position as shown in FIG. 4. This pivotal movement of arm 95, with gripper 93 closed, pulls the upper edge of the folded bottom of the sack outwardly and downwardly, away from the side of the loading station, opening the bottom of the sack. The front wall of the sack is pulled partly away from the back wall, since the top of the back wall is held by retainer 105. In this manner, the opening of the sack is initiated. As the sack opening cycle proceeds, the continuing rotation of shaft 102 again brings the large-diameter portion of plunger 103 around to engagement with plunger 104, moving retainer 105 outwardly and releasing the sack entirely at its upper edge.

As arm 95 moves downwardly, it engages the sensing switch 110 and closes that switch momentarily. The final rotational movement of shaft 88 and cam 97 pivots arm 95 back upwardly through a short distance, enough to clear switch 110 and allow the switch to re-open. The final position of arm 95 is determined by switch 92, which is actuated by cam 91 to its open position, de-energizing solenoid 94 and thus releasing gripper mechanism 93.

The momentary closing of sensing switch 110, occurring virtually at the end of the cyclic movement of arm 95, completes an energizing circuit to the coils 167 and 168 of control relay 166 and time delay relay 169 respectively (FIG. 5). When switch 110 is closed, control relay 166 is actuated, closing its contacts 165 and establishing a holding circuit for the relay coils 167 and 168 through contacts 165 and the normally closed sensing switch 113. After a predetermined time delay, made long enough to assure completion of the sack bottom opening cycle and the de-energization of gripper solenoid 94, the time delay relay 169 is actuated, closing its contacts 171. This completes an operating circuit from power line 151 to solenoid 107, and again energizes that solenoid.

With solenoid 107 energized for the second time, its armature 108 is again pulled to the right, as seen in

FIG. 4. This releases the latch in mechanism 106 that has held the sack top opener flaps 119 and 123 in their raised positions. Furthermore, the resulting short movement of rack member 109 to the right momentarily opens sensing switch 113, de-energizing both of the relays 166 and 169 and also de-energizing solenoid 107. With the latch released, and with solenoid 107 de-energized, a return spring, described more fully hereinafter, moves rack 109 to the left, as seen in FIG. 4, rotating the combination ratchet and gear member 111 in a clockwise direction. As member 111 rotates, gear 115 is rotated counterclockwise by drive link 114.

As gear 115 rotates counterclockwise, it drives rack 116 to the left, as seen in FIG. 4, rotating shaft 118 clockwise and rotating shaft 121 counterclockwise. This rotation of shafts 118 and 121 pivots the sack top opener flaps 119 and 123 downwardly into loading station 26. The flaps enter the top of the sack and spread it to full open position, ready to receive groceries or other checkout items deposited in the sack by the clerk. This completes the operating cycle of counter 20, with an empty sack open and ready for use in loading station 26.

When the open sack is fully loaded, the clerk again actuates cycle control switch 138, initiating a new operating cycle that proceeds as described above. The preliminary closing of switch 146 at the beginning of the cycle again energizes solenoid 107 to raise flaps 119 and 123 as described before. Since this is the first operation that occurs upon actuation of the cycle control switch, the requisite raising of flaps 119 and 123 is assured at the beginning of each cycle of the apparatus, preventing the flaps from interfering with transfer of loaded sacks from station 26 onto internal conveyor 27 and thence to outlet station 28.

FIGS. 6, 7 and 8 afford a more detailed illustration of the magazine 32 and the mechanism for feeding sacks from magazine 32 into loading station 26. The paper sacks are supported in magazine 32 by an open framework comprising a plurality of horizontally extending side frame members 201 (FIG. 7). The front of the magazine is defined by a further plurality of horizontally extending frame members 202 covered with sheet metal members 203. The sack feed fingers 78 are mounted upon two short shafts 204 that extend through a pair of slots in the front of magazine 32 and are affixed to the vertically extending sack feed bar 77. As described above in connection with FIG. 4, magazine 32 is provided with a movable bias plate 127 that is urged toward the front 203 of the magazine, maintaining the sacks in the magazine pressed against the front of the magazine.

In the construction shown in FIG. 7, the biasing apparatus for plate 127 corresponds generally to that described in connection with FIG. 4. A pair of guide members 129A and 129B are affixed to the front of magazine 32 and extend rearwardly thereof along the sides of the magazine. Two guide blocks 128A and 128B are mounted upon the side of plate 127 and engage the guide bars 129A and 129B, respectively, to assure controlled movement of plate 127. The pulley 132A for the bias drive cord for plate 127 is shown in FIG. 7 but the cord itself has been omitted from this drawing.

It is necessary to maintain sack feed bar 77 in accurate alignment with magazine 32 and particularly with the front face of the magazine comprising members

203. The lower part of guide bar 77 is affixed to guide block 76, which moves along the guide rail 75, so that the position of the lower end of sack feed bar 77 is fully controlled. In addition, a guide roller 205 is mounted on the top of sack feed bar 77 (FIGS. 6-8). Roller 205 projects above bar 77 into an elongated channel-shaped guide 206 that extends across the entire front of magazine 32 at the top of the magazine. Roller 205 and channel guide 206 effectively control the position of the upper end of sack feed bar 77 as bar 77 moves from its normal position at the front end of magazine 32 adjacent loading station 26 (FIG. 8) to the rear end of the magazine (FIG. 6) and back again in a sack feed operation. Inasmuch as the folded sacks are relatively thick, being formed of heavy paper, the construction illustrated affords effective assurance of accurate feed of each paper sack from magazine 32, avoiding double feeding of the sacks.

In the bottom of loading station 26, there are two base plates 208 and 209 separated by an open space 211. The base plates 208 and 209 support the open paper sack during loading operations. They are aligned approximately with the top of conveyor 27 to enable ejector 38 to move the loaded sacks easily from loading station 26 onto conveyor 27. The gap 211 between plates 208 and 209 allows movement of sack opener arm 95 through the loading station to engage a sack newly fed to the loading station in order to open the sack.

The sack opening mechanism, including gripper device 93, is best illustrated in FIG. 9. As shown therein, solenoid 94 is mounted on the outer end of an extension member 212 fixedly mounted upon sack opener arm 95. The armature 213 of solenoid 94 is connected to a biasing spring 214 affixed to a pin 215 on arm 95. Armature 213 also carries a pin 216 engaged in an elongated slot in a lever 218 that is pivotally mounted upon the gripper arm extension 212 on a pivot pin 219. The free end of lever 218 carries a pin 221 that is engaged in an elongated slot 222 in an L-shaped gripper member 223 that is pivotally mounted upon extension member 212 on the pivot pin 224. The arm of gripper member 223 opposite slot 222 terminates in a jaw 225 that is aligned with a fixed jaw 226 mounted upon member 212.

In FIG. 9, gripper device 93 is shown in its normal open position, displaced from a sack 79A positioned at the side of loading station 26 in counter 20; sack 79A shows the position of the sack as fed into the loading station from magazine 32. During a sack-opening operation, arm 95 pivots in a counterclockwise direction to the position 95A. The pivotal movement is effected with the jaws 225 and 226 of gripper device 93 open. When the movement of arm 95 to position 95A is completed, the fixed lower jaw 226 is in position 226A, engaging the upper edge of the bottom fold 79B of a sack that has been moved into the side of loading station 26 in folded condition, aligned with a vertical support 227.

With arm 95 raised completely to position 95A, solenoid 94 is energized, pulling armature 213 inwardly of the solenoid to the position 213A against the bias of spring 214. The movement of armature 213 into solenoid 94 pivots lever 218 to the position 218A. This movement of lever 218 pivots jaw member 223 counterclockwise about its pivot pin 224 to the position 223A. As shown in FIG. 9, with solenoid 94 energized, the two jaws 225 and 226, in their actuated positions

225A and 226A, grip the upper edge 79B of the sack bottom. Consequently, when sack opener arm 95 pivots back toward its original position, with the solenoid 94 still energized and the jaws 225 and 226 closed, the upper edge 79B of the folded bottom of the sack is pulled outwardly and downwardly into loading station 26, onto the base plates 208, 209. This occurs with retainer member 105 in its closed gripping position, as shown in FIG. 9, preventing the top edge of the outer side of the sack from moving away from vertical support 227. Solenoid 94 is deenergized when it is returned to the original position, opening jaw members 225 and 226 by the action of biasing spring 214 and releasing the bottom of the sack. At this point, the sack is partially open. Retainer 105 then releases the top of the sack, through the action of cam 103 as described above, and the top of the sack is opened by opener flaps 119 and 123 (FIG. 4). The full open position of the sack is shown in FIG. 9 by phantom outline 25.

FIGS. 10 and 11 afford a more detailed illustration of the principal operating components of the sack top opener mechanism 106. As shown therein, solenoid 107 is affixed to a horizontal frame member 231 extending along the side of counter 20 adjacent loading station 26. The armature 108 of solenoid 107 is connected to a spring 232, the other end of spring 232 being affixed to a pin 233 that is mounted on and projects outwardly of the frame member 231. The outer end of armature 108 also has a vertically extending element 234 affixed thereto which is connected to one end of the rack member 109. Rack member 109 is supported in a guide block 235 mounted on frame member 231.

Rack member 109 is in meshing engagement with a gear 236 mounted upon a shaft 237 that is in turn supported upon frame member 231. Gear 236 is connected to a cam or ratchet member 238 by a unidirectional bearing 239. Bearing 239, which may be a roller clutch of conventional construction, rotates ratchet member 238 conjointly with gear 236 whenever gear 236 turns in a counterclockwise direction (FIG. 11); however, clockwise rotation of gear 236 is not transmitted to ratchet member 238. Gear 236, ratchet member 238, and one-way bearing 239 constitute the gear-ratchet member 111 described above in connection with FIG. 4.

Ratchet 238 has two teeth 241 located diametrically opposite each other. The teeth 241 are positioned for engagement by the pawl 112, which is pivotally mounted upon a pin 242 mounted on frame member 231. The left-hand end of pawl 112 includes a lug 243 and is connected to a spring 244 that normally maintains pawl 112 in the unlatched position shown in FIG. 11. The other end 245 of pawl 112 is positioned in the path of movement of member 234 on the end of armature 108. An elongated arm 254 is affixed to pawl 112 for conjoint rotation therewith, projecting downwardly on the opposite side of member 234 from pawl end 245.

Ratchet member 238 is connected to a disc 247 by link 114. Disc 247 affixed to the gear 115, and both are mounted on a shaft 248 supported upon frame member 231. Frame member 231 also supports the ends of shafts 118 and 122, with their gears 117 and 121 engaging rack member 116. The central portion of rack member 116 is disposed in meshing engagement with gear 115. A pair of guides 251 and 252 engage rack

member 116 near its ends to control the linear movement of the rack.

Starting from the position shown in FIG. 11, energization of solenoid 107 pulls its armature 108 inwardly of the solenoid against the bias afforded by spring 232. This moves rack 109 to the right and drives gear 236 counterclockwise. This is the direction in which bearing 239 affords a driving connection from gear 236 to ratchet member 238, so that the ratchet member is also driven counterclockwise. The resulting movement of link 114 drives disc 115 in a clockwise direction, through an angle of less than 180°, rotating gear 115 clockwise and driving rack 116 in the direction of the arrow C. This movement of rack 116 turns gear 117 and shaft 118 counterclockwise, pivoting opener flap 119 upwardly out of loading station 26. Gear 121 and shaft 122 are turned clockwise, raising opener flap 123 out of the loading station.

Near the end of the movement of armature 108 effected by energization of solenoid 107, the vertical element 234 on the armature engages end 245 of pawl 112 and pivots the pawl in a counterclockwise direction. The lug 243 on pawl 112 is thus brought into position to engage one of the teeth 241 on ratchet member 238. Engagement occurs just as solenoid 107 is deenergized and stops the counterclockwise rotation of ratchet 238 in the desired position with opener flaps 119 and 123 raised, preventing overtravel of the opener flaps that could otherwise result from mechanical inertia of the gears and shafts.

Deenergization of solenoid 107 permits armature 108 to move back to its original position, as shown in FIG. 11, in response to the biasing force exerted by spring 232. Rack 109 returns to its original position, rotating gear 236 in a clockwise direction. However, the counterclockwise rotation of gear 236 is not imparted to ratchet 238, since bearing 239 does not drive the ratchet member for this direction of rotation. Accordingly, the sack top opener mechanism 106 remains in its cleared position, with flaps 119 and 123 raised. On the return movement of armature 108, the vertical extension member 234 engages arm 254 of pawl 112. This pivots arm 254 and pawl 112 away from engagement with ratchet 238, releasing pawl 112 to return to its original position in response to the biasing force exerted by spring 244.

The next time solenoid 107 is energized, armature 108 and rack 109 are again driven to the right against the bias of spring 232. Gear 238 is rotated counterclockwise and ratchet 238 is also rotated in the same direction through the unidirectional coupling afforded by bearing 249. In this instance, link 114 drives disc 247 counterclockwise. As a consequence, rack member 116 is driven in a direction opposite arrow C and rotates shaft 118 clockwise and shaft 122 counterclockwise. This pivots the opener flaps 119 and 123 downwardly into loading station 26 to perform the necessary operation of opening the top of a sack in the loading station. Near the end of its travel, the extension 234 on armature 108 again engages end 245 of pawl 112 and pivots the pawl counterclockwise to its operative position relative to ratchet member 238. Thus, the movement of the opener flaps is arrested at an accurately determined position, by the operation of pawl 112 and ratchet member 238. When solenoid 107 is deenergized, spring 232 returns armature 108 and rack 109 to their original positions, during which movement

pawl 112 is again restored to its normal position as described above.

From the foregoing description, it will be apparent that the automated sacking apparatus incorporated in counter 20 allows a complete checkout operation with each item handled only once from the time it is deposited on the inlet conveyor 21 until the time it is available to the customer at the outlet station 28. The paper sacks are fed automatically from the magazine 32 to the loading station 26, with the loading station being cleared of any loaded sack before the new sack is brought to the loading station. The bottom opening mechanism for the sacks, comprising arm 95 and gripper 93, positively pulls the sack bottom to open position; the sack top opening mechanism 106 affords an equally positive action in opening the top of each sack. All of the operating components of the counter, following the inlet conveyor 21, operate in a positively controlled and accurately timed cycle actuated by the control means illustrated in FIG. 5. The entire operating cycle for the loading apparatus requires no more than a few seconds; six seconds is typical.

In the foregoing description, it has been assumed that the base plates 208 and 209 at the bottom of loading station 26 (FIGS. 6 and 9), on which the sack 25 rests while being loaded, are stationary. Fixed support plates can be used effectively for this purpose. However, if the clerk fills sack 25 completely, to a level above the top opener flaps 119 and 123, in a counter with a fixed base at the loading station, the contents of the sack may interfere with the raising of the top opener flaps. The result may be spillage of some of the sack contents, damage to the sack or its contents, or even damage to the top opener flaps 119 and 123.

To avoid this potential difficulty, the base plates 208 and 209 may be incorporated in an elevator system 300 as shown in FIGS. 6 and 9. As shown therein, the base plates 208 and 209 may be mounted upon a vertical support member 301 extending upwardly along the outer edge of loading station 26. Two guide blocks 302 are mounted on support member 301; each of the guide blocks 302 engages a respective one of a pair of elongated vertical stationary guide rods 303. Each of the guide rods 303 is provided with a spring 304 that extends from its associated guide block 302 down to a fixed stop 305 mounted on the rod (FIG. 9). The two guide rods 303 extend downwardly from a pair of fixed horizontal frame members 306.

Two vertical frame members 307, mounted on the horizontal frame members 306, afford a support for an elevator drive shaft 308. A drive pinion 309 is mounted on shaft 308, near the middle of the shaft, and is disposed in meshing engagement with a vertical rack 311 mounted on member 301. At the right-hand end of shaft 308, as seen in FIG. 6, another pinion gear 312 is affixed to the shaft. Gear 312 engages a vertical rack 313 that is mounted on and extends downwardly from the armature 314 of an elevator drive solenoid 315. Solenoid 315 is mounted on a vertical frame member 316; a guide member 317 mounted on frame member 316 engages rack 313 to maintain the rack in vertical alignment.

A sensing switch 318 is mounted on frame member 316 in position to be actuated by the solenoid armature 314. As shown in FIG. 5, sensing switch 318 is connected in series with another sensing switch 319 and with solenoid 315 across the A.C. supply lines 151 and

152. Switch 319 is a normally closed switch and located adjacent sensing switch 80 (FIG. 4) for actuation by guide block 81. A parallel path for energizing solenoid 315, independently of switches 318 and 319, is provided through a switch 321 that is gauged with switches 138 and 146 (FIG. 5).

The operation of elevator system 300 is relatively simple. At the beginning of each operating cycle, when the clerk closes the main cycle control switch 138 and switch 146, the switch 321 is also closed, energizing solenoid 315 (FIGS. 5, 6 and 9). As shown in FIG. 9, the solenoid armature 314 is pulled upwardly by the energized solenoid 315, so that rack 313 moves upwardly, rotating gear 312 and shaft 308 in a counterclockwise direction. The consequent rotation of pinion 309 drives rack 311 and support member 301 downwardly against the bias afforded by springs 304. The downward movement of support member 301 lowers the base plates 208 and 209 to a point at which the sack 25 in loading station 26 (FIG. 9) is clear of the top opener flaps 119 and 123.

When the clerk releases the main cycle control switch 138, switch 321 opens. Sensing switch 318, however, has been closed by the upward movement of armature 314 (FIG. 9). Consequently, solenoid 315 remains energized through the alternate circuit afforded by switches 318 and 319 and elevator system 300 remains in its actuated (lowered) condition.

During the sack feed and opening cycle, after a loaded sack has been ejected from loading station 26 and while a new sack is being fed into the loading station, sensing switch 319 (FIG. 5) is actuated to its open condition by the return movement of guide block 81 (FIG. 4). Opening of switch 319 de-energizes solenoid 315 (FIG. 5). Accordingly, elevator system 300 is returned to its normal (raised) condition by springs 304, so that the base platforms 208 and 209 for loading station 26 are at the desired level when a new sack is fed to the loading station and opened for loading.

From the foregoing description of the elevator system 300, it will be apparent that the loading station platforms are lowered enough to clear the top opening mechanism 106 at the beginning of each machine cycle, avoiding possible damage to flaps 119 and 123 and avoiding spillage or damage to the contents of a sack loaded above the level of the flaps. Of course, with this modification of the invention, the internal conveyor 27 and the outlet station rollers 29 are aligned with the actuated (lowered) position of base plates 208 and 209 to allow smooth and efficient discharge of each loaded sack to outlet station 28.

I claim:

1. Automated sacking apparatus for retail supermarkets and like applications in which goods are individually checked and loaded into paper sacks of the kind which, when folded, have an external bottom fold extending parallel to the body of the sack, said apparatus comprising:

a magazine for storing a plurality of folded sacks immediately adjacent to a loading station;

sack feed means for feeding sacks one by one from said magazine to an initial position at one side of the loading station, with the sack at the loading station vertically oriented and having the bottom fold of the sack facing toward the loading station;

retainer means for engaging and retaining the top edge of one side of the sack at the outer side of the loading station;

bottom opening means for engaging and pulling the upper edge of the bottom fold of the sack outwardly and downwardly from its initial position into the base portion of the loading station to open the bottom of the sack, the bottom opening means comprising a pivotally movable arm movable into and out of the loading station, a pair of gripper jaws mounted on the free end of the arm in position to grip the upper edge of the bottom fold of the sack when the arm is fully advanced into the loading station, and an electrically energized actuator mounted on the arm for opening and closing the gripper jaws;

release means to release both the retainer means and the bottom opening gripper jaws when the bottom of the sack is open;

and control means, incorporating the release means, for actuating the retainer means and the bottom opening means in timed relation to each other in accordance with a predetermined sack opening cycle.

2. Automated sack opening apparatus, according to claim 1, in which said actuator is an electrical solenoid having a movable armature linked to one of said gripper jaws and in which the other gripper jaw is fixedly mounted on said arm.

3. Automated sacking apparatus, according to claim 1, and further comprising top opening means, actuated by said control means, for spreading the top of the sack in the loading station to full open position following operation of the release means, the top opening means comprising a pair of top opener flaps, individually mounted on two opener shafts extending across the top of the loading station, and drive means, actuated by the control means, for simultaneously rotating the two opener shafts, in opposite directions, to pivot the opener flaps between a raised position clear of a sack in the loading station and a sack-opening position projecting downwardly into a sack in the loading station.

4. Automated sacking apparatus, according to claim 3, in which said drive means comprises a pair of output gears individually mounted on said opener shafts, an elongated rack member engaging both of said output gears, input gear means for driving said rack member in opposite directions, and stop means for limiting movement of said rack, in each direction, to establish said raised and sack-opening positions for said opener flaps.

5. Automated sacking apparatus, according to claim 4, in which said stop means comprises a first input gear, a two-position ratchet limiting rotation of said first input gear to 180° in each cycle of operation, and a drive link connecting said first input gear to a second input gear disposed in meshing engagement with said rack, said second input gear turning through an arc of less than 180° for each cycle of operation of said first input gear.

6. Automated sacking apparatus, according to claim 3, and further comprising a loading platform for supporting a sack in loading position in said loading station, ejector means for ejecting a loaded sack horizontally from said loading platform, and elevator means for lowering said platform from loading position to a discharge position clear of said top opening means, said

ejector means and said elevator means being actuated in timed relation to each other by said control means to lower said platform to discharge position prior to ejection of each loaded sack.

7. Automated sacking apparatus, according to claim 1, and further comprising output conveyor means for transporting a loaded sack from the loading station to an outlet station prior to each cycle of operation of the bottom opening means, the output conveyor means comprising a continuously driven conveyor, extending from one edge of the bottom of the loading station to an outlet storage station, and ejector means, actuated by the control means, for ejecting a loaded sack from the loading station for movement along the conveyor.

8. Automated sacking apparatus for retail supermarkets and like applications in which goods are individually checked and loaded into paper sacks, said apparatus comprising:

a loading station; including a vertically movable sack support;

ejector means for ejecting a loaded sack from said loading station;

a magazine for storing a plurality of folded sacks; sack feed means for feeding a single sack, vertically oriented from said magazine to an initial position at said loading station;

retainer means for engaging and retaining the top edge of one side of the sack with the sack in its ini-

tial position at the loading station;

bottom opening means for engaging and opening the bottom of the sack;

release means to release said retainer means when the bottom of the sack is open;

top opening means for spreading the top of the sack at the loading station to full open condition following operation of said release means;

elevator means for moving said sack support between a normal loading position and a lowered ejection position;

and control means for actuating said ejector means, said retainer means, said elevator means and said bottom opening means in timed relation to each other in accordance with a predetermined sack ejection and sack opening cycle;

said elevator means being actuated by said control means to move said sack support to its ejection position as an incident to initiation of operation of said ejector means and to return said platform to its normal position prior to initiation of a subsequent sack opening cycle.

9. Automated sacking apparatus, according to claim 8, in which said ejector means includes a continuously operating conveyor for transporting loaded sacks from said loading station to an outlet station.

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