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[54] AUTOMATIC APPARATUS FOR PACKING ARTICLES IN BOXES 36 Claims, 35 Drawing Figs.

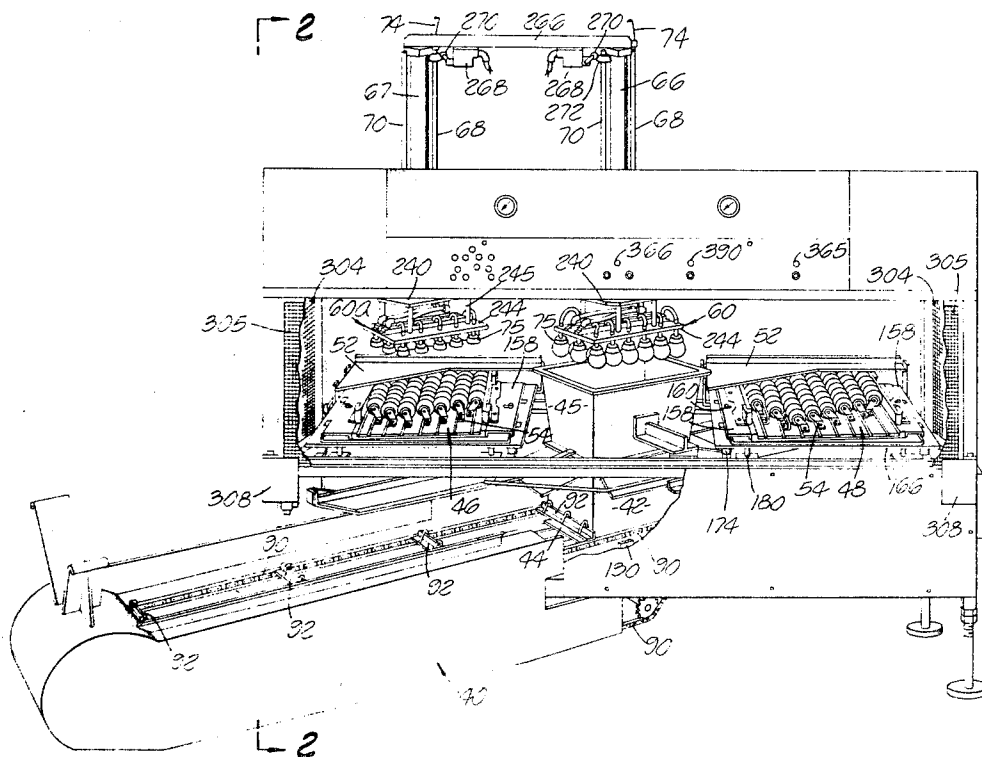
[52] U.S. Cl. 53/60,
53/63, 53/69, 53/165
[51] Int. Cl. B65b 57/06,
B65b 35/38
[50] Field of Search 53/55, 63,
165, 67, 69, 71, 64, 60

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ABSTRACT: A machine to pack oranges in boxes has a central packing station occupied by a box and has two supply stations on opposite sides of the packing station where the fruit is arranged in staggered rows on channel assemblies that expand for gravitational supply movement of the fruit and contract to form patterns of fruit, the right channel assembly forming one particular pattern and the left channel assembly forming another particular pattern, the two patterns alternating in the layers in a box. A right pickup head and a left pickup head are mounted on an overhead carriage that shifts between a right position and a left position. At the right position the vacuum cups of the right head pick up a new layer from the right channel assembly and the vacuum cups of the left pickup head deposit a layer in the box. At the left position of the carriage the vacuum cups of the left head pickup a pattern at the left channel assembly and the vacuum cups of the right head deposit a layer of fruit in the box.

The cycle control comprises a gang of switch-operating cams on a common shaft that is rotated by a suitable electric motor. The cams control the horizontal reciprocations of the carriage, the up and down movements of the two pickup heads, the vacuum cycle in the vacuum cups of the two pickup heads, the vacuum cycle in the vacuum cups of the two pickup heads, and expansion and contraction of the two channel assemblies. A selector switch having four positions for three-layer, four-layer, five-layer, and six-layer boxes, respectively, determines which cams are activated for a particular operating cycle for packing a box with a particular number of fruit in a particular number of layers.



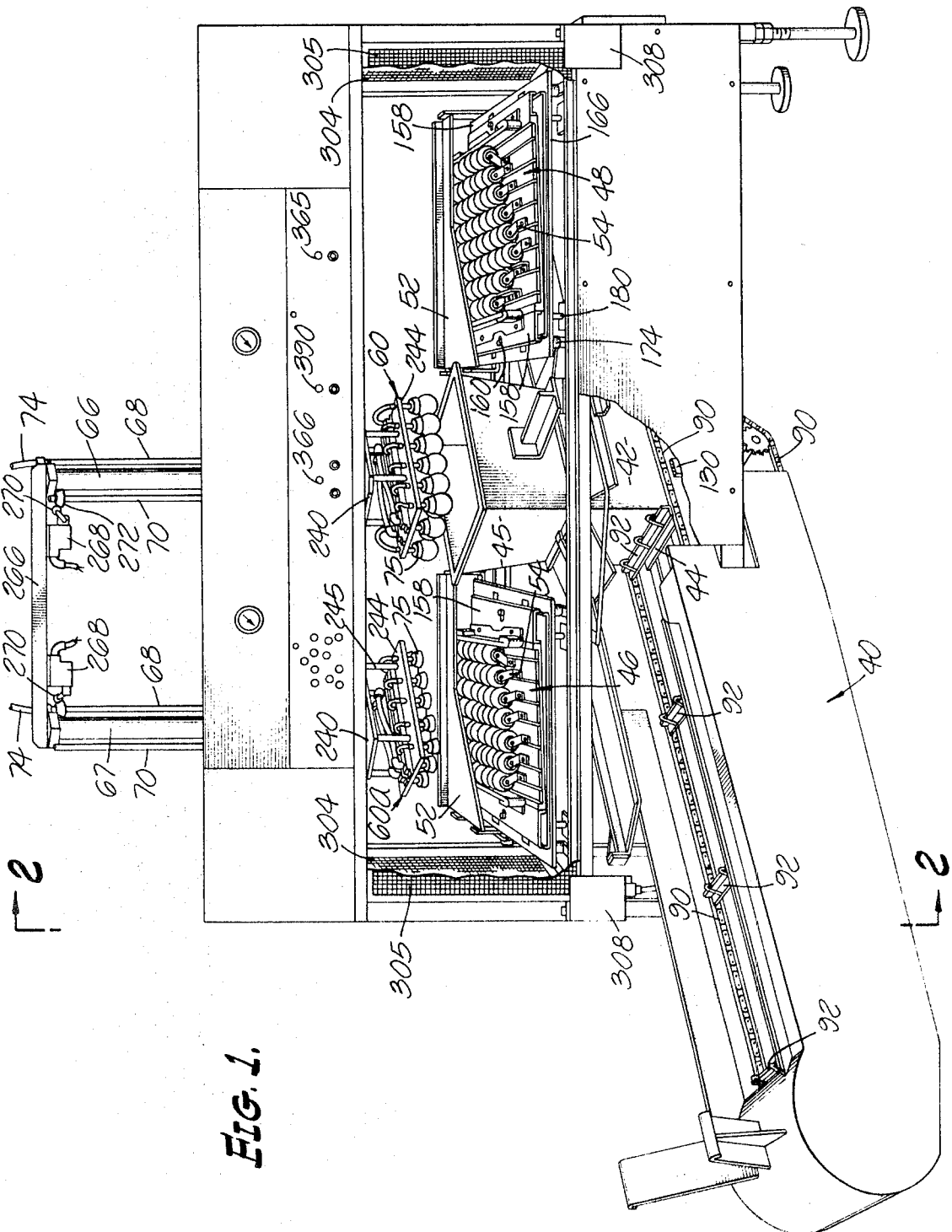


FIG. 1.

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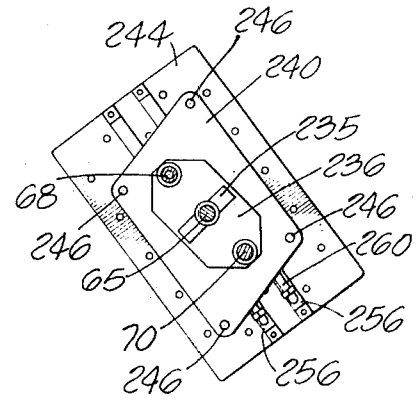
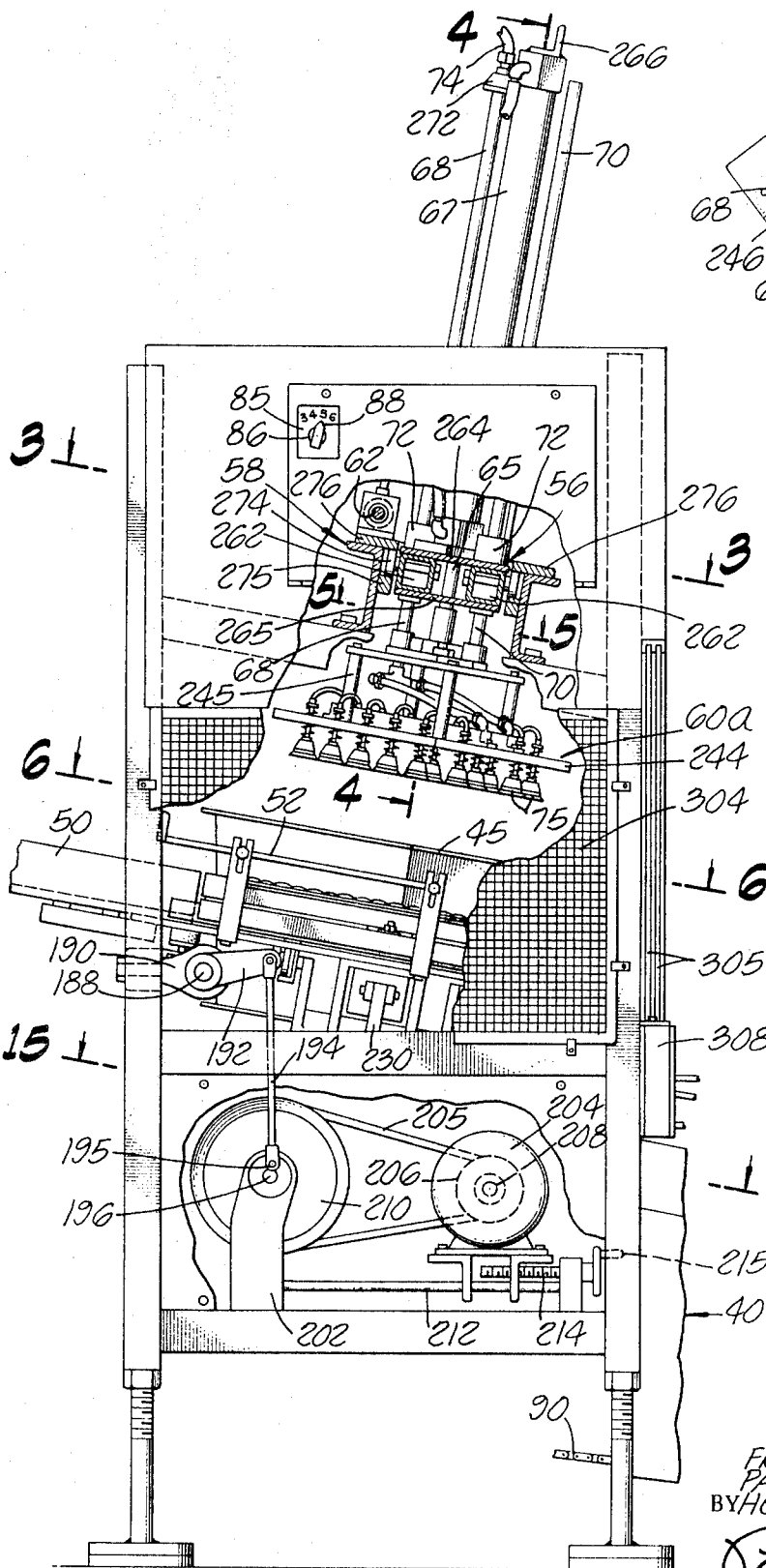


FIG. 5.

FIG. 2.

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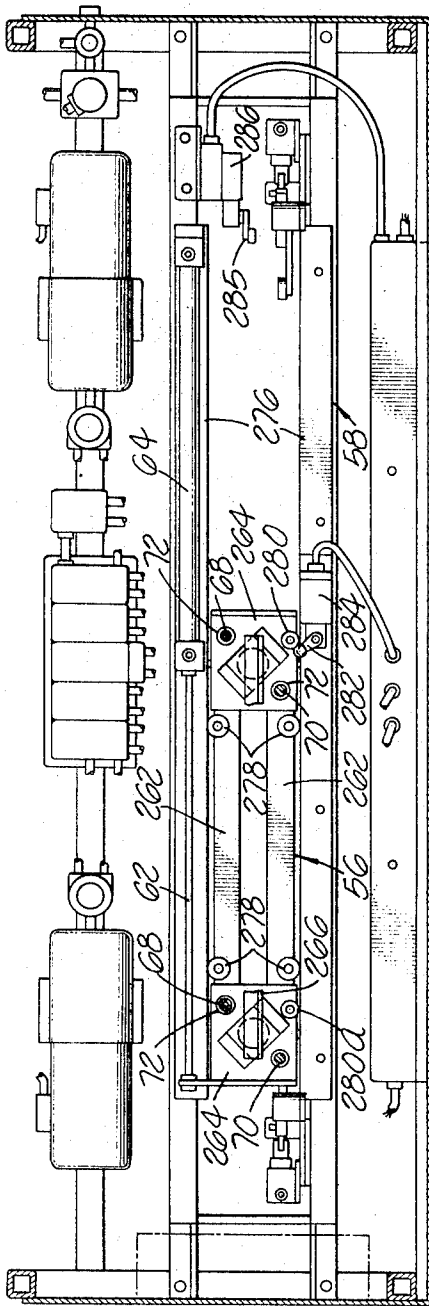


FIG. 3.

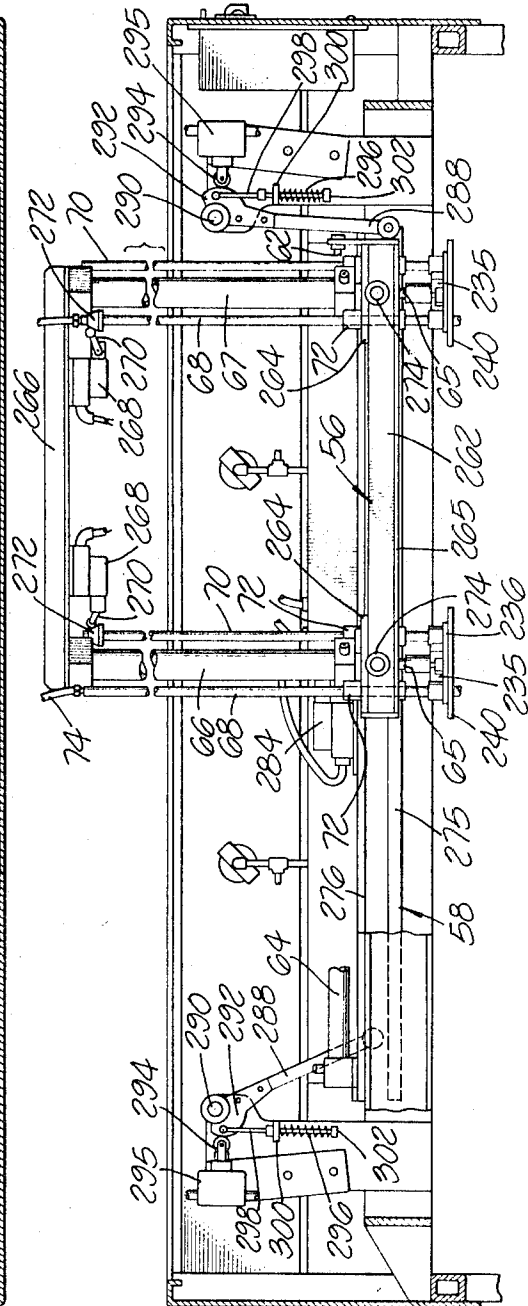


FIG. 4.

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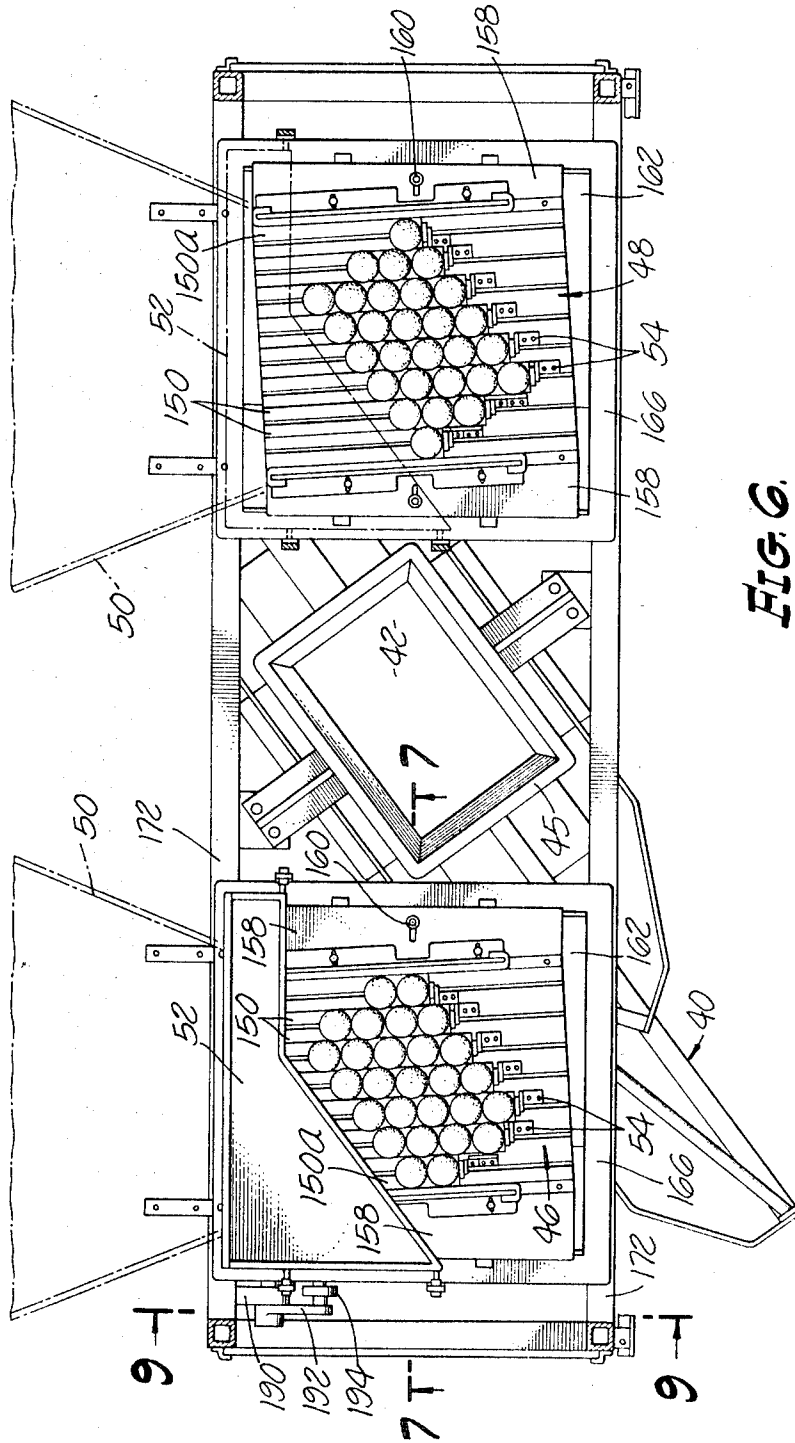


FIG. 6.

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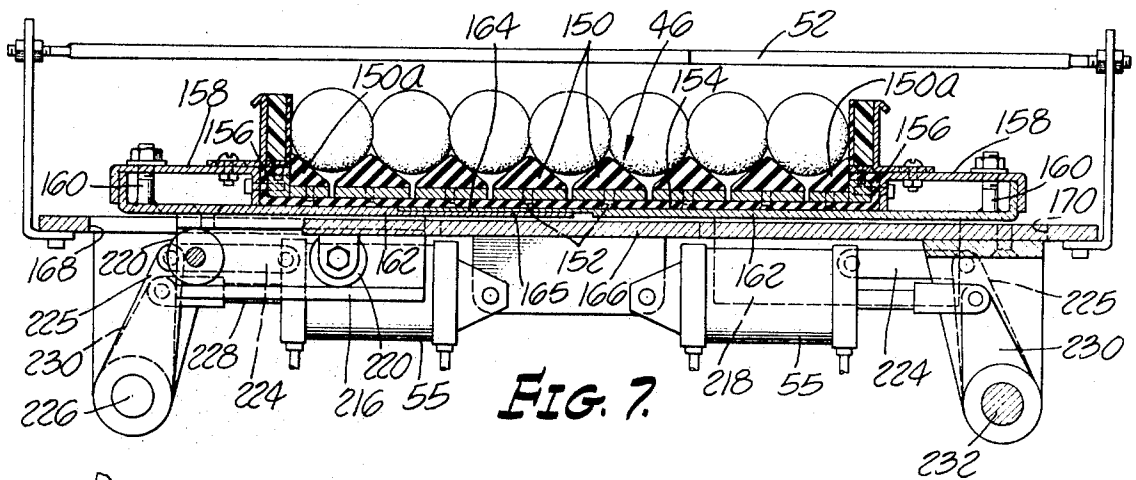


FIG. 7.

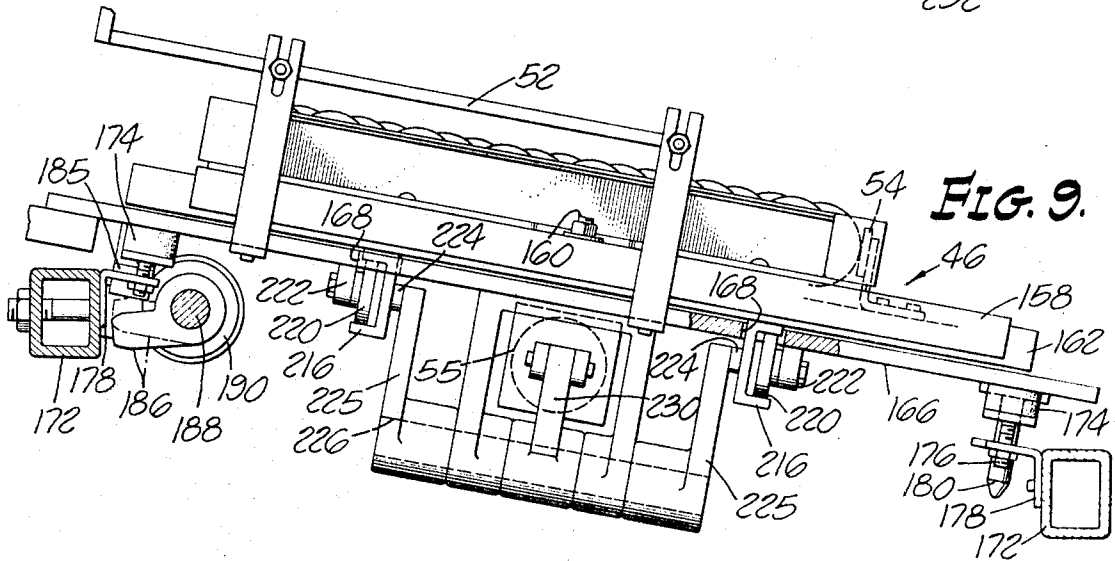


FIG. 9.

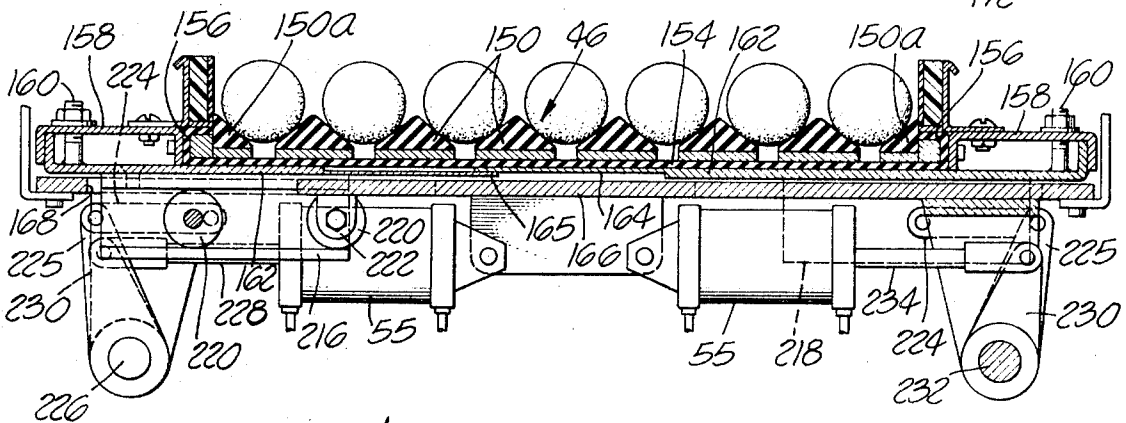


FIG. 8.

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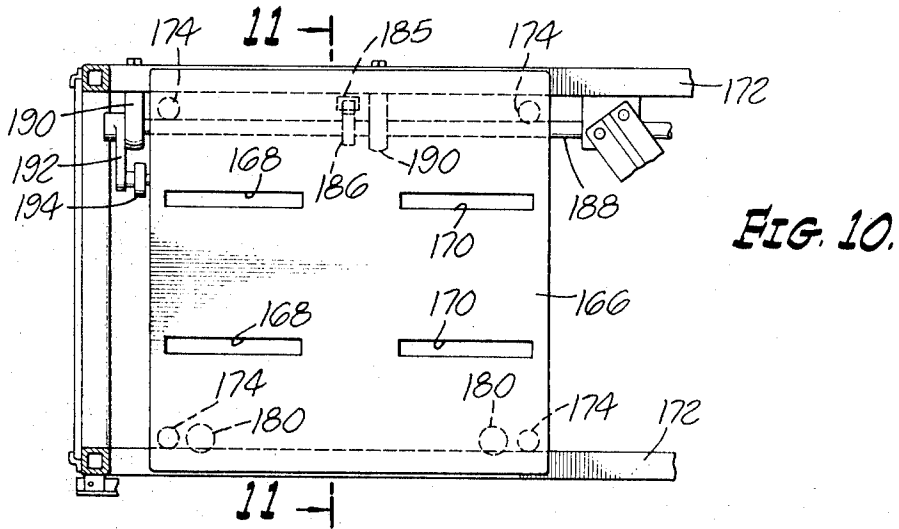


FIG. 10.

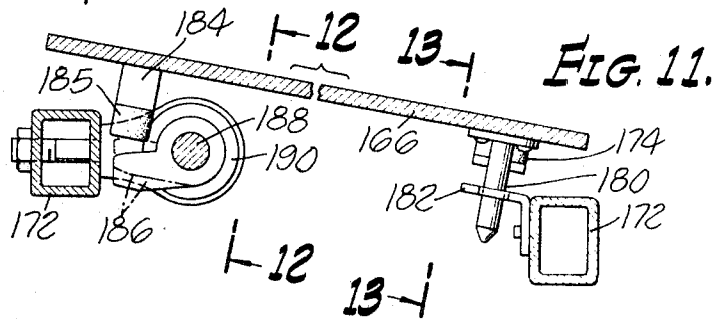


FIG. 11.

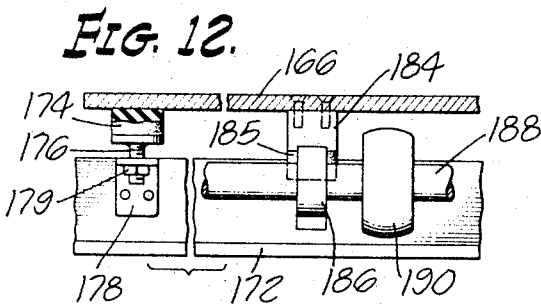


FIG. 12.

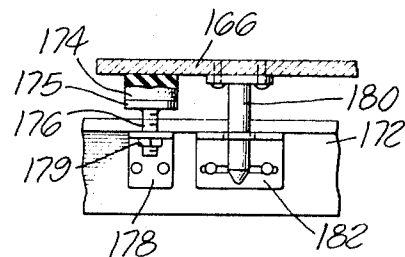


FIG. 13.

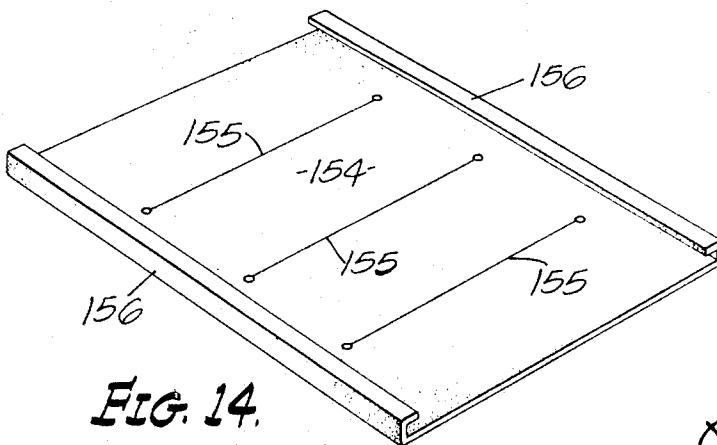


FIG. 14.

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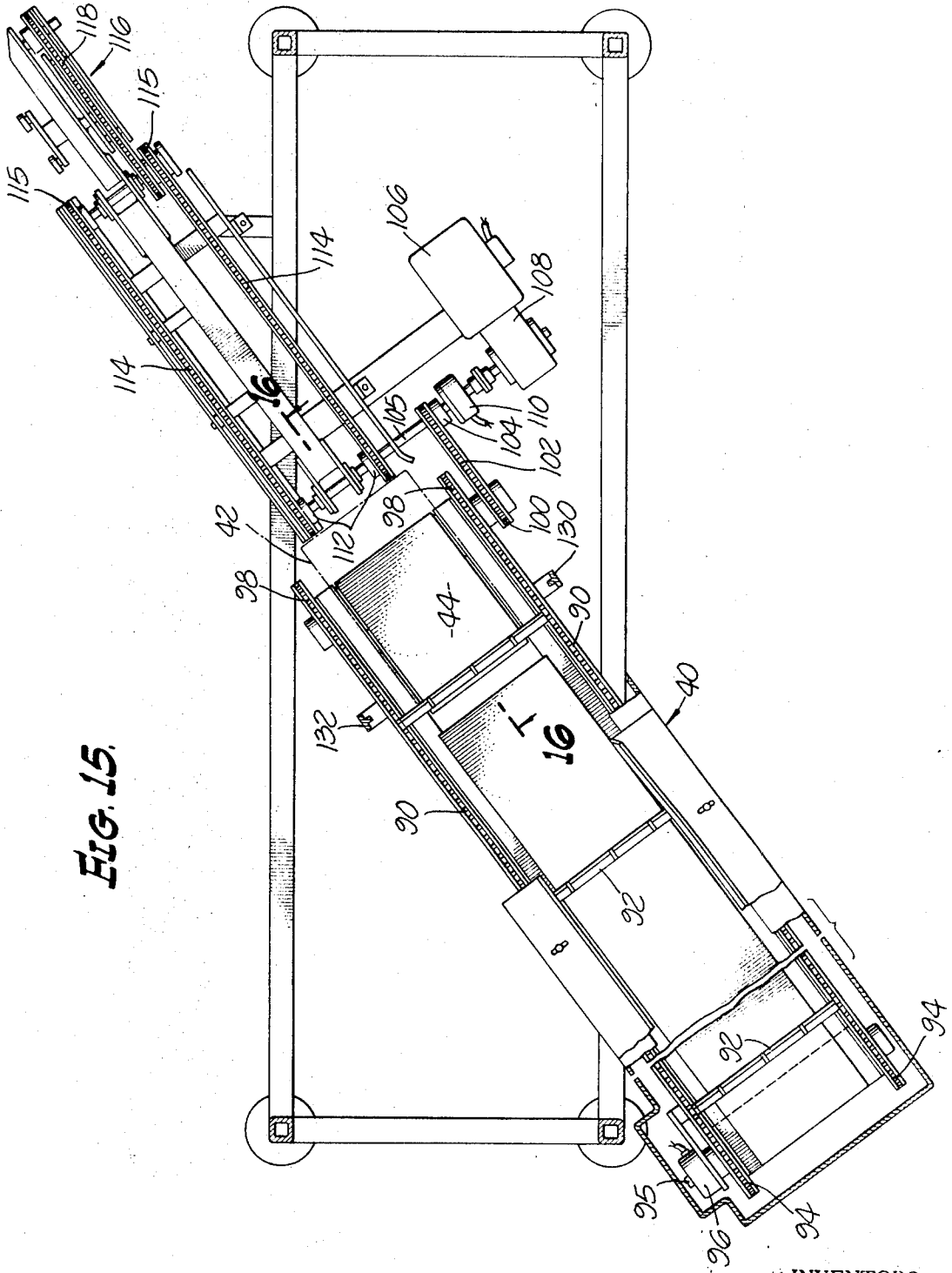


Fig. 15.

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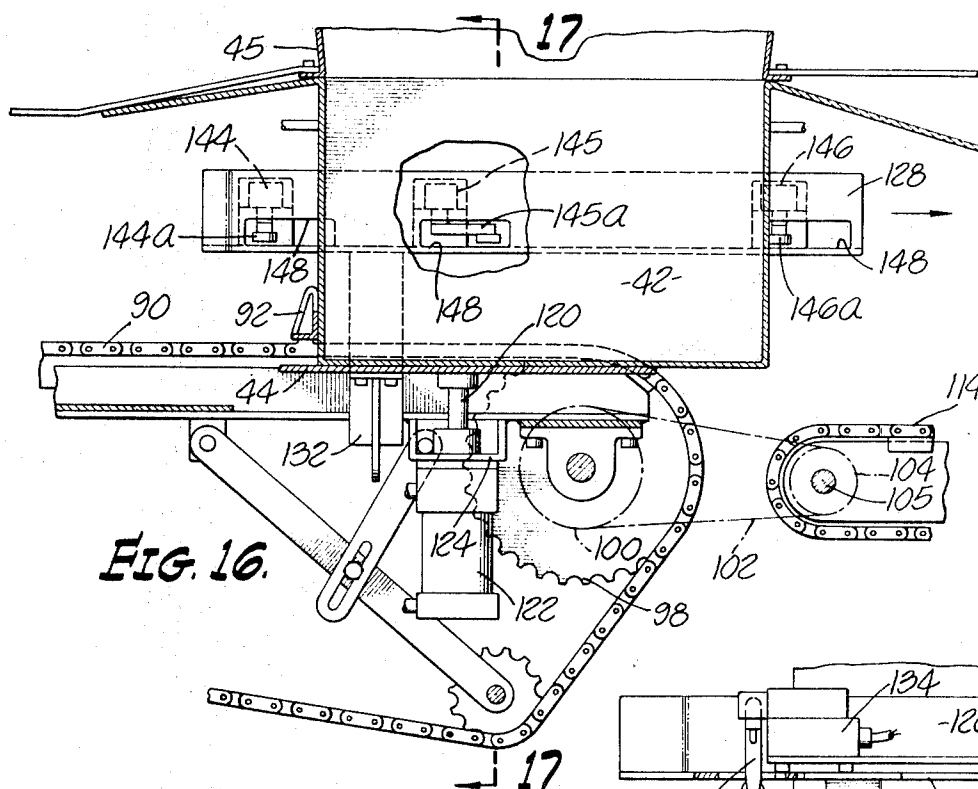


FIG. 16.

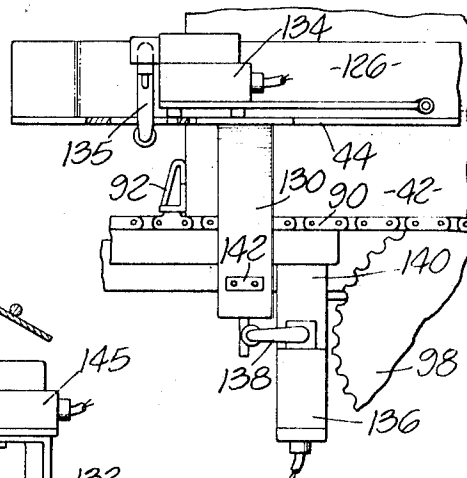


FIG. 18.

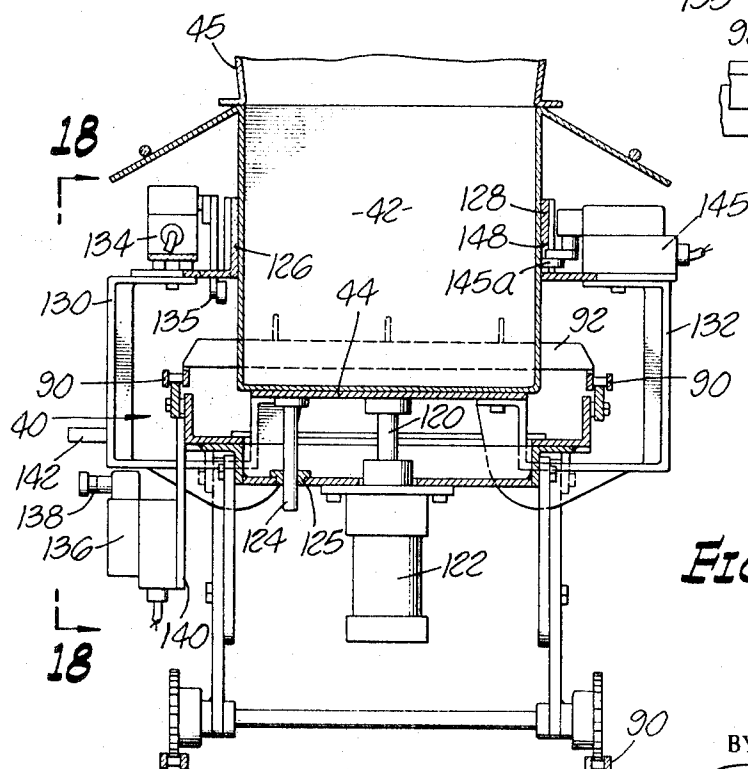


FIG. 17.

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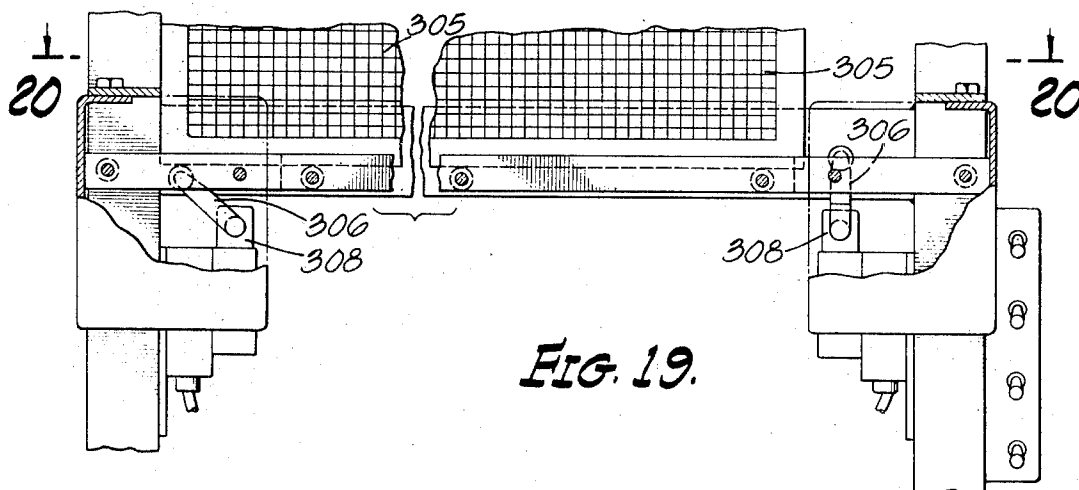


FIG. 19.

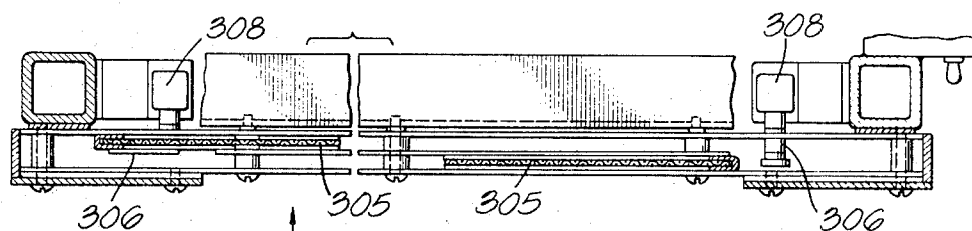


FIG. 20.

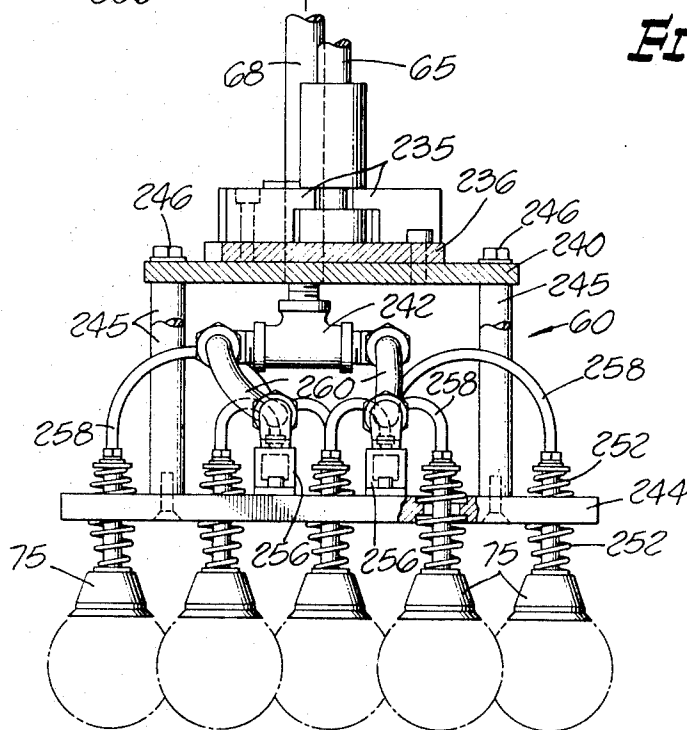


FIG. 21.

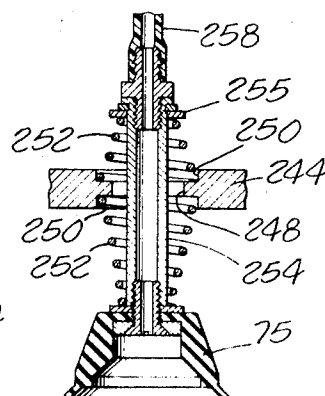


FIG. 22.

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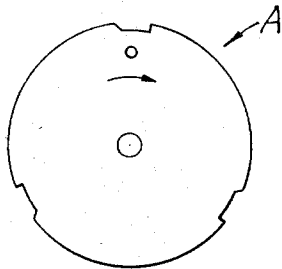


FIG. 24.

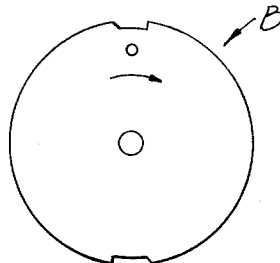


FIG. 25.

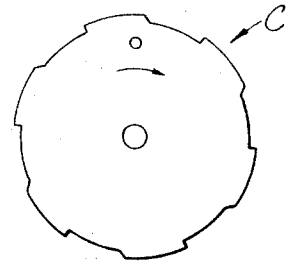


FIG. 26.

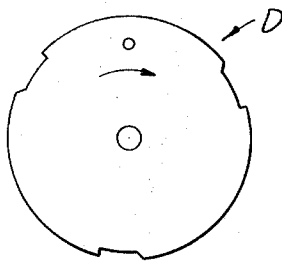


FIG. 27.

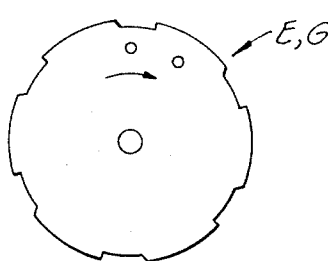


FIG. 28.

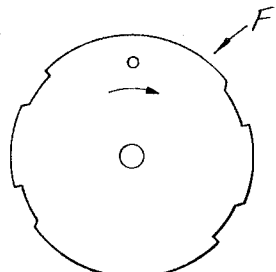


FIG. 29.

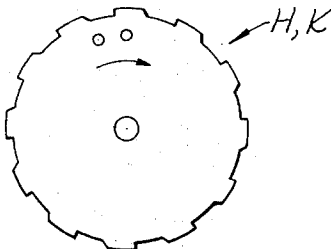


FIG. 30.

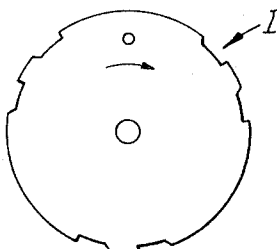


FIG. 31.

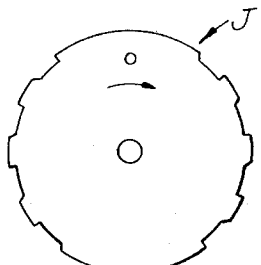


FIG. 32.

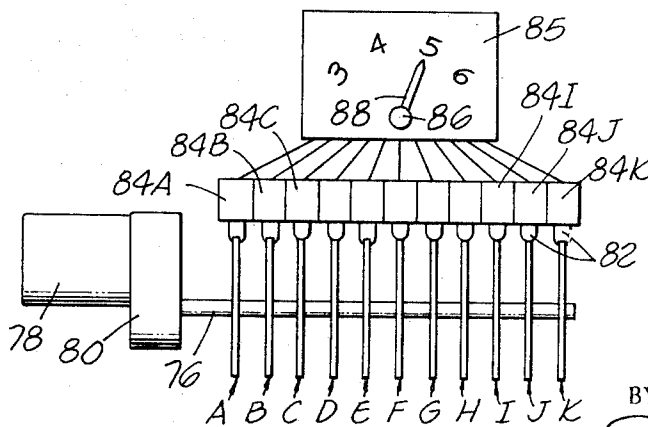


FIG. 23.

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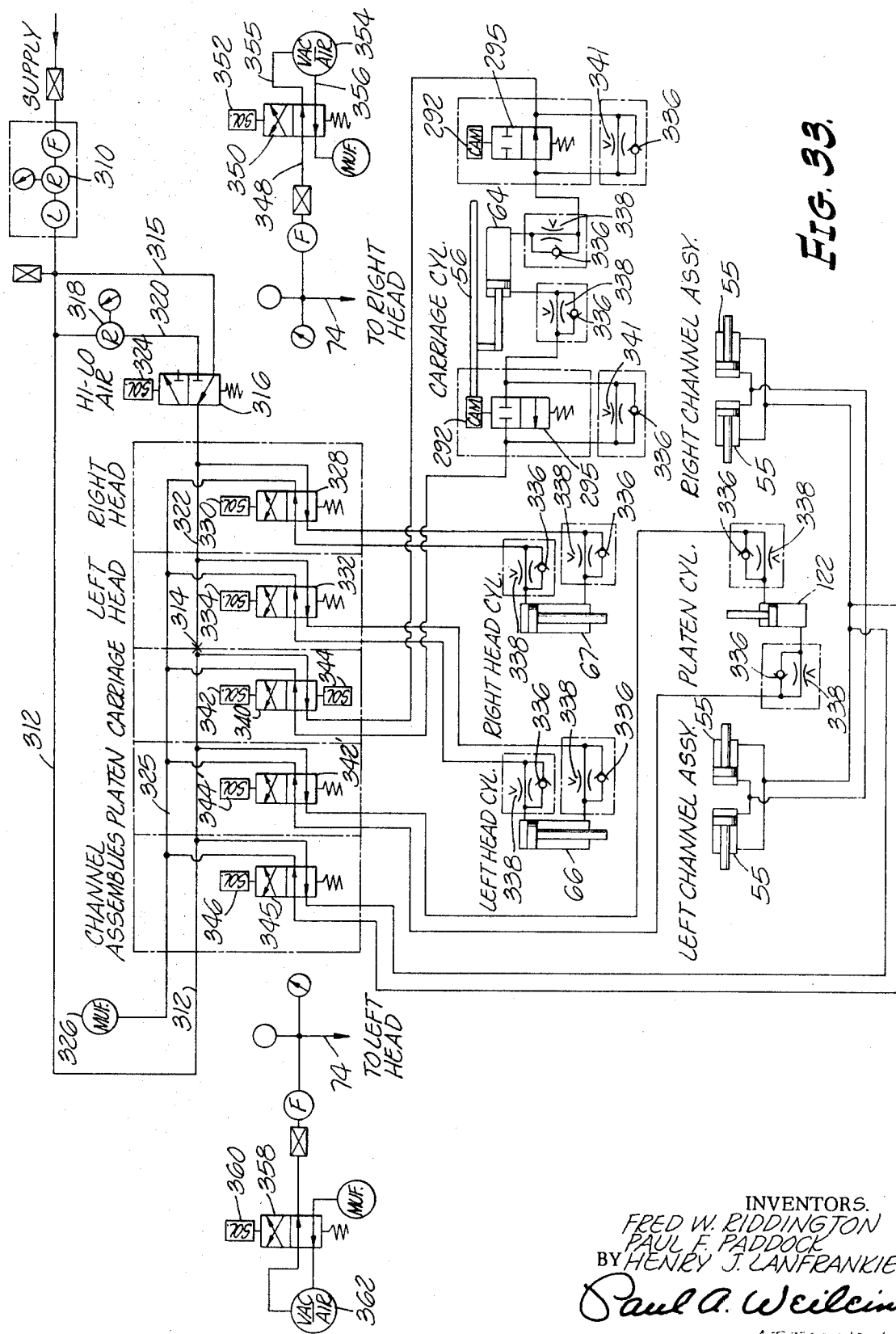


FIG. 33.

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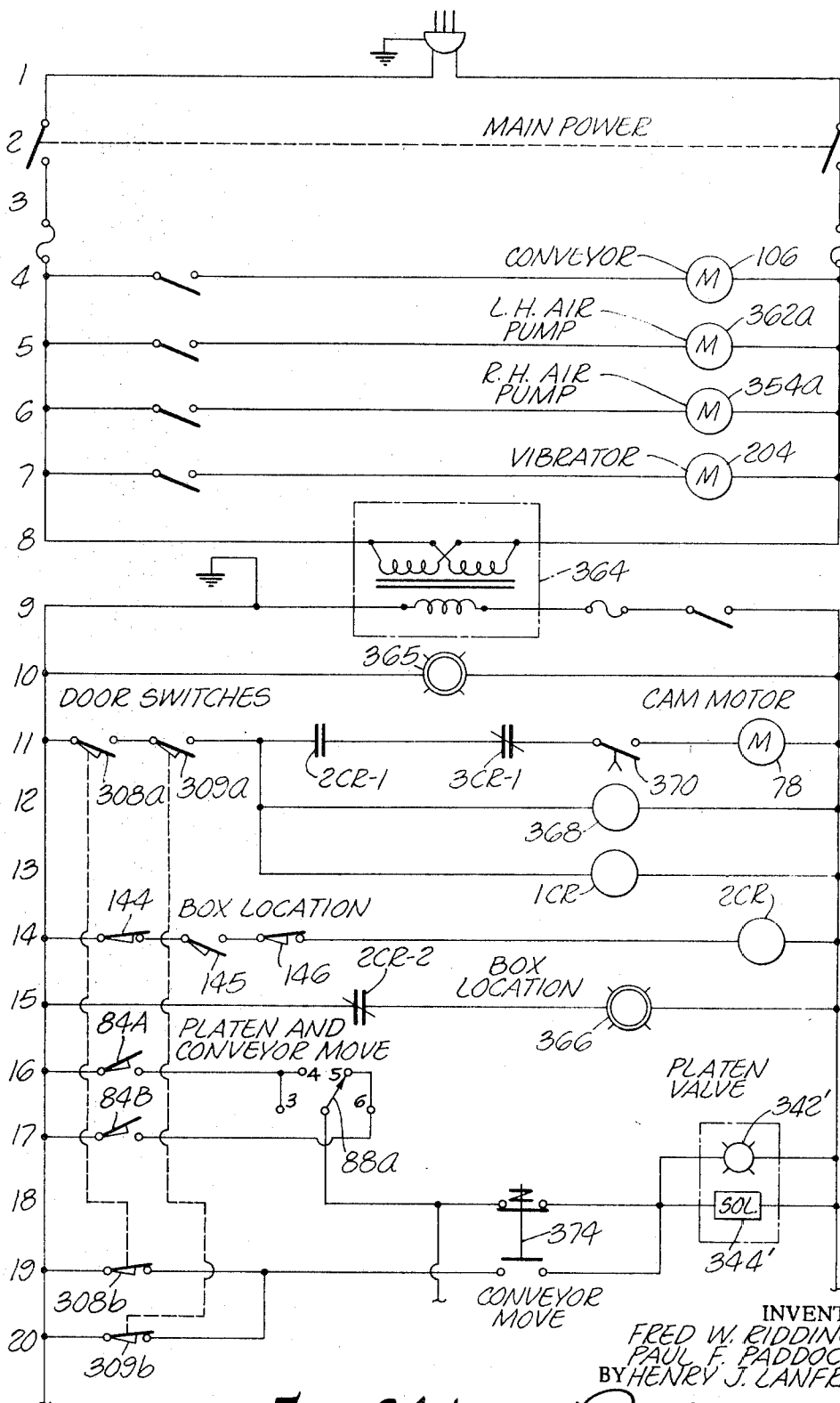


FIG. 34A.

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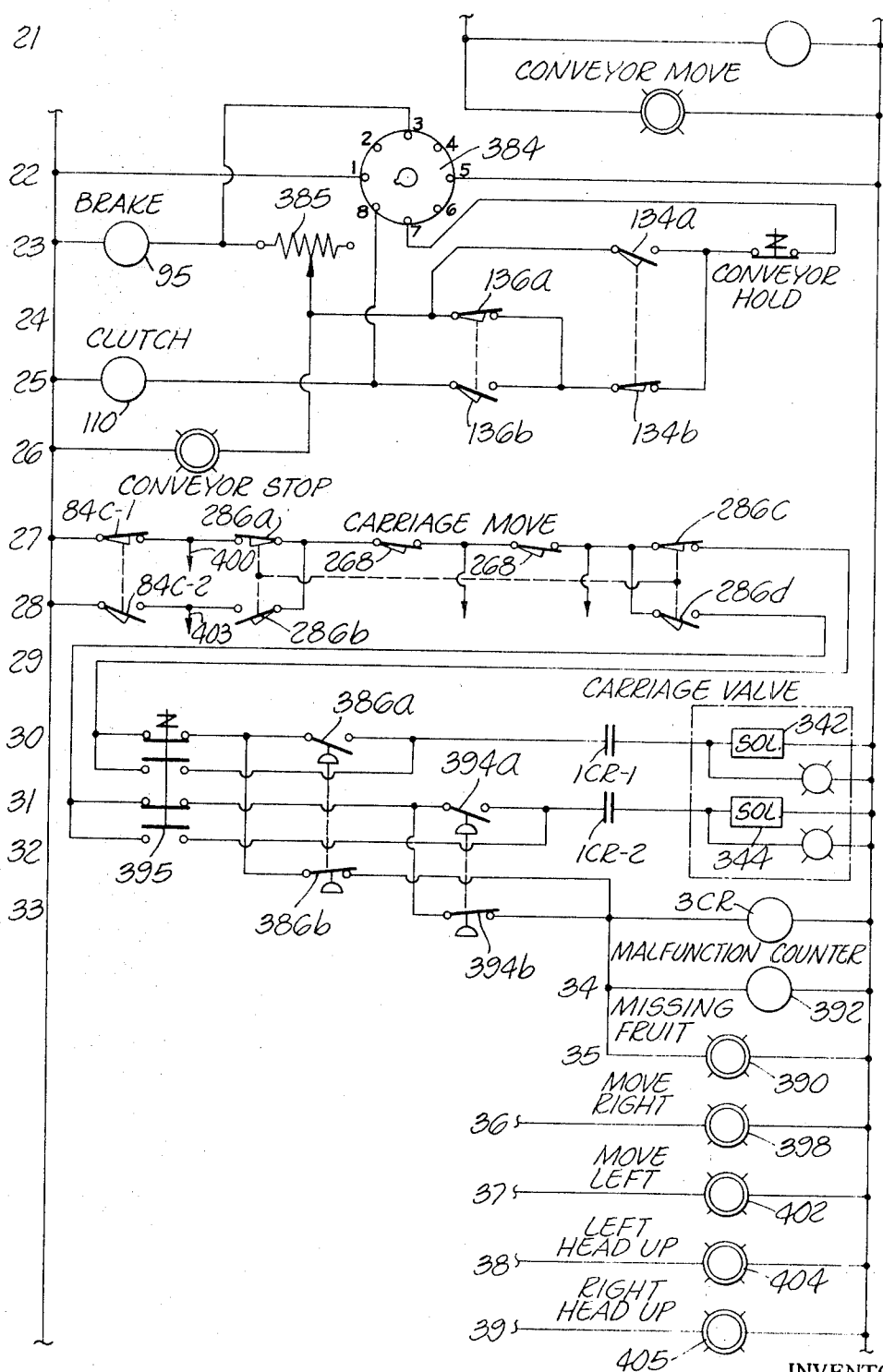


FIG. 34B.

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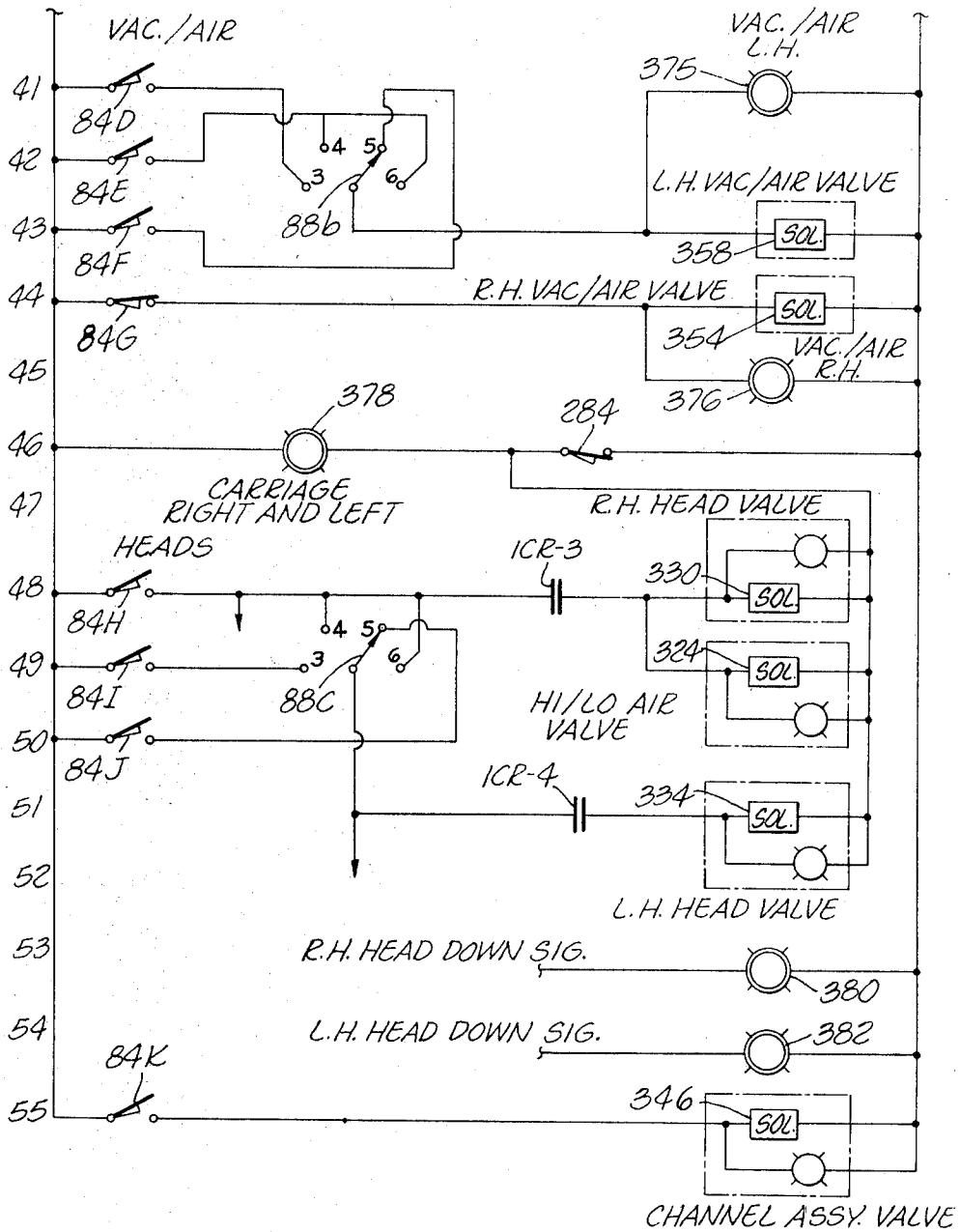
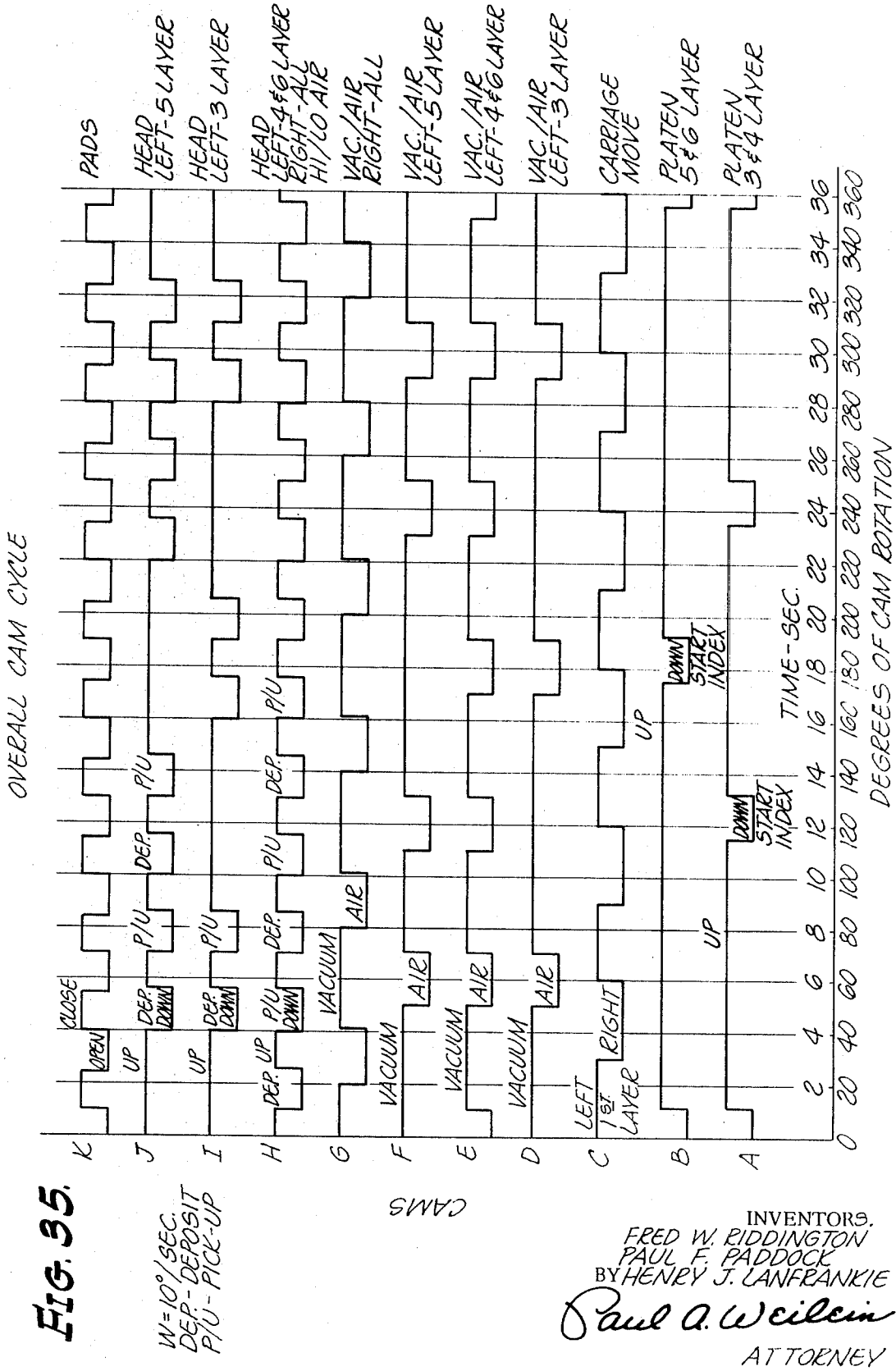


FIG. 34C.

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AUTOMATIC APPARATUS FOR PACKING ARTICLES IN BOXES

BACKGROUND OF THE INVENTION

The invention relates to an apparatus of the character described in the Frost Pat. No. 3,292,341 for packing citrus fruit in boxes wherein layers of two patterns alternate for partial nesting of the successive layers. The citrus fruit is fed gravitationally to two supply stations where the fruit are arranged in staggered rows to provide the two different patterns, respectively. A right pickup head picks up a layer of fruit of what may be termed the right pattern at the right supply station and deposits the layer in the box, and, in like manner, a left pickup head picks up a layer of fruit of what may be termed the left pattern at the left supply station and deposits the layer in the box.

The present invention is directed to the problem of providing a packing machine of this character that is efficient for a high rate of production and is fully automatic, requiring only that empty boxes be supplied to the apparatus as needed. The invention is further directed to such an automatic machine that is versatile in the sense of being capable of packing three, four, five, and six-layer boxes and that may be quickly and conveniently changed over from packing boxes of a given number of fruit in a given number of layers to packing boxes of a different number of fruit in the same or in a different number of layers.

Other objects of the invention include: to provide safety features to protect personnel; to provide for stopping the machine automatically in the event of failure of either pickup head to pick up a complete pattern; to provide indicators to indicate the location of such malfunctions; to provide a cycle control to program the operations for packing different boxes with different numbers of fruit in different numbers of layers; to provide such a cycle control or programmer incorporating a selector that is adjustable for packing boxes of three, four, five and six layers selectively so that changing over from one operating cycle to another operating cycle merely requires change in the setting of the selector control; to provide such a cycle control that will always result in the bottom layer in a box being a given one of the two different alternate patterns, regardless of whether the number of layers in a box is odd or even; and to provide a cycle control that will permit interruption of a cycle and temporary manual control to correct a malfunction with assurance that the resumption of the operation of the machine will begin at the point of the interruption of the operating cycle.

SUMMARY OF THE INVENTION

The invention provides: a central packing station where boxes are filled in succession; a left supply station to the left of the packing station; a right supply station to the right of the packing station; a carriage having a left pickup head and a right pickup head, the carriage being mounted on a track above the three stations for movement between a left position with the left pickup head above the left supply station and the right pickup head above the packing station and a right position with the right pickup head above the right supply station and the left pickup head above the packing station, the carriage being movable by an air cylinder and each of the pickup heads being movable by a corresponding air cylinder between an upper position and a lower position, the left pickup head having a plurality of vacuum cups to pick up and deposit fruit, the vacuum cups being arranged in what may be termed a left pattern, the right pickup head having a plurality of similar vacuum cups arranged in accord with a right pattern, a conveyor to carry empty boxes in succession to the packing station; and a platen at the packing station to lift the newly arrived boxes to a receiving position against the underside of a rectangular guide that guides the pickup heads into the interior of a box.

The left and right supply stations are provided with channel assemblies that form rows of fruit for the corresponding pickup heads, the two assemblies being laterally expanded while the two pickup heads are elevated to permit rows of new fruit to gravitate into position, the channel assemblies being contracted just before the pickup heads are lowered, thereby moving the rows of fruit into staggered nested relationship.

When the carriage is at its left position the two pickup heads may be lowered to permit the left pickup head to pick up a new layer of fruit from the left supply station and to permit the right pickup head to deposit its layer of fruit in the box. When the carriage is at its right position the two pickup heads may be lowered to permit the left pickup head to deposit its layer in the box and to permit the right pickup head to pick up a new layer of fruit at the right supply station.

The invention provides a cycle control which comprises a selector switch in combination with a gang of rotary cams on a common cam shaft. To carry out an operating cycle, the gang of cams is rotated by a suitable electric motor and each of the rotary cams has a circumferential series of appropriately spaced outer and inner dwells to operate corresponding switches for various steps in the operating cycle. The selector switch may be set for packing three, four, five, or six-layer boxes, the setting determining which of the rotary cams are effective, i.e., determines which of the switches corresponding to the cams are activated for an operating cycle.

The arrival of a new box at the precisely correct position at the packing station results in energization of the cam motor to start a packing cycle. One of the cams measures a time period for packing a three or four-layer box and an alternate cam measures a longer time period for packing a five or six-layer box. A third cam shifts the carriage. Other cams control the raising and lowering of the pickup heads and still other cams control the vacuum cycles of the vacuum cups of the two pickup heads. Finally, a cam controls the expansion and contraction of the two channel assemblies at the two supply stations.

Since the number of rows of fruit in a layer in a box varies from three to five and since the number of fruit in each row varies from three to seven, a number of interchangeable sets of left and right pickup heads are required for packing a wide range of fruit sizes and interchangeable sets of channel assemblies are also necessary to cover the same range. With such interchangeable sets of pickup heads and interchangeable sets of channel assemblies available for use as needed and with the selector switch adjustable for three, four, five, and six layers, it is simple matter to make a changeover from an operating cycle for packing a given number of fruit of a given size in a box to an operating cycle for packing a different number of fruit of a different size in a box. It is a simple matter, for example, to change over from packing boxes with 48 fruit in four layers of 12 each to boxes of 120 fruit in six layers of 30 fruit each.

The various features and advantages of the invention may be understood from the following detailed description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are to be regarded as merely illustrative:

FIG. 1 is a front elevational view of the presently preferred embodiment of the invention with a portion broken away;

FIG. 2 is an end elevation as seen along the line 2-2 of FIG. 1 with portions broken away;

FIG. 3 is a longitudinal section taken as indicated by the line 3-3 of FIG. 2 and showing the carriage and track in plan;

FIG. 4 is a fragmentary section taken as indicated by the line 4-4 of FIG. 2 showing the carriage and track in side elevation;

FIG. 5 is a fragmentary section taken as indicated by the line 5-5 of FIG. 2 and showing a pickup head as seen from above;

FIG. 6 is a longitudinal section taken along the line 6-6 of FIG. 2 showing the packing station and the two supply stations on opposite sides thereof;

FIG. 7 is an enlarged fragmentary section taken along the line 7-7 of FIG. 6 showing one of the two channel assemblies in its contracted state;

FIG. 8 is a similar view showing the channel assembly in its expanded state;

FIG. 9 is a section taken along the line 9-9 of FIG. 6;

FIG. 10 is a plan view of a baseplate on which a channel assembly rests;

FIG. 11 is a section taken as indicated by the line 11-11 of FIG. 10;

FIG. 12 is a fragmentary section taken as indicated by the line 12-12 of FIG. 11;

FIG. 13 is a fragmentary section taken as indicated by the line 13-13 of FIG. 11;

FIG. 14 is a perspective view of an elastomeric sheet that is incorporated into the construction of a channel assembly;

FIG. 15 is a longitudinal section taken along the line 15-15 of FIG. 2 to show the conveyor for delivering empty boxes to the packing station and for discharging full boxes therefrom;

FIG. 16 is a fragmentary section taken along the line 16-16 of FIG. 15 showing how a box is supported by a platen at the packing station;

FIG. 17 is a section along the line 17-17 of FIG. 16;

FIG. 18 is a side elevation of the structure shown in FIG. 17 as seen along the line 18-18 of FIG. 17;

FIG. 19 is a fragmentary elevational view of screen doors of the apparatus and switches operated thereby;

FIG. 20 is a section taken along the line 20-20 of FIG. 19;

FIG. 21 is an elevational view partly in section showing the construction of a pickup head;

FIG. 22 is a sectional view of the supporting structure of a vacuum cup of a pickup head;

FIG. 23 is a diagrammatic view of the cam assembly;

FIGS. 24-32 are face views of the various cams in their oriented operative relationships as employed in the cam assembly;

FIG. 33 is a diagram of the pneumatic actuation system;

FIGS. 34A, 34B, and 34C comprise a wiring diagram of the electrical control system; and

FIG. 35 is a chart depicting the overall cam cycle.

DESCRIPTION OF THE PREFERRED EMBODIMENT

General Arrangement

In FIG. 1 a conveyor, generally designated 40, has delivered a box 42 to the packing station where the box rests on a platen 44 and the platen has been elevated to position the box closely below the underside of a tapered rectangular guide 45 that guides the pickup heads into the interior of the box. FIG. 1 further shows a left supply station represented by a left channel assembly 46 and a right supply station represented by a right channel assembly 48. As shown in FIG. 6, each of the two supply stations includes a supply chute 50 to supply fruit to the corresponding channel assembly. To prevent the gravitational movement onto a channel assembly of a mass of fruit that is more than one layer deep, a bridge 52 overhangs each channel assembly and is adjustable in height in accord with the size of the supplied fruit. Each channel assembly provides a series of parallel channels down which rows of fruit gravitate against adjustable stops 54, the stops being adjusted to form staggered rows as best shown in FIG. 6.

In the drawings it is assumed that the apparatus is set up for packing boxes of 138 fruit arranged in five layers that alternate between what may be termed a right pattern and a left pattern, there being three right patterns including the top and bottom layers. In FIG. 6 the fruit is shaded that forms a left pattern on the left channel assembly 46 and the fruit is shaded that forms a right pattern on the right channel assembly 48. It will be noted that the left pattern comprises five rows of five,

six, five, six, and five fruit each and the right hand pattern comprises five rows of six, five, six, five, and six fruit each. These two patterns are complementary to each other in the sense that if either pattern is placed on top of the other pattern, the two patterns nest together in a space-saving manner.

In preparation for the formation of a layer pattern at a supply station, the corresponding channel assembly is expanded laterally by means of a pair of air cylinders 55 as shown in FIG. 8 to permit the rows of fruit to gravitate freely along the channels without interference with each other and subsequently the channel assembly is contracted as shown in FIG. 7 to cause the staggered rows of fruit to nest together as shown in FIG. 6.

As shown in FIGS. 2, 3, and 4, a carriage, generally designated 56, is mounted on an overhead track 58 to reciprocate between a left position and a right position and as shown in FIG. 1, a right pickup head 60 and a left pickup head 60a extend downwardly from the carriage to pick up fruit at the two supply stations and to deposit the fruit at the packing station. As indicated in FIG. 3 the carriage 56 is reciprocated by a piston rod 62 of an air cylinder 64 and as indicated in FIG. 4 the two pickup heads 60 and 60a are raised and lowered by corresponding piston rods 65 that extend downwardly from corresponding air cylinders 66 and 67, respectively.

To stabilize each of the pickup heads and to prevent rotation of the pickup head about the axis of the corresponding piston rod 65, each pickup head is provided with two upwardly extending guide rods 68 and 70, as best shown in FIG. 2, which extend through fixed guide sleeves 72 on the carriage 56. The guide rod 68 is hollow to serve as an air line for the corresponding pickup head and for this purpose the upper end of the guide rod is connected to a flexible air hose 74.

As shown in FIGS. 1, 2 and 21, each of the pickup heads has a plurality of rows of vacuum cups 75 to pick up fruit. The rows of vacuum cups to the left pickup head 60a conform to the left pattern that is formed in the left channel assembly and the rows of vacuum cups in the right pickup head 60 conform to the right pattern that is formed in the right channel assembly 48.

FIG. 1 shows how at the left position of the carriage the left pickup head is above the left channel assembly 46 and the right pickup head is above the rectangular guide 45 at the packing station. At the alternate right position of the carriage the left pickup head is at the packing station and the right pickup head is at the right channel assembly 48. Thus, at the left position of the carriage shown in FIG. 1 with the left pickup head empty of fruit and the right pickup head carrying a layer of fruit, the two pickup heads may be lowered to permit the left pickup head to pick up a new layer of fruit and to permit the right pickup head to deposit a layer of fruit in the box 42. On the other hand, when the carriage is at its right position with the right pickup head empty and the left pickup head loaded with fruit, the two pickup heads may be lowered to permit the right pickup head to pick up a new layer of fruit and to permit the left pickup head to deposit its load of fruit in the box 42.

With the operation of the apparatus fully automatic all that is required is to keep the feed end of the conveyor 40 supplied with empty boxes. Each empty box is moved automatically to the supply station where the platen lifts the empty box against the rectangular guide 45. The carriage and the pickup heads then carry out the required series of operations to load the box with the five layers of fruit. When this loading operation is completed, the box is automatically lowered and discharged at the discharge end of the conveyor.

The automatic cycle is carried out by a cycle control or program timer which, as shown diagrammatically in FIG. 23, comprises a gang of cams A-K which are mounted on a common shaft 76 that is operated by a synchronous motor 78 through a gear box 80. The cams have circumferential inner dwells (notches) and outer dwells for cooperation with corresponding operating members 82 of corresponding switches

84A—84K. A master control in the form of a selector switch 85, which is also shown in FIG. 2, determines which of the switches 84A—84K are activated for a particular operating cycle. The selector switch 85 has a manually operable knob 86 which carries a pointer 88 that may be adjusted to indicate a three-layer pack, a four-layer pack, a five-layer pack, or a six-layer pack.

Box Conveyor

As shown in FIG. 15, the box conveyor 40 has a pair of parallel sprocket chains 90 that carry spaced transverse flight bars 92 to push successive boxes onto and off of the platen 44 at the supply station. The two sprocket chains 90 are actuated by a pair of forward sprockets 94 on a shaft 95 that is controlled by an electrically actuated brake 96 and a rearward pair of sprockets 98 on a shaft that carries a smaller outer sprocket 100. The sprocket 100 is connected by a sprocket chain 102 with a sprocket 104 on a drive shaft 105 that is actuated by a motor 106 through a gear box 108 and an electrically actuated clutch 110. The drive shaft 105 carries a pair of sprockets 112 to drive a pair of sprocket chains 114 that pass around a rearward pair of sprockets 115, the purpose of the two sprocket chains 114 being to carry full boxes away from the packing station and provide a temporary storage therefor. An auxiliary conveyor generally designated 116 has a single sprocket chain 118 to transfer the full boxes to a packing house conveyor that is not shown.

As shown in FIGS. 16 and 18, the platen 44 is mounted on the upper end of a piston rod 120 that extends upwardly from an air cylinder 122 and the platen is stabilized against rotation by a short rod 124 that extends downwardly therefrom through a fixed guide bushing 125.

When a box 42 approaches the platen 44 it is confined between two longitudinal guides 126 and 128 of angular cross section, the two longitudinal guides being mounted on the platen by means of corresponding brackets 130 and 132. As shown in FIGS. 17 and 18, the left hand longitudinal guide 126 carries a switch 134 having a downwardly extending spring-biased control arm 135 and it is to be noted that when the platen 44 is at its lower position the control arm 135 is in the path of the conveyor flight bars 92.

The control arm 135 is operated by a conveyor flight bar 92 for the purpose of stopping the conveyor when a box reaches the desired position on the lowered platen 44. When the platen is elevated, however, as shown in FIGS. 17 and 18, the control arm 135 is positioned above the level of the path of the flight bars 92. When the platen 44 is in its lower position the control arm 135 is swung counterclockwise as viewed in FIG. 18 from a first position to a second position by a conveyor flight bar 92 but when the platen is subsequently elevated as shown in FIG. 18 to lift the control arm above the flight bar, the control arm swings back to its initial position.

As shown in FIG. 17 and 18, a switch 136 having a laterally extending control arm 138 is mounted on a fixed lower bracket 140 with the control arm in the path of an operating lug 142 on the previously mentioned bracket 130 for operation in response to the downward movement of the platen. As will be explained, the switch 134 and the switch 136 cooperate to control actuation of the conveyor.

Mounted at spaced points along the right-hand longitudinal guide 128 are three successive switches 144, 145, and 146 which have corresponding operating arms 144a, 145a, and 146a that extend through corresponding windows 148 in the longitudinal guide into the path of movement of the successive boxes 42. The purpose of the three switches 144, 145, and 146 is to sense whether or not a box is correctly positioned on the platen 44 to start an operating cycle. For this purpose the first and third switches 144 and 146 are normally closed and the intermediate switch 145 is normally open. If a box is correctly positioned on the platen it closes the normally open switch 145 and permits the normally closed switches 144 and 146 to be closed so that the three switches are in series for trans-

mitting a signal to start a cycle of operation. On the other hand, if the box is not advanced far enough, it will open switch 144 to prevent a starting signal and if it has advanced to far it will open switch 146 to prevent a starting signal. In the event there should be no box, the switch 145 will remain open and prevent transmission of a starting signal.

The function of the conveyor switches may be summarized as follows. When a flight bar 92 pushes a box 42 onto the platen 44, the flight bar displaces the control arm 135 of switch 134 to stop the conveyor. If the box is in the correct position on the platen the three switches 144, 145, and 146 are closed with the consequence that the platen 44 is elevated by the air cylinder 122 in preparation for packing fruit into the box. The elevation of the platen lifts the control arm 135 of the switch 134 clear from the flight bar 92 to permit the control arm to return to its initial position but actuation of the conveyor is prevented because in the meantime the control lug 142 which is carried by the platen rises to release the control arm 138 of switch 136 and switch 136 prevents actuation of the conveyor until the platen is subsequently lowered.

The Two Supply Stations

The two channel assemblies 46 and 48 are identical except for the different adjustments of the stops 54 as required to form the two different patterns of the layers of fruit. The left channel assembly 46, for example, is illustrated by FIGS. 7 to 14.

As shown in FIGS. 7 and 8 the channels of the channel assembly 46 are formed by a series of ridge members comprising six full ridge members 150 and two half ridge members 150a at the opposite sides of the assembly, the eight ridge members forming seven channels for seven rows of the fruit. When the channel assembly is laterally expanded as shown in FIG. 8, the rows of fruit are spaced apart to permit free gravitational rolling of the fruit, the channel assembly being inclined to cause the fruit to reach the staggered stops 54. When the channel assembly is laterally contracted as shown in FIG. 7, the spacing between the channels is reduced to cause the rows of fruit to nest together as may be seen in FIG. 6.

As shown in FIG. 7, the various ridge members 150 and 150a are attached by screws 152 to an elastomeric sheet 154 which, as shown in FIG. 14, is provided with spaced slits 155 and is formed with longitudinal side flanges 156 of angular cross section. As shown in FIG. 7 the opposite side edges of the elastomeric sheet 154 are attached to corresponding inverted channels 158 which in turn are connected by studs 160 to two corresponding support plates 162 that are movable apart for the purpose of stretching the elastomeric sheet. As may be seen in FIGS. 7 and 8, the right-hand support plate 162 has an extension 164 of half thickness that overlaps a similar half thickness extension 165 of the left support plate. The two cooperating support plates 162 are mounted on a heavy inclined baseplate 166 which, as shown in FIG. 10, is formed with a pair of left-hand slots 168 and a pair of right hand slots 170.

As shown in FIGS. 10—13, the baseplate 166 is supported by a pair of hollow frame members 172 in a suitable manner that permits the baseplate to be oscillated at a frequency to encourage gravitational rolling of the rows of fruit against the stops 54. In the construction shown, the forward lower edge of the baseplate 166 rests on a spaced pair of cylindrical elastomeric pads 174 which are bonded to the heads 175 of corresponding screws 176. Each screw 176 is threaded into a corresponding angular bracket 178 that is fixedly mounted on the forward hollow frame member 172. To keep the heavy baseplate 166 in position in a floating manner, the forward lower edge of the baseplate is provided with a pair of downwardly extending rigid pins 180 which slidably extend through circular apertures in corresponding angular brackets 182 that are also mounted on the forward hollow frame member 172. The upper rearward end of the baseplate 166 is reset on two additional elastomeric pads 174 on correspond-

ing studs 176 that screw into corresponding angular brackets 178 that are attached to the rearward hollow frame member 172.

To impart vibratory oscillation to the baseplate 166 the rearward end of the baseplate is provided with a rigidly fixed downwardly extending block 184 that carries an elastomeric pad 185 on its underside and a rocker arm 186 on a rocker shaft 188 oscillates against the elastomeric pad 185 at a desired frequency and at a desired amplitude of oscillation.

The rocker shaft 188 is journaled in suitable bearings 190 on the rearward hollow frame member 172 and carries a rearwardly extending actuating arm 192. As shown in FIG. 2, the actuating arm 192 is connected by a link 194 to a crank 195 on a drive shaft 196 that is journaled on a pair of brackets 202. The drive shaft 196 is driven by a suitable motor 204 by means of a V-belt 205 that extends from a sheave 206 on the motor shaft 208 to a larger sheave 210 on the drive shaft 196.

The two sheaves 206 and 210 are split sheaves of a well-known type that may be adjusted to vary the effective diameter of the sheaves and thereby vary the speed at which the drive shaft 196 is rotated. Thus, the two sheaves 206 and 210 may be adjusted to vary the frequency of the oscillation of the rocker shaft 188 and the rocker arm 186 may be rotatably adjusted on the rocker shaft to vary the extent to which the rocker arm raises the elastomeric pad 185 thereby to determine the amplitude of the vibrations of the baseplate. In a well known manner the motor 204 is slidable along a pair of guide rods 212 and the position of the motor is controlled by a screw 214 that is operated by a crank 215. Rotating the crank 215 shifts the spacing of the two sheaves 206 and 210 and thereby varies the effective diameters of the sheaves for controlling the speed of rotation of the drive shaft 196.

With the two opposite side edges of the elastomeric sheet 154 fixedly connected to the two corresponding overlapping support plates 162, the elastomeric sheet may be stretched to expand the channel assembly and may be relaxed to contract the channel assembly by simply controlling the positions of the two support plates relative to each other. For this purpose the left support plate 162 is mounted on the upper sides of a pair of channels 216 that extend into the pair of slots 168 in the baseplate 166 and in like manner the rightward support plate 162 is mounted on the upper sides of a pair of channels 218 that extend into the slots 170 of the baseplate.

Each of the four channels 216, 218, is movably supported by a pair of rollers 220 which are journaled in brackets 222, the brackets being mounted on the undersides of the support plates 162. As shown in FIGS. 7 and 9, the two left channels 216 are connected by links 224 to corresponding rocker arms 225 on a left rocker shaft 226 and a piston rod 228 of a corresponding previously mentioned air cylinder 55 is connected to a central actuating rocker arm on the same rocker shaft. In like manner, the two right-hand channels 218 are connected by links 224 to rocker arms 225 on a right rocker shaft 232 and an actuating rocker arm 230 on the right rocker shaft is connected to a piston rod 234 of the other of the previously mentioned air cylinders 55. It is apparent that the two air cylinders 55 may be energized to expand and contract the channel assembly. It is also apparent that one channel assembly may be substituted for another by simply disconnecting the two support plates 162 from the corresponding channels 216 and 218.

Structure of the Two Pickup Heads

Referring to FIGS. 5 and 21, the piston rod 65 that carries a pickup head 60 or 60a is connected by clamp members 235 to a small plate 236 which, in turn, is connected to what may be termed a mounting plate 240. The previously mentioned guide rods 68 and 70 are rigidly connected to the small plate 236 and the tubular rod 68 terminates in a tee fitting 242 for airflow to and from the vacuum cups 75 of the pickup head.

Each of the two pickup heads 60 and 60a comprises a baseplate 244 on which the various vacuum cups 75 are

mounted and four upright posts 245. The four upright posts are rigidly attached to the headplate 244 and are adapted at their upper ends to be releasably attached to the mounting plate 240 by cap screws 246.

As best shown in FIG. 22 the headplate 244 has a plurality of distributed bores 248, each of which is counterbored to provide two annular seats 250 for a pair of opposed conical spiral springs 252. Each vacuum cup 75 is mounted on a tubular stem 254 that is floatingly mounted in the corresponding bore 248 by the two spiral springs 252, one spiral spring backing against the vacuum cup and the other spiral spring backing against a flange 255 at the other end of the tubular stem. With each vacuum cup 75 floatingly mounted in this manner the vacuum cup is free to shift laterally, axially, and angularly as required for engagement with a particular fruit in a layer of fruit. Mounted on the upper side of the headplate 244 are two air manifolds 256 which are connected by flexible tubes 258 to the tubular stem 254 of the vacuum cups and each of the two manifolds is releasably connected by a flexible hose 260 to the tee fitting 242 at the lower end of the tubular guide rod 68.

The described construction makes it possible to interchange pickup heads in an expeditious manner since a pickup head may be removed simply by removing the four cap screws 246 and disconnecting the two flexible hoses 260 from the tee fitting 242.

In the initial practice of the invention 16 different pickup heads are required and each pickup head, of course, has four posts 245 extending upward from its headplate 244 for releasable connection to the corresponding mounting plates 240 of the apparatus. Since none of the four posts 245 can coincide with the location of a bore 248 of any headplate in which a vacuum cup is mounted, a feature of the invention is the location of the four points at the four corners of a rhomboid, see FIG. 5 wherein the mounting plate is rhomboidal. Such a rhomboid may be arrived at by making transparencies representing the 16 headplates and the locations of the bores 248 thereon. With the sixteen transparencies stacked, locations may be found for the four posts that avoid all of the bores 248.

Normally, air is being pumped out of the tubular guide rod 68 of a pickup head to evacuate the two manifolds 256 and the flexible tubes 258 that connect the manifolds to the vacuum cups 75. Consequently, when a pickup head is brought into contact with a layer of fruit a vacuum quickly develops in each of the vacuum cups 75 for effective engagement with the fruit. When a pickup head carrying a layer of fruit is lowered into a box, airflow in the tubular guide rod 68 is reversed by connecting the tubular guide rod to a source of compressed air with consequent abrupt release of the fruit by the vacuum cups.

The Carriage Structure

As indicated in cross section in FIG. 2, the carriage 56 comprises a pair of hollow parallel beams 262 which are interconnected at each end by an upper plate 264 and a lower plate 265. The two air cylinders 66 and 67 for the two pickup heads 60 and 60a are mounted on the two upper plates 264 respectively, and the upper ends of the two air cylinders are interconnected by an angle iron 266. As shown in FIG. 4, two switches 268 are mounted on the underside of the angle iron 266 to sense complete upward retraction of the two pickup heads. For this purpose, each of the two switches has an operating arm 270 which is actuated by a conical head 272 on a corresponding guide rod 68 or 70 when the corresponding pickup head is fully retracted.

As may be seen in cross section in FIG. 2, the carriage 56 is supported by rollers 274 which ride on rails 275, the rollers being confined by overhanging longitudinal plates 276 of the track structure. As may be seen in FIG. 3, additional side rollers 278 of the carriage cooperate with the inner edges of the two side plates 276.

It has been found desirable to provide an indicating lamp to indicate when the carriage 56 is at either of its two limit positions. Referring to FIG. 3, when the carriage 56 is at its left limit position a projection 280 on the carriage actuates an operating arm 282 of a lamp-controlling limit switch 284 and when the carriage is at its right limit position a second projection 280a on the carriage actuates the same switch.

Since the carriage 56 must be shifted rapidly for a high production rate it is desirable to provide suitable means to decelerate the movement of the carriage as it approaches each of its two limit positions. This object may be accomplished simply by restricting the discharge of air from each end of the cylinder 64 as the piston in the cylinder approaches that end.

For this purpose two downwardly extending arms 288 mounted on pivots 290 are biased toward corresponding ends of the carriage 56 and each arm carries a cam 292 to actuate an operating member 294 of a corresponding valve 295. In the construction shown, the arm 288 is biased by a coil spring 296 that surrounds a short rod 298. The rod 298 is pivotally connected at its upper end to the cam 292 and slidingly extends through a fixed apertured bracket 300, the spring being in compression between the bracket and a head 302 on the lower end of the rod. Thus, for example, as the right end of the carriage 56 approaches the right-hand arm 288, the carriage retracts the arm as shown at the right in FIG. 4 with consequent progressive depression of the operating member 294 of the valve 295 to progressively restrict the discharge airflow from the corresponding end of the cylinder 64.

As shown in FIG. 2, access by the personnel to the region of the moving carriage 56 and the two pickup heads 60 and 60a is cut off by fixed screens 304 at the opposite ends of the apparatus and, as shown in FIGS. 19 and 20, access is normally cut off at the front by a pair of sliding screen doors 305. When each of the screen doors 305 is in its normal closed position it depresses the operating arm 306 of a corresponding door switch 308 so that only slight movement of the screen door out of its normal position releases the operating arm for actuation of the door switch. As will be explained, the door switches 308 are safety switches to disable appropriate parts of the apparatus when either door is open.

Cyclic Control Cam Assembly

As heretofore stated, when the platen 44 elevates a newly arrived empty box at the packing station, the motor 78 of the cyclic control or program timer shown diagrammatically in FIG. 23 is energized to carry out an automatic cycle for filling the box with fruit. It is contemplated that the bottom layer in a box will be of a right pattern and this requirement introduces a certain complication when a box is being filled with an odd number of layers. This complication may be understood by comparing a packing cycle for an even number of layers with a packing cycle for an odd number of layers.

If an even number of layers are being packed in each box, the operating cycle may start with the carriage at its left position and with both pickup heads in their upper positions as shown in FIG. 1, the left pickup head being empty of fruit and the right pickup head carrying a layer of fruit of the right pattern. To start the operating cycle both pickup heads move downwardly simultaneously to permit the right pickup head to deposit its layer of fruit in the bottom of the box and to permit the left pickup head to pick up a left pattern of fruit at the left supply station. The two pickup heads then return to their upper positions and the carriage is shifted to the right where both pickup heads are lowered, the left pickup head depositing its left pattern of fruit in the box and the right pickup head picking up a right pattern of fruit at the right supply station. The operating cycle is carried out in this manner until the box is full, the carriage then being again at its left position shown in FIG. 1 ready to start a new operating cycle to pack the next box. Thus, no time is lost between the termination of one packing cycle and initiation of the next packing cycle.

If the boxes are being packed with an odd number of layers, however, the last layer to be deposited at the end of the packing cycle is a layer of the right-hand pattern and the right pickup head will then be empty of fruit instead of being full of fruit as required for immediate start of the next packing cycle. Consequently, an additional shift of the carriage is required before starting the next packing cycle. Thus, four shifts of the carriage are required to fill a four-layer box and four shifts of the carriage are also required to fill a three-layer box. In like manner, six shifts of the carriage are required to fill a six-layer box and the same number of shifts is required to fill a five-layer box.

In the preferred practice of the invention the additional shift of the carriage required for packing a box with an odd number of layers is carried out at the end of the packing cycle in preparation for the next packing cycle. Thus, when the last or top right pattern layer is deposited in a box the final upward retraction of the two pickup heads leaves the carriage at its left position with the right pickup head empty. In preparation for the next packing cycle the carriage is shifted to the right and since the left pickup head is already full of fruit only the right pickup head is lowered, the right pickup head returning to its upper position with a new right layer of fruit. The new packing cycle is then started by shifting the carriage to its left position where the right-hand pickup head is lowered to deposit the bottom layer in a box, the left pickup head remaining elevated because it is already full of fruit.

In the normal operation of the preferred embodiment of the invention, the carriage shifts to a new position and the two pickup heads move down and up at the new position in a total time interval of 3 seconds.

Therefore, 12 seconds is required to fill either a three-layer box or a four-layer box and 18 seconds is required to fill either a five-layer box or a six-layer box, 36 seconds being the least common denominator. When the electric motor 78 is energized the camshaft 76 is rotated at a rate, for example, of one revolution in 36 seconds and, therefore, a third of a revolution is required to fill either a three-layer box or a four-layer box and a half revolution is required to fill either a five-layer box or a six-layer box.

The profiles of the eleven cams that are required to carry out these operating cycles are shown in FIGS. 24 to 32, each cam having inner dwells or notches for circuit-closing operation of a corresponding switch 84. Cam A has three notches 120° apart and controls the platen at the supply station for three-layer boxes and four-layer boxes, each lower dwell or notch lowering the platen and each of the three outer dwells raising the platen. Thus, cam A elevates the platen for a period of twelve seconds which is the period required for packing a three-layer box or a four-layer box. Cam B controls the platen for a five-layer box or a six-layer box, the cam having two notches or inner dwells 180° apart to measure time periods of 18 seconds. Cam C shifts the carriage in its alternate directions every three seconds and, therefore, has six inner dwells and six alternate outer dwells.

Cam D has three equally circumferentially spaced inner dwells or notches to control the vacuum cycle of the left pickup head for a three-layer box. Cams E and G have the same profile but are out of phase with each other by 30°. Cam E controls the vacuum cycle of the vacuum cups of the left pickup head for four and six-layer cycles and cam G controls the vacuum cycle of the right hand head for all of the cycles. Cam F controls the vacuum cycle of the vacuum cups for the left pickup head for a five-layer box.

Cams H and K have the same profile but are out of phase with each other by 20°. Cam H controls the up and down movements of the right pickup head for all of the cycles and cam K controls the up and down movements of the left head for the four and six-layer cycles. Cam I controls the up and down movements of the left head for a three-layer cycle and cam J controls the up and down movements of the left head for a five-layer cycle.

Pneumatic Actuation System

Referring to FIG. 33, a pressure regulator 310 supplies high pressure air at approximately 80 p.s.i. to a high pressure line 312 which terminates at a plug 314. The high pressure line 312 has a branch 315 connected to one port of a two position-three connection valve 316 and a second pressure regulator 318 supplied by the high pressure line 312 delivers air at approximately 40 p.s.i. to a line 320 which is connected to a second port of the valve 316. The valve 316 may be termed a high-low valve since at one position it supplies high pressure air to a line 322 that ends at the plug 314, and at its alternate position supplies low pressure air to the line. Line 322 supplies low pressure air for lowering the two pickup heads and supplies high pressure air for lifting the two pickup heads.

The schematic in FIG. 33 is drawn with the following assumptions: the carriage 56 is at its left position; the two pickup heads are at their upper positions; the platen at the supply station is at its upper position; and the channel assemblies at the two supply stations are in contracted state.

A two position-three connection directional valve 328 controlled by solenoid 330 is connected to the two lines 322 and 325 to control the air cylinder 87 for the right pickup head and a similar valve 322 controlled by a solenoid 334 controls the air cylinder 66 of the left pickup head. When the solenoids 334 and 330 are energized to cause the two valves 332 and 328 to admit air to the air cylinders 66 and 67 to lift the two pickup heads, the valve 316 supplies high pressure air to the two cylinders and when the two solenoids are deenergized to lower the two pickup heads, the valve 316 supplies low pressure air to the two cylinders. The connection to each end of the two cylinders 66 and 67 is through a corresponding check valve 336 and a corresponding variable restriction 338 which are in parallel, the check valve permitting free flow into the corresponding cylinder while the variable restriction retards discharge flow from the cylinder to regulate the rate of movement of the corresponding pickup head.

A two position-three connection directional control valve 340 operable by solenoids 342 and 344 is connected to the high pressure line 312 and the exhaust line 325 and is connected to the opposite end of the air cylinder 64 for the carriage 56 through the previously mentioned valves 295 that are operated by the previously mentioned cams 292 to decelerate the carriage as it approaches each of its two opposite limit positions. Normally, the rate of outflow from the two opposite ends of the air cylinder 64 is controlled by corresponding variable restrictions 338 which regulate the normal rate of travel of the carriage, but when a valve 295 is operated by the corresponding cam 292 it progressively diverts the outflowing air from the cylinder to a corresponding variable restriction 341 for deceleration of the carriage.

A two position-three connection directional control valve 342' operated by a solenoid 344' is connected to the high pressure line 312 and exhaust line 325 to control the air cylinder 122 that actuates platen 44 at the supply station. A similar valve 345 operated by a solenoid 346 is connected to the opposite ends of the four air cylinders 55 that expand and contract the channel assemblies at the two supply stations.

The air hose 74 for the right pickup head 60 is connected by a line 348 to one port of a two position-four connection directional valve 350 that is controlled by a solenoid 352. The valve 350 is connected to the intake port of an air pump 354 by a line 355 and is connected to the output port of the air pump by a line 356, the fourth port of the valve being connected to a muffler as shown. Normally, the valve 350 connects the air line 74 to the intake port of the pump 354 to create a vacuum for picking up fruit but when the solenoid 352 is energized the connection is switched to the output port of the air pump to deliver compressed air to the air hose 74 for abrupt termination of the vacuum to release the fruit from the pickup head. In like manner, the air hose 74 for the left pickup head 60a is connected to a similar valve 358 actuated by a

solenoid 360 to connect the air hose selectively to the inlet port and the outlet port of a second air pump 362.

Electrical Control System

The wiring diagram shown in FIGS. 34A, 34B, and 34C is drawn with the following assumptions: the selector switch 85 is adjusted for packing five-layer boxes; the power is off; no box is at the packing station; the carriage is at the left with a right signal; the two pickup heads are up; the screen doors are open; the platen at the packing station is in its upper position; and the channel assemblies at the two supply stations are in their contracted states. For convenience, the transverse lines of the wiring diagram are numbered 1-55.

The circuits for the conveyor motor 106, the motors 362a and 354a of the two air pumps 362 and 354 and the motor 204 for vibrating the two channel assemblies are all supplied with 220-volt AC current and the remaining circuits are supplied with 115-volt AC current by a transformer 364. A red lamp 365 on the front of the apparatus is energized when the power is on.

The previously mentioned door switch 308 has a switch arm 308a which is normally open and a switch arm 308b which is normally closed and in like manner door switch 309 has a normally open switch arm 309a and a normally closed switch arm 309b, the two switches being at their normal positions when both doors are open. A relay 1CR in line 13 of the diagram is in series with the two switch arms 308a and 309a to be deenergized when either of the two doors is open. The relay has four sets of normally open contacts (i.e., open when either door is open) comprising contacts 1CR-1 in line 30 of the diagram to prevent left shift of the carriage, contacts 1CR-2 in line 31 of the diagram to prevent right shift of the carriage, contacts 1CR-3 in line 48 of the diagram to prevent or interrupt raising of the right pickup head, and contacts 1CR-4 in line 51 of the diagram to prevent or interrupt raising of the left pickup head.

A relay 2CR in line 14 of the diagram is in series with the three previously mentioned switches 144, 145, and 146 to be energized whenever a box is correctly positioned on the platen at the packing station. This relay has normally open contacts 2CR-1 in line 11 of the diagram to permit operation of the cam motor 78 only when a box is properly located on the platen and has normally closed contacts 2CR-2 in line 15 of the diagram to energize a red signal lamp 366 when a newly arrived box is at a wrong position on the platen at the packing station.

A third relay 3CR in line 33 of the diagram is energized when either of the two pickup heads fails to pick up a full layer of fruit and this relay has normally closed contacts 3CR-1 in line 11 of the diagram to stop the cam motor 78 whenever a fruit is missing from one of the pickup heads.

Whenever a cam cycle is interrupted in this manner by a missing fruit, the operator opens one or both of the screen doors 305 to supply the missing fruit to the pickup head and the consequent deenergization of relay 1CR open contacts 1CR-1 and 1CR-2 to prevent movement of the carriage and opens contacts 1CR-3 and 1CR-4 to deenergize the solenoids to interrupt the upward movement of the two pickup heads and to cause the two pickup heads to move downwardly. When the doors are subsequently closed after the missing fruit is replaced, the two pickup heads being in their down positions instead of being on the way up, it is necessary to delay energization of the cam motor 78 to prevent continuation of the packing cycle until the two pickup heads return to their upper positions. For this purpose, a time delay relay 368 is energized when the doors are first closed to operate a corresponding time delay switch 370 to delay energization of the cam motor 78 until the two pickup heads reach their upper positions.

The manual knob 86 and the pointer 88 of the selector switch 85 are operatively connected to three switch arms of the selector switch that follow the movements of the pointer 88, the three switch arms being a rotary switch arm 88a in line 16 of the diagram, a rotary switch arm 88b in line 42 of the diagram, and a rotary switch arm 88c in line 49 of the diagram.

The rotary switch arm 88a is shown at the number 5 position to permit the switch 84B that is operated by the cam B to operate the valve solenoid 344' for the air cylinder 122 for the platen at the packing station, the switch 84B being also activated when the rotary switch arm 88a is at the number 6 position. When the rotary switch arm 88a is at the number 3 and number 4 positions, it places the valve solenoid 344' under control of the switch 84A that is operated by cam A. A pushbutton switch 374 permits the platen to be lowered independently of the switches 84A and 84B when either one of the two doors is open. If the two doors are closed the pushbutton switch 374 is inoperative.

The second rotary switch arm 88b is shown at the number 5 position in the wiring diagram to enable switch 84F that is controlled by cam F to operate the valve solenoid 358 to release fruit from the left pickup head. At positions number 4 and number 6 the rotary switch arm 88b enables the switch 84E that is controlled by cam E to operate the valve solenoid 358 to release fruit from the left pickup head and at position number 3 the rotary switch arm 88b enables the switch 84D that is controlled by cam D to control the same valve solenoid. Switch 84G that is controlled by cam G controls the corresponding valve solenoid 354 for releasing fruit from the right pickup head. Signal lamps 375 and 376 indicate when the valve solenoids 358 and 354, respectively, are energized.

A signal lamp 378 in line 46 on the diagram is controlled by the previously mentioned limit switch 284 to be energized whenever the carriage 56 is at either its left limit position or its right limit position.

As indicated in line 48 of the diagram, switch 84H that is operated by cam H is in series with the normally open contacts 1CR-3 to control the valve solenoid 330 for raising and lowering the right head and to control the valve solenoid 324 to actuate the high-low valve 316. The third rotary switch arm 88c of the selector switch is shown at position 5 to place the valve solenoid 334 for raising and lowering the left pickup head under control of the switch 84I that is operated by the cam J. If the rotary switch arm 88c is at the number 3 position it places the valve solenoid 334 under control of the switch 84I that is operated by cam I and if the rotary switch arm is at the number 4 and number 6 positions it places the valve solenoid 334 under control of the switch 84H that is operated by the cam H. A signal lamp 380 in line 53 indicates when the right pickup head is down and a signal lamp 382 in line 54 indicates when the left pickup head is down.

Referring to line 55 of the diagram, the switch 84K that is operated by the cam K controls the valve solenoid 346 for actuating the four cylinders 55 to expand and contract the channel assemblies at the two supply stations.

Referring to lines 22-26 of the diagram, a rectifier indicated diagrammatically at 384 supplies direct current at 90 volts to operate the clutch 110 and to operate the brake 95, the voltage to the brake being regulated by a potentiometer 385. The previously mentioned switch 134 of the conveyor has two switch arms 134a and 134b, one being closed when the other is open, and vice versa. In like manner, the switch 136 of the conveyor has two switch arms 136a and 136b one being opened when the other is closed, and vice versa. When the platen 44 is lowered by closing of switch 84B by cam B at the end of a packing cycle, the downward movement of the platen operates the switch 136 as heretofore described to close switch arm 136b thereby to energize the clutch through switch 134b and to open switch arm 136a to deenergize the brake 95. Energization of the clutch 110 starts the conveyor to take away the full box and to deliver a new empty box to the platen 44.

When a flight bar 92 pushes the empty box onto the platen 44, the flight bar operates switch 134 to open switch arm 134b to disengage the clutch to stop the conveyor and to close switch arm 134a to energize the brake 95. If the newly arrived empty box is correctly positioned on the platen 44, the three switches 144, 145, and 146 are closed to energize relay 2CR. Relay 2CR closes contacts 2CR-1 to start the cam motor 78 for a new operating cycle provided that both of the screen

doors are closed and that no fruit is missing on either of the pickup heads. If the newly arrived box is not in the correct position, relay contacts 2CR-2 remain closed to energize the signal lamp 366. When the cam motor 78 is energized to start the new operating cycle, switch 84B is operated by cam B to lift the platen 44 at the packing station.

Referring to lines 27-35 of the diagram, switch 84C that is operated by cam C has two switch arms 84C-1 and 84C-2 one of which closes when the other opens. The previously mentioned switch 286 that is operated by the carriage 56 when it reaches its right limit position is a two-pole, double-throw switch which is shown diagrammatically as four switch arms 286a, 286b, 286c, and 286d, the switch arm 286a being closed when the switch arm 286b is opened, and the switch arm 286c being closed when the switch arm 286d is opened. The switches in line 27 of the diagram are positioned to create a signal to energize the valve solenoid 342 to actuate the valve 340 for rightward movement of the carriage 56. When the carriage reaches its right limit position the switch 286 is actuated to open the two switch arms 286a and 286c and to close the two switch arms 286b and 286d. With the closing of the two switch arms 286b and 286d the subsequent closing of the switch arm 84C-2 by cam C energizes the valve solenoid 344 to actuate the valve 340 to return the carriage to its left limit position.

The two previously mentioned switches 268 that are closed when the two pickup heads are at their upper positions are shown in line 27 of the diagram to prevent movement of the carriage 58 in the event that either pickup head is not at its upper limit position. The normally open relay contacts 1CR-1 and 1CR-2 in lines 30 and 31 of the diagram prevent movement of the carriage if either of the two screen doors is open.

If a fruit is missing when a pickup head picks up a layer of fruit, the pressure in the corresponding air line 74 is substantially higher than the pressure would be if all the fruit were present. The invention takes advantage of this fact by providing pressure switches responsive to the pressure in the two lines 74 to sense whether or not a fruit is missing from the corresponding pickup heads. For this purpose a pressure switch 386 associated with the air line 74 of the right pickup head has two switch arms 386a and 386b, the switch arm 386a opening when a fruit is missing to prevent actuation of the valve solenoid 342 and the switch arm 386b closing to energize a signal lamp 390 as well as a malfunction counter 392 and the previously mentioned relay 3CR. As heretofore stated, the energization of the relay 3CR opens the relay contacts 3CR-1 in line 11 of the diagram to stop the cam motor 78. In like manner, a pressure switch 394 for the air line 74 for the left pickup head has a switch arm 394a that opens in response to the absence of a fruit to prevent energization of the valve solenoid 344 for rightward movement of the carriage and has a switch arm 394b which closes to energize the lamp 390, the malfunction counter 392, and the relay 3CR.

Under some circumstances where the surface of the fruit is especially rough or irregular there may be enough total leakage at the various vacuum cups of a pickup head to cause operation of the pressure switches 386 or 394 even though no fruit is missing. In the event of a false signal created by the pressure switches in this manner, the operator may operate a pushbutton switch 395 to bypass the pressure switches for resumption of the packing cycle.

A signal lamp 398 is connected to a wire 400 in line 27 of the diagram to be energized while the carriage is moving to the right and a similar signal lamp 402 is connected to a wire 403 in line 28 of the diagram to be energized while the carriage is moving to the left. A signal lamp 404 is energized by the limit switch 268 of the left pickup head when the left pickup head is at its upper position and a similar signal lamp 405 is energized by the limit switch 268 of the right pickup head when the right pickup head is at its upper position.

The Operating Cycle for a Five-Layer Box

FIG. 35 which represents the overall cam cycle indicates the timing of all of the switch operations carried out by one revolution of the gang of cams A—K. When the function of the selector switch 85 is explained, this chart makes it possible to follow any particular cycle for packing a particular number of layers of fruit in a box.

When the selector switch 85 is adjusted with the pointer at numeral 3 for a three-layer cycle, the selector switch activates the switches 84 of cams A, C, D, G, H, I, and K; when the selector switch is adjusted for a four-layer cycle, it activates the switches 84 that are operated by cams A, C, E, G, H, and K; at the adjustment for a five-layer cycle, the selector switch activates the switches 84 for cams B, C, F, G, H, J, and K; and when the selector switch is set for a six-layer cycle, it activates the switches 84 for cams B, C, E, G, H, and K.

The particular cycle for a five-layer box, for example, is as follows.

As heretofore stated, the operating cycle starts with the carriage at the right with both pickup heads elevated and both pickup heads loaded with fruit. To start the packing cycle cam B actuates valve solenoid 344' to lift the platen at the packing station and cam C actuates corresponding switch 84C to shift the carriage to the left. Cam H then operates switch 84G in line 48 of the diagram to lower the right pickup head to deposit the first right pattern layer of fruit in the bottom of the box, but the left pickup head is not lowered to pick up a new layer of fruit at the left supply station because the left pickup head is already loaded with fruit. Cam H releases switch 84H for upward return of the right pickup head and then cam C operates switch 84C to close switch arm 84C-1 for shift of the carriage to its right position.

At the right position of the carriage, cam H operates switch 84H to lower the right pickup head and at the same time cam J operates switch 84J in line 50 of the diagram to lower the left pickup head. The left pickup head deposits the second layer of the left pattern in the box and the right pickup head picks up a new layer of fruit at the right supply station. While the two pickup heads are at their upper positions the switch 84K in line 55 of the diagram is operated to expand the two channel assemblies and as the two pickup heads are lowered the switch is operated to contract the two channel assemblies. At this point when both of the pickup heads return to the upper positions, the right pickup head is loaded, the left pickup head is empty, and the carriage is at its right limit position.

Cam C operates switch 84C to shift the carriage to its left position where the right pickup head is lowered by cam H and the left pickup head is lowered by cam J, the left pickup head picking up a new layer of fruit and the right pickup head depositing the third layer in the box. When the two pickup heads are returned to their upper positions by cams H and J, cam C moves the carriage to the right where cams H and J again lower the two pickup heads, the right pickup head picking up a new layer of fruit and the left pickup head depositing the fourth layer in the box.

After the two pickup heads are returned to their upper positions by cams H and J, cam C moves the carriage to the left where cams H and J again lower both pickup heads, the left pickup head picking up a new layer of fruit and the right pickup head depositing the fifth layer in the box. Both pickup heads are then raised to their upper positions by cams H and J and again the cam C moves the carriage to the right.

When the carriage reaches its right position the left pickup head is loaded, but the right pickup head is empty. Cam H then lowers the right pickup head to pick up a new layer of fruit and returns the pickup head to its upper position in preparation for repeating the cycle for loading a five-layer box.

While the invention has been described in general for the packing of fruit, it is not to be limited to such use only, since it is applicable in its broad concepts to the packing of a variety of articles such as balls and the like, which have the requisite shape or form.

Our description in specific detail of the presently preferred embodiment of the invention will suggest various changes, substitutions, and other departures from our disclosure within the spirit and scope of the appended claims.

We claim:

1. In an apparatus for packing different numbers of layers of articles in receptacles wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of the articles from supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

cycle means including a plurality of cycle elements operable simultaneously through repeated cycles,

different cycle elements being effective to control the lateral reciprocations of the pickup means for different numbers of layers of the articles in receptacles,

different cycle elements being effective to control the up and down reciprocations of the pickup means for different numbers of layers of the articles in the receptacles,

different cycle elements being effective to control the engagement and release of articles by the pickup means for different numbers of layers of the articles in the receptacles; and

a single master control means to make the cycle elements effective selectively, said master control means being adjustable to different settings for packing different numbers of layers in the receptacles.

2. An improvement as set forth in claim 1 which includes:

conveyor means to deliver successive empty receptacles to the packing station; and

means to actuate said cycle means in response to arrival of an empty receptacle at the packing station.

3. An improvement as set forth in claim 1

in which said pickup means comprises two pickup heads to pick up layers of two different complementary patterns, respectively, to form alternate layers in a receptacle, said cycle means being programmed to start the packing of each receptacle with a layer of a given pattern of the two complementary patterns.

4. An improvement as set forth in claim 1 in which said supply means includes a set of parallel channels to form rows of articles;

in which means is included to expand the set of channels laterally for free movement of the articles and to contract the set of channels to nest the rows of articles to form the patterns of layers;

and in which said cycle means includes at least one cycle element to control expansion and contraction of the set of channels.

5. An improvement as set forth in claim 1 which includes tapered means at the packing station to guide the pickup means into the interior of the receptacles;

which includes a platen to elevate newly arrived empty boxes up to the guide means;

and in which said cycle means includes at least one cycle element to control said platen.

6. An improvement as set forth in claim 1 in which said pickup means comprises a left pickup head and a right pickup head;

and in which said cycle means includes different cycle elements to control the up and down movements of one of said pickup heads for packing different numbers of layers in the receptacles.

7. An improvement as set forth in claim 1 in which said cycle means includes a plurality of different cycle elements to control the engagement and release of articles by the pickup means for packing different numbers of layers in the receptacles.

8. An improvement as set forth in claim 1 in which said cycle means comprises:

a plurality of cycle elements in the form of cams operatively interconnected for simultaneous operation; and switch means operated by the respective cams.

9. An improvement as set forth in claim 8 in which the master control means makes said switches effective selectively for carrying out operating cycles for depositing different numbers of layers in the receptacles.

10. An improvement as set forth in claim 9 in which said master control means is movable to different positions for packing different numbers of layers of the articles in the receptacles;

and which includes indicia for the different positions to indicate the different numbers of layers.

11. In an apparatus for packing different numbers of layers of articles in receptacles wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from supply means and to release the layers in the receptacles at a packing station,

the improvement comprising:

cycle means operative through a predetermined cycle to control the lateral reciprocations of the pickup means, the up and down reciprocations of the pickup means, and the engagement and release of articles by the pickup means;

conveyor means to deliver successive empty receptacles to the packing station and to remove packed receptacles therefrom;

means to stop the conveyor means and to initiate operation of said cycle means in response to arrival of an empty box at the packing station;

means to actuate the conveyor means in response to completion of the operation of said cycle means;

means to sense the position of a newly arrived empty receptacle at the packing station; and

means responsive to the sensing means to prevent actuation of the cycle means when a newly arrived receptacle is incorrectly positioned at the packing station.

12. A combination as set forth in claim 1 which includes:

conveyor means to deliver successive empty receptacles to the packing station;

tapered means at the packing station to guide the pickup means into the interiors of the receptacles;

a platen to elevate newly arrived empty receptacles up to the guide means; and

means to initiate operation of the cycle means in response to elevation of the platen.

13. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and reciprocates up and down to engage successive layers of articles from a supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

fluid-actuated means to raise and lower the pickup means;

means to supply fluid at a relatively high pressure to the fluid-actuated means to raise the loaded pickup means;

and

means to supply fluid at lower pressure to the fluid-actuated means to lower the empty pickup means.

14. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from a supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

a carriage carrying the pickup means, said carriage being laterally reciprocative for lateral reciprocation of the pickup means, said pickup means being movable up and down relative to the carriage;

a cylinder;

a piston in the cylinder connected to the carriage;

means to admit pressurized fluid into the opposite ends of the cylinder to advance the piston in opposite directions for reciprocation of the carriage; and

means responsive to approach of the carriage to each of its opposite limit positions to restrict the release of fluid from the cylinder on the advancing side of the piston to decelerate the carriage.

15. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from a supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

a conveyor to deliver empty receptacles to the packing station and to remove packed receptacles therefrom;

a continuously running motor;

a clutch to connect the motor to the conveyor in response to completion of said operating cycle and to disconnect the motor from the conveyor in response to arrival of an empty receptacle at the packing station; and

a brake to stop the conveyor in response to arrival of an empty box at the packing station and to release the conveyor in response to completion of said operating cycle.

16. In an apparatus having an operating cycle wherein two pickup heads reciprocate laterally and also reciprocate up and down to engage successive layers of articles from a supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

a substantially horizontal track;

a carriage mounted on the track for lateral reciprocation thereon;

a cylinder;

a piston in the cylinder connected to the carriage;

means to admit pressurized fluid into the opposite ends of the cylinder to advance the piston in opposite directions for reciprocation of the carriage;

two substantially upright cylinders on the carriage;

two pistons in the two upright cylinders respectively, said pistons carrying the two pickup heads respectively; and

means to admit pressurized fluid into the opposite ends of the two upright cylinders to raise and lower the two pickup heads.

17. An improvement as set forth in claim 16 in which said means to admit pressurized fluid to the two upright cylinders comprises means to admit relatively high pressure fluid to raise the two pickup heads and means to admit relatively low pressure fluid to lower the two pickup heads.

18. An improvement as set forth in claim 16 which includes means to decelerate the carriage as it approaches its two opposite limit positions.

19. An improvement as set forth in claim 16 which includes means to prevent movement of the carriage in response to failure of either pickup head to pick up a complete layer of the articles.

20. An improvement as set forth in claim 16, which includes at least one guide rod for each pickup head to stabilize the up and down movements of the head;

in which each pickup head has a group of vacuum cups to pick up the articles; and

in which each of said guide rods is hollow to form an air passage for evacuating the vacuum cups of the corresponding pickup head.

21. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from a supply means and to release the layers in receptacles at a packing station,

the improvement comprising:

a safety enclosure for moving parts of the apparatus including the pickup means; and

means not only to interrupt the upward movement of the pickup means but also to lower the pickup means when the enclosure is opened for replacement of a missing article on the pickup means.

22. An improvement as set forth in claim 20 which includes a conveyor to deliver empty receptacles to the packing station and to remove packed receptacles therefrom;

and which includes means to prevent operation of the conveyor when the safety enclosure is opened.

23. An improvement as set forth in claim 2, including means for receiving and temporarily storing packed receptacles, whereby the packing cycle may continue uninterrupted.

24. An improvement as set forth in claim 20, which also includes means to sense the absence of a receptacle at the packing station, and through said responsive means prevent actuation of the cycle means.

25. In an apparatus for packing layers of articles in receptacles wherein pickup means reciprocates laterally and reciprocates up and down to engage successive layers of articles at a supply means and to release the layers in the receptacles at a packing station, the improvement comprising:

cycle means operative through a predetermined cycle to control the lateral reciprocations of the pickup means, the up and down reciprocations of the pickup means, and the engagement and release of articles by the pickup means;

a safety enclosure for moving parts of the apparatus including the pickup means;

a safety enclosure for moving parts of the apparatus including the pickup means;

means to interrupt said cycle and not only to interrupt the upward movement of the pickup means, but also to lower the pickup means in response to opening of the enclosure for replacement of a missing article on the pickup means; means to resume the upward movement of the pickup means in response to subsequent closing of the safety enclosure; and

means to resume the interrupted cycle of operation in response to the subsequent closing of the safety enclosure,

said means to resume the cycle of operation including time delay means to permit completion of the upward movement of the pickup means before the cycle is resumed.

26. In an apparatus for packing different numbers of layers of articles in receptacles wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of the articles from supply means and to release the layers in receptacles at a packing station, the improvement comprising:

cycle means including cycle elements operable simultaneously to control the lateral reciprocations of the pickup means, to control the up and down reciprocations of the pickup means, and to control the engagement and release of articles by the pickup means,

various of said cycle means being programmed for depositing different numbers of layers of the articles in the receptacles;

control means to make the cycle elements effective selectively, said control means being adjustable to different settings for packing different numbers of layers in the receptacles;

conveyor means to deliver successive empty receptacles to the packing station;

means to actuate said cycle means in response to arrival of an empty receptacle at the packing station;

means to sense the position of a newly arrived empty receptacle at the packing station; and

means responsive to the sensing means to prevent actuation of the cycle means when a newly arrived receptacle is incorrectly positioned at the packing station.

27. In an apparatus for packing different numbers of layers of articles in receptacles wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of the articles from supply means and to release the layers in receptacles at the packing station, the improvement comprising:

cycle means including cycle elements operable simultaneously to control the lateral reciprocations of the pickup means, the up and down reciprocations of the pickup means, and the engagement and release of articles by the pickup means,

various of said cycle means being programmed for depositing different numbers of layers of the articles in the receptacles; and

control means to make the cycle elements effective selectively, said control means being adjustable to different settings for packing different numbers of layers in the receptacles,

said pickup means comprising two pickup heads to pick up layers of two different complementary patterns, respectively, to form alternate layers in a receptacle, said cycle means being programmed to start the packing of each receptacle with a layer of a given pattern of the two complementary patterns,

the two pickup heads moving to the packing station alternately to release layers of the articles and when an odd number of layers is being packed in the receptacle, the cycle means omitting the release operation of one of the two pickup heads between the end of one operating cycle and the beginning of the next operating cycle thereby to cause the packing of each receptacle to start with a layer of said given pattern.

28. In an apparatus for packing different numbers of layers of articles in receptacles wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of the articles from supply means and to release the layers in receptacles at the packing station, the improvement comprising:

cycle means including cycle elements operable simultaneously to control the lateral reciprocations of the pickup means, the up and down reciprocations of the pickup means, and the engagement and release of articles by the pickup means,

various of said cycle means being programmed for depositing different numbers of layers of the articles in the receptacles;

control means to make the cycle elements effective selectively, said control means being adjustable to different settings for packing different numbers of layers in the receptacles;

tapered means at the packing station to guide the pickup means into the interior of the receptacles; and

a platen to elevate newly arrived empty boxes up to the tapered guide means,

said cycle means including at least one cycle element to raise and lower the platen when the receptacles are packed with a given number of layers of the articles,

said cycle means further including a second cycle element to control the raising and the lowering of the platen when the receptacles are packed with a different number of layers of the articles.

29. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from supply means and to release the layers in receptacles at a packing station, the improvement comprising:

means to sense the position of a receptacle at the packing station; and

means to prevent initiation of the operating cycle in response to incorrect positioning of a receptacle at the packing station,

said sensing means comprising three switches in series actuated by the receptacles,

one of the three switches being a normally closed switch positioned short of the correct position of the receptacle, a second of the three switches being a normally closed switch positioned beyond the correct position of a receptacle,

the third switch of the three switches being a normally open switch at the correct position of the receptacle.

30. In an apparatus having an operating cycle wherein pickup means reciprocates laterally and also reciprocates up and down to engage successive layers of articles from supply

means and to release the layers in receptacles at a packing station.

the improvement comprising:

the provision of a plurality of different supply means to supply the articles in layers of different patterns for packing into the receptacles,

the supply means of said plurality of supply means being interchangeable in the apparatus,

and the provision of a plurality of different pickup means each designed to pick up layers of one of said patterns for release into the receptacles,

the pickup means of said plurality of pickup means being interchangeable in the apparatus,

whereby the apparatus may be changed over from packing one pattern of the articles to packing another pattern of the articles by substituting in the apparatus one supply means for another supply means and one pickup means for another pickup means.

31. A control system for automatic packing apparatus to change over the apparatus to pack different numbers of layers of articles in receptacles of different dimensions with different patterns of the layers, wherein the apparatus has supply means to supply layers of selected patterns of the articles, a carriage to reciprocate between the supply means and a packing station, and pickup means carried by the carriage to pick up the layers of the selected patterns by vacuum action, said pickup means being reciprocative vertically relative to the carriage to pick up the layers at the supply means and to deposit the layers in receptacles at the packing station,

said control system comprising:

a plurality of cycle elements movable in synchronism through repeated cycles to cause repeated cycles of operation of the apparatus,

at least one of the cycle elements being effective to control the delivery of empty receptacles to the packing station,

at least one of the cycle elements being effective to control the reciprocations of the carriage,

different cycle elements being effective to control the vertical reciprocation of the pickup means,

different cycle elements being effective to control the vacuum cycles of the pickup means; and

a single master control having different settings to make different combinations of the cycle elements effective during the repeated cycles, each combination of the cycle elements causing the apparatus to pack a given number of layers in a receptacle of a given size

32. A control system as set forth in claim 31 in which some of the cycle elements are common to all of said combinations of cycle elements.

33. A control system as set forth in claim 32 in which a given interval of time is required for the apparatus to pick up a layer of the articles at the supply means and to deposit the layer of articles in a receptacle at the packing station;

in which the carriage reciprocates once in each of said intervals of time;

in which a first given number of time intervals is required to pack a receptacle with a given number of layers;

in which a second given number of the time intervals is required to pack a receptacle with a different number of layers;

and in which one cycle of said plurality of cycle elements occurs in a number of said time intervals which is a multiple of said first given number and is also a multiple of said second given number.

34. A control system as set forth in claim 33 in which one cycle of said plurality of cycle elements occurs in a number of cycles which is the least common denominator of said first and second given numbers.

35. A control system as set forth in claim 33 in which said plurality of cycle elements includes a cycle element effective to arrange the articles in layer patterns at the supply means during each of said time intervals.

36. A control system as set forth in claim 33 in which a platen is provided to raise and lower receptacles at the packing station;

in which one of the cycle elements is effective to raise and lower the platen once in said first given number of time intervals;

and in which a second cycle element is effective to raise and lower the platen once in said second given number of time intervals.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,590,551 Dated July 6, 1971

Inventor(s) Fred W. Riddington et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 75, "reset" should read --rests--.
Column 7, line 75, "baseplate" should read --headplate--.
Column 13, line 37, "84I" should read --84J--.
Column 19, delete lines 20 and 21.

Signed and sealed this 21st day of March 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents