United States Patent

[11] 3,633,732

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[73] Assignee **Brogdex Company Pomona, Calif.**
Original application July 13, 1967, Ser. No. 653,239, now Patent No. 3,492,779, dated Feb. 3, 1970. Divided and this application July 7, 1969, Ser. No. 840,602

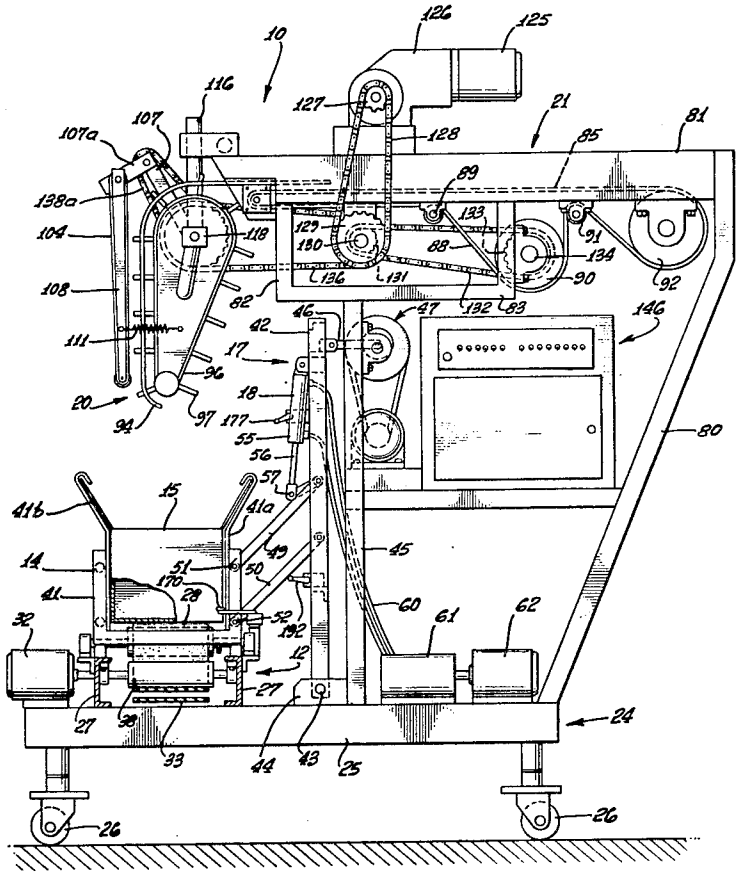
[54] **APPARATUS AND METHOD FOR FILLING BOXES WITH A PRESELECTED QUANTITY OF DISCRETE ARTICLES**
7 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **198/40, 53/59**
[51] **Int. Cl.** **B65g 43/00**
[50] **Field of Search** 198/38, 40, 165; 53/244, 245, 126, 248; 235/98

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ABSTRACT: An apparatus and method for filling a box with a preselected aggregate number of articles or a preselected aggregate weight of articles utilizing a vertical feed conveyor having a bottom article release end received within a box being filled to minimize the distance a released article falls to the bottom of the box or to a layer of articles already deposited in the box. The box is raised to enclose the release end of the vertical feed conveyor and as each article is deposited in the box, it is counted. At a preselected intermediate count of articles the box is incrementally lowered a selected vertical interval to provide space for additional articles. In a second example of the invention, the weight of each article as it is placed in the box is sensed and upon reaching a preselected intermediate weight, the box is incrementally lowered a selected vertical interval. Means are provided for shaking the box during the filling operation to settle and closely arrange the articles in the box.



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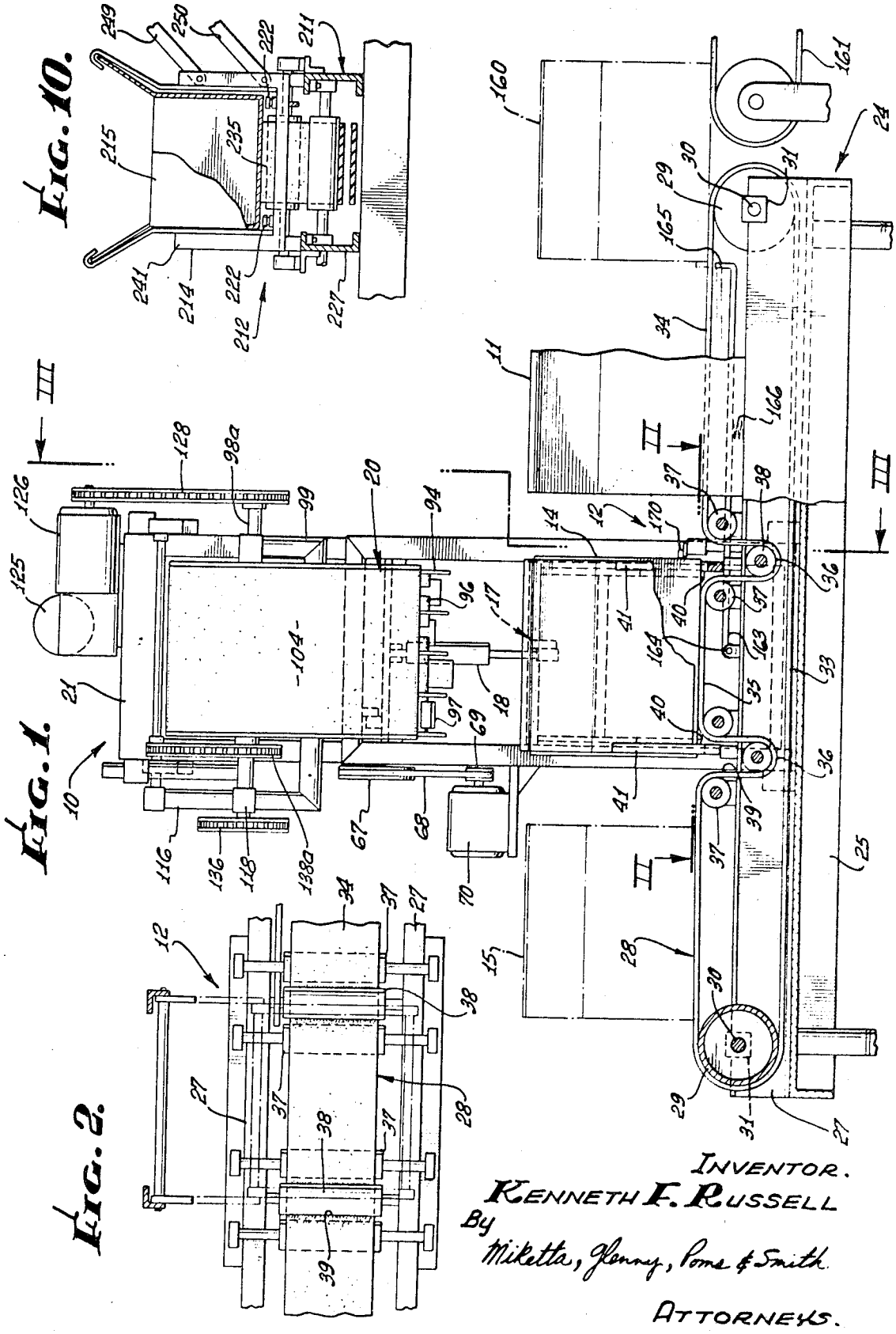
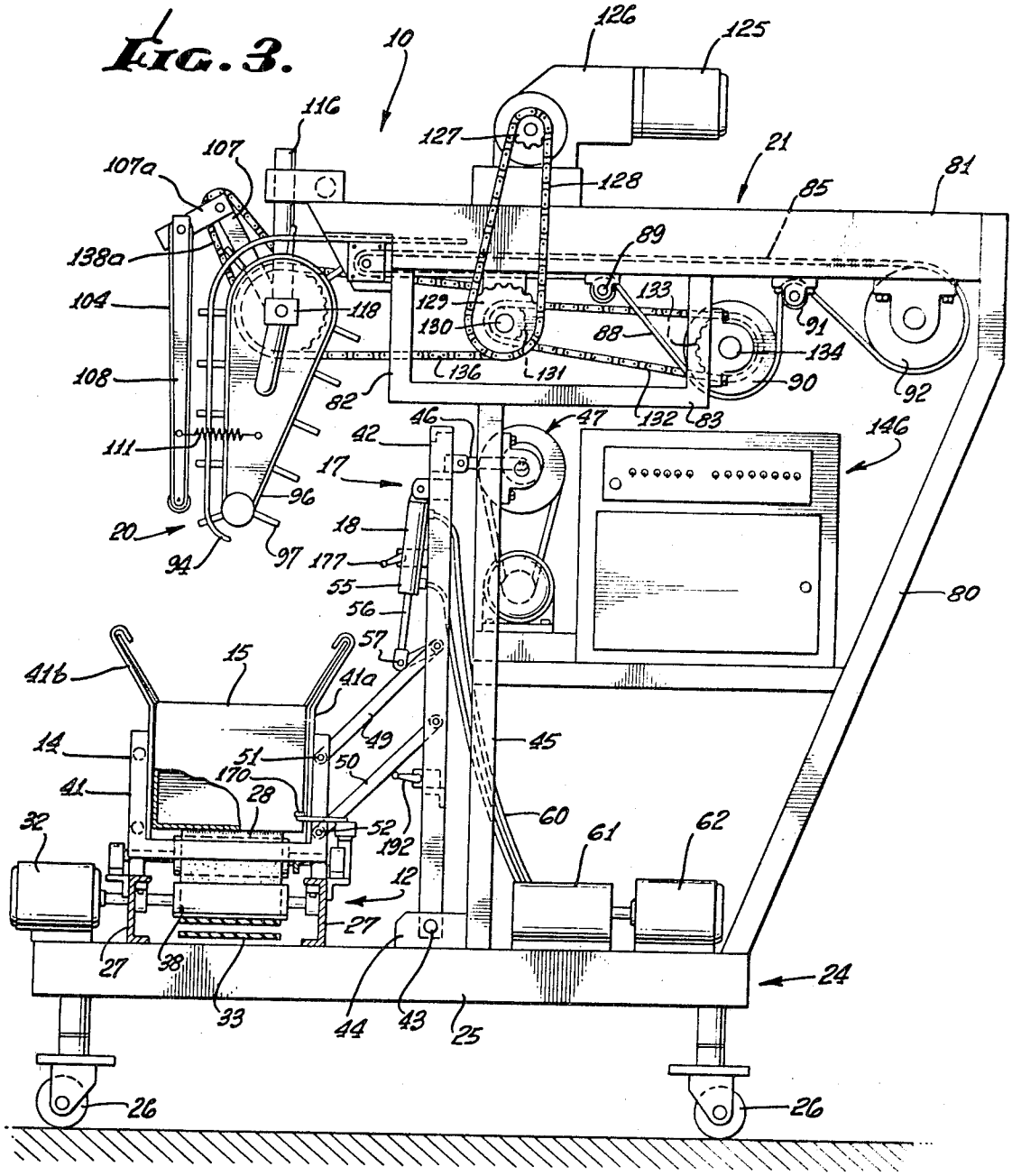


FIG. 3.



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FIG. 4.

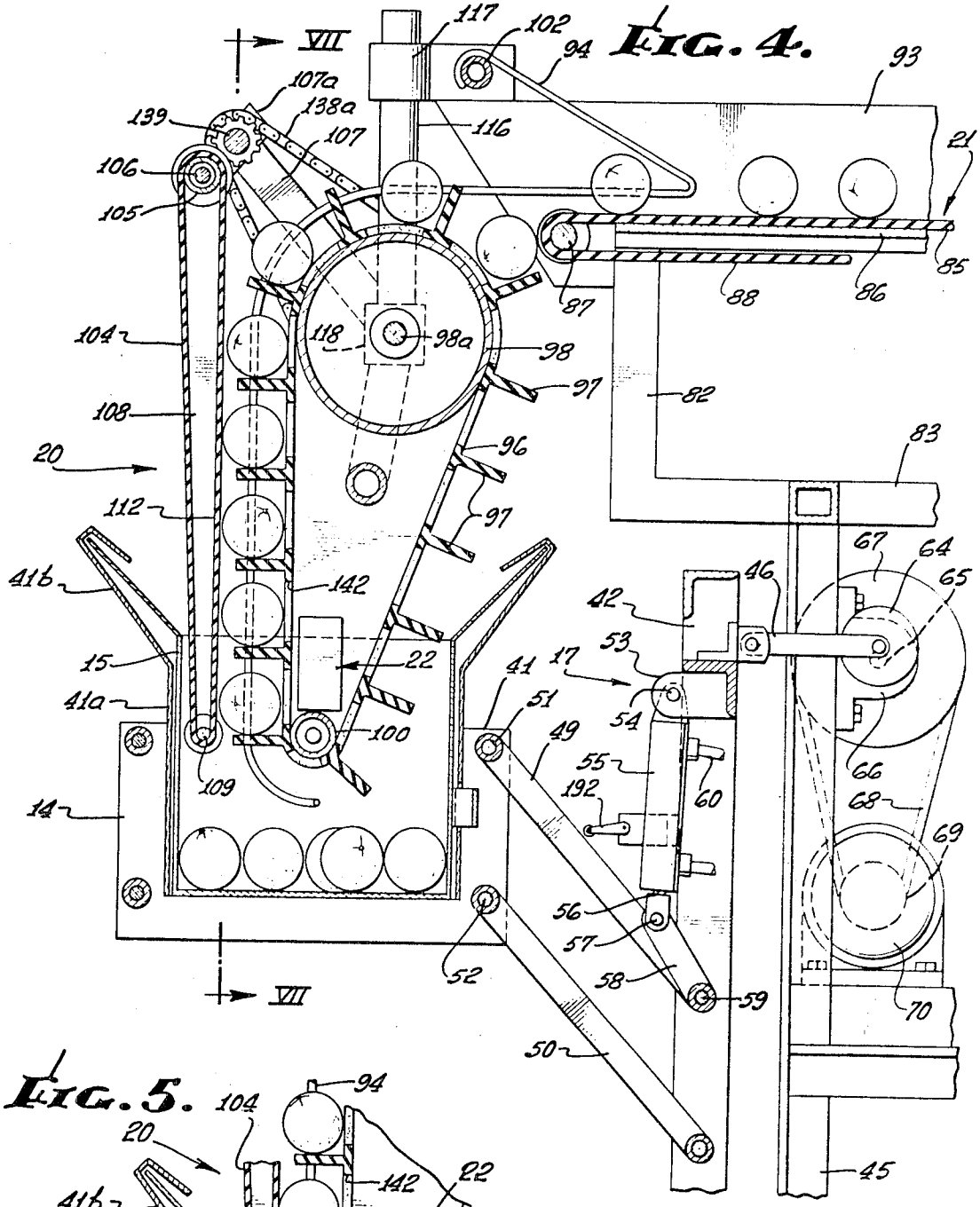
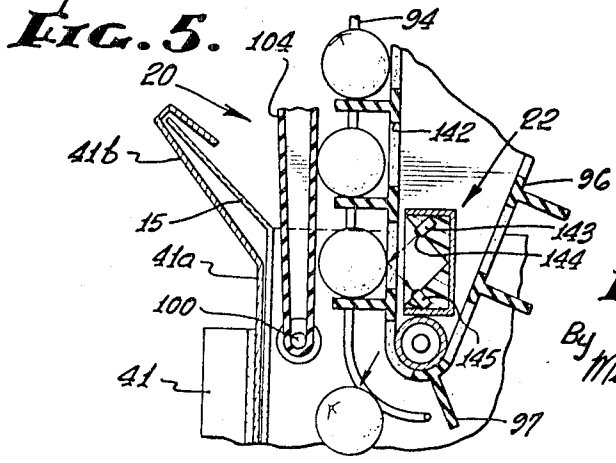


FIG. 5.



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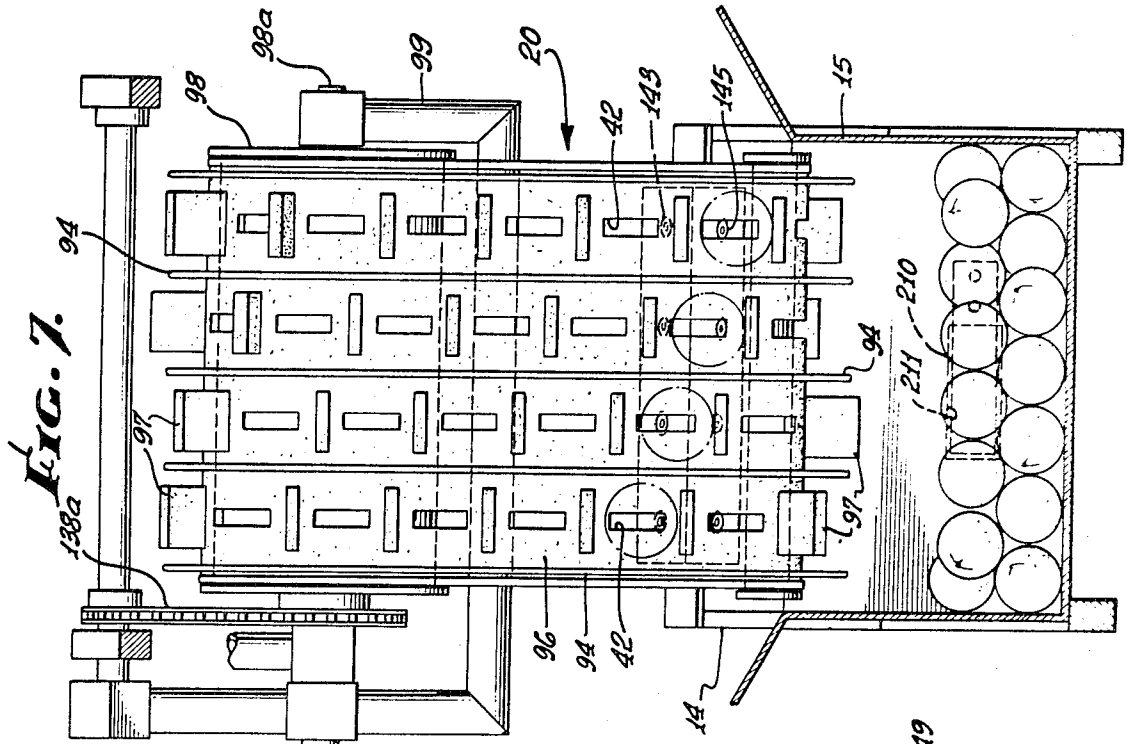


FIG. 7.

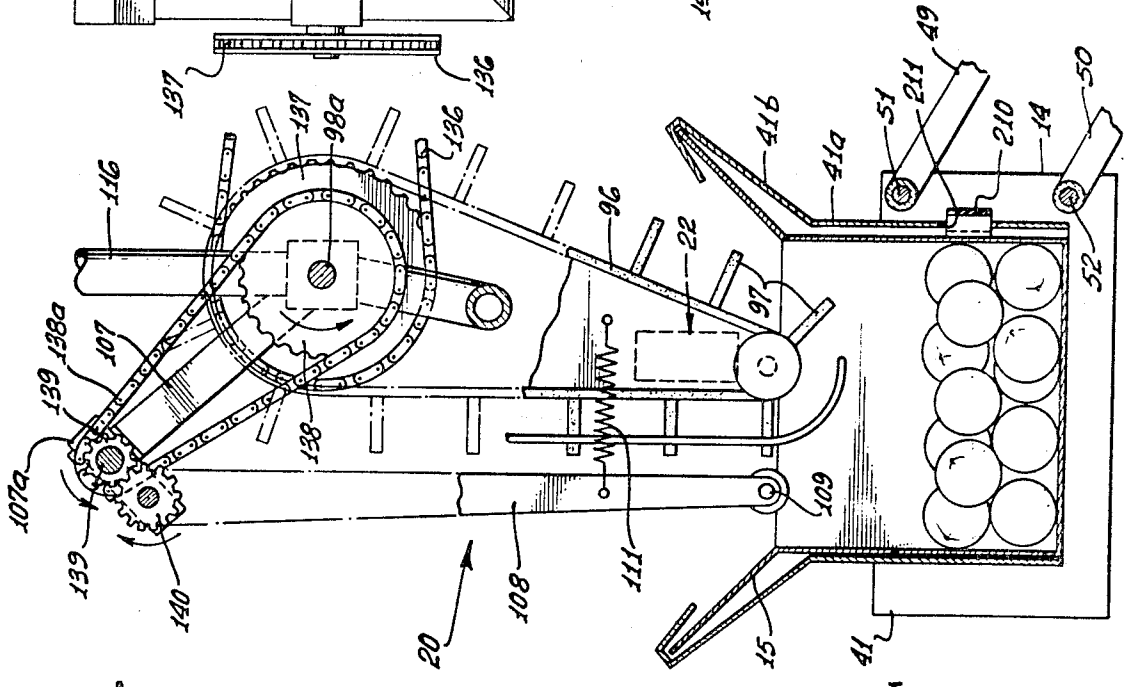


FIG. 6.

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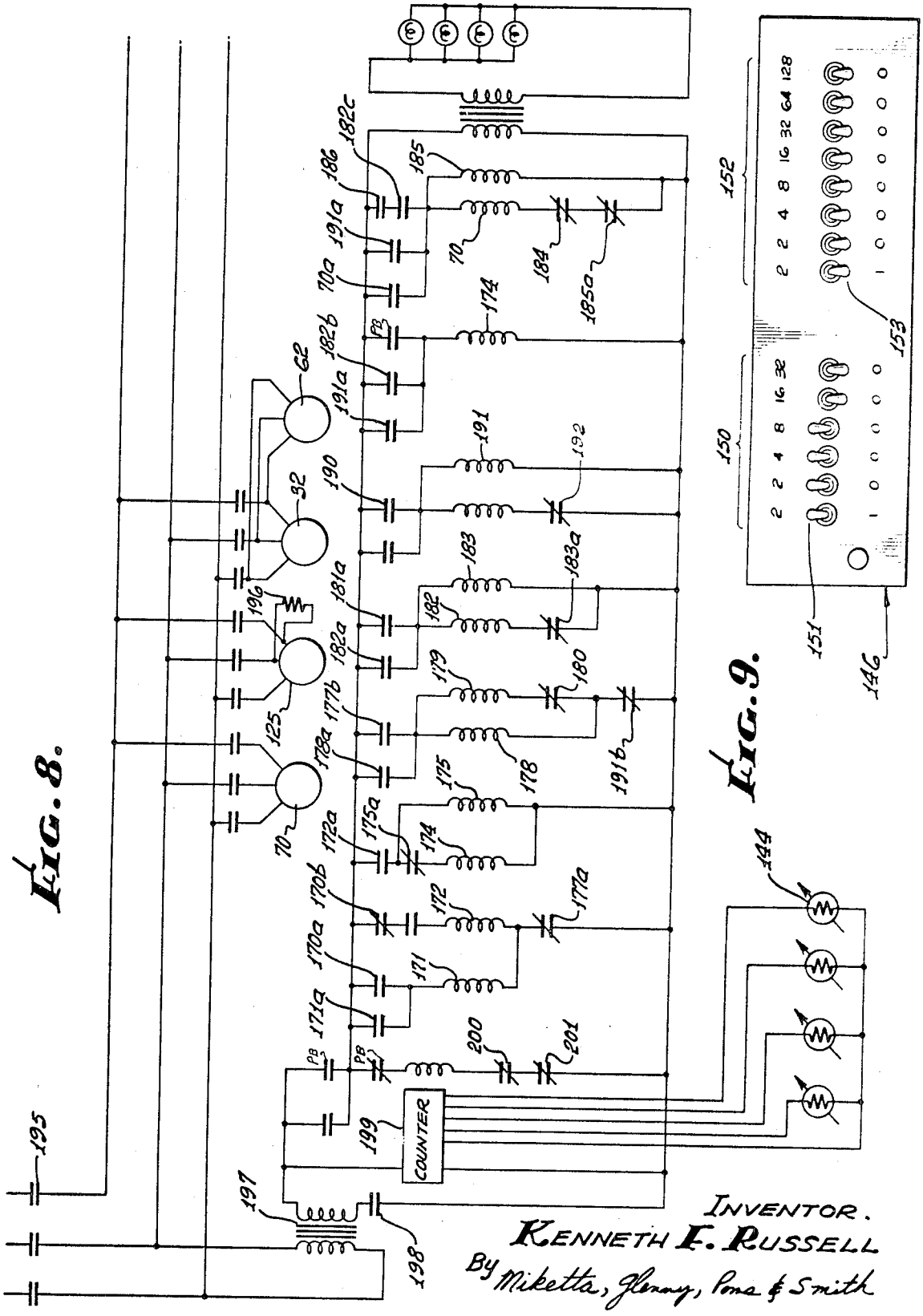


FIG. 8.

FIG. 9.

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APPARATUS AND METHOD FOR FILLING BOXES WITH A PRESELECTED QUANTITY OF DISCRETE ARTICLES

This application is a divisional application of copending application Ser. No. 653,239, filed July 13, 1967, now U.S. Pat. No. 3,492,779 issued Feb. 3, 1970.

The present invention contemplates an apparatus and method for filling boxes or receptacles with discrete articles, such as fruit, in accordance with, in one example, numerical count of the fruit or, in another example, weight of the fruit. The invention contemplates a novel method and apparatus for moving the box and fruit whereby a box may be rapidly filled under conditions which minimize the possibility of damage to the article as it is deposited in the box.

Prior proposed methods for filling a box of selected volume and size with fruit, which may have been already sized in accordance with well-known sizing apparatus, have included hand packing the fruit in the box by arranging the fruit in layer patterns which were predetermined according to the size and number of fruit required to fill such a box. Such hand-packed boxes require skilled packers to rapidly arrange the fruit into the predetermined layer patterns and to maintain over many packing hours a suitable packing rate. Obviously such a method for hand-packing boxes requires many packers, is time consuming, and is generally an economically inefficient method of packing boxes.

Prior proposed apparatuses for mechanically packing boxes have included machines for counting fruit as they are discharged into a box, U.S. Pat. No. 2,928,599. However, in such proposed machine, the lemons fall a substantial distance into the box; certain types of fruit are more fragile and subject to damage by such a fall.

In another proposed machine for filling boxes in which fall in minimized, a vertically disposed feed conveyor lowers articles into a box raised into box-receiving position with respect to the feed conveyor, U.S. Pat. No. 2,061,490. However, the box was successively lowered by scraping contact of the bottom of the conveyor with the top surface of fruit deposited therein.

In another prior construction, a bucket-type elevator was lowered into a container and then progressively raised with respect to the container as the level of the articles deposited therein increased, the raising of the loading conveyor being in response to the increase in level of the articles, U.S. Pat. No. 2,889,676. In still other prior constructions, particularly when filling a box in accordance with weight, articles were fed to the box first in bulk and then singly in order that a precise weight could be obtained.

Such prior proposed constructions, where fall was minimized, controlled the relative separation of the feed conveyor end and the box being filled by contact with the articles placed in the box. Where a feed or bucket conveyor was moved vertically, the mechanical arrangement of such construction was expensive, complex and heavy. In other constructions, movement of the box horizontally and then vertically also involved expensive complex construction.

The present invention relates to a method and apparatus for precise filling of a box with articles by count, in one example, or by weight, in another example. The invention contemplates a novel, simple, efficient box conveyor construction which includes a box-transfer station to permit change in the path of travel of the box from horizontal to vertical. The present apparatus includes means to position the box with respect to a feed conveyor which is vertically disposed so that fall of individual articles into the box are minimized. Means are provided for counting each article as it is deposited in the box or weighing an intermediate quantity of such articles as they are fed to the box. Means are also provided for lowering the box at selected vertical intervals as the box is filled to accommodate additional fruit, shaking the box to settle the articles in the box, and when a precise number articles or weight is reached, to lower the box to the transfer station to continue horizontal path of travel of the box for closing of the box and discharge to storage.

The principal object of the present invention is to disclose and provide a means and method for rapidly, precisely, accurately filling a box with discrete articles.

An object of the invention is to disclose and provide such an apparatus wherein one article is released at a time with a minimum fall to the bottom of the box being filled or to a previously deposited layer of articles in the box.

An object of the invention is to disclose and provide article feed-conveyor means which permit the supply of articles in bulk or random fashion and then separates the articles into a selected number of channels, rows or lines arranged in such a manner that only one article at a time is released for deposit in a box.

Still another object of the invention is to disclose and provide a novel means for shaking or vibrating a box which is positioned in filling relationship with a feed conveyor and at selected intervals so that articles deposited therein may be settled and arranged in a manner which approximates the layered pattern of a hand-packed box.

A further object of the invention is to disclose and provide control means for such an apparatus which permits substantially automatic operation of the machine and which is reliable, rapid and efficient in operation.

A still further object of the invention is to disclose and provide a method and apparatus for filling boxes which is capable of packing articles which are readily subject to damage as by abrasion or bruising by contact with other articles or with walls of a box.

A still further object of the invention is to disclose and provide a novel box-conveyor construction including a box transfer station cooperable with a box-elevating means.

Other objects and advantages of this invention will be readily apparent from the following description of the drawings in which exemplary embodiments of the invention are shown.

IN THE DRAWINGS

FIG. 1 is a front elevational view partly in section of an apparatus embodying this invention.

FIG. 2 is a fragmentary top plan view of the box transfer portion of the box conveyor means, the view being taken in the plane indicated by line II—II of FIG. 1.

FIG. 3 is a side elevational view of FIG. 1, partly in section, the section being taken in the planes indicated by line III—III of FIG. 1.

FIG. 4 is an enlarged fragmentary sectional view taken in the plane indicated by line IV—IV of FIG. 1, but with the box carriage and box in raised filling position.

FIG. 5 is a fragmentary enlarged sectional view taken in the same plane as FIG. 4 and showing the photosensing unit in detail.

FIG. 6 is an enlarged fragmentary sectional view showing the box carriage in an intermediate position and the drive for the vertical feed conveyor and holding belt means.

FIG. 7 is a vertical transverse sectional view taken in the plane indicated by line VII—VII of FIG. 4.

FIG. 8 is a schematic control circuit diagram for the apparatus shown in FIG. 1.

FIG. 9 is a view of the control panel shown in FIG. 2 schematically indicating selection of intermediate fruit count and aggregate fruit count.

FIG. 10 is a modification of the box carriage means whereby the apparatus shown in FIG. 1 may be adapted to filling boxes by weight.

An article loading or packaging apparatus embodying the present invention is generally indicated at **10**, FIG. 1. In this example fruit, such as oranges, are shown; other discrete articles such as lemons, grapefruit, plums or nonproduce type article may be packaged or boxed by this apparatus. Apparatus **10** comprises a box-conveyor means **11** provided with a box-transfer station **12** at which a vertically movable box carriage **14** may receive a box **15** for raising to a top-feed position, FIG. 3. Box-elevator means **17**, FIG. 3, includes fluid-operable

means 18 for moving box carriage 14 from its lower-box receiving position to its upper-box feeding position, FIG. 4. In upper-feed position, box 15 receives therewithin the lower end of a vertical article feed-conveyor means 20 which may be fed by a bulk or random article feed-conveyor means 21. Means 22 responsive to the quantity of fruit being placed in box 15, in this embodiment of the invention counts the fruit just prior to release of each fruit from the vertical feed-conveyor means 20. Control means are provided to control the vertical and bulk feed conveyors 20 and 21 in accordance with the quantitative measurement by count or by weight of fruit placed in the box and includes means for incrementally stepping the box carriage 14 downwardly until the total or aggregate amount of fruit is in the box and the box carriage 14 is then returned to its lowermost position where the continuously moving box conveyor moves the filled box from the box-transfer station. In one embodiment of the invention, each fruit is counted, the number of fruit to be placed in the box being determined by the size of the fruit. In another embodiment of the invention, fruit being placed in the box is continuously weighed and at certain weight intervals the box is lowered until a selected weight of fruit is accumulated in the box whereupon the box is lowered onto the box conveyor for removal.

In detail, apparatus 10 may comprise a base frame means 24 including suitable base from members 25, in this example, supported upon caster 26, it being understood that the frame means 24 may be fixed or secured to a supporting surface if desired. Extending along the front and on top of the base frame means 24 may be a pair of spaced channel members 27 which may form a frame for the box-conveyor means 11.

Box-conveyor means 11 may comprise a continuously moving endless belt 28 supported at its ends by rollers 29 mounted on shafts 30 supported in journal bearings 31 carried by channel members 27. One of the shafts 30 may be driven by a suitable motor means 32 carried by the base frame means. Bottom lay 33 of the belt means 28 extends continuously between the end rollers 29. The top lay 34 is provided with a box-transfer portion 35 located immediately below the vertical feed-conveyor means 20. Transfer portion 35 is defined by a pair of longitudinally spaced belt loops 36, each loop 36 being formed by longitudinally spaced rolls 37 and a lower roll 38 mounted between and below the spaced rolls 37 so as to provide a vertical downwardly disposed transverse opening 39 in the plane of the top lay 34 box-conveyor belt 28. The box-transfer portion 35 may be of less length than the length of a box to be positioned thereon so that bottom end margins 40 of a box supported by portion 35 may overlie the transverse spaces 39. Thus a box 15 moved by the box conveyor onto belt portion 35 is positioned so that its horizontal path of travel may be stopped and changed into a vertical path of travel above portion 35.

Box carriage 14 may comprise spaced U-shaped end members 41 connected by sidewalls 41*a* which flare outwardly at their upper portions 41*b*, such upper portions having a top edge return to hold side flaps of an open box in open position. End flaps of such a box will normally remain open or in noninterfering position. The lower transverse portions of U-shaped end members 41 are received in opening 39 below the plane of the top lay 34 to permit passage of a box thereover.

Means 17 for raising and lowering box carriage 14 and a box 15 thereon may comprise an upstanding planar frame 42 including suitable upright and horizontal frame members. At its bottom end, frame 42 may be pivotally connected at 43 to a forwardly extending plate 44 secured as by welding to a base frame member 25 and to a vertical frame member 45. At its top end, frame 42 is connected by a pivotally mounted link 46 to vibrating motor means 47 as hereafter described.

Frame 42 carries intermediate its length upper and lower pairs of parallelogram arms 49 and 50 respectively pivotally mounted to frame 42 and pivoted at 51 and 52 respectively to members 41 of the box carriage 14. Carried by an upper transverse frame member on the upright frame 42 may be a forwardly extending bracket 53 to which is pivotally mounted at 54 a double-acting fluid cylinder means 55 which has a piston rod 56 pivoted at 57 to an arm 58 fixed to pivot shaft 59 which connects one end of the pair of arms 49 to frame 42. Double-acting cylinder means 55 may be connected by fluid conduits 60 to a fluid pump means 61 driven by a motor means 62. Thus upon selective actuation of the fluid cylinder means 55, as later described, the box carriage 14 will be lifted vertically by the parallelogram arms 49 and 50 until the open box receives therein the lower end of the vertical feed conveyor 20.

It should be noted that the top of frame 42 is connected by pivoted arm 46 to an eccentric 64 carried by a shaft 65 mounted in suitable bearings 66 on vertical frame members 45, said shaft carrying a pulley wheel 67 connected by a belt 68 to a motor pulley 69 driven by vibrating motor means 70. Eccentric arm 46 will be reciprocated generally in a horizontal direction to cause rapid forward and backward movement of frame 42 about its bottom pivotal mounting at 43 for imparting a shaking or vibratory force to carriage 14 and to fruit placed in box 15 to settle, compact, and arrange fruit in layers. The carriage 14 is vibrated at selected intervals during loading as will be described hereafter. In this example, the respective locations of the pivot 43, arms 49 and 50, and arm 46 imparts horizontal and vertical vibratory force components to the articles.

Means for feeding fruit to the box 15 generally comprises the vertical feed conveyor 20 and the horizontal feed conveyor 21 which supplies fruit to the vertical conveyor. Feed conveyor 21, FIG. 2, may be supported in elevated horizontal position above base frame means 24 by vertical frame members 45, upwardly rearwardly inclined frame members 80, top horizontal frame members 81 and a suitable arrangement of vertical and horizontal frame elements 82 and 83 located between the tops of members 45 and the horizontal frame members 81. The feed conveyor 21 may comprise an endless belt 85 having a top lay moving across a supporting plate 86. The forward or delivery end of top lay 85 may be supported by a roller 87 of relatively small diameter so that the delivery end can be closely positioned to the path of travel of the vertical feed conveyor 20. The bottom lay 88 of the endless belt may be supported by a roller 89 mounted on horizontal frame members 81, and may then pass downwardly and partially around a drive roll 90 and then vertically upward. A roller 91 then supports the bottom lay from the frame member 81 and tensions the belt against the drive roll. The bottom lay may pass around an end roller 92 of relatively large diameter. Fruit may be fed to the back end of the feed belt 85 by any suitable means. The fruit may be fed at random and are contained on the top lay of the belt between the side walls 93 of the frame members 81. The fruit fed at random is advanced toward the delivery end of the feed conveyor 21 and at the delivery end such random massed fruit is separated into rows or lines of fruit by guide rails 94 which form part of the vertical feed conveyor 20.

Vertical feed-conveyor means 20 may comprise an endless conveyor belt 96 of the same width as belt 85 and is provided with a plurality of longitudinally spaced cleats or fruit support elements 97 projecting at right angles from the outer face of the belt 96. The cleats 97 in adjacent row are longitudinally offset to form an echelon arrangement as best shown in FIG. 7. Such offsetting of cleats in adjacent rows permits the delivery at the bottom end of conveyor means 20 of only one fruit at a time since the cleat of the adjacent row will be still supporting a fruit at the time of release of the first mentioned fruit from its supporting cleat as the belt 96 turns about the bottom of the conveyor 20.

Belt 96 is supported about a top relatively large diameter roll 98 carried by a shaft 98*a* supported at its ends by a tubular U-shaped frame 99 which extends beneath roll 98. At its opposite end the belt 96 is supported by a relatively small diameter roll 100 so as to provide a relatively small or narrow feed-conveyor nose capable of entering the open top of a box and

extending into the box into selected distance from the bottom of the box. Thus, as cleat **97** turns around the bottom roller **100**, a fruit carried by such a cleat will roll off the cleat and fall only a short distance to the bottom of the box or to a layer of fruit in the box.

Means for guiding fruit from the feed conveyor **21** onto the vertical conveyor **20** may comprise the guide rails **94** which may be supported at their upper ends by a horizontal rod **102** supported from the top of frame members **81**. Guide rails **94** extend rearwardly over the delivery end of feed belt **85** and then sharply turn into parallel relationship with the belt **85** to extend over the top roll **98** of the vertical conveyor **20** and thence downwardly in a vertical direction to a point opposite the narrow bottom roll **100** and then turn partially around roll **100** at the bottom of the feed conveyor. Thus guard rails **94** together with close positioning of the top of the conveyor **20** with the delivery end of conveyor **21** permits fruit to be fed by feed belt **85** to the delivery end where each fruit will fall into line with the rows of cleats on feed conveyor **20**. As fruit are discharged from the delivery end of the feed conveyor, each fruit will fall onto a cleat **97** and be carried by such cleat over the top of roll **98** and then fall upon the cleat forwardly thereof. Thus fruit is held by cleats **97** between rails **94** at the top and vertical sections of conveyor **20**.

Means for holding and preventing fruit from rolling forwardly off a cleat **97** may comprise an endless-holding belt **104** supported at its top by a roller **105** carried on a shaft **106** mounted at opposite ends on the forward depending end portions **107***a* of arms **107**. Shaft **106** supports side members **108** which carry at their bottom a pivotally mounted roll **109** for supporting the lower end of belt **104**. The holding belt **104** is also adjustably supported with respect to the forward lay of the cleated belt **96** by a pair of springs **111** connected to side members **108** for biasing the holding belt toward the vertical lay of the cleated belt **96**. Thus the inner lay **112** of belt **104** may be closely positioned into parallel relationship with the cleated belt **96** so that the inner surface of the inner lay **112** may contact and hold, if necessary, fruit carried by cleats **97**. It is desirable that each fruit be not only prevented from falling forward and off cleat **97** as it travels downwardly on conveyor **20** but also that it be properly positioned with respect to an opening **142** in cleated belt **96** to assist in counting the fruit being dropped into the box as later described.

Each fruit supported by a cleat **97** as it travels downwardly toward the box is held virtually stationary on the cleat by the inner lay **112** of the belt **104**. Belt **104** is driven in correlation with the driving of the vertical feed conveyor **20** so that the linear speed of the adjacent lays **112** of belt **104** and the vertical front lay of belt **96** will move at virtually the same linear speeds.

Means for adjusting the vertical relationship of the top of conveyor **20** with the delivery end of conveyor **21** may comprise a vertical post **116** slidable and fixed in a clamp means **117** secured to the forward end of one of the frame members **81**. The lower end of post **116** may be welded to a sleeve **118**, FIG. **1**, carrying shaft **98***a*.

Means for driving the feed conveyors **21** and **20** and its associated holding conveyor **104** may comprise a motor means **125** supported on top of top frame members **81**. Motor means **125** drives through a suitable gear means **126** a sprocket **127** which drives a chain **128** engaged at its lower end by a sprocket **129** carried by a transverse shaft **130**. Shaft **130** supports a sprocket **131** which is engaged by a drive chain **132** which engages at its other end a sprocket **133** carried by shaft **134** for driving the feed belt **85** of the feed conveyor **21**.

From shaft **130** may be supported a sprocket of approximately the same diameter as sprocket **129** which drives a forwardly extending drive chain **136** which engages sprocket **137** carried on shaft **98***a* of the top roll of the vertical feed conveyor **20**. Sprocket **137** drives shaft **98***a* and an internal sprocket **138** which is engaged by chain **138***a* extends forwardly and upwardly to drive a small diameter sprocket **139** which meshes with a sprocket **140** carried at the top end of the holding-belt means **104**. The selection of sprocket sizes correlates the linear movement of the feed belts **85**, vertical elevator belt **96** and holding belt **104** so that fruit advanced along the feed conveyor **21** will move at a substantially uniform rate from the belt **85** to the belt **96** and be held without relative movement between the belts by the inner lay **112** of belt **104**.

Means **22** for counting each fruit just before it falls from the vertical feel conveyor **20** into the box may comprise windows or openings **142** in belt **96** between adjacent cleats **97** and centrally between adjacent rails **94**, each opening **142** being of generally vertically elongated rectangular shape to afford sufficient belt material between cleats **97** to prevent a fruit from falling rearwardly through the opening. Adjacent bottom roller **100** of the vertical feed conveyor **20** are transversely arranged a plurality of photo or light-responsive means **143**, each of said means being aligned with a vertical row of windows **142**. Each photoresponsive means **143** may comprise a light source **144** directing a light beam through window **142** toward the surface of a fruit carried by a cleat **97**. Each light-responsive unit also includes a beam receptor **145** aligned with the window and light beam to receive the beam when it is reflected from the surface of the fruit as the fruit passes by the beam. Thus as belt **96** travels in a downward path to deposit a fruit into the box, each window **142** admits the beam from the light source **143** and the presence of a fruit is indicated by reflection of the beam into the light receptor **145**. In the event no fruit is being carried by a cleat **97**, then the light beam from the light source **143** is not reflected and the light receptor receives no indication of a fruit being present. Preferably belt **96** has a smooth nonreflecting black surface facing light-responsive means **143**.

The light receptors **145** of each light-responsive unit **143** are connected to an electrical counting device (not shown) of well-known make which includes a control panel **146**, FIGS. **2**, **9**, for selection of intermediate or subcount of articles and also selection of the total count or aggregate number of articles desired to be deposited in a box. In this example, control switches for indicating intermediate or subcount of articles are indicated generally at section **150** and may include a row of toggle switches **151** each placed below a numerical indicia indicating count, as for example, 2,2,4,8,16,32 in one row and therebeneath 1,0,0,0,0,0. The count is progressively arranged so that, for example as indicated with the position of toggle switches **151** the intermediate article count would be **16**, that is 2+2+4+8. The set of toggle switches for preselecting total or aggregate count is indicated in the section **152**, the toggle switches being in a row **153**. In this example, the numerical count indicia is extended up to 128 so that combinations of 2,2,4,8,16,32,64,128, and 1, may be made to preselect a desired quantity of fruit. Thus, for example, if 88 oranges were to be placed in a box, the intermediate set **150** may be set to count at 25 by turning up toggle switches beneath 16, 8 and turning toggle switch down towards 1. The 25 count would be three times for a subcount total of 75. As each intermediate or subcount was reached, the box would be lowered an incremental amount as hereafter described. After reaching the aggregate count of 88 set on section **152**, the box would be lowered to the box-transfer station. The distance that the box carriage travels downwardly in response to the present intermediate count is determined by a time delay which will be described hereinafter in connection with the operation of the device.

In operation of the apparatus shown in FIGS. **1** through **9**, inclusive and referring first to FIG. **1**, box **15** may be fed to box conveyor **11** from a supply or feed conveyor **160** having a continuously moving belt **161** which moves at a slower speed than belt **34** of the box conveyor **11**. Conveyor **160** is aligned with box conveyor **11** and is closely adjacent thereto as shown in FIG. **1**. When box carriage **14** is in lowermost position, the cross member of U-shaped carriage members **41** may depress a box-stop lever **163** pivoted at **164** to the frame and having an upturned opposite box stop end **165** located between ends of the infeed portion of conveyor means **11**. Lever **163** is nor-

mally biased upwardly by a spring **166** located between stop end **165** and the pressure contact of member **41**.

When box carriage **14** is in lowermost position, a box **15** thereon which has been filled will be transported by the box-conveyor belt **34** from the box-transfer station **12**. Since box-stop lever **163** is depressed, a second box will be advanced to belt **34** of conveyor **11** and as that box contacts belt **34**, it will be advanced rapidly to the box-transfer station because of the difference in speed of the belts **161** and **34**. When a second box is advanced onto box-transfer portion **12**, it will contact a switch means **170** carried at the proximate end of the box-transfer station by the channel members **27** of the box conveyor. Switch **170** has a normally open and a normally closed pair of contacts **170***a* and **170***b* respectively, FIG. **8**. When contacts **170***a* are closed by a box **15**, a relay **171** having normally open contacts **171***a* and **171***b* are closed and when switch **170** is released by clearance of a box, actuate a relay **172** with normally open contacts **172***a* for operating a four-way solenoid-actuated valve **174** with a time delay **175** having normally closed contacts **175***a* to cause fluid in the conduits **60** to actuate the hydraulic-cylinder means **55** to raise box carriage **14** through the parallelogram arms **49** and **50**. The carriage is times to raise just as the box is completely in the box station **12** (when switch **170** is released by the passing box), the carriage lifting the box off moving belt-transfer portion **35**. As soon as the carriage **14** releases pressure contact with box-stop lever **163**, the upturned stop end **165** will be interposed in the path of the next succeeding box **15** on belt **161** so that a succeeding box will not be advanced by more rapidly moving belt **34** to the box-transfer station **12**. Time delay **175** serves as a safety device to deactuate the solenoid valve **174** in case of jamming by a box or the like.

The fluid-cylinder means **55** raises the box carriage **14** to an uppermost box-filling position determined by contact of arm **49** with switch means **177** supported from a vertical member of side frame **42**, FIG. **4**. Switch means **177** has normally closed contacts **177***a* and normally open contacts **177***b*. When contacts **177***a* are opened by arm **49**, the circuit controlling valve **174** is deenergized and lifting of carriage **14** is stopped. When normally open contacts **177***b* are closed, relay **178** having normally open contacts **178***a* is energized to actuate the magnetic starter **179** to start the feed-conveyor motor **125**. This feed-conveyor motor circuit may be provided with an overload **180** which is normally closed. Thus, when the box carriage reaches its uppermost position as determined by switch means **177** and fluid-cylinder means **55**, the feed conveyors **20** and **21** are simultaneously energized through the above-described drive means and fruit fed to the feed conveyor **21** will be advanced toward the vertical feed conveyor **20** as previously described.

As the fruit are channeled into rows, are picked up by the cleats **97** on the belt **96**, and are lowered in a vertical path with fruit in adjacent paths being vertically offset, each fruit with its correlated window **142** in belt **96** will pass the photoelectric sensing unit **22**. The beam from each light source **143** which is directed toward the fruit and which will pass through the window opening **142** will be reflected by a fruit carried by cleat **97** and returned to a light receptor **144**. Light receptor **144** transmits a signal to the electrical counting device **199** in the control panel where as previously described an intermediate or subcount of fruit and a total aggregate count of fruit have been selected depending upon the size of the fruit and quantity of the fruit desired to be deposited in the box.

As each fruit passes a light beam from light source **143**, it is counted and then deposited on the bottom of the box. When the selected subcount is reached, the electrical counting device **199** through its contacts **199***a* energizes a counter relay **181** having normally open contacts **181***a* and a relay **182** having normally open relay contacts **182***a*, **182***b* and **182***c* for actuation of a time delay **183** having normally closed contacts **183***a*. Time delay **183** determines the vertical distance through which the carriage is lowered at the end of each predetermined subcount of articles fed to the box. Time delay **183** may be adjusted for any selected time period. Upon closing of the open contacts of relay **182***b*, solenoid-actuating valve **174** of the hydraulic pump will cause hydraulic-cylinder means **55** to move the box carriage downwardly a preselected distance as determined by the time delay **183**. During such stepped downward movement of the box carriage **14** feeding of fruit to the box and counting of the fruit is continued.

When relay **182** has its contacts closed, it will also energize motor-vibrating means **70** to move frame **42** rapidly reciprocally forwardly and backwardly to cause shaking of the box carriage **14** and the box **15** carried thereby. The vibrating-motor circuit may be provided with a normally closed contacts **185***a*, time delay **185** determining the length of time that the box carriage is subject to vibration. The motor-vibrating circuit may be provided with a normally open toggle switch **186**. If desired, the box and box carriage may not be vibrated during filling or lowering of the box and the period of vibration may be varied depending upon the type of articles being packaged.

After the box has been successively moved downwardly in stepped fashion in accordance with a selected number of intermediate or subcount of articles, ultimately the total count of articles as selected on the control panel is reached. Normally open relay contacts **190** of the total count counter relay are closed to energize time delay **191** which serves to keep the vertical feed-conveyor belt in operation until the last fruit counted is discharged. When the time delay contacts **191***a*, which are normally open, are closed at the end of the time delay cycle, the solenoid-actuated valve **174** is actuated to move the box carriage downwardly by actuation of the cylinder means **55**. At the same time normally closed contacts **191***b* are opened, and the feed conveyors **20** and **21** stop. When box carriage **14** reaches its lowermost position in the box-transfer station, parallelogram arm **50** contacts a switch means **192** carried on the frame **42**. Switch means **192** is normally closed and upon opening, the hydraulic pump is deactivated, downward movement is stopped, and the circuit is ready for the next cycle which is started by the succeeding box **15** which has started toward the box-transfer station **12** because stop lever **163** is down.

As soon as the filled box is in its lowermost position as provided by the down position of carriage **14**, the bottom of the box is engaged by box-transfer conveyor portion **35** and is immediately advanced from the box-transfer station unto the adjacent discharge portion of the box conveyor where the box may be closed and it may be transported to storage.

In the schematic diagram shown in FIG. **8** it will be apparent that the several motors may be connected with a suitable power source through a circuit breaker **195** and that the feed-conveyor motor **125** may be provided with a suitable brake **196** in order to promptly stop the feed conveyors so that additional fruit are not released from the bottom of the feed conveyor to provide an overcount of fruit. The control circuit described above may be fed from the main power source through a suitable transformer **197** with a suitable circuit breaker **198**. The electrical counting device is indicated in circuit diagram at **199** and is schematically connected to the light receptor photocells **144** as shown. The carton-conveyor motor **32** may be provided with circuit having normally closed overload **200** and a normally closed overload **201** connected with the hydraulic motor means **62**.

Operation of the above-described apparatus and method of filling a box with discrete articles has been illustrated with a vertical feed conveyor having four channels or lanes to feed articles to the discharge or release end of the vertical feed conveyor. Where fruit may be of a smaller size than that intended for packaging with the four-channel feed belt, it will be readily apparent that the feed belt together with its arrangement of guide rails may be readily removed from the vertical feed conveyor frame and replaced with a feed belt having five, six, seven or eight channels or lanes for feeding smaller sized fruit. The construction of such a multichanneled feed belt may be the same as that described above and corresponding

number of light-responsive means would be mounted in the vertical feed belt frame in place of the four-responsive means shown in the present embodiment. Thus by simply changing the belt of the vertical feed conveyor and the light-responsive means, it will be apparent that apparatus **10** may be readily modified for packaging articles of different size.

Vibrating means for the box carriage and box may permit vibration thereof during a box-filling operation, during lowering of a box carriage, or during both filling and lowering operations simultaneously. Certain sized fruit may be preferred to be vibrated in the box only during vertical movement of the box as it is incrementally stepped downwardly in accordance with the number of fruit deposited in the box. In such instance, the combination of downward movement and horizontally and vertically directed shaking force components imparts movement to articles being deposited which causes them to quickly closely arrange themselves in a layer pattern.

Means to steady and hold the box **15** against relative movement with respect to carriage **14** during the filling operation and during vibration of the box may comprise a biased spring arm or plate **210** carried by the carriage and extending through opening **211** in side wall **41***a* for spring pressure engagement against the opposed wall of the box so as to press the box against the outer wall **41***a* of the carriage. Spring plate **210** is mounted so that in lowermost position of carriage **14** the spring plate is retracted in opening **211** so that passage of a box onto the carriage will not be interfered with. As the carriage is initially raised, the spring plate is caused to move through the opening **211** and into pressure engagement with the box. As the box is returned to its lowermost position after filling, the spring plate is again retracted through the opening **211**. It will thus be apparent that movement of the box relative to the carriage **14** during a filling operation is restrained and the box is frictionally held in the carriage.

The width of the vertical feed-conveyor belt **36** may be only slightly less than the longitudinal dimension of the box placed upon the box-transfer station. Thus when fruit are deposited in the box by accommodation of the release end of the feed conveyor therein, each fruit is deposited substantially in a transverse zone in which it will be ultimately located, and thus movement of the fruit into such final location is minimized. Such placement of fruit in the box by the vertical feed conveyor also tends to facilitate more rapid formation of the layer pattern of fruit in the box.

Apparatus **10** may be readily adapted to fill a box with discrete fruit in accordance with weight by modifying the box-carriage means and the means responsive to quantitative measurement of the articles so that weight instead of count is made the unit of measure. When describing this embodiment parts similar to like parts in the prior embodiment will be given the same reference numeral plus 200.

Box carriage **214** may be lowered and raised from a box-transfer station **212** by parallelogram arms **249** and **250** in a manner similar to that described in the prior embodiment. The box-conveyor means **211** includes channel section frame members **227** provided with transverse rolls arranged as in the prior embodiment so that a belt-transfer portion **235** will be provided at the box-transfer station **212**.

Each U-shaped end member **241** of the box carriage may carry a pair of transversely spaced, pressure-sensing units **222** of strain gage or electrical resistant type. As shown in FIG. **10**, each pressure-sensing unit **222** may contact and support a corner of a box **215** when raised above the transfer station. The top face of each pressure-sensing unit **222** is located below the plane of the top lay portions of the box-conveyor belt so that a box **215** will readily pass thereover.

When the box carriage is raised, it will be apparent that the box **215** is supported by four pressure-sensing units **222** from the box carriage **214**. Each of the four pressure-sensing units **222** may be electrically connected to an electronic weight unit which may be substituted for the counter **199** of the prior embodiment and which is responsive to signals from the pressure-sensing units **222** in accordance with the sensing of the weight of each article deposited in the box. Such an electronic weight unit is of well-known manufacture and may be programmed in a manner similar to that described for the electric counter. Thus, on a control panel, a selected sub or intermediate weight may be preset so that as articles are fed into the box and as the subweights are attained, the box will be lowered in response to such subweight total in the same manner as that described in the prior embodiment. When the aggregate total weight is attained as preselected on the control panel, the box carriage will be caused to move downwardly to the box-transfer station and a box filled with articles to a preselected weight will be discharged by the continuously running box conveyor **212**.

It will be understood that other types of pressure-sensing units may be employed and may be carried by box carriage **214**. In some instances it may be desirable to use two pressure-sensing units, one carried by the transverse portion of each U-shaped end member.

When apparatus **10** is modified as above described to measure weight of articles deposited in the box, it will be apparent that the apparatus and box-filling method of this invention becomes readily adaptable for filling boxes to a predetermined weight with articles or material capable of being fed individually to the box.

In the above-described embodiments of the present invention, a box may be rapidly filled with articles by count of the articles or by actual weight of the articles. Thus, the articles are quantitively measured as they are deposited in the box and the present invention discloses a means for such quantitive measuring of the articles at approximately the moment of placement or deposit in the box. Means for moving apart the box carriage and the article release end of the vertical feed conveyor in response to such quantitive measuring means is provided at an arbitrarily preselected quantitive measurement by either count or by weight of said articles. Precise, accurate, rapid filling of a box with a selected number of articles or a selected aggregate weight of articles is therefore readily accomplished.

It will be understood that various modifications and changes may be made in the above-identified apparatus and method which come within the spirit of this invention. It will be understood that the term "articles" may include fruit or produce of different type and kind capable of being handled in bulk and discretely for packaging, and that the article may be relatively large as for example grapefruit or may be relatively small as for example plums, nuts or other types of discrete articles which are of nonproduce type. All such modifications and changes coming within the scope of the appended claims are embraced thereby.

What is claimed is:

1. An article conveyor means for use with an apparatus for filling receptacles with a predetermined, precise, quantitative measure of articles, including the combination of:

an endless conveyor belt having a belt lay disposed vertically for entrance into the top opening of a receptacle to be filled with articles,

said belt lay including a plurality of spaced article support elements and an opening between adjacent support elements and opposite the position of an article on said support elements,

means supporting said receptacle below said endless conveyor belt,

an article holding belt extending parallel to said vertical belt lay and having a portion thereof cooperable with an adjacent portion of the vertical belt lay to hold and position an article on a support element,

counting means associated with the conveying means for sensing, through the openings, the presence or absence of an article on an article support element, and

means for moving said conveyor belt and article holding belt at substantially the same linear speed to move the adjacent portions thereof downwardly to carry the articles therebetween into said receptacle.

2. An article conveyor means for use with an apparatus for filling boxes with a predetermined, precise, quantitative measure of articles, including the combination of:

an endless conveyor belt having a belt lay disposed vertically for entrance into the top opening of a receptacle to be filled with articles,

said belt lay including a plurality of spaced article support elements and having an opening between adjacent support elements and opposite the position of an article on said article support element,

an article holding belt extending parallel to said vertical belt lay and cooperable to hold and position an article on a support element;

light-responsive means adjacent the lower end of said conveyor belt for directing a light beam through said opening for detecting the presence or absence of an article on an article support element,

and means for moving said conveyor belt and article holding belt at substantially the same linear speeds.

3. In an apparatus for precise filling of receptacles with fruit or the like, the combination of:

means conveying each fruit in discrete longitudinal position relative to adjacent fruit, said conveying means including

a first advancing belt provided with spaced support elements to space said fruit;

a companion advancing belt normally biased in the direction of the first belt and extending therealong for holding fruit in position at said support elements on said first belt;

and light-responsive means including an opening in said first belt adjacent each support element for response to the presence or absence of a fruit at said support element.

4. In a conveyor means for transporting discrete articles in spaced relation for precise filling of a receptacle with such articles, the combination of:

means for advancing articles along a selected path;

conveyor means for changing the direction of said path into a vertical pathway leading to a receptacle;

said conveyor means including spaced generally parallel belt means extending into said receptacle and for holding articles in discrete spaced relation along said vertical pathway;

means biasing one of said belt means toward the other belt means to position and hold such articles;

and means along said vertical pathway responsive to the presence or absence of an article in said pathway.

5. In a conveyor means as stated in claim 4 wherein said article responsive means includes an opening in one of said belt means and;

a light-responsive means directing a beam through said opening.

6. A conveyor means as stated in claim 5 wherein said light-responsive means is located adjacent the lower end of said vertical pathway for counting an article just prior to its release into said receptacle.

7. A conveyor means as stated in claim 4 wherein said article responsive means includes photoelectric means for directing a light beam into said vertical pathway to determine the presence or absence of an article.

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