

Dec. 20, 1966

J. D. FROST

3,292,341

ORIENTING AND PACKING APPARATUS

Filed Aug. 27, 1963

10 Sheets-Sheet 1

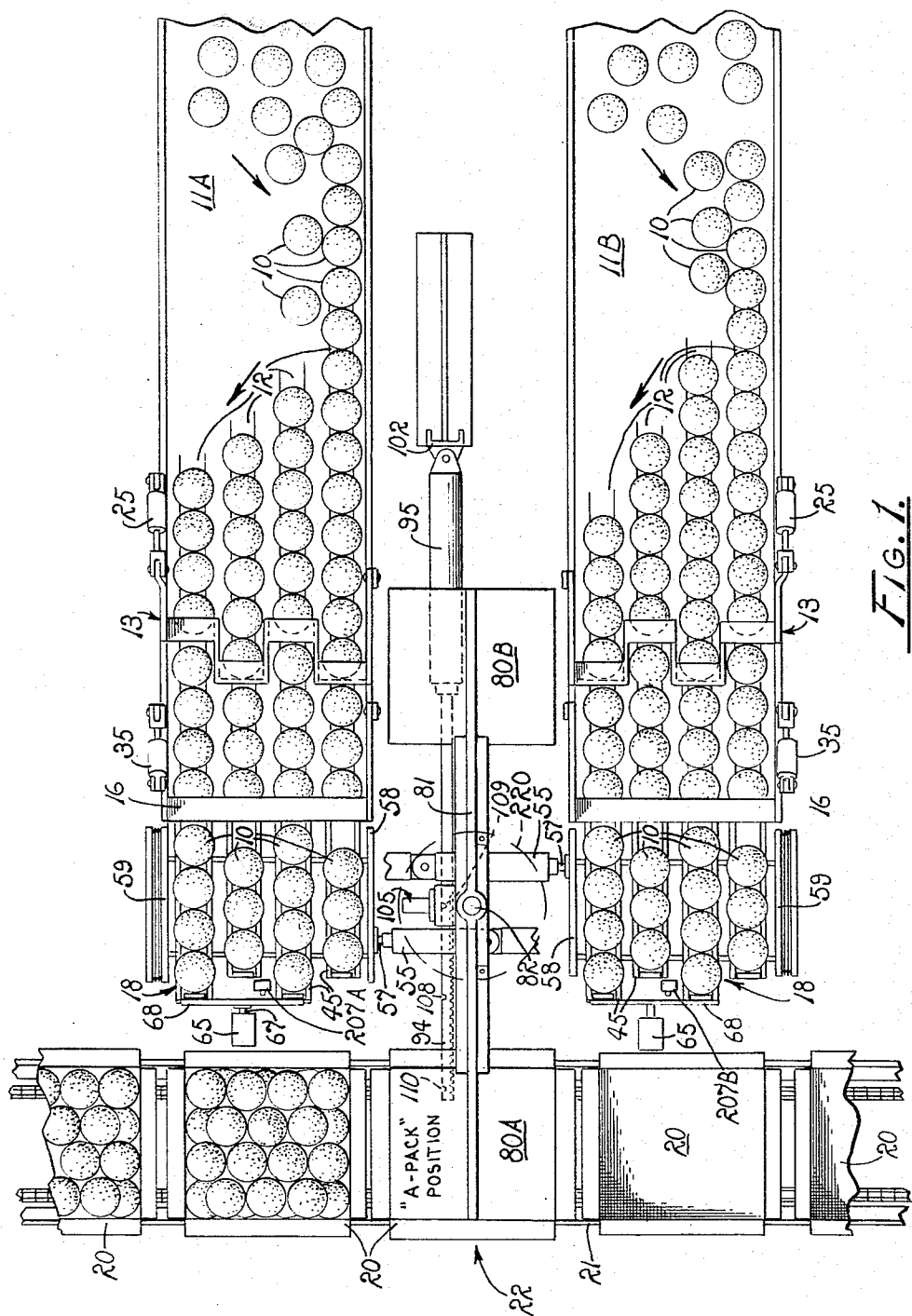


FIG. 1.

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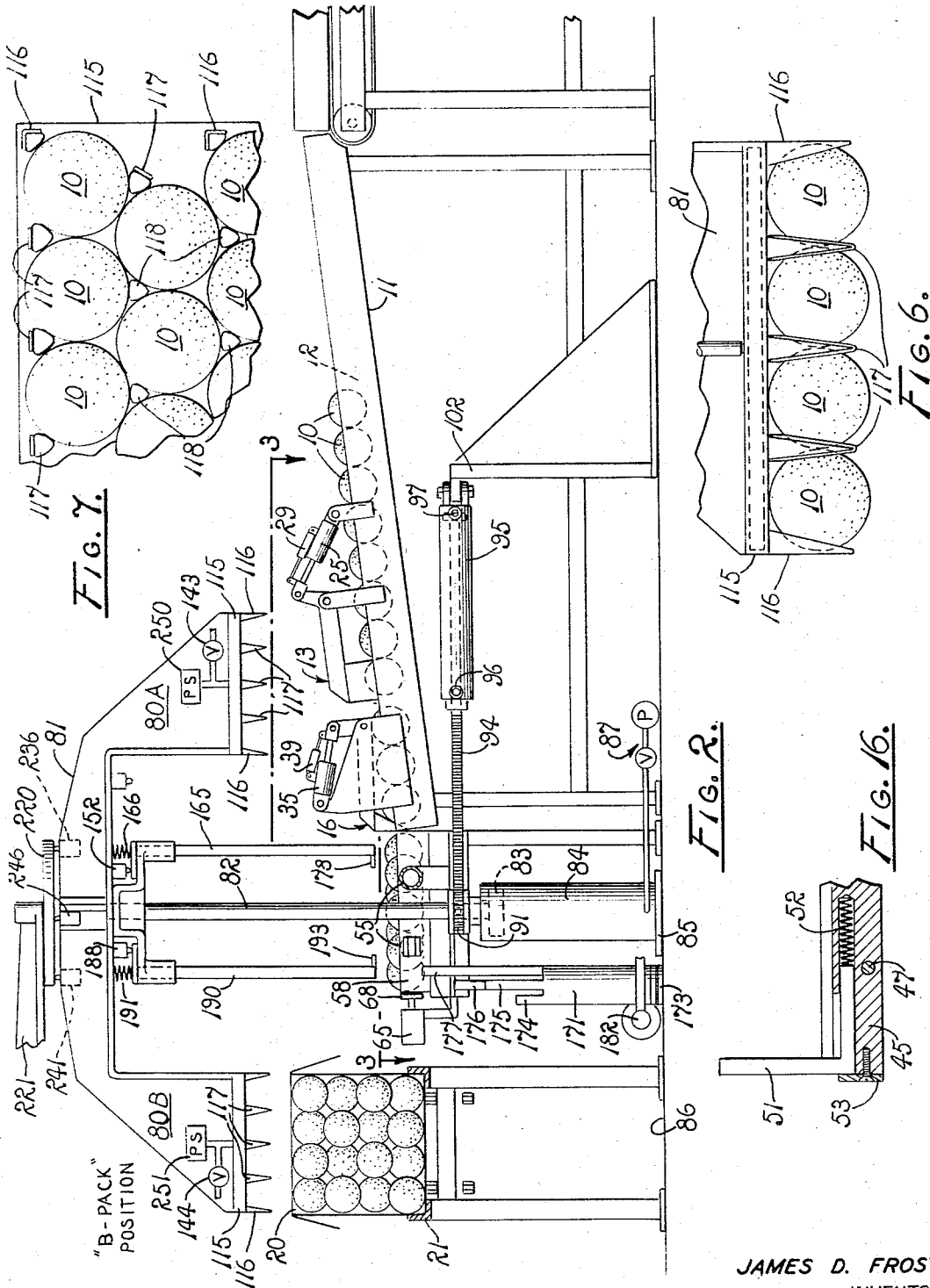
J. D. FROST

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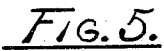
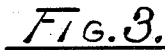


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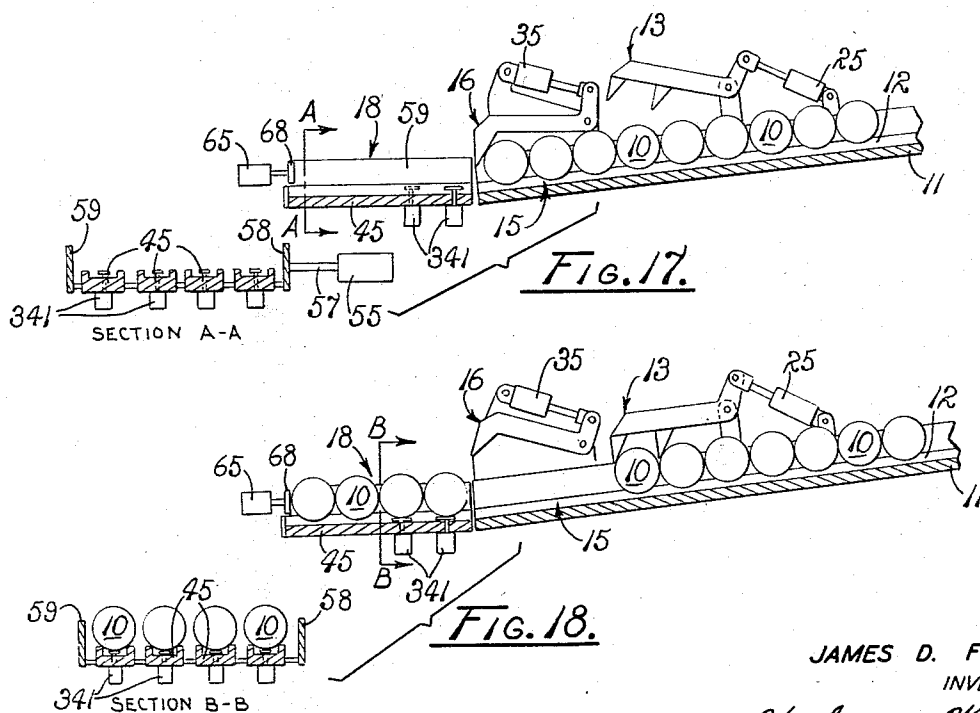
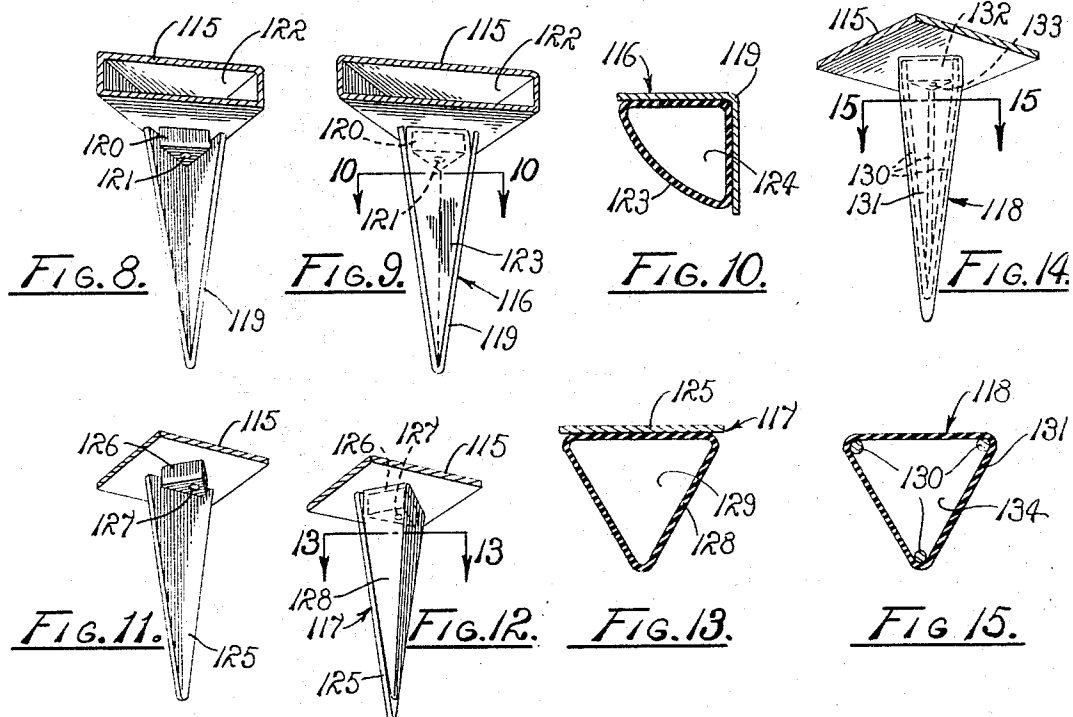
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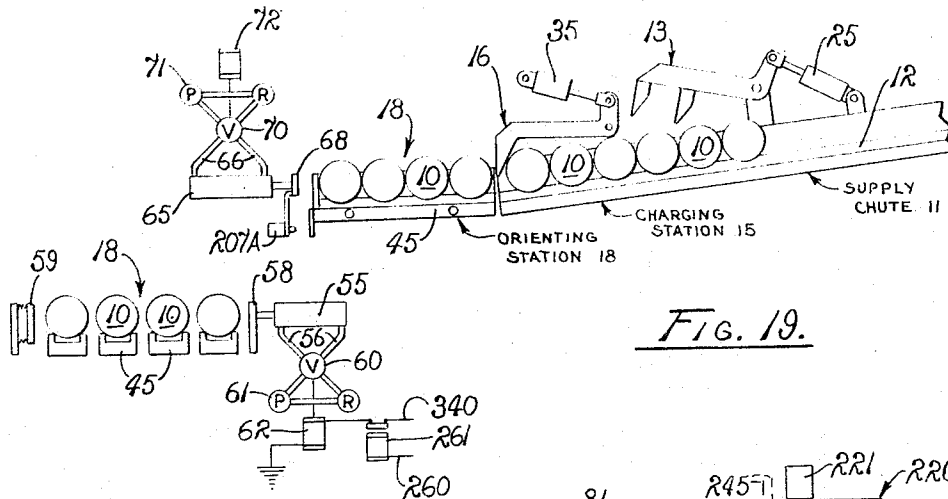


FIG. 19.

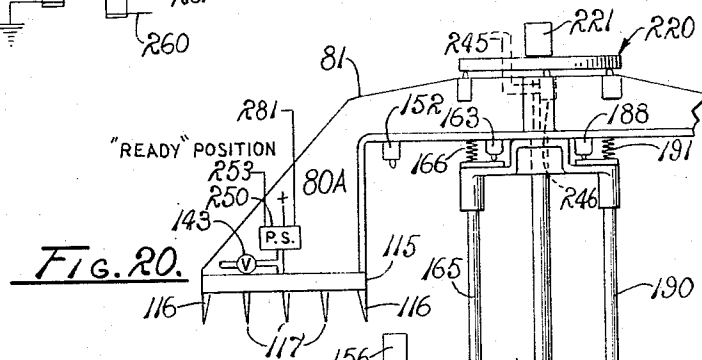


FIG. 20.

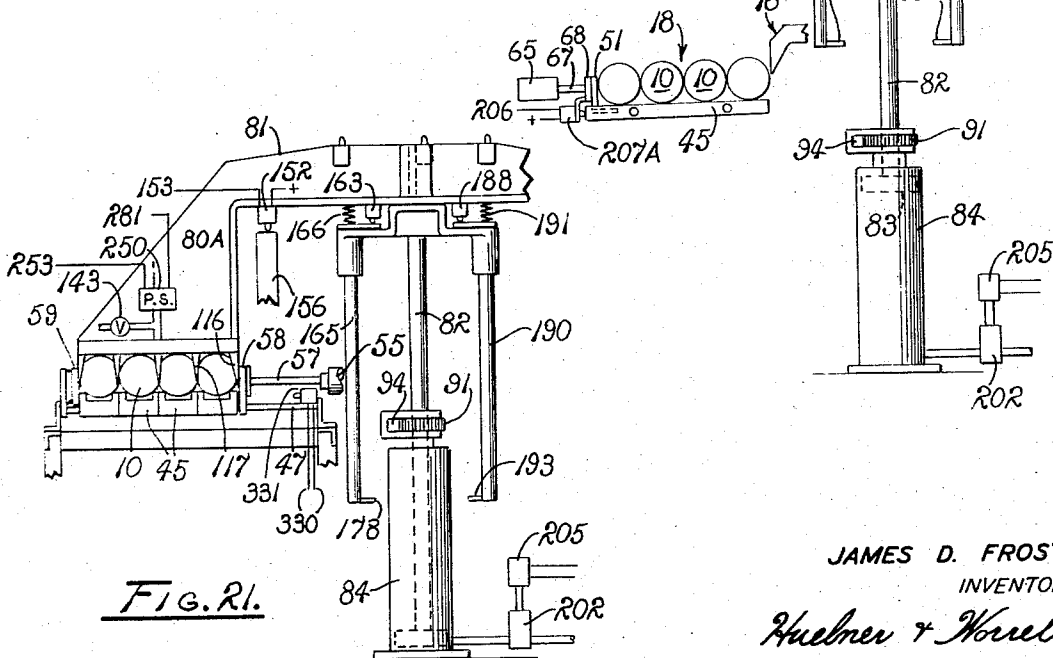


FIG. 21.

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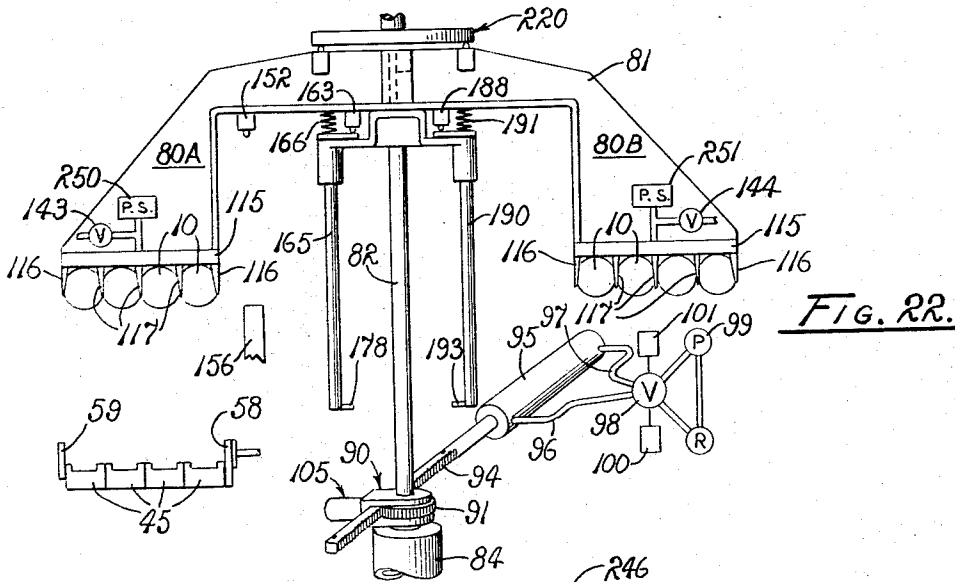


FIG. 22.

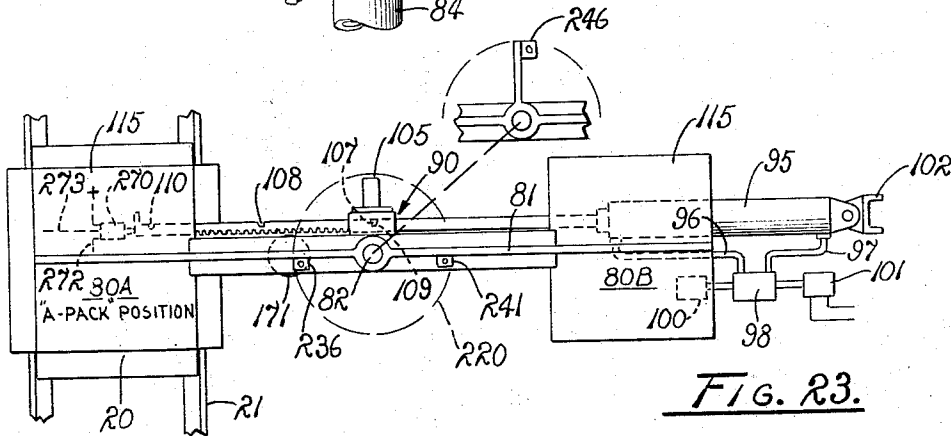


FIG. 23.

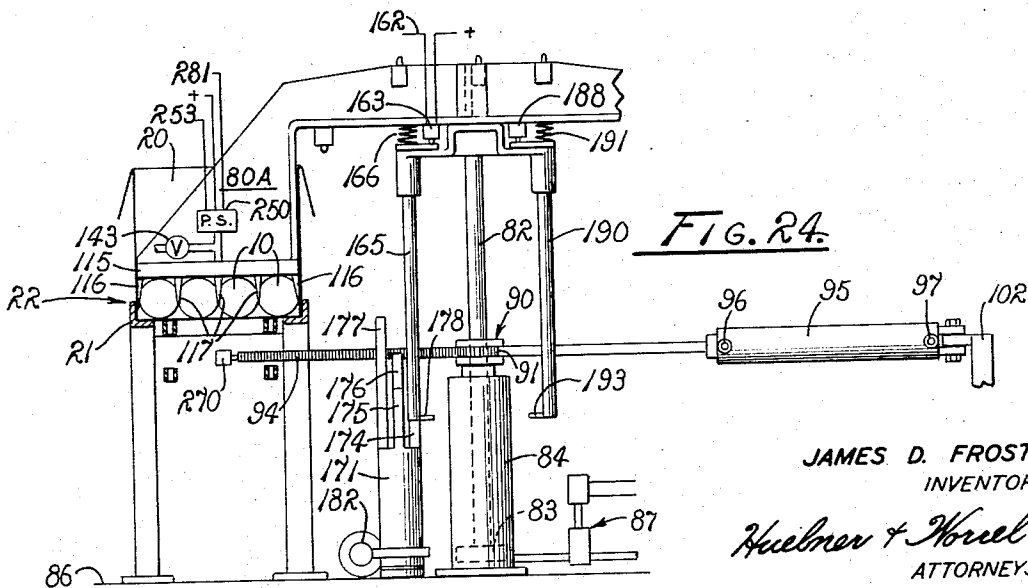


FIG. 24.

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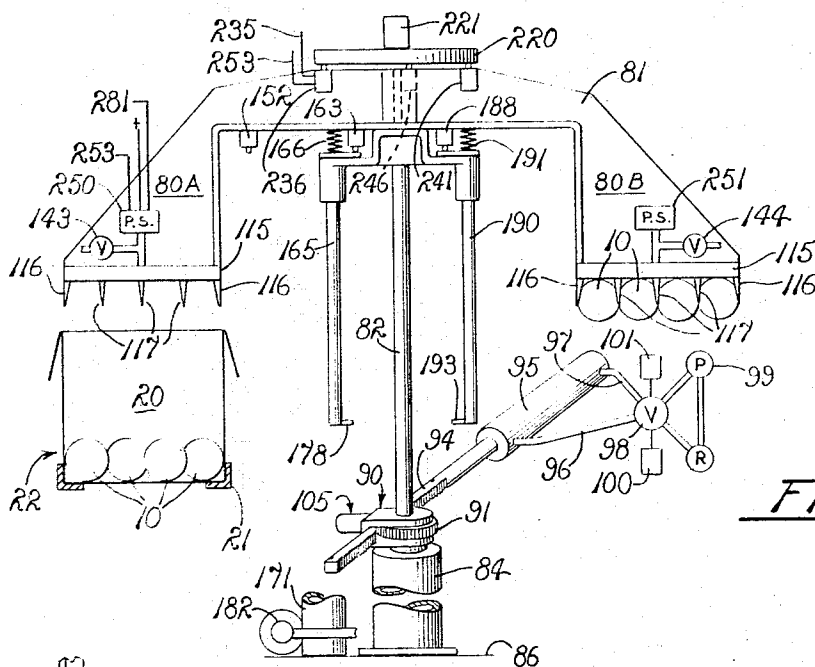


FIG. 25.

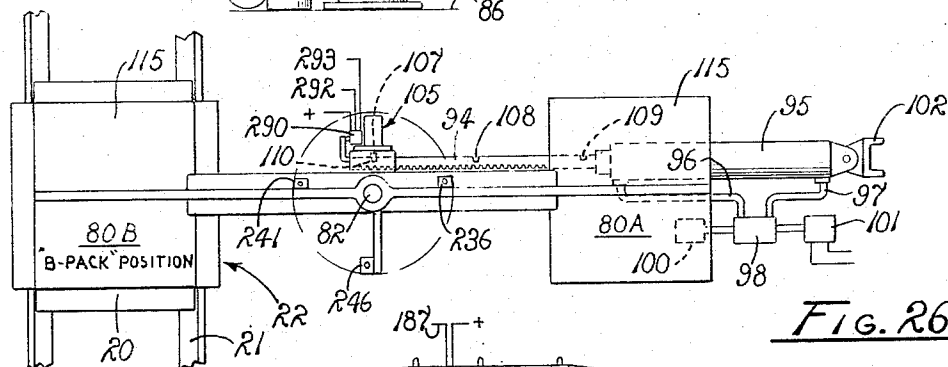
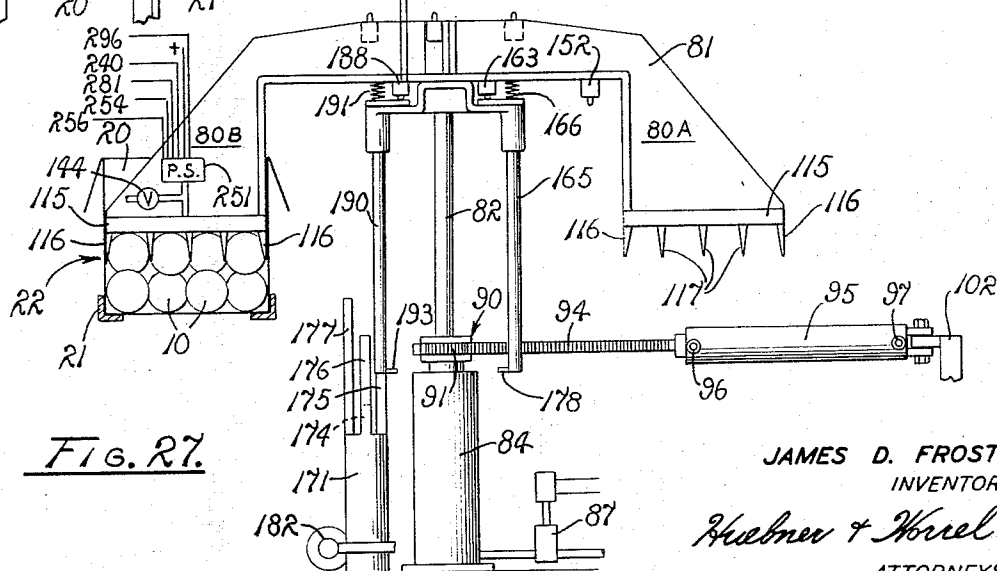


FIG. 26.



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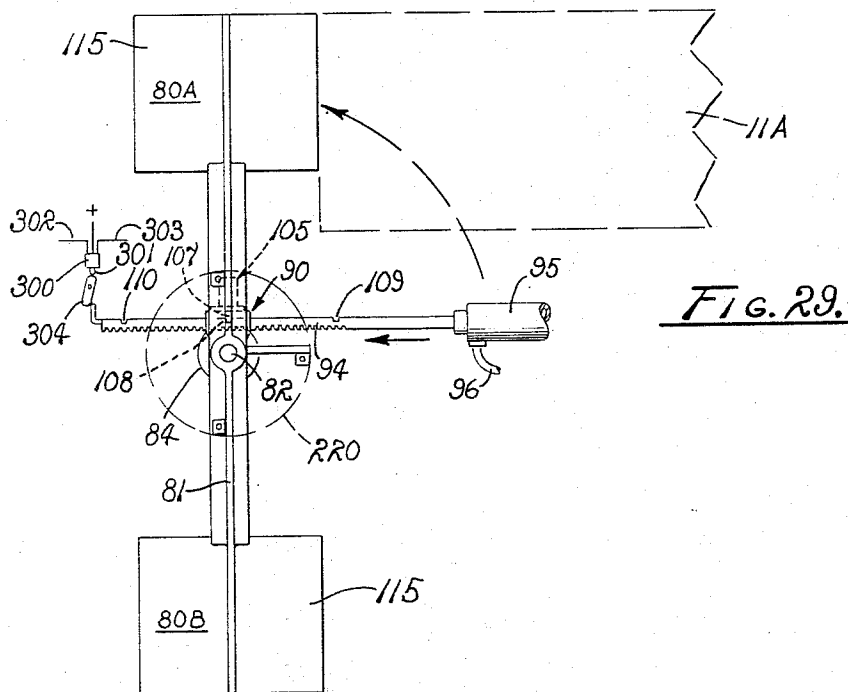
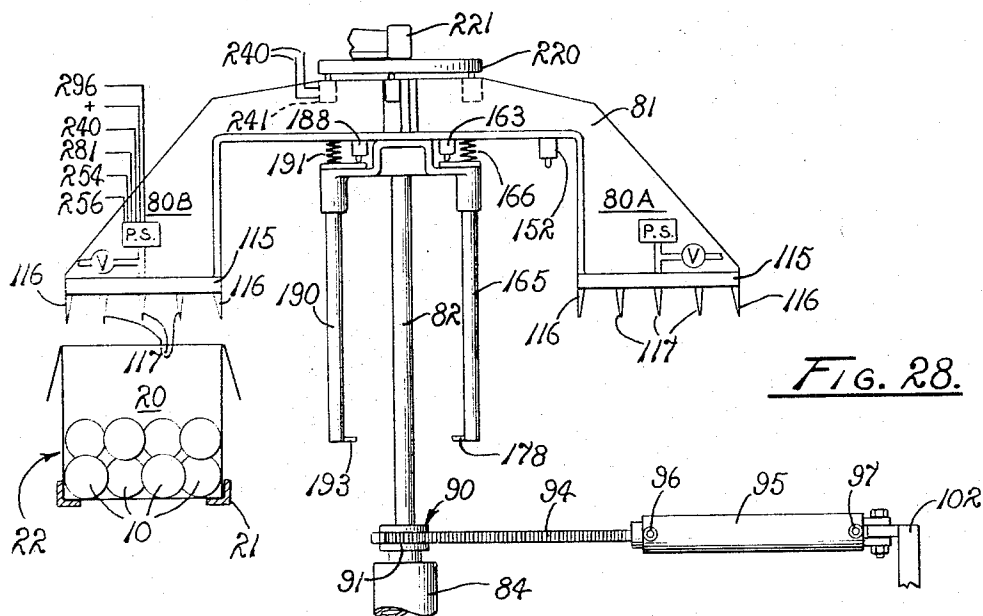
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10 Sheets-Sheet 8



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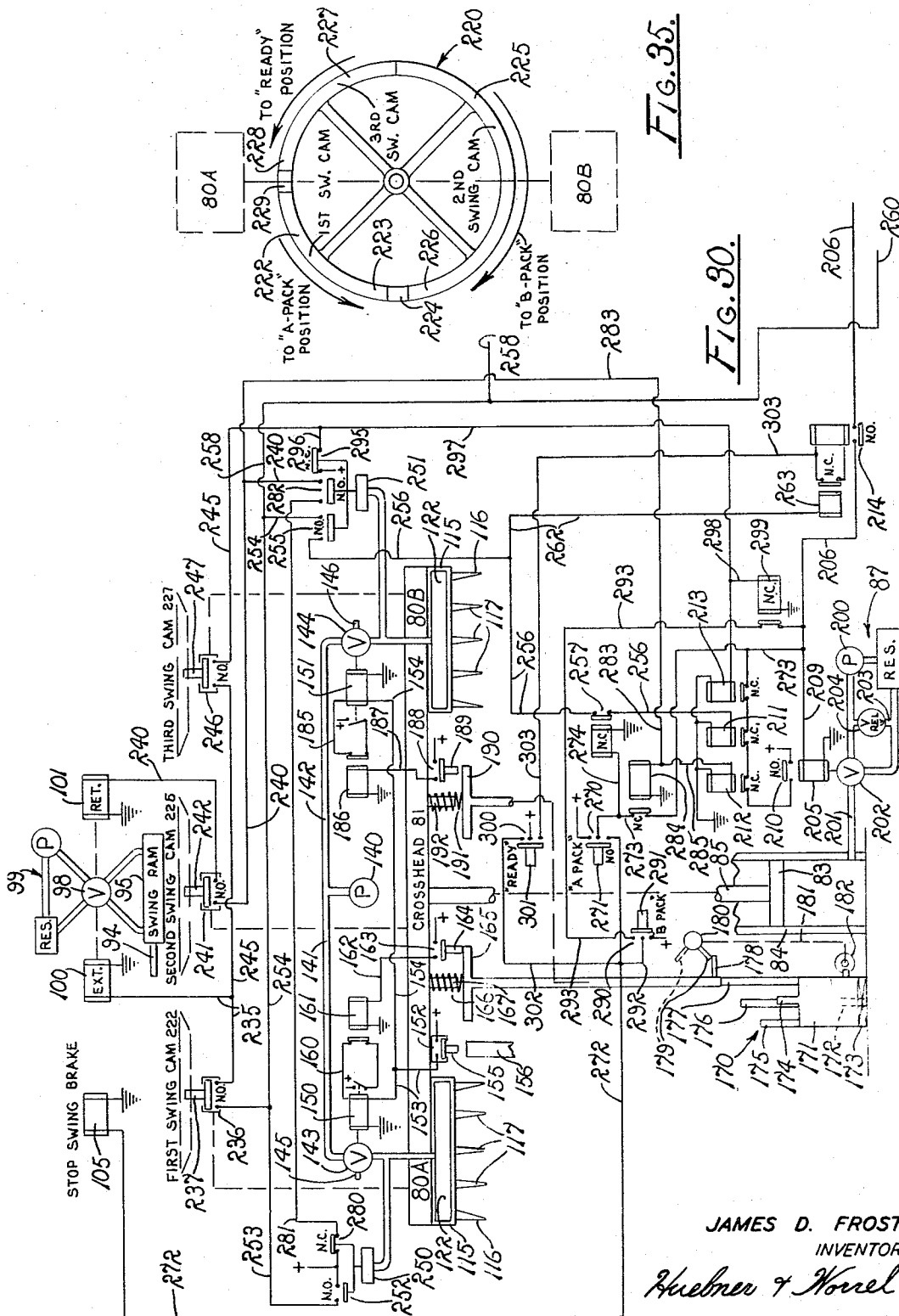
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ORIENTING AND PACKING APPARATUS

Filed Aug. 27, 1963

10 Sheets-Sheet 9



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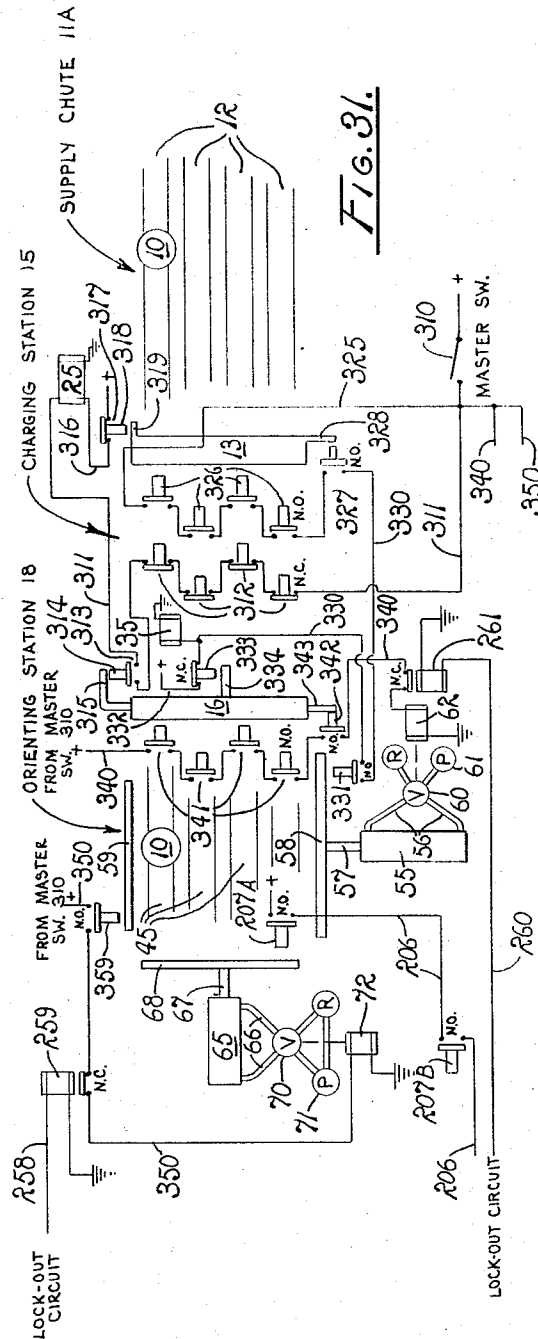
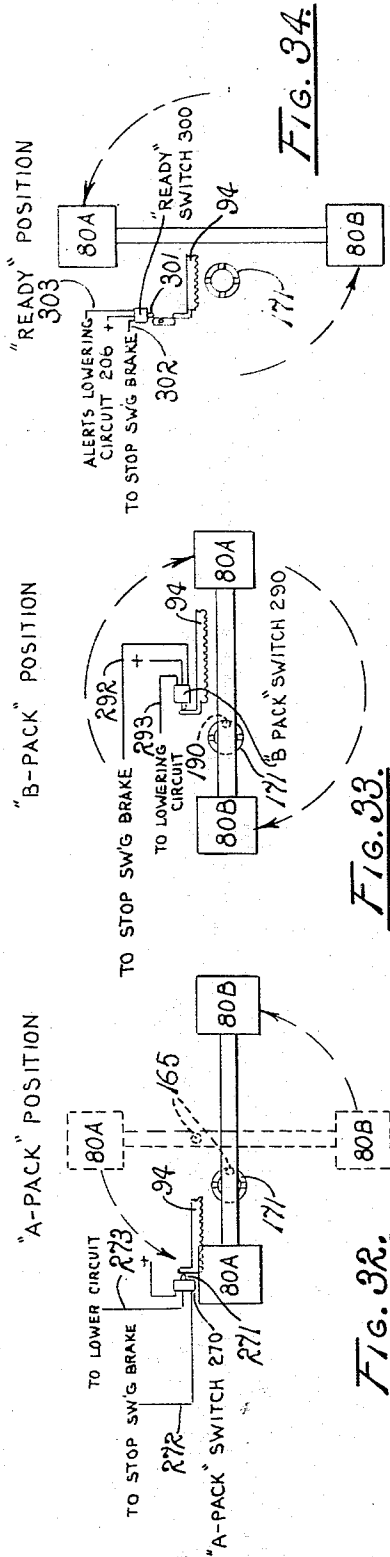
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10 Sheets-Sheet 10



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ORIENTING AND PACKING APPARATUS

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21 Claims. (Cl. 53—61)

This invention relates to apparatus for arranging substantially uniform articles in a predetermined relationship and depositing such articles in a receiving container while maintaining said relationship. The invention provides individual means to perform separate measures in accomplishing the overall objective of packing such articles in a receiving container in predetermined ordered arrangement, and also includes interlock means to insure the successive performance of such measures in accordance with a predetermined schedule.

To effect a maximum utilization of the internal volume of packing containers, many types of articles are advantageously arranged in a predetermined order to accommodate such utilization. In addition, the inherent characteristics of the articles require a predetermined order of arrangement in the packing container to preclude shifting of the articles after packing therein. Otherwise, such shifting, particularly during transit, causes damage to the articles. This is particularly true in the case of fresh fruits, the arranging and packing of which are ably performed by apparatus of the present invention.

The present invention is particularly well suited for the arranging and packing of fresh fruit which is capable of being graded according to size prior to shipment. For purposes of convenient illustration, the present invention is described in the connection with the arranging and packing of fresh oranges, it being understood that the invention is equally well-suited to other types of substantially uniform articles to be packed in a predetermined arrangement.

Heretofore, the majority of fresh oranges packed in containers for shipment to geographical locations removed from the growing area have been manually packed. Such packing is predominantly performed by temporarily employed agricultural laborers, many of whom are considered of the migratory type in that successive temporary periods of employment involves successive movements from one geographical area to another in which the crop then being harvested has been grown. Although the performance of such workers is normally satisfactory, it will be appreciated that non-uniform results are achieved, due to personal differences in such workers. In addition, considerable cost is incurred in their recruiting and training, and unfortunately, such personnel are sometimes totally unavailable during a short, but critical, harvesting period.

The cost of manually packaging oranges, as well as other types of articles wherein the units of the type are substantially uniform, normally represents a disproportionate share of the total cost of producing and preparing such articles for shipment. Therefore, a need has also existed for apparatus which can perform equivalent, or superior, packing at a cost substantially less than that of manual packing. To effect such efficient packing, means must be provided for sequentially pre-orienting the articles, transporting the articles to the shipping container, and depositing the articles therein. Power means employed to perform such sequential steps of operation must be controlled to effect the successive performance of such steps. Such a control should ideally include an interlock to prevent any single step from being performed in a non-sequential order.

Accordingly, it is an object of the present invention to provide apparatus adapted to perform a completely automated packing of substantially uniform articles.

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Another object is to provide packing apparatus adapted to perform the sequential operations of arranging a plurality of such articles in a predetermined order and packing such articles in a receiving container while maintaining said order.

Another object of the invention is to provide a pickup means which is specifically adapted for gripping a plurality of substantially uniform articles arranged in a predetermined order.

Another object is to provide in a completely automated packing apparatus a control system to insure the sequential successive steps of arranging such articles in a predetermined order, gripping the articles and transporting them to a packing container, and depositing said articles in the container while maintaining their predetermined order of arrangement.

These, together with other objects, will become more fully apparent upon reference to the following description and accompanying drawings.

In the drawings:

FIG. 1 is a top plan view of packing apparatus embodying the principles of the present invention and includes a supply means for the articles to be packed and a supply of packing containers in which the articles are to be deposited in predetermined quantities and a predetermined order of arrangement.

FIG. 2 is a view in side elevation, partly in vertical section, of the apparatus shown in FIG. 1, portions thereof being shown schematically.

FIG. 3 is an enlarged fragmentary view in horizontal section taken on line 3—3 of FIG. 2, portions of the power means and control therefor being shown schematically.

FIG. 4 is a view in longitudinal vertical section taken on line 4—4 of FIG. 3.

FIG. 5 is a fragmentary view in transverse vertical section taken at a plane represented by the line 5—5 of FIG. 3.

FIG. 6 is a fragmentary view in side elevation of one of the pickup heads employed in the present invention and showing the individual gripping fingers holding a plurality of the articles to be packed.

FIG. 7 is a fragmentary bottom plan view of the pickup head of FIG. 6.

FIG. 8 is an enlarged perspective view of the rigid members of one of the gripping fingers provided on each pickup head at each corner thereof.

FIG. 9 is like FIG. 8 showing the complete finger, including the expansible member thereof.

FIG. 10 is a view in horizontal section taken on line 10—10 of FIG. 9.

FIG. 11 is an enlarged perspective view of the rigid member of one of the lateral gripping fingers.

FIG. 12 is like FIG. 11 showing the complete finger structure, including the expansible member thereof.

FIG. 13 is a view in horizontal section taken on line 13—13 of FIG. 12.

FIG. 14 is a perspective view of one of the intermediate gripping fingers of the pickup heads.

FIG. 15 is a view in horizontal section taken on line 15—15 of FIG. 14.

FIG. 16 is an enlarged fragmentary view in vertical longitudinal section of one of the movable stops mounted in the orienting station provided in the apparatus.

FIG. 17 is a composite view at a reduced scale in longitudinal vertical section similar to FIG. 4 but somewhat schematic and partly in vertical transverse section taken on line A—A of FIG. 17, showing the supply gate at the terminal portion of its closing cycle and with the charging station filled with articles.

FIG. 18 is like FIG. 17, portions of the control circuitry being shown schematically, with the supply gate

being shown in a closed position and the admission gate in raised position to permit the articles to move from the charging station to the orienting station, section B—B being taken in a vertical transverse plane therethrough.

FIG. 19 is similar to FIG. 18 but shows the admission gate in a closed position and blocking communication between the supply chute and the orienting station, and showing the supply gate in a raised open position so as to permit a new charge of articles to be admitted to the charging station.

FIG. 20 is a fragmentary view in side elevation, and schematically showing a portion of the control circuit for the separate power means to effect initial longitudinal squeezing movement of the articles in the orienting station preparatory to assuming a predetermined order of arrangement, as well as the detecting circuitry to sense completion of this step.

FIG. 21 is similar to FIG. 20 but in front elevation showing a pickup head rotated to a "READY" position and lowered to grip the articles resting in the orienting station, the articles having been transversely gathered so as to assume respective positions in a predetermined order of arrangement.

FIG. 22 is a view similar to FIG. 21 showing both of the pickup heads raised to a transport elevation and holding respective quantities of the articles while maintaining their predetermined arrangement, portions of the power means and controls therefor being shown schematically.

FIG. 23 is a top plan view of the apparatus shown in FIG. 22, with the mast on which the pickup heads are supported, rotated 90° counterclockwise to an initial packing position, designated as an "A-PACK" position.

FIG. 24 is a fragmentary view similar to FIG. 23, but in side elevation and showing the mast lowered to a packing position with one pickup head disposed within a container and in the act of depositing a first layer of articles therein.

FIG. 25 is similar to FIG. 24 but showing the mast and pickup heads raised to a transport elevation and wherein the articles have been released from one of the pickup heads.

FIG. 26 is a top plan view of the apparatus of FIG. 25, but shown rotated 180° in a clockwise direction about the axis of the mast.

FIG. 27 is a fragmentary view in side elevation of the apparatus of FIG. 26, but showing the other pickup head in a lowered packing position.

FIG. 28 is similar to FIG. 27 but showing the pickup heads raised to a transport position with the articles released from both pickup heads.

FIG. 29 is a top plan view of the apparatus of FIG. 28 but rotated 90° in a counterclockwise direction about the axis of the mast to position the pickup heads for movement to a lowered gripping position, as shown in FIG. 21.

FIG. 30 is a schematic view of the pickup heads and supporting mast and includes power actuators therefor including an integrated control circuitry and switches to achieve sequential performance of the various separate measures during the packing operation; and

FIG. 31 is a schematic view similar to FIG. 30 and is to be taken in conjunction therewith as showing the remaining portion of the control circuitry and operating switches to effect orienting of the articles in a predetermined order of arrangement by separate measures and to achieve sequential performance thereof.

FIG. 32 is a schematic illustration of a top plan view of the crosshead of the packing apparatus of FIG. 1 showing the pickup heads in an elevated "A-PACK" position after having been swung from a "READY" position, shown in dashed lines.

FIG. 33 is similar to FIG. 32, but showing the pickup heads in an elevated "B-PACK" position.

FIG. 34 is similar to FIG. 32, but showing the pickup heads returned to an elevated "READY" position.

FIG. 35 is a schematic plan view of the fixed cam member employed in controlling sequential swinging of the crosshead.

The apparatus of the present invention was designed for the purpose of arranging a plurality of substantially identical articles and packing such articles in a container while maintaining their predetermined order. For illustrative convenience, the invention is described herein in connection with the arranging and packing of substantially identical articles in the form of oranges 10. Referring in greater particularity to FIGS. 1, 2 and 3, a quantity of oranges 10 are delivered by means of a pair of inclined parallel delivery chutes 11. It is to be understood that the oranges 10 have been previously graded as to size and quality by any suitable means, not shown, cleaned, and surface treated as desired. Accordingly, the present invention has been designed to accommodate the mean diametral dimension of such oranges, and the oranges can be considered as constituting substantially uniform articles. It is also to be understood that the supply chutes 11 are substantially identical so that the description of one will suffice. As the description progresses, wherever apparatus is duplicated in parallel relationship, the same reference numeral is used to designate like elements. In certain instances, such reference numerals are provided with an identifying suffix to distinguish between parallel apparatus, such as the supply chutes 11, one of which is designated 11A and the other 11B.

Each of the supply chutes 11 is provided with channels 12 to align the oranges 10 in a pre-oriented arrangement immediately before reaching a supply gate 13 and to constrain the oranges to parallel adjacent paths of travel. As indicated by the arrows in FIG. 1, the supply chutes 11 are alternately transversely inclined to insure a supply of oranges in each of the pre-orienting channels 12. As can be seen more clearly in FIG. 2, the supply chutes are also sufficiently longitudinally inclined to effect a gravitational movement of the oranges along their respective paths of travel toward the supply gate 13.

Each of the supply gates 13 is pivotally mounted on its respective chute 11 by means of transversely aligned pivot pins 14. Accordingly, the supply gate 13 is adapted for movement between a lowered closed position, as shown in FIG. 2, and a raised open position, as illustrated in FIG. 19. When in a raised position, the supply gate permits oranges to move to a charging station, indicated at 15, the longitudinal limits of which are determined by the supply gate 13 and an admission gate 16 spaced downstream therefrom. The admission gate is likewise adapted for movement between a lowered closed position, as shown in FIG. 2, and a raised open position, as shown in FIG. 18, by means of transversely aligned pivot pins 17 mounting the gate on the supply chute 11. When moved to a raised open position, the gate 16 admits four parallel columns of the pre-oriented longitudinally aligned oranges from the charging station 15 to an orienting station 18. Power means, subsequently to be described move the oranges in the orienting station 18 to a predetermined order of arrangement preparatory to subsequent transporting to and packing in receiving containers.

A plurality of packing containers 20 are supported on a conveyor 21, which includes means, not shown, to advance the containers to a packing station to which the oranges are transferred from the orienting station 18.

As illustrated in FIGS. 3 and 4, an actuating solenoid 25 is operatively connected to the supply gate 13 by means of an armature rod 26, a connecting pin 27, and a lever 28. The armature for the solenoid is not shown, it being conventional in form. Upon energizing the solenoid 25, the armature is drawn inwardly to retract the rod 26 to effect raising of the gate 13. A dash-pot 29 is connected to the armature rod 26 by means of a link 30 to decrease the rate of movement of the retraction of the rod 26, as well as the gravitational lowering of the

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gate 13 upon subsequent de-energizing of the solenoid 25. Accordingly, the dash-pot is constructed and arranged to effect a predetermined cycle time in the raising and lowering of the gate 13 by means of the solenoid being energized during the raising cycle and immediately de-energized, by means to be described below. Such predetermined cycle time is selected so as to be of sufficient duration to permit a predetermined quantity of oranges to move, by gravity, from the preorienting channels 12 of the supply chute 11, past the raised supply gate 13, and to come to rest in the charging station 15.

In a manner substantially identical to that of supply gate 13, the admission gate 16 is arranged for powered movement to an open position and gravitational movement to a closed position. To effect raising of the gate 16, a solenoid 35 is operatively connected to the gate by means of an armature rod 36, a pivot pin 37, and a lever 38. The armature of the solenoid 35, not shown, is connected to the rod 36 and arranged to effect an extension of the rod upon energizing of the solenoid 35. A dash-pot 39 is mounted on the solenoid and connected to the operating rod by a link 40 to effect a predetermined cycle time, as in the case of the dash-pot 29. The dash-pot 39 is also constructed and arranged so as to effect a cycle time of raising the gate 16 upon energizing the solenoid 35 and gravitational lowering upon immediate de-energizing as soon as the gate 16 reaches a predetermined limit, the duration of such cycle time being selected to permit gravitational movement of the predetermined quantity of oranges from the charging station 15 to the orienting station 18.

The orienting station includes a plurality of parallel longitudinally extended, transversely spaced receiving trays 45, each being provided with laterally opposed flanges 46 spaced at a predetermined distance less than the mean diametral dimension of the oranges 10. Accordingly, as can be seen in FIG. 5, upon subsequent transverse relative movement of the oranges 10, effected by means subsequently to be described, the spacing of the flanges 46 on each tray 45 is sufficiently less than the mean diameter of the oranges to permit contact between adjacent oranges. The trays 45 are provided with a pair of transversely aligned, longitudinally spaced bores, each adapted to receive a respective one of a pair of longitudinally spaced elongated rods 47 rigidly supported relative to the chute 11. Adjacent trays 45 are interconnected by flexible chains 48 of predetermined length so as to determine the relative position of the trays upon transverse movement of the trays 45 to a normal receiving position of FIG. 5 and consequent stretching of the chains 48.

Of the group of transversely spaced trays 45, alternate trays are provided with fixed stops 50, illustrated in FIGS. 3 and 4, thereby to determine the position of oranges 10 gravitationally urged into contact therewith. The remaining, oppositely alternate trays are provided with movable stops 51 which are resiliently biased for movement away from the gate 16 by means of individual springs 52 carried in the trays 45 and shown in FIG. 16. Each of the movable stops 51 is limited in biased movement by individual retainers 53 rigidly secured to a respective tray and is spaced longitudinally from the adjacent fixed stop 50 to effect an arrangement of the oranges in parallel, alternately staggered columns. Stated differently, the parallel columns are arranged with transversely extended staggered rows.

A pressure fluid ram 55, shown in FIGS. 3 and 5, is supported by a suitable base adjacent to each of the orienting stations of the chutes 11 and adapted to effect a transverse gathering of the trays 45 by sliding movement on the rods 47. The ram 55 is provided with a pair of flexible conduits 56 which alternately serve as supply and return lines to effect extension and retraction of a piston rod 57. A platen 58 is carried at the distal end

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of the piston rod and adapted for movement toward and away from a resilient bellows 59 disposed on the side of the chute opposite from the ram 55. One of the chains 48 is connected between the platen 58 and the most adjacent tray 45 to insure proper alignment of the trays 45 with the chutes 11 upon retraction of the rod 57. A control valve 60 is provided to admit pressure fluid from a source of pressure 61 upon appropriate movement of the valve to effect extension and retraction of the piston rod 57. The valve 60 is disposed in a normally-open position to admit fluid to the cylinder 55 and to effect retraction of the piston rod 57. A solenoid actuator 62 is operatively connected to the valve 60, and upon being energized by means subsequently to be described, effects movement of the valve 60 to a position to admit pressure fluid to the cylinder 55 and effect extension of the rod 57.

As illustrated in FIGS. 1, 18 and 19, a pressure fluid ram 65, substantially identical to 55, is supported by suitable means, not shown, adjacent to the biased stops 51 at the longitudinal limit of each of the chutes 11. The ram 65 is also provided with a pair of conduits 66 which alternately serve as inlet and return conduits during operation. A piston rod 67 extends from the ram and carries at its distal end a platen 68 adapted for reciprocal movement toward and away from the biased stops 51. A valve 70 is disposed in flow control relationship to the conduits 66 and in communication with a source of fluid pressure 71. The valve 70 is normally-open to admit fluid to the cylinder 65 to effect a retraction of the piston rod 67. A solenoid 72 is operatively connected to the valve 70, and upon energization is effective to move the valve 70 to a position appropriate for extension of the piston rod 67 and movement of the platen 68 into contact with the biased stops 51. The function of the cylinder 65 and the platen 68 is to cause a longitudinal squeezing of the oranges 10 resting in the receiving trays 45, thereby to effect, in combination with the stops 50, the gate 16, ram 55, and bellows 59, a compressed arrangement of the oranges in a predetermined order.

As can best be seen in FIG. 2, a pair of laterally opposed substantially identical pickup heads are provided in the packing mechanism and identified as 80A and 80B carried at respective opposite ends of a crosshead 81. The crosshead is rigidly fixed to the upper end of a piston rod 82 rigidly secured to a piston 83 which is rotatably and longitudinally slidably received in a cylindrical mast 84. The mast is supported in a substantially upright position by means of an integral pedestal 85 rigidly secured to a floor structure 86, which serves as a surface of support. A pressure fluid system, generally indicated at 87, is provided to effect controlled raising and lowering of the crosshead 81.

A swing mechanism 90 provides for controlled rotation of the crosshead in both a clockwise and counter-clockwise direction, as viewed in FIG. 1. As can be seen more clearly in FIGS. 3, 25 and 26, the swing mechanism 90 includes an annular pinion gear 91 provided with an axially extended inwardly facing slot 92 adapted to receive an elongated axially extended peripheral lug 93 provided on the periphery of the piston rod 82. A rack bar 94 is disposed in mesh with the pinion 91 and adapted for reciprocal movement upon appropriate extension of the piston of a swing ram 95. The ram 95 is provided with a pair of conduits 96 and 97 which alternately serve as supply and return conduits during extension and retraction of the piston and rack bar 94. A valve 98 is disposed in flow control relationship to a pressure fluid supply system generally indicated at 99 and incorporating a conventional pump and reservoir. The valve is normally in an "OFF" position blocking flow to both of the conduits 96 and 97. An extend solenoid 100 and a retract solenoid 101 are each operatively connected to the valve 98, and upon respective energization are adapted to effect appropriate movement of the valve to cause extension and retraction of the rack bar 94. The swing

ram 95 is mounted adjacent to the mast 84 by means of a support frame fragmentarily illustrated at 102 and resting on the floor 86.

As shown in FIGS. 3, 22 and 23, a stop swing brake 105 is provided in the swing mechanism and includes a solenoid 106 adapted to effect controlled extension of a plunger 107. A plurality of axially spaced grooves are provided on the rack bar 94 and adapted to receive the plunger 107 and thereby to halt movement of the rack bar 94 as well as the pinion 91. In the form of the invention shown, the rack bar 94 is provided with a centrally located groove 108 which corresponds to the "READY" azimuthal position of the pickup heads 80A and 80B when superposed over their respective orienting stations 18, as shown in FIG. 29. The rack bar 94 is provided with a second groove 109, which corresponds to the "A-PACK" azimuthal position of pickup head 80A, and is also provided with a groove 110 spaced from the groove 109 and adapted to halt the rotation of the piston rod 82 and the crosshead 81 in the position to dispose the pickup head 80B in a "B-PACK" position over the packing station 22 of the conveyor 21.

Both of the pickup heads 80A and 80B are intended to be substantially identical, so that a description of one will suffice. As can be seen in FIGS. 2, 6 and 7, each of the pickup heads includes a rigid frame 115 having a plurality of depending inflatable gripping members in the form of corner fingers 116, lateral fingers 117, and intermediate fingers 118. The respective fingers are disposed on the pickup head in predetermined positions corresponding to the configuration and dimensions of the articles to be packed, which in the present description are in the form of the oranges 10. The corner fingers 116 and the lateral fingers 117 constitute substantially rigid peripheral members to determine and maintain the predetermined arrangement of the oranges.

As can be seen more clearly in FIGS. 8, 9, and 10, each of the corner fingers 116 is provided with a longitudinally rigid reaction member 119 secured to the frame 115 adjacent to a finger base 120. The base is provided with a fluid admission port 121 in communication with a hollow chamber 122 provided in the pickup head 80 and serving as a distributing manifold. A resilient gripping boot 123 is secured to the base 120 and provides an internal fluid confining chamber 124. The boot is preferably fabricated of an elastomeric material, such as rubber and the like, so that upon admission of pressure fluid to the chamber 124 sufficient distention of effected to cause a gripping of the oranges 10 between opposed fingers. The boot 123 is sufficiently resilient to assume a normal deflated condition upon the venting of pressure fluid from the chamber 124 so that an immediate release of the oranges is effected upon such venting.

The lateral fingers 117, as shown in FIGS. 11, 12, and 13, are similar in structure to the corner fingers 116 and include a substantially flat rigid reaction member 125 and a base 126 secured to the pickup head 80. The reaction member 125 is intended for disposition adjacent to the periphery of the oriented oranges and thereby assists in maintenance of the predetermined order. The base 126 is also provided with a fluid admission port 127 in communication with a respective portion of the manifold 122. A boot 128 is secured to the base 126 and affords a fluid confining chamber 129 substantially similar to the chamber 124. The boot, upon inflation and distention, is adapted to engage adjacent oranges, as illustrated in FIG. 7.

The intermediate fingers 118, as illustrated in FIGS. 14 and 15, are provided with longitudinally rigid struts 130 embedded in an elongated boot 131. Such struts serve as reaction members under circumstances such as an uneven distribution of gripping force caused by slight size variations in the oranges. The boot 131 is substantially in the form of a triangular prism and is hermetically affixed to a base 132. The base is provided with a fluid

admission port 133 in communication with an internal chamber 134 formed by the boot 131. As in the case of the other boots, the boot 131 is adapted for appropriate inflation and deflation upon the admission of and venting of pressure fluid through the port 133 which is in fluid communication with the manifold 122. When inflated, the boots 131 of the intermediate fingers engage individual oranges adjacent to the respective sides of the triangular prisms defined by the boots. Accordingly, while the respective boots of the corner, lateral and intermediate fingers are substantially identical in the form of the invention shown, only the intermediate fingers respectively provide three sides for respective engagement with the three oranges surrounding each intermediate finger. The lateral fingers each provide two sides for engagement with respectively adjacent oranges, and the corner fingers are each provided with one engaging side. The predetermined disposition of the fingers is effective to maintain the oranges in a predetermined order of arrangement upon inflation of the fingers and gripping of the oranges.

A source of pressure fluid to effect controlled inflation of the fingers 116, 117 and 118, respectively carried on the pickup heads 80A and 80B is provided in the form of a pump, schematically illustrated at 140 in FIG. 30. Communication between the pump 140 and the fingers on each of the pickup heads 80A and 80B is provided by the conduits 141 and 142 leading to the respective manifolds 122 of the pickup heads. The conduits are each provided with respective flow control valves 143 and 144, which are both in a "normally-open-to-vent" position, thereby to provide communication between the fingers of their respective pickup heads and respective vents, indicated at 145 and 146. Accordingly, the valves 143 and 144 are constructed and arranged so that the fingers on their respective pickup heads are deflated until the valves 143 and 144 are moved from their normally-open-to-vent position to a position to establish communication between the source of fluid pressure, such as the pump 140, and the manifolds 122 leading to the fingers 116, 117, and 118.

To effect movement of the valves 143 and 144 from their normal vent position, respective solenoids 150 and 151 are operatively connected to the valves. Both of these solenoids incorporate a holding circuit described below. Upon energizing of the solenoids, their respective valves 143 and 144 are moved to an appropriate position to provide communication between the source of fluid pressure 140 and the fingers 116, 117, and 118 carried on the respective pickup heads 80A and 80B. Therefore, the fingers are inflated incident to energization of the solenoids 150 and 151.

To effect concurrent energization of the solenoids 150 and 151, a normally-open switch 152 is mounted on the crosshead 81 in depending relation. The switch is connected to a suitable source of electrical current, and when moved to a closed position, energizes branch circuits 153 and 154 connected respectively to the solenoids 150 and 151. A depending probe 155 is carried by the switch 152 and adapted to engage a fixed cam stop 156 upon lowering of the crosshead 81 by means of the cylindrical mast 84 and piston 83. The stop 156 is mounted on the floor 86 in an appropriate position so that lowering of the crosshead 81 from a raised transport elevation while in a "READY" azimuthal position, wherein the pickup heads 80A and 80B are superposed over the respective one of the orienting stations 18, will effect engagement of the probe 155 and closing of the normally-open switch 152.

Since the solenoid 150 is of the holding relay type, only momentary closure of the switch 152 is required to effect and maintain energization of the solenoid. The solenoid 150 includes a conventional holding circuit 160 incorporating a normally-open switch mechanically linked to the solenoid armature and which is moved to a closed position when the solenoid 150 is energized.

Since such holding relays are well-known in the art, the schematic representation in FIG. 30 should suffice. Throughout the remainder of the description it is to be understood that other holding relays described herein are substantially identical to holding solenoid 150 and incorporates a holding circuit such as that illustrated at 160. The holding circuit 160 also includes a normally-closed relay switch 161 which opens upon energization from a controlled source other than the holding circuit, thereby de-energizing the solenoid 150, assuming switch 152 is open, and permitting movement of the valve 143 to a position normally-open to the vent 145. The normally-closed relay switch 161 is provided with an energizing circuit 162 connected to a suitable source of electrical current through a normally-open switch 163. A switch actuator 164 depends from the switch 163 and is adapted to engage a probe 165 resiliently carried on the crosshead 81 by means of a spring 166. A stop 167 secured to the crosshead 81 limits the relative movement between the switch actuator 164 and the sensing probe 165.

A cam mechanism, generally indicated at 170 in FIGS. 19, 20, and 30, is provided in the packing mechanism to determine the sequence of packing several layers of oranges in packing containers. Contemporary packing practices provide for four separate layers of oranges in such packing containers. The cam mechanism 170 includes a cylindrical cam member 171 provided with an axially extended shaft 172 supported in a bearing 173 secured to the floor 86. The shaft 172 and bearing 173 support the cam member 171 for rotation about the axis of the cylinder. A plurality of elevationally spaced cam lands 174, 175, 176, and 177, corresponding in number and relative elevation to the layers of oranges to be packed in the containers, are uniformly circumferentially spaced about the periphery of the cam member and extend upwardly for successive engagement by the lower end of the depending sensing probe 165. As can be seen in FIGS. 20, 21 and 30 the cam land 174 is relatively lowest in elevation and corresponds to the first layer of oranges to be deposited in the container. The cam lands 175, 176, and 177 are disposed at successive increments of superior elevation relative to the land 174, such increments each corresponding to the thickness of one layer of oranges. The intended function of the sensing probe 165 and the lands 174, 175, 176, and 177 is to determine the elevation of the pickup head at an appropriate time to deflate the fingers 116, 117, and 118 thereof, thereby to effect a release of the oranges and packing thereof in the container.

A dog 178 laterally projects from the lower end of the sensing probe 165 and is adapted to engage an operating arm 179 extending from a ratchet schematically illustrated at 180. A linkage 181 operatively interconnects the ratchet 180 and a drive mechanism 182 operatively associated with the cam member 171. Accordingly, raising of the sensing probe 165 causes the dog 178 to engage the arm 179 and effect, through the ratchet 180, linkage 181, and drive mechanism 182, rotation of the cam member 171 about the axis of the shaft 172. In the form of the invention illustrated which is specifically adapted for packing four separate layers of oranges, the cam member 171 is rotated through an arc of 90°. The drive mechanism 182 may be of any suitable form, such as a friction drive or a conventional screw-worm gear.

The solenoid 151 associated with the valve 144 of the pickup head 80B, is provided with a holding circuit 185 substantially identical to the holding circuit 160 of solenoid 150. Upon energization of the solenoid 151 through the branch circuit 154, the holding circuit 185 is also energized through normally-open switch means in the holding circuit 185 and operatively connected to the armature of the solenoid 151. The holding circuit 185 includes a normally-closed relay switch 186 selectively connected to a source of electrical current through an

energizing circuit 187 and a normally-open switch 188. A switch actuator 189 projects from the switch 188 and is adapted to be engaged by a sensing probe 190 carried on the crosshead 81 adjacent to the pickup head 80B. The probe 190 is substantially identical to the probe 165 associated with pickup head 80A and is resiliently mounted on the crosshead 81 by means of a spring 191 to permit movement toward the crosshead. A stop 192 limits the magnitude of such movement, it being sufficient to close the normally open switch 188 through the actuator 189. The lower end of the probe 190, not shown in FIG. 30 but illustrated in FIGS. 20 and 21, is provided with a dog 193 adapted to engage the ratchet arm 179 when the mast has been rotated to a position corresponding to a "B-PACK" position with the pickup head 80B superposed over one of the packing containers 20 resting on the conveyor 21. With the pickup head 80B in the "B-PACK" position, the lower end of the probe 190 is adapted to engage one of the cam lands 174, 175, 176, or 177, depending upon the then position of rotation of the cam member 171.

As also illustrated schematically in FIG. 30, the pressure fluid system 87, which is provided to effect controlled raising and lowering of the crosshead 81, includes a suitable source of pressure fluid, such as a pump 200.

The pump 200 is in fluid communication with the cylindrical mast 84 through a conduit 201. A control valve 202 is interposed in the conduit 201 and is constructed and arranged in a normally-open position to admit fluid to the cylindrical mast 84 and to raise and hold the crosshead 81 in an elevated position. A return circuit 203 leads to a reservoir and includes a conventional pressure relief valve 204.

The control valve 202 is under the influence of a solenoid 205 mechanically linked to the valve and adapted to move the valve to a position blocking pressure fluid from the pump 200 and permitting release of pressure fluid within the cylindrical mast and consequent lowering of the crosshead 81. The solenoid 205 is connected to a suitable source of electrical current by means of an energizing conductor 206 and a pair of normally-open switches 207A and 207B, as shown in FIG. 31. The switches 207A and 207B are each mounted on a respective one of the delivery chutes 11 and connected in series to control initial lowering of the crosshead during the packing cycle. For purposes of clarity, only one delivery chute 11A is illustrated in conjunction with only one of the switches 207A. Switch 207B is shown schematically in series with switch 207A, but not mounted on its respective chute 11B. These switches are considered primary control switches insofar as the sequence of the separate steps performed by various elements of the packing mechanism of the present invention.

Each of the switches 207A and 207B is provided with a probe 208 adapted to be engaged by the platen 68 of the ram 65 which is employed to effect a longitudinal squeezing of the oranges in the orienting station 18. The solenoid 205, when energized by momentary concurrent closing of the switches 207A and 207B, is constructed to remain in an energized condition by means of a holding circuit 209 substantially similar to holding circuits previously described. The holding circuit 209 includes a normally-open switch 210 mechanically linked to the armature of the solenoid 205 to complete the holding circuit 209 upon energization of the solenoid 205 through the conductor 206. The holding circuit 209 also includes a plurality of normally-closed relay switches 211, 212 and 213 which are controlled by other elements of the packing mechanism. A normally-open relay switch 214 of the holding relay type, is included in the energizing conductor 206. Although of the normally-open type, the relay switch 214 is moved to a closed position by means subsequently to be described prior to the closing of the switches 207A and 207B. Accordingly, energization of

the solenoid 205 results in a lowering of the crosshead 81, and with either the holding relay 214 in a normally-open position, or with either of the switches 207A and 207B in a normally-open position, subsequent energization of any of the normally-closed relay switches 211, 212, and 213 effects de-energizing of the solenoid 205 and a return of the valve 202 to a normally-open position. When returned to such a normally-open position, the valve 202 admits pressure fluid to the cylindrical mast 84 to effect raising of the crosshead 81.

A swing control cam member, generally indicated at 220 in FIGS. 2 and 35, is supported on the floor 86 by means of a standard, fragmentarily illustrated at 221 thereby to dispose the cam member 220 directly above the piston rod 82 and the crosshead 81. The swing control cam member includes a first swing cam segment 222 of approximately 88° of circumferential extent and provided with a terminal portion 223 adjacent to a drop-out sector 224. A second swing cam segment 225 is approximately 178° in circumferential length and includes a terminal portion 226 adjacent to the drop-out sector 224. A third swing cam segment 227 is extended throughout an arc of approximately 88° and includes a terminal cam portion 228 adjacent to a drop-out sector 229. These cam segments are illustrated schematically in FIG. 30 in a physically separated condition.

The control circuitry for sequentially effecting rotation of the crosshead 81 includes a first swing conductor 235 leading from a normally-open switch 236 to the "extend" solenoid 100 of the swing ram control valve 98. The switch 236 is mounted on the crosshead 81 with an actuating probe 237 adapted to engage the cam member 220. The control circuitry is provided to alert conductor 235 only when the actuator is in a position of engagement with the first swing cam segment 222, when the crosshead 81 is raised to an elevated position.

A second swing conductor 240 includes a normally-open switch 241 adapted to be closed by an actuator 242 when engaged by the second swing cam segment 225. When so engaged, the conductor 240 energizes the return solenoid 101 of the swing ram control valve 98. Appropriate circuitry to be described below provides for the alerting of the conductor 240 only when the actuator 242 is in a position to be engaged by the second swing cam segment 225 of the cam member 220.

A third swing conductor 245 includes a normally-open switch 246 and leads to a portion of the conductor 235 to energize the "extend" solenoid 100 upon appropriate alerting of the conductor 245 and closing of the switch 246 by means of an actuator 247 engaged by cam segment 227. Appropriate control circuitry is provided by means subsequently to be described to alert the conductor 245 only when the actuator 247 is in a position to be engaged by the third swing cam segment 227 of cam member 220.

The manifolds 122 of each of the pickup heads 80A and 80B are provided with respective pressure sensing detectors 250 and 251. Upon admission of pressure to the manifolds 122 and consequent inflation of the fingers 116, 117, and 118, the pressure sensing detector 250 is adapted to close a normally-open switch 252 leading from a source of electrical energy and alerting the first swing conductor 235 by means of an alerting conductor 253. A coupling conductor 254 leads from the conductor 253 to a normally-open switch 255 carried on pickup head 80B and under the influence of pressure sensing detector 251. The switch 255, when closed upon admission of pressure fluid to the manifold 122 of pickup head 80B, energizes a sequencing conductor 256 leading through a normally-closed relay 257 to energize the relay 211 in the holding circuit of solenoid 205. Accordingly, the solenoid 205 is de-energized to permit the valve 202 to resume a normally-open position and effect a raising of crosshead 81. A lock-out conductor 258 is in series re-

lation with the coupling conductor 254, and when energized, controls a normally-closed relay 259, shown in FIG. 31, to prevent operation of the ram 65 at any time when the normally-open switch 252 is closed. A second lock-out conductor 260 is in branch circuit relationship to the conductor 258 and leads to a normally-closed relay switch 261, and when energized, disables the control circuit of the ram 55. An interlock conductor 262 is in branch circuit relationship with the conductor 256 and leads to a normally-closed relay switch 263 in the holding circuit of normally-open relay 214 of conductor 206.

A normally open "A-PACK" switch 270 is supported on the floor 86 in a position relative to the rack bar 94 of swing ram 95 to permit engagement thereby of a switch actuator 271, a condition illustrated in FIG. 23. When closed, the switch 270 connects a source of electrical current to the stop swing brake 105 through a conductor 272. A second conductor 273 is also energized upon closing of the switch 270 to effect a sequential lowering of the crosshead by energizing the solenoid 205 through a portion of the conductor 206. A branch conductor 274 is connected to conductor 273 to energize the normally-closed relay 257 and thereby open conductor 256 and de-energize relay 211 to re-establish the holding circuit 209 of solenoid 205.

A normally-closed switch 280 is carried on pickup head 80A and adapted to be moved to an open position upon detection of pressure in the respective manifold 122 of 80A by the detector 250. Also, upon venting of the manifold 122 through valve 143 and vent 145, the pressure sensing detector 250 will move to a position permitting the switch 280 to assume a normally-closed position. An alerting conductor 281 leads from a source of electrical current through normally-closed switch 280 to a normally-open switch 282. Upon appropriate movement of detector 251, when sensing pressure in the manifold 122 of pickup head 80B, the switch 282 is moved to a closed position to energize conductor 283 leading to a normally-closed relay 284. A branch conductor 285 connects conductor 283 with normally-closed relay 212 to open the holding circuit 209 of solenoid 205. When the conductor 283 is so energized, the valve 202 is permitted to return to a normally-open position admitting fluid to the cylindrical mast 84 to cause a raising of the crosshead 81.

With switch 280 returned to a normally-closed position and switch 282 closed incident to pressure in manifold 122 of head 80B, the second swing circuit 240 is energized thereby. Upon appropriate closing of the switch 241 by the second swing cam segment 225, the "retract" solenoid 101 is energized to cause movement of the crosshead 81 in a clockwise position until drop-out segment 224 permits the switch 241 to move to a normally-open position and the crosshead contacts a normally-open "B-PACK" switch 290 supported on the floor 86 by any suitable means and positioned to be engaged by the rack bar 94 when in a retracted position, as shown in FIG. 26. The switch 290 is provided with an actuator 291 for such engagement, and when engaged connects a source of electrical energy to the stop swing brake conductor 272 through a branch conductor 292. A sensing conductor 293 is also connected to the electrical source through the switch 290 and leads to a portion of the conductor 206 to energize the solenoid 205. This causes a lowering of the crosshead 81 preliminary to packing of the oranges held in pickup head 80B.

As the crosshead is lowered, probe 190 engages cam 171 thereby closing switch 189 and consequently causing valve 144 to assume a vent position. Upon subsequent release of the fluid pressure from the manifold 122 of the pickup head 80B and resultant release of the oranges by the fingers 116, 117, and 118 thereof, the detector 251 permits the switches 255 and 282 to open, while permitting a closing of a switch 295. The switch 295 leads from a source of electrical energy and through

a conductor 296 alerts the third swing conductor 245. The conductor 296 is in branch circuit relationship with a sequencing conductor 297 leading to the relay 213 in the holding circuit 209 thereby releasing solenoid 205. An interlock conductor 298 branches from the conductor 297 to a normally-closed relay switch 299 which opens the circuit previously completed by conductor 293 of the "B-PACK" switch 290 and permits raising of the crosshead 81.

Subsequent elevation of the crosshead 81 engages actuator 247 of switch 246 with the third swing cam segment 237 to energize "extend" solenoid 100 of the swing ram 95. This causes a counterclockwise rotation of the crosshead 81 of approximately 90°. A normally-open "READY" switch 300 is supported on the floor 86 by any suitable means and in a position to dispose a switch actuator 301 for engagement by a lever 304 through rack bar 94 at the terminal portion of the aforesaid 90° of counterclockwise movement, as illustrated in FIG. 29. Lever 304 is supported relative to switch 300 so that actuator 301 is contacted by the lever only upon extension of the rack bar in moving from a "B-PACK" position to a "READY" position. The switch 300, when closed, energizes the stop swing brake conductor 272 through a branch conductor 302. A sequencing conductor 303 is also energized and leads to the normally-open holding relay 214 to re-establish communication between the switches 207A and 207B and the solenoid 205 through the conductor 206.

The control and interlock circuitry for the gates 13 and 16 and the rams 55 and 65 is schematically illustrated in FIG. 31. A master switch 310 is connected to a suitable source of electrical energy and through a primary conductor 311 energizes the solenoid 25 through a plurality of normally-closed switches 312 in series relationship. Preferably, each of the pre-orienting channels 12 of the chutes 11A and 11B is provided with a respective one of the switches 312. The primary conductor 311 also includes a normally-open switch 313 having an actuator 314 adapted to be engaged by an arm 315 carried by the gate 16. Accordingly, the solenoid 25 is energized only when the switches 312 are in a normally-closed position and the gate 16 is in a lowered position with the switch 313 moved to a closed position by the arm 315. The solenoid 25 is of the conventional holding relay type with a holding circuit 316 provided with a normally-closed switch 317. The holding circuit switch 317 is provided with an actuating probe 318 adapted to be engaged by an arm 319 mounted on the gate 13, when the gate is moved to a raised position, thereby to open switch 317 and disable the holding circuit 316.

The solenoid 35 is provided with an alerting conductor 325 leading from the master switch 310 and connecting a plurality of normally-open switches 326 in series relationship leading to a normally-open switch 327 adapted to be moved to a closed position by an arm 328 carried on the gate 13. Preferably, each of the pre-orienting channels 12 is provided with a respective one of the normally-open switches 326. The switch 327 is closed only when the gate 13 is in a lowered position. A coupling conductor 330 leads from the switch 327 through a normally-open switch 331 to the solenoid 35. The switch 331 is adapted to be moved to a closed position when the platen 58 of the ram 55 is moved to a normally retracted position. The solenoid 35 includes a conventional holding circuit 332 incorporating a normally-closed switch 333. The switch 333 is adapted to be moved to an open position upon engagement of an arm 334 when elevated by the gate 16 on which it is carried. As described above, both of the solenoids 25 and 35 are operatively connected with respective dash-pots 29 and 39 to effect a controlled rate of raising and lowering of the gates 13 and 16.

The control circuit for the valve of the transverse gathering ram 55 includes a conductor 340 leading from a source of electrical current under the influence of master

switch 310 through a plurality of normally-open switches 341 in series relationship. Preferably, each of the normally-open switches 341 is mounted in a respective one of the receiving trays 45 in a position to be closed by the terminal orange in the tray adjacent to the gate 16 and within the orienting station 18. The conductor 340 also includes a normally-open switch 342 adapted to be closed by an arm 343 carried on the gate 16, when the gate is lowered to a closed position. The conductor 340 includes a normally-closed relay switch 261 and leads to the solenoid 62 which controls movement of the valve 60.

The solenoid 72 in control relationship with the ram 65 is energized through a conductor 350 leading from master switch 310 and also under the influence of a normally-open switch 351 mounted on the supply chute 11. The bellows 59, when compressed by the oranges 10 in the trays 45 incident to a transverse gathering thereof by the ram 55, engages the switch 351 and thereby energizes the solenoid 72 through conductor 350.

OPERATION

The operation of the described embodiment of the subject invention is believed to be readily apparent and is briefly summarized at this point. A quantity of oranges 10 is admitted to each of the transversely spaced supply chutes 11 from a source, not shown. Each of the pre-orienting channels 12 receives a substantially equal amount of oranges as they are gravitationally motivated toward the supply gate 13, due to the longitudinal inclination of the supply chutes 11 and the alternately transversely inclined attitude of the supply chutes.

Referring to the schematic diagrams of FIGS. 30 and 31, it will be seen that with the master switch 310 in an open position and with the crosshead 81 disposed in a normal "READY" position, as shown in FIG. 29 and schematically illustrated in FIG. 34, wherein the actuating probe 301 of the "READY" switch 300 is engaged by the crosshead, the stop swing brake 105 is energized, as well as the holding relay 214 so that continuity is provided by the conductor 206 from switch 207 to the crosshead lowering solenoid 205. Accordingly, the lowering circuit is alerted by "READY" switch 300. The actuating probe 247 of the third swing control switch 207 is also positioned in the drop-out sector 229 of the third swing cam 227. The actuating probe 237 of the first swing switch 236 is engaged by the first swing cam segment 222, however, since the first swing conductor 235 has not been energized by the alerting conductor 253, the swing control valve 98 remains in a neutral position blocking flow between the conduits 96 and 97 leading to the swing ram 95.

The sequence of orienting the oranges 10 and packing them in successive layers in the containers 20 is initiated by closing of the master switch 310 and thereby energizing the primary conductor 311. At this time, both the gate 13 and the gate 16 are in a lowered position, as shown in FIG. 2, blocking movement of the oranges toward the orienting station 18. With the gate 16 in a lowered position, the arm 315 engages the actuating probe 314 to close the normally-open switch 313, thereby energizing solenoid 25 through conductor 311 and the normally-closed switches 312. The solenoid 25 consequently raises gate 13 to admit a quantity of oranges to the charging station 15, as illustrated in FIG. 17. Due to the damping action of the dash-pot 29, the rate of movement of the gate 13 toward a raised position is sufficiently retarded to admit a full charge of oranges so that the normally-closed switches 312 are held open by the last to be admitted oranges adjacent to the gate 13. Upon the opening of one of the switches 312, the primary conductor 311 is disconnected from the source of electrical energy, and solenoid 25 would be de-energized if it were not for the holding circuit 316. Upon movement of the gate 13 to a raised position, the arm 319 engages the actuating probe 318 to open the normally-closed switch 317, thereby de-energizing the holding circuit 316. Consequently,

the solenoid 25 is no longer energized and the gate 13 moves to a lowered position, the return movement being retarded by the dash-pot 29.

The oranges in the terminal positions in each of the pre-orienting channels 12 also close the normally-open switches 326 at the same time as moving the normally-closed switches 312 to open positions. Accordingly, the alerting conductor 325 is energized through the normally-open switches 326 to the junction with normally-open switch 327. Upon movement of the gate 13 to a lowered position, the arm 328 closes the switch 327 to energize the conductor 330 leading to the actuating solenoid 35 of the gate 16. With the ram 55 in a normally retracted position, the platen 58 closes switch 331 to provide circuit continuity to energize solenoid 35 and effect raising of gate 16, as shown in FIG. 18. The rate of raising of the gate 16 is retarded by dash-pot 39 to permit the oranges previously held in the charging station 15 to resume their gravitational movement and assume respective positions in the orienting station 18, such positions being determined by the trays 45 and the stops 50 and 51 carried thereby.

As soon as the terminal oranges in the charging station adjacent gate 13 have moved from a position overlying and closing the normally-open switches 326, the conductor 330 is de-energized. The solenoid 35 would likewise be de-energized, if it were not for the holding circuit 332. As soon as the gate 16 has moved to a fully raised position, arm 334 contacts switch 333 in the holding circuit 332 and thereby effects a de-energization of solenoid 35. This permits gate 16 to descend to a closed position, illustrated in FIG. 19, under the retarding influence of dash-pot 39.

With a full charge of oranges in the orienting station 18 having been received from the charging station 15, the terminal oranges in each of the trays 45 and adjacent to the gate 16 rest upon the normally-open switches 341 in series relationship in conductor 340 of the transverse gather circuit. The normally-open switch 342 is also moved to a closed position by the arm 343 mounted on gate 16. Accordingly, with the conductor 340 so energized from the master switch 310, the solenoid 62 is energized to move valve 60 to a position to admit pressure fluid from pump 61 through one of the conduits 56 and thereby to extend the piston rod 57 of ram 55. As a consequence of such extension, the platen 58 effects a transverse gathering, as viewed in FIG. 19, of the trays 45 which are slidably mounted on the longitudinally spaced, transversely extended rods 47. Concurrently, switch 331 of conductor 330 leading to solenoid actuator 35 of gate 16 moves to a normally-open position and prevents raising of the gate 16, until the trays 45 are again aligned with the pre-orienting channels 12 incident to retraction of platen 58.

Upon achieving a predetermined magnitude of transverse movement sufficient to compress the bellows 59 a predetermined degree, the switch 351 is closed under the influence of the bellows 59 and thereby energizes the conductor 350 leading to the solenoid actuator 72 of the control valve 70. The control valve 70 is moved from a normally-open-to-retract position to a position to effect extension of the piston rod 67 of the fluid operated ram 65. Consequently, the platen 68 engages the movable biased stops 51 and effects a longitudinal squeezing, as shown in FIG. 20, of each of the four columns of oranges, the oranges having been previously arranged in longitudinally staggered rows by reason of the fixed and biased stops 50 and 51 carried by alternate trays 45. Each of the switches 207A and 207B is mounted on a respective one of the supply chutes 11 in a position relative to the platen 68 so that the actuating probe 208 is engaged by the platen 68 upon achieving a predetermined degree of longitudinal compression of the columns of oranges. Consequently, the switch 207 is closed to complete the circuit through conductor 206 to the solenoid 205.

Valve 202, under the influence of solenoid 205, is moved

from a normally-open position to a position appropriate to return pressure fluid from within the cylindrical mast 84 to the return conduit 203 of the pressure fluid system 87. The piston 83 then gravitationally moves to a lowered position carrying with it the crosshead 81. Such movement continues until each of the pickup heads 80A and 80B, through their respective fingers 116, 117, and 118, contacts the oranges 10 being held in the respective orienting station 18 of each of the supply chutes 11. The cam stop 156 is positioned relative to the actuating probe 155 of the switch 152 to effect a closing of the switch 152 immediately following the engagement of the oranges by the fingers. Such a condition is illustrated in FIG. 21. Therefore, upon resultant energizing of the branch circuit 153 to solenoid 150 and branch circuit 154 to solenoid 151, the valves 143 and 144 are moved from their normally-open-to-vent position to a position to admit from pump 140 a pressure fluid, such as air, to the respective manifolds 122 of the pickup heads 80A and 80B. The pressurizing fluid is effective to inflate the fingers 116, 117, and 118 and through their respective rigid reaction members 119, 125 and 130 grasp the entire quantity of oranges being held in the respective orienting stations 18 of each of the supply chutes 11.

To facilitate such grasping of the oranges in the orienting stations, the pressure sensing detectors 250 and 251, upon admission of pressure fluid to the manifolds 122 and consequent inflation of the gripping fingers, are moved upwardly as viewed in FIG. 30. The detector 250 moves the normally-open switch 252 to a closed position thereby energizing alerting conductor 253, coupling conductor 254, and lock-out conductors 258 and 260. As shown in FIG. 31, the lock-out conductors 258 and 260 respectively energize the normally-closed relay switches 259 and 261 and cause a de-energization of the solenoids 72 and 62, and temporarily prevent any subsequent energizing. Accordingly, both of the fluid operated rams 65 and 55 are moved to a normally retracted position, thereby releasing transverse and longitudinal pressure on the oranges 10 being held in the orienting stations 18. Concurrently, the normally-open switch 255 is moved to a closed position under the influence of pressure sensing detector 251, thereby energizing sequencing conductor 256 leading to relay 211 to open holding circuit 209 of solenoid 205. Since the switches 207A and 207B have been concurrently permitted to move to normally-open positions by the retraction of platen 68, conductor 206 is no longer energized. Consequently, valve 202 returns to a normally-open position to admit pressure fluid from pump 200 to the cylindrical mast 84 and to raise crosshead 81 to the position shown in FIG. 22. An interlock conductor 262 branches from sequencing conductor 256 to normally-closed relay 263 to open the holding circuit of the holding relay switch 214 and permit the relay switch 214 to move to a normally-open position upon subsequent release of "READY" switch 300 by the crosshead 81 as it is swung to an "A-PACK" position, as will be subsequently described. Accordingly, as soon as switch 300 moves to a normally-open position, the conductor 262 remaining energized will permit relay 214 to open and thereby prevent subsequent energization of solenoid 205 through switch 207. This interlock condition persists until either of the switches 252 or 255 have been moved to a normally-open position and "READY" switch 300 has again been closed. The sequencing conductor 256 and interlock conductor 262 assure successive accomplishment of each of the separate orienting and packing measures performed by the mechanism of the present invention and preclude operation in other than a predetermined sequence of such measures.

It will also be observed by reference to FIGS. 30 and 31 that the lock-out conductors 258 and 260 energized by alerting conductor 253 and coupling conductor 254 prevent operation of the transverse gathering ram 55 and the longitudinal squeezing ram 65 until the oranges held in

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pickup head 80A have been released. This insures an orderly, sequential performance of the separate measures of orienting and packing the oranges and prevents interference between the various operating elements as they perform their respective functions. The supply and charging gates 13 and 16 are permitted to operate in their normal manner, subject to their respective control and interlock circuits as described above, so that a new supply of oranges is available in charging station 15.

Upon movement of the piston 83 to its upper limit, crosshead 81 is raised to a position engaging and closing first swing switch 236, second swing switch 241, and third swing switch 246. Since alerting conductor 253 is effective to energize only the first swing conductor 235, the second and third swing conductors 240 and 245 are not energized. Their energization is prevented by normally-closed switch 280 having been moved to an open position by pressure sensing detector 250 and normally-closed switch 295 having been moved to an open position by pressure sensing detector 251. Consequently, upon closing of the switch 236 under the influence of actuating probe 237, the "extend" solenoid 100 of the swing ram 95 admits pressure fluid from supply system 99, thereby to extend rack bar 94, as illustrated in FIG. 23. This causes counterclockwise rotation of the annular pinion 91, and, by means of the rotatable driving connection with the piston rod 82 constituted by the lug 93 and the slot 92 slidably receiving the lug, the swing ram 95 is effective to rotate the crosshead 81 to the "A-PACK" position, schematically illustrated in FIG. 32. As the crosshead approaches such a position, actuating probe 237 extends into dropout sector 224 of first swing cam 222 as the probe passes terminal portion 223. Upon entering the drop-out sector 224, solenoid 100 is de-energized permitting the valve 98 to return to a normal position blocking flow between the conduits 96 and 97. The drop-out sector 224 is positioned on the first swing cam so that the solenoid 100 is de-energized substantially simultaneously upon engagement of the actuating probe 271 of the "A-PACK" switch 270 by the rack bar 94. Consequently, the swing ram 95 is de-activated substantially at the same time of energization of the stop swing brake 105 through stop swing conductor 272 leading from the "A-PACK" switch 270. Concurrently, the "A-PACK" switch through lowering sequence conductor 273 energizes solenoid 205 through conductor 206. Branch conductor 274 energizes normally-closed relay 257 to interrupt conductor 256 and re-establish holding circuit 209 of solenoid 205. Consequently, the valve 202 is moved to a position permitting lowering of the crosshead 81 with the pickup head 80A overlying the packing station 22 of the conveyor 21, as illustrated in FIG. 24. With the packing mechanism in such a position relative to the packing container 20 on the conveyor 21, a first layer of oranges 10 is ready to be deposited within the packing container so positioned. It should be noted that normally-closed relay switch 284 remains closed, even though energizing circuit continuity is provided through normally-open switch 282 which has been closed incident to inflation of the fingers of pickup head 80B. Since relay switch 284 is in series relationship to normally-closed switch 280, conductor 273 is not interrupted, so long as the fingers of pickup head 80A remain inflated, which incidentally effects opening of switch 280.

Upon reaching a sufficiently low position, the packing probe 165 carried on crosshead 81 adjacent to pickup head 80A engages the lowermost cam land 174 to prevent further lowering of the crosshead 81 while concurrently closing switch 163 through actuator 164. This position is shown in FIG. 24. Release of the oranges held by head 80A is effected through conductor 162 leading to normally-closed relay 161 in the holding circuit 160 of solenoid 150. Therefore, solenoid 150 is de-energized and permits valve 143 to move to its normally-open-to-vent position. As soon as the valve 143 returns to such an open position, pressure fluid is vented from the mani-

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fold 122 and the gripping fingers 116, 117, and 118 are deflated and returned to a normal, released position. Accordingly, the oranges are deposited by pickup head 80A within the container 20 as the first layer of oranges in a conventional four-layer shipping arrangement. It is to be noted that throughout the gripping, transporting, and depositing of the oranges 10, the predetermined order of arrangement, which the oranges assumed within the orienting station 18, is maintained by the pickup head 80A through the particular construction and arrangement of the gripping fingers 116, 117, and 118. The sequencing and interlock circuitry through a predetermined arrangement of switches and actuating probes therefor, insures a predetermined order of performance of successive steps in the orienting and packing of oranges within the containers 20.

The remaining operation of the present packing mechanism is to insure successive completion of the packing of the second, third and fourth layers within the packing container 20. Upon release of pressure fluid from manifold 122 and the gripping fingers 116, 117, and 118 of pickup head 80A, pressure sensing detector 250 simultaneously permits switch 252 to move to its normally-open position and switch 280 to move to a normally-closed position. Consequently, alerting conductor 253 de-energizes the first swing conductor 235. Concurrently de-energized is coupling conductor 254 which, through interlock conductor 262, leads to normally-closed relay switch 263. Therefore, the holding circuit of holding relay 214 has been returned to a normal condition upon subsequent energization by "READY" switch 300, which occurs upon completion of all successive steps in the packing sequence. In addition, sequencing conductor 256 is also de-energized so that holding circuit 209 of solenoid 205 is not affected upon subsequent release of "A-PACK" switch 270.

Under the influence of normally-closed switch 280, the alerting conductor 281 alerts second swing conductor 240 through switch 282, which remains in a closed position under the influence of pressure sensing detector 251. Concurrently, conductor 283 energizes relay 284 to open conductor 273 leading to solenoid 205 through a branch of conductor 206. Also, conductor 285 leading from conductor 283 energizes relay 212 to open holding circuit 209 of the solenoid 205. Therefore, solenoid 205 is completely de-energized and permits valve 202 to move to a normally-open position to raise piston 83 and crosshead 81 to an elevated position shown in FIG. 25. During such raising, the dog 178 carried at the lower end of probe 165 engages operating arm 179 of ratchet 180. Through the linkage schematically illustrated at 181 and the drive mechanism 182, the cylindrical cam member 171 is rotated about the axis of shaft 172 throughout an arc of approximately 90°. This rotation disposes cam land 175 in a position to be engaged by sensing probe 190 of pickup head 80B upon subsequent lowering of the crosshead 81. The cam land 175 is at a higher elevation relative to land 174, the elevation differential corresponding to the vertical height of one layer of oranges within the packing container 20.

Upon reaching the upper limit of its travel, as shown in FIG. 25, crosshead 81 urges actuating probe 242 of second swing switch 241 into engagement with the second swing segment 225 of cam member 220. The second swing conductor 240, having been previously alerted by conductor 281 through switch 282, energizes the retract solenoid 101 upon closing of the second swing switch 241. Subsequent movement of valve 98 causes the swing ram 95 to retract the rack bar 94 and effect a clockwise rotation of the crosshead 81 about the substantially vertical axis of the piston rod 82, the rotation being approximately 180° of circumferential travel. Such a position is shown in FIG. 26 and illustrated schematically in FIG. 33. It is to be noted that the force exerted by the swing ram 95 is sufficient to overcome the stop swing brake 105, so that initial movement of the crosshead 81 is performed with the brake

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engaged until the conductor 272 is de-energized by movement of the rack bar from the respective actuating probes 271, 291, and 301 of "A-PACK" switch 270, "B-PACK" switch 291 and "READY" switch 300. Upon approximately 178° of clockwise rotation of the crosshead 81, the actuating probe 242 enters the drop-out sector 244 to de-energize retract solenoid 101 and return valve 98 to a normal flow-blocking position. Substantially simultaneously, rack bar 94 engages the actuating probe 291 of "B-PACK" switch 290 to energize conductor 292 and stop swing conductor 272 of the brake 105. As a result, the plunger 107 enters groove 110 visible in FIG. 3, and the crosshead is in a position illustrated in FIG. 33. Concurrently, sensing conductor 293 is energized to energize solenoid 205 through conductor 206. As a result, valve 202 is moved to a position permitting lowering of piston 83 and crosshead 81 with pickup head 80B overlying the packing station 22 and ready to deposit the second layer of oranges within the container as shown in FIG. 27.

As soon as a predetermined magnitude of lowering movement has been achieved by the crosshead 81, the sensing probe 190 of pickup head 80B engages cam land 175 and is moved toward the crosshead 81 to engage stop 192. This movement is permitted by reason of the resilient mounting afforded by the spring 191. The switch 188 is concurrently closed by the actuator 189 engaged by the probe 190. Consequently, through conductor 187, the normally-closed relay 186 of the holding circuit 185 is opened allowing valve 144 to move to a normally-open-to-vent position and release pressure fluid from the manifold 122 of the pickup head 80B. Accordingly, the oranges held by the previously inflated fingers 116, 117, and 118 of 80B assume a normally deflated condition and deposit the oranges 10 previously held thereby within the packing container 20 as the second layer of oranges.

The release of pressure from the manifold 122 of 80B is detected by the pressure sensing detector 251 permitting switch 282 to move to a normally-open position thereby de-energizing second swing conductor 240 and sequencing conductor 283. Concurrently, switch 295 is permitted to move to a normally-closed position, which through conductor 296 alerts third swing conductor 245. Concurrently, sequencing conductor 297 is energized to open the holding circuit 209 of solenoid 205 through normally-closed relay 213. Interlock branch conductor 298 is also energized by sequencing conductor 297 to open the normally-closed relay switch 299, which previously was energized by the "B-PACK" switch 290. Therefore, the solenoid 205 is de-energized and crosshead 81 is moved to a raised position shown in FIG. 28 as soon as valve 202 returns to a normally-open position. During such raising movement, the dog 193 carried in the lower end of sensing probe 190 engages operating arm 179 of the ratchet 180, and through linkage 181 and drive mechanism 182 rotates the cam member 171 to dispose cam land 176 in a position subsequently to be engaged by sensing probe 165 of pickup head 80A.

Upon crosshead 81 reaching the upper limit of its travel, as shown in FIG. 28, actuating probe 247 of switch 246 engages the third swing cam 227. The third swing conductor 245, having been previously energized by switch 295, is now effective to energize "extend" solenoid 100 and position valve 98 to cause extension of rack bar 94. Through the previously described annular pinion 91, rotation of crosshead 81 proceeds in a counterclockwise direction throughout an arc of approximately 88° until actuating probe 247 traverses terminal portion 228 and is released by the third swing cam segment 227 upon reaching the drop-out sector 229. Substantially simultaneously, the "READY" switch 300 is closed by the actuating probe 301 being engaged by the rack bar 94 as shown in FIG. 29. Consequently, stop swing brake 105 is energized through conductor 272 and 302. The crosshead 81 is thus stopped in a "READY" position illustrated in FIG. 34. Concurrently, the interlock constituted by normally-open relay

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switch 214 in conductor 206 is disabled by energization of the sequencing conductor 303 leading to relay 214. Accordingly, continuity between switches 207A and 207B and solenoid 205 is re-established by the "READY" switch 300.

During the above steps of the packing cycle of the mechanism, the gates 13 and 16 continue to operate in the previously described manner to admit a quantity of oranges to the charging station 15 for the purposes of pre-orienting and determining the quantity of oranges subsequently to be admitted to the orienting station 18. The lockout conductors 258 and 260 are energized only while the fingers 116, 117, and 118 of pickup head 80A were inflated. Upon release of fluid pressure from these fingers, the switch 252 returns to a normally-open position to de-energize the normally-closed relays 259 and 261. Consequently, the control circuitry of the solenoids 62 and 72 of the rams 55 and 65 associated with the orienting station 18 are permitted to operate in a normal manner as soon as the oranges are released from pickup head 80A. Accordingly, while the crosshead 81 is being moved to successive "A-PACK" and "B-PACK" positions prior to its return to the "READY" position, a new charge of oranges has already been admitted to the respective orienting stations 18 of the supply chutes 11A and 11B. Therefore, the "READY" switch 300 through holding relay 214 re-establishes continuity between switches 207A and 207B and solenoid 205 and is effective to lower the crosshead 81, assuming that switches 207A and 207B have been moved to a closed position by platen 68 of ram 65. The oranges arranged in the respective orienting stations 18 of the supply chutes 11 are then grasped by the pickup heads 80A and 80B as described above.

The third and fourth layers of oranges are successively deposited within the packing container 20 in the same manner as described above in connection with the depositing of the first and second layers. The pickup heads 80A and 80B are successively moved to "A-PACK" and "B-PACK" positions overlying the packing station 22. Upon depositing of the fourth layer of oranges within the packing container, as shown in FIG. 2, a new container is moved to the packing station 22 and subsequently packed with oranges by the heads 80A and 80B.

Accordingly, a completely automated packing mechanism for substantially identical articles is provided by the present invention, the mechanism including means to arrange the articles in a predetermined order and to effect successive steps of grasping the articles, transporting the articles to a packing container, and depositing the articles therein while maintaining the predetermined order of arrangement thereof. Appropriate sequencing and interlock controls are provided to insure a predetermined sequence of performance of the packing steps and to preclude any power element from operating without a full charge of articles in the orienting station and without prior accomplishment of all previous steps in the schedule of performance.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In apparatus for orienting and packing a plurality of articles in predetermined relative positions, the combination of means to receive a predetermined quantity of said articles and to arrange the articles in a predetermined ordered relationship in a substantially common predetermined plane; means engageable with said articles to urge the articles in said plane into compressive engagement; means to grip said arranged articles and to remove the articles from said receiving means while maintaining said

compressive engagement; and transport means operatively connected to said article gripping means to carry said articles to a packing container while maintaining said compressive engagement in said predetermined relationship and to deposit the articles therein.

2. In apparatus adapted for packing a plurality of substantially uniform articles in a predetermined order of arrangement comprising means to deliver a supply of said articles; means disposed in receiving relationship to said supply means adapted to arrange and hold a predetermined quantity of the articles in a predetermined order in a substantially common predetermined plane; means engageable with said articles to urge the articles in said plane into compressive engagement; and transport means to remove said arranged articles from said receiving means, to carry the articles to a packing container, and to deposit said articles therein while maintaining said predetermined order and compressive engagement until deposit.

3. In apparatus for packing a plurality of substantially uniform articles in predetermined relative positions, the combination of means to deliver a supply of said articles; means disposed in receiving relationship to said supply means and adapted to arrange and hold a predetermined quantity of the articles in a predetermined order of arrangement in a substantially common plane; article engaging means operable to thrust the articles into compressive engagement in the plane; gripping means adapted to hold said arranged articles in said compressive engagement and to remove the articles from said receiving means; and transport means operatively supporting said gripping means to carry said articles to a packing container and to deposit the articles therein while maintaining said predetermined order and compressive engagement.

4. Apparatus for packing a plurality of substantially uniform articles in predetermined relative positions comprising means to deliver a supply of said articles; reception means in receiving relation to said supply means to hold a predetermined quantity of said articles; power means operatively connected to said reception means sequentially to effect arrangement of said articles therein in a predetermined substantially coplanar order and to compress the articles into engagement in said order in the plane; gripping means adapted to hold said arranged articles in compressive engagement; power means operatively connected to said gripping means to effect powered adjustment thereof between released and gripping conditions; transport means operatively supporting said gripping means to carry said articles to a packing container in compressive engagement and to deposit the articles therein while maintaining said pre-arranged order; power means connected to said transport means to effect the carrying and depositing functions of said transport means; and control means operatively connected to each of said power means to effect sequential individual operation thereof in a predetermined order.

5. In apparatus for packing a plurality of substantially uniform articles in predetermined relative positions comprising means to deliver a supply of said articles; reception means in receiving relation to said supply means to hold a predetermined quantity of said articles; power means operatively connected to said reception means sequentially to effect arrangement of said articles therein in a predetermined substantially coplanar order and to compress the articles into engagement in said order in the plane; gripping means adapted to hold said arranged articles in compressive engagement; power means operatively connected to said gripping means to effect powered adjustment between released and gripping conditions; transport means operatively supporting said gripping means to carry said articles to a packing container in compressive engagement and to deposit the articles therein while maintaining said pre-arranged order; power means connected to said transport means to effect the carrying and depositing functions of said transport means; control means operatively connected to each of said power means to effect se-

quential individual performance steps thereof in said predetermined; order and interlock means operatively associated with said control means to render each of the individual power means inoperative until the successive completion of all performance steps preceding that of each of said power means.

6. In apparatus for packing a plurality of substantially uniform articles, the combination of a supply chute adapted to direct a plurality of said articles along a predetermined path of travel; pre-orientation means carried by said chute to insure a predetermined minimum quantity of said articles in respective parallel adjacent paths of travel defined by said means; a charging station in receiving relationship to said chute and adapted to hold a predetermined quantity of said articles; admission means normally blocking communication between said chute and said charging station and adapted selectively to permit entry of articles to said station; a plurality of transversely spaced, elongated receiving trays; means supporting the trays in parallel relationship, each being longitudinally aligned with a respective one of said parallel paths of travel, including means permitting transverse movement of the trays to effect intimate contact between articles in adjacent trays; means to orient the articles in said trays in parallel columns having transversely extended staggered rows; power means to effect lateral compression of the articles transversely of said trays; and power means to effect longitudinal compression of the articles in said trays so that the articles are compressed transversely and longitudinally of the trays and maintained in a predetermined order of contiguous columns having transversely extended staggered rows.

7. The apparatus of claim 6 wherein control means are provided for said power means to effect sequential operation thereof.

8. The apparatus of claim 6 wherein sensing means are provided in said charging station to detect the presence of said predetermined number of articles.

9. The apparatus of claim 8 wherein interlock means are provided between said sensing means and said control means to render both said power means inoperative until said predetermined number of articles is detected by said sensing means.

10. In apparatus for packing a plurality of substantially uniform articles in predetermined relative positions, a charging station adapted to receive and to arrange a predetermined quantity of said articles in a predetermined order in a substantially common plane; means for compressing said articles into engagement in said plane; a packing station adapted to receive packing containers in predetermined article receiving position; a pickup head including means to grip and maintain said articles in compressive engagement in said predetermined order; means to move said pickup head successively between an article grasping position at the charging station and an article releasing position in a container at the packing station; and synchronous actuating means sequentially supplying articles to the charging station, actuating the compressing means to compress the articles in the charging station, actuating the pickup head to pick up the articles at the charging station, actuating the moving means to carry the head and articles from the charging station to the packing station while maintaining the articles in said predetermined order and compressive engagement, actuating the head to release said articles in a container at the packing station, and returning the head to the charging station.

11. In an apparatus for packing a plurality of resiliently compressible articles in predetermined ordered arrangement in a container having circumscribing walls defining a receiving area, the combination of means to receive a predetermined number of said articles and to arrange the articles in a predetermined ordered relation in a substantially common plane, said articles when uncompressed having an aggregate area in the plane greater than the receiving area defined by the walls of the con-

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tainer, means engageable with said articles to compress the articles in the plane sufficiently that their aggregate area is less than the receiving area defined by the walls of the container, and means engageable by the articles under compression adapted successively to remove the articles from the receiving means, to transport the articles under substantially constant compression in their plane, to insert the articles between the walls of the container while under said compression, and to release the articles in their predetermined ordered relation in the container for expansion against the side walls thereof.

12. In an apparatus for packing a plurality of substantially uniform articles, the combination of a plurality of elongated article receiving trays; means supporting the trays in substantially parallel relation for transverse reciprocal movement between predetermined article receiving relation with the trays transversely spaced and article arranging relation with the trays more closely adjacent to each other; means operably associated with the tray supporting means successively moving said trays between said relations, means for supplying articles to the trays when the trays are in article receiving relation, and means engageable with said articles in their ordered arrangement when the trays are in the article arranging relation adapted to remove the articles from the trays and to transport them to a packing container in said ordered arrangement.

13. In apparatus for packing a plurality of substantially uniform articles, means to arrange said articles in a predetermined order comprising a supply chute adapted to direct a plurality of said articles along a predetermined path of travel; pre-orienting means carried by said chute to divert said articles in respective parallel adjacent paths of travel defined by said means; a supply gate mounted on the chute and adapted for movement between a position blocking said parallel paths of travel and a displaced admitting position; a charging station supported on the chute, disposed in receiving relation thereto downstream from said supply gate, and being adapted to receive a predetermined quantity of said articles; an admission gate mounted on said chute and supported in a position spaced downstream from said supply gate to define therebetween said charging station, said admission gate being adapted for movement between a blocking position and a displaced admitting position; an orienting station disposed in receiving relationship to said charging station, including reception means longitudinally aligned with said parallel paths of travel and adapted to hold said predetermined quantity of articles; means resiliently supported on said charging station and defining a longitudinal limit thereof opposite from said admission gate; individual power means respectively operatively connected to each of said gates and adapted to displace the same to respective admitting positions; and interlock means preventing the displacing of said supply gate when said admission gate is displaced from said blocking position.

14. In apparatus for packing a plurality of substantially uniform articles; means to arrange said articles in a predetermined order comprising a supply chute adapted to constrain a plurality of said articles along a predetermined path of travel; pre-orienting means carried by said chute to divert said articles in respective parallel adjacent paths of travel defined by said means; a supply gate mounted on the chute and adapted for movement between a position blocking said parallel paths of travel and a displaced admitting position; a charging station supported on the chute, disposed in receiving relation thereto downstream from said supply gate, and being adapted to receive a predetermined quantity of said articles in said parallel paths of travel; an admission gate; means supporting the admission gate downstream from said supply gate to define therebetween said charging station, said admission gate being adapted for movement between a blocking position and a displaced admitting position; an orienting station disposed in receiving relationship to

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said charging station and including reception means longitudinally aligned with said parallel paths of travel and adapted to hold said predetermined quantity of articles; means resiliently supported on said charging station and defining a longitudinal limit thereof opposite from said admission gate; individual power means respectively operatively connected to each of said gates and adapted to displace the same to respective admitting positions; and interlock means preventing the displacing of said admission gate when said supply gate is in displaced position.

15. The apparatus of claim 14 wherein interlock means is operatively connected between said gates to prevent the displacing of said supply gate when said admission gate is in admitting position.

16. In apparatus for arranging a plurality of substantially uniform articles in a predetermined order and packing said articles while in said order, the combination of a supply chute adapted to constrain a plurality of said articles along a predetermined path of travel, the chute having a predetermined number of transversely spaced parallel pre-orienting channels guiding said articles in respective parallel paths of travel; a supply gate mounted on the chute and adapted to be moved from a lowered position blocking said paths of travel to a raised position; an admission gate disposed downstream from said supply gate and carried by the chute for movement between a lowered blocking position and an elevated admitting position; said supply and admission gates defining therebetween a charging station holding a predetermined quantity of said articles arranged in parallel adjacent columns; article orienting means disposed downstream from said admission gate and affording elongated receiving trays, said orienting means including support means normally supporting the trays in a receiving position aligned with the columns of said charging station; individual power means respectively operatively connected to each of said gates; interlock means in control relationship with each of said power means to prevent raising of either of said gates when the other is in an elevated position; sensing means in said charging station to detect said predetermined quantity therein; a control circuit for said supply gate power means and including said sensing means to lower said gate when said predetermined quantity is contained in said charging station; means to detect the presence of said quantity of the articles in said orienting station; power means to effect a movement of said articles in the orienting station to a predetermined order of arrangement by transverse gathering and longitudinal compression of said columns; and means to detect the movement of said articles to said predetermined order.

17. In apparatus for packing a plurality of substantially uniform articles in a predetermined order of arrangement, orienting means to admit and confine a predetermined quantity of said articles and arrange said quantity in said predetermined order; a pickup head; extensible support means for the head including elevational power means adapted to move said head between a raised transport position and a lowered position; means mounting said extensible means for rotation about a substantially upright axis; rotational power means to effect circumferential movement of said pickup head about said axis between predetermined elevated pickup and packing azimuthal positions respectively overlying said orienting means and a receiving container spaced from the orienting means; a plurality of inflatable resilient gripping fingers carried by said head and arranged to grasp said articles while in said predetermined order; a source of pressure fluid; fluid control means selectively establishing communication between said source and said fingers to admit pressure fluid thereto and also selectively venting pressure fluid from the fingers; sensing means to detect the presence of articles in said orienting station and adapted to control said elevational power means; sensing means to detect the presence of pressure fluid in said fingers; and interlock means connected between both of said sensing

means to effect sequential operation of said elevational power means, rotational power means and said pressure fluid control valve means to lower the pickup head while in a pickup azimuthal position only when the orienting station contains said predetermined quantity, to inflate the fingers and grasp said quantity of articles, to raise the head to a transport position, to move the head to an elevated packing azimuthal position, to lower the head to a lowered packing position, to release the articles by venting said fingers, and to return the head to an elevated pickup position.

18. Apparatus for arranging and packing a plurality of substantially uniform articles in a predetermined quantity and order of arrangement comprising a pair of laterally spaced elongated longitudinally inclined supply chutes adapted to constrain a plurality of said articles along a predetermined path of travel under the influence of gravitational force, each of said chutes having a predetermined number of transversely spaced parallel preorienting channels; said chutes being individually, alternately, transversely inclined to insure a substantially equal supply of said articles to respective parallel adjacent paths of travel defined by said channels; each of said chutes having a charging station supported in receiving relationship thereto and adapted to hold said predetermined quantity of articles in pre-oriented positions; individual supply gates pivotally mounted on each of said chutes and adapted for movement between a lowered position normally blocking communication between each chute and the respective charging station thereof and a raised position permitting entry of articles to said station; power means operatively connected to each of said supply gates and adapted individually to raise each of said gates, and including means to retard the raising and lowering of said gates; control means for each of said supply gates and incorporating means to sense the presence of a predetermined quantity of articles in each charging station and thereby disable said power means permitting gravitational lowering of the supply gates, the retarding means being proportioned to the supply gate so that a predetermined raising and lowering cycle time is effected of sufficient length relative to the inclination of the chutes to permit said predetermined quantity to enter said charging station during said cycle time; a plurality of parallel, transversely spaced, elongated receiving trays; means supporting the trays in respective longitudinal alignment with said parallel paths of travel defined by said channels, including means permitting transverse movement of the trays to effect intimate contact between the articles supported in adjacent trays; an admission gate; means supporting the admission gate for movement between a lowered position blocking communication between said charging station and said trays and a raised position admitting said predetermined quantity of articles to said trays, said trays constituting an orienting station; power means to effect selective raising and lowering of said admission gate, including control means to determine the cycle time of said raising and lowering so that said cycle time is sufficient to permit entry of said predetermined quantity within said orienting station when said admission gate is raised; power means to effect lateral compression of the articles transversely of said trays; power means to effect longitudinal compression of the articles in said trays so that said articles are compressed transversely and longitudinally of the trays and maintained in a predetermined order of contiguous, alternately staggered columns; a cylindrical mast including an extensible upwardly disposed rod supported thereon; means supporting the

mast intermediate said chutes and substantially centrally located relative to said orienting stations; a crosshead secured to said rod and providing opposite ends; a pair of pickup heads, each being secured to a respective one of said opposite ends; a plurality of inflatable gripping members carried by each of said heads and adapted to be individually distended toward adjacent members upon inflation thereby to grip said articles therebetween; pressure fluid supply means, including control means, in fluid communication with said members to effect selective inflation and deflation thereof; rotational power means operatively connected to said mast and adapted to rotate the mast between a predetermined azimuthal Ready position wherein said pickup heads overlie respective chutes, a predetermined azimuthal A-Pack position wherein one of said heads overlies a predisposed receiving container, and a predetermined azimuthal B-Pack position wherein the other of said heads overlies said container; elevational power means operatively connected to said mast and adapted to reciprocate the mast between a raised transport position and a lowered position; separate control means for said rotational power means and said elevational power means; and interlock means connected between said pressure fluid supply means and said separate control means to prevent raising of said mast from a lowered Ready position until said gripping members have been inflated to grip said articles.

19. The apparatus of claim 18 wherein interlock means are connected between said separate control means to permit rotation of said mast only when in a raised transport position.

20. The apparatus of claim 18 wherein sensing means are provided in communication with said gripping members to detect inflation and deflation thereof and wherein interlock means are connected between said lateral compression power means and said sensing means to disable said power means while the gripping members of said one head are inflated.

21. In an apparatus for packing a plurality of substantially uniform articles, the combination of a plurality of elongated article receiving trays; means for supplying articles to the trays so that the articles are disposed therein in rows; article engaging means for compressing the articles longitudinally of their respective rows into intimate contact; means supporting the trays in substantially parallel relation for transverse reciprocal movement between predetermined article receiving positions with the trays transversely spaced and article arranging positions with the trays in more closely adjacent relation with the articles compressed transversely of the rows into intimate contact; means operably associated with the tray mounting means successively moving said trays between said positions, and means engageable with said articles when the trays are in the article arranging position adapted to remove the articles from the trays and to transport them to a packing container in said intimate contact longitudinally and transversely of said rows.

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Disclaimer

3,292,341.—*James D. Frost*, Porterville, Calif. ORIENTING AND PACK-
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filed Jan. 10, 1977, by the inventor.

Hereby enters this disclaimer to all claims of said patent.

[*Official Gazette October 4, 1977.*]