United States Patent

[11] 3,596,747

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[73] Assignee **Alto Company York, Pa.**

[54] **BAKERY-PRODUCT-STACKING METHOD AND APPARATUS**
38 Claims, 22 Drawing Figs.

[52] **U.S. Cl.** **198/35, 198/33**
[51] **Int. Cl.** **B65g 57/00**
[50] **Field of Search** ..... 198/33 R, 35; 314/6 F

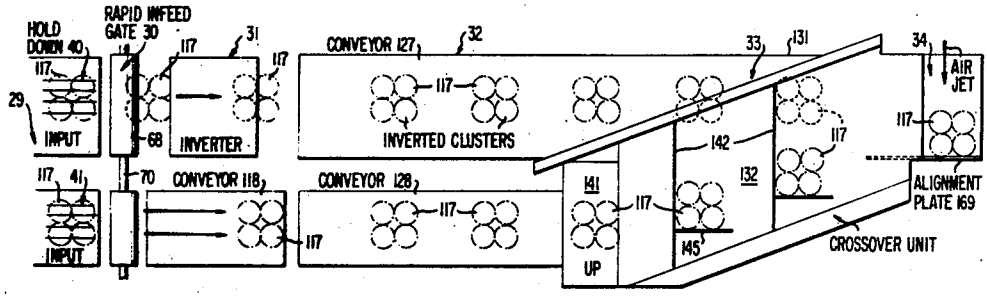
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ABSTRACT: Bakery product units are received from a depanner and/or slicer at a marshaling station in two discrete rows. Product units from the two rows are then released in a controlled manner and are advanced in timed relation with or without inversion of the units in one or both rows. The product units in one row move gradually into superposed relation with corresponding product units of the second row and each superposed pair of product units is then engaged and advanced in unison until stacked registering relationship of each superposed pair is attained.



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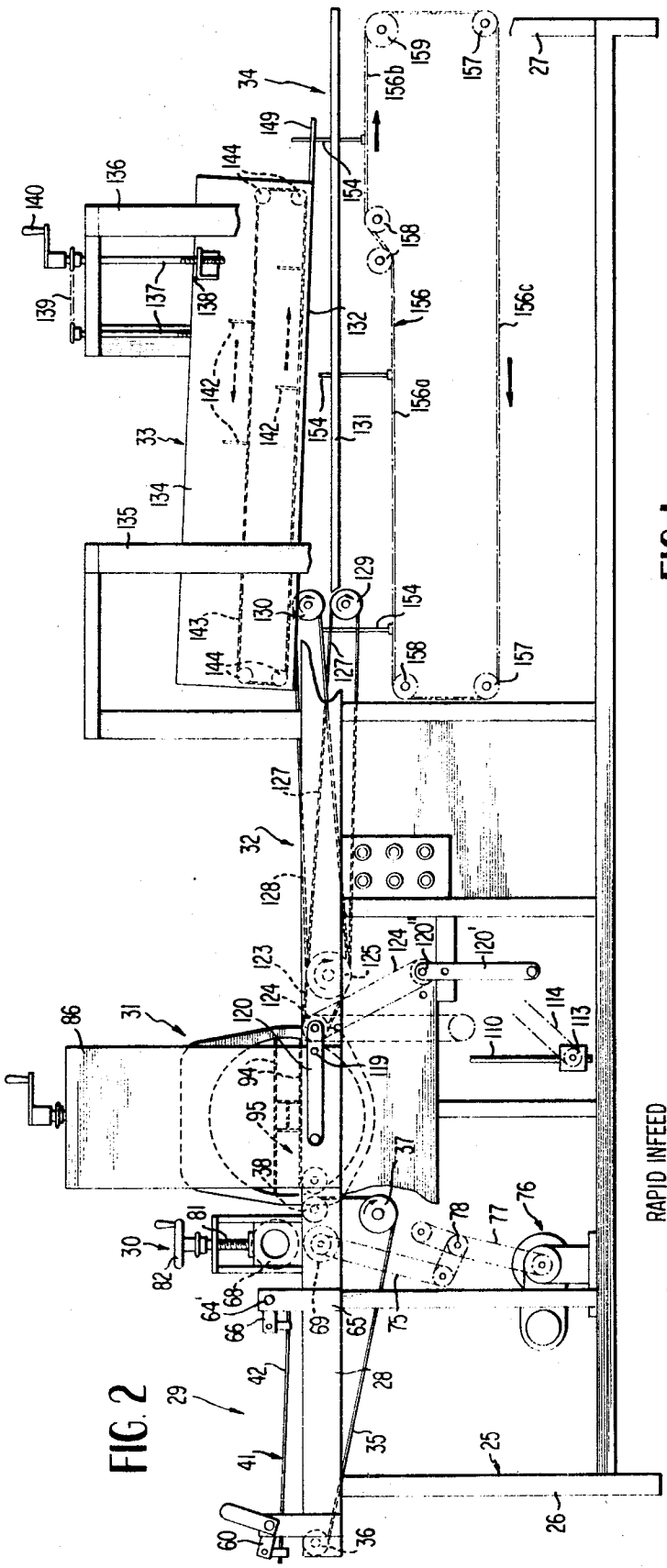


FIG. 2

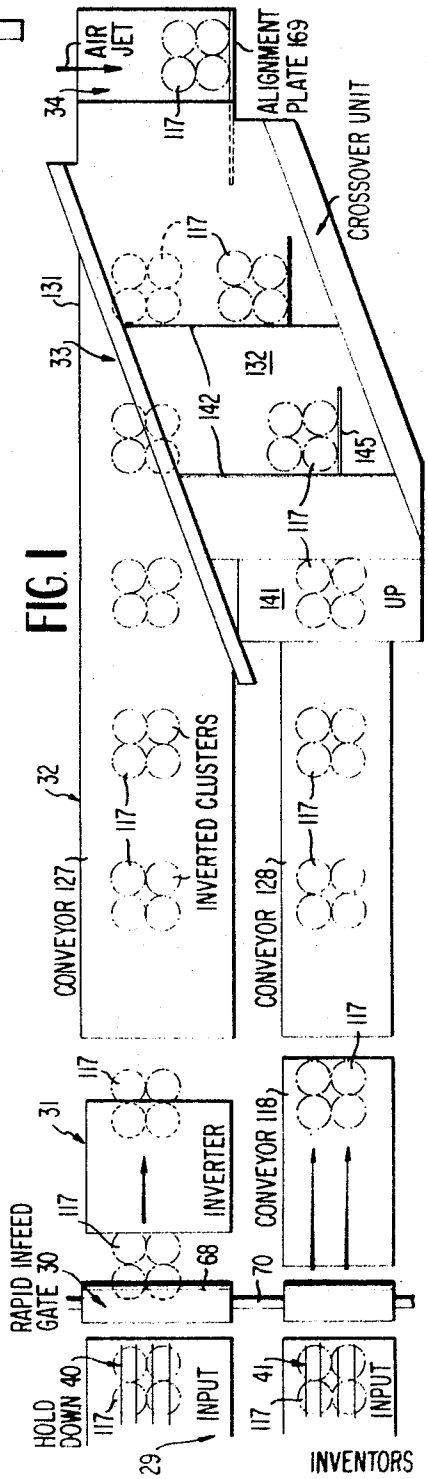


FIG. 1

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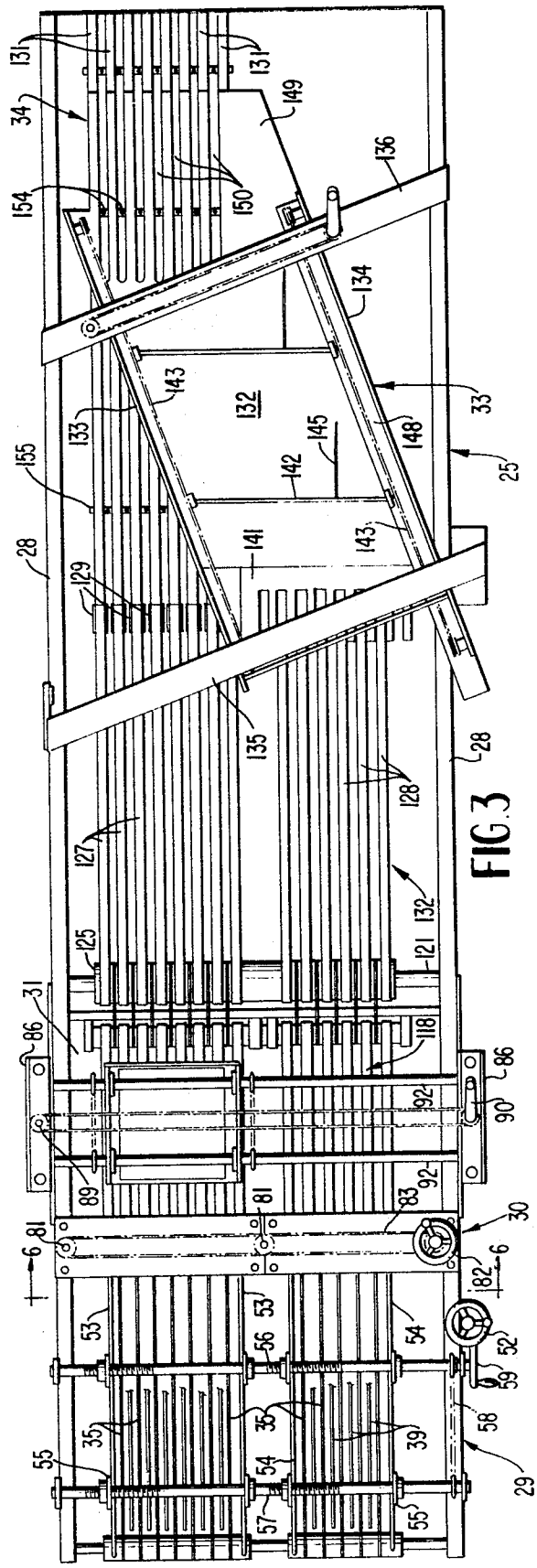


FIG. 3

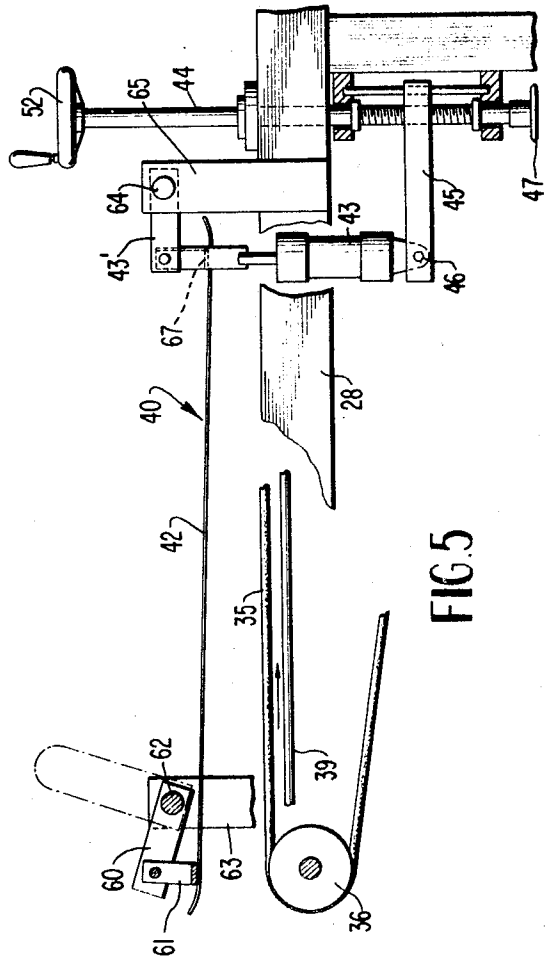


FIG. 5

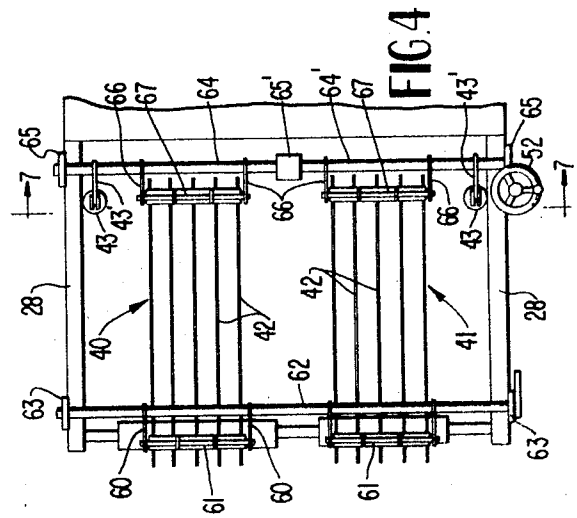


FIG. 4

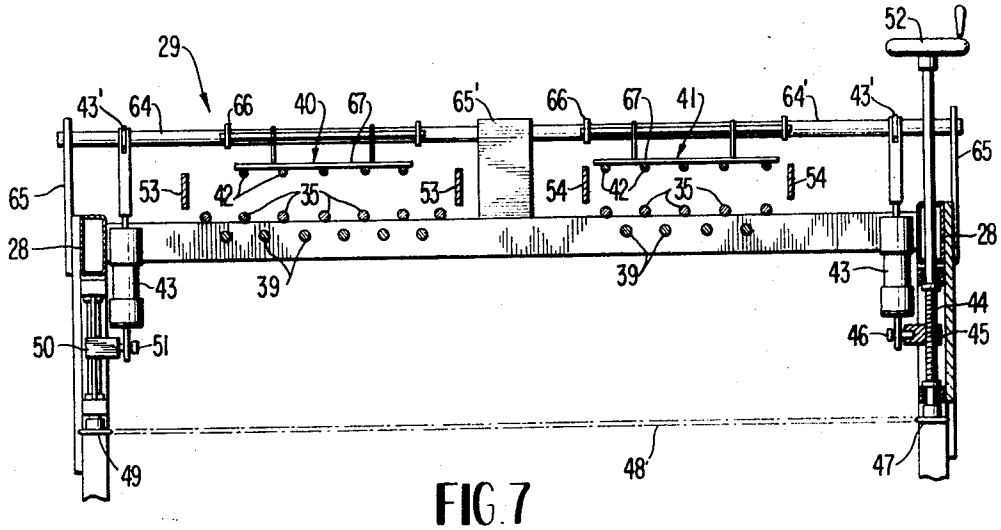

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FIG. 7

FIG. 6

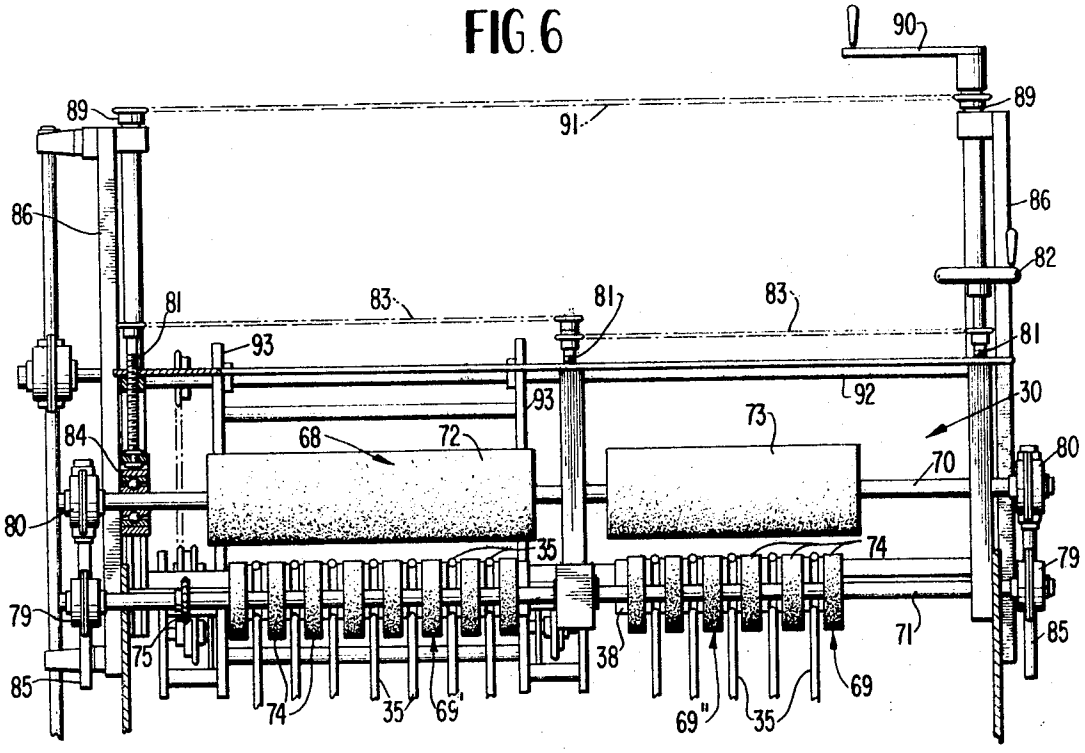
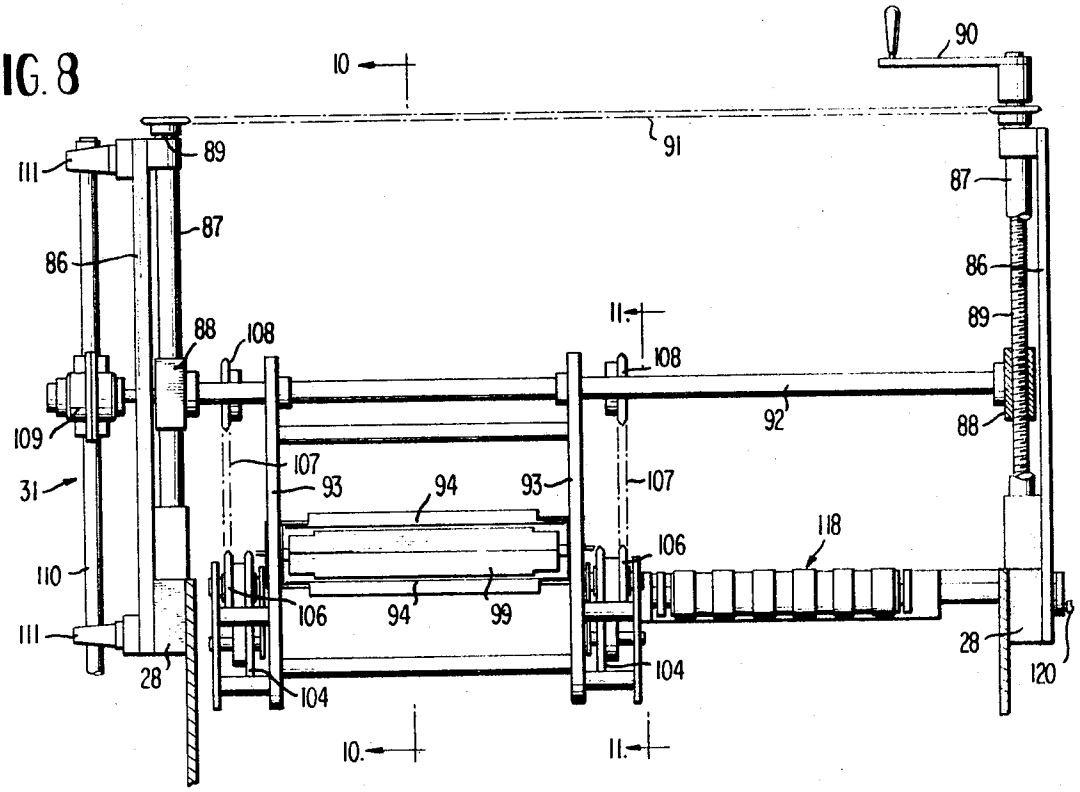

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FIG. 8


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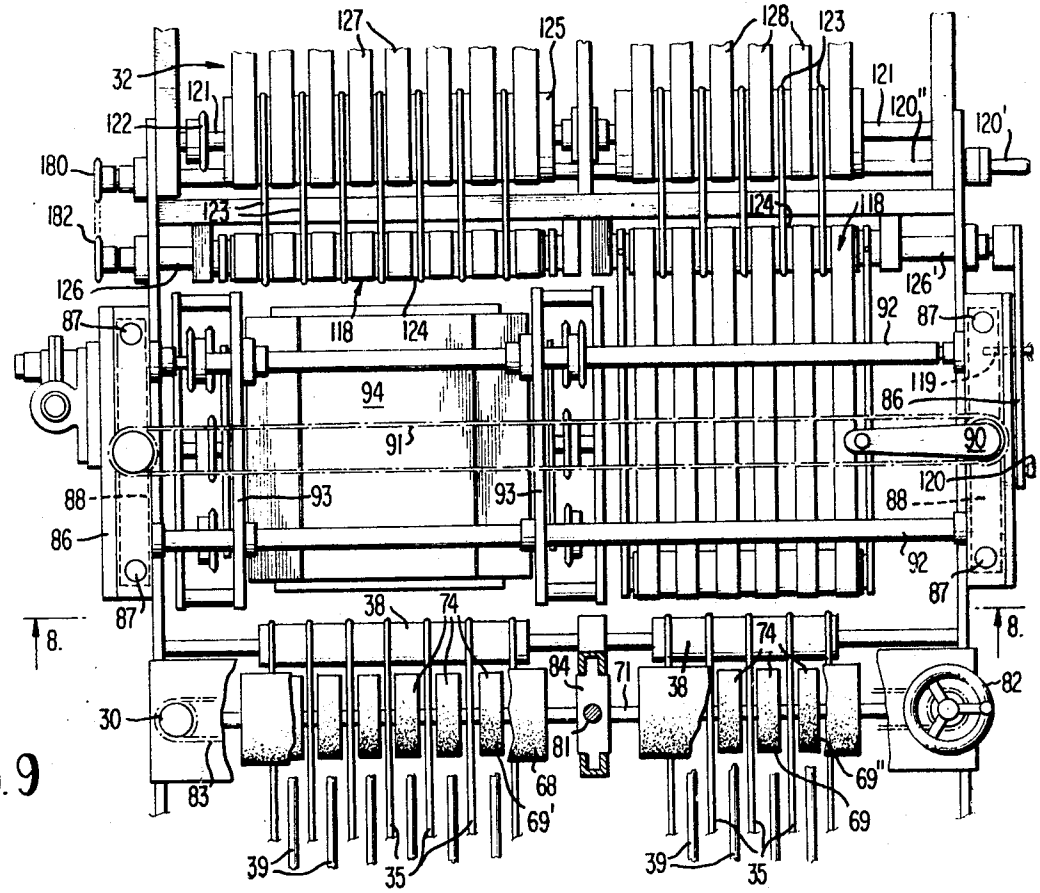

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FIG. 9

FIG. 10

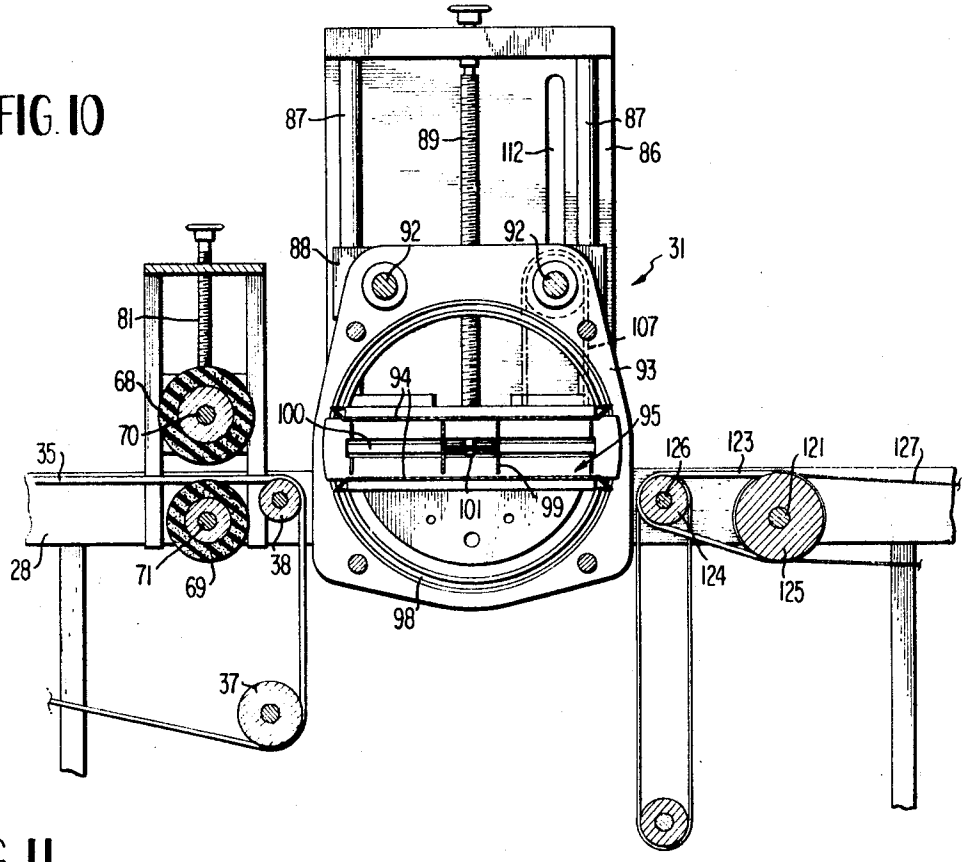


FIG. 11

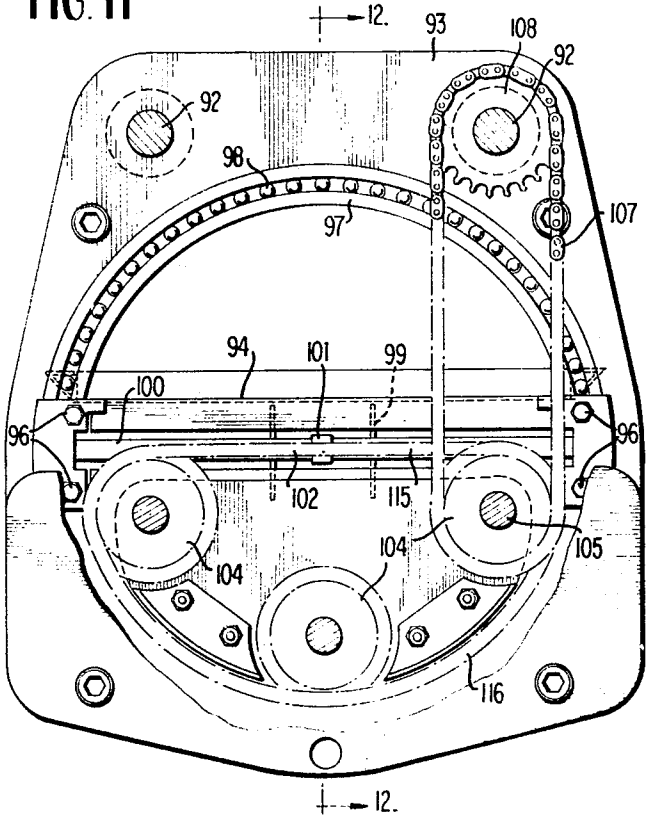
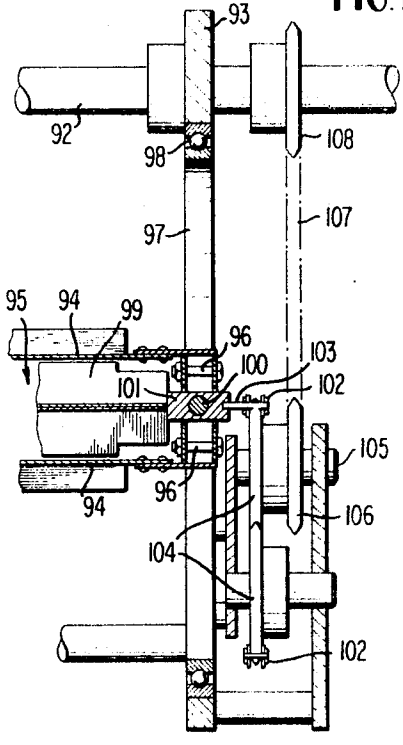


FIG. 12



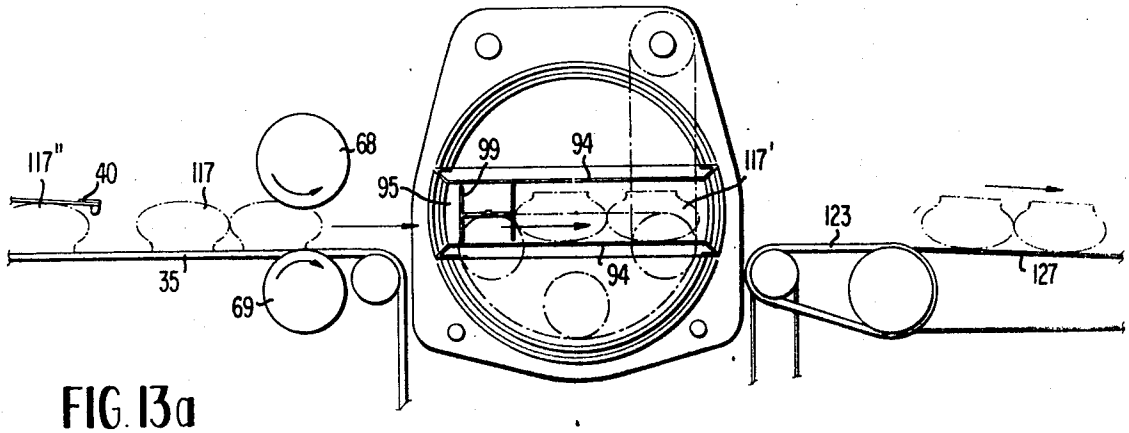


FIG. 13a

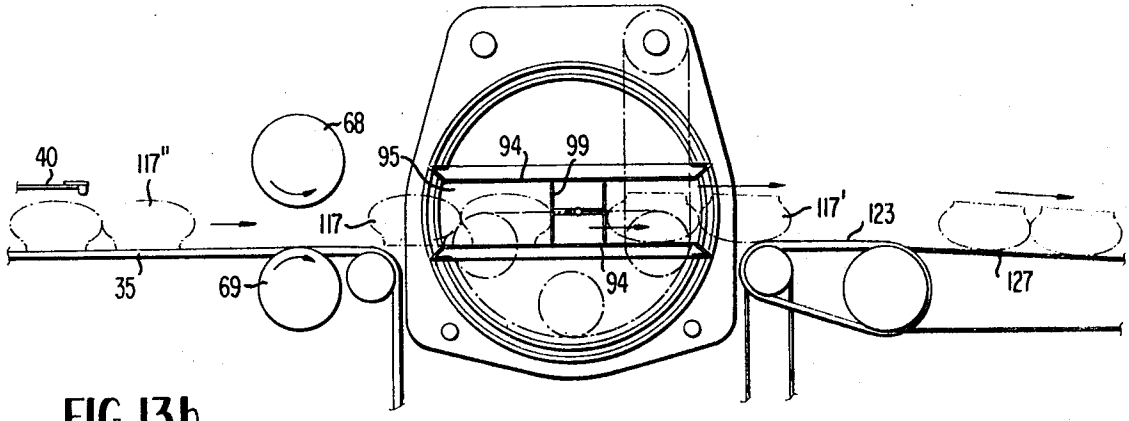


FIG. 13b

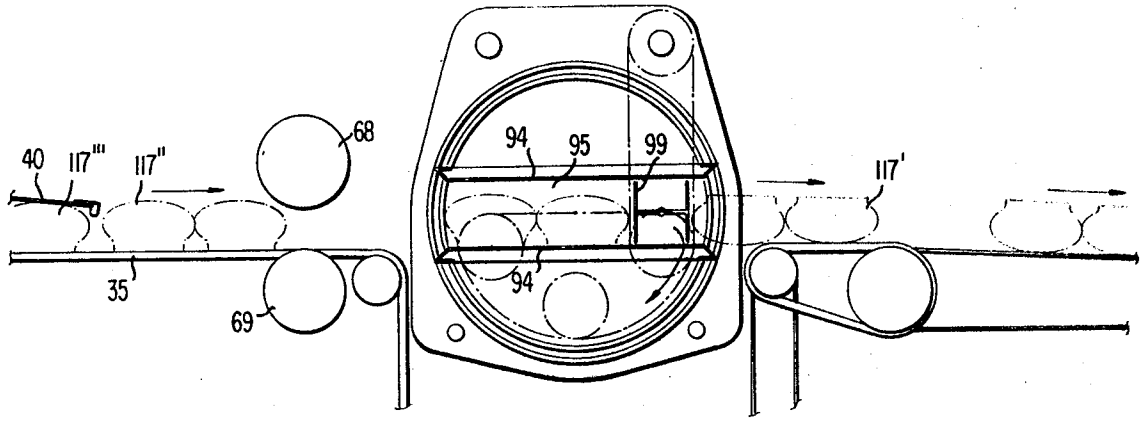


FIG. 13c

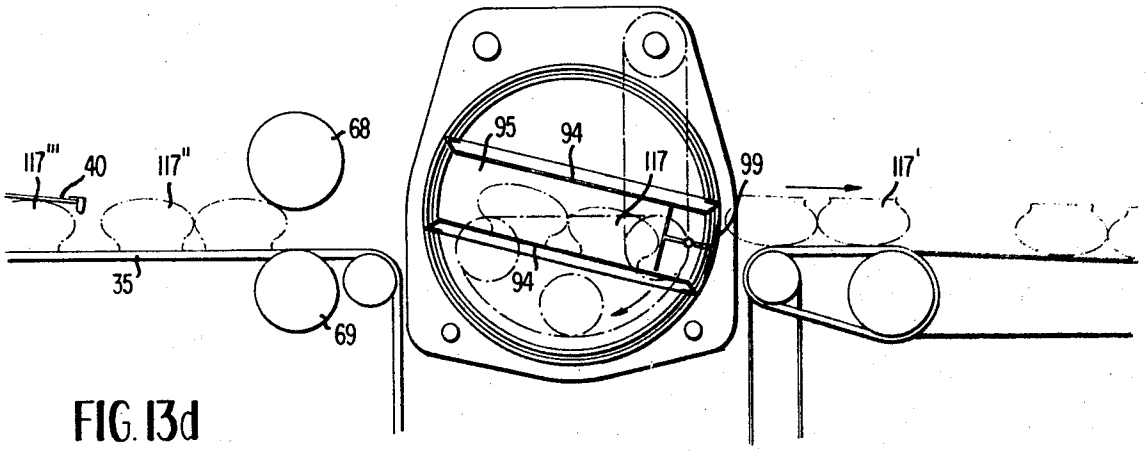


FIG. 13d

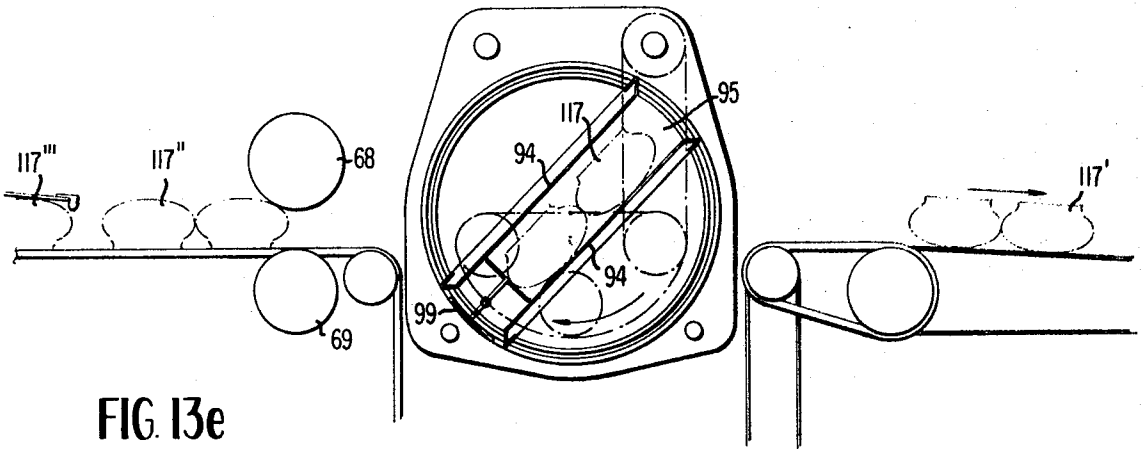


FIG. 13e

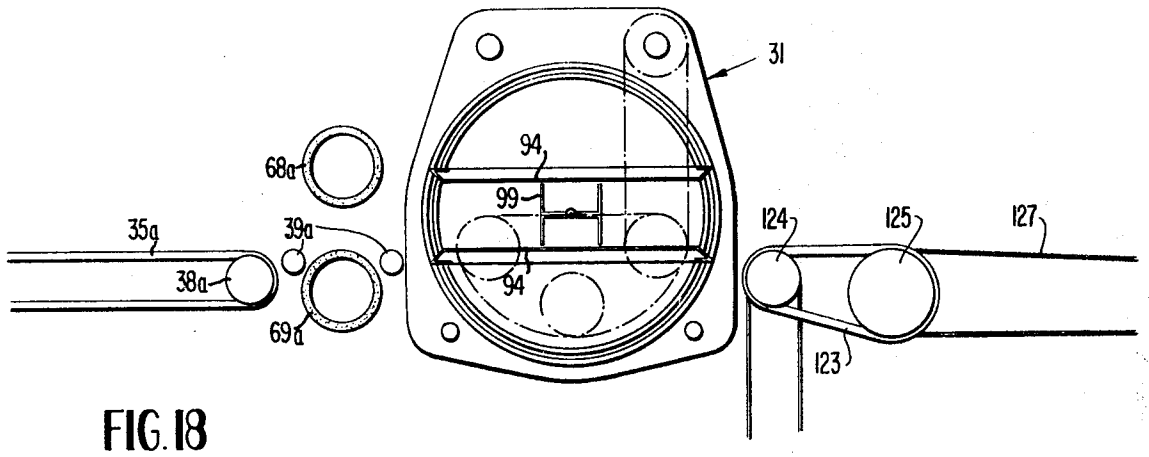


FIG. 18

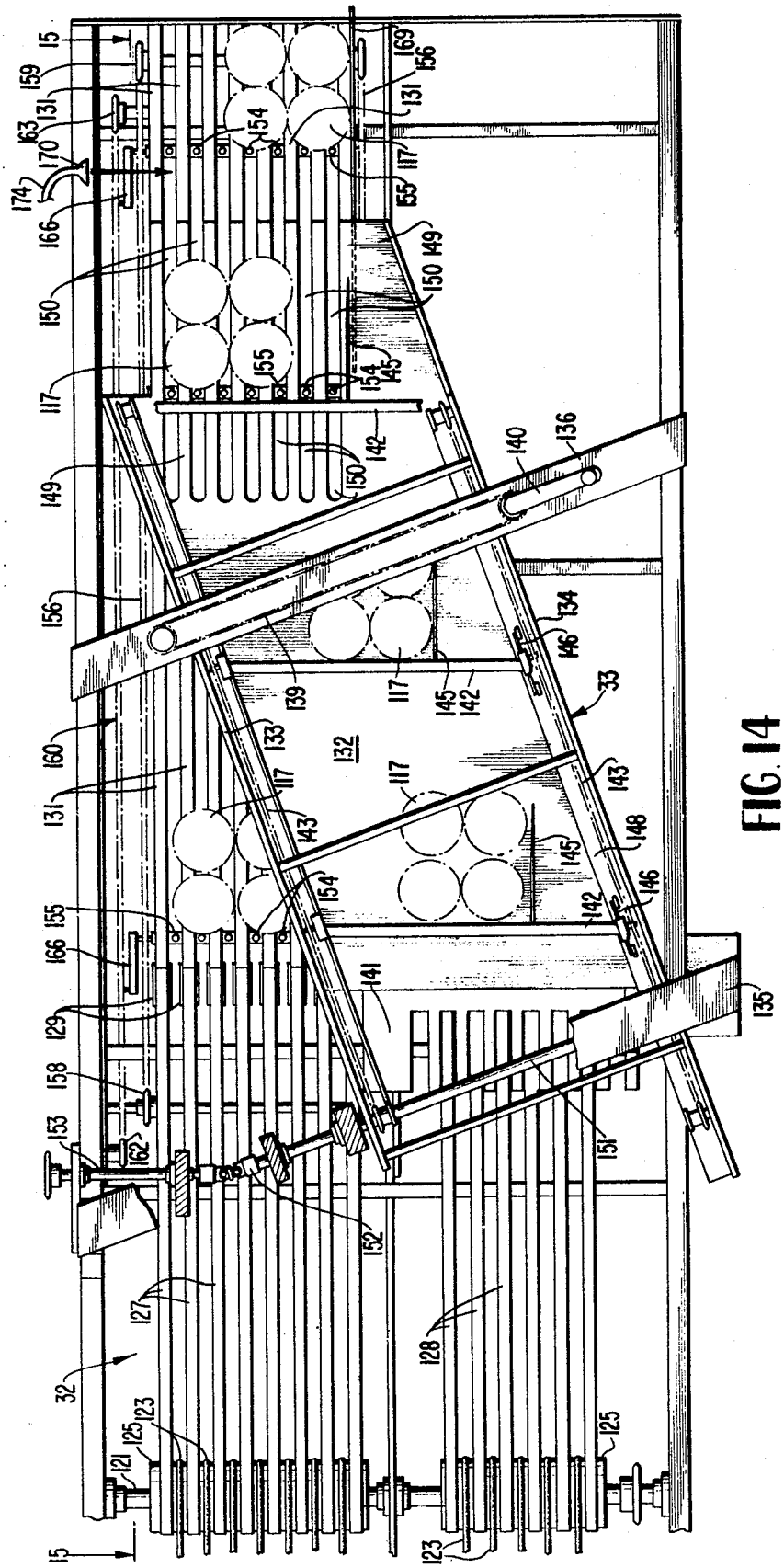

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FIG. 14

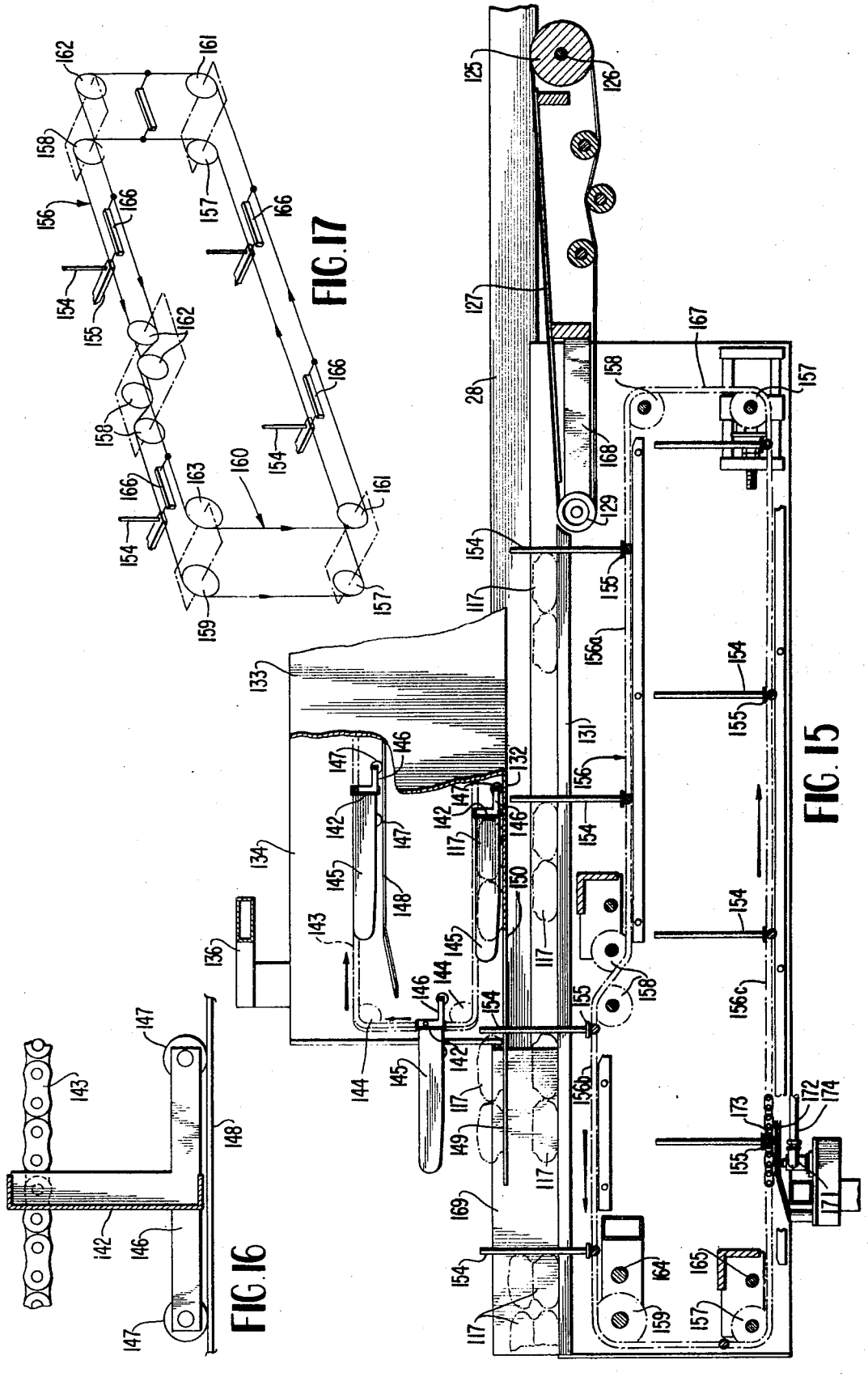


FIG. 15

FIG. 16

FIG. 17

BAKERY-PRODUCT-STACKING METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

Machines and devices are known in the prior art for stacking bakery products, such as roll clusters, as the products are traveling from a depanner or slicer toward packaging equipment. One example of such a prior art machine is found in U.S. Pat. No. 3,322,314, issued May 30, 1967, to Irving, Jr. et al. As disclosed in this patent, bakery product units are advanced from a marshaling zone to a turnover station. Forward movement of one product unit in each lateral pair of units is arrested while the companion unit is lifted and turned over laterally and is dropped freely on top of the second unit in stacked relationship. The stacked product units are then advanced from the turnover station by a conveyor toward packaging equipment or the like. While the patented machine operates satisfactorily, it has certain inherent deficiencies, the most important of which is lack of desirable speed in stacking the product units. Additionally, the mode of operation involving lifting of one product unit and allowing it to fall freely through a considerable distance onto the second unit is somewhat awkward and slow and requires extremely accurate timing and alignment of parts.

The invention method and apparatus improves greatly upon the prior art in that the invention is much faster and more reliable in achieving accurate stacking and registration of product units with or without inversion of one or both units in each pair and with the elimination of the dropping or free falling movement of one product unit upon the other, noted above. In the present invention, laterally related product units are moved in a controlled manner from a marshaling station and optionally the units in either of two discrete rows or both rows may be quickly inverted individually without being displaced on their main path of movement. The product units in one row are gradually moved diagonally toward superposed relation with corresponding product units of the second row and companion superposed units are then engaged by a common conveying means and advanced gently into stacked registering relation without any appreciable dropping or free falling of the top product unit in the stacked pair. The process is continuous, very reliable and quite rapid. Furthermore, the apparatus employed in the practice of the method is relatively simple in construction, fully adjustable and economical.

SUMMARY OF THE INVENTION

Clusters of rolls or similar bakery products are received from a depanner and/or slicer on a inlet conveyor means in discrete parallel rows at a product-marshaling station. Holddown means is provided at the marshaling station to arrest movement of the product units in a controlled manner without damaging them. Leading product units in the rows are engaged by rapid infeed gates or rollers which deliver the leading clusters in properly timed relationship to an inverter device and a conveyor or, optionally, to a pair of conveyors if inversion is not desired, or to a pair of inverters.

Laterally related pairs of product units are advanced away from the inverting zone and one unit of each pair is conveyed upwardly slightly and is carried diagonally toward the other product unit in the related pair until the two units are superposed. At this point, a pusher means common to the superposed pair of product units engages the pair and further advances the pair while they move gently into stacked relation and are further aligned by an abutment member and an aligning airjet. From this point, the accurately stacked product units can be carried to a packaging machine or the like by a conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view of the method and apparatus embodying the invention;

FIG. 2 is a partly diagrammatic side elevation of the apparatus;

FIG. 3 is a plan view of the apparatus with parts removed and omitted for clarity of illustration;

FIG. 4 is a fragmentary plan view of product holddown means omitted in FIG. 3;

FIG. 5 is an enlarged fragmentary side elevational view, partly in section and partly broken away, showing the infeed conveyor and product holddown means;

FIG. 6 is an enlarged transverse vertical section taken on line 6–6 of FIG. 3;

FIG. 7 is a similar section taken on line 7–7 of FIG. 4;

FIG. 8 is a transverse vertical section taken on line 8–8 of FIG. 9;

FIG. 9 is a fragmentary plan view on an enlarged scale of that portion of the apparatus depicted in FIG. 8 adjacent the turnover device and associated elements;

FIG. 10 is a fragmentary longitudinal vertical section taken on line 10–10 of FIG. 8;

FIG. 11 is a similar and enlarged section taken on line 11–11 of FIG. 8;

FIG. 12 is a vertical section taken on line 12–12 of FIG. 11;

FIGS. 13*a* through 13*e* are partly diagrammatic side elevational views of the turnover device in various positions during a cycle of operation;

FIG. 14 is an enlarged fragmentary plan view of the discharge end portion of the apparatus adjacent the diagonal crossover means and associated components;

FIG. 15 is a longitudinal vertical section taken on line 15–15 of FIG. 14;

FIG. 16 is an enlarged fragmentary side elevation of a chain propelled pusher on the diagonal crossover device;

FIG. 17 is a diagrammatic perspective view of chain propelled pushing finger or pin elements and the means for keeping them erect during movement;

FIG. 18 is a partly diagrammatic view similar to FIG. 10 showing a modification.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings in detail, wherein like numerals designate like parts throughout the same, reference is made first to FIGS. 2 and 3 which show the apparatus in its entirety. In these figures, a supporting framework 25 is shown for positioning the several working components of the apparatus at a convenient elevation above the floor and this framework includes end leg units 26 and 27 as shown and a pair of main upper horizontal side rails 28 constituting the bed of the apparatus. The details of the framework 25 may be varied and are not important.

Continuing to refer to FIGS. 2 and 3, the product intake end of the apparatus constitutes a product-marshaling station 29, following which is a rapid infeed means 30 for the leading product units at the marshaling station 29. A product inverting or turnover means 31 is disposed close to the infeed means 30 to receive product units directly therefrom and following the turnover means is a conveyor section 32 of the apparatus which carries discrete rows of the product units in a controlled manner toward a stacking and discharge station. A diagonal crossover conveyor device 33 is provided to convey product units from one row into superposed relation with companion units of the second row. Finally, the apparatus includes a discharge station or means 34 where the pairs of product units are brought into stacked registering relation and proper alignment prior to delivery to packaging equipment or the like.

MARSHALING STATION

The marshaling station 29, referring to FIGS. 2 through 6, comprises two laterally spaced groups of horizontal parallel longitudinal product intake conveyor belts 35 which are endless and engage about rollers 36, 37 and 38, as shown. The belts 35 are relatively slack so that they may yield readily

under the force of certain product holddown means, to be described. Closely beneath the conveyor belts 35 and midway between adjacent pairs of the belts, FIG. 6, are stiff rods 39 which engage the bottoms of the product units when the latter are clamped by the said holddown means. These rods 39 are fixed relative to the belts 35 and are supported on the frame structure 25 in any desired manner.

Above the belts 35 are substantially horizontal product holddown grids 40 and 41 comprising rigidly connected spaced parallel rods 42, FIGS. 4, 5 and 6. The two grids 40 and 41 are independently operable above the respective groups of belts 35 and their purpose is to clamp the product units moving with the relatively slack belts 35 against the stationary rods 39 to thereby arrest the movement of the product units while the belts slide harmlessly thereunder.

The forward ends of the grids 40 and 41 are independently raised and lowered by fluid pressure operated vertical cylinder piston units 43 disposed near and inwardly of the frame said rails 28, FIGS. 5 and 7. The extensible and retractable piston rods of these units are pivotally connected at their tops with crank arms 43 rigid with a supporting cross-shaft, to be described. The cylinder piston units 43 are also bodily adjustable vertically relative to the apparatus framework by means of a vertical screw shaft 44 carrying a nut member 45 connected at 46 to the bottom of one unit 43. The lower end of screw shaft 44 carries a sprocket gear 47 connected with a horizontal transverse sprocket chain 48 which in turn engages a sprocket gear 49 on the lower end of a second vertical screw shaft near the opposite side of the apparatus, carrying a nut 50 connected at 51 with the second cylinder piston unit 43. By turning the hand wheel 52 of screw shaft 44, both units 43 may be bodily raised and lowered in unison. The units 43 are utilized to raise and lower the holddown grids 40 and 41 with respect to bakery products of a given size or thickness. When products having a significantly greater or lesser thickness must be accommodated by the apparatus, the screw shaft 44 is utilized to raise or lower the units 43.

The rear ends of the grids 40 and 41, FIG. 5, are suspended from crank arms 60 by bracket members 61 pivoted thereto, the arms 60 being carried on a cross shaft 62 supported at its ends by bearing plates 63 on the side rails 28. A two-part cross-shaft 64–64' mounted on upstanding bearing plates 65 and a center bearing 65' near the forward ends of the grids 40 and 41 carries crank arms 66 from which the forward ends of the holddown grids are suspended by bracket means 67. The previously described crank arms 43' connected with the raising and lowering units 43 are secured to the cross-shaft sections 64–64', as noted.

In order to assembly or marshal the bakery product units such as clusters of hamburger rolls, in two discrete rows at the marshaling station 29, pairs of laterally spaced parallel guide bars 53 and 54 are provided closely above the belts 35. The guide bars are carried by dependent arms 55 on transverse screw shafts 56 and 57. The parallel screw shafts are operatively connected by sprocket gearing 58 and the shaft 56 carries a hand wheel 59 to facilitate turning it. By utilizing this hand wheel, the spacing between the pairs of guide bars may be adjusted for proper guidance of the product units in the two discrete rows.

RAPID INFEED STATION

The mentioned rapid infeed means 30 which advances laterally spaced pairs of product units away from the marshaling station in timed relation comprises upper and lower relatively large diameter infeed rollers 68 and 69, mounted on rotatable shafts 70 and 71 to turn therewith, said shafts being in vertical alignment. The rollers 68 and 69 are each formed in two sections 72 and 73 and 69' and 69'', respectively, FIG. 6. As best shown in FIG. 10, the infeed rollers have a solid core and an outer heavy layer of soft compressible material such as foam rubber or foam plastic so that the rollers are resilient. The lower roller 69, FIG. 6, is also formed in plural segments 74 to provide clearance for the belts 35 passing forwardly to the guide roller 38, FIG. 10. The upper runs of belts 35 are generally tangent to the top of roller 69 so that these belts may carry the product units to the rapid infeed rollers when the units are released by holddown grids 40 and 41. The two sections 72 and 73 of the upper infeed roller are entirely covered with the compressible material, whereas this material is applied in strips to the lower roller segments 74.

As shown in FIG. 2, the lower roller 69 is driven through suitable gearing 75 which may include clutch and brake means, not shown, by means of which the infeed rollers are intermittent in operation. The gearing 75 derives power from a main motor 76, and additional gearing 77 connected with the motor 76 drives a main transverse drive shaft 78 from which other powered components of the apparatus are driven, as will be described.

Driving power from the shaft 71 and roller 69 is transmitted to the upper shaft 70 and roller 68 by conventional right angular drives 79 and 80 whose details need not be described. As viewed in FIG. 2, the upper infeed roller 68 will turn counterclockwise whereas the lower roller 69 will turn clockwise so that the product units passing therebetween will be fed away from the marshaling station 29 by the soft sponge infeed rollers.

The upper roller 68 is vertically adjustable through the medium of vertical screw shafts 81, one of which has a hand wheel 82 thereon. The several screw shafts 81 are connected for turning in unison by chain gearing 83, and when the screw shafts are turned, they cause the raising or lowering of bearing assemblies 84 within which the shaft 70 is journaled and supported. The shaft 71 for roller 69 remains at a fixed elevation. Vertical drive shafts 85 interconnecting the right angular drives 79 and 80 move upwardly and downwardly with the drives 80 when the shaft 70 is vertically adjusted by turning the hand wheel 82. The shafts 85 transmit power between the drives 79 and 80 in all adjusted positions and this construction is conventional regarding the shafts 85.

TURNOVER STATION

The turnover means 31 comprises vertical support plates 86 secured rigidly to the frame rails 28 and extending thereabove for a considerable distance. Pairs of vertical guide bars 87 are secured rigidly to the plates 86 close to their inner sides, and vertically shiftable crossheads 88 engage the guide bars 87 and are adjustable thereon under the influence of vertical screw shafts 89 also near the plates 86, one of which is equipped at its top end with a hand crank 90. The two screw shafts 89 are interconnected by chain gearing 91 so as to turn in unison for raising and lowering the crossheads 88 which have screw-threaded engagement with the adjusting screw shafts. The crossheads 88 carry a pair of spaced transverse horizontal bars 92 at one elevation and these bars are raised and lowered in unison by turning the crank 90.

The product inverting or turnover mechanism shown in detail in FIGS. 10 through 13*e* constitutes an important feature of the invention and comprises vertical frame sides 93 suspended from the bars 92, as shown, whereby the entire mechanism carried by the frame sides 93 may, when required, be manually adjusted laterally along the bars 92 to position the turnover device at either side of the apparatus for inverting product units in either discrete row. As shown, the turnover mechanism is positioned at the left-hand side of the apparatus as viewed in FIGS. 6 to 9 and will be described in this position. The remaining elements of the turnover mechanism, now to be described, are bodily carried by the frame sides 93 and are thus movable therewith when the mechanism is raised and lowered by the screw shafts 89 or shifted laterally, as described.

Referring now to FIGS. 10 through 13*e*, the turnover mechanism further comprises a pair of spaced parallel plates 94 forming between them a relatively shallow passage 95 for product units which are to be inverted while remaining on

their same longitudinal path of travel, that is, without lateral displacement. The two plates **94** forming this passage **95** are secured as at **96**, FIG. **12**, to the inner race **97** of a large ball bearing **98** whose outer race is fixedly held in the frame side **93**, FIGS. **11** and **12**. The same construction is present on both sides of the turnover mechanism for attaching the ball bearing to the element **93** and for attaching the plates **94** to the inner race of the ball bearing.

The mechanism further includes a reciprocating pusher plate or member **99** which traverses the passage **95** from one open end thereof to the other end, as shown in FIGS. **13***a* to **13***e*. The pusher plate **99** is guided in its movement by guide rods **100** which are also secured to the internal races **97** of the two bearings. The opposite sides of the pusher plate unit carry extensions **101** which are slidably mounted on the rods **100**, as best shown in FIG. **12**.

A drive chain **102** for the turnover mechanism travels in a D-shaped path as depicted in FIG. **11** including an upper horizontal run and a lower approximately semicircular run. One such chain is provided at each side of the mechanism and is connected as at **103**, FIG. **12**, with one of the elements **101** of the pusher plate. Each chain **102** engages three equidistantly spaced sprocket gears **104**, as indicated, and the shaft **105** of one sprocket gear is powered by another sprocket gear **106**, connected by a chain **107** with an overhead sprocket gear **108** on one of the bars **92** which is rotational. The bar **92** and sprocket gear **108** in turn are driven through a conventional right angular drive unit **109**, vertically movable with the bar **92** on a vertical drive shaft **110** journaled for rotation in bearings **111** which are stationary. A slot **112**, FIG. **10**, is provided in the adjacent plate **86** to allow vertical movement of the end extension of the rotary bar **92** connected with the drive **109**. The vertical shaft **110**, FIG. **2**, is driven near the bottom of the apparatus through another conventional right angular drive unit **113** in turn deriving its power from gearing **114** ultimately connected with and driven by the main motor **76**. Intermediate parts of the main drive gearing leading from the motor **76** have been omitted from the drawings for simplicity and because such gearing is conventional and need not be fully shown for a proper understanding of the invention. It should be apparent, however, that when the vertical drive shaft **110** is driven, power is applied to the bar or shaft **92** carrying sprocket gears **108** and through the related chains **107** and associated gearing shown in FIGS. **11** and **12**, the drive chains **102** will be operated for producing the cycle of momement of the turnover mechanism graphically depicted in FIGS. **13***a*—**13***e*.

As shown in these figures, the upper straight run **115** of each chain **102** constitutes the travel segment of the pusher bar **99**, whereas the lower curved run **116** constitutes the rotational segment of the drive for the parallel plates **94** and associated elements including the interior bearing race **97**. The turnover mechanism in its entirety is actually a constant speed intermittent motion mechanism. As shown in FIGS. **13***a*—**13***e*, the pusher bar **99** is stationary and does not reciprocate relative to the two plates **94** while the turning of the plates is taking place as in FIGS. **13***d* and **13***e*.

Referring first to FIG. **13***a*, the mode of operation is essentially as follows: regarding the turnover means **31**. The shaft **110** is driving the chains **107** and in turn sprocket gears **104** and D-shaped chains **102**. In FIG. **13***a*, the rotational portion of the turnover cycle has just been completed, and the pusher bar **99** is at the rear end of the passage **95** between the two plates **94**, and is moving toward the forward end of the passage and discharging the inverted product unit **117'**. At this moment, the rapid infeed rollers **68** and **69** start to rotate in the direction of the arrows and feed the product unit **117** into the passage **95** immediately behind the moving pusher bar, as further illustrated in FIGS. **13***b* and **13***c*. At this moment, as shown in FIG. **13***a*, the holddown grid **40** is in the down or active position.

In FIG. **13***b*, product unit **117'** is partially discharged from passage **95**. Product unit **117** is partially inside of passage **95** and is now moving at a relatively high velocity to slide completely into the passage until stopped by pusher bar **99** as shown in FIG. **13***c*. The rapid infeed rollers **68** and **69** are still rotating as shown by the arrows in FIG. **13***b* until product unit **117** completely disengages the rollers. The holddown grid **40** elevates when product unit **117** is about three-fourths beyond the nips of the rollers **68** and **69** and allows product unit **117''** to move forwardly with belts **35**. Rollers **68** and **69** propel product unit **117** at a much higher velocity than the belts **35** move product unit **117''**.

In FIG. **13***c*, product unit **117'** is almost completely discharged from passage **95** and pusher bar **99**, together with plates **94**, starts on its circular path as shown by the arrow. Product unit **117** is now completely inside of passage **95** and against pusher bar **99**. The infeed rollers **68** and **69** have stopped and product unit **117''** has moved into the space vacated by the product unit **117**. The holddown grid **40** moves down immediately behind product unit **117''** and before this unit reaches infeed rollers **68** and **69**.

In FIG. d, d,product unit **117'** is completely discharged from the passage **95** and pusher bar **99**, with plates **94**, has started on its semicircular path of movement. Product unit **117''** is being held back by the stationary rollers **68** and **69** while the belts **35** are sliding beneath it. Product units **117'''** are being held back by the grid **40** at this time.

FIG. **133** shows product unit **117'** moving toward the discharge end of the apparatus illustrated in FIG. **14**. Product unit **117** is now partially inverted and is being held by pusher bar **99** and plates **94**. Product unit **117''** is in position to start a new cycle as soon as pusher bar **99** reaches the position shown initially in FIG. **13***a*.

The pusher bar **99** is constantly moving on the D-shaped path at the constant speed of the chains **102**. Relative to the passage **95**, the pusher bar is moving only on its horizontal run and during this time the passage **95** is stationary or nonrotating. On the lower semicircular path of movement of the pusher bar, FIGS. **13***d* and **13***e*, there is no movement of the pusher bar in the passage **95** relative to the plates **94**, but the passages itself is being turned upside down along with the product unit **117** within it. Actually, therefore, the pusher bar **99** is never stationary in space although it does become stationary relative to the plates **94**.

As shown in FIGS. **8** and **9**, a relatively short conveyor belt section **118** occupies the space laterally adjacent the turnover mechanism in the other product row beneath the bars **92**. As stated, the turnover mechanism can be shifted laterally on the bars **92** to handle product units moving in either row through the apparatus. Additionally, the entire turnover mechanism can be raised to a nonuse position above the conveyor bed where no inverting of the product in either row is desired. For example, the products in one row may enter the apparatus already inverted with respect to the products in the second row. In some cases, a pair of the turnover mechanisms **31** may be employed side-by-side instead of a single mechanism and in these respects the method and apparatus is highly versatile.

In the arrangement shown in the drawings, the conveyor section **118** is employed to bridge the gap in the conveyor bed which would otherwise be occupied by the turnover mechanism. If this mechanism is shifted laterally to service the other row of products, then the conveyor section **118** may be employed at the position of the turnover mechanism in FIGS. **8** and **9**.

The conveyor sections **118** are raised and lowered independently by swinging on the axes of their shafts **126** and **126'**. The shaft **126'** has a hand crank **120** on the operator's side of the apparatus which is turned for raising and lowering the conveyor section **118** on the near side. A locking pin **119** is provided to lock the handle **120** and the associated conveyor section in the raised or lowered position. The conveyor section **118** on the far side of the apparatus is raised and lowered by another hand crank **120'** connected with a transmission shaft **120''** operating sprocket gearing **180** on the far side of the apparatus, said gearing including a sprocket gear **182** on the

shaft 126 of the far side conveyor section 118. By this means the operator on one side of the apparatus may control the raising, lowering and locking independently of the two conveyor sections 118.

As viewed in FIG. 9, the conveyor section 118 on the left hand or far side of the apparatus is lowered while the opposite side conveyor section is locked in the up or active position. Belts 123 drive conveyor sections 118 from rolls 125 to rolls 124, the latter idling or freewheeling on shafts 126 and 126'.

APPARATUS CONVEYOR SECTION

The previously mentioned downstream conveyor section 32 of the apparatus follows immediately after the turnover means 31. The shaft 121, FIG. 9, is powered by suitable gearing from the main drive motor 76 leading to a sprocket gear 122 on this shaft. The narrow belts 123 engage rollers 125 on the shaft 121, as stated, and also engage drive rollers 124 on the conveyor sections 118. The rollers 125 also engage and drive strip or tape belts 127 and 128 in the two rows or product paths, FIGS. 3 and 14. The belts 127 and 128 engage additional rollers 129 and 130 a substantial distance downstream from the rollers 125 as seen in FIG. 2. This figure also shows that the belts 127 slope downwardly somewhat from the rollers 125 whereas the belts 128 slope upwardly. To effect this arrangement, the roller 130 is disposed above rollers 129.

CROSSOVER SECTION

The downstream end of the conveyor section formed by belts 127 terminates at the rear ends of stationary horizontal bars 131 over which the product units may slide. These bars 131 are parallel and spaced apart laterally equidistantly to provide longitudinal slots between them for an important purpose, to be described. The bars 131 extend to the extreme discharge end of the apparatus in FIGS. 14 and 15 and are suitably supported on the apparatus framework.

The conveyor section formed by the belts 128 carries the product units from one row forwardly and slightly upwardly toward the rear intake end of a diagonal generally troughlike crossover conveyor or mechanism, previously designated 33 in its entirety. This mechanism includes a bottom stationary plate 132 arranged between upstanding sidewalls 133 and 134, the latter being suspended from elevated frame portions 135 and 136 which span the apparatus diagonally from side-to-side. The forward end of the crossover mechanism is rendered vertically adjustable as best shown in FIG. 2 by means of screw shafts 137 having threaded connections with lugs 138 on the sidewalls 133 and 134. The screw shafts 137 are connected by gearing 139 at the tops thereof and one shaft is equipped with a hand crank 140 for turning.

A slotted intake ramp 141 at the rear of the crossover mechaniam allows the belts 128 to feed the product units 117 onto the bottom plate 132 in a smooth manner where the belts pass around the roller 130. Plural flights 142 are provided to propel the product units through the diagonal crossover mechanism and these flights are connected at the sides of the mechanism with endless chains 143 including upper and lower runs which are both above the bottom plate 132 at all times. The chain engage suitable guide sprockets 144 at the ends of the crossover mechanism. The several flights 142 are parallel to each other and are at right angles to the belts 127 and 128 and fixed bars 131. As shown in FIG. 14, the flights extend diagonally between their propelling chains 143. Each flight carries a forwardly projecting blade 145 rigid therewith and extending at right angles thereto. As shown in FIGS. 1 and 14, the flights 142 and their blades 145 sweep each product cluster or unit 117 diagonally across the plate 132 from one product row toward the other row while maintaining the squareness and alignment of the cluster for ultimate registration with like clusters moving over the bars 131, as will be further described. The blades 145 are therefore parallel to the bars 131.

The several flights 142 are maintained erect at all times during their movement with the chains 143 by erecting links 146 having small rollers 147, FIG. 15, which travel on the bottom plate 132 at the lower runs of the chains and also travel on an erecting cam track 148 secured to the sidewall 134 near the upper run of the adjacent chain 143. As the chains 143 continuously cycle in the direction of the arrows in FIG. 2, the flights 142 pass downwardly between the sprocket gears 144 and move in behind the product units 117 at the discharge ends of the belts 128 and begin to engage and push the product units from the ramp 141 onto and across the bottom plate 132. At the forward extremity of the crossover mechaniam, where the flights 142 begin to rise for movement rearwardly, they will disengage the product unit 117 after depositing the same onto a slotted forward extension 149 of the bottom plate or apron 132. The slots 150 of extension 149 are directly over and in vertical alignment with the slots between the bars 131. The extension 149 terminates a considerable distance forwardly of the chains 143, as shown. The bars 131 continue on to the discharge end of the apparatus somewhat beyond the crossover mechaniam, FIGS. 14 and 15.

The chains 143 of the crossover conveyor mechanism are powered in the proper direction by a diagonal drive shaft 151 having sprocket gears to engage the chains and, through a universal joint 152 and input shaft 153, power to turn the shaft 151 is derived from the main power source 76 through intermediate chain gearing, not shown.

Arranged generally beneath the spaced bars 131 and extending slightly under the downstream ends of the belts 127, FIG. 15, is a pusher conveyor structure comprising upright pins or pusher fingers 154 arranged in transverse rows and spaced in the rows so that the fingers may project up through the slots between the several bars 131 and ultimately through the slots 150 in the plate 132 and its extension 149. At their lower ends, the upright fingers 154 are anchored to crossbars or flights 155 which in turn are connected with endless drive chains 156 on opposite sides of the group of bars 131. The chains 156 are driven in unison and engage the necessary guiding sprocket gears 157, 158 and 159 as best shown in FIG. 15 to impart to the flexible chains the desired configuration and path of movement. As shown in FIG. 15, the upper runs of the chains 156 are in two levels 156*a* and 156*b*, for a purpose to be described. The lower runs 156*c* of chains 156 travel near the extreme bottom of the apparatus so that the tops of the fingers 154 at this time are well below the bars 131 and the belts 127. The chains 156 are powered through gearing from the main drive 76 which interlocks with the drive for the shaft 151 and chains 143 of the crossover mechanism whereby these two conveyor means are locked in synchronism. Additionally, it should be mentioned that the drive gearing for the turnover mechanism, FIGS. 11 and 12, is mechanically locked with the drives of the crossover mechanism and the conveyor chains 156 so that the apparatus is properly timed and synchronized. The details of the gearing necessary to achieve this are conventional and all of the gearing need not be shown, as stated.

Means to maintain the pusher fingers 154 erect at all times is provided in the form of a third endless chain 160, FIGS. 14 and 17, outwardly of the outboard chain 156 and offset rearwardly thereof by another set of guiding sprocket gears 161, 162 and 163 carried by shafts which are spaced rearwardly of the shafts supporting the chains 156 as indicated at 164 and 165 in FIG. 15. The erecting chain 160 moves in unison with the two chains 156 and its sole purpose is to keep the fingers 154 erect at all times. To accomplish this, erecting links 166 for the fingers 154 interconnect the outside pair of chains 156 and 160, as shown best in diagrammatic FIG. 17 but also shown in FIG. 14.

As the rows of pusher fingers 154 rise at the rear vertical runs 167 of the conveyor chains 156, they will enter between the discharge end portions of the belts 127 and engage behind the product units 117 being delivered by these belts onto the stationary bars 131. That is to say, the fingers 154 will begin to push the product units over the bars 131 by engaging the

product units as shown. The belt rollers 129 and their support arms 168, FIG. 15, are separated and individual to the belts 127 so that the fingers can pass up and through the spaces between the belts and enter the slots between the bars 131 without obstruction.

The fingers 154 continue to push the product units 117 toward the discharge end of the apparatus while at the elevation of the chain runs 156*a*. At this time, the tops of the fingers 154 are below the bottom plate 132 of the crossover mechanism and its extension 149 having the slots 150 therein.

When the chains 156 engage the sprocket gears 158, however, they and the fingers 154 are elevated to the level of the runs 156*b* and the erect fingers move upwardly and enter the slots 150 behind the product units 117 which are being delivered by the continuously moving flights 142 of the crossover conveyor mechanism onto the slotted apron or extension 149. Consequently, as clearly indicted in FIGS. 14 and 15, the elevated fingers 154 at this time will begin to push a pair of superposed product units 117 in unison toward the discharge end of the apparatus. The upper product unit 117 has been kept laterally squared and aligned by the action of the blade 145 as the unit is pushed diagonally through the crossover mechanism. When the two product units 117 have been pushed by the fingers beyond the slotted extension 149, the units will move into stacked registering relation as shown at the left-hand end of FIG. 15 and the fingers 154 still passing between the spaced bars 131 will deliver the stacked product units to the discharge end of the apparatus for further handling as may be desired by other equipment.

While the plate 132 and extension 149 for clarity are shown adjusted upwardly to a level position in FIG. 15, it should be remembered that the crossover structure can be adjusted by turning the handle 140 so that the extension 149 is very close to the tops of the lower product units 117 sliding over the bars 131. With proper adjustment, there is only the thickness of the plate 132 between the upper and lower product units when they clear the extension 149 and assume stacked relationship. Therefore any appreciable drop free fall of the tender product is avoided and the product units move continuously and gently into stacked relationship with a sliding movement under influence of the fingers 154.

To assure final aligning and squaring of the stacked product units at the discharge end of the apparatus, a longitudinal alignment plate is fixedly mounted at the inner side of the bed formed by the bars 131. This alignment plate preferably extends under the extension 149 of plate 132. Before two product units 117 are stacked on and under extension 149, a strong jet of air from airjet nozzles 170 opposite the plate 169 nudges the product units transversely against the alignment plate which is at right angles to the row of fingers 154 pushing the product units at this time. Preferably separate airjets act on the upper and lower product units 117 of a given pair. This assures final squaring up and registry of the product units even before they move into stacked relation at the end of the extension 149. The airjet from the nozzles 170 may be activated automatically by a valve 171, FIG. 15, having an actuator arm 172 engaged by an element 173 on each bar or flight 155 as the lower run 156*c* passes the valve. The opening of the valve 171 intermittently sends compressed air through a pipe 174 to the airjet nozzles 170 for the stated purpose.

SUMMARY OF OPERATION

The main drive motor 76 and output gearing produces operation of the infeed belts 35, rapid infeed rollers 68 and 69, turnover mechanism, conveyor belts 127 and 128, crossover conveyor chains 143 and chains 156 and 160 of the pusher finger conveyor all in unison. These various components are locked together in their drives for proper synchronism and timing.

With the above situation prevailing, the product units 117, such as roll clusters coming from a depanner, are allowed to accumulate at the marshaling station 29 having the infeed belts 35. Initially, the leading product units or clusters are held up by the sponge rollers 68 and 69 until both lanes are filled with product units at the marshaling station. This is before the rapid infeed rollers 68 and 69 begin to turn. Subsequently, all leading product units in the two rows are held up or restrained by the holddown grids 40 and 41.

It should be borne in mind that the product units enter the marshaling station in the two rows either bottom side up or bottom side down in both rows or either row. This is why the method and apparatus is made flexible with respect to the lateral positioning of the turnover mechanism over either product row or over both rows, in some instances, where plural inverting is required and is accomplished with side-by-side identical turnover mechanisms.

With the situation illustrated in the drawings where it is desired to invert the product units in one row only, the operation continues in the following manner. The holddown grids 40 and 41, when down, press the leading product units down against the rods 39 to restrain them while the slack belts 35 yield and simply slide beneath the product units. Photoelectric cells, not shown, may be utilized to detect the presence of product units entering the rapid infeed rollers 68 and 69 and leaving this area. Such detection means can be used to control the operation of the holddown grids 40 and 41 thereby properly timing the release of the leading product units for entry into the rapid infeed rollers and delivery into the turnover mechanism and onto the conveyor section 118 for the row which is not utilizing a turnover mechanism. Numerous variations in the control and timing means can be employed at this part of the apparatus and here the apparatus has a wide range of versatility in its operation.

In any event, the holddown grids 40 and 41 elevate in proper sequence to release a leading product unit from the marshaling station in each row after the rapid infeed rollers 68 and 69 have propelled a product unit 117 into the passage 95 of the turnover mechanism. As shown by the spacing of the product units 117 at the left-hand portion of FIG. 1, there is a time delay interval in the operation of grids 40 and 41 to assure a proper lateral relationship of adjacent products units in the two rows following the inverting operation in the one row.

Following the inverting operation at the station 31 which has already been described in full detail, the product units in the two rows advance on the belts 127 and 128 leading respectively to the slide bars 131 and to the slightly elevated crossover conveyor mechanism. The operation of these components has been described in detail and need not be repeated. Finally, as described, the companion product units emerge from the apparatus in accurately stacked relation for passage on to packaging equipment or the like.

In FIG. 18 of the drawings, there is shown somewhat diagrammatically a modification of the apparatus at the inlet side of the turnover station 31. In this figure, rapid infeed rollers 68*a* and 69*a* are arranged somewhat closer to the turnover mechanism than in the first embodiment shown in FIG. 10. Additionally, the previously described guide roller means 38 between the rapid infeed rollers and the turnover mechanism has been eliminated and also the guide roller means 37 is eliminated, FIG. 10. In place of this arrangement, infeed conveyor belts 35*a* terminate ahead of infeed rollers 68*a* and 69*a* and engage a guide roller 38*a* at approximately the level of the roller 69*a*. Relatively small transfer rollers 39*a* are disposed on opposite sides of infeed roller 69*a*, and assure a smooth transferring of the product units from the belts 35*a* to the rapid infeed rollers and from these rollers into the chamber formed between the plates 94 of the turnover mechanism.

The advantage of the construction in FIG. 18 is that the belts 35*a* no longer pass between the infeed rollers as depicted in FIG. 10 and the necessity for forming the lower infeed roller in segments such as shown at 74 in FIGS. 6 and 9 is eliminated, and the lower infeed roller, like the upper one, may be formed in continuous sections. The construction is considerably simpler and more economical. The general mode of operation of the apparatus is not effected at all by this modification and,

except as described above, all other parts and their functions are identical with the first embodiment.

The methods and apparatus are characterized by simplicity, speed of operation, and reliability, without damage to the product. The apparatus is highly versatile, as explained. Its advantages should be readily apparent to those skilled in the art.

It is to be understood that the forms of the invention herewith shown and described are to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be restored to, without departing from the spirit of the invention or scope of the subjoined claims.

We claim:

1. A method of arranging product units comprising marshalling moving plural product units in two discrete rows, stopping movement of the leading product units in a transversely aligned condition, releasing and advancing leading product units in the two rows and temporarily restraining the following units in said rows, moving the product unit in one row diagonally toward and over the companion moving product unit in the other row while maintaining transverse alignment until the pair of product units in the two rows are substantially in superposed relation, and then advancing the superposed and vertically separated pair of product units in a manner to establish and maintain vertical alignment transversely of the direction of movement while retaining their superposed and vertically separated relation and depositing the top product unit on the bottom product unit while maintaining said vertical alignment transversely of the direction of movement to produce a transversely aligned stack of product units.

2. A method of arranging product units as defined by claim 1, and the intermediate step of inverting each product unit in at least one row following the releasing of the product units from the marshaling zone and prior to said diagonal movement.

3. A method of arranging product units as defined by claim 2, and wherein said inverting step comprises turning over each product unit without displacing it laterally from its primary path of movement.

4. A method of arranging product units as defined by claim 1, and the additional step of engaging each stacked pair of product units after their movement into stacked relationship to assure their longitudinal alignment and registration in the stack.

5. A method of arranging product units as defined by claim 4, where said engagement to assure longitudinal alignment and registration comprises directing a fluid jet toward one side of the stack while engaging the opposite side of the stack with an abutment member.

6. A method of arranging product units comprising advancing a spaced and transversely aligned pair of product units in two discrete rows, directing the product unit of one row on a diagonal path toward the related unit of the other row while the unit of the other row continues to be advanced and maintaining the squareness and transverse alignment of the product unit on said diagonal path until said related product units from the two rows become substantially superposed, and then engaging the superposed pair of product units with a common moving element to further advance the superposed and vertically separated pair of product units in a manner to establish and maintain vertical alignment transversely of the direction of movement while maintaining vertical separation of the product units and deposition the top product unit on the bottom product unit while maintaining said vertical alignment transversely of the direction of movement to produce a transversely aligned stack of product units.

7. A method of arranging product units as defined by claim 6, and slidably supporting the product units moving on the diagonal path at an elevation slightly above the product units advancing in said other row, and said common moving element causing the product units sliding on the elevated diagonal path to move off of the support on which they are sliding and to then become stacked with the underlying product units of the superposed pairs of units.

8. A method of arranging product units as defined by claim 2, and releasing the leading product units in one row after the lapsing of a predetermined time delay interval following the release of corresponding product units in the other row.

9. A method of arranging product units as defined by claim 6, and the additional step of inverting each product unit in at least one of said rows during said advancing of the product units.

10. Apparatus for handling product units comprising power conveyor means for moving product units from a marshaling station in two discrete rows, a diagonal crossover mechanism receiving the moving product units in one row and including means to convey the product units from said one row on a diagonal path toward superposed relation with corresponding product units of the other row, said crossover mechanism further including means to support the product units moving on said diagonal path at an elevation above the product units of said other row while maintaining transverse alignment of said corresponding product units, and an additional conveyor means common to the product units on said diagonal path and in said other row and engaging pairs of said superposed product units in a manner to establish and maintain vertical alignment transversely of the direction of movement while maintaining vertical separation of the product units, and advancing the superposed transversely aligned pairs together until the upper unit of each pair is removed from said supporting means and thereby rests upon the lower product unit of the pair in stacked relation.

11. Apparatus for handling product units as defined by claim 10, wherein said means to support the product units moving on said diagonal path comprises a generally horizontal plate over which the product units are moved by the conveyor means of the crossover mechanism, said plate having a slotted terminal portion overlying the conveyor means for the product units in said other row, and said additional conveyor means including spaced pusher elements which propel the product units of said other row and rise through the slots of said terminal portion to also engage the product units deposited thereon in said superposed relation by the conveyor means of the crossover mechanism.

12. Apparatus for handling product units as defined by claim 11, and means to adjust the height of at least the end of the crossover mechanism carrying said slotted terminal portion.

13. Apparatus for handling product units as defined by claim 11, and wherein the conveyor means for the product units in said other row includes a substantially level portion consisting of stationary parallel spaced bars having passages between them and through which passages said pusher elements also rise to engage rearwardly of the product units thereon.

14. The apparatus of claim 10, and a turnover mechanism for product units moving in one of said rows in advance of said crossover mechanism.

15. The apparatus of claim 14, and means supporting said turnover mechanism and operable to raise the mechanism to an inactive position and also allowing the mechanism to be shifted laterally from one discrete row to the other row for use in inverting the product units of the other row.

16. The apparatus of claim 14, wherein said turnover mechanism comprises a relatively stationary support structure, a rotary assembly on said support structure, means forming a turnover compartment on the rotary assembly adapted to receive individual product units from the conveyor means while in a substantially level position, and intermittently operable pusher device within said compartment forming an abutment to engage product units introduced into the compartment and later ejecting such product units from the compartment, and mechanism to rotate the rotary assembly intermittently and move said pusher device intermittently from one end of said compartment to the opposite end and to maintain the pusher device stationary during the rotation of the assembly.

17. The apparatus of claim 16, wherein said turnover compartment is formed by a pair of spaced parallel plates and the distance between the plates is sufficient to accommodate the thickness of one product unit.

18. The apparatus of claim 16, wherein said mechanism comprises at least one drive chain for said rotary assembly and pusher device having a connection with the pusher device and assembly and power means to move the drive chain on a substantially D-shaped path, the straight side of said path defining movement of the pusher device and the arcuate portion of the path defining rotary movement of said assembly.

19. The apparatus of claim 18, and wherein the rotary assembly comprises at least one low-friction bearing having an outer race secured to said support structure and a freely rotating inner race, said means forming the turnover compartment secured to the inner race.

20. The apparatus of claim 19, and linear guide rod means for the pusher device secured to said inner race and turning therewith.

21. The apparatus of claim 13, and mechanism connected with said pusher elements and maintaining them upright at all times.

22. The apparatus of claim 21, wherein said mechanism comprises endless drive chains for said pusher elements, flights connected with said drive chains and carrying pusher elements in spaced apart rows and with the elements spaced laterally in each row, and an additional endless chain near one of the drive chains and being offset longitudinally relative thereto and pusher element erecting links interconnecting said additional chain and said one chain at each flight.

23. The apparatus of claim 10, and wherein the conveyor means of the crossover mechanism comprises spaced flights extending at right angles to said discrete rows and diagonally of the path defined by the crossover mechanism, alignment blades carried by said flights and extending forwardly thereof and substantially at right angles thereto and coacting with the flights to maintain the squareness and lateral alignment of product units moving on said diagonal path, and endless chain drive means for said flights.

24. The apparatus of claim 23, wherein the chain drive means for said flights is a pair of endless chains adjacent the sidewalls of the diagonal crossover mechanism including upper runs spaced substantially above the floor of the crossover mechanism and lower runs arranged close to said floor, whereby said flights may push the product units over said floor slidably in one direction, and means for maintaining said flights erect as they travel with said chains.

25. The apparatus of claim 24, wherein the erecting means comprises roller carriages on said flights engageable with the floor of the crossover mechanism along said lower run, and an elevated cam track on one sidewall of the crossover mechanism engageable with said carriages along said upper runs.

26. The apparatus of claim 10, wherein said power conveyor means comprises a product infeed conveyor conveyor section including relatively slack infeed belts supporting the product units at said marshaling station, substantially rigid rods arranged slightly below the belts and between the belts at the marshaling station, and vertically movable product holddown grids above the belts at the marshaling station operable to press product units against the rods for restraining the units while the slack belts slide beneath the product units.

27. The apparatus of claim 10, and power means connected with the holddown grids to raise and lower the same relative to said belts independently.

28. The apparatus of claim 27, wherein the power means to raise and lower the grids independently is a cylinder piston unit connected with each grid near the forward end thereof.

29. The apparatus of claim 28, and means to bodily adjust the elevation of the cylinder piston units.

30. The apparatus of claim 26, and a pair of relatively large soft compressible product infeed rollers closely following said infeed conveyor section and holddown grids and adapted to receive between them leading product units released by the holddown grids and advance such product units forwardly at increased speed toward further apparatus components without damaging said product units.

31. The apparatus of claim 30, and a product unit turnover device closely following the infeed rollers and having a shallow product compartment to receive product units from the infeed rollers preparatory to inverting such product units.

32. Apparatus for handling product units comprising a marshaling station including product infeed conveyor sections and means to interrupt the movement of product units on the infeed conveyor sections so that a substantial number of product units can accumulate at the marshaling station in two discrete rows, a product-inverting mechanism for the product units in at least one row downstream form the marshaling station, a product rapid infeed mechanism between the marshaling station and said inverting mechanism to deliver individual product units in a controlled and timed sequence from the marshaling station to the inverting mechanism, downstream product conveyor means for product units in the two rows following the inverting mechanism, a crossover conveyor downstream of said last-named conveyor means to carry product units in one row on a diagonal path toward and above corresponding product units of the second row, and an additional conveyor means common to the product units of the two rows near the discharge end of the crossover conveyor engageable with product units from both rows arranged in superposed pairs and delivering the same in stacked relationship to a discharge end of the apparatus.

33. The apparatus of claim 32, wherein the rapid infeed mechanism comprises a pair of infeed rollers in substantially vertically spaced relation, and transfer roller means on opposite sides of the infeed rollers and between such rollers and the infeed conveyor sections and inverting mechanism.

34. The apparatus of claim 33, and wherein the tops of said infeed conveyor sections, transfer roller means and the lowermost infeed roller lie substantially in a common plane in advance of the product inverting mechanism.

35. A method of stacking one product unit upon another comprising:

moving the product unit in one row toward and over the product unit in the other row while maintaining transverse alignment of the units,

advancing the resultant superposed and vertically separated product units in a manner to establish and maintain vertical alignment transversely of the direction of movement while maintaining vertical separation of the product units, and

depositing the top product unit on the bottom product unit while maintaining said vertical alignment transversely of the direction of movement to produce a transversely aligned stack of product units.

36. Apparatus for stacking one product unit upon another comprising:

means for moving the product unit in one row toward and over the product unit in the other row while maintaining transverse alignment of the units,

means for advancing the resultant superposed and vertically separated product units in a manner to establish and maintain vertical alignment transversely of the direction of movement while maintaining vertical separation of the product units, and

means for depositing the top product unit on the bottom product unit while maintaining said vertical alignment transversely of the direction of movement to produce a transversely aligned stack of product units.

37. A method as defined in claim 34 including means for aligning the transversely aligned stack longitudinally of the direction of movement.

38. Apparatus as defined in claim 36 and including means for aligning the transversely aligned stack longitudinally of the direction of movement.