

[54] **METHOD AND APPARATUS FOR ORIENTING ELONGATED ARTICLES**

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[58] Field of Search 193/43, 43 B; 198/33 AD; 209/97, 85, 112, 118; 221/172

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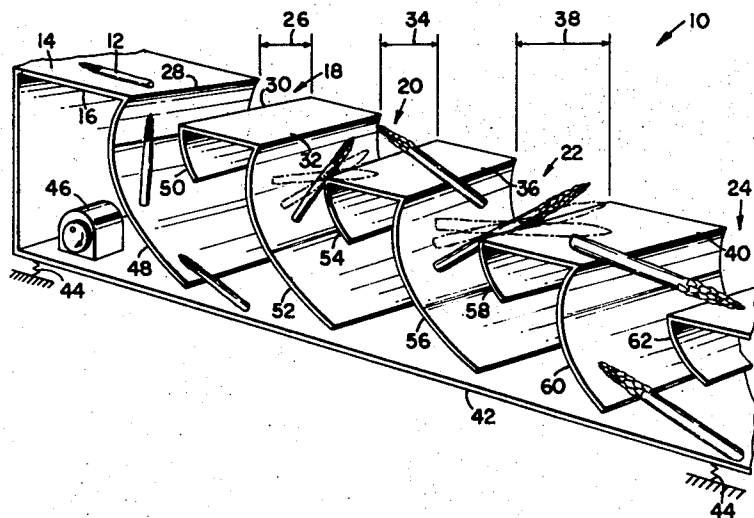
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[57] **ABSTRACT**

A method and apparatus for lengthwise orientation of elongated articles having a center of gravity displaced from the geometric center. Articles in random lengthwise orientation are moved along a path interrupted by at least one gap. The gap length along the direction of movement is sized in relation to a given range of article length so that the articles of one orientation tilt about a fulcrum near one edge of the gap and drop through with their heavier end foremost. In one form articles of heavier end foremost orientation are segregated from the reversely orientated articles. In another form lighter end foremost articles which initially bridge the gap are tilted backwards and dropped through the gap with their heavier ends foremost. In another form a plurality of gaps are interposed in the path of movement with successively increasing gap lengths to both grade and orient articles of increasing length ranges. In still another form articles are dropped through gaps for length grading, and then through further gaps for lengthwise orienting.

5 Claims, 9 Drawing Figures



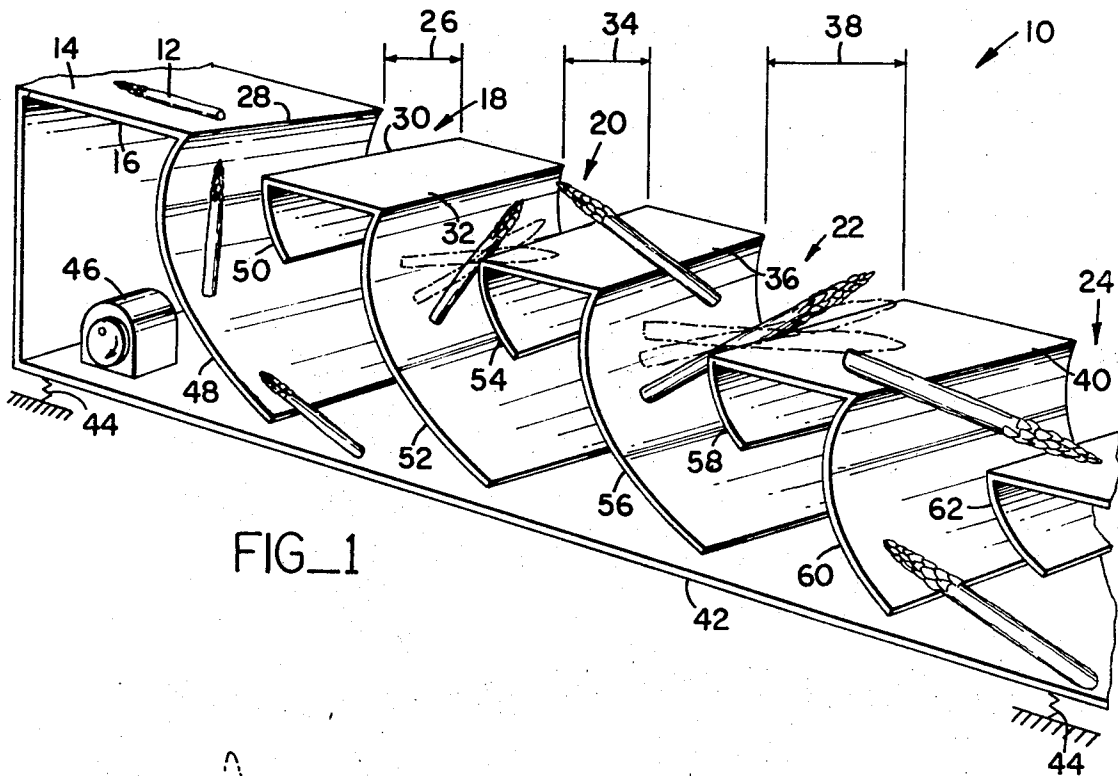


FIG_1

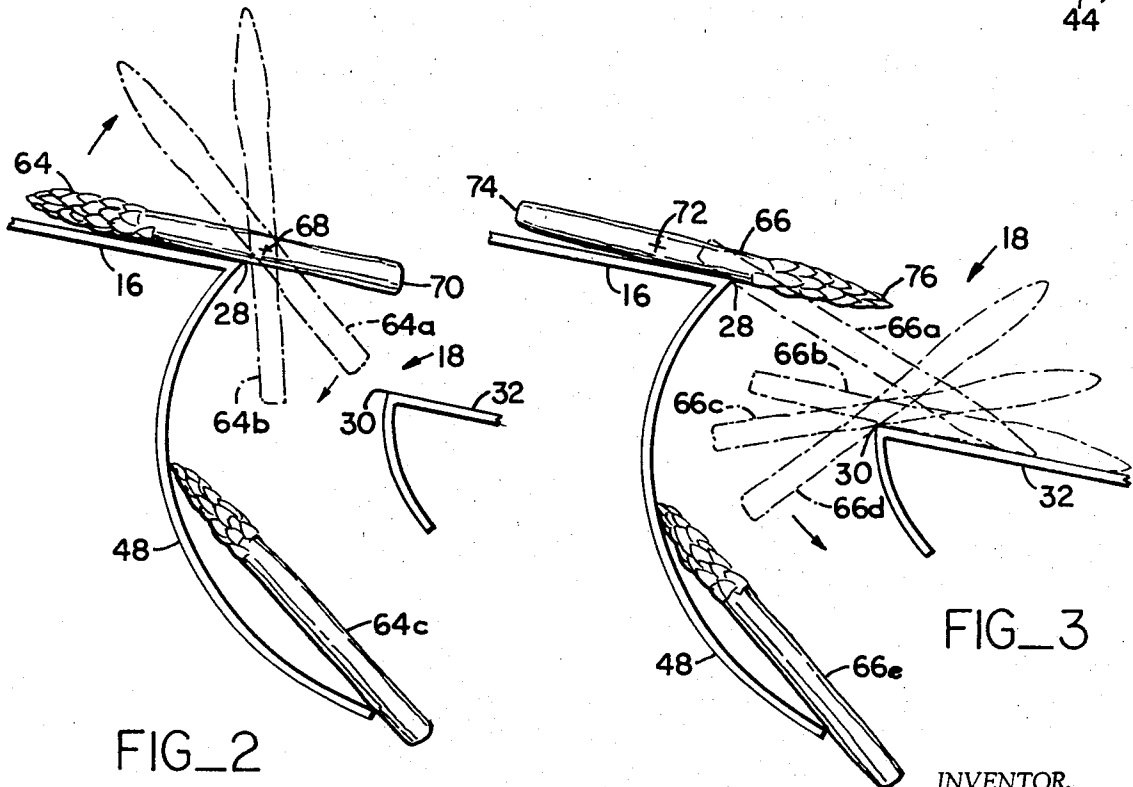
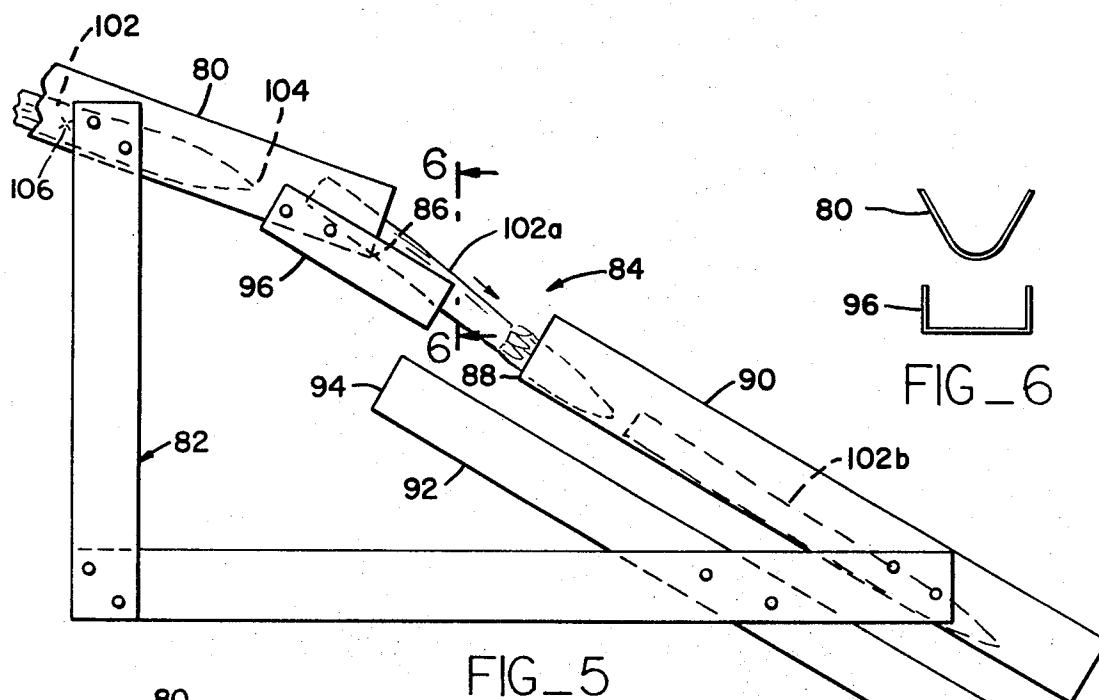


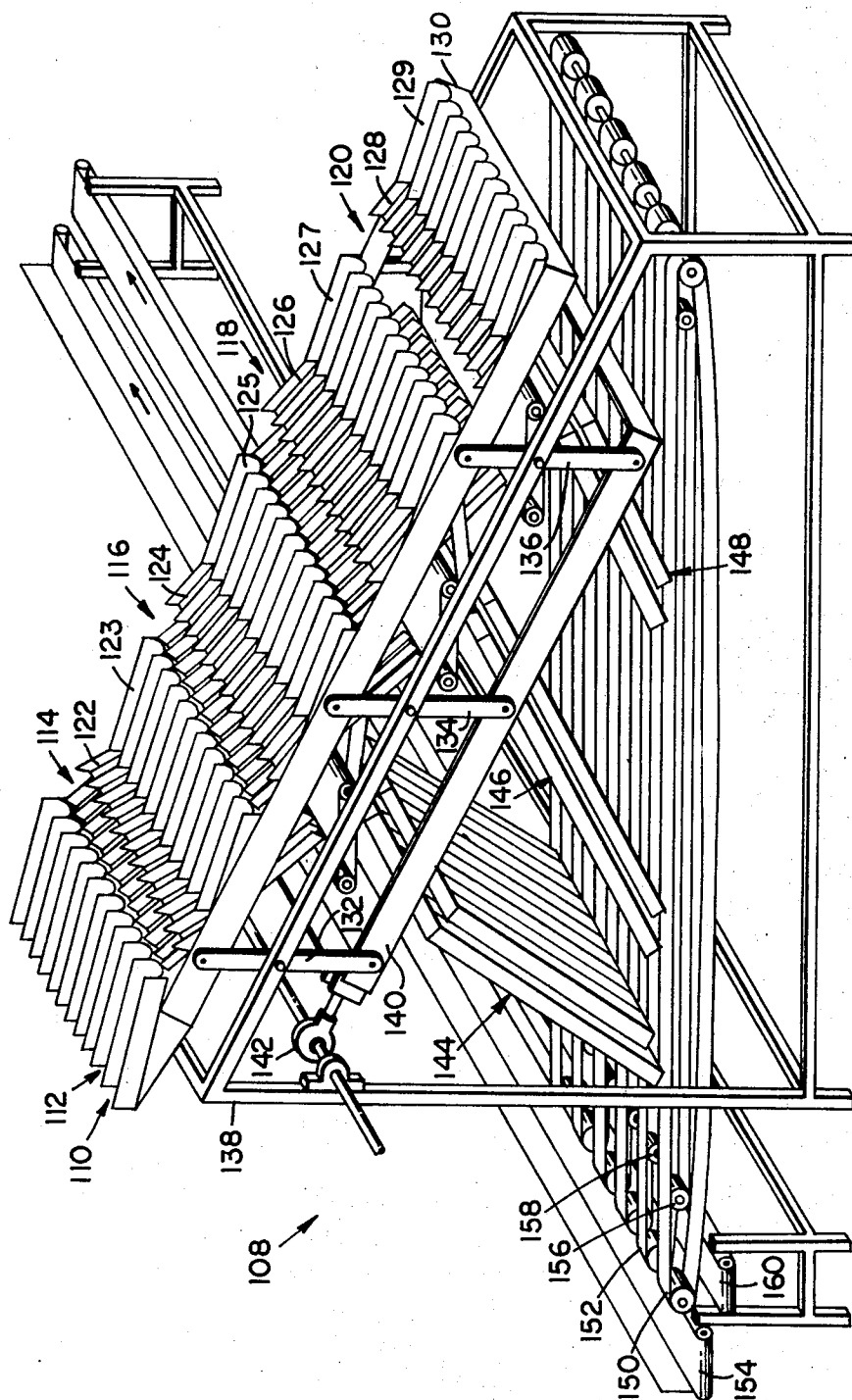
FIG_2

FIG_3

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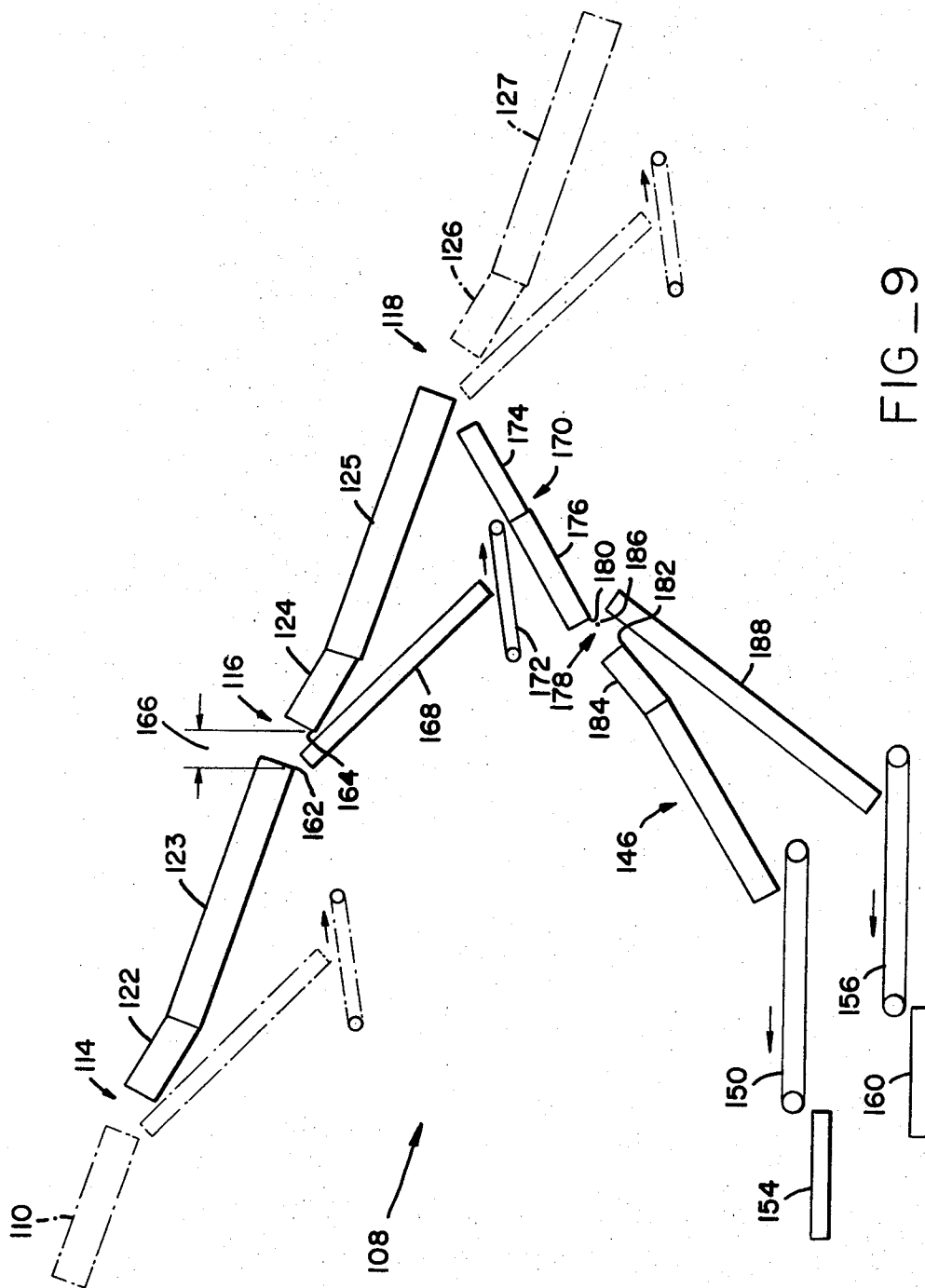


FIG. 9

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METHOD AND APPARATUS FOR ORIENTING ELONGATED ARTICLES

BACKGROUND OF THE INVENTION

This invention relates generally to methods and apparatus for handling elongated articles. More particularly it relates to handling methods and apparatus adapted to orient articles having a center of gravity displaced lengthwise from the geometric center. It further relates to methods and apparatus for handling agricultural products such as asparagus, corn or carrots and the like to provide a common lengthwise orientation for subsequent processing operations.

Conventional processing equipment for handling articles such as elongated agricultural products and the like normally employ steps which require that the articles have a common lengthwise orientation. For example, asparagus spears are arranged in common orientation for delivery to a cutting or trimming operation for canning or further processing.

One method commonly employed is to manually orient products such as asparagus so that all tips point in the same direction. This method, however, is slow, inefficient, expensive, and requires the presence of a worker. Various mechanical orienting devices have been proposed for handling tapered products such as husked corn, for example, but these are not successful in handling products having little or no taper. In one such prior art orientor the tapered products are rolled down an inclined surface for subsequent segregation. In another device, sensors engage the product to pivot it in a direction determined by its orientation, after which products of a common orientation are moved apart for segregation. Another device which has been proposed utilizes a series of conveying means adapted to separate the products according to their end-wise orientation. These prior orienting devices are complicated and expensive to build and maintain in view of their many moving parts, such as the sensors, pushers, or conveyors. The need has been recognized to provide a method and apparatus for orienting elongated agricultural products which is simple in construction and operation, is inexpensive to build and maintain, is fully automatic in operation, and which does not damage the product in any way.

Summary of the Invention and Objects

It is an object of the invention to provide a method and apparatus for orienting products and articles of the type described which have a center of gravity displaced lengthwise of the geometric center.

Another object of the invention is to provide a method and apparatus for processing agricultural products of elongated shape with a center of gravity displaced from the geometric center in a direction away from lighter and toward the heavier end thereof in which the products are moved along a path and then oriented by tilting about a fulcrum near one edge of a gap in the path.

Another object of the invention is to provide a method and apparatus for orienting elongated products of the type described which is relatively simple in construction and method of operation, and which will not cause physical injury or damage to the products.

A further object is to provide a method and apparatus for orienting agricultural products of the type

described in which products of random orientation are moved along a path interrupted by a gap, tilting those products having butt-first orientation down through the gap by gravity, bridging those products having a tip-first orientation over the gap, and segregating the common butt-first and tip-first products for subsequent processing.

Another object is to provide a method and apparatus for orienting agricultural products of the type described in which products of random orientation are moved along a path interrupted by a gap of predetermined length adapted to tilt those products of butt-first orientation downwardly along a first edge of the gap, tilting back those products of tip-first orientation along a second edge of the gap, and combining the products together in butt-first orientation for subsequent processing.

Another object is to provide a method and apparatus for orienting a range of elongated agricultural products of the type described in which products of random orientation and disparate length are moved along a path interrupted by a plurality of gaps of successively increasing gap lengths with each gap adapted to tilt forwardly across its front edge those products of butt-first orientation, and to tilt backwardly across the gap rear edge those products of tip-first orientation.

Another object is to provide a method and apparatus for grading and orienting agricultural products of the type described in which products of random orientation and length are moved along a path interrupted by a plurality of gaps of progressively increasing gap lengths for segregation both as to orientation and length range by gravital tilting through a respective gap correlated as to product length.

A further object is to provide a method and apparatus for orienting and grading agricultural products of the type described in which products within a given length range are graded by dropping through a series of grading gaps in the path of product movement, and the products within each graded range are oriented lengthwise by gravital tilting across an orienting gap.

In general, the present invention orients elongated articles having a center of gravity displaced substantially lengthwise from the geometric center by the action of gravital tilting. Agricultural products such as asparagus spears, husked corn, and carrots have this common characteristic in that one end normally is of greater density than the other end. Field-cut asparagus, for example, has a greater density and is heavier at its butt-end so that it will tilt butt-first when supported near its geometric center. The invention provides lengthwise orientation of such articles received in random orientation by moving them along a path interrupted by at least one gap of a length less than the length of the articles. Articles moving along the path are tilted about a fulcrum near one edge of the gap and drop from the fulcrum through the gap with their heavier ends foremost. Articles with their heavier ends foremost tilt forwardly about a fulcrum near the leading edge of the gap. In one preferred form articles with their lighter ends foremost tilt about a fulcrum near the trailing edge of the gap, while in another preferred form the lighter end foremost articles bridge the gap and continue along the path. A plurality of gaps of successively increasing length are provided in the path of

product flow for orientation of a full range of product lengths. 36 a

In another preferred form a plurality of gaps of successively increasing length are provided to first grade the products as to length, and then segregate as to orientation by gravital tilting action through another series of gaps in the path of the product movement.

One disclosed embodiment generates product movement by vibratory movement of a sloping surface defining laned paths for directing the products across the gaps. In another disclosed embodiment multiple sloping lanes direct the products across the grading gaps, and products graded through these gaps by gravital tipping are reversed in direction for gravital tilting across orienting gaps for segregation as to lengthwise orientation.

In the copending application Ser. No. 7,615 by Ralph C. Lent filed Feb. 2, 1970 and entitled "Method and Apparatus for Handling Articles" further orienting methods and apparatus are disclosed embodying certain features of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an orienting apparatus incorporating features of the invention;

FIG. 2 is a partial side elevational view of the apparatus of FIG. 1 illustrating one phase in the operation thereof;

FIG. 3 is a partial side elevational view similar to FIG. 2 illustrating another phase in the operation of the invention;

FIG. 4 is a side elevational schematic view of a modified form of the invention illustrating one phase in the operation thereof;

FIG. 5 is a side elevational schematic view similar to FIG. 4 illustrating another operation phase;

FIG. 6 is a cross-sectional view taken along the lines 6-6 of FIG. 5;

FIG. 7 is a cross-sectional view taken along the lines 7-7 of FIG. 4;

FIG. 8 is a perspective view of a modified form of the invention; and,

FIG. 9 is a partial side elevational schematic view of the modification of FIG. 8 illustrating the operation thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings and particularly FIG. 1 a preferred form of the orienting apparatus of the invention is illustrated generally at 10. The orienting apparatus of the invention would find use in orienting elongated articles having a center of gravity displaced longitudinally of the geometric center. Agricultural products having one end denser in weight than the other end would be processed by the invention. Asparagus spears, husked corn, carrots and the like are examples of this type of product. While the invention herein will be described in relation to the processing of asparagus spears, it is understood that the invention will find application with all such elongated articles and products.

The exemplary asparagus spears 12 are received in random lengthwise orientation, i.e., either butt-first or tip-first, at a receiving area or surface 14 from a suitable

metering device such as an inclined cleated conveyor or shaker and the like, not shown. These spears are advanced along a path defined by a series of downwardly inclined planar surfaces interrupted by a plurality of gaps 18, 20, 22, 24. The spears are constrained to move lengthwise along a narrow lane by suitable guideway or trough means, not shown. While a single lane first planar surface 16 is illustrated as defining the path of movement, the spears could also be advanced along a plurality of side-by-side lanes or troughs for increased productivity.

The gaps 18-24 are defined by spaced apart planar surfaces 16, 32, 36 and 40 with the leading and trailing edges of respective gaps spaced with progressively increasing lengths along the path. This facilitates the processing of a complete range of spear lengths. Thus, the first gap 18 defines a gap length 26 between trailing edge 28 of surface 16 and leading edge 30 of second planar surface 32 for dropping out the shortest spears. Gap 20 defines a gap length 34 between surface 32 and third planar surface 36, and this gap length is incrementally increased on the order of about one-fourth inch for dropping out the next larger range of spear lengths. Similarly, gap 22 defines an increased gap length 38 between surface 36 and fourth planar surface 40. The number of gaps provided can be varied as desired to accommodate the length range of the products to be oriented. The shorter spears are thus both oriented and size graded through an upstream gap, with longer spears bridging and moving across the upstream gap for orientation and size grading at a down-stream gap of appropriate length.

Successive planar surfaces across the gaps are stepped-down to prevent hang-ups which may occur if a curved spear advances in tip-first orientation. Thus, as illustrated in FIG. 2, for gap 18 the second planar surface 32 is stepped-down vertically from trailing edge 28 of surface 16.

The spears 12 are advanced downwardly along the path preferably by vibrating the surfaces. In the illustrated embodiment the planar surfaces are mounted as an integral unit with downwardly inclined take-away pan 42 which in turn is supported by suitable resilient mounting means 44. This unit is vibrated or shaken by suitable means, shown as rotary eccentric weight device 46. This vibrating action moves the spears down the surfaces where they tilt down into the appropriately sized gaps. Each gap is provided with a chute for receiving the tilted spears and directing them butt-first onto take-away pan 42. For example, downwardly and forwardly curving wall 48 depending from the trailing edge of first planar surface 16 and downwardly curving wall 50 depending from the leading edge of surface 32 together define the first chute for gap 18. Similarly, curved walls 52, 54 define the take-away chute for gap 20. Walls 56, 58 define the chute for gap 22, and walls 60, 62 define the chute for gap 24.

Referring to FIGS. 2 and 3 the operation of orientor 10 for processing the shortest length spears through gap 18 is illustrated. This gap is adapted to process all randomly oriented spears of the shorter length and to direct the same in butt-first lengthwise orientation for delivery to take-away pan 42. FIG. 2 illustrates the orientation of an exemplary butt-first spear 64, while FIG. 3 illustrates the orientation of an exemplary tip-first spear 66.

As illustrated in FIG. 2 the exemplary butt-first or heavier end foremost oriented spear 64 is denser at its butt or heavier end 70 with its center of gravity 68 displaced toward this end. As spear 64 advances down the path defined by vibrating planar surface 16 it will start to tilt or pivot by gravital action as center of gravity 68 clears trailing edge 28, which acts as a fulcrum against the spear. The spear will pivot to the position at 64a where, because the butt-end distance from the center of gravity is short, it will clear leading edge 30 of a second surface 32 and continue to pivot to the position at 64b. The spear will continue to drop against curved wall 48 which directs it to the position at 64c, where it moves in butt-first orientation onto take-away pan 42. Vibration of inclined pan 42 continues to move the spear downwardly where it is collected by suitable means such as a conveyor, not shown, for delivery to a further processing operation. As desired, a series of separate take-away pans, not shown, may be provided to collect articles from one or more gaps to provide segregation as to length.

Referring to FIG. 3 processing of an exemplary tip-first or lighter end foremost oriented spear 66 through gap 18 is illustrated. It is assumed in this example that spear 66 is of substantially the same length as that of exemplary spear 64 described in relation to FIG. 2. Spear 66 also has its center of gravity 72 displaced from the geometric center towards butt-end 74. As spear 66 advances by vibration of surface 16 it will not tend to tilt until center of gravity 72 clears trailing edge 28. Because the length of tip end 76 from the center of gravity is greater than the gap 18 length, tip 76 will contact second surface 32 so that the spear bridges the gap, as illustrated at 66a, and continue to advance until butt-end 74 clears gap edge 28. As the butt end clears this edge the spear drops to the position at 66b where, because the center of gravity has not yet cleared leading edge 30 of surface 32, the spear will tilt back by gravital action to the serial positions at 66c, and 66d. The spear then drops butt-first at 66e where chute wall 48 directs it for delivery onto take-away pan 42 for further processing. As a result, all spears of the shorter length whether received in butt-first or tip-first orientation are delivered by apparatus 10 in butt-first orientation.

Referring to FIGS. 4 and 5 a modified orienting apparatus 78 is provided in which randomly oriented articles or products are segregated as to either tip-first or butt-first orientation. Agricultural products such as asparagus spears would be segregated as to orientation by apparatus 78, although the modified invention would also find application in handling other similar products having a center of gravity displaced from the geometric center.

Apparatus 78 receives the exemplary asparagus spears from a suitable metering device, not shown, for movement along a path defined by a preferred aligning trough 80 mounted on frame 82. Trough 80 extends downwardly at an inclined angle sufficient to freely move the particular product being processed. For asparagus spears, a trough angle of substantially 15° from the horizontal is effective. If this angle is too shallow, then the spears will move too slow for good efficiency, and if the angle is too steep the spears will move too fast across the gap and not orient properly. It is also preferred that trough 80 be formed with a U-shaped

cross-sectional configuration, as illustrated in FIG. 6, so that all spears will move down the center of the trough. The trough should be wide enough so that any crooked spears can move freely, but narrow enough so that the shorter spears cannot turn end-for-end in the trough. The trough length should be at least slightly longer than the longest spear to be processed.

The path of article movement is interrupted by a gap 84 defined between the trailing edge 86 of aligning trough 80 and leading edge 88 of a tip-first orientor chute 90. Chute 90 provides a continuation in the path of product movement for those products or spears segregated as to tip-first orientation. A butt-first orientor chute 92 is disposed below chute 90 with an upper end 94 below gap 84 in product-receiving relationship with the end of the aligning trough. Chute 92 provides a continuation of the path of product movement for those products or spears segregated as to butt-first orientation.

Chutes 90 and 92 are both mounted on frame 82 at a downwardly inclined angle selected to freely move the spears. Preferably, an angle of approximately 30° from the horizontal for chutes 90 and 92 is provided to slightly accelerate each spear after it moves over the gap. Tip-first chute 90 preferably is formed with an open box-shaped cross-sectional configuration as illustrated in FIG. 7 to insure free movement, without hang-up, of the tip-first spears. Chute 90 preferably is of sufficient width to insure that any crooked spear does not catch on the edge of the chute. Chute 92 is preferably U-shaped in cross-sectional configuration to freely move the butt-first spears, and the width of this chute should be similar to that of trough 80, i.e., wide enough so that any crooked spears can move freely but narrow enough so that any short spears cannot turn end-for-end.

Aligning trough 80 receives the spears in random lengthwise orientation and moves them along the path by gravital action. This movement may be assisted by suitable vibrating or shaking means, not shown. All tip-first oriented spears bridge gap 84 and, as explained hereinafter, continue on chute 90. A suitable supporting means 96, shown as a chute, is mounted below the trailing edge of aligning trough 80 to prevent the tip-first oriented spears from tilting backwards as they bridge across the gap. The lower end of chute 96 projects outwardly from trough edge 86 and supports the butt-end of the tip-first spears as they fall from edge 86. Support means 96 could also be any suitable rod or support surface positioned below the gap.

FIG. 4 illustrates the operation of apparatus 78 in segregating butt-first oriented spears. As exemplary butt-first oriented spear 98 having its center of gravity 100 displaced towards its butt end is shown as moving along trough 80. As spear 98 continues along the path it will tilt downwardly through gap 84 to the position at 98a after center of gravity 100 clears trough edge 86, which acts as a fulcrum against the spear. The butt-end of the spear will continue to pivot downwardly as it is short enough to clear the leading edge 88 of chute 90. Continued tilting by gravital action moves the spear into position 98b in chute 94. All butt-first oriented spears are thus segregated in chute 94 and delivered by suitable means such as a conveyor, not shown, for subsequent processing.

FIG. 5 illustrates the segregation of tip-first oriented spears by apparatus 78. An exemplary tip-first oriented spear 102, in this instance assumed to be of equal length to spear 98 of the preceding example, is illustrated as moving downwardly through aligning trough 80. Tip 104 of this spear has a greater dimension from center of gravity 106 than the butt-end to center of gravity dimension. As spear 102 exits from trough 80 tip 104 will bridge across the gap and contact upper end 88 of tip-first chute 90, as illustrated at position 102a. Spear 102 continues to move into chute 90 until its butt end clears trough edge 86. As the butt end drops from edge 86 it is supported by chute 36 until the spear center of gravity moves beyond chute edge 88, thus preventing the spear from tilting backwards. This segregates all tip-first oriented spears into chute 90 where they continue along the path for subsequent removal by suitable means such as a conveyor, not shown, for further processing.

FIGS. 8 and 9 illustrate a modification of the invention in which full length range of articles, shown as field cut asparagus spears, are segregated both as to length classification and lengthwise orientation. This modification embodies the principle of tilting an elongated article having its center of gravity displaced lengthwise from its geometric center for the orienting operation.

The modified form of FIGS. 8 and 9 comprises a grading and orienting apparatus 108 including a plurality of side-by-side infeed lanes or troughs 110,112. The infeed lanes 110,112 preferably comprise U-shaped aligning troughs receiving a flow of asparagus spears from a suitable metering device such as an inclined cleated conveyor or shaker and the like, not shown. The lanes or troughs 110,112 incline downwardly and are sized in the manner explained with respect to FIGS. 4 and 5 for freely moving the spears. The lanes direct the spears to a plurality of grade-out zones comprising gaps 114,116,118, and 120 provided in the flow path of each aligning trough. The length of the gaps 114-120 progressively increase along the flow path for grading out spears of gradually increasing lengths. A series of side-by-side transfer chutes 122,124,126 are provided downstream of the grade-out gaps to transfer those spears not graded out at a respective grade-out zone to the next succeeding aligning trough or lane 123,125,127 feeding the following grade-out zone. A plurality of transfer chutes 128 and troughs 129 are provided to receive over-flow spears from the last grade-out zone for delivery to any suitable take-away conveyor means or over-flow bin, not shown.

The infeed troughs, grade-out gaps, transfer chutes, and over-flow chutes are mounted together on upper shaker bed frame 130 which in turn is mounted for vibrating or oscillating movement on a plurality of pivotal arms 132,134,136 supported on main frame 138. The lower projecting ends of arms 134-136 pivotally support lower shaker bed frame 140 which in turn supports a plurality of orienting stages or units 144,146,148. A suitable motive power means 142 is operatively connected with frame 140 for oscillating both upper and lower shaker beds advance the spears along the troughs and chutes. Oscillation of the bed frame with a stroke of from one-eighth inch to one-fourth inch at approximately 400-500 rpm by means of

a rotary motor 142 has been found adequate to freely move the spears.

The spears graded out at each trough are delivered to respective orienting stages or units 144-148 mounted on shaker bed frame 140. In FIG. 8 the orienting unit for grade-out gap 120 is not shown for purposes of clarity. These orienting units segregate the graded spears into flow paths with either butt-first or tip-first orientation. In the illustrated embodiment all tip-first oriented spears are directed onto a plurality of powered, laterally disposed transfer belts 150, 152 discharging onto a transversely running trim belt 154. All butt-first oriented spears are delivered by the orienting stages onto a plurality of transversely spaced transfer belts 156, 158 discharging onto a transversely running trim belt 160. The belts 154 and 160 deliver the separately segregated and oriented spears for further processing operations, such as trimming or canning and the like. Alternatively, separate transfer and trim belt combinations, not shown, could be provided to receive the discharge from one or more of the orientor stages 144-148 so that the spears are received in both length classification and orientation segregation.

Referring to FIG. 9 elements of grader-orientator apparatus 108 for grade-out gap 116 and orientor stage 146 are shown in greater detail. It is understood that the construction and operation for the remaining grade-out gaps and orientor stages of the apparatus are similar thereto. The gap length for each orientor stage is less by approximately one-half inch than the respective grade-out gap length. For example, where the infeed asparagus spears are of the full range of field-cut random lengths, diameters, and orientation, then it is preferred to have the first grade-out gap 114 with a gap length of 3 inch, with consecutive grade-out gaps increasing by approximately 1 inch in length so that gap length for grade-out gap 120 is 6 inches. Additional smaller or larger gap lengths could be provided for processing a greater size range. With this dimensioning of the grade-out gaps, a corresponding dimensioning for the orienting stages would preferably be with the gap length for stage 144 of 2½ inch, gap length for stage 146 of 3½ inch, and gap length for stage 148 of 4½ inch. With the foregoing exemplary dimensioning, grade-out gap 116 is effective to grade out all tip-first spears between approximately 5-7 inches in length, and all butt-first spears between 7-9 inches in length. Shorter spears are graded out in gap 114, while longer spears will pass on to the succeeding grade-out gaps.

In FIG. 9 the grade-out gap for each lane of product flow comprises the trailing edge 162 of aligning trough 123 and the longitudinally spaced leading edge 164 of transfer chute 124. The grade-out gap dimension 166 (a dimension of 4 inches for gap 116) is measured horizontally between the edges 162 and 164.

All tip-first spears of lengths between 5-7 inches will grade out through gap 116 because spears of this size generally have a center of gravity to tip dimension of approximately or slightly less than 4 inches, but not less than 3 inches. A spear of this size moving across the gap in tip-first orientation will drop through the gap and fall onto a grade-out chute 168 mounted below the gap. The spears will drop onto chute 168 without a change of lengthwise orientation.

The butt-first spears advancing along aligning trough 123 sized between 7-9 inches normally have a center of gravity to butt-end dimension of between 3-4 inches. Thus, this dimension for a 7 inch spear is 3 inches while it is 4 inches for a 9 inch spear. All butt-end spears within this range will drop by gravital action in front of transfer chute edge 164, drop through gap 116, and move downwardly along grade-out chute 168.

A direction reversing arrangement 170 is provided below the discharge end of grade-out chute 168 for reversing the direction of the asparagus spears so that the spears are accurately fed into orientor stage 146. This provides a more compact arrangement of elements of the orientor. Reversing arrangement 170 includes an upwardly inclined accelerator belt 172 disposed below the discharge end of chute 168 and discharging onto a downwardly and reversely inclined chute 174. Reversing chute 174 in turn discharges into orientor aligning trough 176. Accelerator belt 172 is adapted to move at a sufficient speed, preferably on the order of 250 feet per minute, to accelerate the spears upwardly in a trajectory throwing them onto reversing chute 174 without the spear tipping downward or turning end-for-end.

Reversing chute 174 inclines downwardly at an angle to the horizontal substantially the same as that for grade-out aligning trough 123 so that the spears received from the accelerator belt are moved downwardly by vibration onto orientor trough 176 with the change of direction completed.

Orientor stage 146 segregates the graded spears as to lengthwise orientation by moving the same across gap 178 interrupting the flow path. Gap 178 is defined between the trailing edge 180 of aligning trough 176 and leading edge 182 of tip-first orientor chute 184. With an orienting gap of approximately 3½ inch all tip-first oriented spears which were graded through grade-out gap 116 with a length range of 5-7 inches will have a center of gravity to tip end dimension of between 4-5 inches. The tip end is thus long enough to contact chute 184, edge 182, and bridge gap 178. As the butt end of this spear clears trough edge 180 it is supported by suitable means such as supporting wire 186 preventing tilt-back of the spear. All tip-first oriented spears thus are segregated in chute 184 and are vibrated downwardly onto tip-first transfer belt 150 which discharges onto trim belt 154.

The butt-first spears graded between 7-9 inches by grade-out gap 116 have a center of gravity to butt end dimension of between 3-4 inches. As the center of gravity of these spears advance over edge or fulcrum 180 they will tilt by gravital action so that the butt ends clear leading edge 182 of trough 184, and these spears then drop through gap 178 into butt-first orientor chute 188. All butt-first oriented spears are thus segregated into chute 188 and directed onto transfer belt 156 which in turn discharges onto trim belt 160.

Orientor stages 144 and 148 segregate the spears according to either butt-first or tip-first orientation for the remaining graded spear lengths in a similar manner of operation. The graded and segregated spears from each grade-out and orientation stage are delivered to respective tip-first or butt-first transfer belts for combined flow for further processing operation. However, separate transfer belts, not shown, for one or more of

the stages may be provided for separate collection of commonly oriented spears within the different length ranges.

From the foregoing it is apparent that there has been provided an improved method and apparatus for orienting elongated products having a center of gravity displaced from the geometric center, and in which the orientation and/or grading is more efficiently carried out with a minimum of steps and operating elements. While the foregoing embodiments are considered to be preferred, it is understood that numerous variations and modifications may be made in the steps and arrangement of parts without departing from the spirit and scope of the invention as expressed in the appended claims.

I claim:

1. In apparatus for handling elongated agricultural articles having a center of gravity displaced from the geometric center in a direction away from the lighter and toward the heavier end thereof, means forming an article conveying path including a plurality of supporting surfaces spaced apart in the direction of article movement, each successive surface being spaced from a preceding surface to define therewith a plurality of gaps having successively increasing gap lengths, means forming a fulcrum near one edge of each of said gaps, and means moving articles of random lengthwise orientation along the path and over said surfaces whereby articles of a given length size range are caused to tilt by gravitational rotation about the fulcrum of an upstream gap and to drop through said upstream gap with their heavier ends foremost, and whereby articles of a length size range greater than said given size range are moved across said upstream gap and along said path where they are caused to tilt by gravitational rotation about the fulcrum of a downstream gap and to drop through said downstream gap with their heavier ends foremost.

2. A method of handling elongated agricultural articles to effect endwise orientation of the same, the articles being characterized by having a center of gravity displaced from the geometric center in a direction away from the lighter and toward the heavier end thereof, the steps of moving articles in the direction of their length along a predetermined path interrupted by a gap of a length that is less than the length of some of the articles of a given length size range, causing articles of at least one orientation and within said given length size range to tilt by free gravitational rotation about a fulcrum near one edge of the gap and to drop from said fulcrum through the gap with their heavier ends foremost, causing other articles within a length size range greater than said given size range to bridge across the gap and continue along an extension of said path which is interrupted by another gap of a length greater than said first mentioned gap length, and causing said other articles of at least one orientation to tilt by free gravitational rotation about a fulcrum near one edge of said second mentioned gap and to drop from said fulcrum through said gap with their heavier ends foremost.

3. A method as in claim 2, in which said articles moving with their heavier ends foremost are caused to tilt forwardly by free gravitational rotation about a fulcrum near the leading edges of said gaps and to drop from said fulcrums through the gaps with their heavier ends

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foremost, and said articles moving with their lighter ends foremost are caused to tilt backwardly by free gravitational rotation about fulcrums near the trailing edges of said gaps and to drop from said fulcrums through the gaps with their heavier ends foremost.

4. In apparatus for handling elongated articles having a center of gravity displaced from the geometric center in a direction away from the lighter and toward the heavier end thereof, means forming an article conveying path including a supporting and conveying surface inclined downwardly from the horizontal and interrupted by a gap of a length that is less than the length of the articles, means forming a first fulcrum near the leading edge of the gap and a second fulcrum near the

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trailing edge of the gap and spaced vertically below the level of said first fulcrum by a predetermined distance sufficient to preclude hang-up of any curved articles moving across the gap, and means for moving articles of random lengthwise orientation along the path at a speed such that each article moving with its heavier end foremost is cause to tilt by gravitational rotation about the first fulcrum while each article moving with its lighter end foremost is cause to tilt by gravitational rotation about said second fulcrum.

5. Apparatus as in claim 4, in which the means for moving the articles includes means to impart vibratory movement to said conveying and supporting surface.

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