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Shefet et al.

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(54) **AUTOMATED LATERALLY OFFSET
RETRACTABLE FOOD DISLODGE
MENT OR
GUIDING MECHANISMS AND ASSOCIATED
METHODS AND SYSTEMS**

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(75) Inventors: **Sarid M. Shefet**, Cary, NC (US);
Lawrence Alan Chandler, Raleigh, NC (US)

(73) Assignee: **ConAgra Foods, Inc.**, Edina, MN (US)

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(51) **Int. Cl.**
A22C 11/00 (2006.01)

(52) **U.S. Cl.** **452/51**

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See application file for complete search history.

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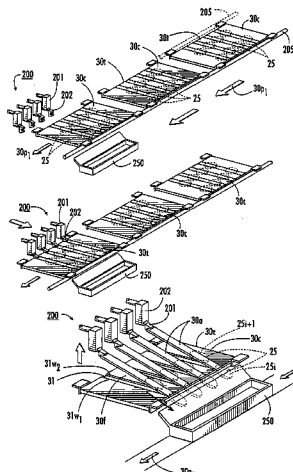
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Primary Examiner—Thomas Price
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(57) **ABSTRACT**

Commercial production transport systems, mechanisms, and guides for food processing are configured so as to automate food handling and/or transport. The systems employ fingers that can be inserted to gap spaces in a carrier surface so as to dislodge, guide and/or route food to travel over predetermined travel lanes. Associated methods can angularly trans- late food being transported in an automated food processing system in a longitudinally offset direction.

20 Claims, 11 Drawing Sheets



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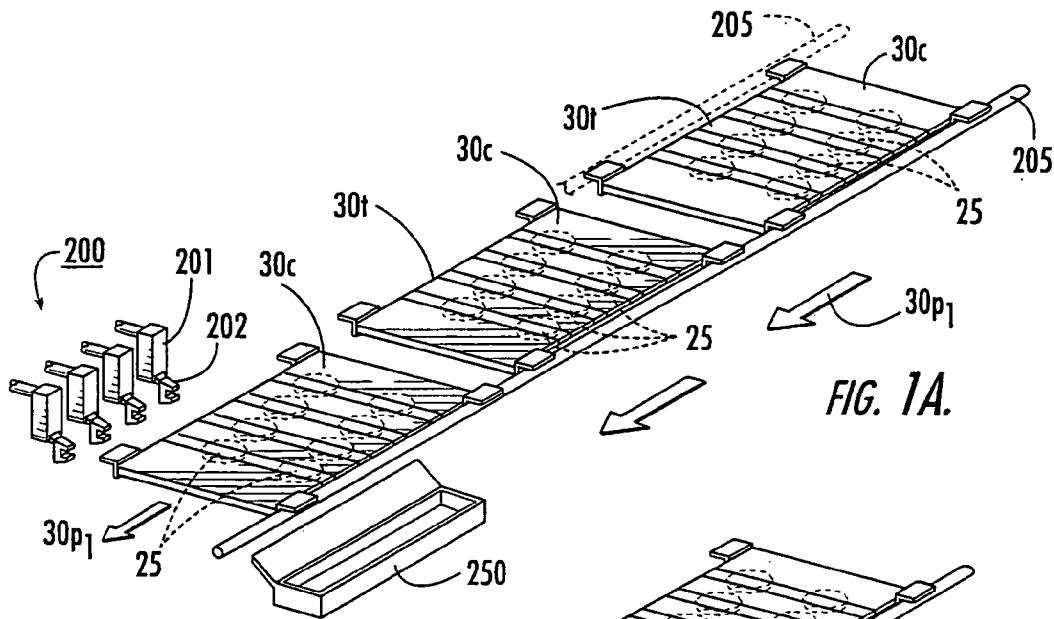


FIG. 1A.

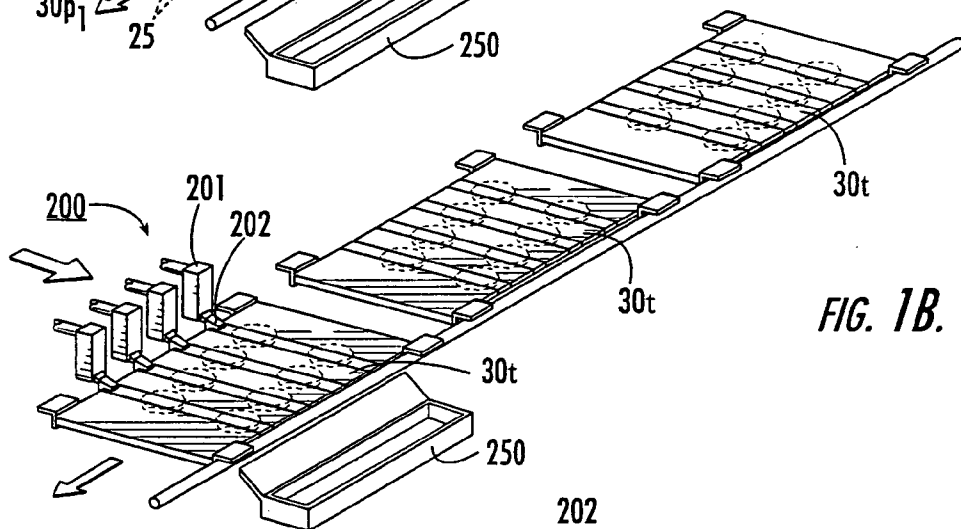


FIG. 1B.

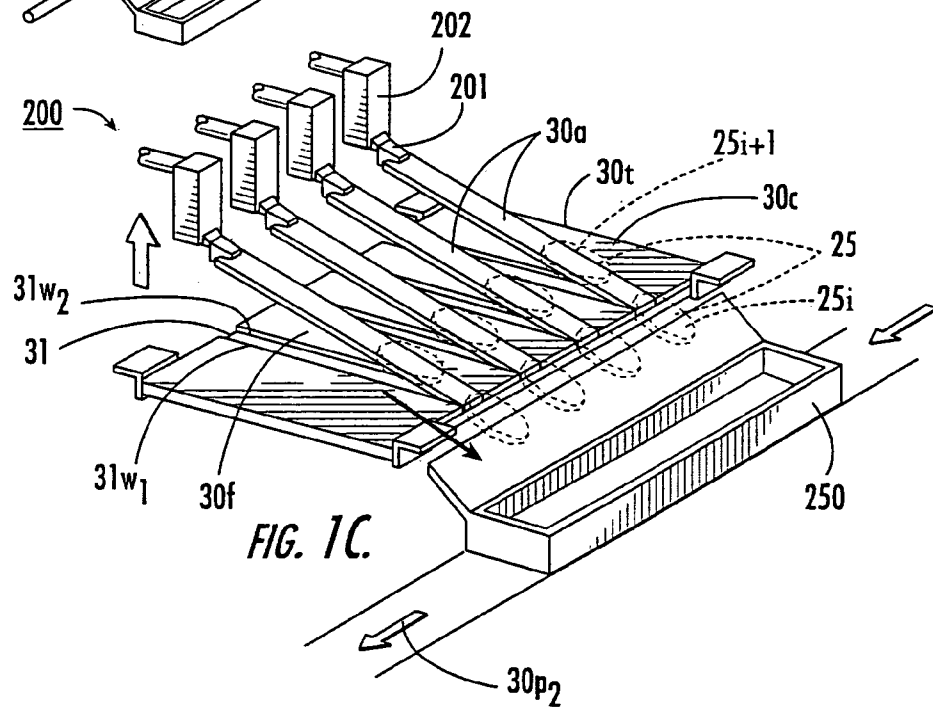


FIG. 1C.

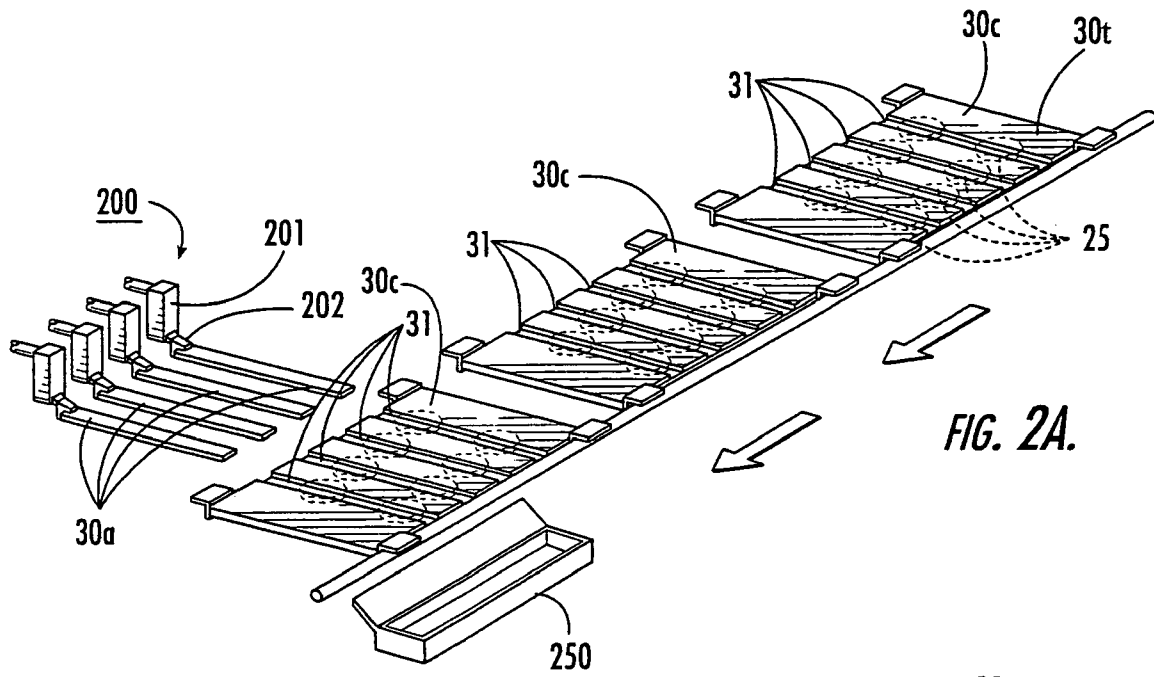


FIG. 2A.

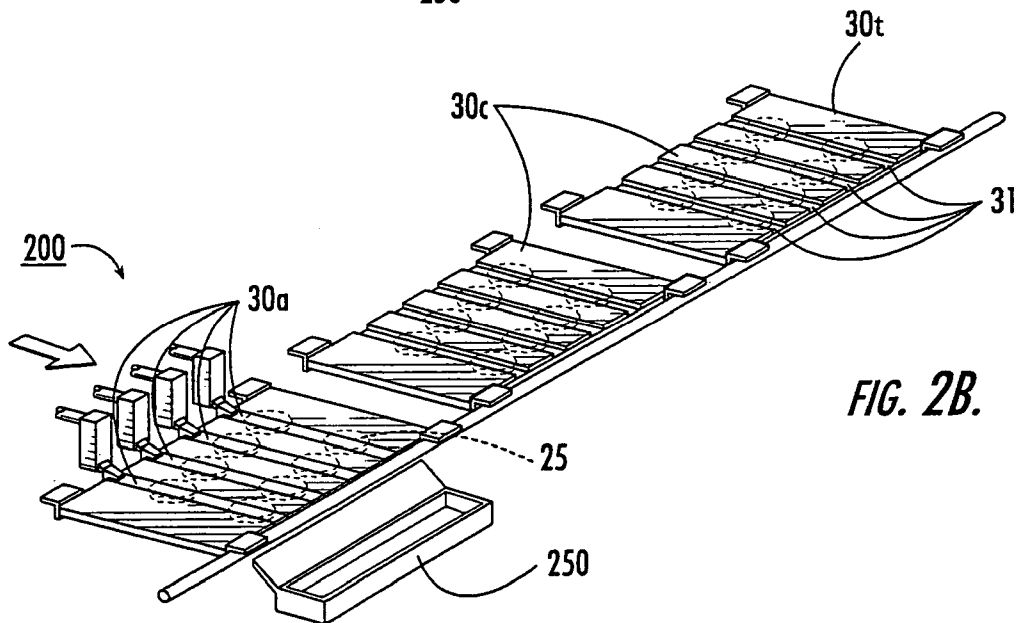


FIG. 2B.

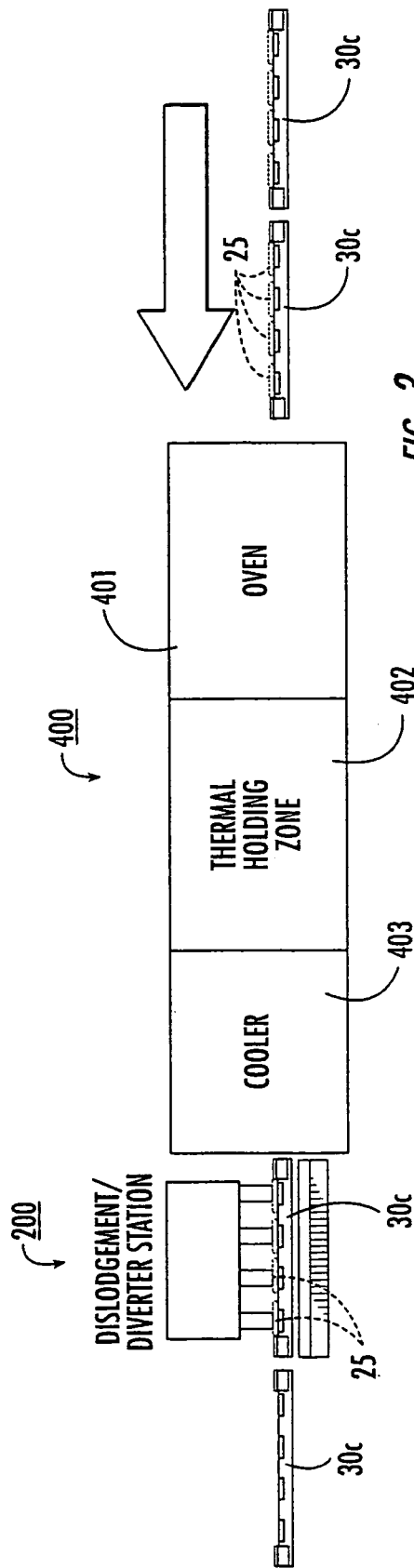
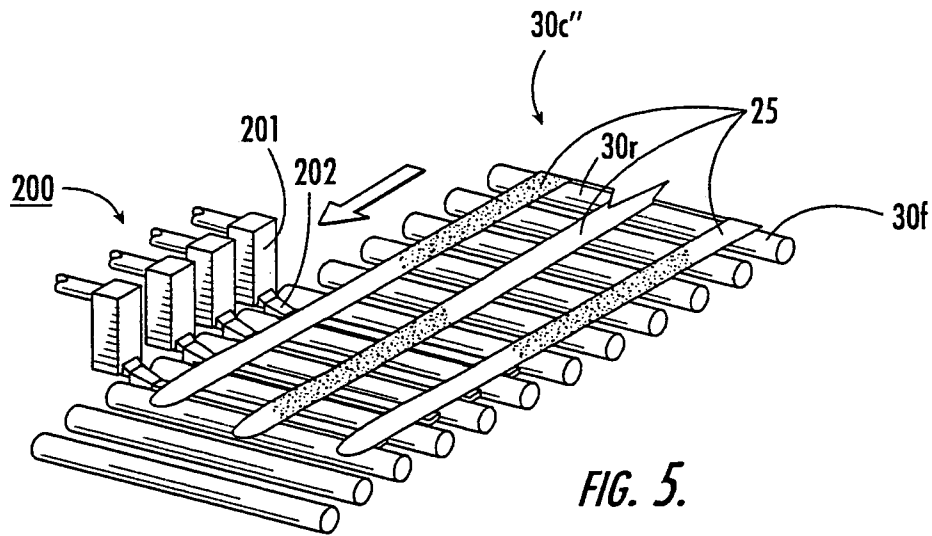
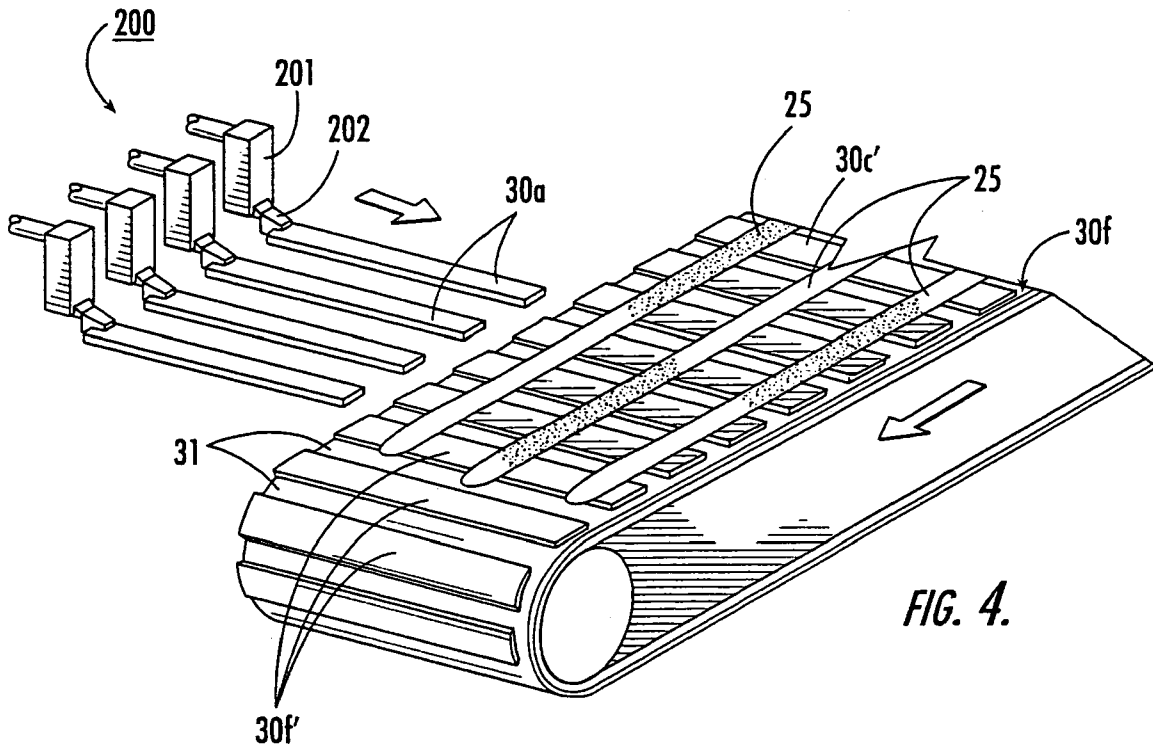


FIG. 3.



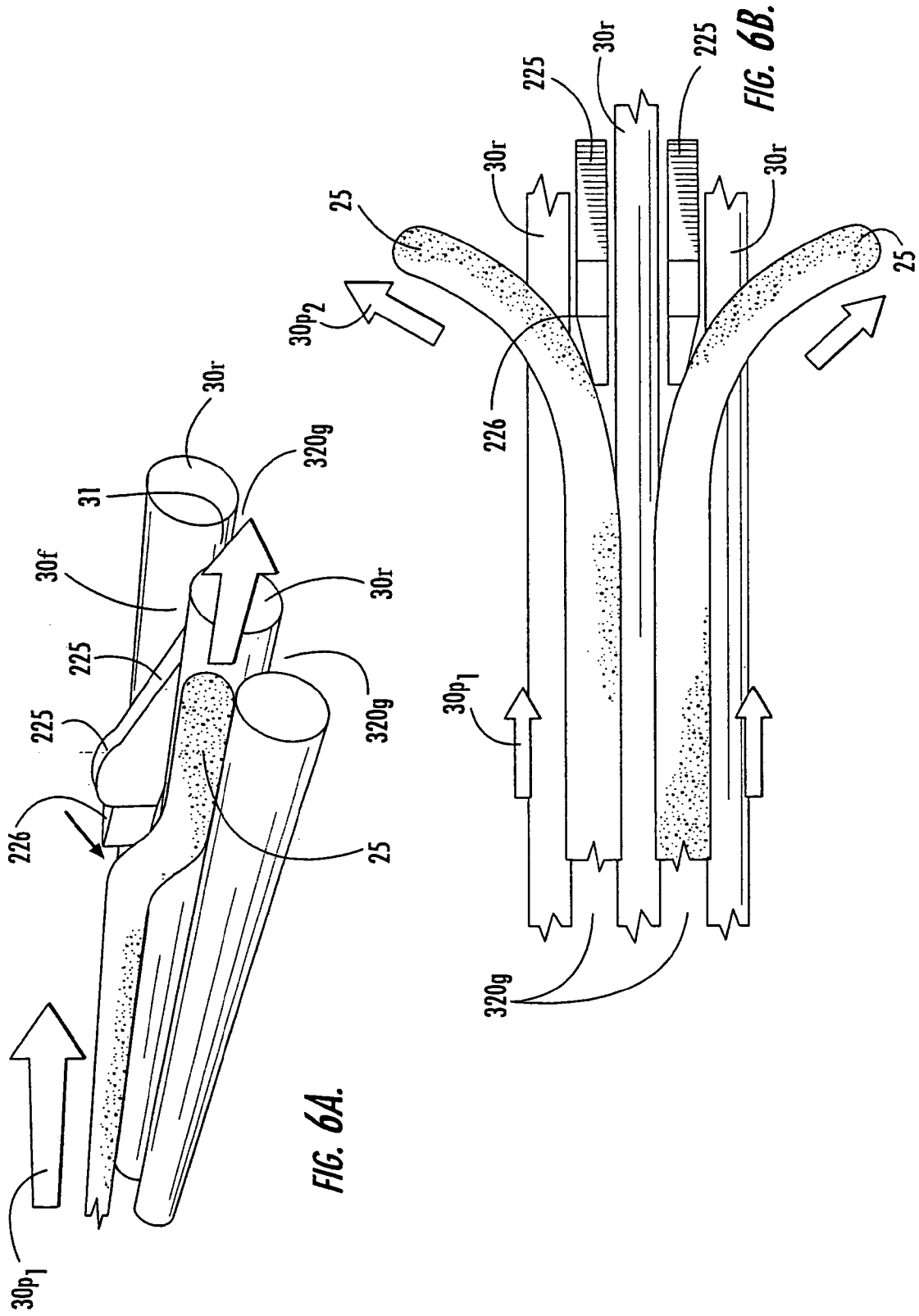


FIG. 6A.

FIG. 6B.

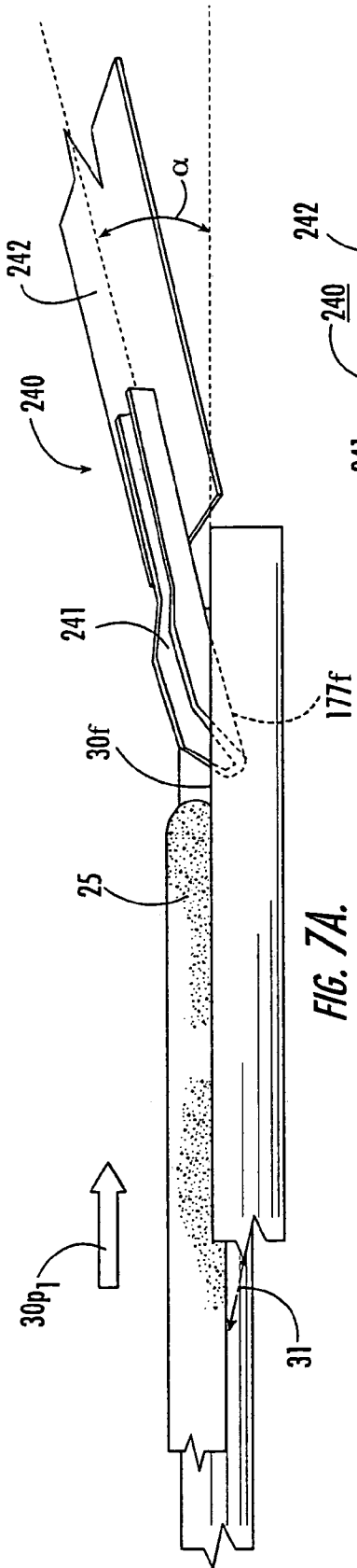


FIG. 7A.

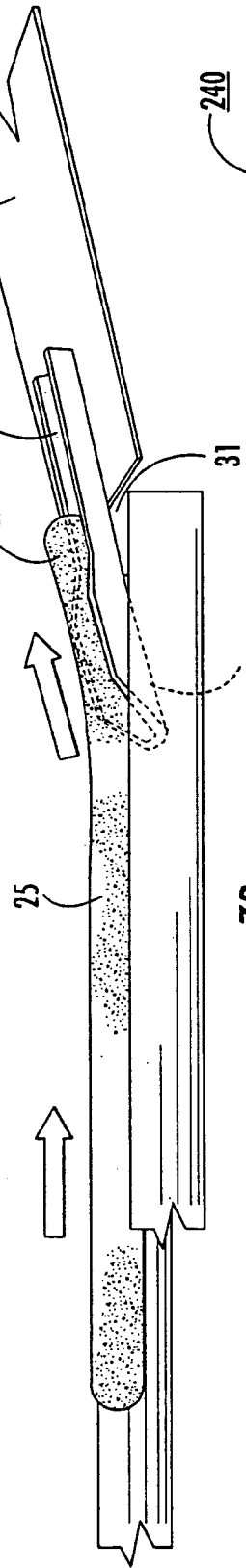


FIG. 7B.

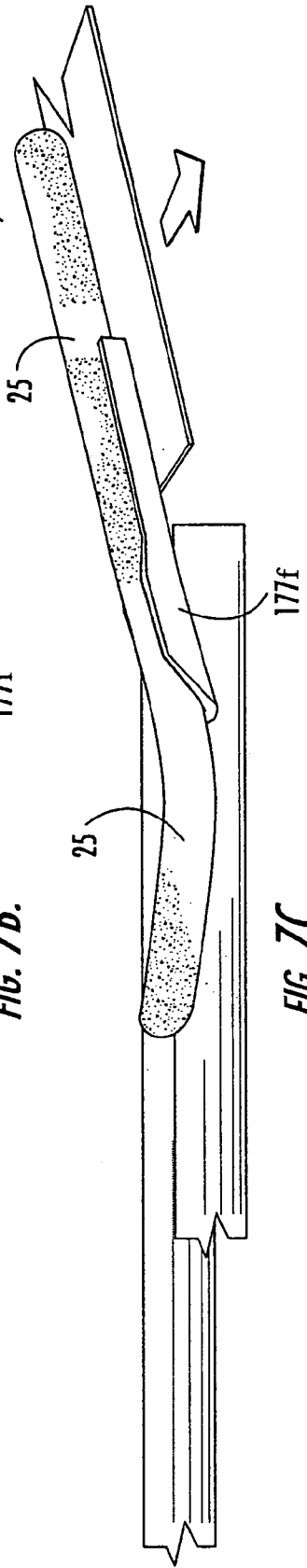


FIG. 7C.

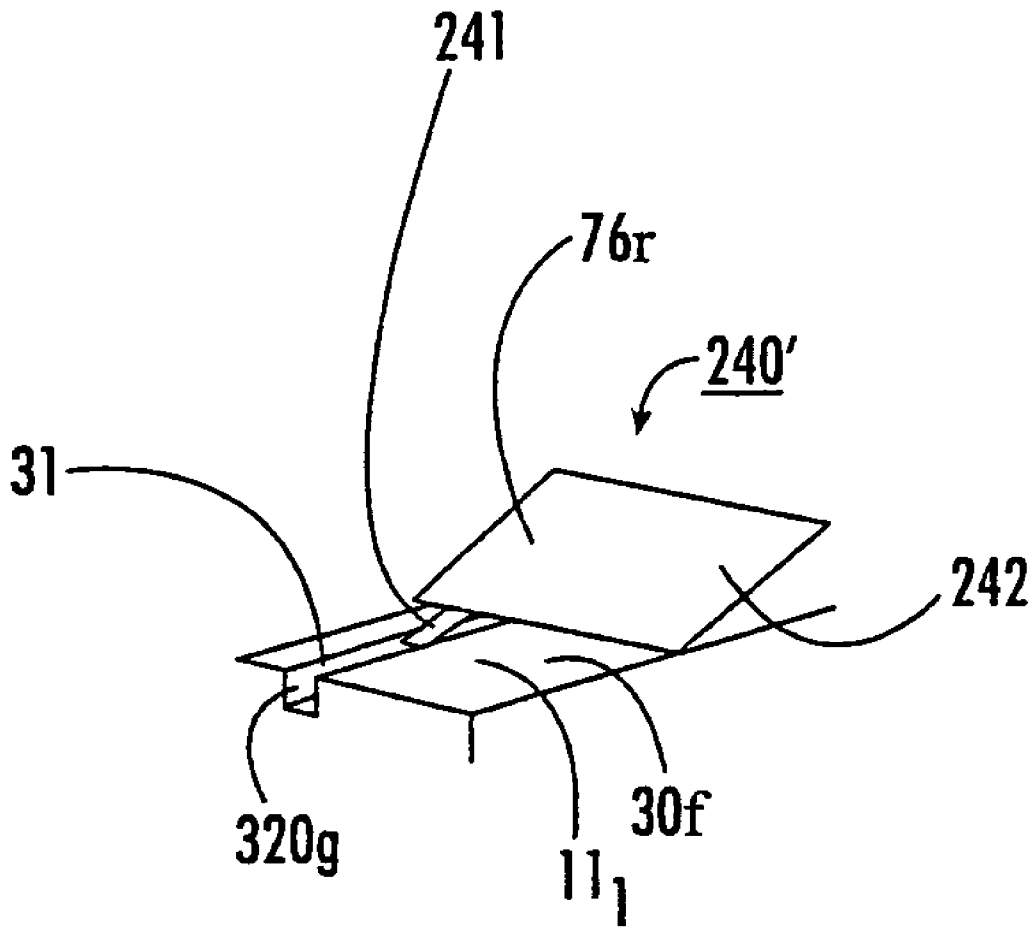
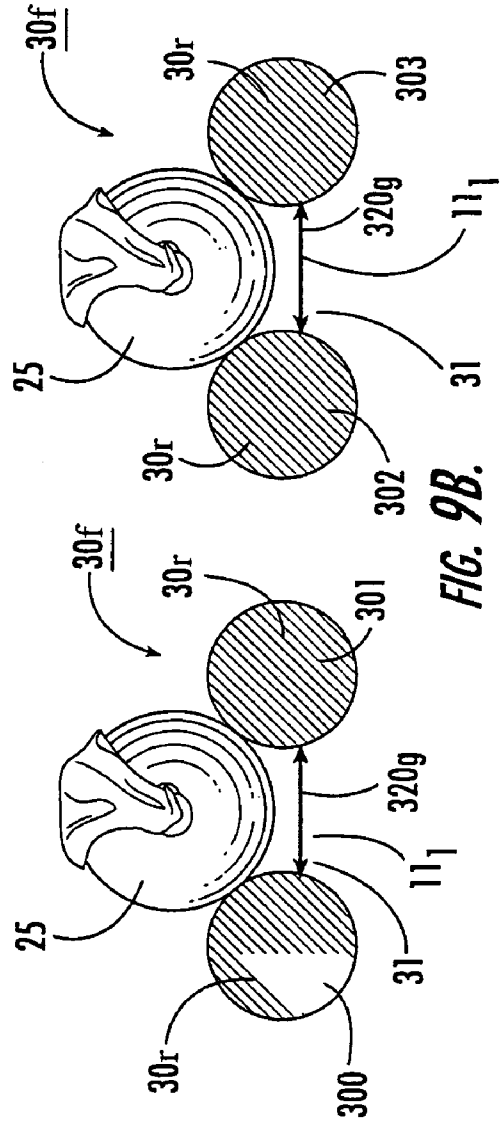
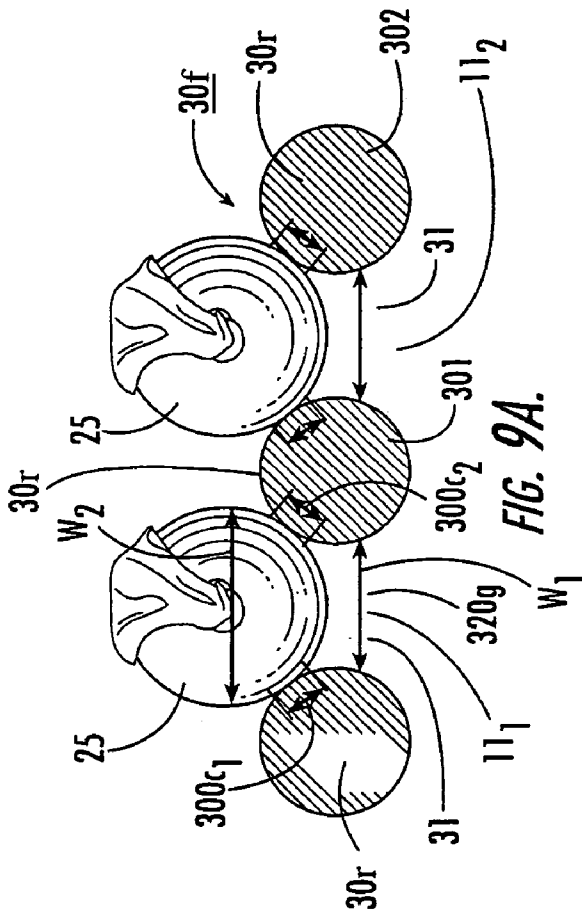


FIG. 8.



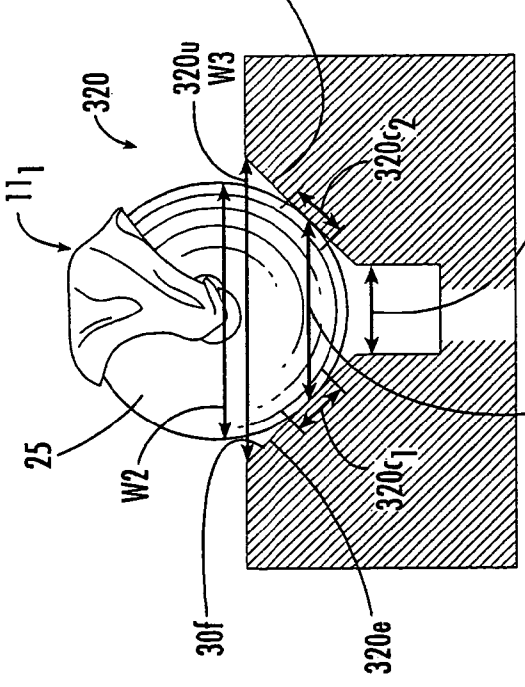


FIG. 10A.

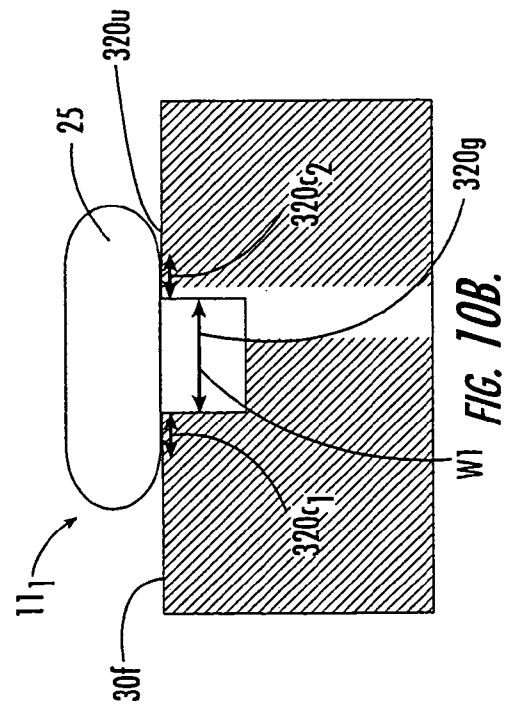


FIG. 10B.

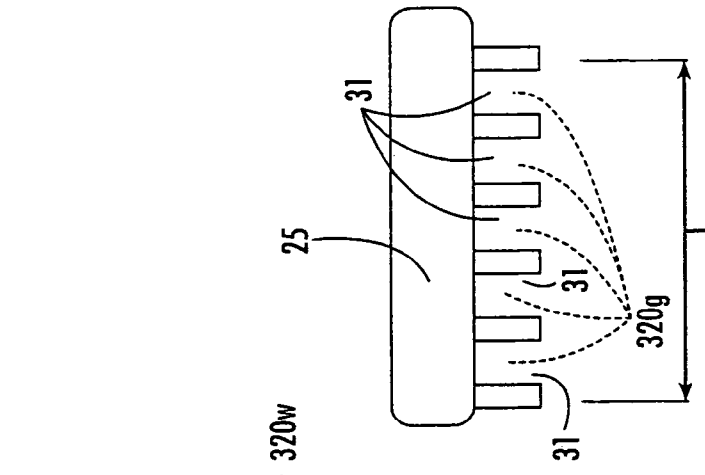


FIG. 10C.

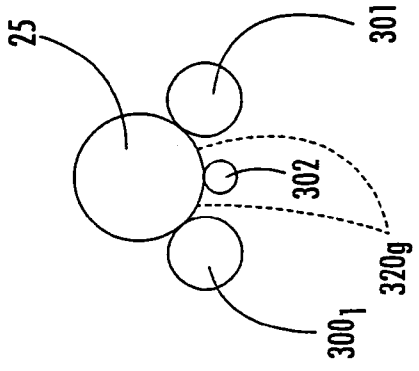


FIG. 10D.

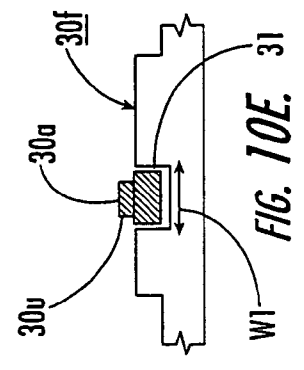


FIG. 10E.

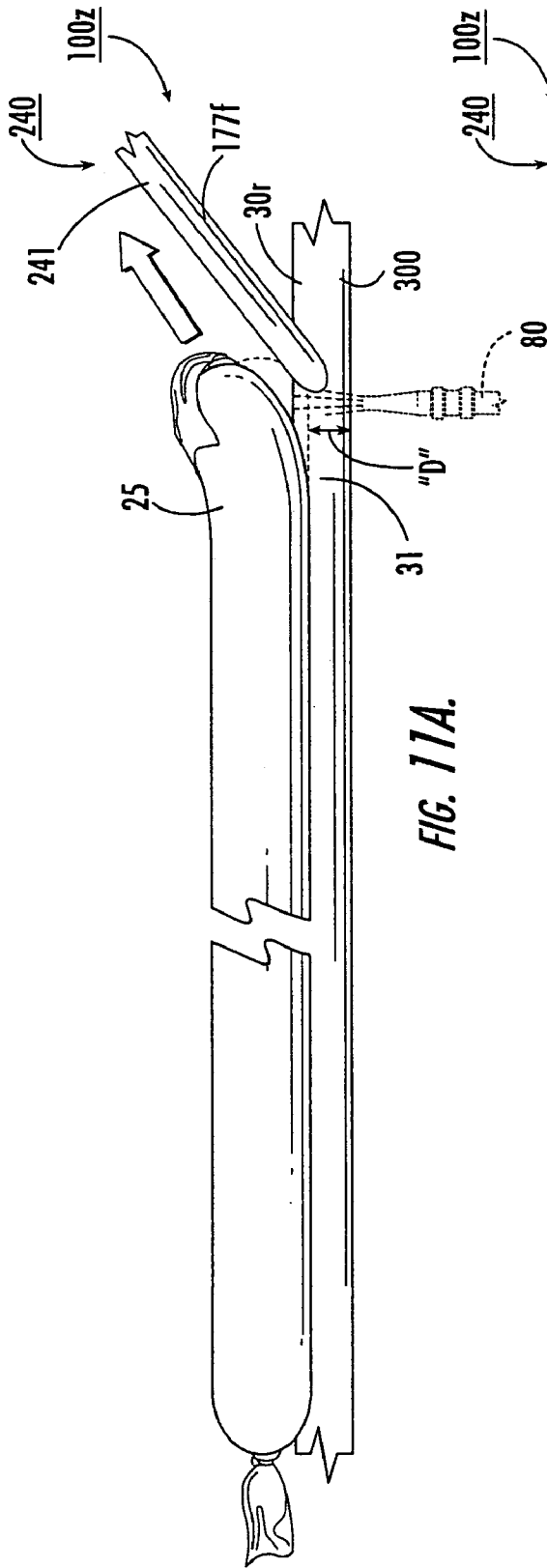


FIG. 11A.

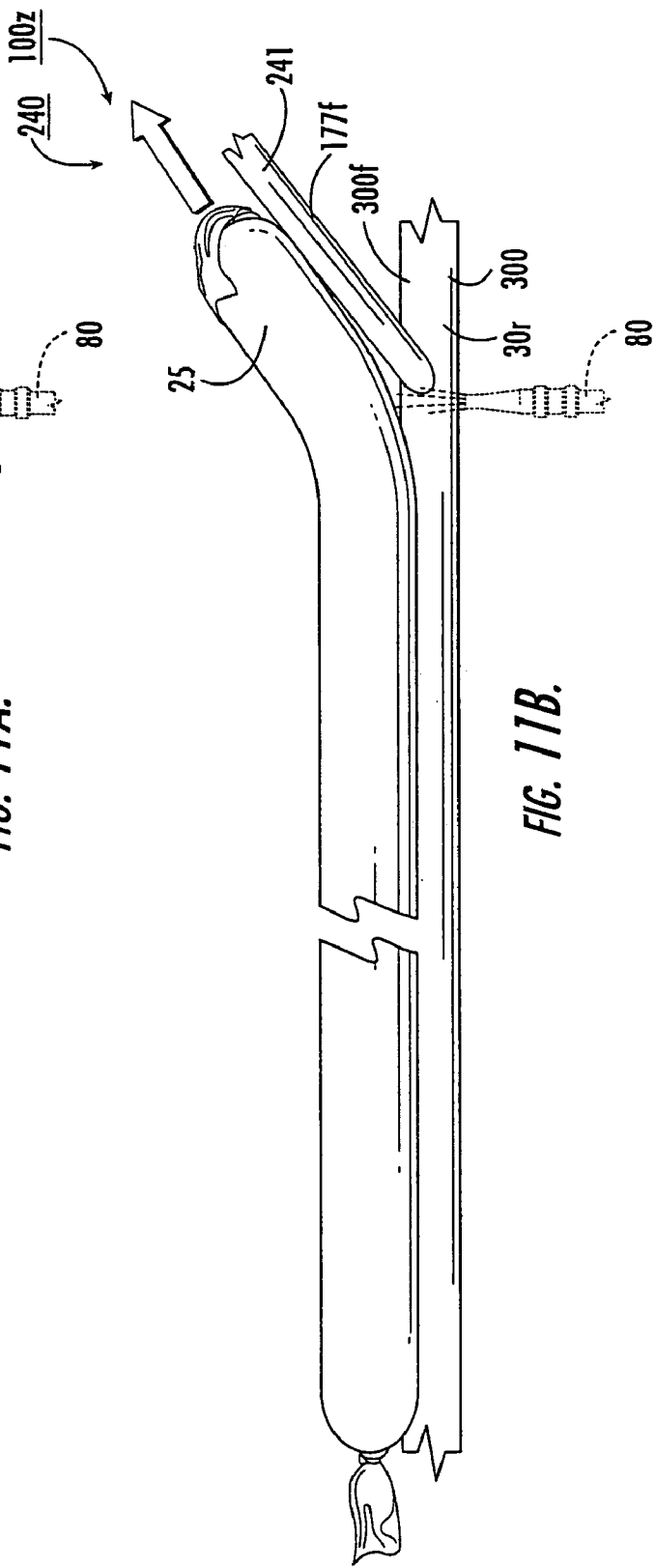


FIG. 11B.

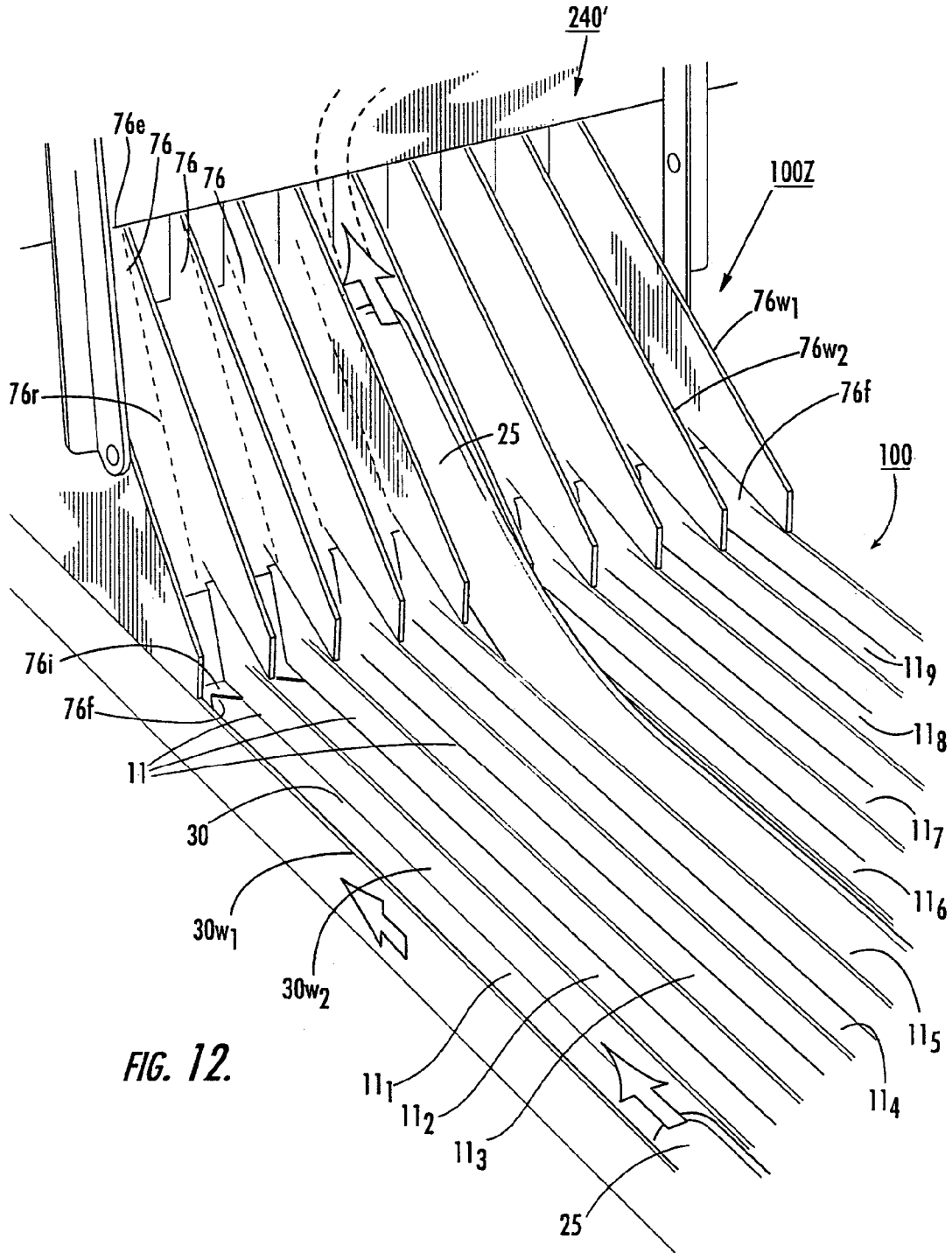


FIG. 12.

**AUTOMATED Laterally OFFSET
RETRACTABLE FOOD DISLODGEment OR
GUIDING MECHANISMS AND ASSOCIATED
METHODS AND SYSTEMS**

RELATED APPLICATIONS

This application is a divisional of U.S. patent application Ser. No. 10/171,864 filed Jun. 13, 2002 now U.S. Pat. 7,048,622 which claims priority from U.S. Provisional Application Ser. No. 60/354,097, filed Feb. 4, 2002, the contents of which are hereby incorporated by reference as if recited in full herein.

FIELD OF THE INVENTION

The present invention relates to food treatment systems such as vertical rise dryers, smokers, curing chambers, ovens, warmers, coolers, and freezers.

BACKGROUND OF THE INVENTION

Conventionally, several different food treatment system configurations have been proposed to smoke, cure, dry, cook, cool, or freeze food products (such as meat products) with the hope of increasing production capacity while attempting to limit the floor space required for carrying out same. In so doing, vertical rise systems have been used with spiral conveyors to move food vertically through the oven while exposing the food to certain processing conditions as it moves from top to bottom or bottom to top.

For example, the Northfield LST (Large Spiral Technology) freezer available from Frigoscandia Equipment (finc-foddtech.com) is a high capacity non-self stacking spiral freezer that employs spiral conveyors with belts available in different widths. Ryson International Inc. of Newport News, Va., provides spiral conveyors that allegedly feature a small footprint and space savings over other brands with load capacities of up to 200 fpm.

Another example is the TURBO-Dryer® from Wyssmont (wyssmont.com). The TURBO-Dryer® uses a stack of slowly rotating circular trays. In operation, food is fed onto the top tray and, after one revolution, is wiped or swept onto the next lower tray where the operation is repeated. The trays are enclosed in a vertical enclosure that circulates heated air or gas about the food on the trays. All or selected levels in the enclosure may be held at a uniform temperature or the enclosure may be configured with zoned temperature regions having different temperatures.

Yet another example of vertical rise system is found in U.S. Pat. No. 5,942,265, which describes conveying pepperoni meat to a conventional spiral dryer which includes a number of tiers (typically about 38–42) according to the initial moisture level, the desired final moisture level, the relative humidity of the air, the total amount of water to be removed, the temperature, and the conveyor speed.

Recently, U.S. patent application Ser. No. 09/888,925 to Shefet et al. described an increased capacity food processing system that can limit the amount of dedicated floor space required to support the system in food processing facilities and/or that can increase the amount of food that can be processed through the food processing system over a production period. The contents of this application are hereby incorporated by reference as if recited in full herein.

Despite the above, there remains a need to provide food routing apparatus in food processing systems, particularly in high-speed mass production systems, that can effectuate

food transfer along desired travel paths in an automated manner that promotes continuous movement and/or inhibits machine or system downtime.

SUMMARY OF THE INVENTION

The present invention provides food dislodgement or guiding systems, devices, and methods that can move or dislodge food items at a diverter station so that the food items are laterally translated away from the primary downstream direction of travel. The food items are held on a carrier member that includes a primary support surface with at least one recess that is disposed under a portion of the food item(s). The diverter station can employ at least one food diverter that is stationary or retractable/extendable. In certain embodiments, the food diverter can include an arm that can be configured to enter a distance into and/or cooperably engage with the support floor recess(es) to dislodge, lift, push, or pull the food item from a first support surface to a different second support surface and/or carrier member. In other embodiments, the carrier floor includes a plurality of moveable segments, at least one of each residing in the carrier floor recess in advance of the diverter station.

Certain embodiments of the present invention are directed to methods for routing, dislodging or guiding food in a food processing system, including: (a) advancing at least one food item on a carrier surface having a plurality of laterally extending recesses with associated lengths and widths formed therein, the at least one food item positioned so that it overlies a portion of at least one of the plurality of laterally extending recesses; (b) inserting an arm member to engage with the carrier surface so that the arm that enters into at least one of the recesses at a first side portion in the carrier surface under the at least one food item; and (c) moving the arm member so that it travels a distance in the laterally extending recess to dislodge the at least one food item.

In certain embodiments, the food items can be held stationary on a support floor (that can itself be stationary or movable such as a tray or conveyor) and the food diverter arm can be configured to move into the flooring recesses under the support surface to dislodge, scoop, scrape, lift, push, or pull the food item from the support surface onto the diverter. Alternatively, the arm can reside in the recess and the diverter activated to push the arm a distance along the length of the recess.

In other embodiments, the food items can be held on a moving first support surface when the food diverter arm(s) extends to move in the recess and contact the food items and guide or dislodge the food items to a next desired support surface.

In certain embodiments, the food diverter can be configured as a retractable component that periodically extends to engage with a floor or carrier member and then retracts. In other embodiments, the food diverter can be a stationary component that is positioned at a desired location in the travel path of the food item(s).

Other embodiments are directed to methods for routing or guiding food in a food processing system, including: (a) advancing at least one food item on a carrier surface in a first travel direction, the carrier surface having at least one recess with associated length and width formed therein, the at least one food item positioned so that it overlies a portion of at least one recess; (b) positioning a food diverter having an outwardly extending arm member so that the arm member enters into the recess under the at least one food item; and (c) routing the at least one food item so that it departs from

the first travel direction to an angularly offset second travel direction responsive to the positioning step.

The food diverter can be angularly offset from the immediately upstream direction of travel of the food such as, but not limited to, at least about 30 or 45 degrees and typically within about 30–150 degrees. In certain embodiments, the food diverter is angularly offset by about 90 degrees.

Still over embodiments are directed to systems for processing food, including: (a) means for advancing at least one food item on a carrier surface having a plurality of laterally extending recesses with associated lengths and widths formed therein, the at least one food item positioned so that it overlies a portion of at least one of the plurality of laterally extending recesses; (b) means for directing an outwardly extending arm member to engage with the carrier surface so that the arm enters into at least one of the recesses at a first side portion in the carrier surface under the at least one food item; and (c) means for moving the arm member so that it travels a distance along a desired length in the laterally extending recess dislodges the at least one food item off of the carrier surface.

Other embodiments are directed to systems for routing or guiding food in a food processing system, comprising: (a) means for advancing at least one food item on a carrier surface in a first travel direction, the carrier surface having at least one recess with associated length and width formed therein, the at least one food item positioned so that it overlies a portion of the at least one recess; (b) means for positioning a food diverter having a forwardly extending finger so that it engages with the carrier surface and allows the arm member to enter into the recess under the at least one food item; and (c) means for routing the at least one food item so that it departs from the first travel direction to an angularly offset second travel direction.

The food diverter can include either a stationary or moving floor, or combinations thereof, that cooperates with stationary or moving floors (such as one or more conveyors) located on one or either side thereof. In certain embodiments, the food diverter is stationary and resides in the line of travel of the food and is positioned between two moving floors to transfer food being advanced therebetween so as to provide the desired speed and inhibit collisions or disruptions in the transport process. In other embodiments, the router guide is dynamically configured to repetitively extend and retract into the travel path (positionally offset relative thereto).

In certain embodiments, the carrier surface is provided by a moving floor proximate the router guide that is configured with a support surface that has a gap portion that underlies a food product. The a forwardmost finger be configured to be forwardly located and downwardly extending so that, in operation, it is received into the gap of the moving or stationary floor underlying the food to thereby direct, scoop, or lift the food onto or over the and through the rearward portion of the router guide so as to automatically cause or direct the food to travel a desired travel path associated therewith. The finger can be configured to direct the food upward or downward to a subsequent carrier surface or travel path so as to advance the food in the processing system environment.

In other embodiments, the arm member and/or finger can be configured to retract and extend to repetitively enter the gap portion(s) of the floor so as to engage with a stationary or moving floor, and, in operation, dislodge food items resting on the surface of the floor proximate the underlying finger of the router guide.

The food processing system can be configured to provide separate temperature regulated (and moisture or humidity, air velocity, cooling, heating, sprinkling, gas, and the like) spaces over one or more tiers in the vertically stacked ovens (or over other spaces in non-stacked ovens).

As before, in operation, in certain particular embodiments, the food item can be propelled forward to travel upwardly over the finger of the food diverter (that may have a dynamic and/or stationary floor portion) that can be positioned intermediate a first moving floor portion and a second moving floor portion.

The foregoing and other objects and aspects of the present invention are explained in detail in the specification set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a perspective view of a portion of a travel path with a plurality of carrier members and a diverter station according to certain embodiments of the present invention.

FIG. 1B illustrates the travel path shown in FIG. 1A with the diverters of the diverter station engaging with a carrier member according to embodiments of the present invention.

FIG. 1C illustrates the carrier member shown in FIG. 1B, with the diverters raised to an elevated position, thereby directing the food items to be dislodged from the carrier member into a receiving station or member according to embodiments of the present invention.

FIG. 2A is a perspective view of a portion of a travel path with a plurality of carrier members and a diverter station with a plurality of diverter members according to additional embodiments of the present invention.

FIG. 2B illustrates the diverter members of FIG. 2A engaging a carrier member at the diverter station according to embodiments of the present invention.

FIG. 3 is a schematic side view of a thermal processing system and associated food diverter and/or dislodgement station according to embodiments of the present invention.

FIG. 4 is a front perspective view of a portion of a carrier member forming a portion of a travel path as well as an associated diverter station according to additional embodiments of the present invention.

FIG. 5 is a front perspective view of a portion of yet another configuration of a carrier member forming a portion of a travel path according to other embodiments of the present invention.

FIG. 6A is a side perspective view of a portion of a travel path having a laterally offset guide positioned within a recess therealong according to embodiments of the present invention.

FIG. 6B is a top view of a portion of a travel path that is configured to divert the food or other item to angularly travel away from the adjacent primary downstream direction of travel in a larger angular movement relative to that shown in FIG. 6A according to embodiments of the present invention.

FIGS. 7A–7C are side views of a portion of a travel path illustrating a sequence of operations that can redirect the direction of travel according to yet other embodiments of the present invention.

FIG. 8 is a side perspective view of a portion of a food travel path with a floor with a gap space underlying a portion of the width of the food product according to embodiments of the present invention.

FIG. 9A is a front section view of a portion of a floor according to embodiments of the present invention.

FIG. 9B is a front section view of a portion of a floor according to embodiments of the present invention.

FIGS. 10A–10E are front section views of a portion of a floor according to embodiments of the present invention.

FIG. 11A is a partial side view of a portion of a food travel path with the food being guided forward as it approaches a finger positioned lower than the upper surface of the floor in a food guide transition zone.

FIG. 11B is a partial side view of the food travel path of FIG. 11A with the food progressing forward up the finger of a router guide according to embodiments of the present invention.

FIG. 12 is a perspective view of a pivotable assembly according to embodiments of the present invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention will now be described more fully hereinafter with reference to the accompanying figures, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout; In the figures, certain layers, components or features may be exaggerated for clarity and broken lines illustrate optional features or operations unless stated otherwise.

In the description of the present invention that follows, certain terms are employed to refer to the positional relationship of certain structures relative to other structures. As used herein, the term “forward” and derivatives thereof refer to the general or primary direction that food travels as it moves inside a food processor from a processing point or region to the next processing point or region; this term is intended to be synonymous with the term “downstream,” which is often used in manufacturing environments to indicate that certain material being acted upon is farther along in the manufacturing process than other material. Conversely, the terms “rearward” and “upstream” and derivatives thereof refer to the directions opposite, respectively, the forward and downstream directions.

The present invention is directed to food preparation and/or processor systems. The systems can be used in commercial low volume and/or large-scale mass production of food items. The food processor system can be a horizontal or vertical rise system and can include different zones exposed to different processing conditions, such as one or more of a dryer, a heater, an oven, a curing or smoking source, a cooler or refrigerator or freezer and the like. The food processor system can be configured to process solid or semi-solid food items or liquid items in containers or casings or shells. Examples of food items include, but are not limited to, baked goods, candies, bakery and dairy products, and meat products. In certain embodiments, the food processing system and/or related devices may be particularly suitable to process discrete low profile items (substantially planar or flat objects or meat products), as well as elongated food items such as, but not limited to, elastic or partially elastic food items such as cheese (like mozzarella strands), dough (for incubation), meat sticks or strands, and the like.

Of course, the processing system can be configured to convey or move other items through a processing facility where enhanced capacity is desired. For example, the processing system may be adapted for medical products; pharmaceuticals where sterilization is desired or for implements, surgical tools or other items desiring sterilization, or manufacturing facilities for products undergoing curing, coating, brazing, tempering, sintering, or other processing condition. Still additional examples of other elongated products that

may be routed, guided, or handled by the devices, methods, and systems of the instant invention include candles, ropes, cables, wires, and the like. See U.S. Pat. No. 4,582,047 and RE35,259, U.S. Pat. No. 5,942,265, U.S. Pat. No. 5,078,120, and U.S. Pat. No. 4,079,666 for discussions of exemplary processing conditions for food and conveyor means, the contents of which are hereby incorporated by reference as if recited in full herein.

In certain embodiments, the present invention is used to move a length of an elongated product held in a casing. The casing can be any suitable casing (edible or inedible) such as a collagen casing. The elongated product can be an elongated meat product. Exemplary products include, but are not limited to, strands of meat such as pepperoni or beef, a processed meat product such as a pepperoni or beef stick, sausage, hotdog, or the like.

The elongated meat product can be configured as a continuous length of product. The length may be selected so as to cover one or a plurality of lanes, tracks or perimeter paths over at least one tier or level. In certain embodiments, the length of product is continuous so as to be able to extend over at least one revolution in a lane in a desired travel path. In certain embodiments, the elongated meat product has a length of at least about 20–25 feet, and preferably at least about 50 feet. In particular embodiments, the elongated meat product can have a length of between about 50–85 feet or more.

In some embodiments, the elongated food item may be elastic (at least in tension) so as to allow stretching without unduly altering or deforming its desired shape during processing. The elongated food item may be held in a natural or synthetic casing.

In operation, the product may have an exterior surface that exhibits increased friction relative to a finished, cured, or dried configuration. For example, a collagen casing can be described as having a relatively gelatinous sticky residue prior to its finished state that can cause the food to attempt to stick to a floor or support surface during transport and may make it difficult to route or guide this type of product in an automated relatively fast speed transport arrangement, particularly where non-linear or selectably changeable travel paths are desired. Alternatively, as the food item is prepared or processed, it may adhere to the underlying carrier member or support surface, making it difficult to easily remove the items after cooking or other preparation procedure.

Turning now to FIG. 1A, one embodiment of a system with a food diverter station **200** and food path with an associated advancing transport system is shown. In this embodiment, the advancing transport system employs a plurality of discrete carrier members **30c**. In the embodiment shown, the carrier members **30c** are trays **30t** that can be oriented with the primary surfaces being disposed substantially horizontally and serially aligned to advance along a predetermined transport path defined by opposing support rails or tracks **205**. As shown in FIGS. 1B and 1C, the food product **25** can be positioned on the carrier member **30c** and advanced to the food diverter station **200** whereupon the food diverter station **200** engages the carrier member **30c** to dislodge or guide the food product **25** into a laterally offset holding bin or receptacle **250** or other suitable food support component. The rails or tracks **205** can be motorized tracks that are automatically driven, such as via a belt or chain drive or other drive mechanism, so as to advance each carrier member **30c** to serially present them at the food diverter station **200**. In other embodiments, the trays **30t** can be advanced by manually or automatically pushing the trays

from behind upon contact with the adjacent rearwardly (downstream) disposed tray **30t**.

In operation, each tray **30t** or portion of the carrier member **30c** can be advanced to the diverter station **200** where it can dwell as the diverter member **201** engages the arm members **30a** and moves them laterally along a portion of the length of the recess and/or upward as shown. The food diverter station **200** diverts the food product **25** from a first travel path **30p₁** (illustrated by the broken line with arrow shown in FIG. 1A adjacent element **30p₁**) to a second travel path **30p₂** (illustrated by the broken line arrow adjacent the element number **30p₂** in FIG. 1C) that is laterally spaced apart a distance from the first travel path. "Laterally spaced apart" means that the food **25** is moved sideways. In certain embodiments, such as shown in FIGS. 1A–1C, the food product **25** is moved in a direction that is transverse or substantially perpendicular to the downstream direction of travel, either in an inward or outward direction (moving either to the right or left away from the primary direction of travel).

It is noted that, although shown in the figures as carried out in a horizontal orientation, the food diverter **200** can be configured to engage vertically oriented trays **30t** or carrier members **30c**, to push food substantially vertically downwardly, typically starting from a top portion of the tray **30t** and/or to push food substantially vertically upwardly from a position that is adjacent a bottom portion of the tray **30t** (not shown). In still other embodiments, the tray **30t** may be held in an inclined or descending orientation (not shown).

As shown in FIG. 1C, the carrier members **30c** are formed with a plurality of recesses or channels **31** that are sized and configured to receive at least one arm member **30a** therein. The arm members **30a** can be sized to substantially fill the recesses **31** and act as planks to form a portion of the food support surface on the carrier member **30c** so as to be substantially flush with the adjacent food support surface. In other embodiments, the arm members **30a** can be configured to occupy a subset of the volume or area defined by the recesses **31** so as to reside under the level of the food support surface **30f** of the remaining portion of the food support floor provided by the carrier member **30c**. For the sub-surface embodiment, the arm member **30a** will not typically contact the overlying food products until the food diverter station **200** causes the arm members **30a** to rise thereby inhibiting the food product from adhering to it during processing. Thus, when the arm members **30a** are raised above the floor surface **30f** as shown in FIG. 1C, the food product **25** may be more easily dislodged from the carrier member **30c**. Further, the food product **25** may gravimetrically slide down the inclined arm **30a**. In any event, in certain embodiments, the arm member **30a** may be lubricated and/or vibrated during the inclining or inserting operation to facilitate the dislodgement and/or removal of the food product **25** from the arm member **30a** and/or tray **30t**.

The food products **25** may be substantially symmetrically arranged and/or substantially centered over the recesses **31** as shown in FIGS. 1A–1B. In other embodiments, no such deliberate or symmetrical arrangement is required and the food product **25** can be asymmetrically distributed over as the floor of the carrier member **30f**.

In the embodiment shown in FIG. 1C, the recess **31** includes two upstanding stationary wall portions **31w₁**, **31w₂** positioned on opposing sides of the recess **31**. The recess **31** may be enclosed with an underlying sub-floor, or may be open or partially open (e.g., grated or the like). The arm member **30a** may be configured to be substantially free floating within the corresponding recess **31**, attached to the

carrier member **30c** via securing means such as matable female and male components (grooves and channels), frictional engagement, pivot joints or hinges disposed on one side edge portion of the member **30c** (away from the side with the diverter station **200** to allow the arm member **30a** to flip up or down as desired), or otherwise moveable within the recess **31**.

FIGS. 1A–1C illustrate that the arm members **30a** can reside within the recess **31** during processing in advance of the food diverter station **200**. FIG. 3 illustrates that the processing system **400** that is located downstream of the food diverter station **200** can include one or more of an oven **401**, a thermal holding zone **402**, and/or a cooler **403**. FIGS. 2A and 2B illustrate that the arm members **30a** can be inserted at the food diverter station **200**. In other embodiments, the arm members **30a** can be inserted into the respective recesses **31**, after the food processing system **400** (FIG. 3) but before the food diverter station **200** (not shown).

The trays **30t** and/or arm members **30a** may be formed of a food compatible material such as stainless steel and can include suitable anti-stick or lubricious coatings as desired.

It is also noted that, as shown in FIG. 1C, in certain embodiments, the food diverter station **200** can be operated to dislodge a first longitudinally aligned series of food **25_i** onto a cooperating pathway or container and then serially dislodge a second longitudinally aligned series of food **25_{i+1}**. The carrier member **30c** may be sized and configured to hold additional lines of food **25**. In operation, the diverter station **200** can be configured to temporarily stall or halt the lateral movement of the arm(s) **30a** across the width of the carrier member **30c** intermediate the first and second dislodgments. The first series and second series **25_i**, **25_{i+1}**, respectively, can be dislodged so as to form a substantially linear continuous arrangement of food on the second pathway **30p₂**.

In certain embodiments, the food **25** can be diverted onto a laterally spaced apart moving pathway **30p₂**. FIG. 1C illustrates the holding receptacle or bin **250** as being held on an advancing pathway such as a conveyor or other suitable advancement means. In other embodiments, the food **25** can be removed from the carrier member **30c** and deposited directly onto the second pathway **30p₂**. In other embodiments, the food holding receptacles **250** can be manually positioned in cooperating alignment with the carrier member **30c** at the food diverter station **200** and removed as needed.

Turning again to FIGS. 1A–1C, the food diverter station **200** includes at least one (shown as a plurality of serially and/or concurrently activatable) food diverter **202** with an associated securing mechanism **201**. The food diverter **202** can be automated and configured as an electric, pneumatic, and/or hydraulic driven cartridge body that extends and retracts at desired timing intervals to cause the securing mechanism **202** to serially engage the arm members **30a** in the respective carrier members **30c**. FIGS. 2A–2B illustrate a similar embodiment, but the securing mechanism **202** holds the arm members **30a** and together they move back and forth in concert to engage with carrier members **30c**. The securing mechanism **202** is shown as a clamp that closes against opposing sides of an end portion of the arm member **30a** to (detachably or semi-permanently) engage therewith. The securing mechanism **202** may be otherwise configured so as to be able to engage the arm member **30a** and direct the arm member **30a** to laterally translate across at least a portion of the width of the carrier member **30c**. Examples of other securing means include, but are not limited to, magnetic components, tongue and groove engagement, frictional slide fittings, bayonet fittings, spring loaded fittings, and other suitable attachment mechanisms.

In certain embodiments, the arm member **30a** may be longer than the width of the floor **30f** of the carrier member **30c** and can include at least one upwardly extending projection (shown as feature **30u** in FIG. 10E) that extends above the surface level of the floor **30f** so that, as the arm member **30a** moves laterally in a substantially planar or horizontal orientation (not shown), the projection contacts the bottom surface of the food to dislodge it or move it laterally off of the carrier member **30c**. Alternatively, in certain embodiments, as shown in FIG. 1C, the food diverter **201** rises thereby lifting the securing mechanism **202** that, in turn, raises the arm member **30a**. This operation can be carried out while moving the arm member **30a** a lateral distance across the carrier member **30c**, with the arm member **30a** stationary in the lateral direction (having primarily vertical directional components).

FIG. 4 illustrates another embodiment where the carrier member **30c'** is conveyor (shown as an endless conveyor). The floor **30f'** of the conveyor **30c'** is formed with a series of spaced apart primary flooring **30f** that form the primary food contact and/or support surfaces with intermediately positioned recesses **31**. As before, the arm members **30a** may be configured to be inserted into the respective recesses **31** at the food diverter station **200** (or reside in the gaps of the recesses in advance of the diverter station). The conveyor floor **30f'** may be formed of any suitable food compatible material, including, but not limited to, stainless steel, resin, elastomeric, ceramic, and the like.

FIG. 5 illustrates yet another embodiment, in which the carrier member **30c''** is defined by a plurality of spaced apart laterally extending rods **30r**. The food **25** is shown as an elongated food product, but may be configured otherwise as noted above. The spacing of the adjacent rods **30r** defines the recesses **31** that receive the arm members **30a**. The rods **30r** may be supported by side rails (not shown), underlying brackets (not shown) or other support means that allow the arm members **30a** to enter a side portion of the recess **31** and extend the arm member **30a** thereacross. As before, the arm member **30a** may be held substantially horizontally as the arm member **30a** is laterally translated across a portion or the entire distance of the width of the carrier member **30c''** or be inclined to rise above the floor **30f** defined by the upper perimeter of the rods **30r**.

FIGS. 6A and 6B illustrate an alternate food diverter device **225**. In this embodiment, the food diverter device **225** is located in the primary direction of travel, held in a gap space **320g** of the recess **31** defined by the food support flooring **30f**. The gap space **320g** is defined by the floor **30f**, which, in the embodiment shown, is defined by two adjacent longitudinally extending rods **30r**. In so doing, as a leading edge portion of the food **25** approaches on a first path corresponding to a first pair of rods **30r**, it contacts the food diverter **225** and is forced laterally over to overlie the next adjacent pair.

The diverter device **225** can be held stationary in the position in the recess **31** at the desired vertical height. Alternatively, in operation, the diverter device **225** can be configured to be controllably retractable and extendable, (held either below or above the floor **30f**) into the desired gap space **320g** or recess **31** associated with the travel path **30p₁**.

The food **25** can be advanced independently of, or with, the rods **30r**. As such, the rods **30r** may be configured to move or be held stationary, with the food moving forward over the rods **30r**, to divert to an angularly and/or laterally offset travel path **30p₂** after contacting the forwardmost portion of the diverter **225**.

As shown in FIG. 6B, the food **25** can be directed to depart from the first travel path **30p₁** at an angle that is about 30–90 degrees offset from the primary direction of travel on the first travel path **30p₁**, automatically upon contact with the diverter device **225**. FIG. 6B also illustrates that two separate lanes of food **25** can be concurrently diverted off the first travel path **30p₁**, in opposing directions. The food **25** may be moving forward at a speed of about 3–7 fps, and typically between about 5–6.5 fps as it approaches the diverter device **225**.

FIGS. 7A–7C illustrate a sequence of operations to alter the travel direction of the food **25** according to certain embodiments of the present invention. As before, the food **25** is positioned to overlie a recess **31** provided by the food support floor **30f**. The diverter device **240** can include a forward member **177f** that is a first contact portion **241** that extends a distance into the well **31** to position it under the lowermost perimeter surface of the food **25**. In operation, the diverter device **240** first engages the food and lifts, “picks up” or directs the food up (or down, if desired) and over a lateral distance as shown by the lateral arrow in FIG. 7C. The diverter device **240** can be pivotally arranged to turn, slide, swivel, or rotate laterally over a suitable distance after engaging a forward portion of the food **25** to position the food **25** at a desired location away from the first travel path. In other embodiments, the diverter device **240** may be configured to be stationary prior to receiving the food **25** to provide a pathway angularly disposed away from the first direction of the travel path **30p₁** immediately upstream thereof. In the latter, as for certain embodiments discussed above, the diverter device **240** can be configured to retract and extend into position.

FIG. 9A illustrates the floor **30f** similar to that shown in FIG. 6A where that the food support floor **30f** can include lanes **11** defined by pairs of spaced-apart elongated rods **300**, **301** (as shown, these two rods **300**, **301** define lane **11₁**). Other embodiments can employ laterally spaced apart cooperating rollers or other suitable structures (not shown). In any event, the spaced apart rods, rollers, or other structures can define the recess **31** of the travel lane(s) **11**. In operation, the food **25** resides above the gap space **320g** (**320g**, FIGS. 14A, 14B). FIGS. 9A and 9B illustrate that the pairs of rods can be configured so that each lane **11₁**, **11₂** has its own corresponding pair of rods **300**, **301** and **302**, **303**, respectively (FIG. 9B), or so that adjacent travel lanes **11₁**, **11₂** share one of the rods, **300**, **301** and **301**, **302**. In operation, the rods **300** et seq. can be configured to advance in a desired rate of speed to form the moving floor **30f** so as to advance the food **25** item along the travel path **100**. In particular embodiments, two stainless steel rods **300**, **301** define a travel floor or lane and the rods may have about a 5/8 inch outer diameter and be spaced apart a distance so that there is about 0.5–1 inch between centers. In certain embodiments, about a 5/8 inch cross-sectional area meat product nests therein such as shown in FIG. 9A. The spacing and size may vary depending on the product size and density and the like.

FIG. 10A illustrates an alternate configuration of the floor **30f** of a carrier member **30** (FIGS. 1A–1C), **30'** (FIG. 4). As shown in FIG. 10A, the recess **31** can be configured to receive a lower portion of the food **25** therein. The floor **30f** can be a moving floor **30f** with a gap space **320g** formed therein to define the recess **31**. In this embodiment, the conveyor can be used to define one or more concurrently traveled side-by-side food travel lanes **11** (or a portion of same). As discussed for FIG. 4, the conveyor itself can be configured with a channeled floor surface **30f** that provides

the gap space 320g and recess 31. In any event, the gap spaces 320g or recesses 31 in the floor 30f can be arranged symmetrically or offset relative to adjacent floor surfaces (so as to be wider on a first side, and narrower on the opposing second side of the floor 30f) as shown in FIG. 8 in the lane 11 below the food 25. The gap space 320g or recess 31 is configured to open into or be in communication with the upper portion of the floor 320u upon which the food 25 rests. FIG. 8 also illustrates that the diverter mechanism 240 can include a tongue 76f that extends below the surface of the floor 30f (below the bottom perimeter of the food) a sufficient distance into the recess 31 and leads to a ramp portion 76r that rises a distance above the floor 30f. The tongue or receiving portion 76f of the diverter mechanism or device 240 may also be configured to be substantially flush with the lower perimeter portion of the food 25 (FIG. 12).

As shown in FIG. 10A, the upper portion of the floor 320u can have an aperture with a width W_3 that is larger than the width of the food W_1 and is sized and shaped to receive a portion of the food item therein so that the food 25 item resides above the gap space 320g. In so doing, the food item 25 can be supported by a reduced area physical contact portions 320c₁, 320c₂ on opposing side edge contact portions 320e of the floor 30f. At the contact locations 320c₁, 320c₂, the width of the aperture W_4 can be greater than about 50% of the width of the food item 25. In the embodiment shown in FIG. 10A, when viewed from the front, the floor aperture width narrows from top to bottom to hold the food item 25 suspended above the underlying gap space 320g. As such, the sidewalls 320w of the travel lane 11 can be configured to angularly extend between the top surface of the floor 320u and the top portion of the gap space 320g. In certain embodiments, the gap space 320g can be configured as a rectangular channel. Other shapes and sizes can also be used.

FIG. 10B illustrates an alternate configuration of a conveyor floor 30f having the gap space 320g formed directly under the upper portion of the floor 320u. The upper portion of the floor 320u may be a planar support surface. Ridges, valleys, or other axially extending lane guides may also be used (not shown). The width of the gap space 320g may be selected to correspond to the width of the food 25 as desired to form a sufficient support surface to inhibit deformation of the product as it travels on the conveyor. In certain embodiments, suitable gap widths may be widths that are between about 10–80% of the width of the product 25.

FIG. 10D illustrates yet another embodiment of a floor 30f similar to that shown in FIGS. 9A and 9B. As shown, the food 25 travels on a surface defined by two elongated spaced apart rods 30r, identified as 300, 301 and a centrally located smaller rod 302. The gap space 320g can be either one, or both, of the regions between the rods 300 and 302 or 302 and 301. FIG. 10C shows an additional embodiment where the food product 25 overlies a plurality of recesses 31 formed by closely spaced gap spaces 320g that the food product overlies. In operation, the arm member 30a (FIGS. 1A, 2, 4, 5) can enter into each or selected ones of the recesses to dislodge or divert the food 25. In operation, the diverter mechanism 200, 225, 240 (FIGS. 1A, 2A, 4, 5, 7) extends and enters one, all, or a plurality of the gap spaces 320g to cause the food to travel through the pick-up mechanism and/or to dislodge, pull, push, scoop, scrape, or otherwise manipulate the food 25 from the floor 30f.

FIG. 10E illustrates a floor 30f configuration with a recess 31 configured to receive the arm member 30a (FIGS. 1A, 2A, 4). In this embodiment, the arm member 30a includes at

least one projection portion 30u that rises above the surface of the primary surface of the floor 30f.

The gap space 320g can have a width W_1 (FIGS. 10B, 10E). In particular embodiments, the width W_1 may be selected so as to be greater than about 20–50% the width of the food item W_2 (FIG. 12) that travels thereon. In certain embodiments, the product may have a width of between about 0.5–5 inches, and the gap space 320g can be sized with a width that is between about 0.25–1 inches. The gap space 320g may have a depth of any suitable size. In certain embodiments, the depth is at least about 0.5 inches.

FIGS. 11A and 11B illustrate that the diverter device 240 shown in FIGS. 7A–7C can be configured with a forward member 177f that can be described as a downwardly extending protruding tongue or finger (instead of a scoop-like member). As shown, the forward member 177f is sized and configured to enter the gap space 320g of the recess 31. It may be centrally located with respect to the corresponding travel lane 11, or offset relative thereto, with a length that is sufficient to position a portion of the forward member 177f is positioned a distance into the gap space 320g. As shown in FIG. 11A, the forward member 177f is located proximate to and typically below the level of the food as the food 25 approaches the diverter device 240. In certain embodiments, the forward member 177f at a stationary vertical distance “D” into the gap space 320g, as shown, in position, the forward member 177f is proximate to, but resides below, the floor surface level (below or under the food). Of course the forward member 177f can be configured to extend downwardly greater distances into the gap space 320g as desired, such as below the level of the rods, where used. The angle of incline (or decline) of the forward member 177f can be selected so as to inhibit the disruption of the food as the food 25 transfers from the moving floor to travel over the forward member. Typically, the angle of incline will depend on the size and/or weight of the product, the speed of the moving floor 300f, 320f, and the like. The angle of incline for the forward member 177f and/or the ramp 76r can be any desired angle, typically under about 90 degrees. In certain embodiments the angle can be about 10–80 degrees, and in particular embodiments about 20–70 degrees. In some embodiments, the angle of both or one of the forward member 177f and/or the ramp portion 76r (FIG. 8) is about 45 degrees. As before, the floor of the forward member 177f or floor of the ramp portion 76r can be stationary (formed of a rod, plate, or other static structure) or may include conveyors, rollers, bearings, or other suitable flooring components.

In operation, as shown in FIGS. 11A and 11B, the food 25 can straddle or overlie the underlying gap space 320g and is then directed to contact and climb the forward member 177f. For automated continuous movement systems such an action can be carried out in a manner that inhibits the disruption of the continuous automated (forward) movement. As before, the forward member 177f and/or the floor of the diverter mechanism 240 may be stationary and the food propelled partially or wholly by its forward momentum. The forward member 177f may be configured from stainless steel or other desired material (coated or uncoated as noted above). This embodiment may reduce the friction or interference of the movement at the junction 100z of the floor 30f of the carrier member 30c, conveyor 30c', or rods 30r. Air may be optionally used at desired locations along the junction or transfer zone 100z to help direct the food.

In certain embodiments, the location in the travel path that carries out the directional change can be described as a transition zone 100z (FIGS. 11A, 11B). As shown in FIG. 12,

looking at lane **115**, as the food product **25** advances toward the transition zone **100z**, it approaches the ingress portion **76i** of the diverter device **240'**, then enters and climbs to exit at the egress portion **76e**.

Still referring to FIG. **12**, one embodiment of a portion of a travel path **100** in a food processing system **400** (FIG. **3**) with a food product **25** and a transfer or changeover zone or region **100z** (shown as a lateral translation region or zone) is shown. The arrows shown in FIG. **12** with respect to each of the food products **25** (one in lane **11₁** and the other in lane **11₅**) indicate the direction of travel or food movement along a particular tier. The direction of travel can be reversed where desired and/or alternated between tiers in multi-tier systems. The pick-up mechanism **76'** can be used to alter or transition the travel path for the food in a particular travel lane **11** to change from a first path to a higher, lower, longitudinally, or laterally offset second path.

In certain embodiments, the travel path **100** includes a plurality of side by side adjacent travel lanes **11**. In the embodiment shown, there are nine side-by-side lanes **11**: namely, from the left side to the right side, a first lane **11₁**, a second adjacent lane **11₂**, a third adjacent lane **11₃**, a fourth adjacent lane **11₄**, a fifth adjacent lane **11₅**, a sixth adjacent lane **11₇**, an eighth adjacent lane **11₈**, and a ninth adjacent lane **11₉**. In operation, in particular embodiments, the food product **25** can serially progressively travel over each or selected lanes. The food travels more than one revolution, and in so doing, passes a predetermined reference location associated with the tier a plurality of times. In certain embodiments, the food initiates travel from a predetermined lane (that may be the outer or inner lane) and moves across a number "n" of intermediately positioned lanes to an opposing lane. In the embodiment shown, the product **25** can start from either the inner lane **11₁** or outer lane **11₉**. For multi-tier configurations with circular, oval, elliptical or other endless lane configuration, the system may be configured so that the food alters travel direction and/or lane progression so as to travel from a selected inner lane portion to a selected outer lane portion, then to a selected outer lane portion to a selected inner lane portion on adjacent or selected tiers, or vice versa. For additional description of multi-tier systems and/or the alternating lane travel progression, see U.S. patent application Ser. No. 09/888,925 to Shefet et al., incorporated by reference hereinabove.

In certain embodiments, a plurality of non-connected elongated products are processed concurrently and the products are forced to laterally translate a sufficient distance to cause the products to skip adjacent lanes and to subsequently travel over a respective lane that is laterally spaced over a predetermined number of lanes from its first travel lane. For example, if three separate products **25** are processed, the first may travel in lane **11₁**, the second in lane **11₂**, and the third in lane **11₃**. As they approach the transfer zone **100z**, the first product in lane **11₁** is laterally transferred over to lane **11₄** (and then to **11₇** if it travels another revolution over the tier), the second product to **11₅** (and then to **11₈** if it travels another revolution over the tier), and the third product travels or is diverted to lane **11₆** (and then to **11₉** if it travels another revolution over the tier).

In certain embodiments, the food **25** is held so that it is substantially centered over the recess **31** even when the food is moving at a rate of between about 1–20 feet per second, typically about 1–10 ft/sec, and more typically about 5 ft/sec, just before it enters or contacts the divert guide **225**, **240**, **240'** (FIGS. **6A**, **6B**, **7A**, **11A**, **12**). Other speeds may be used depending on the application (dwell time, food configuration or size, food density, food frictional param-

eters, and the like). In other embodiments, such as that shown in FIGS. **1A**, **2A**, and **4**, the food and its support floor **30f** are stationary at the diverter station **200** and the diverter **200** can be configured to translate to engage with the food to dislodge, lift, scrape, pull, or push the food from the floor **30c**.

In certain embodiments, the forward member **177f** can include an angled or beveled edge portion **77b** to help engage or scoop the food (gradually increasing in thickness along the travel direction) while minimally disrupting the forward movement thereof as the food approaches the transition zone **100z**. The forward member **177f** can be angled at an angle corresponding to the angle of the ramp of the diverter device **240**, **240'** (FIGS. **7A**, **11B**, **12**).

As shown in FIG. **12**, the food is directed to angularly depart from a first travel lane **11** to a second different angularly offset travel lane and direction. Thus, the angle of offset defined by the diverter device **240**, **240'** between the upstream to downstream portion of the travel path can vary depending on one or more of the amount of lateral translation desired, the length over which it occurs, the type or size of product being processed, and/or the speed at which the translation between lanes occurs. Thus, in operation, the food diverter device **240**, **240'** can be configured to simultaneously or concurrently automatically divert the food in each predetermined travel lane to the next desired lane at the same place in the travel path. The travel lanes **11** may be linear, curvilinear, circular, or other desired shape. Of course, other numbers of lanes **11** (larger or smaller numbers) can be used and different numbers of lanes can be used on different tiers or levels. The lanes do not necessarily need to abut and can be spaced apart as desired.

In certain embodiments, the series of operations to process the food can include advancing at least one food item on a carrier surface in a food processing system. The carrier surface or floor includes a plurality of recesses configured with two opposing side edge portions separated by a gap space having an associated width and depth. In certain embodiments, the gap space width can be greater than about 20–50% (or a major portion) of the width of the food item. In position, the food item spans the gap space and rests against the two opposing side edge portions above the underlying gap space. The food item can be an elongated meat product in a casing, a casingless product, a planar substantially dehydrated meat product, and/or other desired product.

In summary, food **25** is directed to travel over a floor that engages with a diverter mechanism **200**, **225**, **240**, **240'**. The mechanism may be configured to repetitively retract and enter and/or move over a length of the recesses **31**. In other embodiments, the mechanism can be configured to define a portion of the travel path that is in the stream of travel such as intermediate two moving floor portions.

The food item can be directed to travel greater than one revolution, traveling over at least two adjacent lanes on a selected tier, before moving to the next tier. See co-pending U.S. patent application Ser. No. 10/170,887, corresponding to U.S. Provisional Application Ser. No. 60/354,097, filed Feb. 4, 2002, the contents of which are incorporated by reference as if recited in full herein.

In certain embodiments, a plurality of end-to-end cooperating conveyors or an endless conveyor are used to form the travel path through the processing system **400** (FIG. **3**). The moving floor portions may be set to move at the same or dissimilar speeds as desired.

In particular embodiments, the predefined side by side travel lanes **11** (FIG. **12**) can be configured or formed using

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one conveyor having a sufficient width to provide the number of lanes, or by using at least two (two or more) side-by-side cooperating conveyors. The conveyors “cooperate” in that they are configured to be in communication and operate together to either present or receive food from the other conveyor so that the food serially (directly or indirectly) travels first on one then on the other. The cooperating conveyors can be configured as side-by-side and/or in-line conveyor arrangements. Of course other combinations of conveyors (such as side-by-side alone, in-line alone, or other quantities or shapes of conveyors arranged to define the travel path and/or lanes) can also be used. Additionally, two or more sets of cooperating conveyors can be used to concurrently process different food items (or strands or sets of items) about the same tier (not shown). See U.S. patent application Ser. No. 09/888,925 to Shefet et al. for additional description of conveyor configurations, the contents of which are hereby incorporated by reference as if recited in full herein.

The speed of the conveyor(s) used to form one or more of the moving floors can be set to match the desired residence time according to the time desired in each processing region.

The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-function clauses, where used, are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.

The invention claimed is:

1. A method for routing or guiding food in a food processing system, comprising:

advancing at least one food item on a carrier floor in a first travel direction, the carrier surface having at least one recess with associated length and width formed therein, the at least one food item positioned so that it overlies a portion of the at least one recess;

positioning a food diverter having a forwardly extending finger so that it engages the carrier floor and allows the finger to enter into the recess under the at least one food item; and

routing the at least one food item so that it departs from the first travel direction to an angularly offset second travel direction responsive to the positioning step.

2. A method according to claim 1, wherein the at least one food item is an elongated meat product.

3. A method according to claim 1, wherein the at least one food item is an elongated food item, and wherein the food diverter comprises a stationary floor, and wherein the routing step comprises:

conveying the elongated food item along the first travel direction;

receiving the elongated food item into an ingress portion of the food diverter; and

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advancing the elongated food item over the stationary floor of the food diverter at least partially responsive to the forward momentum generated by the conveying speed generated in the first travel direction upstream thereof.

4. A method according to claim 1, wherein the food item is an elongated food item, wherein the food diverter comprises a moving floor with an associated ingress and egress portion, and wherein the routing step comprises:

receiving the elongated food item into the ingress portion of the food diverter and

advancing the elongated food item over the moving floor and out the egress portion of the food diverter at least partially responsive to the speed of the moving floor of the food diverter.

5. A method according to claim 1, wherein the advancing and routing steps are carried out to cause the at least one food item to travel serially from an upstream floor being disposed at a first height, into the food diverter that directs the food item to travel upwardly over an inclined ramp portion associated therewith to exit an egress portion of the food diverter at a downstream floor that is at a height that is greater than the height of the upstream floor.

6. A method according to claim 1, wherein the second travel direction is angularly offset at least about 30 degrees from the first travel direction in the longitudinal direction.

7. A method according to claim 1, wherein the food item is an elongated food item.

8. A method according to claim 7, wherein the elongated food item has a continuous length of at least about 20–50 feet.

9. A method according to claim 1, wherein the food diverter is stationary and includes a forwardly positioned planar edge portion with a forked leading edge having two opposing side portions and central gap space therebetween.

10. A method according to claim 9, wherein the central gap space angularly narrows in the direction of travel toward an egress portion of the stationary food diverter.

11. A method according to claim 1, wherein the advancing step is carried out using a moving food support floor that defines a gap space that is configured to underlie the food item.

12. A method according to claim 1, wherein the advancing, positioning, and routing steps are carried out in an automated manner to semi-continuously or continuously direct the food to move from the first travel direction to the second travel direction.

13. A method according to claim 1, wherein the food is at least partially adhered to or attached to the carrier surface, and wherein in response to inserting the finger into the gap space, the food is dislodged from the carrier surface.

14. A method according to claim 1, wherein the carrier support surface, in at least the first travel direction, is defined by a corresponding pair of spaced-apart elongated rods.

15. A method according to claim 1, wherein the carrier support surface defined by a conveyor that is configured with an upper floor portion having an aperture formed therein that opens to an underlying gap space that defines the recess, and wherein, in operation, the food item spans the upper floor portion aperture and resides above the gap space.

16. A method according to claim 1, wherein the carrier surface is defined by a moving floor, and wherein, in operation, the at least one food item automatically travels first onto the finger.

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17. A method according to claim 1, wherein the carrier surface is a stationary floor, and wherein, in operation, the food item automatically travels from the first travel direction onto the finger and then to the second travel direction.

18. A method according to claim 1, wherein the paths defined by the first and second travel directions reside within an oven and experience substantially the same environmental conditions.

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19. A method according to claim 1, wherein the food item is an elongated meat product held in a casing.

20. A method according to claim 19, wherein the at least one food item is an elongated meat product having a continuous length of at least about 20–50 feet.

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