APPARATUS SYSTEM AND METHOD FOR EXPOSING PRODUCT FILLED CONTAINERS TRANSPORTED VIA AN INTERMITTENT CONVEYER TO A CONTROLLED ENVIRONMENT

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ABSTRACT

An apparatus, system and method for exposing product-filled container or tray being transported by an intermittent conveyor to a controlled environment are provided. The apparatus may include a vertically reciprocating gassing rail, a stationary gassing rail, and an angled gassing rail. The vertically reciprocating gassing rail includes a rail head and an outer shell, which clamps to the conveyer. High velocity gas is flowed through a longitudinally oriented manifold in the rail head and the exhaust gas is removed by exhaust channels. The stationary rail provides a laminarized flow, and the angled rail provides a stream of controlled environment gas beneath the film which is sealed to the tray.
APPARATUS SYSTEM AND METHOD FOR EXPOSING PRODUCT FILLED CONTAINERS TRANSPORTED VIA AN INTERMITTENT CONVEYOR TO A CONTROLLED ENVIRONMENT

FIELD OF THE INVENTION

[0001] The invention relates to an apparatus, system and method for exposing containers filled with product, including, for example, food product and any product that has an adverse reaction to air, to a controlled environment as the containers are transported via an intermittent conveyor to a scaling station. More particularly, this invention relates to improved apparatus and process for replacing air in product-filled trays with a desired controlled environment, including inert gas, combinations of gases and other aromas, mist, moisture, etc. by use of a stationary and/or reciprocating high velocity gassing rail as the containers are transported via an intermittent conveyor, to a tray sealer.

BACKGROUND OF THE INVENTION

[0002] Various products including food product, and any other product that has an adverse reaction to air, are packaged in a controlled environment. Various attempts have been made to efficiently package these products in a modified atmosphere using vacuum and/or controlled environment.

[0003] Various food products, including bakery goods, meats, fruits, vegetables, etc. are packaged under atmospheric conditions. Many of these products are presented in supermarkets, for example, in cartons or cardboard containers with a plastic or cellophane wrap covering the product.

[0004] One problem with this type of packaging is that the goods have a minimum limited shelf life, which for many products is only several days to a week. With bakery goods, for example, mold may begin to grow after a few days under atmospheric conditions. Such products obviously cannot be sold or consumed and must be discarded.

[0005] Another problem arises with respect to many fruits and vegetables, which continue to ripen and continue their metabolic process under atmospheric conditions. For example, within a few days a banana can become overripe and undesirable to the consumer.

[0006] The space available for gassing operations is often limited at many facilities. In general, existing controlled environment systems are often expensive, bulky, and require use of vacuum pumps, and, accordingly impractical for use at many of these facilities.

[0007] In an effort to alleviate these problems, various attempts have been made to package food in a controlled environment by injecting controlled environment directly into filled containers. A high velocity flow is often necessary to penetrate into the food product. In general, these attempts have proved unsuccessful. With bakery goods, for example, the high velocity jets pull in air and re-contaminate the product, thereby failing to reduce the oxygen to levels that would prevent the normal onset of mold.

[0008] Various techniques for removing air in food filling processes are known in the art. Such processes are used, for example, in the packaging of nuts, coffee, powdered milk, cheese puffs, infant formula and various other dry foods. Typically, dry food containers are exposed to a controlled environment gas flush and/or vacuum for a period of time, subsequent to filling but prior to sealing. The product may also be flushed with a controlled environment gas prior to filling, or may be flushed after the filling process. When the oxygen has been substantially removed from the food contents therein, the containers are sealed, with or without vacuum. Various techniques are also known for replacing the atmosphere of packaged foods with a modified atmosphere of carbon dioxide, oxygen and nitrogen, and/or other gases or mixtures of gases to extend shelf life.

[0009] Many existing modified atmosphere tray sealing systems use an indexing conveyor to allow the tray and product to enter into a vacuum chamber and be exposed to reduced pressure, and then sealed within the vacuum chamber. In some applications, inert gas is used to back flush as the pressure is returned to atmospheric. The tray may then be permanently sealed with plastic film heat sealed to the tray flange with a vertically reciprocating seal bar.

[0010] In general these systems are designed to allow the trays to index forward along a conveyor. The cycle time is the time it takes to move the tray into position and to modify the atmosphere in the tray and seal it, which may, for example, require ½ second to pull a vacuum, ½ second to back flush, and ½ second to seal.

[0011] One drawback to these existing systems is that the vacuum chambers are expensive to operate and maintain and limit line speeds by combining four cumulative operations, three of which are within a vacuum chamber, and thus increase the overall cycle time. Other drawbacks in rapid vacuum applications include pulling product into the seal area causing leaks, as well as, the necessity that the lidstock or film must be extra wide to cover the entire chamber, increasing overall scrap. It would be desirable to have a controlled environment tray sealing system for use with a non-continuous or indexing conveyor system and vertically reciprocating tray sealers that would economically reduce cycle time to increase line speeds.

SUMMARY OF THE INVENTION

[0012] One aspect of the invention provides an apparatus for exposing product-filled containers being transported by an intermittent conveyor to a controlled environment including a reciprocating gassing rail positioned along the conveyor and timed to engage with the conveyor when the conveyor is paused, the reciprocating gassing rail including an outer shell and a rail head, the outer shell including a bottom surface for sealing to a flange portion of the container, a rail head which includes a longitudinally oriented manifold, the rail head including an opening formed therein for receiving controlled environment gas from a source. A bottom shell which seals to a bottom region of the conveyor may alternatively be included, to allow a vacuum to be pulled on the tray without collapsing it. The rail head preferably includes at least one exhaust orifice to receive exhaust gas. Alternatively, a second or multiple manifolds may be formed in the rail head, each of which may be supplied with a separate source of controlled environment.

[0013] Another aspect of the invention provides a method of exposing a container to a controlled environment. A reciprocating gassing rail including a rail head, and an outer shell is provided. The rail head includes a longitudinally
oriented manifold. An intermittent conveyor for carrying product filled containers is also provided. A container is conveyed to a position beneath the rail head. The conveyor then passes. The outer shell then clamps to a top region of the conveyor. A high velocity flow of controlled environment gas is supplied through the manifold to provide a desired flow pattern of controlled environment gas into the container. The rail head and outer shell are then retracted, and the container is conveyed to a sealing station. The method may further include removing exhaust gas through channels formed in the rail head on each longitudinal side of the manifold.

Another aspect of the invention provides a system for exposing a product-filled container being transported by an intermittent conveyor to a controlled environment including a reciprocating gassing rail including a rail head, an outer shell, and a stationary gassing rail. The rail head including at least one longitudinally oriented manifold positioned to align with a product-filled compartment of the container, and including at least one longitudinally oriented exhaust channel positioned along at least one longitudinal side of the manifold. A stationary gassing rail positioned adjacent the reciprocating gassing rail, the gassing rail including at least one longitudinally oriented manifold positioned to align with a middle portion of a product-filled compartment of the container. The system may further include an angled gassing rail positioned adjacent the stationary gassing rail to provide a stream of controlled environment gas beneath film immediately prior to being heat sealed to the containers. A bottom shell may be included to clamp to a bottom region of the conveyor to allow a vacuum to be pulled on the container. An exhaust channel in communication with an exhaust tube extending through an opening formed in the outer shell may also preferably be included. The manifold may be preferably positioned between two exhaust manifolds to provide a preferred flow pattern through the container. Alternatively one exhaust channel may be positioned between two manifolds. Each manifold may be supplied with a separate source of controlled environment.

Another aspect of the invention provides a method for exposing a container transported via an intermittent conveyor to a controlled environment. A vertically reciprocating gassing rail including a rail head and an outer shell is provided. The rail includes at least one longitudinally oriented manifold and at least one longitudinally oriented exhaust channel. A stationary gassing rail positioned adjacent the reciprocating gassing rail, and an angled gassing rail positioned adjacent the stationary gassing rail and a vertically reciprocating tray sealer are also provided. A container is conveyed beneath the reciprocating gassing rail and then the conveyor is paused. The outer shell is then clamped to the conveyor. A high velocity stream of controlled environment gas is flowed through the manifold of the rail head. The exhaust gas is removed through the exhaust channels. The container may then be conveyed beneath the stationary gassing rail where a low velocity stream of controlled environment gas is flowed through the manifold. The container may then be conveyed beneath a conveying the container beneath the tray sealer where a stream of controlled environment gas is flowed beneath a film to be sealed to the container.

Another aspect of the invention provides a gassing system for exposing product to a controlled environment being transported along a conveyor including a stationary gassing rail including a first and a second distribution chamber positioned along a conveyor moving product filled containers toward a sealer, and an angled rail including a distribution chamber having at least one opening formed therein, a resistance sheet positioned over the opening, the angled rail being oriented to direct a stream of controlled environment gas parallel to and beneath film being fed to a sealing station. The first chamber including a plurality of openings formed therein, a resistance sheet longitudinally oriented adjacent the chamber openings, and a distribution manifold longitudinally oriented adjacent the resistant sheet. The manifold including a plurality of nozzles oriented at an angle to the manifold and aligned with the first chamber openings. The second distribution chamber including at least one opening formed therein, and a resistance sheet longitudinally oriented adjacent the second chamber opening. The angled rail is positioned adjacent the second distribution chamber. The system may further include a sealing station including a seal head to seal film to the container. The seal head preferably includes a seal head blow off port to direct controlled bursts of gas against an upper side of the film while the seal head vertically descends to clamp the film against the container. The seal head blow off may preferably also direct a controlled burst of gas immediately prior to the upstroke of the seal head. Alternatively, a continuous flow of gas may stream from the seal head blow off port against the film.

Another aspect of the invention includes a gassing system for exposing product to a controlled environment being transported along a conveyor including a stationary gassing rail including a rail top and rail bottom positioned along a conveyor moving product filled containers toward a sealer, and an angled rail including a distribution chamber having at least one opening formed therein. The rail base includes at least one longitudinally oriented opening formed therein. At least one gassing element is oriented adjacent the rail base opening. The angled rail is oriented to direct a stream of controlled environment gas beneath film being fed to a sealing station.

Another aspect of the invention includes a method of gassing a product moving along an intermittent conveyor. A stationary gassing rail longitudinally oriented along a conveyor, and an angled gassing rail positioned adjacent the stationary gassing rail are provided. Controlled environment gas is flowed through a gassing element positioned over a longitudinally oriented opening formed in the stationary gassing rail. Controlled environment gas is flowed through a gassing element positioned over an opening formed in the angled gassing rail in a direction substantially parallel to film being fed to a sealing station.

Another aspect of the invention provides an apparatus for providing a controlled environment to a tray moving along an intermittent conveyor to a position beneath a vertically reciprocating tray sealer including an angled gassing rail including a manifold oriented to provide a stream of controlled environment gas substantially parallel to film being fed to the tray sealer and around and into the tray positioned under the tray sealer. The angled gassing rail
may preferably include an opening to flow a stream of controlled environment gas in a direction substantially perpendicular to the film.

[0020] Another aspect of the invention provides a method for providing a controlled environment to a tray moving along an intermittent conveyor to a position beneath a vertically reciprocating tray sealer. An angled gassing rail including a manifold oriented adjacent film being fed to the tray sealer. Gas is flowed through the manifold substantially parallel to the film at a velocity sufficient to flow beneath the tray sealer and into and around the tray positioned beneath the tray sealer.

[0021] Another aspect of the invention providing an apparatus for controlling the positioning of carrier plates on an intermittent conveyor including an intermittent conveyor, a plurality of carrier plates positioned on the conveyor; a sensor bracket positioned along the conveyor adjacent the carrier plates; and a programmable logic controller electronically communicating with the sensor bracket to receive signals from the bracket as to location of the carrier plates. The controller automatically sending signals to reposition the carrier plates on the conveyor. The carrier plates may be positioned in carrier plate pairs including a first and second carrier plate. The first plate including a notch formed in a corner having a first length, and the second plate including a notch formed in a corner having a second length differing from the first length. The sensor bracket senses the differing lengths and sends signals to the programmable logic controller which provides return signals to move the conveyor forward or backwards to a desired location.

[0022] Another aspect of the invention includes a method of controlling the positioning of carrier plates on an intermittent conveyor. A sensor bracket positioned along a conveyor and connected to a programmable logic controller is provided. A plurality of carrier plate pairs including first and second carrier plates positioned on the conveyor. The first carrier plate includes a notch formed in a corner therein having a first length, and the second plate including a notch formed in a corner therein having a second length differing from the first length. The first notch length and second notch length are sensed with the sensor bracket and the programmable logic controller recognizes the positioning of the carrier plate pairs. The direction to correct the positioning of the carrier plate pairs is automatically determined and a signal is sent from the programmable logic controller to move the conveyor to correct the position of the carrier plate pairs.

[0023] Another aspect of the invention includes an apparatus for preventing air from contaminating containers positioned under a vertically reciprocating sealing station including an angled gassing rail including a manifold angled to provide a stream of controlled environment gas substantially parallel to film being fed to the sealing station, the manifold including at least one gassing element.

[0024] Another aspect of the invention includes a vertically reciprocating sealing apparatus including a seal head including a seal head blow-off port to provide a stream of gas against a top surface of the film positioned beneath the seal head.

[0025] Another aspect of the invention includes a method of scaling trays with film. A vertically reciprocating seal head is provided. The seal head is positioned over the film and includes a seal head blow-off port. A stream of gas is flowed from the seal head blow-off port to contact with a top surface of the film during or immediately prior to the movement of the seal head.

[0026] Another aspect of the invention provides an apparatus for exposing a multi-compartment tray to a controlled environment including a stationary gassing rail including at least two longitudinally oriented manifolds. Each manifold oriented to align with one compartment of the multi-compartment tray. Each manifold including at least one gassing element.

[0027] Another aspect of the invention includes a method of exposing multi-compartment trays to a controlled environment. A stationary gassing rail including at least two longitudinally oriented manifolds is provided. Each manifold is positioned over a compartment of the tray. Each manifold includes at least one gassing element. Controlled environment gas is flowed through each of the manifolds into the compartments.

[0028] The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the accompanying drawings. The detailed description and drawings are merely illustrative of the invention rather than limiting, the scope of the invention being defined by the appended claims and equivalents thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] FIG. 1 is a side view of a preferred embodiment of the gassing system and sealing system;

[0030] FIG. 2 is a sectional view of a preferred embodiment of a vertically reciprocating gassing rail in a retracted position;

[0031] FIG. 3 is a sectional view of the vertically reciprocating gassing rail of FIG. 2 in the down position;

[0032] FIG. 4 is an alternative preferred embodiment of the vertically reciprocating gassing rail in a retracted position;

[0033] FIG. 5 is a side view of a preferred embodiment of the angled gassing rail positioned adjacent the reciprocating tray sealer;

[0034] FIG. 6 is a perspective view in partial section of the angled gassing rail and tray sealer of FIG. 5;

[0035] FIG. 7 is an alternative preferred embodiment of a reciprocating gassing rail in the retracted position;

[0036] FIG. 8 is an alternative preferred embodiment of the reciprocating gassing rail of FIG. 7 in the closed and operating position;

[0037] FIG. 9 is a side view of a preferred embodiment of a stationary gassing rail longitudinally disposed along a row of containers being transported by a conveyor;

[0038] FIG. 10 is a sectional view of the embodiment of FIG. 9;

[0039] FIG. 11 is an exploded perspective view of a preferred gassing rail embodiment;
[0040] FIG. 12 is a bottom view of a preferred embodiment of the rail top;

[0041] FIG. 13 is a bottom view of an alternative preferred embodiment of the rail top of FIG. 11 for use with containers with small openings;

[0042] FIG. 14 is a sectional view of the embodiment of FIG. 13;

[0043] FIG. 15 is a sectional view of an alternative preferred embodiment of a gassing rail wherein the rail top and rail base are made of plastic;

[0044] FIG. 16 is a partial view of an alternative preferred embodiment of the gas limiting member which includes a plurality of openings;

[0045] FIG. 17 is an alternative embodiment of a dovetail-shaped port block and bracket;

[0046] FIG. 18 is a side view of a preferred embodiment of the gassing system longitudinally disposed along a row of food product being transported by a conveyor;

[0047] FIG. 19 is an end view of the embodiment of FIG. 18, with a sectional view of an adjusting member;

[0048] FIG. 20 is a top view of a first section of the embodiment of FIG. 18 with the gassing rail shown in partial section;

[0049] FIG. 21 is a sectional view of the gassing rail taken through line 21-21 of FIG. 20;

[0050] FIG. 22 is an enlarged partial sectional view of the embodiment of FIG. 21 showing a nozzle extending from manifold tubing within the distribution chamber;

[0051] FIG. 23 is an exploded perspective view of a preferred embodiment of the gassing rail;

[0052] FIG. 24 is an enlarged partial sectional view of an alternative embodiment of the gassing rail of FIG. 18;

[0053] FIG. 25 is an enlarged partial sectional view of an alternative embodiment of the gassing rail of FIG. 18;

[0054] FIG. 26 is an enlarged partial sectional view of an alternative embodiment of the gassing rail of FIG. 18;

[0055] FIG. 27 is a perspective view of an alternative embodiment of a bottom portion of a distribution chamber for use in the gassing rail of FIG. 18;

[0056] FIG. 28 is an enlarged partial sectional view of an alternative embodiment of a lower velocity section of the gassing rail of FIG. 18;

[0057] FIG. 29 is an enlarged partial sectional view of an alternative embodiment of a lower velocity section of the gassing rail of FIG. 18;

[0058] FIG. 30 is an enlarged partial sectional view of an alternative embodiment of a lower velocity section of the gassing rail of FIG. 18;

[0059] FIG. 31 is an enlarged partial sectional view of an alternative embodiment of a high velocity and/or low velocity section of the gassing rail of FIG. 18;

[0060] FIG. 32 is an enlarged partial perspective view of an alternative embodiment of the jet manifold including openings for providing controlled environment into the distribution chamber;

[0061] FIG. 33 is a bottom view of a preferred embodiment of an angled gassing rail;

[0062] FIG. 34 is a bottom view of a preferred embodiment of two sealing head plates;

[0063] FIG. 35 is a top view of a preferred alternative embodiment of sealing area gassing rails positioned on each of the four sides of a carrier plate;

[0064] FIG. 36 is a perspective view of a preferred embodiment of a sensor bracket positioned at the edge of one of a pair of carrier plates on a conveyor;

[0065] FIG. 37 is a side sectional view of a preferred embodiment of the angled gassing rail with controlled environment gas flow profile;

[0066] FIG. 38 is a top view of a preferred embodiment of a pair of carrier plates;

[0067] FIG. 39 is a sectional view of an alternative preferred gassing rail with quick release system;

[0068] FIG. 40 is a top view of a preferred embodiment of a jet manifold for the vertically reciprocating gassing rails;

[0069] FIG. 41 is a sectional view of the jet manifold taken through lines 41-41 of FIG. 40;

[0070] FIG. 42 is a sectional view of an alternative embodiment of the vertically reciprocating gassing rail in the down position;

[0071] FIG. 43 is a schematic diagram of the hepa-filter system for use with the gassing rail system;

[0072] FIG. 44 is a sectional view of an alternative preferred embodiment of the stationary gassing rail with jet manifold; and

[0073] FIG. 45 is a sectional view of an alternative preferred embodiment of the stationary gassing rail for use with a dual-compartment tray.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0074] Referring to FIGS. 1 and 2, a preferred embodiment of the intermittent conveyor gassing system 210 is shown. The system 210 may include a vertically reciprocating gassing rail 212, stationary gassing rail 214, and angled gassing rail 216 disposed along a row of product-filled trays 218 traveling on a conveyor 220 in a direction of travel designated by arrow 222. The angled gassing rail may be separate from or an integral section of the stationary gassing rail 214. The angled gassing rail 216 may be positioned adjacent the vertically reciprocating tray sealer 224 and plastic film feeder 226. The vertically reciprocating gassing rail 212, and vertically reciprocating tray sealer 224 may be synchronized with the indexing conveyor 220 using a programmable logic controller 228. All other gassing functions may also be controlled by the programmable logic controller 228. The conveyor 220 may be designed to index forward at, for example, 1, 2, 3, 4 or more tray positions. The conveyor may carry carrier plates having one or more tray openings.

[0075] As shown in FIG. 2, the vertically reciprocating gassing rail 212 is shown in the retracted or up position, and includes outer shell 230, rail head 232, shaft 234, and feed block 236. The feed block 236 includes a gas inlet 238 which
communicates with distribution orifice 240 (shown in phantom). The distribution orifice 240 continues through the shaft 234, which communicates with rail head 232. A longitudinally oriented manifold 242 is formed in the bottom of the rail head 232. The manifold 242 may include one or more gassing elements and/or gas limiting members, as shown with respect to the stationary gassing rail 10 in FIGS. 11-16. Preferably, the length of the rail head 232 is approximately the length of the tray opening or tray openings when 2 or more trays are gassed together at one time with the vertically reciprocating gassing rail 212. The rail head 232 may be designed as shown in part in FIG. 10, with the shaft 234 replacing the port block 22. Alternatively, the rail head 232 may be designed as shown in FIGS. 20-32, and 44 with the shaft 234 communicating with the inlet 442, as shown in FIG. 32. Preferably, as shown in FIGS. 40-42, a jet manifold 370 has a center oriented distribution block 372 for feeding each of the tubes 374. The shaft 234 with distribution orifice 240, preferably communicates with inlet opening 376. The tubes 374 may alternatively include openings 378 which provide controlled environment gas to the distribution chamber 380. As shown in FIG. 41, the jet manifold may include channel 373 and plug 371. Referring to FIGS. 3-13, and 42, the rail head 232 may also include exhaust elements 244 positioned in communication with exhaust channels 246 formed in the rail head 232. Preferably, the exhaust channels 246 may be positioned as shown in FIGS. 2, 3, and 42, to provide a preferred gas flow profile from the manifold 242 through the middle of the tray and up and out through the exhaust elements 244, positioned near the sides of the tray. The controlled environment gas may preferably enter through a longitudinally oriented manifold 242 aligned over a center region of the tray opening or tray compartment. The controlled environment gas may then penetrate into the product and flow downward through the center region of the tray and exit along the side or sides of the tray. Exhaust tubes 248 communicate with the exhaust channels 246. For applications requiring a controlled environment with high levels of hazardous gas, for example, oxygen, the exhaust system may be critical to prevent potentially hazardous amounts of oxygen from escaping into the environment. In some applications, the exhaust gas may be reused. Preferably, the exhaust channels 246 are parallel to and extending the length of the manifold 242, which may preferably be approximately the length of the tray opening or openings. Configurations may vary depending on the actual tray or package.

As shown in FIGS. 2 and 3, an air cylinder 250 or other linear motion actuator actuates the vertically reciprocating gassing rail 212, and may, for example, be preferably connected to the feed block 236 with jam nut 252. During operation, the air cylinder 250 forces the vertically reciprocating gassing rail 212 downward. For the embodiment shown, a bottom surface 254 of the outer shell 230 seals against the flange 258 of the tray 218 which is pressed against seal base 362 formed around the tray opening 316 of carrier plate 312, which rides on conveyor 220. Seals 255 are preferably positioned in recessed areas formed in the outer shell 230 around the shaft 234 and exhaust tubes 248 to prevent gas from leaking during the flushing operation. Preferably, the seals 255 may include standard U-cup seals. The shaft 234 may continue to move downward and force rail head 232 further toward and/or into the tray opening. As shown in FIG. 3, the rail head 232 may, if desired, tamp down the product 805 into the tray 218. In this embodiment, a spring 256 may be used to allow the shaft 234 to move relative to the outer shell 230 while the outer shell 230 provides a substantially air-tight seal against the flange 258 to prevent any leakage of the controlled environment gas and contamination of the seal area while in the clamped or down position.

Once the outer shell 230 achieves a positive seal with the flange 258, high or multi-velocity gas flow may then be initiated through the distribution orifice 240 and through the preferably longitudinally oriented manifold 242. Preferably, the high velocity gas may be cut off or reduced to a lower velocity gas flow while in the down position to provide time for the exhaust system to carry away the exhaust gas, which includes excess controlled environment gas and the air within the tray and product. Cutting off or reducing the flow velocity while in the down position may also prevent product from being blown out of the tray and/or outside air from being pulled back into the tray to contaminate the product. A low velocity, preferably laminarized flow, may continue as the vertically reciprocating gassing rail 212 retracts.

Alternatively, the rail head 232 may be pre-set in various positions including an extended position with the rail head 232 lower than the outer shell 230 when in the up or retracted position. This will allow the rail head 232 to tamp down any product, and push it back into the tray prior to the outer shell 230 contacting the tray flange 258. Alternatively, as shown in FIG. 7, the rail head 232 may be fixedly attached to and/or formed as an integral member with an outer shell 260. The distribution orifice 262 and exhaust orifice 264 may be formed through the outer shell 260.

It may be necessary, for some applications, to expose different products in separate tray compartments in, for example, dual-compartment trays 288 to different controlled environments. Referring to FIG. 4, an alternative vertically reciprocating gassing rail 270 has two separate gas inlets 272, 274 in communication with manifolds 283 and 284 respectively, to expose each compartment of the tray to a controlled environment, which for some applications may require different controlled environments. More than two gas inlets and corresponding manifolds may be provided for some applications or for multi-compartment trays. The reciprocating gassing rail 270 includes rail head 276, and outer shell 277. The shafts 278, tube 280, and distribution orifices 282 are also provided and perform functions as described with respect to single manifold reciprocating gassing rails. The rail head 276 may be designed with the longitudinally oriented exhaust channel 286 including at least one exhaust element 285 centered on the portion of the tray separating the two compartments. As shown in FIG. 4, the manifolds 283, 284 are preferably located near the outer side of each compartment to provide a preferred flow profile through one side of the compartment and out the other side through the exhaust element 285. Alternatively, additional exhaust elements may be positioned along the outer sides of the tray compartments, and the manifolds centered over the compartments, to provide an alternative preferred flow profile. This flow profile would be similar to the flow profile created with the embodiments shown in FIGS. 2 and 3. The exhaust element 285 may, for example, be made of a 5-ply, 75 micron stainless steel mesh. In the closed position, the exhaust channel 286 receives exhaust gasses from each
compartment simultaneously as the separate food products 290, 292 are flushed with high velocity streams of controlled environment gas. For applications requiring two or more different controlled environments, the stationary gassing rails and angled gassing rail described herein, may be modified or positioned side by side to provide a dual or multi-manifold distribution chamber, with each longitudinally oriented manifold supplied with a different controlled environment. With respect to the stationary gassing rails 10, 410 and 411, the width of the rail base may be narrowed so that each manifold aligns with one of the compartments of the dual or multi-compartment tray to achieve the desired flow profile through each compartment.

[00800] Referring to FIG. 45, a stationary gassing rail for dual-compartment trays 810 may include rail top 818, rail base 819, with gassing manifolds 820 and 821 positioned on either side of exhaust channel 822. Each gassing manifold 820, 821 may include one or more gassing elements 826, 827 and may be supplied through inlets 824, 825 from separate sources of controlled environment. The exhaust channel 822 communicates with exhaust outlet 832 and allows a dual-compartment tray positioned with the partition aligned with the exhaust channel to prevent cross-contamination of the separate controlled environment gases flowing from manifolds 820, 821. The rail top 818 and rail base 819 may be attached with a plurality of screws 830 and stud welds 831 as described herein, with respect to stationary gassing rail 10. A jet manifold 718 may be positioned within each gassing manifold 820, 821. The angled rail 300 may provide a separate inlet connection to each of the openings 342 to supply a different controlled environment to a dual-compartment tray. Additional angled rails and/or stationary gassing rails may be positioned side by side to provide flow to additional compartments of a multi-compartment tray.

[00801] Referring to FIG. 7, some food product, including bakery products, may require exposure to sub-atmospheric pressure to assure acceptable oxygen residuals. Bottom shelf 253 may preferably be attached to feed block 251 and actuated with air cylinder 257 or other linear actuator. After a tray 218 indexes forward into position beneath the rail head 232, the air cylinder 257 may force the bottom shelf 253 upward and clamp against a bottom seal base 363 of the carrier plate 312. The air cylinder 250, may preferably simultaneously force the outer shelf 260 to clamp against the flange 258 and carrier plate 312 on the conveyor. Referring to FIG. 8, once the outer and bottom shelves are clamped in the closed and operating position, gas exhaust valves 263 may be automatically closed, and valve 265 opened to allow a vacuum to be pulled from both the inlets 238 and 259 for a pre-programmed period of time. As the pressure is returned to atmospheric, the exhaust valves 263 may be programmed to open and a high velocity controlled environment gas may, for example, in some applications, be supplied through inlet 238, while the vertically reciprocating gassing rail is in the closed position.

[00802] In some applications, a high velocity gas flush may not be necessary, and the tray may proceed along the conveyor beneath the stationary gassing rail 214. In other applications, a low velocity back flush may be supplied through inlets 238, 272, 274 and may be appropriate as the rail head 232, 276 is retracted. To further increase cycle time, for some applications, it may be appropriate to apply a vacuum with and back flush with one reciprocating gassing rail and then index the tray or trays forward beneath a second reciprocating gassing rail where a high velocity gas flush is applied to the product. All air cylinder, valve, vacuum and gas supply functions may be programmed with a programmable logic controller 228.

[00803] Once the rail head 232 retracts away from the tray 218, the tray may, for some applications, be indexed forward directly to the vertically reciprocating tray scaler 224. Preferably, in other applications, the tray or trays 218 may index forward beneath a stationary gassing rail 214 and be exposed to a low velocity preferably laminarized flow of controlled environment gas.

[00804] Referring to FIGS. 9 and 10, a preferred embodiment of the stationary gassing rail system is shown. The gas purging apparatus or stationary gassing rail 10 is disposed along a row of containers with product 12 traveling on a conveyor 14 along stationary gassing rail 10 in a direction of travel designated by arrow 16. Although containers 12 are shown, the stationary gassing rail 10 may also be positioned along a conveyor carrying trays 218. As shown in FIG. 10, stationary gassing rail 10 includes rail top 18 and rail base 19, and gassing elements 40, 41. As shown in FIG. 9, the stationary gassing rail 10 is composed of two 2 ft sections 60, 70. Alternatively, sections of various lengths may be used and positioned in series to create the desired length of rail. For example, rail sections having a length of 3 or 4 inches may be combined with 2 ft sections.

[00805] In the embodiment of FIGS. 9-11, one section of stationary gassing rail 10 includes a rail top 18 having a height of about 0.75 inch, a length of about 2 ft, and a width of about 3.0 inches. The rail top 18 is made of a rigid material. Preferably, for the embodiment shown in FIG. 11, the rail top 18 is made of plastic. The rail base 19 is also made of a rigid material, preferably stainless steel, aluminum, or rigid plastic. In the embodiment of FIG. 11, the rail base 19 preferably has a height or thickness of 0.188 inch, a width of about 3.0-8.0 inches, and a length of 2 ft. The reduced thickness is made possible in this embodiment by the use of stud welds which are studs 68 welded to the top surface of the rail base 19. The use of stud welds also eliminates the need for screw holes formed through the rail base, which tend to collect product particles during use. The bottom surface of the base 19 remains an unbroken smooth surface except for the open regions 30, 31 where the controlled environment exits. The studs 68 include threaded openings to receive thumb screws 64, which are inserted through openings 65 formed in the rail top and retained with retaining washers 67. The studs 68 and rail top openings 65 are, for the preferred embodiment shown, spaced in pairs along the stationary gassing rail 10. The thumb screws 64 are preferably knurled and have slots 69, which are adapted to receive a screwdriver and/or coin to allow easy assembly and disassembly of the stationary gassing rail 10. Alternatively, as shown in FIG. 39, a quick release system may be used, which includes a plurality of rotatable clamps 381, 383 that may preferably be screwedly attached to studs 382, which are welded to the rail base 19. A spring 384 may preferably be positioned between the head portion of screw 386 and an inner shelf 388 of the clamp 381. Dust cap 387...
preferably covers the opening 389 formed through each of the clamps 381, 383, to prevent dust and other contaminants from entering. When turned to the open position as shown by clamp 383, the spring 384 expands. When turned to the lock position as shown by clamp 381, the spring 384 compresses and the arm 390 of the clamp engages with a shoulder member 392 attached to the distribution chamber 394. Preferably, the clamps 381, 383 are made of a resilient plastic, or other durable material. The shoulder members 392 are also made of a durable material, preferably, for the embodiment shown, stainless steel.

[0086] As shown in FIG. 15, the rail base may alternatively be made of plastic. Plastic or other non-metal rails are necessary in gassing systems which include metal detection to monitor container movement. When plastic is used it is preferable that the thickness of the rail base 17 be increased to allow screw holes 13 to be bored into the rail base 17 without penetrating the bottom surface of the rail base.

[0087] The rail top 18, for the embodiment shown in FIGS. 10-12, has a longitudinally oriented channel region 75 formed therein for receiving a distribution baffle 50. For the embodiment shown, the channel region 75 is approximately 10.578x0.719 inches. The distribution baffle 50 which form fits to the channel, may, for example, be made of 5-ply, 75 micron stainless steel mesh. As shown in FIG. 12, a recessed region (shown in phantom line) 53 formed in the rail top along the channel region 75, may, for the embodiment shown, have measurements of 9.75x0.187 inches. The channel region 75 may have a depth of, for example, about ½ inch and the recessed region 53 of an additional ¼ inch. One end of the recessed region 53 is preferably aligned with the distribution openings 24, 25. The recessed region 53 allows the incoming gas to be distributed along the length of the distribution baffle 50.

[0088] Positioned around the perimeter of the channel region 75 is a pair of O-rings, which include outer O-ring 60 and inner O-ring 62. The outer O-ring 60 preferably seals against the surfaces of the rail top 18 and rail base 19 to prevent controlled environment gas from leaking. The inner O-ring 62 is aligned to press against the gassing element 40, for the embodiment shown. This secures the gassing elements 40, 41 in place, and prevents any movement of these gassing elements during operation to maintain a consistent flow.

[0089] As shown in FIGS. 13-14, a gas limiting member 90 includes two longitudinally oriented sections 94, 95. The sections 94, 95 have dimensions to fit within the channel 75 with the distribution baffle 50 in place. A gap 92 may be precisely preset using shim stock. The sections 94, 95 include openings 96, 97 at their longitudinal ends, which allows the sections 94, 95 to be fastened together using a bolt or other conventional fastener to provide the desired preset gap width. Medical flasks, for example, which may have openings of ½ inch may be provided with a preferred velocity flow stream by adjusting the gap 92, for example, to approximately ¼ inch. The gas limiting member 90 may be operated within a rail with or without one or more gassing elements. Each section 94, 95 preferably has an arcuate surface 98, which aids in reducing turbulence as the gas passes through the narrow gap 92. Alternatively, as shown in FIG. 16, openings 99 may be formed through each of the sections 94, 95 to allow the gas to pass directly through gassing elements 40, 41 and provide lower velocity flows on either side of the higher velocity flow which passes through the gap 92. Using the gassing element configuration shown in FIG. 11, the gas passing through the gap 92 would pass through slots 43, 45 of gassing element 40 and through gassing element 41. Various other gassing element configurations may be used to achieve the desired resistance and exit flow velocity. For flasks having a height of 6 inches and an opening of ½ inch, one preferred embodiment provides for the higher velocity flow region having a ½ inch width, and a lower velocity flow regions having a ¼ inch on both longitudinal sides of the higher velocity flow region.

[0090] Stationary gassing rail 10 should preferably be at least as wide, and more preferably somewhat wider, than the product or container opening. Stationary gassing rail 10 may also be narrower than the product or container opening, but under certain conditions this may allow outside air to contaminate the product and/or container. Structure or other means may be combined with the narrower rail to maintain the controlled environment. The length of the rail may vary depending on the desired line speed and minimum residence time underneath stationary gassing rail 10 for each container or product 12. Also, a plurality of rail sections may be arranged lengthwise in series to create a greater “effective” length. The actual length or number of rail sections required will depend on various factors, including conveyor speed, container and product volume, and product type.

[0091] For a given residence time, the maximum line speed increases as the length of stationary gassing rail 10 is increased. For the embodiment described above, a preferred line speed for gassing, for example, most food products is approximately 120 containers per minute (which have, for example, a length of 6 inches, a width of 3.5 inches and a depth of 2.5 inches) (80 ft. per minute of conveyor speed) and requires approximately 16 ft. of effective rail length.

[0092] The controlled environment gas enters from inlet tube 80 through the opening 20 formed in the port block 22. As shown in FIG. 10, port block opening 20 communicates with distribution opening 24. For the embodiment shown in FIG. 12, two distribution openings 24, 25, are perpendicular to the port block opening 20, and allow the controlled environment gas to pass through to the distribution baffles 50, 51. A port block baffle 70 may also be positioned across the distribution opening 24 in a recessed area near the base of the port block 22. The port block baffle 70 may also, for example, be made of 5-ply 75 micron stainless steel mesh, and may act as a filter. The port block 22 is preferably attached to the rail top 18 with screws or other conventional fasteners inserted through openings 52, which also secure the distribution baffle 50 to the top rail 18. O-ring 72 prevents any leakage of gas between the port block 22 and the rail top 18.

[0093] The gassing elements 40, 41 are positioned in the longitudinally oriented openings 30, 31 of the rail base 19. Around the longitudinally oriented openings 30, 31 are rims 33 which aid in supporting the gassing elements 40, 41. In the embodiment of FIGS. 10-12, each of the open regions 30, 31 include bridge region 35 to further support the gassing elements 40, 41. For that embodiment the gassing elements have a length of about 11.25 inches and a width of about 2.187 inches. The open regions 30, 31 are of the same length and width, and include a ¼ inch rim 33 and a ½ inch bridge region 35.
For the embodiment of FIG. 11, top gassing element 40 is preferably formed from a 5-ply wire screen having a hole size of between about 10-100 microns. The top gassing element 40 has two 4.875x0.25 inch slots 43, 45 formed therein. The bottom screen 41 is preferably formed from a 2-ply wire screen having a hole size of preferably 80 microns. The gas limiting member 90, shown in FIGS. 13, 14 and 16, may be used with one or both screens to provide higher velocity flow surrounded by lower velocity flow.

For the embodiment of FIGS. 10-12, for example, the 2 ft. section of rail may have an inlet and an outlet flow rate of about 1 to about 7.5 cubic ft. per minute. The optimum controlled environment flow rate will vary depending on the line speed, product and/or container dimensions.

The height adjusting apparatus 62 provides the operator an efficient means of lowering the stationary gassing rail 10 to a desired level from various sized packages and products. It also allows the stationary gassing rail 10 to be quickly removed for cleaning. The adjusting members 62 each include adjusting knob 116, vertical threaded shaft 118, horizontal mounting shaft 124, port block bracket 122, and mounting block 128. For the embodiment of FIGS. 9 and 10, the horizontal mounting shaft 124, may be made of a 12 inch long, 0.750 inch diameter shaft of stainless steel. One end of the horizontal mounting shaft is connected to a support member 130, which may be in contact with the floor, or be secured to a rigid structure. Horizontal mounting shaft 124 slidably fits within an opening formed in mounting block 128, which is also preferably made of stainless steel. Horizontal adjusting handle 120 is used to secure the shaft 124 to mounting block 128, and may be turned to allow the mounting block 128 and thus the stationary gassing rail 10 to be moved in a horizontal direction to an optimal alignment with the conveyor 14 and product 12. Vertical threaded adjusting shaft 118 is screwably received within adjusting knob 116, and fastened to mounting block 128. Shaft 118 is preferably fastened to port block bracket 122 which is slidably fastened to stationary gassing rail 10. The port block bracket 122 is designed to interface with a top portion 123 of the port block 22. Preferably, as shown in FIG. 10, the port block 22 has a T-shaped cross-section and the port block bracket 122 slidably attaches to the top portion 123 of the port block 22. Alternatively, the port block may be configured to slidably interface with the port block bracket in various other configurations, including, for example, the bracket 150 and dovetail-shaped port block 152 shown in FIG. 17. The adjusting screw 125 may be loosened to allow the stationary gassing rail 10 to be slid horizontally to a desired position. When the adjusting screw 125 is tightened, the stationary gassing rail 10 is prevented from moving, and the vertical adjustments may be made to achieve the appropriate distance between the rail and container and/or product. Plunger 126, which is preferably spring-loaded, may be pulled horizontally outward from its engagement with a groove formed in shaft 118 to allow the operator to make major vertical adjustments to the rail position. The thumb screw 127 may be used to tighten the mounting block 128 and adjusting knob 116. Fine tuning the stationary gassing rail 10 to the precise position from the container or product 12 may be accomplished by turning adjustment knob 116. For the embodiment of FIGS. 9 and 10, adjusting knob 116 is preferably made of delrin, and is 6.125 inches long with a 4.625 inches long, 1.860 diameter center portion, a 1 inch, 2.5 inch diameter cap portion, and a 0.5 inch, 1.174 inch grooved portion which is received in an opening formed in the mounting block 128. Vertical threaded shaft 118 is preferably made of stainless steel and has a length of 6 inches with an upper grooved portion having a length of 4.75 inches. The shaft 118 has an outer diameter of 0.75 inch, with 0.125 inch deep by 0.165 inch wide grooves, which are spaced to provide 3 grooves per inch. Preferably, the grooves have a rectangular shape. Preferably, the vertical distance between the bottom of the stationary gassing rail 10 and the product or container 12 is small, and should not exceed about ⅛ inch.

Sidewalls may be used. The sidewalls aid in preventing outside air from entering the purging area, and increase the efficiency of the system. The sidewalls also act to force the gas, which includes the air flushed from the container and/or product and controlled environment to exit primarily through the entrance and/or exit, where the gas may be collected. It may be preferable to have a relatively sealed exit portion so most gas exits through the entrance.

Alternatively, the stationary gassing rail 410, 411 shown in FIGS. 18-32 and 44 may be used in place of or in combination with stationary gassing rail 10. Accordingly, for single compartment containers or trays, the stationary gassing rail 214 shown in FIG. 1 may preferably include either stationary gassing rail 10, 410, or 411 or a combination of rail 410 or 411 positioned adjacent stationary gassing rail 10, which is adjacent the seal station. Referring to FIGS. 18 and 19, a preferred embodiment of the stationary gassing rail system is shown. The gas purging apparatus or gassing rail 410 is disposed along a row of product 12 traveling on a conveyor 14 along rail 410 in a direction of travel designated by arrow 416. In the embodiment of FIG. 18, the gassing rail 410 includes a distribution chamber 418, which in the embodiment shown is composed of two 2 ft. sections 460, 470. The distribution chamber 418 may be positioned in series with other chambers if necessary. In the embodiment of FIGS. 18-22, rail 410 includes a distribution chamber 418 having a height of about 1.325 inches, a length of about 4 ft., and a width of about 4.5-8.0 inches. The controlled environment through the chamber has an inlet and an outlet flow rate of about 2 to about 15 cubic ft. per minute, for this embodiment. The optimum controlled environment flow rate will vary depending on the line speed, product and/or container dimensions.

Similarly, preferably, distribution chamber 418 is closed except for controlled environment inlets 420, 422, 456, 454 formed in its top portion 490, and the openings 433, 435 formed in the its bottom portion 432. Distribution chamber 418 may preferably, be rectangular as shown in FIGS. 18-20, and may be constructed of stainless steel, aluminum, rigid plastic or any other rigid material. Distribution chamber 418 should preferably be at least as wide, and more preferably somewhat wider, than the product or container opening 412. Distribution chamber 418 may also be narrower than the product or container opening, but under certain conditions this may allow outside air to contaminate the product and/or container. Structure or other means may be combined with the narrower distribution chamber to maintain the controlled environment. The length of the distribution chamber 418 may vary depending on the desired line speed and minimum residence time underneath distribution chamber 418 for each container or product 12. Also, a plurality of distribution chambers 418 may be arranged lengthwise in series to create
a greater “effective” length. The actual length or number of distribution chambers 418 required will depend on various factors, including conveyor speed, container and product volume, and product type.

[0100] For a given residence time, the maximum line speed increases as the length of the distribution chamber 418 is increased. For the embodiment described above, a preferred line speed for gassing, for example, most food products, including chips, nuts, salads may be approximately 120 containers per minute (which have, for example, a length of 6 inches, a width of 3.5 inches and a depth of 2.5 inches) (80 ft. per minute of conveyor speed) and requires approximately 16 ft. of effective chamber length.

[0101] Referring to FIG. 44, the gassing rail 411 may preferably be alternatively designed similar to the stationary gassing rail 10 shown in FIG. 11. The gassing rail 411 includes a jet manifold 718 positioned within the inner cavity 724 formed between the rail top 714 and rail base 716. Jet manifold 718 has a design similar to jet manifold 426 (FIG. 23), but allows both the tubes 712 and inner cavity 724 to be separately fed with controlled environment gas from a centralized location. The controlled environment gas may flow through longitudinally oriented channels 719, and then into the inner cavity 724 through a plurality of spaced openings 723 which are formed through the side rails 721 of the jet manifold 718. O-rings 725 are positioned in a groove formed in the side rails 721. The rail bottom has as plurality of studs 702 welded on its surface which receive screws 704. The screws are held to the rail top 714 with retaining washers 722. The rail 411 may include one or more gassing elements 708, 710. The jet manifold 718 preferably includes a plurality of distribution tubes 712, which include nozzles 726 to provide a high velocity gas flow. A lower velocity flow of controlled environment gas passed through the gassing elements 708, 710 and opening 720 in the rail base. The lower velocity flowencircles the high velocity flow from the jet nozzles. At least one O-ring 706 may preferably be positioned between the rail top 714 and rail base 716.

[0102] Sidewalls 453, 455, as shown in FIG. 19, may preferably be made of a clear plastic material, or polycarbonate, and may have a 4 ft. length, a 7 inch height, and a 0.5 inch thickness, which allows the sidewalls 453, 455 to fit within the grooves of the horizontal mounting shaft 124. Various lengths of mounting shafts 124 may be used, and the sidewalls 453, 455 may be adjusted to reduce the internal volume of the tunnel area formed between sidewalls 453, 455. Product positioning members 521 may also be used to maintain alignment of the product 12 under rail 410 as it travels along the conveyor 14. Each of the positioning members 521 includes a receptacle 531, a shaft 525, a guide rail 523 and clamp 529. Guide rail 523 is preferably 4 ft. long with a 0.375 inch diameter and is attached to the inner end of shaft 525. Shaft 525 extends through receptacle 531, and may be adjusted by loosening clamp 529, and then horizontally sliding shaft 525 to the desired position. Receptacle 531 has an inner flange portion 533 for retaining the receptacle within the opening 532 formed through sidewalls 453, 455.

[0103] Preferably, the vertical distance between the bottom portion 432 of the distribution chamber (or the bottom of rail base 716) and the product or container is small, and should not exceed about 0.509 inches. Preferably, this vertical distance is between about 0.125 and about 0.250 inches, and most preferably between about 0.175 and about 0.200 inches. These reduced gap distances provide for optimal results with minimum gas usage.

[0104] The sidewalls 453, 455 aid in preventing outside air from entering the purging area, and increase the efficiency of the system. The sidewalls 453, 455 also act to force the gas, which includes the air flushed from the container and/or product and controlled environment to exit substantially through the entrance, where the gas may be collected. A gasket 421, including any food-safe sealing material, may also be used in combination with sidewalls 453, 455 to further seal the system from the outside environment.

[0105] A scaling station 480 is preferably positioned at the end of the rail section 470 to achieve the desired controlled environment. Other types of rail and scaling arrangements may also be utilized, including rails, which may run in an upward and/or downward direction, and vertical or rotary sealing stations. Preferably one or more high velocity sections 460 are followed by one or more lower velocity sections 470 prior to sealing the container. However, when sidewalls 453, 454 are used, for example, with a scaler 480 and conveyor 14, which are designed to prevent infiltration of air, a complete rail with high velocity sections may be used, without the need for a low velocity section.

[0106] Referring to FIGS. 18-23, the distribution chamber 418 includes a top portion 490 and bottom portion 432. Formed in the top portion 490 of chamber section 460 is a first inlet 422 for receiving controlled environment from a first source (not shown) and a second inlet 420 from a second source (not shown). Inlet 422 allows gas to be supplied to the inner cavity 424 of the distribution chamber 418. The second inlet 420 connects to a jet flow tube distribution manifold 426, which includes a rectangular frame 510 which fits over screens 430, 434. For the embodiment shown, five distribution tubes 428 extend over a plurality of openings 431, 437, 439 formed in screens 434, 430 and openings 433, 435 formed in the bottom portion 432 of the distribution chamber 418. It is contemplated that any number of tubes 428 may be used and is product dependent.

[0107] Referring to FIGS. 20-23, a preferred resistance region includes screens 434, 430 overlying the openings 433, 435 formed in the bottom portion 432 of the distribution chamber. In the embodiment of FIGS. 1-6, equally spaced rows of openings 433 are formed in the bottom of the chamber 432. Center openings 435 are preferably slots having a ½ inch width. The outside rows are staggered with ¼ inch diameter circular openings 433 spaced 0.938 inch between centers. This arrangement is designed for providing consistent contact of the very high velocity controlled environment streams with the product. The distance between the outer two rows of circular openings may be approximately as wide as the product or container. The bottom portion of the chamber 432 may, alternatively, include greater or lesser number of openings depending on the type of product, line speed, etc. The openings 433 may also be arranged in equally spaced parallel rows, rather than in staggered rows as shown in FIG. 23. Alternatively, the center slots 435 may be formed as one long slot through a section of chamber. Arrangements and number of the openings 433, 435 may be altered to meet the requirements of product with varying sizes and consistencies.
Top screen 434 is preferably formed from a five-ply wire screen having a hole size of between about 10-100 microns. In the above embodiment, the circular openings 437 have diameters of 0.188 inch and center slots 439 with matching 0.188 inch widths. The bottom screen 430 is preferably formed from a 2-ply wire screen having a hole size of preferably about 80 microns. The bottom screen 430, in the preferred embodiment of FIGS. 18-22, has preferably 5 staggered rows of circular openings 31 with diameters of 0.125 inches and spaced 0.938 inches between centers.

As shown in FIGS. 18 and 20, jet manifold 426 is supplied with controlled environment from a second source through inlet 420, which aligns with opening 442. As shown in FIG. 32, alternatively inlet 422 could serve as the sole inlet with an alternative jet manifold design which provides for spaced openings 622 in tubes 621 to allow controlled environment to flow into the inner cavity 424. The openings may be formed in some or all of the tubes 520, and may be in the top or sides and spaced at varying distances for various product and resistance regions.

As shown in FIGS. 20 and 23, the rectangular frame 510 of the jet manifold 426 fits over the perimeter of the top screen 434. In a preferred embodiment, five tubes 438 extend longitudinally over the rows of openings 437, 439. Extending from the tubes are very high velocity nozzles 440 having an O.D. of approximately ½ inch, an I.D. of between about 0.020-0.030 inch, and a length which allows the nozzle to extend through top screen openings 437, 439, and bottom screen opening 431. Preferably, as shown in FIG. 22, the nozzle does not extend beyond the bottom of chamber 432 to facilitate cleaning of the chamber bottom 432 and to avoid damage to nozzles 440 during operation or cleaning. Tolerances of approximately + or -0.010 inches are held between screens 430, 434 and jet manifold 426 which can be easily removed from the distribution chamber 418 for cleaning. Simpler configurations are possible which do not require close tolerance, but may not be as easily reassembled or mass produced. As shown in FIGS. 20 and 21, distribution chamber 418 is preferably sealed with an O-ring 450, which extends along the perimeter of screens 430, 434 and frame 510 of jet manifold 426 to seal the chamber 424. As shown in FIGS. 20 and 21, top portion 490 and bottom portion 432 of the distribution chamber 418 have a plurality of threaded openings 491, 493 spaced along their perimeter for sealing the distribution chamber 418. In the embodiment of FIGS. 20 and 21, O-ring 450 extends around both sections of chamber 460, 470.

In operation, for the embodiment shown in FIGS. 20-22, controlled environment or combination of gases is used, for example, to prolong product freshness or inhibit bacterial growth. The gas enters distribution chamber 418 through inlet 422, which is in communication with opening 445 formed in top portion 490 of distribution chamber 418. The controlled environment flows through screens 434 and 430 and screen openings 431, 437, 439 and distribution chamber openings 433, 435. Simultaneously, controlled environment enters through a second inlet 420 which communicates with opening 442 formed in jet manifold 426, and passes through tubes 428 and nozzles 440. The gas stream from nozzles 440 is of a high velocity, in the range of, for example, 100-1100 ft./sec., or from 100 ft./sec. up to sonic speeds (speed of sound). The high velocity jet flow is designed to impinge upon the product and/or interior of the container as the product is moved along conveyer 14 to sealing station 480. This extremely high velocity flow, will generally, actually penetrate into the product to replace air entrapped within and around the product. The lower velocity, and preferably laminarized flow surrounding the high velocity jet flow substantially prevents outside air from being pulled into the container and/or product.

The gas stream exiting chamber 418 has a much lower velocity. As shown in FIG. 22, the outer region of the flow profile 540 has the lowest velocity because the controlled environment passes through both screens 430, 434. The next region of flow passes only through the bottom screen 430 and has a slightly higher flow velocity. Preferably, the next flow region, which is directly around the nozzle, has no resistance and has a slightly higher velocity than the two outer regions. This flow profile, with a lower velocity flow surrounding the very high velocity flow exiting the jet nozzles 440, substantially prevents outside air from being pulled back into the container and product. The quadruple flow profile, as shown in FIG. 22, may alternatively be modified, as shown in FIG. 24, to a triple flow profile 560 by eliminating the top screen 434. Alternatively, as shown in FIG. 20, for some product, including nuts, providing flow only through the center slot 435 with one or both screens 430, 434, and through the center distribution tube 451 may be adequate to achieve the desired controlled environment for sealing or packaging the product.

Alternatively, as shown in FIG. 25, shortened nozzles 551 may be used with a screen 552, which is similar to screen 430 without openings, to provide a dual flow profile 550. Both top and bottom screens 430, 434 may also be eliminated, as shown in FIG. 26 to provide an alternative dual flow profile 570. Various other flow profiles which provide for a lower velocity flow surrounding a very high velocity flow may also alternatively be created by altering the number of screens and openings.

It is preferable for gassing rail 410 to have a distribution chamber or section thereof that provides only a lower velocity flow of controlled environment, preferably laminarized flow. Alternatively, the stationary gassing rail 410 may be used in place of a section of the distribution chamber providing a lower velocity flow. As shown in FIG. 18, providing a low velocity flow to the section 470 of distribution chamber 418 preceding entry to the sealing station 480 aids in preventing air from being pulled into the product or container 412 at the end of distribution chamber 418, which is adjacent the sealing station 480. As shown in FIG. 18, the section 470 may be constructed similar to rail section 460 described above. The desired lower velocity gassing effect is achieved by shutting off the source of controlled environment to inlet 454 which supplies the jet flow tube manifold 456 of rail section 470. Alternatively, section 470 may be altered, as shown in FIG. 27, to have a bottom chamber portion 512 having only slots 514 formed therethrough. Alternatively, as shown in FIG. 28, the jet manifold 426 may be removed altogether to achieve the triple low velocity flow profile 580. Alternatively, as shown in FIG. 29, lower screen 430 may be replaced with screen 552, which has no openings bored therethrough, to create the low velocity flow profile 590. Referring to FIG. 30, the top screen 434 may be removed to provide the single flow profile 600. Other variations of longitudinally oriented regions of flow resistance may be created by altering the
number and type of mesh screens, porous materials or other resistance-type sheets. For example, the embodiment of FIG. 31, may be used in either a low or high velocity section. When used in a high velocity flow section, an orifice 614 formed through a resistance material 612, provides high velocity flow with the dual flow profile 610. The resistance material 612 is preferably sintered metal-type material, but may be any material that will provide a sufficient reduced velocity flow, and preferably a laminarized flow. With the design of FIG. 31 a jet manifold may not be necessary.

[0115] A series of tests were conducted that confirm the desirability of this gassing rail system. Referring to FIG. 18, a 4 ft. gassing rail 410, having two 2 ft. sections 460, 470 was placed on the top of conveyor 14 leaving a clearance of 0.375 inches between the bottom of the distribution chamber 418 and the top of the container 412. The conveyor 14 was operated at 5 inches per second.

[0116] One series of tests were conducted with tubs, having 9 inch lengths, and 5.5 inch widths, filled with miniature powdered donuts. The tubs fit into cut-out openings in the conveyor, which allowed for the top of the tubs to be flush with the top of the conveyor. The area beneath the gassing rail was not closed. There were no sidewalks 453, 455 used in this series of tests. In addition, there were openings in the conveyor chain which allowed outside air to access the gas flushing area. After passing through both sections 460, 470 of the gassing rail, the tubes entered a scaling station 480. First a layer of plastic covered the tub openings. Next the plastic sheet was heat sealed to the tub, and then the plastic between the tubes was cut. An oxygen sensor was used to determine the oxygen residual in the sealed tubs 482.

[0117] In the first test, Test A, nitrogen gas was provided to distribution chamber 418 through inlets 422, 457 and to jet manifolds 426, 456 through inlets 420, 454. The average oxygen residuals for Test A were approximately 2.4 percent. This is an undesirable oxygen residual for many products including baked goods, and would not adequately inhibit mold growth or prevent oxidative rancidity.

[0118] In the second test, Test B, the nitrogen gas was fed only through the distribution chamber inlets 422, 456. The source of gas to jet manifold inlets 420, 454 was turned off. The average oxygen residual for Test B was 1.06 percent. This was a better residual than Test A, however, it would also not adequately inhibit mold growth or prevent oxidative rancidity.

[0119] A third test, Test C was run under preferred operating conditions. Gas was provided to distribution chamber 418 and jet manifold 426 in the first section 460, and was provided to the distribution chamber only in the second section 470. The gas supply to jet manifold 456 in second section 470 was shut off. This resulted in average oxygen residuals of approximately 0.23 percent. At this level of residual oxygen, mold growth should be substantially, if not, completely inhibited.

[0120] Similar tests were run with packages of two chocolate cupcakes. In this series of tests, 16 ft. of rail was used, with the distribution chamber, having only center slot openings 435. The two layers of screen 430, 434 having openings 439, 431, as described above, were positioned along the center slot openings 435. Nozzles from jet manifold 426 extended through the screen openings 439, 431, spaced at 2.875 inches between centers. Gas to the jet manifold was turned off for a 4 ft. section of rail immediately preceding the scaling station 480. This resulted in average oxygen residuals in the sealed cupcakes of between 0.5 and 0.5 percent. When the gas to the jet manifold was turned off for the entire 16 ft. length of rail, the average oxygen residuals rose to an average range of about 1.6-1.8 percent.

[0121] Referring to FIGS. 5 and 6, a preferred embodiment of an angled rail 300 is shown. Preferably, the angled rail 300 is positioned adjacent the film feeder 226. A portion of the angled rail is preferably oriented to direct a stream of controlled environment parallel to the film which is diagonally fed by the film feeder 226 to feed roller 227. The flow of gas from the angled rail 300 is controlled to provide a flow of gas beneath the film 294 and through the seal station or vertically reciprocating tray sealer 224. The two-tray vertically reciprocating tray sealer 224 shown in FIG. 5, preferably includes seal heads 302 and spring-loaded clamping plate 303. Preferably, the angled rail 300 may include a manifold 304 designed similar to the stationary gassing rail 10, but having at least a portion directed at an angle to maximize the penetration of gas beneath the film 294. Referring to FIG. 1, the angled gassing rail 216 may, for example, include angled rail 300, or alternatively an angled section of the stationary gassing rail 214.

[0122] Preferably, as shown in FIGS. 33 and 37, the angled rail 300 may be curved or bent having a convex side directed to provide flow diagonally toward the vertically reciprocating tray sealer 224. The angled rail 300 may preferably be oriented to provide a laminarized flow parallel to the film 294 which may be provided from the film feeder 226 and fed diagonally about feed roller 227 and then beneath vertically reciprocating tray sealer 224. As shown in FIGS. 5 and 37, the angled portion of the manifold 304 may direct a laminarized stream parallel to the film 294 with sufficient velocity to penetrate beneath the film and around and into the tray or trays positioned under the seal heads 302. The manifold 304 of the angled rail 300 may preferably have a length which extends beyond the width of the tray opening. The controlled environment gas provided to the angled rail 300 may preferably be controlled to provide a higher flow rate during transport of the trays 218 beneath the scaling heads 302, and to provide a lower flow rate during the scaling process. For two tray scaling stations, as shown in FIG. 5, the flow rate during transport may, for example, be 200 scfh, and 75 scfh during sealing. Alternatively, a constant rate, for example, 150 scfh, may be used.

[0123] Referring to FIGS. 33 and 37, the angled gassing rail 300 preferably includes an inlet 330 for receiving controlled environment gas from a source (not shown) and flows through baffle 336, (shown in phantom). Preferably, two gassing elements similar to the stationary gassing rail 10 may be positioned over openings 342 in the distribution chamber 344. The top element 332, for example, may preferably be formed from a 5-ply wire screen with a hole size between about 10-100 microns, and the bottom element 334 may preferably be formed from 2-ply wire screen with a hole size of about 80 microns. In the embodiment shown in FIGS. 33 and 37, the top element 332 may include an opening 340, to allow a higher velocity flow from a center region of the manifold 304, as indicated by long arrows 343, and a lower velocity flow from regions around the opening
As indicated by short arrows 345. As shown by the flow profile arrows in FIG. 37, some of the controlled environment gas flows between the angled rail 300 and the film in the opposite direction to prevent air entering the tray during the scaling process. Preferably, the angled rail may further include an opening 331 positioned to provide flow substantially perpendicular to the film and prevent air from being drawn in by the advancing film. The opening 331 may preferably be a narrow slot or a series of small holes transverse to the film.

Alternatively, as shown in FIG. 35, side rails 350, 351, designed similar to the lead-in angled rail 300, except that the manifold may be constructed without a bend and oriented to direct a horizontal flow of controlled environment gas from the sides of the scaling station and beneath the film and around and into the trays positioned beneath the seal heads. The manifold 353 of the side rails 350, 351 may have a length which preferably extends at least the length of the tray or trays positioned beneath the seal heads 302. An angled exit rail 352 designed similar to the lead-in angled rail 300 with the manifold directing all flow either substantially parallel to the out-going film scrap or the film positioned under the seal heads, may also be positioned at the exit side of the seal station adjacent the film roller 354 (as shown in FIG. 1) to provide additional controlled environment flow beneath the film while the tray is beneath the seal head 302.

Referring to FIG. 34, a preferred embodiment of the seal head 302 includes at least one seal head blow-off port 310, which may be supplied with air or inert gas from a source (not shown). Once a tray is positioned beneath the seal head 302, the downward stroke of the seal head may take 150-200 milliseconds, which may cause a dome in the film when sealed to the tray. During the down stroke, a timed pulse of gas may be released from the seal head blow-off port 310 to force the film into the tray. Preferably, as shown in FIG. 34, the seal head blow-off port 310 is positioned immediately above the center of the tray. The seal head blow-off port 310 may alternatively be positioned at the opening 312, or elsewhere on the seal head to direct a burst of gas against a top portion of the film positioned over the tray opening. The timed burst of gas allows the film 294 to be sealed to the tray without a dome in the sealed film, which may be commonly perceived negatively by purchasers of the product.

The film 294 may be sealed to the tray with the seal heads 302, which may be applied to the tray flange, for example, for \( \frac{1}{4} - \frac{1}{2} \) seconds to preferably effect a hermetic seal. The up stroke of the seal head 302 may also take about 150-200 milliseconds, which may tend to draw or create a partial vacuum and pull the tray from the carrier plate. The seal head blow-off port 310 may also preferably be timed to release a burst of gas just prior to the up stroke to cause a positive pressure and ensure that the tray is not dislodged out of the carrier plate, which may disrupt the packaging operation by breaking the film. The seal head blow-off port 310 may alternatively be set to provide a continuous flow of gas against the top surface of the film.

The film feeder 226 may preferably be servo-driven independent of the servo-driven conveyer. This allows quick replacement of various configured and sized carrier plates on the conveyer without the need to change the chain length, which may take several hours. For example, in accordance with the invention, to change from a 8 inch tray to a 9 inch tray, the carrier plates may be quickly changed on the conveyer. The servo-driven film feeder may be programmed to the new length of, for example, 9 inches.

Referring to FIG. 36, two preferred carrier plates 312, 313 are shown positioned on a conveyer chain 314. The carrier plates 312, 313 are designed so that the tray openings 315 are adjacent to each other to reduce the amount of film necessary to seal the trays together. At least one sensor bracket 320 may preferably be positioned along the conveyer. Preferably, only one sensor bracket 320 is necessary, however, two are shown in FIG. 36. Sensor bracket 320 may preferably include signal sensors 322-324 positioned over receptor sensors 325-327. Sensors 325-327 may be either set to locate a carrier plate and advance, or index forward the carrier plate a preset number of pulses, which may be converted into linear inches or other units. Sensors 323 and 326, for example, are positioned, so that the carrier plate blocks communication. Sensors 322 and 325 are positioned to communicate with each other. Together the sensor pairs 324, 327, and 323, 325 may accurately locate the edge of the carrier plate. As shown in FIGS. 36 and 38, the proximity of the tray openings 316 to each other in the carrier plate pairs, combined with the sensor bracket and independent servo-driven conveyer and independent servo-driven film feeder, allows precise tolerances to be held. This accordingly allows a knife which slides within clamping plate 303 to precisely cut between a knife opening 360 in the seal base 362 which is formed around the circumference of each of the tray openings 316. This precision cutting may also save on scrap film and may also improve package appearance. In existing vacuum systems, the cut may be made against a base positioned an increased distance from the periphery of the tray opening which increases film scrap.

As shown in FIG. 36, for each pair carrier plates 312 and 313 positioned on conveyer 314, each may have a notch 315 and 317, respectively. Notch 315 may preferably have a length different from notch 317, for example, \( \frac{1}{4} \) inch and \( \frac{1}{2} \) inch, respectively. This distance allows sufficient clearance to allow the sensors to locate the edge of the carrier plate without reflections from the adjacent carrier plate. As the notches pass through the sensor bracket 320 in the direction indicated by arrow 311, the length of the notch is determined and the sensor bracket 320 may locate the position of each plate in the pair with respect to the sensor bracket 320. The programmable logic controller 228 may be programmed to automatically correct any error that may occur due to different sections of chain length, which may vary in tightness and may change in chain stretch with use. For example, a 540 inch chain may have 54 carrier plates or 27 indexes of carrier plate pairs. The program controls the number of pulses or linear inches the conveyer indexes forward. If the proper sensors do not line up, for example, the carrier plate blocks both pairs of sensors, the program self adjusts by pulsing backward or forward. Because the sensors have measured the notch length, the controller may determine where on the carrier plate pair the sensors are presently at, and adjust forward or backward accordingly. The self-adjusting program will allow the gassing and sealing operation to run with less down time, and quickly compensate for partial or complete change outs of conveyer.
It may also alert the operator to improperly install carriers after a changeover or cleaning.

[0130] The rails discussed above may further be used to provide sterile atmosphere, which may be desirable in some applications. Referring to FIG. 43, a hepa-filter system 770 may be placed in line with a controlled environment gas source 772 (with manual shut off 774) to remove any foreign particles including bacterial spores and mold particles from the controlled environment gas. Prior to gassing the food product, the entire gassing system, including stationary, reciprocating, angled rails 375 may be sanitized in place by delivery steam from a source 776 (with manual shut off valve 778) through the hepa-filter system and then through each of the gassing rails, inlets and held at a temperature of, for example, 230°F for a period of time sufficient to kill off the desired bacteria, for example, at least 14 minutes. A thermo-well 780 may be provided to collect the steam condensate, and the required temperature could be measured at the outlet 782. This would assure that the hepa-filter system 770 and gassing system 775 would achieve the thermal death curve and validate the sanitation. As shown schematically in FIG. 43, the hepa-filter system 770 may, for example, include hepa-filter 784, solenoid valve 786, pressure switch 788, and one or more pressure regulators 790, gauges 792 and restricting orifices 794.

[0131] While the embodiments of the invention disclosed herein are presently considered to be preferred, various changes and modifications can be made without departing from the spirit and scope of the invention. The scope of the invention is intended in the appended claims, and all changes that come within the meaning and range of equivalents are intended to be embraced therein.

We claim:

1. An apparatus for exposing product-filled containers being transported by an intermittent conveyor to a controlled environment comprising:

- a reciprocating gassing rail positioned along the conveyor and timed to engage with the conveyor when the conveyor is paused, the reciprocating gassing rail including an outer shell and a rail head, the outer shell including a bottom surface for sealing to a flange portion of the container, the rail head which includes a longitudinally oriented manifold, the rail head including an opening formed therein for receiving controlled environment gas from a source.

2. The apparatus of claim 1 further comprising a bottom shell which seals to a bottom region of the conveyor and allow a vacuum to be pulled on the tray.

3. The apparatus of claim 2 wherein the opening formed in the rail head may be used for pulling a vacuum on the tray.

4. The apparatus of claim 1 wherein the rail head includes at least one exhaust orifice to receive exhaust gas.

5. The apparatus of claim 4 wherein the rail head further comprises a longitudinally oriented exhaust channel in communication with the exhaust orifice.

6. The apparatus of claim 1 further comprising a shaft including a distribution orifice, the shaft attached to a feed block, the distribution orifice in communication with the manifold and an inlet formed in the feed block.

7. The apparatus of claim 1 further comprising a second manifold formed in the rail head, the second manifold in communication with a second source of controlled environment.

8. A method of exposing a container to a controlled environment comprising:

- providing a reciprocating gassing rail including a rail head, and an outer shell, the rail head including a longitudinally oriented manifold;
- providing an intermittent conveyor carrying product-filled containers;
- conveying a container beneath the rail head;
- pausing the conveyor;
- clamping the outer shell to a top region of the conveyor;
- supplying a high velocity flow of controlled environment gas through the manifold to provide a desired flow pattern of controlled environment gas into the container;
- retracting the rail head and the outer shell; and
- conveying the container to a sealing station.

9. The method of claim 8 wherein the rail head has a longitudinally oriented exhaust channel formed on each longitudinal side of the manifold, removing exhaust gas flowing from the container through the exhaust channels to maintain a desired flow pattern.

10. A system for exposing a product-filled container being transported by an intermittent conveyor to a controlled environment comprising:

- a virtually reciprocating gassing rail including a rail head and an outer shell, the rail head including at least one longitudinally oriented manifold positioned to align with a product-filled compartment of the container, the rail head including at least one longitudinally oriented exhaust channel positioned along at least one longitudinal side of the manifold; and
- a fixed gassing rail positioned adjacent the reciprocating gassing rail, the gassing rail including at least one longitudinally oriented manifold positioned to align with a middle portion of a product-filled compartment of the container.

11. The system of claim 10 further comprising an angled gassing rail positioned adjacent the fixed gassing rail to provide a stream of controlled environment gas beneath film being heat sealed to the containers.

12. The system of claim 10 further comprising a bottom shell to clamp to a bottom region of the conveyor to allow a vacuum to be pulled on the container.

13. The system of claim 10 further comprising a feed block attached to a shaft, the shaft being attached to the rail head, the shaft including a distribution orifice in communication with the manifold and an inlet formed in the feed block.

14. The system of claim 13 further comprising a spring positioned around the shaft between a bottom portion of the feed block and a top portion of the outer shell.

15. The system of claim 13 further comprising an exhaust tube in communication with the exhaust channel, the tube extending through an opening formed in the outer shell, a
seal positioned around the tube and in contact with the outer shell to prevent gas from escaping when the outer shell is in a clamped position.

16. The system of claim 15 wherein the shaft extends through an opening formed in the outer shell, a seal is positioned around the shaft and in contact with the outer shell to prevent gas from leaking when the outer shell is clamped against the conveyor.

17. The system of claim 10 wherein the vertically reciprocating gassing rail includes one manifold positioned between two exhaust manifolds.

18. The system of claim 10 wherein the vertically reciprocating gassing rail includes one exhaust channel positioned between two manifolds, the manifolds aligned with a divider region of product-filled compartments of the container.

19. The system of claim 10 wherein each manifold of the vertically reciprocating gassing rail is supplied with a separate source of controlled environment, the stationary gassing rail includes two manifolds supplied with controlled environment from a separate source.

20. A method for exposing a container transported by an intermittent conveyor to a controlled environment comprising:

- providing a reciprocating gassing rail including a rail head and an outer shell, the rail including at least one longitudinally oriented manifold and at least one longitudinally oriented exhaust channel;
- providing a fixed gassing rail positioned adjacent the reciprocating gassing rail;
- providing an angled gassing rail positioned adjacent the fixed gassing rail and a reciprocating tray sealer;
- conveying a container beneath the reciprocating gassing rail and pausing the conveyor;
- clamping the outer shell to the conveyor;
- flowing high velocity controlled environment gas through the manifold of the rail head;
- removing exhaust gas through the exhaust channels;
- conveying the container beneath a fixed gassing rail;
- flowing a low velocity controlled environment gas through the manifold of the fixed gassing rail;
- conveying the container beneath a tray sealer; and
- flowing a stream of controlled environment gas beneath a film to be sealed to the containers.

21. A gassing system for exposing product to a controlled environment being transported along a conveyor comprising:

- a stationary gassing rail including a first and a second distribution chamber positioned along a conveyor moving product filled containers toward a sealer, the first chamber including a plurality of openings formed therein, a resistance sheet longitudinally oriented adjacent the chamber openings, and a distribution manifold longitudinally oriented adjacent the resistant sheet, a manifold including a plurality of nozzles oriented at an angle to the manifold and aligned with the first chamber openings, the second distribution chamber including at least one opening formed therein, and a resistance sheet longitudinally oriented adjacent the second chamber opening; and
- an angled rail including a distribution chamber having at least one opening formed therein, a resistance sheet positioned over the opening, the angled rail being oriented to direct a stream of controlled environment gas parallel to and beneath film being fed to a sealing station, the angled rail positioned adjacent the second distribution chamber.

22. The gassing system of claim 21 further comprising a sealing station including a seal head to seal film to the container, the seal head including a seal head blow-off port to direct controlled bursts of gas against an upper side of the film while the seal head vertically descends to clamp the film against the container.

23. The gassing system of claim 22 wherein the seal head blow-off port is directed to direct a controlled burst of gas during both the down stroke of the seal head and immediately prior to the upstroke of the seal head.

24. The gassing system of claim 21 further comprising a sealing station including a seal head including a seal head blow-off port for providing a continuous flow of gas against the film.

25. The gassing system of claim 21 further comprising an intermittent conveyor to carry the product filled containers along the gassing rails to the sealing station.

26. The gassing system of claim 21 wherein the stationary gassing rails include a quick change clamp system including a plurality of clamps screwably attached to a rail bottom to secure and seal a rail top to the rail bottom.

27. The gassing system of claim 21 further comprising at least one side rail positioned along the sides of the sealing station to direct a stream of controlled environment gas beneath the film positioned under the seal head.

28. The gassing system of claim 21 further comprising an angled exit rail positioned on the side of the sealing station opposite the angled rail to direct a stream of controlled environment gas beneath the film positioned beneath a seal head.

29. The gassing system of claim 21 further comprising a hepa-filter system in communication with the gassing system to provide steam sterilization of the gassing system.

30. The gassing system of claim 21 further comprising an independently controlled servo-driven film feeder and an independently controlled servo-driven conveyor.

31. The gassing system of claim 30 further comprising a sensor bracket attached adjacent the conveyor for locating the edge of any of a plurality of carrier plates positioned on the conveyor.

32. The gassing system of claim 21 further comprising a plurality of carrier plate pairs positioned upon a conveyor, each carrier plate of the pair includes a tray opening positioned adjacent the tray opening of the other carrier plate in the pair.

33. The gassing system of claim 21 wherein the angled gassing rail includes an opening to provide a flow of controlled environment substantially perpendicular to the film to prevent air from being drawn in as the film advances.

34. A gassing system for exposing product to a controlled environment being transported along a conveyor comprising:
a stationary gassing rail including a rail top and rail bottom positioned along a conveyor moving product filled containers toward a sealer, the rail base including at least one longitudinally oriented opening formed therein, at least one gassing element oriented adjacent the rail base opening; and

an angled rail including a distribution chamber having at least one opening formed therein, a resistance sheet positioned over the opening, the angled rail being oriented to direct a stream of controlled environment gas beneath film being fed to a sealing station, the angled rail positioned adjacent the stationary gassing rail.

35. The gassing system of claim 34 further comprising a second stationary gassing rail including a jet manifold for directing high velocity controlled environment toward the product.

36. The gassing system of claim 34 wherein the angled gassing rail includes an opening to provide a flow of controlled environment substantially perpendicular to the film to prevent air from being drawn in as the film advances.

37. The gassing system of claim 34 further comprising a conveyor and a plurality of carrier plates positioned on the conveyor, a sensor bracket oriented to detect the carrier movement and locate an edge of each of the carrier plates.

38. The gassing system of claim 37 wherein the carrier plates comprise a plurality of carrier plate pairs, each carrier plate pair includes a first and second carrier plate, the first plate including a notch in a corner having a first length, the second plate including a notch in a corner having a second length differing from the first length to allow the sensor bracket to determine the location of the pair.

39. The gassing system of claim 38 further comprising a programmable logic controller preprogrammed to automatically adjust the position of the carrier plate pair based on readings taken by the sensor bracket.

40. A method of gassing a product moving along an intermittent conveyor comprising:

providing a stationary gassing rail longitudinally oriented along a conveyor, a angled gassing rail positioned adjacent the stationary gassing rail;

flowing controlled environment gas through a gassing element positioned over a longitudinally oriented opening formed in the stationary gassing rail; and

flowing controlled environment gas through a gassing element positioned over an opening formed in the angled gassing rail in a direction substantially parallel to film being fed to a sealing station.

41. The method of claim 40 further comprising flowing controlled environment gas through a second opening formed in the angled gassing rail in a direction substantially perpendicular to the film.

42. An apparatus for providing a controlled environment to a tray moving along an intermittent conveyor to a position beneath a vertically reciprocating tray sealer comprising:

an angled gassing rail including a manifold oriented to provide a stream of controlled environment gas substantially parallel to film being fed to the tray sealer and around and into the tray positioned under the tray sealer.

43. The apparatus of claim 42 further comprising an opening formed in the angled gassing rail to provide a flow of controlled environment gas substantially perpendicular to the film fed to the tray sealer.

44. A method for providing a controlled environment to a tray moving along an intermittent conveyor to a position beneath a vertically reciprocating tray sealer comprising:

providing an angled gassing rail including a manifold oriented adjacent film being fed to the tray sealer; and

flowing gas through the manifold substantially parallel to the film at a velocity sufficient to flow beneath the tray sealer and into and around the tray positioned beneath the tray sealer.

45. The method of claim 44 further comprising an opening formed through the angled gassing rail, flowing controlled environment gas substantially perpendicular to the film.

46. An apparatus for controlling the positioning of carrier plates on an intermittent conveyor comprising:

an intermittent conveyor;

a plurality of carrier plates positioned on the conveyor;

a sensor bracket positioned along the conveyor adjacent the carrier plates; and

a programmable logic controller electronically communicating with the sensor bracket to receive signals from the bracket as to location of the carrier plates, the controller automatically sending signals to reposition the carrier plates on the conveyor.

47. The apparatus of claim 46 wherein the carrier plates are positioned in carrier plate pairs including a first and second carrier plate, the first plate including a notch formed in a corner having a first length, the second plate including a notch formed in a corner having a second length differing from the first length, the sensor bracket sensing the differing lengths and sending signals to the programmable logic controller which provides return signals to move the conveyor forward or backwards to a desired location.

48. A method of controlling the positioning of carrier plates on an intermittent conveyor comprising:

providing a sensor bracket positioned along a conveyor and connected to a programmable logic controller;

providing a plurality of carrier plate pairs including a first and second carrier plates positioned on the conveyor, the first carrier plate including a notch formed in a corner therein having a first length, the second plate including a notch formed in a corner therein having a second length differing from the first length;

sensing the first notch length and second notch length with the sensor bracket and signaling the programmable logic controller to recognize the positioning of the carrier plate pairs; and

automatically determining the direction to correct the positioning of the carrier plate pairs and sending a signal from the programmable logic controller to move the conveyor to correct the position of the carrier plate pairs.

49. An apparatus from preventing air from contaminating containers positioned under a vertically reciprocating sealing station comprising:

an angled gassing rail including a manifold angled to provide a stream of controlled environment gas sub-
stantially parallel to film being fed to the sealing station, the manifold including at least one gassing element.

50. A vertically reciprocating sealing apparatus comprising:

a seal head including a seal head blow-off port to provide a stream of gas against a top surface of film positioned beneath the seal head.

51. The apparatus of claim 50 wherein the stream of gas is controlled and timed to be released immediately prior to the seal head moving downward, and immediately prior to the seal head moving upward.

52. A method of sealing trays with film comprising:

providing a vertically reciprocating seal head, the seal head positioned over the film, the seal head including a seal head blow-off port; and

flowing a stream of gas from the seal head blow-off port to contact with a top surface of the film during or immediately prior to the movement of the seal head.

53. An apparatus for exposing a multi-compartment trays to a controlled environment comprising:

a stationary gassing rail including at least two longitudinally oriented manifolds, each manifold oriented to align with one compartment of the multi-compartment tray, each manifold including at least one gassing element.

54. The apparatus of claim 53 further comprising at least two jet manifolds, each jet manifold positioned over one of the manifold.

55. The apparatus of claim 53 wherein the stationary rail comprises at least two separate stationary rails, each separate stationary rail including one longitudinally oriented manifold.

56. The apparatus of claim 53 further comprising an exhaust orifice positioned over a partition separating the tray compartments.

57. A method of exposing multi-compartment trays to a controlled environment comprising:

providing a stationary gassing rail including at least two longitudinally oriented manifolds;

each manifold positioned over a compartment of the tray;

each manifold including at least one gassing element; and

flowing controlled environment gas through each of the manifolds into the compartments.

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