ABSTRACT

A package wrapping machine includes a wrapping station where film is to be manipulated during a packaging operation. A support is provided for holding rolled film, the support located to permit film to be drawn into the wrapping station. A sensor arrangement detects package size data that is used to set one or more wrap parameters.
PACKAGE WRAPPING MACHINE WITH DETECTION OF LIP FEATURES OF TRAYED PRODUCTS TO BE WRAPPED

TECHNICAL FIELD

[0001] This application relates generally to packaging machines for placing film around products and more particularly to a packaging machine that detects and takes into account tray lip height and or trayed item leading edge to tray bottom wall leading edge distance before wrapping.

BACKGROUND

[0002] Packaging machines are frequently used to automatically wrap film about product, such as trayed food items. The packaging machines often include a film gripper that grips and pulls the film from a roll of film, side clamps that grip the film and folders that fold the film underneath the product. Various control systems and sensors may be employed, for example, to control operation of the gripper and to sense product location.

[0003] In circumstances where food product such as meat is being wrapped, various types of trays can be used to hold the meat. Trays having similar projected footprints when viewed from the top can have different actual footprints due to differing tray depths. Moreover, it is possible that in some cases the food product may accidentally hang over the side of the tray. Obtaining a high quality wrap for each product is important, and can be affected by variances between products such as lip height and trayed item leading edge to tray bottom wall leading edge distance before wrapping.

SUMMARY

[0004] In one aspect, a package wrapping machine includes an infeed station at which trayed items to be wrapped are placed. A conveying system moves trayed items into the machine and to a wrapping station where film is manipulated to wrap the trayed items. A sensor arrangement detects trayed items moved by the conveying system. A controller is associated with the sensor arrangement and operates to identify tray lip height for trayed items based upon outputs from the sensor arrangement. The controller setting one or more wrap parameters based upon the identified trayed item volume or trayed item center of gravity location.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a side, perspective view of an embodiment of a package wrapping machine;

[0008] FIG. 2 is a schematic front elevation of a trayed item moving through a package size and position sensor arrangement of the machine of claim 1;

[0009] FIG. 3 is a schematic side elevation of FIG. 2;

[0010] FIG. 4 is a schematic front elevation detailing light sensor and detector cooperation; and

[0011] FIG. 5 is a top schematic view of a trayed item moving upward through film with underfolders moved into position to frame the trayed item.

DETAILED DESCRIPTION

[0012] Referring to FIG. 1, a package wrapping machine 10 includes an in-feed portion 12 at which a product such as a trayed food item can be introduced to the machine 10, a wrap station 16 at which the product can be wrapped, e.g., by a wrap film such as a food contact grade film, and an out-feed portion 18 at which the wrapped product can be accessed to remove the product from the machine 10. The wrap station 16 includes an adjacent support for holding rolled film 14 and mechanisms (e.g., film grippers and underfolder plates) for manipulating the film during a packaging operation. The support is located to permit film to be drawn off the roll 14 and into the wrapping station and a film grip assembly (not shown) is used for gripping at least one edge of film during at least part of a packaging operation.

[0013] More specifically, and as described in U.S. Pat. No. 6,851,250, the entirety of which is hereby incorporated by reference, a package is fed into the machine at an infeed station 12 and is moved rearward by a conveying system 20 to an elevator. The infeed station 12 may include a weighing mechanism and the conveying system may be adjustable to center the package on the elevator as described in U.S. Pat. No. 6,851,250.

[0014] A raised position of the elevator at least partially defines the wrap station 16. Before or when the package reaches the wrap station, a film gripper and side-clamps cooperate to draw an appropriate amount of film from a source roll out over the wrap station and to stretch the film in a desired manner. The amount of drawn film is determined by package size. The elevator 22 then moves the package up through a plane of the stretched film and the film is wrapped around the package by front, rear and side folder members. The wrapped package is moved onto a heat sealing conveyor 24 that receives and seals the wrapped film at the bottom of the package. Other wrapping machine variations having different wrapping station configurations could also be utilized.

[0015] Referring now to FIGS. 2 and 3, an exemplary package size and position sensor arrangement 30 located along the infeed conveying system is shown, where direction of travel of the trayed item 32 is into the page. The arrangement 30 may be positioned proximate to that portion 26 (FIG. 1) of the machine housing into which items are conveyed. The size and position sensor arrangement of FIG. 2 includes a light source 34 mounted below the conveyor 36 (shown as a series of spaced apart, narrow conveyor belts that permit light to flow upward through the conveyor. The light source may be, for example, an elongated light bulb that has been coated such
that light 38 from the bulb escapes only upward and toward a pair of spaced apart cameras 40. The cameras 40 may, by way of example, be line scan cameras that are arranged with overlapping fields of vision. The cameras and light source create a light plane through which the trayed item 32 passes when moving toward the elevator. Each line scan camera may output pixel scan data identifying which pixels of each camera are blocked by the trayed item 32 from receiving light from the source 34. By adding the number of OFF pixels from each camera a width of the trayed item can be determined, with each OFF pixel corresponding to a corresponding width measurement. The OFF pixel count can be adjusted by any known overlap between the line scan cameras. The relative number of OFF pixels as between the two line scan cameras 64 also indicates the lateral position of the trayed item on the conveyor.

[0016] The belts of the conveyor 36 will block some pixels to the sides of the trayed item 32. However, because the belts are made much more narrow than any package to be wrapped, a small, defined number of blocked pixels in sequence can be interpreted as a conveyor belt and disregarded.

[0017] It is recognized that the height of the trayed item, combined with the angle of the tray wall 50 below the tray lip 52, could impact the width measurement. Accordingly, the size and position sensor arrangement also includes a series of side located IR emitters 54 and corresponding side located IR detectors 56. While five emitters and corresponding detectors are shown, the number could vary as desired for any application. For example, the number and vertical proximity of the emitters and detector pairs could be increased to provide better detection of tray profile, which will be described below. The emitters and detectors setup a height detection plane. As shown in FIG. 3, where movement of the trayed item is right to left, in one example the height detection plane 62 is substantially vertical and the width detection plane 64 is angled, crossing the height detection plane 62. The trayed item may typically be moved by a pusher paddle 66 associated with the conveyor. The front lip of a trayed item will typically cross, and be detected by, the sensors of the height detection plane, enabling the length (i.e. direction d1 in the direction of right to left travel in FIG. 3) of the trayed item 32 to be determined because the position of the paddle 66 is known. In a case where a tray lip is at a height such that it is pushed by the paddle 66, the length dimension is simply the distance of the paddle from the height detection plane 62 at the time the lip of the trayed item is detected in the plane 62. Where the tray lip is at a height above the height of the paddle 66, then the actual length of the trayed item (i.e. from lip edge to lip edge) will be slightly greater than the distance of the paddle 66 from the plane 62. The sensor arrangement may account for this difference by using the detection plane to determine a profile of the tray.

[0018] Referring to FIG. 4, where travel direction of the trayed item 32 is again into the page, each light emitter 54 outputs a field of light that tends to impinge upon the light sensor 56 directly across from it, as well as the light sensors immediately above and below such light sensor. Thus, entry of the tray lip 52 into the height detection plane 62 (FIG. 3) will block some light to at least some of the light sensors 56, enabling detection of the presence of the lip in the plane. Continued monitoring of changes in light detected by the light sensors 56 as the tray wall 60 enters the plane enables detection of the angle of the tray wall 60, the horizontal extension of the lip 52 from the tray wall 60 and the height of the lip 52. By determining these dimensions, a suitable tray length dimension adjustment can be made for those trayed items in which the paddle 66 (FIG. 4) contacts the tray wall 60 rather than the tray lip 52. With respect to lip height, detection of entry of the upper end of tray wall 60 (FIG. 3) into the height detection plane 62 is used to identify the lower edge of the lip. In this manner, proper lip height detection is not adversely impacted by food product “overhang” that occurs when food product is resting atop the lip. Such overhanging food product may or may not extend beyond the perimeter of the tray defined by the edge of lip. In such overhang cases, the height of the food product resting on the lip could inadvertently be identified as the lip height. By identifying the lower edge of the lip and using that identification as the indication of lip height, h1, the effect of any food product overhang is avoided. The determined height, h1, can be used to make appropriate adjustments to the width measurement by the cameras 40.

[0019] It is also desirable to identify the distance, d2, between the edge of the tray lip and the edge of the tray bottom. This distance can be determined by the difference between the position of the paddle 66 when the height detection plane 62 is first broken by the tray and the position of the paddle when the lowest light detector 56 no longer receives light (e.g., because the lower end of the tray wall has broken the height detection plane). Some minor compensation can be made to this determined difference based upon the height of the lowest detector 56 and the angle of the tray wall 60. In cases where product overhang actually extends beyond the leading edge of the tray lip 52, the determined distance d2 will take into account such overhang.

[0020] The package dimension and position determinations discussed above can be used to control various wrap parameters of the machine. A wrapping machine may include a controller that uses the determinations to specify a Wrap Box for a given trayed item, where the Wrap Box may identify a specific tray size. Trays of the same family have the same width and length dimensions, but have different tray heights. Thus, the lip height determination, h1, can be used to assure that the proper tray size is selected. This result can be achieved by using the tray length and width determinations to identify the correct tray family, and then comparing the lip height to certain lip height windows associated with the tray sizes making up that tray family. By selecting the proper tray size, other wrapping parameters can be modified to achieve a better wrap for that tray size. For example, wrap parameters such as prepositioning of the film underfolders (see side underfolders 70 and 72, rear underfolder 74 and front underfolder 76 in FIG. 5) as the trayed item is moved upward through the plane of wrap film 78 that has been pulled from the film roll 80, and subsequent repositioning of the underfolders for beginning the wrap can be modified to achieve better wrap quality.

[0021] In one implementation, the front underfolder 76 is removed with a gap distance between its edge and the edge of the tray coming up to move through the film. When the package hits peak height, the front underfolder 76 will move towards the package and close the gap to keep the package secure while the wrap process occurs. Large lip trays will have gap around the tray just like any other, but when a large lip tray reaches peak, the front underfolder closes in to the edge of the tray plus a distance proportionate to the lip height, removing the gap and slightly undercutting the edge of the
tray. Small lip trays, will close the gap and attempt to justify the edge of the tray lip with the edge of the front folder.

[0022] The determined distance, d₂, is also useful in setting wrap parameters. For example, the premove of the rear underfolder 74 will maintain the gap between the underfolder and the package edge as the edge passes upward reaches peak height. The distance d₂ is used to control film tension when the rear underfolder 74 is ready to complete the underfold. Specifically, distance d₂ is used to move the rear underfolder 74 slightly under the base of the tray to tuck the film under the tray and tuck the film to the rear edge of the tray bottom. The film cutting knife 82 will fire and the rear underfolder 74 will complete its underfold process. Without the distance d₂, any attempt to close the gap and tuck the film prior to a knife cut and full underfold could result in inconsistent tensions of film ranging from opens to tensions so high that the rear cannot scoop under the tray at all, potentially resulting in a crush. By identifying distance d₂, the film can be tucked under to the same distance under the base of each tray.

[0023] Other wrap parameters such as film stretch %, position on elevator, side clamp open timing, knife fire timing, overall wrap speed, discharge speed, and side underfolder adjustments could also be set in accordance with measurements made by the package size and position sensor arrangement.

[0024] It is to be clearly understood that the above description is intended by way of illustration and example only and is not intended to be taken by way of limitation, and that changes and modifications are possible. For example, the sensor system described above can be used to determine or approximate the volume of the tray/product combination (e.g., by considering product width as determined by detection plane 64 in combination with the overall height profile as determined as the trayed product passes through detection plane 62) and allow the wrapper to make wrapping decisions (e.g., set wrap parameters) based upon such volume. Further, the sensor system can determine or approximate the location of the center of gravity (assuming all of the product is of equal weight) of the tray/product combination (e.g., by considering the overall height profile as determined as the trayed product passes through detection plane 62) and allow the wrapper to make wrapping decisions (e.g., set wrap parameters) based upon such center of gravity location. Other embodiments are contemplated and modifications and changes could be made without departing from the scope of this application.

1. A package wrapping machine for handling trayed items, each trayed item including product within a tray that has a tray lip, the machine comprising:
   an infeed station at which trayed items to be wrapped are placed;
   a conveying system for moving trayed items into the machine and to a wrapping station where film is manipulated to wrap trayed items;
   a sensor arrangement for detecting trayed items moved by the conveying system;
   a controller associated with the sensor arrangement and operable to identify tray lip height for trayed items based upon outputs from the sensor arrangement, the controller setting one or more wrap parameters based on identified tray lip height.

2. The package wrapping machine of claim 1 wherein the sensor arrangement includes sensors defining a substantially vertical detection plane and sensors defining an angled detection plane.

3. The package wrapping machine of claim 2 wherein the angled detection plane crosses the vertical detection plane.

4. The package wrapping machine of claim 2 wherein the substantially vertical detection plane is defined by multiple light emitters spaced apart vertically and located to one lateral side of the conveying system and multiple light sensors spaced apart vertically and located to an opposite lateral side of the conveying system, and the angled detection plane is defined by a light source located below the conveying system and at least two cameras located above the conveying system.

5. The package wrapping machine of claim 1 wherein identified lip height is used by the controller to identify a specific tray size.

6. The package wrapping machine of claim 1 wherein the position of at least one film underfolder of the wrap station is controlled based at least in part upon the identified lip height.

7. The package wrapping machine of claim 1 wherein tray carrying trayed items include a tray lip, an angled tray wall and a tray bottom, lip height is identified at least in part by detecting the angled tray wall.

8. The package wrapping machine of claim 7 wherein the tray wall is detected by sensors defining a substantially vertical detection plane.

9. The package wrapping machine of claim 1 wherein the controller is further operable to identify a distance between a trayed item leading edge and a tray bottom wall leading edge based upon outputs from the sensor arrangement, the controller setting one or more wrap parameters based upon the identified distance.

10. A package wrapping machine comprising:
   an infeed station at which trayed items to be wrapped are placed,
   a conveying system for moving trayed items into the machine and to a wrapping station where film is manipulated to wrap trayed items;
   a sensor arrangement for detecting trayed items moved by the conveying system;
   a controller associated with the sensor arrangement and operable to identify a distance between a trayed item leading edge and a tray bottom wall leading edge based upon outputs from the sensor arrangement, the controller setting one or more wrap parameters based on the identified distance.

11. The package wrapping machine of claim 10 wherein the sensor arrangement includes sensors defining a substantially vertical detection plane and sensors defining an angled detection plane.

12. The package wrapping machine of claim 11 wherein the angled detection plane crosses the vertical detection plane.

13. The package wrapping machine of claim 11 wherein the substantially vertical detection plane is defined by multiple light emitters spaced apart vertically and located to one lateral side of the conveying system and multiple light sensors spaced apart vertically and located to an opposite lateral side of the conveying system, and the angled detection plane is defined by a light source located below the conveying system and at least two cameras located above the conveying system.

14. The package wrapping machine of claim 10 wherein the position of at least one film underfolder of the wrap station is controlled based at least in part upon the identified distance.
15. The package wrapping machine of claim 10 wherein trays carrying trayed items include a tray lip, an angled tray wall and a tray bottom wall, the distance is identified at least in part by detecting the angled tray wall.

16. The package wrapping machine of claim 15 wherein the sensor arrangement includes vertically spaced apart sensors defining a substantially vertical detection plane, the distance is identified based upon a trayed item first breaking the substantially vertical detection plane and the angled wall of the trayed item obstructing a lowest one of the vertically spaced apart sensors.

17. The package wrapping machine of claim 10 wherein the trayed item leading edge is defined by either (i) the leading edge of the tray lip or (ii) product overhanging beyond the leading edge of the tray lip.

18. A package wrapping machine comprising:

   an infeed station at which trayed items to be wrapped are placed;

   a conveying system for moving trayed items into the machine and to a wrapping station where film is manipulated to wrap trayed items;

   a sensor arrangement for detecting trayed items moved by the conveying system;

   a controller associated with the sensor arrangement and operable to identify at least one of a trayed item volume or a trayed item center of gravity location based upon outputs from the sensor arrangement, the controller setting one or more wrap parameters based upon the identified trayed item volume or trayed item center of gravity location.