White Paper

Streaming Pouch Case Loader Concept

Pack Flow Concepts LLC

Dr. Stephen Derby
172 Lockrow Rd
Troy, NY 12180
518-279-3419 (office)
518-441-6101 (cell)
sderby1@gmail.com

David Brown
9 Surrey Lane
Pittsford, NY 14534
585-267-7829

Gene Eckert
23 Briar Ct.
Hamburg, NJ 07419
201 317 5777
eck327@aol.com

Dr. John McFadden
35 Creek Rd
Wynantskill, NY 12198
518-429-5746

Patent Pending

March 4, 2014

Executive Summary

This confidential document discusses a novel robotic packaging machine that takes a stream of pouches, bags or other type of products directly from the jaws of a filling machine and places them into a case or tray while maintaining control of each item. It has been designed for pouches (and other products) ranging from 1 ounce to several pounds. It will handle up to 120 pouches/bags per minute. It can load the pouches into the case either vertically or lay them down horizontally. Changeover for different pouch/bag size is minimal. Other rigid or semi-rigid items can also be case packed.

1.0 Pouch/Bag Loading into Cases and Trays

This machine has been designed to fill individual pouches (Figure 1) or bags into a case. This machine will also case load loose objects such as plastic bottles or other semi-rigid items vertically into a case

Figure 1 Standup Pouches

2.0 Traditional Case Loader Machines

Traditional case loading machines will accumulate a case load of pouches or bags and then insert the group as a unit into the case. These systems work fine but require significant floor space and are costly. Some machine versions accumulate pouches or bags so as to insert them vertically into the top of an open case. Other versions turn the empty case on its side and slide the group of pouches or bags (which are laying flat) into the case and then turn the case upright. Loaders that lay pouches or bags horizontally often drop them into the case. A key element of all of these designs is that the pouches or bags are in general loose on a conveyor, and that they need to be oriented and collated into their proper spot in the queue.

Pouches in particular are normally filled on a horizontal machine that nominally holds the pouch by grippers, one on each side of the pouch. The pouches are sent to different stations where they are opened, filled and sealed. They are held by these grippers until their final releasing. Here the pouches slide down a ramp either onto a conveyor or into a bulk container. Leak detection, if needed, is usually performed before the pouch is released.

There are a significant number of case loader machines in the marketplace. Some use off the shelf industrial robots, others use custom designed and built robots, while others use more traditional hard automation. But they all need to have significant amount of conveyors, accumulators, buffers and other functioning devices that the process is complex.

3.0 Streaming Robotic Case Loader Concept – Vertical Loading

The novel case loader concept starts by removing the traditional ramp onto the inclined conveyor and works with the axiom that automation should never loose position and orientation of an object throughout its operational steps. By use of a flexible conveyor belt with flites (Figure 2) and covers (or guide bars or rails) to form pockets (Figure 3), the pouches, bags or other product remain in a stream from the completion of the filling process (the left side of Figures 2 and 3) to the inclined robot case packer (the right side). The conveyor flites may be intertwined with the cover (Figure 4) to keep products from jumping from one pocket to the next and either side guides (Figure 5) or an upwardly curved flexible conveyer are likely needed to keep product from falling out. The end of this flexible conveyor near the filling machine is indexed using a sensor driving a servo motor (Figure 6) to bring a new empty pocket for each finished item. The other end of the flexible conveyor is attached to the robot over the case and the pocket contents are dropped into the case when the robot is in the correct position. Support rollers control the flexible conveyor's position and orientation

Since the timing of each end of the flexible conveyor is independent of the other end, the flexible conveyor can adjust its length of pockets holding product (Figure 7). A more complete CAD picture can be seen in Figure 10.

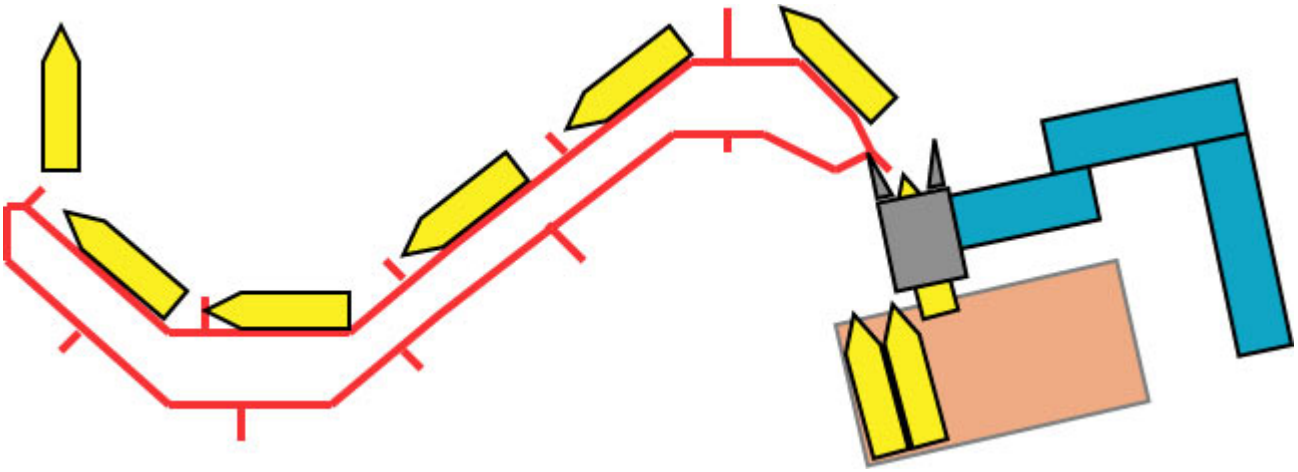

Figure 2 Flexible Conveyor Creates Stream of Product for Robotic Case Loading

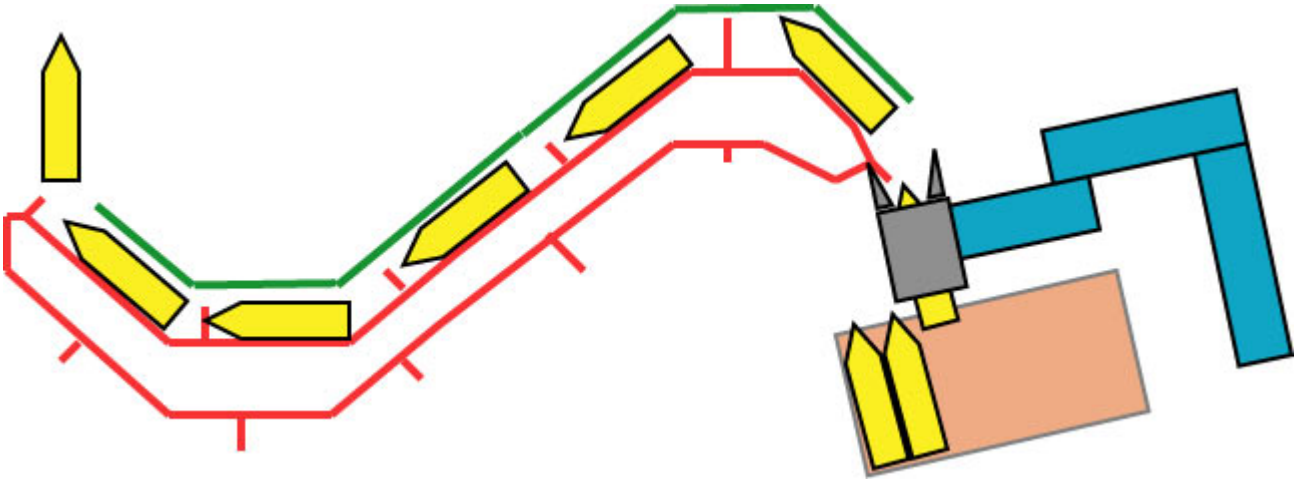

Figure 3 Top Cover Added to Assist Product Containment

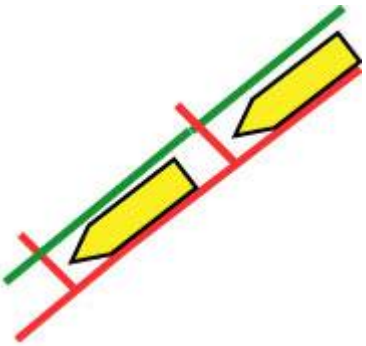

Figure 4 Intertwining of Conveyor Flites with Top Cover to Assure Product Containment

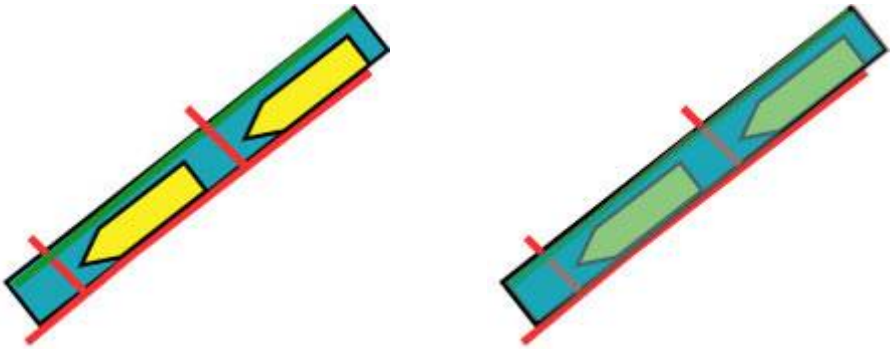

Figure 5 Side Guide – Only a Far Side Guide – Both Sides Have Side Guides

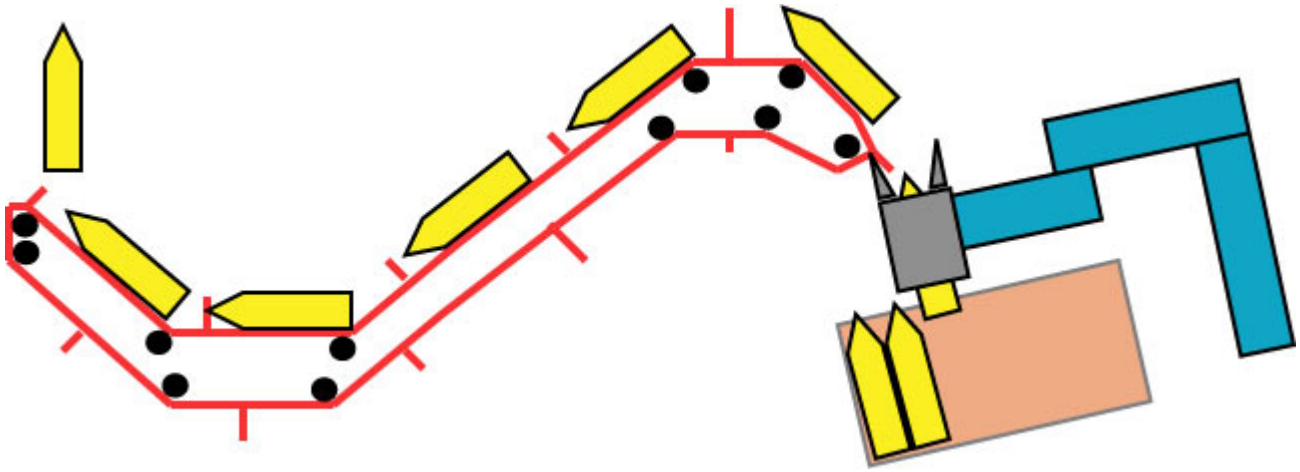

Figure 6 Servo Motors and Support Rollers for Flexible Conveyor – Nominal Position

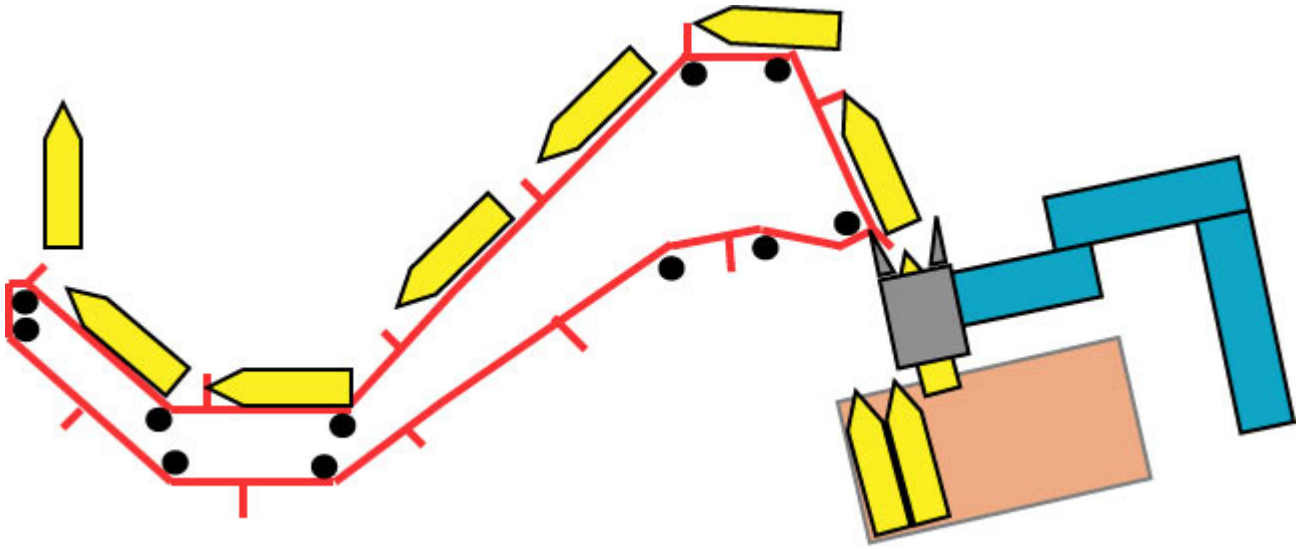

Figure 7 Support Rollers Create a Modified Conveyor Length to Accumulate Products

The robot moves over the case with a side to side motion (in and out of the page in Figures 2, 3, 6, and 7) while the conveyor moving the case up and down the incline (in the page of Figures 2, 3, 6, and 7 but not shown). So the flexible conveyor needs to also move side to side (in and out of the page in Figures 2, 3, 6, and 7) and thus the conveyor needs to move as per Figure 8.

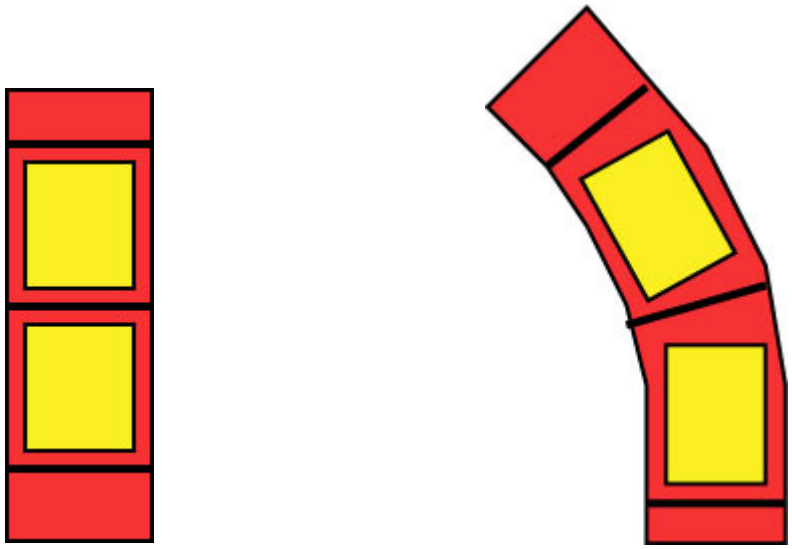

Figure 8 Top View of Flexible Conveyor – Straight Section vs. Curved Section

There are many commercial flexible conveyors that can move side to side. One type is shown in Figure 9, where the rigid conveyor links can pivot in a traditional mode, just turn side to side, or turn in both directions. The unique application here is that traditional uses of the flexible conveyors are with fixed frames and support rollers and the conveyor's flexibility allows for the predetermined path to traverse around poles and other obstacles.

In this concept the flexible conveyors support rollers will be moved dynamically, producing a linked flow from one independent event driven system to a second system with its own event driven occurrences.

Figure 9 Conveyor Pivots Up/Down – Side to Side - Combined

It is likely that some of the moving support rollers will have to also support the accompanying top covers and side guides in order to guarantee product containment.

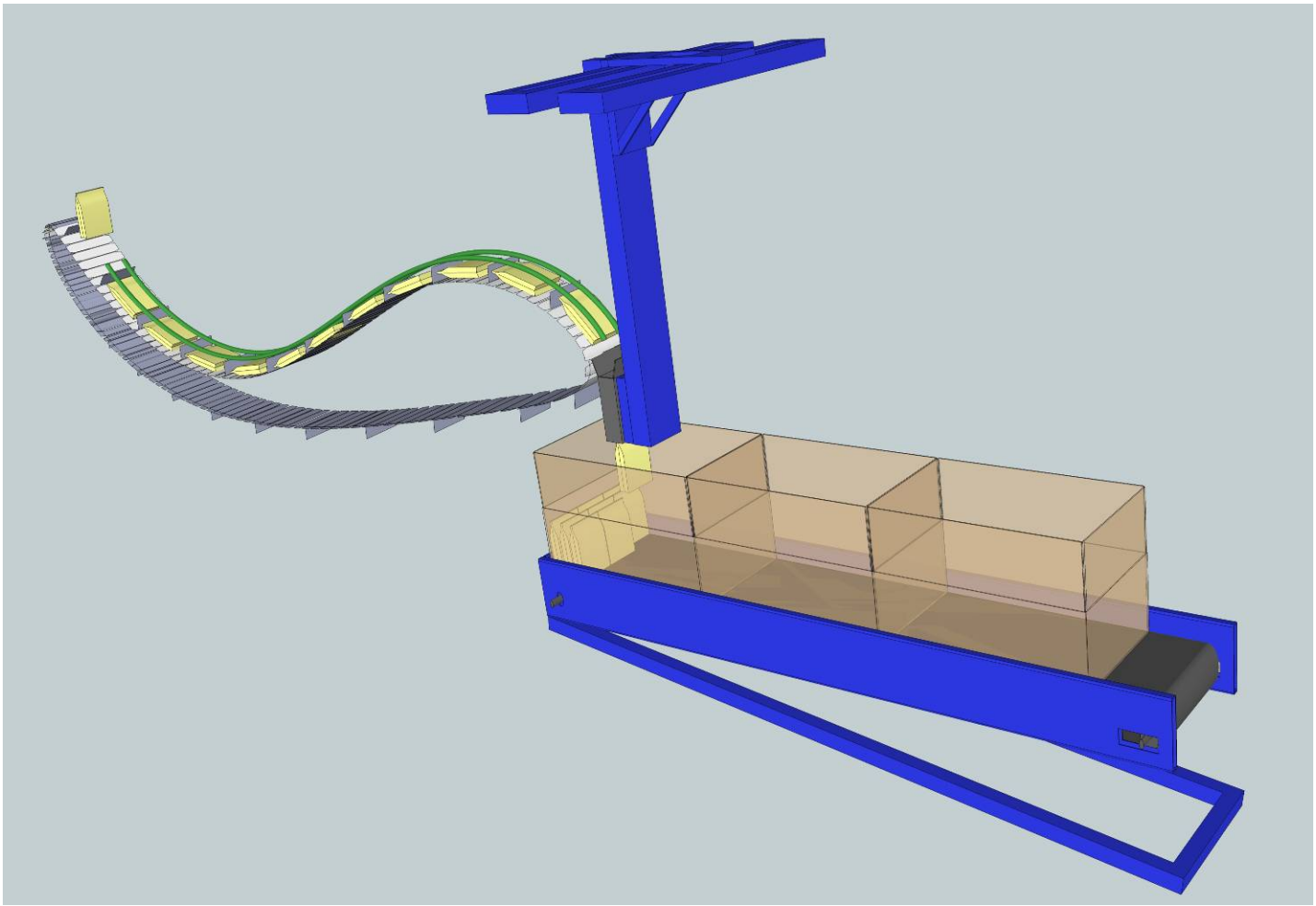

Figure 10 Robotic Streaming Loader

3.1 Robot Tooling

The robot tooling would be a set of belts to grab the pouch (or bag or product) as it falls from the flexible conveyor pocket and propels the product into the case. The tilted case (as shown in Figures 2, 3, 6 and 7) will assist with the product remaining correctly positioned in the case to allow the next product to correctly be deposited. Additional flanges or guides may be needed to assure the last row of product will be packed successfully.

4.0 Streaming Robotic Case Loader Concept – Horizontal Loading

The horizontal product loading into the case is a variation on the vertical loading concept. Figure 11 shows the modified flexible conveyor where the product is picked up from the right hand end of the conveyor instead of the product falling off of the conveyor. Several options for picking the product include grippers or vacuum cups, or the use of a vacuum belt. Figures 11, 12 and 13 show the operation of a gripper or vacuum cup, where the movement is either facilitated by the robot's motion or a dedicated motion system in the robot tooling.

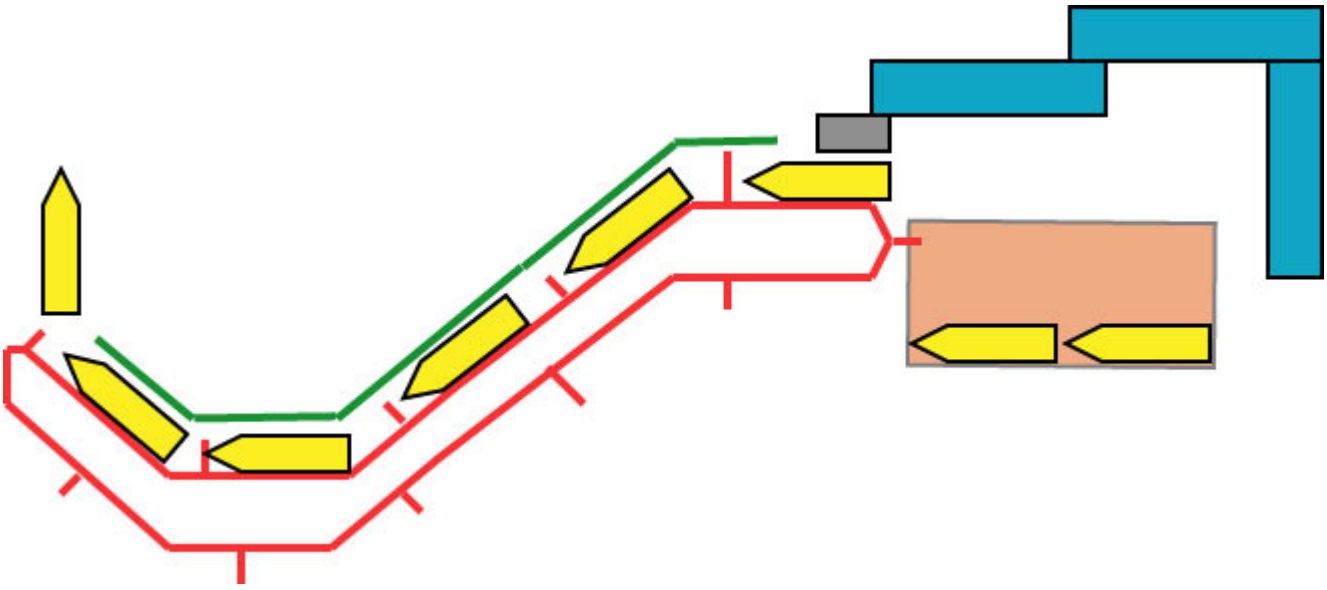

Figure 11 Horizontal Product Loaded by Streaming Robot System – Grabbing Product

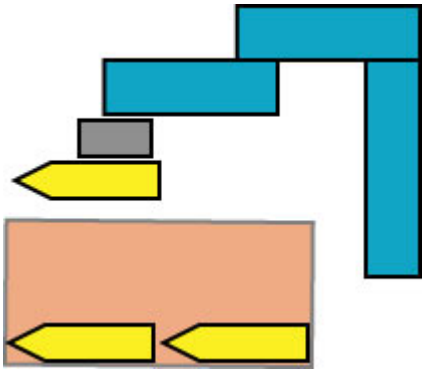

Figure 12 Grabbed Product Moved Over the Case

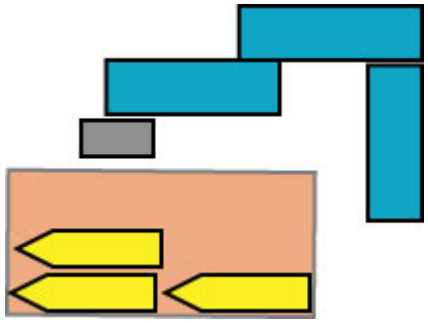

Figure 13 Product Dropped Into Case

The vacuum belt (Figures 14, 15, and 16) lift the product from the flexible conveyor belt and move the product over the case location without any significant robot motion.

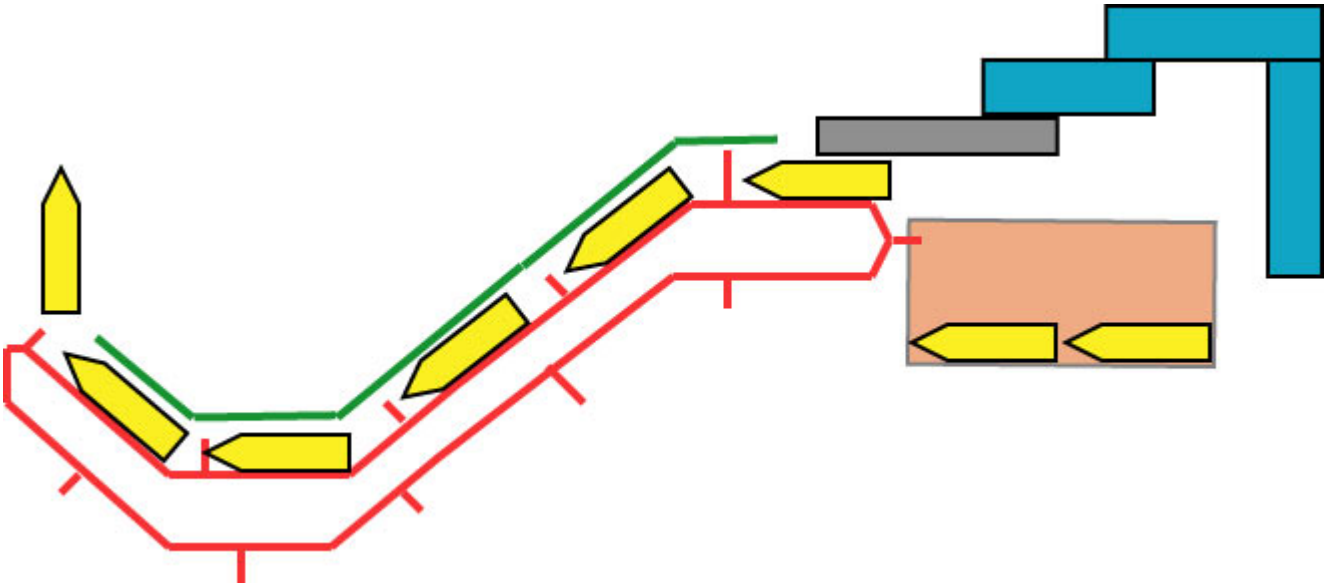

Figure 14 Vacuum Transfer Head Grabs Product

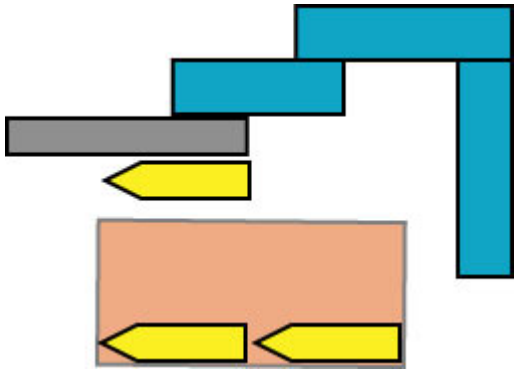

Figure 15 Vacuum Transfer Head Moves Product over Case Location

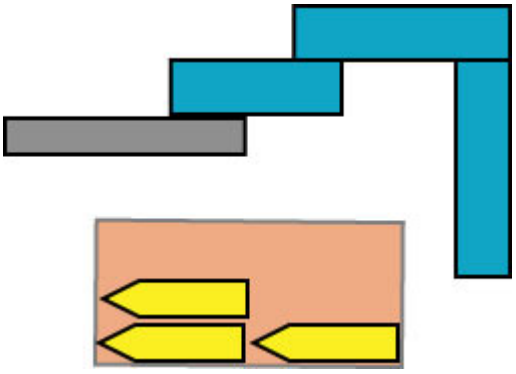

Figure 16 Vacuum Transfer Head Drops Product into Case

One option some customers desire is to case pack the product (particularly bags of rice or beans) in an alternating pack pattern, where each layer is offset by 90 degrees from the previous layer. Here, the case conveying system must have a rotational axis to achieve the needed rotation. Figures 17 and 18 show the case rotated and the dropping of product to make such a pack pattern.

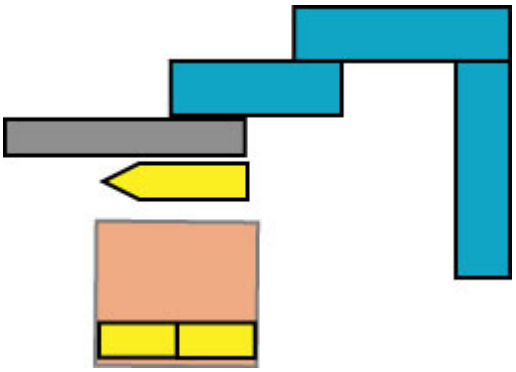

Figure 17 Case is Rotated 90 to Create Alternating Pack Pattern

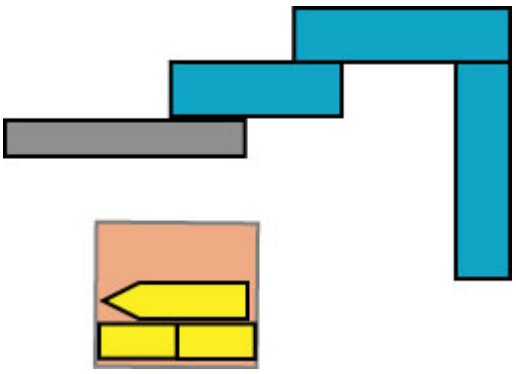

Figure 18 Product Dropped into Case for Alternating Pack Pattern

Conclusions

A novel case packer concept has been developed that allows for a continuous flow of product from a filling machine directly into a case for shipping. The number of moving parts is limited and the control functions are minimal. Floor space is also reduced from the competitions' machines.