Cut-size paper packaging of the '80s and beyond

T. Lutzke

Precision cut-size sheets and high-speed packaging lines are linked together by an "electronic" lineshaft that enables the ream wrapper to match the discharge speed of the sheeter, resulting in greater uptime.

Today's precision cut-size sheeters are capable of averaging 200–250 tons/day. Discharge speeds are frequently in excess of 130 reams/min on a dual packaging line and 100 reams/min on a single packaging line. These goals are realistic for many mills, particularly when uptime is increased through the use of double backstands, automatic splicing, automatic splice detection and removal, and the electronic monitoring of faults. Most of the equipment also incorporates programmable logic controls for ease of maintenance and operation.

The packaging lines are critical in attaining these rather high goals. Each packaging line consists of a ream wrapper, a ream labeler, a ream inspection and rejection system, a ream stacker/accumulator, a case packer and lidder, a case labeler, and a palletizer. Having this many components in a packaging line could result in periodic stops, which could halt production on a single packaging line (**Fig. 1**). The "dual line" concept allows the user to produce 100 reams/min on one line when the other line is down for repairs (**Fig. 2**).

High-speed ream wrapping

Concept and equipment

High-speed, cut-size ream wrappers use a "straight-through" product flow rather than the "right-angle" flow used on older ream wrappers. The straight-through concept allows an 8-in. × 11-in. ream to enter in the short dimension (**Fig. 3**). In "right-angle" flow, the ream would enter in the long dimension, the 11-in. side (**Fig. 4**). This difference is the most important aspect of attaining wrapping speeds in excess of 100 reams/min, compared to a maximum of 80 reams/min when using wrappers of the earlier design.

Other improvements include the use of dc servo motors to control the sheet cut-off length of the wrapper and the wrapper's position over the ream. Cut-off and position are easily adjusted using thumbwheel switches. A rotary shear, similar in design to those used on precision sheeters, is also incorporated. All reciprocating motions are driven by "conjugate" cams, which provide vibration-free operation.

Operation

Unwrapped reams enter the ream wrapper on a flighted infeed conveyor. As each successive ream is pushed along by its mating flight paddle, it is overtaken by a set of loader fingers. The loader fingers transfer the ream onto the elevator section, squaring, or "jogging," the ream in the process. Meanwhile, an overwrap sheet is precisely cut to length on the rotary shear and is transferred into the position directly above the ream, which is now in place on the ream elevator. Hot melt glue for the girth seal is applied by the wheel applicator as the wrapper sheet is transferred from the shear section to the elevator section. As the elevator moves upward, pushing the ream into the waiting wrapper sheet, the two sides of the sheet are pulled down around the sides of the ream. When the elevator reaches the top of its stroke and starts its return downward, front and rear underfolders travel inward and under the ream, completing the girth folds in the process. The partially wrapped ream is now transferred forward into the overhead section.

This transfer is accomplished by using overhead flight fingers mounted on a chain assembly. These fingers push the ream along, sliding it over a hardened transfer plate. During this process, the girth seal is completed while being compressed by the weight of the ream. Also, as the ream is transferred forward, front and rear tucks are completed. The front tuck is made using stationary tuckers, while the rear tuck is accomplished with reciprocating tuckers.

After the tucks are completed, the ream passes through the fold and glue section. Hot melt glue, as in the girth gluing section, is applied by wheel applicators to both end flaps. With the flap folding process completed, the ream enters a short-belt compression section. This compression completes the ream wrapping process.

Ream labeling

In hot-melt labeling equipment, improved aspects include the vacuum cylinder-head drive assembly, the label feed

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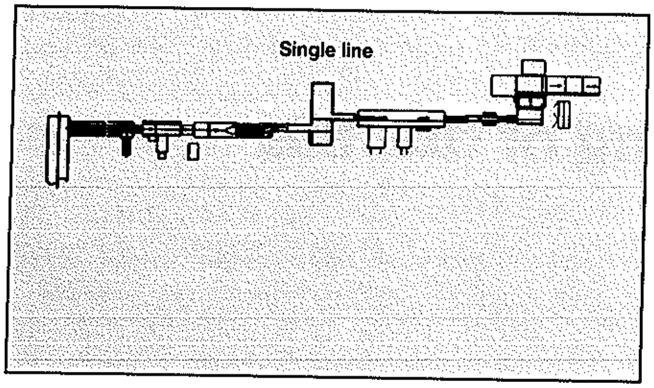
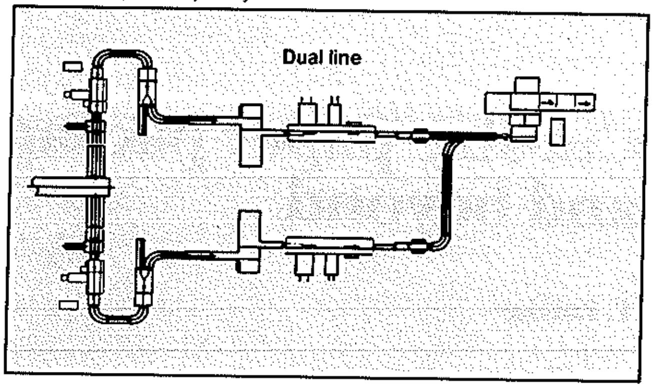
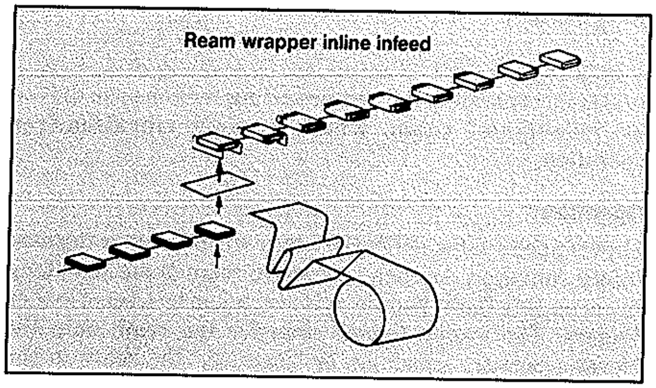
1. Single line



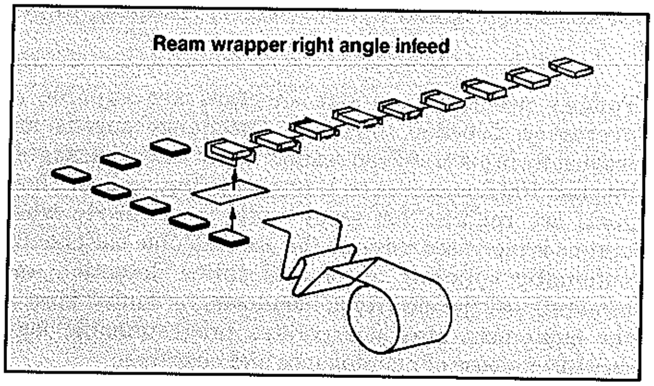
2. Ream inspect/Reject system



3. Case packer/Lidder



4. Dual line



assembly, and the label magazine. The vacuum cylinder-head and the label feed rolls are now driven directly from a totally enclosed gearbox, as opposed to the chain and sprocket concept used on earlier machines. The label magazine is now designed to store and properly feed approximately 1,500 ungummed precut labels.

A vacuum bar is located at the front side of the magazine, and a vacuum wheel is located near the leading edge of the first label. Pressure is applied to the stack of labels in the magazine, pushing them forward against the vacuum bar. The vacuum bar is switched on at this time, causing the bar to hold the first label in place. The pressure is removed from the remaining stack, allowing the labels to relax.

As a ream approaches the labeler, it actuates a limit switch, which initiates a signal to turn off the vacuum to the vacuum bar, allowing the vacuum wheel, which is in contact with the leading edge of the first label, to pull one label from the magazine. As the label leaves the vacuum wheel, it passes through a series of feed rolls which carry it over the hot-melt glue applicator roll. After the glue is applied, the label passes through a short set of guides and is compressed against the passing ream. This entire process is repeated for each successive ream.

Ream inspection

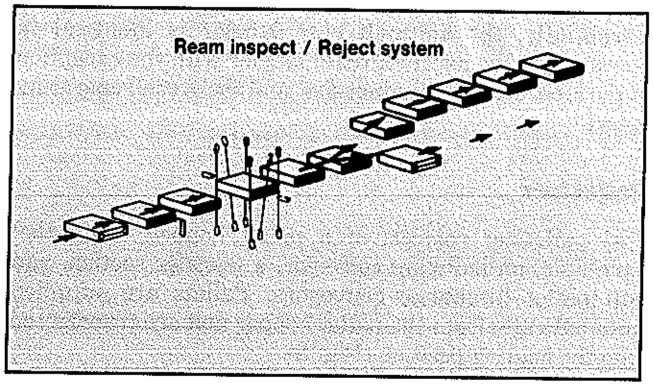
While visual ream inspection is acceptable on low-speed or medium-speed lines, today's high-speed packaging lines require automatic inspection and rejection systems (**Fig.** 5).

A new development in the inspection of labeled reams is the use of a temperature-sensing detector, which is mounted on the labeler immediately after the label applicator. As mentioned, hot melt glue is applied to the label, which is then transferred to the passing ream. Since the label is the carrier of the hot melt glue to the ream, there will be no hot melt glue without a label. The detector senses the presence or absence of hot melt glue, which determines whether or not a label has been applied. In the event that a label is missing, the selected ream will automatically be removed from the normal product flow.

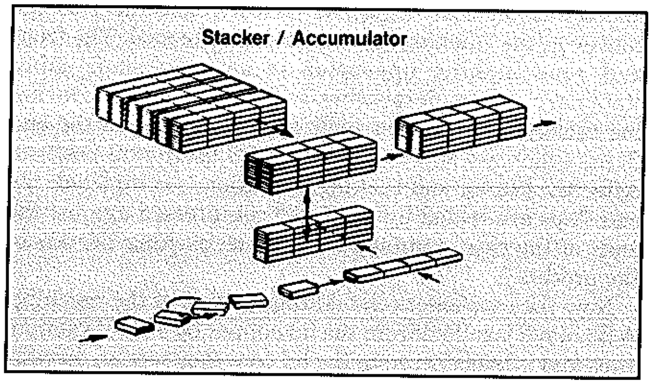
Another function of the inspection system is to check for improperly wrapped reams. Flaws would include open flaps, missed tucks, and open girth seals. This aspect of ream inspection is accomplished by using a series of electric eyes through the machine. Two sets of eyes look down past the ends of the ream, checking for open flaps. Two additional sets of eyes simultaneously look downward past the sides of the ream checking for a loose wrap, which determines whether or not tucks have been properly made. The last set of eyes checks for an open girth seal by looking across the bottom of the passing ream. A properly timed and properly positioned air blast will cause an unglued girth seal to pull away from the product, making it easier to detect. Reams with any of these defects will be rejected from the normal product flow.

Unlabeled or otherwise-defective reams are removed from the normal product flow using a "plaque" style diverter conveyor. This concept allows for diversion at high speeds, unlike the speed-restricted "drop gate" and "pop-up" roller designs.

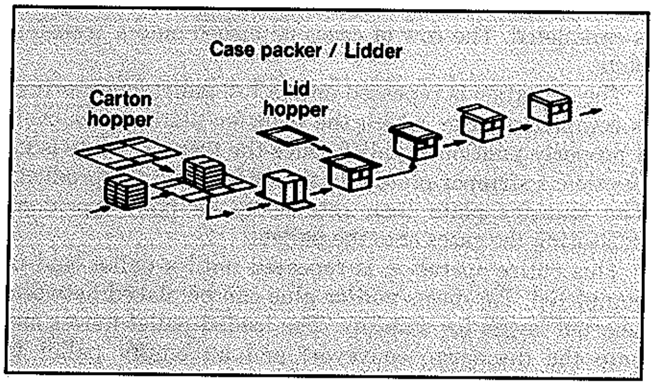
5. Stacker/Accumulator



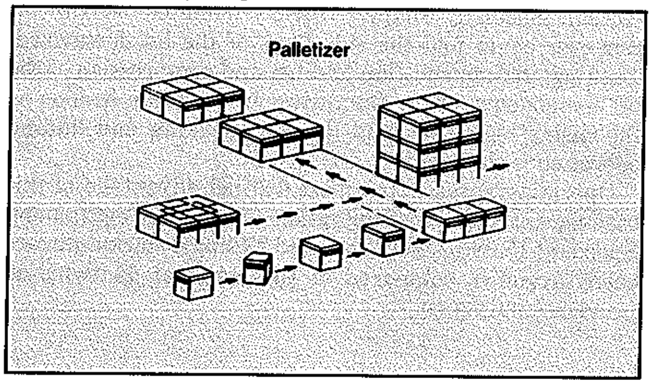
6. Ream wrapper



7. Palletizer



8. Ream wrapper right angle infeed



Stacker/accumulator

The stacker accumulates reams back-to-back, one behind the other, on its infeed conveyor until an eye is blocked, signaling the stacker to complete a stacking cycle. One stacking cycle consists of a pusher transferring up to six reams simultaneously onto a down-stacking elevator and returning to its original position in time for the next cycle. Reams continue to accumulate on the infeed conveyor during the stacking cycle, making this a continuous operation (**Fig. 6**).

Once the stacks reach a predetermined height or count, the stacking elevator ascends to its original position, at which time the pusher pushes the stacks onto a cross conveyor. Depending on the type of case packer included in this line, these stacks of reams could transfer directly onto the packer infeed, or they could wait for a matching set of stacks from the stacker section. Some case packers accept twin stacks of reams back-to-back, while others accept them side-by-side. The case packer described here accepts them side-by-side.

The stacks of reams (up to six twin stacks) are now in position on the cross conveyor. The stacks may now be transferred in block form onto the case packer infeed or onto the accumulation conveyor. This accumulation conveyor has a capacity of up to 480 reams and is capable of automatically feeding stacks of reams back into the system whenever the normal production process permits.

Re-entry into the system is simplified by setting the operating speeds of the downstream equipment slightly faster than the equipment prior to or upstream of the stacker/accumulator. This difference creates gaps in the normal product flow, allowing the re-entry process to occur. The prestacking of product prior to the case packing operation and the ability to accumulate and re-enter product into the production line stabilizes the overall operating speeds of the line, which in turn increases production efficiency.

Case packer and lidder

After the stacker/accumulator equipment is the case packer and lidder. The case packer and lidder described here uses wrap-around blanks as opposed to regular slotted cases or half-scored and slotted cases. Wrap-around cases are formed around the product, making it possible to have almost zero clearance between the product and the case (**Fig. 7**).

The "twin stacks" of reams are squared up and transferred into the machine in the indexer section. Simultaneously, a case blank is pulled from the case blank hopper by a set of vacuum cups, after which time it is transferred to the loading area directly over the elevator section. The twin stacks of product are transferred onto the case blank by the product indexer. The elevator supporting the case blank and the product descends to the level of the case conveyor section as both carton side flaps are folded upward around the product. This folding process is initiated by a set of prefolders and is completed by fingers attached to the case packer conveyor chain.

The constantly moving conveyor chain carries the product through the remaining portion of the case packing and lidding process. Once the side flaps are completely folded and the case begins its forward movement on the conveyor, the "tucking" operation is performed. The front and rear tucking operation is accomplished using stationary and reciprocating tucker assemblies. During the tucking process, hot melt glue is applied to the end flaps, which are still in their original horizontal position. After the gluing and tucking operation is completed, the end flaps are folded upward and compressed against the ends of the case, completing the case packing portion of the process.

Now the case enters the lidding section of the machine. A lid blank is pulled from the lid hopper by a set of vacuum cups and is transferred to the lid conveyor section directly above the previously completed case. The case conveyor and lid conveyor are synchronized. As the case moves along on the case conveyor, it is elevated into the lid conveyor section. Specially shaped fingers mounted on the lid conveyor chain fold the side flaps of the lid downward. Tucking, gluing, end-flap folding, and compression of the lid components are accomplished in the same fashion as the casing operation, and the case packing and lidding operation is complete.

Operating speed is the most distinct advantage of this case packer and lidder operation over earlier equipment. Speeds of 15 twin stacks/min and 22 single stacks/min are easily attained, compared to 15 singles or 15 twins on previous equipment.

Case labeling

Essentially, the hot-melt case labeler is identical in operation to the hot-melt ream labeler with the exception of the label size, the product size, and the overall operating speed.

Palletizer

The palletizer consists of a pallet hopper, a product turntable, an indexing conveyor, a transfer section, and full pallet discharge conveyors. Pallets are supplied automatically from the pallet hopper and are transferred into the loading position (**Fig. 8**).

On entering the palletizer, each case passes through a turntable, where it is properly oriented for the pallet before entering the product indexing conveyor. Successive cases are accumulated on the indexing conveyor until one row is completed. The row of cases is pushed onto a transfer plate.

The operation is repeated until a full pallet layer or tier is completed, after which the transfer plate moves over a properly positioned pallet. Once the transfer plate is in position, a stripper plate is positioned behind the product. The transfer plate then returns to its home position, depositing the cases onto the pallet.

This entire operation is repeated until a pallet load is completed. Tie sheets and/or glue can be placed between selected layers for stability. The loaded pallet moves out onto the discharge conveyor, and an empty pallet is removed from the pallet hopper and is transferred into the loading position in preparation for the next cycle.

Received for review June 9, 1988.
Accepted June 13, 1988.
Presented at the 1988 Finishing and Converting Conference.