address the problems with conventional machines used to automatically stuff envelopes.

Summary

~~[0009] To these ends, in one particular embodiment of the invention an~~ apparatus is provided for conveying envelopes traveling in a travel direction in a generally upright orientation. The apparatus includes a first pair of conveyor assemblies disposed opposite one another and configured to engage lateral edges of the envelopes, and configured to move the envelopes in the travel direction. The apparatus includes a second pair of conveyor assemblies disposed opposite one another and positioned downstream of the first pair of conveyor assemblies in the travel direction, with the second pair of conveyor assemblies being configured to move the ~~envelopes in the travel direction independently of the first pair of conveyor assemblies.~~

[0009] In a first aspect, there is provided an apparatus for conveying envelopes traveling in a travel direction in a generally upright orientation, comprising: a first pair of conveyor assemblies disposed opposite one another and configured to engage lateral edges of the envelopes, said first pair of conveyor assemblies configured to move the envelopes in the travel direction; and a second pair of conveyor assemblies disposed opposite one another and positioned downstream of said first pair of conveyor assemblies in the travel direction, said second pair of conveyor assemblies configured to move the envelopes in the travel direction independently of said first pair of conveyor assemblies, wherein at least one of said first or second pairs of conveyor assemblies includes at least one conveyor belt and a plurality of flexible and deflectable elements extending from said belt for engaging the lateral edges of the envelopes, said flexible deflectable elements being bendable with respect to said belt by action of the engagement of the lateral edges of the envelopes therewith so as to position each of the lateral edges between displaced flexible and deflectable elements; and wherein at least a portion of said first pair of conveyor assemblies overlaps said second pair of conveyor assemblies in the travel direction.

[0010] At least a portion of the first pair of conveyor assemblies may overlap the second pair of conveyor assemblies in the travel direction. At least one of the first or second pairs of conveyor assemblies may include deflectable elements for engaging the lateral edges of the envelopes. The deflectable elements may flex in response to the respective thicknesses of the envelopes to allow the envelope edges to reside slightly between individual bristles. The deflectable elements may be configured to flex in a direction opposite the travel direction to thereby permit movement of the first pair of conveyor assemblies relative to envelopes held by the second pair of conveyor assemblies. The deflectable elements may, for example, include bristles.

[0011] The first and second pairs of conveyor assemblies may be configured to respectively hold first and second envelopes in generally upright orientations, with the first and second pairs of conveyor assemblies being configured to move the first and second envelopes at respective first and second speeds that are substantially equal to one another. The apparatus may include a drive apparatus for driving the first pair of conveyor assemblies and at least one sensor that is operatively coupled to the drive apparatus and configured to detect a gap in front of a first envelope carried by the first pair of conveyor assemblies in the travel direction and send a corresponding signal to the drive apparatus. The drive apparatus is responsive to the signal to advance the first pair of conveyor assemblies and move the first envelope at a first speed greater than a second speed associated with the second pair of conveyor assemblies. The drive apparatus may be configured, in response to the signal, to accelerate the first pair of conveyor assemblies to thereby close the gap detected by the at least one sensor.

~~[0012] In another embodiment, an apparatus is provided for conveying envelopes traveling in a travel direction in a generally upright orientation. The apparatus includes a first pair of conveyor assemblies disposed opposite one another and including deflectable elements for engaging lateral edges of the envelopes, with the first pair of conveyor assemblies being configured to move the envelopes in the travel direction. A second pair of conveyor assemblies are disposed opposite one another and include deflectable elements for engaging lateral edges of the envelopes, and are positioned downstream of the first pair of conveyor assemblies, with the second pair of conveyor assemblies being configured to move the envelopes in the travel direction independently of the first pair of conveyor assemblies.~~

[0012] In a second aspect, there is provided an apparatus for conveying envelopes traveling in a travel direction in a generally upright orientation, comprising: a first pair of conveyor assemblies disposed opposite one another and each including a belt and a plurality of flexible and deflectable elements extending from said belts for engaging lateral edges of the envelopes, said first pair of conveyor assemblies configured to move the envelopes in the travel direction; a second pair of conveyor assemblies disposed opposite one another, each including a belt and a plurality of flexible and deflectable elements extending from the belts of the second pair of conveyor assemblies for engaging lateral edges of the envelopes, and positioned downstream of said first pair of conveyor assemblies, said second pair of conveyor assemblies configured to move the envelopes in the travel direction independently of said first pair of conveyor assemblies, said flexible and deflectable elements configured to bend by action of the engagement of the lateral edges of the envelopes therewith; said first and second pairs of conveyor assemblies having respective overlapping portions; and wherein flexible and deflectable elements of said first pair of conveyor assemblies are oriented to engage envelopes engaged by said second pair of conveyor assemblies and to deflect upon such engagement with said envelopes.

[0012a] A drive apparatus drives the first pair of conveyor assemblies. At least one sensor is operatively coupled to the drive apparatus and is configured to detect a gap in front of a first envelope carried by the first pair of conveyor assemblies in the travel direction, with the drive apparatus being responsive to a signal received from the at least one sensor to accelerate the first envelope and thereby close the gap detected by the at least one sensor.

~~[0013] In yet another embodiment, an automatic envelope stuffing machine is provided. The machine includes a first end associated with feeding of a roll of paper and a processing apparatus for converting the roll of paper into discrete sheets. A stuffing apparatus feeds the discrete sheets into envelopes, with a second end having a conveying apparatus for conveying the envelopes toward the stuffing apparatus in a travel direction. The conveying apparatus includes a first pair of conveyor assemblies that are disposed opposite one another and which are configured for engaging lateral edges of the envelopes, with the first pair of conveyor assemblies being configured to move the envelopes in the travel direction. The conveying apparatus also includes a second pair of conveyor assemblies that are disposed opposite one another and that are positioned downstream of the first pair of conveyor assemblies in the travel direction, with the second pair of conveyor assemblies being configured to move the envelopes in the travel direction independently of the first pair of conveyor assemblies. At least one of the first and second pairs of conveyor assemblies may include a plurality of deflectable elements for engaging the lateral edges of the envelopes.~~

[0013] In a third aspect, there is provided an automatic envelope stuffing apparatus having a first end associated with feeding of a roll of paper, and a processing apparatus for converting the roll of paper into discrete sheets for feeding the discrete sheets into envelopes, further comprising: a conveying apparatus for conveying the envelopes toward the stuffing apparatus in a travel direction, said conveying apparatus including: (a) a first pair of conveyor assemblies disposed opposite one another and configured for engaging lateral edges of the envelopes, said first pair of conveyor assemblies configured to move the envelopes in the travel direction; and (b) a second pair of conveyor assemblies disposed opposite one another and positioned downstream of said first pair of conveyor assemblies in the travel direction, said second pair of conveyor assemblies configured to move the envelopes in the travel direction independently of said first pair of conveyor assemblies, wherein at least one of said first or second pairs of conveyor assemblies each includes flexible and deflectable elements for engaging the lateral edges of the envelopes, said flexible and deflectable elements being mounted on respective belts of said assemblies, said flexible and deflectable elements being bendable with respect to said belts by action of the engagement of the lateral edges of the envelopes therewith so as to position each of the lateral edges between displaced flexible and deflectable elements, said first and second pairs of conveyor assemblies overlapping one another at respective ends thereof; and said first and second pairs of conveyor assemblies at said ends each engaging at least a same envelope simultaneously.

~~[0014] In another embodiment, a method is provided for conveying envelopes traveling in a travel direction. The method includes sliding an envelope in a generally upright orientation between a first set of deflectable elements engaging opposite lateral edges of the envelope and moving the deflectable elements to thereby move the envelope in the travel direction. The envelope is transferred in the generally upright~~

orientation to a second set of deflectable elements and the second set of deflectable elements is moved independently of the first set of deflectable elements to thereby move the envelope in the travel direction.

[0014] In a fourth aspect, there is provided a method of conveying envelopes traveling in a travel direction, comprising: sliding an envelope in a generally upright orientation between a first set of flexible and deflectable elements engaging opposite lateral edges of the envelope; bending and displacing the flexible and deflectable elements by action of the engagement of the lateral edges of the envelope therewith so as to position each of the lateral edges between displaced flexible and deflectable elements; moving the flexible and deflectable elements to thereby move the envelope in the travel direction; transferring the envelope in the generally upright orientation to a second set of flexible and deflectable elements while still engaged by said first set of flexible and deflectable elements; and moving the second set of flexible and deflectable elements independently of the first set of flexible and deflectable elements to thereby move the envelope in the travel direction, away from said first set of flexible and deflectable elements.

[0015] The method may include flexing the deflectable elements of the first set in response to a thickness of the envelope. The method may additionally or alternatively include detecting a gap in front of the envelope in the travel direction and accelerating movement of the first set of deflectable elements in the travel direction in response to detection of the gap. The first set of deflectable elements may be accelerated to close the gap. Sliding the envelope in the generally upright orientation may include moving the envelope in a direction transverse to the travel direction. Transferring the envelope in the generally upright orientation to the second set of deflectable elements may include moving the envelope in the travel direction. The method may include simultaneously engaging the envelope with the first and second sets of deflectable elements. The first set of deflectable elements may be moved relative to an envelope held by the second set of deflectable elements.

[0016] Such apparatus and methods are particularly useful in a paper converting and envelope stuffing system contemplating improved paper converting and sheet inserting apparatus and methods, modular based, and having improved paper handling apparatus, servo driven components, improved sensor density and improved control concepts controlling the system operation. One or more of the embodiments of the invention contemplate the provision of an improved envelope conveying apparatus which can be used as a module of a modular paper converting and sheet insertion system where human capital, required space, required equipment, maintenance, labor and materials and facilities therefore are reduced compared to conventional systems of similar throughput.

[0017] More specifically, such improved apparatus and methods contemplate a plurality of functional modules providing the following functions in a series of modules of like or dissimilar modules where a specific module is multi-functional. The functions comprise:

- printed paper roll handling/unwinding;
- paper slitting and cutting;
- sheet collation and accumulation;
- sheet folding;
- transportation for interfacing with inserts;
- envelope feeding;