A new and improved semi-automatic machine, for forming slits within side wall members of a packaging structure so as to render successive sections of the packaging structure articulated with respect to each other whereby the packaging structure can be folded into a packaging container, includes a pair of oppositely disposed circular saw blade assemblies which are disposed at a cutting station and which are mounted upon a vertically movable reciprocating carriage mechanism. The carriage mechanism is initially disposed at a first ELEVATED INOPERATIVE position, the packaging structure is fed into the machine and stopped at a predetermined longitudinal position at which it is desired to cut or slit the packaging structure, and the carriage mechanism is moved vertically downward toward a second LOWERED OPERATIVE position at which the pair of circular saw blades cut the oppositely disposed dependent side wall members of the packaging structure. Subsequently, the circular saw blade assemblies are retracted vertically upwardly as a result of moving the carriage mechanism back to the first ELEVATED INOPERATIVE position, the packaging structure is advanced further and stopped at another predetermined axial position at which it is desired to cut the packaging structure, and the entire operative cycle is repeated as necessary.
SEMI-AUTOMATIC MACHINE FOR CUTTING AND SCORING PACKAGING STRUCTURES

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This patent application is related to United States Patent Applications entitled DEVICE FOR PERMITTING RE-ENTRY OF CIRCULAR SAW BLADE DURING RECIPROCATING STROKE MOVEMENTS, filed on ______ in the name of Anatoly Gosis et al. and assigned Ser. No. ______, and ANTI-VIBRATION DEVICE FOR USE WITH A CIRCULAR SAW BLADE filed on ______ in the name of Anatoly Gosis et al. and assigned Ser. No. ______.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a semi-automatic machine, and more particularly to a new and improved semi-automatic machine for simultaneously moving a pair of oppositely disposed circular saw blades in a predeterminedly timed, reciprocating manner between an elevated, RETRACTED, INOPERATIVE position and a lowered, EXTENDED, OPERATIVE position so as to repeatedly form slits within oppositely disposed dependent side wall members of a substantially C-shaped packaging structure at a plurality of positions which are located at predeterminedly defined locations spaced along the longitudinal or axial extent of the packaging structure such that different, axially or longitudinally spaced sections of the resulting packaging structure, which are integrally connected together in an articulated manner at the aforesaid, predeterminedly defined slit locations, can effectively be folded with respect to each other, as a result of the sections also being scored at the slit locations, such that a completely enclosed packaging container can be formed from the original C-shaped packaging structure.

BACKGROUND OF THE INVENTION

[0003] Various articles, having substantial width, thickness, and length dimensions, need to be protected during, for example, the transportation and shipping thereof from their manufacturing facilities to their storage and/or point of sale locations so as to prevent damage from occurring to such articles prior to the purchase of the same by consumers. It is conventional practice to utilize substantially rigid, laminated U-shaped or channel-shaped packaging structures so as to effectively define composite packaging containers, which encase the articles thereinwith, whereby the packaging structures can subsequently be secured together by means of, for example, suitable strapping or banding. One type of conventional packaging structure, which has been utilized for the foregoing purposes, is disclosed, for example, within U.S. Pat. No. 4,976,374 which issued to Macaluso on Dec. 11, 1990. More particularly, as disclosed within FIG. 1, which substantially corresponds to FIG. 3 of the aforementioned patent, it is seen that the composite packaging container comprises a substantially U-shaped base unit 10 and a substantially U-shaped cover unit 12. The substantially U-shaped base unit 10 is seen to comprise a base or bottom portion 10a, and a pair of oppositely disposed, upstanding side wall or leg members 10b,10c integrally connected to the base or bottom portion 10a, while the substantially U-shaped cover unit 12 is seen to comprise a cover or top portion 12a, and a pair of oppositely disposed, dependent side wall or leg members 12b,12c integrally connected to the cover or top portion 12a.

[0004] Alternatively, in lieu of utilizing two separate packaging structures, such as, for example, the base unit 10 and the cover unit 12, so as to form the aforesaid composite packaging container, a single packaging structure can be utilized to form a composite packaging container. More particularly, by effectively forming slits within the pair of oppositely disposed dependent side wall members of the packaging structure at predetermined locations spaced along the longitudinal or axial extent of the packaging structure, and by scoring the wall member of the packaging structure which effectively integrally interconnects the pair of oppositely disposed dependent side wall members of the packaging structure, the packaging structure is effectively divided into sections which are integrally connected together in an articulated manner whereby the various sections can effectively be bent or folded at predetermined angles with respect to each other so as to effectively form the composite packaging container within which the predetermined articles can be packaged. For example, as disclosed within FIGS. 2 and 3, there is disclosed a packaging structure which is generally indicated by means of the reference character 110 and which is effectively illustrated in its manufacturing mode or disposition within FIG. 2 wherein the same is being conveyed along the conveyor path of the machine or apparatus which will form the slits and score lines within the packaging structure at the predeterminedly spaced longitudinal or axial positions thereof in order to effectively define the different sections of the packaging structure which are integrally connected together in an articulated manner, and wherein further, the packaging structure 110 is effectively illustrated in its assembly mode or disposition within FIG. 3 wherein the different sections of the packaging structure will be readily and easily capable of being bent and folded with respect to each other so as to form the finalized composite packaging container.

[0005] More particularly, it is seen, for example, that when the packaging structure 110 is disposed in its manufacturing orientation as disclosed within FIG. 2, the packaging structure 110 comprises an upper wall member 112 and a pair of oppositely disposed, dependent side wall members 114,116 which are integrally connected to the opposite side edge portions of the top wall member 112. The packaging structure 110 has a predetermined length dimension L, and in accordance with the fabrication techniques implemented in connection with enabling the single packaging structure 110 to be formed into a composite packaging container, a first pair of longitudinally spaced, vertically oriented slits 118, 120 are formed within the side wall member 114 such that the first slit 118 is disposed at a position which is located a predetermined distance D, upstream from the leading edge portion 122 of the packaging structure 110, while the second slit 120 is disposed at a position which is located a predetermined distance D, upstream from the first slit 118 wherein the distance D is effectively or substantially the same as the depth or vertical extent of the side wall member 114 for a reason or purpose which will become clear shortly hereinafter. In a similar manner, a second pair of longitudinally spaced, vertically oriented slits 124,126 are formed within the side wall member 116 such that the third and fourth slits 124,126 are respectively disposed directly opposite the first and second slits 118,120. In addition, a first pair of scored regions 128,130 are formed within the upper wall member 112 so as to respectively effectively extend between and interconnect the oppositely disposed slit regions 118,124.
and 120, 126 formed within the side wall members 114, 116 of the packaging structure 110.

[0006] Continuing further, a third pair of longitudinally spaced, vertically oriented slits 132, 134 are formed within the side wall member 114 such that the fifth slit 132 is disposed at a position which is located a predetermined distance D3 upstream from the position at which the second slit 120 of the packaging structure 110 is located, while the sixth slit 134 is disposed at a position which is located a predetermined distance D3 upstream from the fifth slit 132 wherein the distance D3 is effectively or substantially the same as the distance D2, as well as the depth or vertical extent of the side wall member 114, for the same reason or purpose in connection with the distance D2 which will become clear shortly hereinafter. In a similar manner, a fourth pair of longitudinally spaced, vertically oriented slits 136, 138 are formed within the side wall member 116 such that the seventh and eighth slits 136, 138 are respectively disposed directly opposite the fifth and sixth slits 132, 134. In addition, an second pair of scored regions 140, 142 are formed within the upper wall member 112 so as to respectively effectively extend between and interconnect the oppositely disposed slit regions 132, 136 and 134, 138 formed within the side wall members 114, 116 of the packaging structure 110. It can therefore be appreciated that as a result of the aforesaid structure, particularly the formation of the particular slits 118,120,124, 126, 132, 134, 136, 138 and the scored regions 128, 130, 140, 142 within the side wall members 114, 116 and the upper wall member 112 of the packaging structure 110, the packaging structure 110 is effectively divided into several articulated sections by means of which the resulting composite packaging container can be formed.

[0007] More particularly, as a result of the aforesaid structure, particularly the formation of the particular slits 118,120,124, 126, 132, 134, 136, 138 and the scored regions 128, 130, 140, 142 within the side wall members 114, 116 and the upper wall member 112 of the packaging structure 110, the upper wall member 112 of the packaging structure 110 is effectively divided into sections 112-1, 112-2, 112-3, 112-4, 112-5, the side wall member 114 of the packaging structure 110 is effectively divided into sections 114-1, 114-2, 114-3, 114-4, 114-5, and the side wall member 116 of the packaging structure 110 is likewise effectively divided into sections 116-1, 116-2, 116-3, 116-4, 116-5. Accordingly, as can best be appreciated from FIG. 3, after all of the slits 118, 120, 124, 126, 132, 134, 136, 138 and the scored regions 128, 130, 140, 142 have in fact been formed within the side wall members 114, 116 and the upper wall member 112 of the packaging structure 110, the packaging structure 110 is now ready to be formed into the composite packaging container. Therefore, it may be further appreciated that in accordance with such a formation process, the packaging structure 110 is, for example, initially inverted from its manufacturing disposition or orientation, as disclosed within FIG. 2, so as to disposed in the disposition or orientation, as disclosed within FIG. 3, and subsequently, the upper wall member sections 112-1, 112-2, the side wall member sections 114-1, 114-2, and the side wall member sections 116-1, 116-2 are effectively rotated or pivoted in a clockwise direction, as indicated by means of the arrow CW, around the pivotal axis effectively defined by means of the scored region or section line 130.

[0008] The pivotal rotation of the upper wall member sections 112-1, 112-2, the side wall member sections 114-1, 114-2, and the side wall member sections 116-1, 116-2, is continued until the flaps members 114-2, 116-2, effectively formed respectively within the side wall members 114, 116, are able to be respectively completely tucked or disposed inside or between the primary side wall sections 114-3, 116-3 at which time the section 112-2 of the original upper wall member 112 now becomes one of the vertically oriented, upstanding end walls of the finalized composite packaging container. Still further, the upper wall member section 112-1 and the side wall member sections 114-1, 116-1 are then pivotally rotated in the clockwise direction CW around the pivotal axis effectively defined by means of the scored region or section line 128 whereby when the side wall member sections 114-1, 116-1 are respectively tucked or disposed internally between the side wall sections 114-2, 114-3 and 116-2, 116-3, original upper wall member section 112-1 will now be disposed opposite original upper wall member 112-3. Similar pivotal, rotational, and folding operations are also to be performed in connection with the upper wall member sections 112-4, 112-5 and the side wall member sections 114-4, 114-5, 116-4, 116-5 in the counterclockwise direction CCW around or with respect to the scored regions or section lines 122, 140 whereby, for example, when such pivotal, rotational, and folding operations are completed, the side wall member sections 114-4, 116-4 will be respectively tucked or disposed inside of or between the side wall sections 114-3, 116-3, and the original upper wall member section 112-4 will now form the opposite, vertically oriented, upstanding end wall of the composite packaging container. In addition, the side wall member sections 114-5, 116-5 will be respectively tucked or disposed inside or between the side wall member sections 114-4, 114-3, and the side wall member sections 116-4, 116-3, and the original upper wall member section 112-5 will not only be disposed opposite the original upper wall member section 112-3 but will also be partially disposed atop the previously folded original upper wall member section 112-1 so as to complete the assembly of the composite packaging container.

[0009] A need therefore exists in the art for a new and improved semi-automatic machine for simultaneously forming pairs of slits within the oppositely disposed side wall members of a packaging structure, as well as scored regions extending between the oppositely formed slits, at predetermined axially or longitudinally spaced locations along the longitudinal or axial extent of the packaging structure such that the different, axially or longitudinally spaced sections of the resulting packaging structure, which are integrally connected together in an articulated manner at the aforesaid predeterminedly defined slit and scored locations, can effectively be folded with respect to each other such that the completely enclosed packaging container can be formed from the original C-shaped packaging structure in accordance with the aforesaid mode of operation.

SUMMARY OF THE INVENTION

[0010] The foregoing and other objectives are achieved in accordance with the teachings and principles of the present invention through the provision of a new and improved semi-automatic machine which comprises an upstream set of longitudinally spaced idler rollers upon which the substantially U-shaped inverted packaging structure is guidably
supported as the packaging structure is conveyed toward and through the cutting station, and a downstream railing upon which the substantially U-shaped inverted packaging structure is guidedly support as the packaging structure is conveyed out from the cutting station. A pair of oppositely disposed circular saw blade assemblies are disposed at the cutting station and are mounted upon a vertically movable reciprocating carriage mechanism. In accordance with a typical cutting operation cycle, whereby the aforementioned articulated structure can be fabricated, the vertically movable reciprocating carriage mechanism is initially disposed at a first ELEVATED INOPERATIVE position, the packaging structure is fed or conveyed into the apparatus and stopped at a predetermined axial or longitudinal position at which the same is desired to be cut, and the vertically movable reciprocating carriage mechanism is moved vertically downwardly toward a second LOWERED OPERATIVE position at which the pair of circular saw blades cut the oppositely disposed independent side wall members of the packaging structure so as to define a first pair of vertically oriented slits therein. Subsequently, the circular saw blade assemblies are retracted vertically upwardly as a result of moving the vertically movable reciprocating carriage mechanism back to the first ELEVATED INOPERATIVE position, the packaging structure is conveyed or advanced further to and stopped at another predetermined axial or longitudinal position at which it is desired to cut the side wall members of the packaging structure so as to define another pair of slits within the side wall members of the packaging structure, and the entire operative cycle can be repeated as desired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Various other features and attendant advantages of the present invention will be more fully appreciated from the following detailed description when considered in connection with the accompanying drawings in which like reference characters designate like or corresponding parts throughout the several views, and wherein:

[0012] FIG. 1 is a perspective view of a conventional PRIOR ART packaging assembly comprising mating packaging structures;

[0013] FIG. 2 is a perspective view of a packaging structure, as the same is disposed in its orientation for conveyance through the new and improved machine of the present invention, such that the plurality of vertically oriented slits, and the plurality of scored regions, can be formed within the side wall members and top wall member thereof so as to form the integrally connected articulated sections of the packaging structure;

[0014] FIG. 3 is a perspective view of the packaging structure illustrated within FIG. 2 wherein, however, the packaging structure has been inverted so as to facilitate the formation of the same into the finalized packaging container by folding the opposite end sections of the packaging structure inwardly toward the primary central section of the packaging structure;

[0015] FIG. 4 is an upstream, packaging structure infeed or entry end perspective view of the new and improved semi-automatic machine, constructed in accordance with the principles and teachings of the present invention, for fabricating the articulated packaging structure illustrated within FIG. 2 and 3, and showing the use of a plurality of longitudinally spaced, upstanding or elevated infeed idler rollers;

[0016] FIG. 5 is a downstream, packaging structure outfeed or discharge end perspective view of the new and improved semi-automatic machine, constructed in accordance with the principles and teachings of the present invention and as illustrated within FIG. 4, for fabricating the articulated packaging structure illustrated within Figs. 2 and 3, and showing the use of an elevated discharge railing;

[0017] FIG. 6 is an enlarged detailed view of one of the packaging structure alignment devices utilized within the upstream, packaging structure infeed or entry end portion of the new and improved semi-automatic machine, as illustrated within FIG. 4, so as to effectively ensure and maintain the co-linear alignment of the packaging structure with respect to the longitudinal conveyor path effectively defined by means of the plurality of longitudinally spaced infeed idler rollers;

[0018] FIG. 7 is an enlarged detailed view of one of the packaging structure alignment devices utilized within the downstream, packaging structure outfeed or discharge end portion of the new and improved semi-automatic machine, as illustrated within FIG. 5, so as to effectively ensure and maintain the co-linear alignment of the packaging structure with respect to the longitudinal conveyor path effectively defined by means of the elevated discharge railing;

[0019] FIG. 8 is an enlarged perspective view of the infeed or entry end portion of the new and improved semi-automatic machine of the present invention showing the details of the rotary encoder, the stepper-motor infeed drive roller for cooperation with a clamping roller, an air cylinder mechanism for actuating the clamping roller, and one of the circular saw blade assemblies, including the air motor and bag dust collector components operatively associated therewith, mounted upon the carriage plate which is vertically movable upon or relative to the machine framework;

[0020] FIG. 9 is a perspective view of the infeed or entry end portion of the new and improved semi-automatic machine of the present invention, similar to that disclosed within FIG. 8, showing the rotary encoder, the stepper-motor or infeed drive roller, the stepper motor for driving the stepper-motor infeed drive roller, and both of the circular saw blade assemblies, including the air motor and bag dust collector components operatively associated therewith, mounted upon the carriage plate which is vertically movable upon or relative to the machine framework;

[0021] FIG. 10 is an enlarged perspective view of the outfeed or discharge end portion of the new and improved semi-automatic machine of the present invention showing the packaging structure edge sensor, the packaging structure clamping bar, the air cylinder mechanism for operatively controlling the packaging structure clamping bar, the packaging structure outfeed or discharge drive roller, and the drive motor for driving the packaging structure outfeed or discharge drive roller;

[0022] FIG. 11 is a substantially downstream end elevational view of the new and improved semi-automatic machine of the present invention showing the pair of circular saw blade assemblies and their bag dust collectors, the
clamping bar and its air cylinder actuator, the discharge or outfeed drive roller and its drive motor, and the pair of counterweights, attached to the carriage plate, for counterbalancing the air motors operatively driving the circular saw blades;

[0023] FIG. 12 is a downstream end perspective view of the new and improved semi-automatic machine of the present invention showing the pair of circular saw blade assemblies and their bag dust collectors, the clamping bar and its air cylinder actuator, the discharge or outfeed drive roller and its drive motor, the pair of counterweights, attached to the carriage plate, for counterbalancing the air motors operatively driving the circular saw blades, and the primary air cylinder for driving the carriage plate and the circular saw blade assemblies within their vertically upward and downward reciprocal modes, and the programmable logic controller (PLC) having the control panel mounted upon the front face thereof;

[0024] FIG. 13 is an enlarged downstream end perspective view of the new and improved semi-automatic machine of the present invention showing one of the circular saw blade assemblies and its bag dust collector, the drive motor for the discharge or outfeed drive roller, one of the counterweights, attached to the carriage plate, for counterbalancing the air motor operatively driving one of the circular saw blades, the primary air cylinder for driving the carriage plate and the circular saw blade assemblies within their vertically upward and downward reciprocal modes, one of the Hall Effect limit switches for controlling the vertical movement of the piston assembly of the primary air cylinder, and the programmable logic controller (PLC);

[0025] FIG. 14 is a front elevational view of the control panel of the programmable logic controller (PLC);

[0026] FIG. 15 is a substantially side elevational view showing the operative connection of the carriage plate to the piston rod of the primary air cylinder mechanism, the C-shaped bearing members permitting the carriage plate to smoothly move along the machine framework under the control of the primary air cylinder mechanism, and the inward/outward adjustment mechanisms for the air motors and circular saw blade assemblies;

[0027] FIG. 16 is a partial top perspective view of the new and improved semi-automatic machine of the present invention showing the clamping bar, the pair of circular saw blade assemblies, the idler roller mounting block, and a particular one of the pair of spacers, having a male scoring die member mounted within the upper regions thereof, for cooperating with the circular saw blade assemblies for forming the vertically oriented slits within the side wall members of the packaging structure;

[0028] FIG. 17 is a top perspective view of the plurality of different spacers and male die members which may be selectively installed within the new and improved semi-automatic machine as illustrated within FIG. 16 whereby the new and improved semi-automatic machine of the present invention can be utilized to fabricate packaging structures of different sizes; and

[0029] FIG. 18 is a partial, enlarged perspective view of the new and improved semi-automatic cutting or slitting machine of the present invention illustrating, in particular, the female scoring die member integrally secured to the underside of the carriage plate for cooperation with the male scoring die member illustrated within FIG. 16.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

[0030] Referring now to the drawings, and more particularly to FIGS. 4 and 5 thereof, a new and improved semi-automatic machine system, for cutting or forming pairs of slits within the oppositely disposed side wall members of a packaging structure, and for scoring the upper wall member of the packaging structure along the lines or loci which effectively interconnect the pairs of slits formed within the oppositely disposed side wall members of the packaging structure so as to render the longitudinally spaced sections of the packaging structure capable of articulated movement with respect to each other, is disclosed and is generally indicated by the reference character 210. FIG. 4 is an upstream, packaging structure infeed or entry end perspective view of the new and improved semi-automatic machine system 210, while FIG. 5 is a downstream, packaging structure outfeed or discharge end perspective view of the new and improved semi-automatic machine system 210. The new and improved semi-automatic machine system 210 is further seen to comprise a new and improved semi-automatic machine 212 which actually performs the aforementioned cutting or slitting operations, and it is seen still further that the new and improved semi-automatic machine 212 is fixedly mounted upon an elongated, longitudinally oriented support beam 214, as can best be additionally appreciated from FIGS. 6 and 12, at a position which is substantially at the mid-point between the infeed or entry end of the system 210 and the outfeed or discharge end of the system 210.

[0031] The elongated, longitudinally oriented support beam 214 is, in turn, fixedly supported upon a plurality of longitudinally spaced stanchions 216, each one of which has a substantially inverted T-shaped cross-sectional configuration, and it is seen that a plurality of vertically, upwardly idler roller mounting brackets 218 are fixedly mounted atop the elongated, longitudinally oriented support beam 214 at longitudinally spaced positions upstream of the semi-automatic cutting or slitting machine 212. An idler roller 220 is respectively mounted within an upper elevon portion of each of the vertically upwardly idler roller mounting brackets 218, and it is seen that the plurality of idler rollers 220 are co-linearly aligned with respect to each other such that the plurality of idler rollers 220 together define an upstream, packaging structure infeed or entry end conveyor for conveyably supporting, for example, a U-shaped packaging structure, similar to the packaging structure 110 as disclosed in its inverted orientation within FIG. 2, toward the semi-automatic cutting or slitting machine 212. In a similar manner, as can best be appreciated from FIG. 5, a plurality of vertically upwardly, coplanar support brackets 222 are fixedly mounted atop the elongated, longitudinally oriented support beam 214 at longitudinally spaced positions downstream from the semi-automatic cutting or slitting machine 212, and a rail member 224, having a substantially inverted, U-shaped cross-sectional configuration, is fixedly secured to the upper end portion of each one of the vertically upwardly support brackets 222. In this manner, the rail member 224 effectively serves as a downstream, packaging structure outfeed or discharge end conveyor mechanism for conveyably supporting, for example, the U-shaped packaging structure, similar to the packaging structure 110 as disclosed in its
inverted orientation within FIG. 2, outward from the semi-
automatic cutting or slitting machine 212 as the longitudi-
nally spaced pairs of cuts or slits are formed within the
oppositely disposed side wall members thereof.

[0032] It is to be noted that the semi-automatic cutting or
slitting machine 212 can be utilized to form cuts or slits
within the side wall members of various different U-shaped
packaging structures having, for example, different width
dimensions, such as, for example, within the range of two
inches (2.00") to twelve inches (12.00"). It is noted further,
however, that the same arrangement or array of idle rollers
220, serving as the upstream packaging structure infeed
conveyor mechanism, and that the same rail member 224,
serving as the downstream packaging structure outfeed
conveyor mechanism, are to be utilized regardless of the size
or width dimension of the particular packaging structure. It
may therefore be appreciated still further that if the trans-
verse or lateral width dimension of the particular packaging
structure substantially or significantly exceeds the transverse
or lateral width dimensions of the idle rollers 220 and the
rail member 224, then the longitudinal axis of the packaging
structure will not necessarily be coaxially aligned with the
longitudinal axis of the machine system 210 as effectively
defined by means of the co-linearly arranged idle rollers
220 and the longitudinally extending rail member 224.
Accordingly, when the packaging structure is conveyed into
the semi-automatic cutting or slitting machine 212 so as to
be processed in accordance with the manufacturing tech-
niques for forming the articulated packaging structure, a
properly fabricated articulated packaging structure may not
in fact be achieved. Therefore, in accordance with further
structure characteristic of the new and improved machine
system 210 of the present invention, it is seen from FIG. 6
that a pair of upstanding packaging structure alignment
guide rollers 226,228 are provided at two or more locations
along the packaging structure infeed conveyance path
upstream of the semi-automatic cutting or slitting machine
212.

[0033] The packaging structure alignment guide rollers
226,228 are adapted to be disposed beneath the inverted
U-shaped packaging structure, which is being conveyed
along the packaging structure infeed conveyance path by
means of the packaging structure infeed idle rollers 220, in
such a manner that the packaging structure alignment guide
rollers 226,228 will effectively engage oppositely disposed
interior surface portions of the oppositely disposed depend-
sive side wall members of the packaging structure. There-
fore, since at least two sets of packaging structure alignment
guide rollers 226,228 are being utilized, at least four of the
packaging structure alignment guide rollers 226,228 will
effectively form a parallelogram array so as to guide the
packaging structure toward the semi-automatic cutting or
slitting machine 212 in a coaxially aligned, stabilized man-
ner. It is further appreciated from FIG. 6 that the pair of
packaging structure alignment guide rollers 226,228 are
mounted upon opposite distal ends of a support arm 230
which is rotatably adjustable upon an upstanding post 232,
by means of a suitable set screw fastener 234 or the like,
wherein the post 232 is fixedly secured atop the support
beam 214. In this manner, by rotatably adjusting the angular
disposition of the support arm 230, the effective radial-
ward disposition of the packaging structure alignment
guide rollers 226,228 can be altered and adjusted depending
upon the lateral extent or size of the packaging structure
being fabricated.

[0034] In a similar manner, as can be appreciated from
FIG. 7, corresponding packaging structure alignment struc-
ture is likewise provided at two or more locations along the
packaging structure outfeed or discharge conveyance path,
downstream from the semi-automatic cutting or slitting
machine 212, as defined by means of the rail member 224.
More particularly, an alignment guide arm 236 is pivotally
or rotatably mounted beneath the rail member 224, by means
of a suitable set screw fastener or the like, at the two or more
longitudinally spaced positions along the rail member 224,
and therefore, the opposite distal end portions 238,240 of
each guide arm 236 can engage the interior surface portions
of the dependent side wall members of the packaging
structure. A pair of the guide arms 236,236 can in fact be
seen within FIG. 5, and as was the case with the upstanding
guide rollers 226,228, since at least four of the packaging
structure alignment guide arm end portions 238,240 will
effectively form a parallelogram array, and will engage the
interior surface portions of the dependent side wall members
of the packaging structure, the end portions 238,240 of the
guide arms 236,236 can effectively guide the packaging
structure outwardly from the semi-automatic cutting or
slitting machine 212 in a coaxially aligned, stabilized man-
ner with respect to the longitudinal axis of the machine
system 210.

[0035] The new and improved semi-automatic cutting or
slitting machine 212 is adapted to be pre-programmed, in a
manner to be described shortly hereinbelow in detail, whereby
the new and improved semi-automatic cutting or slitting
machine will be ready to perform its cutting or slitting
operations upon a particular packaging structure having
predetermined dimensions or specifications. Accordingly,
when cutting or slitting operations are in fact to be per-
formed upon a packaging structure blank in order to effec-
tively fabricate the packaging structure 110 comprising its
integrayy connected articulated sections as illustrated within
FIGS. 2 and 3, a packaging structure blank will be manually
fed into the semi-automatic cutting and slitting machine 112
as a result of being manually moved along the plurality of
infeed idle conveyor rollers 220 until the leading edge
portion of the packaging structure blank encounters a stop
mechanism, an operator will then push a START button 242
which is disposed adjacent to an operator control panel 244
of the semi-automatic cutting or slitting machine 212, as
illustrated in FIG. 14, the operator control panel 244 effec-
tively forming the front face of a computer housing 246
within which, for example, a programmable logic controller
(PLC), for controlling the various operative components of
the semi-automatic cutting or slitting machine 212, is con-
tained. Subsequently, the stop mechanism will effectively be
released and the semi-automatic cutting or slitting machine
212 will in fact initiate the various, pre-programmed cutting
or slitting operations so as to in fact fabricate the packaging
structure 110 comprising its integrally connected articulated
sections as illustrated within FIGS. 2 and 3. Therefore, in
order to appreciate the operation of the new and improved
semi-automatic cutting or slitting machine 212 of the present
invention, reference will now be made to FIGS. 7-11 and 16
within which some of the various operative control compo-
ments of the new and improved semi-automatic cutting or slitting machine 212 of the present invention are disclosed and will be described.

[0036] More particularly, as best seen in FIG. 9, the new and improved semi-automatic cutting or slitting machine 212 of the present invention comprises a machine framework which comprises a lower base plate 248 that is fixedly mounted upon the support beam 214 by means of suitable fasteners 250, as best seen in FIG. 6, a plurality of support posts or mast members 252,254,256,258 which are fixedly connected at the corner regions of the base plate 248 and which extend vertically upwardly therefrom, and an upper support plate 260 which is fixedly connected to the upper end portions of the vertically oriented support posts or mast members 252-258 and upon which the programmable logic controller (PLC) housing 246 is fixedly supported. A first horizontally disposed bridge member 262 fixedly interconnects the upstream pair of vertical support posts or mast members 252,254, as can best be seen in FIG. 8, while a second horizontally disposed bridge member 264 fixedly interconnects the downstream pair of vertical support posts or mast members 256,258 as can best be seen in FIGS. 10 and 11.

[0037] A first vertically oriented air cylinder mechanism 266 is fixedly mounted upon the second horizontally disposed bridge member 264, and a vertically oriented, reciprocally movable piston rod 268, operatively connected to the air cylinder mechanism 266, is adapted to pass downwardly through the bridge member 264 and be fixedly connected to a horizontally oriented clamping bar 270. A roller mounting bracket 272, having a substantially triangular cross-sectional configuration, is disposed beneath the clamping bar 270, and an idler roller 274 is mounted at a substantially central, upwardly projecting apex portion of the roller mounting bracket 272. In this manner, when the clamping bar 270 is lowered to its lowestmost position by means of the piston rod 268 of the air cylinder mechanism 266, the under-surface portion of the clamping bar 270 will engage the idler roller 274 and effectively form therewith the aforesaid stop mechanism against which the forward edge portion of the packaging structure is engaged at the commencement of a cutting or slitting operation. A pair of laterally spaced guide rods 276 are connected to the clamping bar 270 and pass upwardly through bearing members 278 fixedly mounted within the bridge member 264 so as to guide the vertically reciprocating movements of the clamping bar 270 between its elevated and lowered positions. Bumpers or shock absorbers 280, which can be seen in FIG. 13 although only one can be seen in FIGS. 10 and 11, are annularly disposed around the lower end portions of the guide rods 276 so as to prevent the generation of any vibrations attendant the movement of the clamping bar 270 back to its elevated position.

[0038] With continued reference to FIGS. 6-11, an optical edge sensor 282 is fixedly mounted within the downstream edge portion of the bridge member 264, as can best be seen in FIG. 10, so as to be disposed above the stop mechanism effectively formed by means of the clamping bar 270 and the idler roller 274. In this manner, when the automatic conveyance of the packaging structure through the machine 212 is commenced as a result of the operator pushing the START button 242, the edge sensor 282 will, in fact, be able to detect the forward edge portion of the packaging structure, which has been previously prevented from moving past the aforesaid stop mechanism as a result of the clamping bar 270 being disposed at its lowered position into engagement with the idler roller 274, as a result of the clamping bar 270 having been moved back to its elevated position and as a result of the packaging structure being advanced through the machine 212 by drive means which will now be described. More particularly, as can best be appreciated from FIGS. 8 and 9, a rotary encoder 284 is mounted upon the upstream bridge member 262 by means of a suitable bracket 266, and an infeed drive roller 288 is disposed adjacent to the rotary encoder 284. The infeed drive roller 288 is rotatably mounted upon the front end of a stepper motor 290 which is also mounted upon the bridge member 262, and the infeed drive roller 288 is adapted to operatively cooperate with a driven roller 292 which is movably mounted upon the upstream end portion of the roller mounting bracket 272.

Driven roller 292 is actually rotatably mounted within a clevis bracket 294 which is vertically movable toward and away from the infeed drive roller 288 by means of a second air cylinder mechanism 296 which is mounted beneath the upstream end portion of the roller mounting bracket 272. Guide pins 298, attached to the bottom region of the clevis bracket 294, pass downwardly through the upstream end portion of the roller mounting bracket 272 so as to guide the vertical upward and downward movements of the clevis bracket 294. Accordingly, when the air cylinder mechanism 296 is activated so as to extend the piston rod thereof, not shown, the clevis bracket 294 will be moved vertically upwardly so as to force the driven roller 292 into engagement with the infeed drive roller 288 whereby the stepper motor 290 will rotate the infeed drive roller 288 for a predetermined number of revolutions so as to, in turn, advance the packaging structure a predetermined distance relative to a cutting station which is effectively defined within the cutting or slitting machine 212 by means of a pair of oppositely disposed circular saw blade assemblies 300, 302 as can best be seen in FIG. 11.

[0039] In a manner similar or corresponding to that which has been described in connection with the mounting and disposition of the upstream or infeed drive and driven rollers 288,292, and with reference now being made to FIGS. 7 and 10-13, a drive motor 302 is mounted upon the second bridge member 264 by means of a suitable mounting bracket 304, and an outfeed or discharge drive roller 306 is rotatably mounted upon and operatively connected to the output drive shaft of the drive motor 302. The outfeed or discharge drive roller 306 is adapted to operatively cooperate with a driven roller 308 which is movably mounted upon the downstream end portion of the roller mounting bracket 272. Driven roller 308 is actually rotatably mounted within a clevis bracket 310 which is vertically movable toward and away from the outfeed drive roller 306 by means of a third air cylinder mechanism 312 which is mounted beneath the downstream end portion of the roller mounting bracket 272. Guide pins 314, only one of which is visible within FIG. 7, are attached to the bottom region of the clevis bracket 310 and pass downwardly through the downstream end portion of the roller mounting bracket 272 so as to guide the vertically upward and downward movements of the clevis bracket 310. Accordingly, when the air cylinder mechanism 312 is activated so as to extend the piston rod thereof, not shown, the clevis bracket 310 will be moved vertically upwardly so as to force the driven roller 308 into engagement with the outfeed drive roller 306 whereby the drive motor 302 will
rotate the outfeed drive roller 306 for a predetermined period of time until, for example, the trailing edge portion of the packaging structure has been detected by means of the edge sensor 282. The packaging structure may then be removed from the semi-automatic cutting or slitting machine 212 in view of the fact that the entire cutting or slitting process has been completed.

[0040] With reference now being made to FIGS. 8-13 and 15-18, a detailed description of the machine components comprising or disposed adjacent to the cutting station of the semi-automatic cutting or slitting machine 212 will now be described. More particularly, as can best be appreciated from FIG. 11, the new and improved semi-automatic cutting or slitting machine 212 comprises the pair of oppositely disposed circular saw blade assemblies 300,300 which are adapted to be moved vertically downwardly from a first ELEVATED, INOPERATIVE position to a second LOWERED, OPERATIVE position at which the circular saw blade members 316,316 will form the cuts or slits within the dependent side wall members of the packaging structure 110 which is fixedly supported within the cutting or slitting machine 212 along the longitudinally or axially oriented conveyor path thereof as defined by means of the plurality of infed idler conveyor rollers 220 and the rail member 224. The circular saw blade members 316,316 are respectively enclosed within plastic housings 318,318 which are substantially sealed, except for the side portions thereof which face the interior region of the machine 212 and through which a circumferential portion of each one of the circular saw blade members 316,316 projects outwardly from its respective housing 318,318 in order to perform its cutting or slitting operation, and it is additionally seen that the oppositely disposed side portions of the housings 318,318 are operatively connected to a vacuum suction exhaust system which has a dust collection bag 320,320 operatively connected thereto.

[0041] Continuing further, a pair of air or pneumatic drive motors 322,322 are respectively disposed externally of each one of the plastic housings 318,318 in such a manner that the plastic housings 318,318 are fixedly mounted upon flange portions of the drive motors 322,322, and rotary drive shafts, not illustrated, of the drive motors 322,322 extend through the side walls of the plastic housings 318,318 so as to be operatively connected to the circular saw blade members 316,316. As can best be seen in FIGS. 8,9, and 18, a pair of vertically oriented mounting shafts 324,324 respectively have lower flange portions 326,326 fixedly bolted to the drive motors 322,322, while upper flange portions 328,328 of the mounting shafts 324,324 are disposed in abutment with undersurface portions of a vertically movable carriage plate 330. As can best be seen from FIGS. 15 and 18, the carriage plate 330 has a pair of slots 332,332 formed therein so as to extend transversely or substantially perpendicular to the longitudinal direction along which the packaging structure is being conveyed through the semi-automatic cutting or slitting machine 212, and a pair of cap members 334,334 are adapted to be extend across the slots 332,332 so as to be disposed in contact with upper surface portions of the carriage plate 330. The cap members 334,334 effectively form upper mating flange members which are adapted to be respectively fixedly connected to the upper flange members 328,328 of the mounting shafts 324,324, by means of suitable fasteners 336,336, so as to effectively secure the carriage plate 330 therebetween, and it is seen that each one of the cap members 334,334 has a substantially hexagonal cross-sectional configuration whereby, for example, an end portion 338,338 of each cap member 334,334 serves as a pointer.

[0042] A pair of scales or rulers 340,340 are effectively embedded within the upper surface portion of the carriage plate 330, and the pointer portions 338,338 of the cap members 334,334 are operatively associated with the scales or rulers 340,340 so as to effectively indicate to the operator the width dimension or size of the particular packaging structure, and the corresponding disposition of the circular saw blade assemblies 300,300 with respect to such particular packaging structure, which is being fabricated. It can therefore be appreciated that when, for example, the threaded fasteners 336,336 of the cap members 334,334 are effectively loosened so as to, in turn, effectively release the clamping forces impressed upon the upper and lower surface portions of the carriage plate 330 by means of the cooperating cap members 334,334 and the upper flange members 328,328 of the mounting shafts 324,324, the pair of circular saw blade assemblies 300,300 can be adjusted toward or away from each other so as to be capable of performing their cutting or slitting operations upon predeterminedly sized packaging structures. In addition, in order for the circular saw blade members 316,316 to properly perform their cutting or slitting operations in connection with the dependent side wall members of a particular one of the packaging structures, it is further seen that a vertically upstanding spacer block 342, having a substantially square cross-sectional configuration, is fixedly secured to the base plate 248 of the machine 212 along the longitudinal conveyor axis of the machine system 210, as can best be appreciated from FIG. 7, and that the roller mounting bracket 272 is fixedly secured atop the spacer block by means of a plurality of fasteners 344 as can best be seen in FIG. 16.

[0043] Still further, a pair of cutting dies 346,346 are fixedly connected to the opposite sides of the spacer block 342 by means of, for example, suitable bolt fasteners which are adapted to be inserted through through-apertures 348 formed within the cutting dies 346,346 and threadedly engaged within the spacer block 342 as can best be appreciated from FIGS. 7,8 and 17. As can best be appreciated still further from FIGS. 7 and 8, each one of the cutting dies 346,346 is numbered at the lower end portion thereof, such as, for example, with the number “6”. The numbering of the particular cutting dies 346,346 enables the operator to properly select the cutting dies 346,346 which are required in connection with the cutting or slitting of particular packaging structures. For example, if the packaging structure is six inches (6.00”) wide, then the cutting dies 346,346 with the number “6” on them are selected. As can be seen in FIG. 17, a plurality of dual sets of cutting dies 346,346 are provided such that depending upon the particular width dimension of the particular packaging structure, the appropriate cutting dies can be selected. In connection with the particular semi-automatic cutting or slitting machine 212 of the present invention, packaging structures ranging in size from two inches (2.00”) to twelve inches (12.00”) can be processed. It is further seen that each one of the cutting dies 346,346 is provided with a vertically oriented slot 350 within the external, numbered surface or face of the cutting die 346,346 such that the peripheral edge portions of the circular saw blade members 316,316 can be accommodated during the cutting or slitting procedures.
With reference continuing to be made to FIG. 17, it is further seen that the upper end portion or face of each one of the cutting dies 346 is also provided with a slot 352 which has a predetermined depth, and as best seen in FIG. 16, such slots 352 are adapted to accommodate a male scoring die 354. A plurality of male scoring dies 354, having varying length dimensions, and numbered, as at 356, so as to correspond to the cutting dies 346, are illustrated within FIG. 17, and it can therefore be appreciated that when particularly selected numbered cutting dies 346,346 are installed upon the semi-automatic cutting or slitting machine 212 so as to perform a cutting or slitting operation upon a particular packaging structure, a particular, corresponding male scoring die 354 is likewise selected and installed. As can be further appreciated from FIG. 16, the roller mounting bracket 272 is also provided with a transversely oriented slot 358, which is adapted to be co-linearly aligned with the slots 352,352 defined within the pair of cutting dies 346,346, so as to accordingly accommodate the particular male scoring die 354 which spans or extends across the pair of cutting dies 346,346 and the roller mounting bracket 272. The male scoring die 354 may be secured within the pair of cutting dies 346,346 and the roller mounting bracket 272 by any suitable means, including magnetic, and the male scoring die 354 is of course adapted to operatively cooperate with a female scoring die 360 which is formed within a die plate 362 which is fixedly mounted upon the undersurface portion of the vertically movable carriage plate 330 as can best be seen in FIG. 18. As also shown in FIG. 18, when the carriage plate 330 is moved downwardly so as to correspondingly move the pair of oppositely disposed circular saw blade assemblies 300,300 downwardly in connection with the performance of a cutting or slitting operation, the female and male scoring dies 360,354 will cooperate together so as to form, for example, one of the score lines 128,130,140,142 upon the packaging structure 110 in a non-cutting, deformation manner.

With reference now being made to FIGS. 13 and 15, the mechanism for moving the carriage plate 330, and the pair of circular saw blade assemblies 300,300, between their ELEVATED, INOPERATIVE positions and their LOWERED, OPERATIVE positions, such that the circular saw blade members 316,316 can perform their cutting or slitting operations upon the side wall members of the packaging structure, will now be described. A vertically oriented, upstanding air cylinder mechanism 364 is fixedly mounted upon the upper surface portion of the upper support plate 260, and a piston rod 366 of the air cylinder mechanism 364 is adapted to pass downwardly through the upper support plate 260 so as to be fixedly connected to the upper surface portion of the movable carriage plate 330 by means of a suitable mounting flange 368 as can best be seen in FIG. 15.

It is further seen that the carriage plate 330 has a substantially C-shaped cross-sectional configuration and that the carriage plate 330 is only operatively engaged with, and mounted upon, the downstream pair of vertically oriented upstanding posts or masts 256,258. In particular, a pair of substantially C-shaped bearing members 370,372, fabricated, for example, from TEFLEX® enable the carriage plate 330 to be smoothly moved along, and guided by, the posts or masts 256,258 under the operative control of the piston rod 366 and the air cylinder 364. It is additionally seen and appreciated that in view of the fact that the pair of oppositely disposed circular saw blade assemblies 300,300 are mounted upon upstream end portions of the carriage plate 330 through means of the cap members 334,334 and the mounting shafts 324,324 fixedly connected to the air drive motors 322,322, a pair of cylindrically configured counterweights 374,374 are fixedly mounted upon the downstream end or leg portions 376,376 of the substantially C-shaped carriage plate 330. In this manner, the carriage plate 330 is properly counterbalanced so as to in fact be capable of being smoothly and easily moved during its reciprocal vertical movements between the aforesaid ELEVATED and LOWERED positions attendant the performance of the cutting or slitting operations by means of the circular saw blades 316,316.

With reference lastly being made to FIG. 14, the various operator control, data entry input, and data extraction buttons provided upon the operator control panel 244 will now be briefly described. As has been noted, the operator control panel 244 is disposed upon the front surface of the programmable logic control (PLC) housing 246, and it is seen that the control panel 244 includes an information display window 378. In addition, there are several control buttons 380,382,384,386,388 respectively marked or entitled NEW PART, SELECT PART, MACHINE SET-UP, CURRENT STATUS, and MAINTENANCE RECORDS. Still further, UP and DOWN scroll buttons 390,392 are provided upon the control panel 244 so as to effectively control scrolling operations through various listed data displayed, for example, within the window display 378. An ENTER button 394 is also provided upon the control panel 244 so as to, for example, select or enter particular data, and a keypad button array 396, similar to a conventional telephone keypad array, is also provided by means of which data information may also be entered. Accordingly, when, for example, the NEW PART button 380 is depressed, information comprising the pertinent parameters concerning a particular one of the packaging structures, such as, for example, its width and length dimensions, can be entered using the keypad button array 396. In a similar manner, after various data or information concerning different packaging structures has in fact been entered into the memory or database of the programmable logic controller (PLC) 246, a particular packaging structure can be subsequently selected by depressing the SELECT PART button 382 and then scrolling upwardly or downwardly, by means of the UP and DOWN scroll buttons 390,392, through the list of parts or packaging structures displayed within the display window 378.

Once a particular part or packaging structure has in fact been selected, the MACHINE SET-UP button 384 is depressed whereby, in effect, a checklist or similar monitoring program is displayed so as to inform the operator of the necessary procedures that must be taken in connection with the preparation of the machine 212 for performing the particular cutting or slitting operations upon the particular packaging structure. In a similar manner, depression of the CURRENT STATUS button 386 informs the operator of what is transpiring within the machine, such as, for example, which particular packaging structure is being fabricated, the progression of the cuts or slits within the overall operative cycle, and the like. Still further, when the MAINTENANCE RECORDS button 388 is depressed, information concerning the various operative components of the machine 212 will be displayed within the display window 378, such as, for
example, how many cutting cycles the circular saw blade members 316,316 have performed, the date when they were replaced or refurbished, and the like. Lastly, the START button has been previously noted at 242, and an emergency STOP button 398 is also of course provided. In addition to the various control buttons 380-396 being operatively connected to the programmable logic controller (PLC) 246, it is to be noted that the programmable logic controller (PLC) 246 is of course operatively connected to the various operative programmable components of the semi-automatic cutting or slitting machine 212, such as, for example, the edge sensor 282, the rotary encoder 284, the stepper motor or 290 for driving the drive roller 288, the air cylinder mechanisms 296,312 for controlling the driven rolls 292,308, the drive motor 302, the vacuum means operatively associated with the dust collection bags 320,320, the air motors 322,322 for controlling the operations of the circular saw blade members 316,316, and the air cylinder 364 for controlling the vertical reciprocal movements of the carriage plate 330.

[0049] Having described substantially all of the operative components of the new and improved semi-automatic cutting or slitting machine 212 of the present invention, a brief description of a typical cutting or slitting operation, as performed upon a particular packaging structure 110, will now be described. Once a particular packaging structure 110 has been selected and the particular cutting dies 346,346 and the male scoring die 354 have been installed upon the machine 212, the particular parameters concerning such packaging structure 110 will be entered into the memory of the programmable logic controller (PLC) 246 such that the various pairs of slits 118-124,120-126,132-136, and 134-138 can be formed within the side wall members 114,116 of the packaging structure 110 at the precise or predetermined positions located along the axial or longitudinal extent of the packaging structure 110. The operator will then load the packaging structure 110 into the machine 212 in the orientation illustrated within FIG. 2 such that the upper wall member 112 of the packaging structure 110 is effectively disposed atop the plurality of infeed conveyor idler rollers. At this point in time, it is noted that the air cylinder 364 has been previously activated such that the piston rod 366 thereof is disposed at its elevated position so as to, in turn, displace the carriage plate 330 and the circular saw blade assemblies 300,300 at their respective elevated positions. It is to be additionally noted that the elevated and lowered movements of the piston rod 366 of the air cylinder 364 are effectivelly controlled by means of suitable limit switches or similar devices, such as, for example, a Hall Effect sensor 400 which is located upon a lower external surface portion of the air cylinder 364. A similar sensor, not shown, is likewise positioned upon an upper external surface portion of the air cylinder 364, and such sensors are operatively connected to the programmable logic controller (PLC) 246 whereby the programmable logic controller (PLC) 246 can control the flow of the control air to the air cylinder 364 in order to activate or terminate movement of the piston rod 366.

[0050] Continuing further, it is also noted that at this point in time, the stepper motor 290 and the drive motor 302 are inactive such that the infeed and outfeed drive rollers 288,306 are likewise inactive, the air cylinder mechanisms 296,312, for controlling the disposition of the driven rolls 292,308 have been activated such that the roller mounting brackets 294,310 are disposed at their lowered positions whereby the driven rollers 292,308 are spaced from, and not in contact with, the infeed and outfeed drive rollers 288,306, and the air cylinder mechanism 266, for controlling the disposition of the clamping bar 270, has been activated such that the clamping bar 270 has been lowered, by means of the piston rod 268, so as to be engaged in contact with the idler roller 274 and thereby form therewith the aforesaid stop mechanism against which the forward edge portion of the packaging structure is now engaged in preparation for the commencement of a cutting or slitting operation. Accordingly, when the cutting or slitting operation is in fact ready to be commenced, the operator will push the START button 242 upon the programmable logic controller (PLC) display panel 244, and at this time, the programmable logic controller (PLC) 246 will activate the air cylinder 266 so as to retract the piston rod 268 thereof and thereby disengage the clamping bar 270 from the idler roller 274.

[0051] At substantially the same time, the programmable logic controller (PLC) 246 will activate the air cylinder 296 so as to cause the driven roller to be disposed in contact with the infeed drive roller 288. In addition, the programmable logic controller (PLC) 246, within the memory bank or database of which has been previously stored the specific parameters of the particular packaging structure being processed, such as, for example, the precise positions at which the pairs of slits 118-124,120-126,132-136 and 134-138 are to be formed within the side wall members 114,116 of the packaging structure 110, will activate the stepper motor 290 so as to rotate the infeed drive rollers 288, and the driven roller 292 engaged therewith, whereby the packaging structure 110 will be fed into the machine 212. The edge sensor 282 will also detect the leading edge portion of the packaging structure 110 and will transmit a suitable signal to the programmable logic controller (PLC) 246, and concomitantly therewith, the rotary encoder 284 will also transmit suitable signals to the programmable logic controller (PLC) 246 concerning the actual linear length that the packaging structure 110 has travelled past the rotary encoder 284. The programmable logic controller (PLC) 246 will therefore operatively control the stepper motor 290 so as to terminate the operation thereof when the packaging structure 110 has been fed the precise distance into and through the machine 212 such that the position, at which the first pair of cuts or slits 118-124 are to be formed, has been reached. Accordingly, further conveyance or advancement of the packaging structure 110 within the machine 212 is halted or terminated, and the air cylinder 266 is once again activated so as to extend the piston rod 268 and thereby effectively move and lower the clamping bar 270 into contact with the idler roller 274 whereby the packaging structure 110 will be clamped therebetween.

[0052] Subsequently, the programmable logic controller (PLC) 246 will activate the air cylinder 364 so as to extend and lower the piston rod 366 thereof whereby the carriage plate 330, upon which the circular saw blade assemblies 300,300 are fixedly mounted, will likewise be lowered from their ELEVATED, INOPERATIVE positions or states to their LOWERED, OPERATIVE positions or states, the air drive motors 322,322 will be actuated so as to rotate the circular saw blade members 316,316, and the first pair of cuts or slits 118-124 will therefore be simultaneously formed within the oppositely disposed side wall members 114,116 of the packaging structure 110. When the carriage plate 330 reaches its lowestmost position, it is noted that the male and
female scoring dies 354, 360 will also form the score line 128 within the upper wall member 112 of the packaging structure 110. Upon completion of the downward stroke of the piston rod 366, the carriage plate 330, and the circular saw blade assemblies 300,300, and the completion of the cutting or slitting operation, the programmable logic controller (PLC) 246 will terminate the air drive motors 322,322 and will activate the air cylinder 364 so as to retract the piston rod 366 thereof back to its original position whereby the carriage plate 330 and the circular saw blade assemblies 300,300 will likewise be returned to their original ELEVATED, INOPERATIVE positions. At this point in time, the programmable logic controller (PLC) 246 will activate the air cylinder 266 so as to retract the piston rod 268 whereby the clamping bar 270 is disengaged from the idler roller 274, and the stepper motor 290 will be activated so as to rotate the infed drive roller 288 in order to advance or convey the packaging structure 110 the next predetermined distance at which the next pair of cuts or slits 120-126 are to be formed.

[0053] The entire cycle is then of course repeated until the last pair of cuts or slits 134-138 are formed within the side wall members 114,116 of the packaging structure 110, the only significant difference in the operative cycle being the fact that, after the stepper motor 290 and the infed drive roller 288 have advanced or conveyed the packaging structure to its position at which the last pair of cuts or slits 134-138 are to be formed, the stepper motor 290 and the infed drive roller 288 are not re-activated in order to effectively discharge the completed packaging structure 110 from the machine 212. The reason for this is that the stepper motor 288 and the infed drive roller 288 are only activated in a substantially intermittent manner in order to advance or convey the packaging structure 110 for predetermined distances corresponding to the locations or positions at which the pairs of cuts or slits 118-124,120-126,132-136 and 134-138 are to be formed. Therefore, upon completion of the formation of the last pair of cuts or slits 134-138, the programmable logic controller (PLC) 246 will activate the outfeed drive motor 302, and will also activate the air cylinder mechanism 312 so as to effectively elevate the driven roller 308 into engagement with the outfeed drive roller 306 rotatably mounted upon the output drive shaft of the outfeed drive motor 302 such that the completed packaging structure 110 will be discharged from the semi-automatic cutting or slitting machine 212 and thereby be ready to be folded into its packaging container state.

[0054] It is to be lastly noted that in conjunction with each one of the circular saw blade members 316,316, there is provided a guide member 402,402, as best seen in FIG. 11, which is movable along and disposed in a coplanar manner with each one of the circular saw blade members 316,316 so as to effectively guide the retracted elevated movements of the circular saw blade members 316,316 back through the cuts or slits just formed within the side wall members 114,116 of the packaging structure 110. A detailed description of such guide members 402,402 is omitted herefrom in view of the fact that such guide members 402,402 form the basis or subject matter of the aforesaid patent application entitled DEVICE FOR PERMITTING RE-ENTRY OF CIRCULAR SAW BLADE DURING RECIPROCATING STROKE MOVEMENTS, filed on in the name of Anatoly Gosis et al. and assigned Ser. No. 294,575. In a similar manner, each one of the circular saw blade members 316,316 also has a compression element 404,404 which is pivotally mounted with respect to the circular saw blade members 316,316 so as to effectively compress the side wall members 114,116 of the packaging structure 110 against the cutting dies 346,346 in order to effectively stabilize the side wall members 114,116 of the packaging structure 110 while the same are being cut or slit by the circular saw blade members 316,316. Suitable air cylinder mechanisms, only one of which is visible in FIG. 8 at 406, are provided for applying the necessary force to bias the compression elements 404,404 into contact with the cutting dies 346,346, and as was the case with the guide members 402,402, a detailed description of the compression elements 404,404 is omitted herefrom in view of the fact that such subject matter is the basis of the aforesaid patent application entitled ANTI-VIBRATION DEVICE FOR USE WITH A CIRCULAR SAW BLADE filed on in the name of Anatoly Gosis et al. and assigned Ser. No. 294,575.

[0055] Thus, it may be seen that in accordance with the principles and teachings of the present invention, there has been provided a new and improved semi-automatic cutting or slitting machine, comprising a pair of oppositely disposed, vertically movable, circular saw blade assemblies for forming pairs of oppositely disposed cuts or slits at predetermined axially located positions within side wall members of a packaging structure so as to render the sections of the packaging structure articulated and foldable with respect to each other in order to form an enclosed packaging container. The movement of the circular saw blade assemblies, and the various components operatively associated therewith, are controlled by means of a suitable programmable logic controller (PLC).

[0056] Obviously, many variations and modifications of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be protected by Letters Patent of the United States of America, is:
1. Apparatus for forming slits within an elongated structure, so as to fabricate the elongated structure in integrally connected, articulated sections, comprising:
   a conveyor path along which an elongated structure can be conveyed;
   cutting means, disposed at a cutting station defined at a predetermined position along said conveyor path and movable between a first ELEVATED, INOPERATIVE position and a second LOWERED, OPERATIVE position, for cutting slits within an elongated structure;
   means for conveying the elongated structure along said conveyor path in an intermittent manner so as to successively dispose longitudinally spaced locations of the elongated structure at said cutting station; and
   means for repetitively moving said cutting means between said first ELEVATED, INOPERATIVE position and said second LOWERED, OPERATIVE position such that said cutting means can successively cut slits within the elongated structure at the longitudinally spaced locations of the elongated structure so as to fabricate the elongated structure in integrally connected, articulated sections.
2. The apparatus as set forth in claim 1, wherein:
said cutting means comprises a pair of oppositely dis-
posed cutting mechanisms for cutting a pair of slits
within oppositely disposed sides of the elongated
structure.

3. The apparatus as set forth in claim 2, wherein said
means for repetitively moving said cutting means be-
tween said first ELEVATED, INOPERATIVE position and said
second LOWERED, OPERATIVE position comprises:
   a framework;
a carriage mechanism;
means for mounting said pair of oppositely disposed
cutting mechanisms upon said carriage mechanism;
means mounted upon said framework and operatively
connected to said carriage mechanism for moving said
carriage, and said pair of oppositely disposed cutting
mechanisms upon said carriage mechanism, between
said first ELEVATED, INOPERATIVE position and said
second LOWERED, OPERATIVE position.

4. The apparatus as set forth in claim 3, further compris-
ing:
   means for adjustably mounting said pair of oppositely
disposed cutting mechanisms upon said carriage
mechanism at one of a plurality of predetermined
positions such that said pair of oppositely disposed
cutting mechanisms can cut slits within different elon-
gated structures having different width dimensions.

5. The apparatus as set forth in claim 4, further compris-
ing:
   means for removably mounting one of a plurality of
differently sized pairs of cutting dies, having slots
defined therein for respectively accommodating said
pair of oppositely disposed cutting mechanisms, upon
said framework so as to cooperatively cooperate with said
pair of oppositely disposed cutting mechanisms when
said pair of oppositely disposed cutting mechanisms are
deployed at any one of said plurality of predetermined
positions.

6. The apparatus as set forth in claim 3, wherein:
said means for conveying the elongated structure along
said conveyor path in an intermittent manner, so as to
successively dispose the longitudinally spaced loca-
tions of the elongated structure at said cutting station,
comprises a stepper motor mounted upon said frame-
work, an infeed drive roller operatively connected to
said stepper motor, and a first driven roller operatively
engagable with said infeed drive roller;

   edge sensor means is mounted upon said framework for
detecting the forward edge portion of the elongated
structure;

   rotary encoder means is mounted upon said framework
for determining how far the elongated structure has
been conveyed by said stepper motor; and

   a programmable logic controller (PLC) is mounted upon
said framework for controlling said stepper motor in
response to signals transmitted from said edge sensor
means and said rotary encoder means.

7. The apparatus as set forth in claim 6, further compris-
ing:
   an outfeed drive motor means, mounted upon said frame-
work and operatively connected to said programmable
logic controller (PLC), for discharging the elongated
structure when all slits have been cut within the elon-
gated structure;

   an outfeed drive roller operatively connected to said
outfeed drive motor means; and

   a second driven roller operatively engageable with said
outfeed drive roller.

8. The apparatus as set forth in claim 7, further compris-
ing:
   means for moving said first and second driven rollers
between a first position, at which said first and second
driven rollers are disposed in engagement with said
infeed and outfeed drive rollers such that said infeed
and outfeed drive rollers and said first and second
driven rollers can respectively convey the elongated
structure along said conveyor path, and a second pos-
tion at which said first and second driven rollers are
disengaged from said infeed and outfeed drive rollers
such that said infeed and outfeed drive rollers and said
first and second driven rollers cannot respectively con-
vey the elongated structure along said conveyor path.

9. The apparatus as set forth in claim 5, further compris-
ing:
   scoring dies mounted upon said carriage mechanism and
said cutting dies so as to score the elongated structure
at positions corresponding to the longitudinally spaced
locations of the elongated structure at which the slits
are cut within the elongated structure.

10. Apparatus for forming slits within an elongated
structure, so as to fabricate the elongated structure in integrally
connected, articulated sections, comprising:
   an elongated structure;

   a conveyor path along which said elongated structure can
be conveyed;

   cutting means, disposed at a cutting station defined at a
predetermined position along said conveyor path and
movable between a first ELEVATED, INOPERATIVE
position and a second LOWERED, OPERATIVE
position, for cutting slits within said elongated structure;

   means for conveying said elongated structure along said
conveyor path in an intermittent manner so as to
successively dispose longitudinally spaced locations of said
elongated structure at said cutting station; and

   means for repetitively moving said cutting means between
said first ELEVATED, INOPERATIVE position and
said second LOWERED, OPERATIVE position such
that said cutting means can successively cut slits within
said elongated structure at said longitudinally spaced
locations of said elongated structure so as to fabricate
said elongated structure in integrally connected, articu-
lated sections.

11. The apparatus as set forth in claim 10, wherein:
said cutting means comprises a pair of oppositely dis-
posed cutting mechanisms for cutting a pair of slits
within oppositely disposed sides of said elongated
structure:

12. The apparatus as set forth in claim 11, wherein said
means for repetitively moving said cutting means between
said first ELEVATED, INOPERATIVE position and said
second LOWERED, OPERATIVE position comprises:
a framework;
a carriage mechanism;
means for mounting said pair of oppositely disposed cutting mechanisms upon said carriage mechanism;
means mounted upon said framework and operatively connected to said carriage mechanism for moving said carriage, and said pair of oppositely disposed cutting mechanisms upon said carriage mechanism, between said first ELEVATED, INOPERATIVE position and said second LOWERED, OPERATIVE position.
13. The apparatus as set forth in claim 12, further comprising:
means for adjustably mounting said pair of oppositely disposed cutting mechanisms upon said carriage mechanism at one of a plurality of predetermined positions such that said pair of oppositely disposed cutting mechanisms can cut slits within different elongated structures having different width dimensions.
14. The apparatus as set forth in claim 13, further comprising:
means for removably mounting one of a plurality of differently sized pairs of cutting dies, having slots defined therein for respectively accommodating said pair of oppositely disposed cutting mechanisms, upon said framework so as operatively cooperate with said pair of oppositely disposed cutting mechanisms when said pair of oppositely disposed cutting mechanisms are disposed at any one of said plurality of predetermined positions.
15. The apparatus as set forth in claim 12, wherein:
said means for conveying said elongated structure along said conveyor path in an intermittent manner, so as to successively dispose said longitudinally spaced locations of said elongated structure at said cutting station, comprises a stepper motor mounted upon said framework, an infeed drive roller operatively connected to said stepper motor, and a first driven roller operatively engageable with said infeed drive roller;
edge sensor means is mounted upon said framework for detecting the forward edge portion of said elongated structure;
rotary encoder means is mounted upon said framework for determining how far said elongated structure has been conveyed by said stepper motor; and
a programmable logic controller (PLC) is mounted upon said framework for controlling said stepper motor in response to signals transmitted from said edge sensor means and said rotary encoder means.
16. The apparatus as set forth in claim 15, further comprising:
outfeed drive motor means, mounted upon said framework and operatively connected to said programmable logic controller (PLC), for discharging said elongated structure when all slits have been cut within said elongated structure;
an outfeed drive roller operatively connected to said outfeed drive motor means; and
a second driven roller operatively engageable with said outfeed drive roller.
17. The apparatus as set forth in claim 16, further comprising:
means for moving said first and second driven rollers between a first position, at which said first and second driven rollers are disposed in engagement with said infeed and outfeed drive rollers such that said infeed and outfeed drive rollers and said first and second driven rollers can respectively convey said elongated structure along said conveyor path, and a second position at which said first and second driven rollers are disengaged from said infeed and outfeed drive rollers such that said infeed and outfeed drive rollers and said first and second driven rollers cannot respectively convey said elongated structure along said convey-or path.
18. The apparatus as set forth in claim 14, further comprising:
sco ring dies mounted upon said carriage mechanism and said cutting dies so as to score said elongated structure at positions corresponding to said longitudinally spaced locations of said elongated structure at which said slits are cut within said elongated structure.
19. A method for forming slits within an elongated structure, so as to fabricate the elongated structure in integrally connected, articulated sections, comprising:
providing a conveyor path along which an elongated structure can be conveyed;
positioning cutting means at a cutting station defined at a predetermined position along said conveyor path;
conveying said elongated structure along said conveyor path such that a first location of said elongated structure, at which a first slit is to be formed, is positioned at said cutting station;
moving said cutting means from a first ELEVATED, INOPERATIVE position to a second LOWERED, OPERATIVE position so as to cut said first slit within said elongated structure at said first location;
moving said cutting means from said second LOWERED, OPERATIVE position back to said first ELEVATED, INOPERATIVE position;
conveying said elongated structure along said conveyor path such that a second location of said elongated structure, longitudinally spaced from said first location of said elongated structure and at which a second slit is to be formed, is positioned at said cutting station;
moving said cutting means from said first ELEVATED, INOPERATIVE position to said second LOWERED, OPERATIVE position so as to cut said second slit within said elongated structure at said second location;
whereby a plurality of slits are formed within said elongated structure at longitudinally spaced locations of said elongated structure so as to fabricate said elongated structure in integrally connected, articulated sections with respect to each other.
20. The method as set forth in claim 19, further comprising the step of:
simultaneously scoring said elongated structure at said first and second longitudinally spaced locations so as to facilitate folding of said integrally connected, articulated sections with respect to each other.

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