**Method and apparatus for providing tension control of a web of bags in a packaging machine**

An improved packaging machine feeds a web in the form of a continuous chain of bags through the machine. The bags are fed from a supply along a first section of path through a dancer roll assembly and then to a second section of the path. Tension in the web between the supply and the dancer assembly is isolated from tension downstream in the path. The path then passes between rolls 71, 72 and belts 76, 77 up to rolls 73, 74. The nip rolls 73, 74 are greater in diameter than the belts 76 at that point. This provides positive web tensioning through this third section and assures proper alignment of the web and slight pre-opening of the bags.
The present invention relates generally to packaging systems, more particularly to apparatus and methods for forming packages by sequentially loading and separating bags from a web in the form of a chain of interconnected and pre-opened bags, and in particular, but not exclusively, to packaging machines and methods.

The use of chains of preopened bags to form packages is well known. Such chains of bags are disclosed and claimed in U.S. Patent Nos. 3,254,828 and 3,815,318. A machine described in U.S. Patent 4,899,520 includes an ability to use two chains of interconnected bags while packaging.

With each of these machines, a pair of drive nip rolls are adjacent a load station. In the majority of cases, a coil of so-called "bags-on-a-roll" is mounted on a mandrel to supply a web in the form of a chain of preopened bags to be fed through the machine. During set-up the web is fed from the supply along a path of travel through a so-called dancer arrangement, then through any accessory devices such as imprinters or hole punchers that may be provided, and thence through a section of the machine known as a bagger to the nip rolls. In order to feed the web through the bagger, it is necessary to open or remove a cover and hand-feed the web over and under rolls delineating the path of travel to the nips. While some machines such as that shown and described in Patent 4,928,455 facilitate the feed by having certain of the rolls elevated when the cover is opened, the feed of the web during set-up is nonetheless a manual, time-consuming operation.

It is an object of this invention, to obviate and/or mitigate this and other disadvantages of the prior art.

According to one aspect of the invention, there is provided a packaging machine comprising a structure delineating a path of travel for a web in the form of a chain of pre-opened plastic bags, drive means to feed the web along the path of travel through the machine to a loading station with the bags each oriented closed end first, characterised by a web feed mechanism comprising:

(a) opposed conveyor belts respectively position on opposite sides of the path;
(b) opposed pairs of spaced roll members respectively positioned on opposite sides of the path;
(c) each of the belts being stretched around the roller pair on the like side of the path and delineating as to each belt a feed reach adjacent the path and a return reach spaced from the path; and
(d) drive means coupled to at least one of the roller members selectively to rotate at least one coupled member and thereby cause the feed reaches to move in directions toward the load station.

According to another aspect of the invention there is provided a packaging machine having a web feed mechanism comprising:

(a) a first pair of grooved rolls;
(b) a first set of elastic belts reeved about the first pair of rolls to form a first web conveyor with the belts, each having a web feed reach extending between the rolls along a path of travel and opposed return reaches;
(c) a second pair of grooved rolls;
(d) a second set of elastic belts reeved about the second pair of rolls to form a second web conveyor with the belts, each having a web feed reach extending between the rolls along a path of travel and opposed return reaches.
(e) first rolls of each pair abutting nip rolls at the downstream ends of the feed reaches;
(f) second rolls of each pair being an upstream set with the second roll of the first pair being downstream from the second roll of the second pair;
(g) the feed reaches of the first conveyor having axes locating an imaginary plane; characterised by
(h) the second roll of the second pair being, at least in part, on the same side of such imaginary plane as the return reaches of the first conveyor such that the feed reaches of the second conveyor are deflected over and engage surfaces of the second roll of the first pair.

According to another aspect of the invention there is provided, apparatus for delivering a web of pre-opened bags from a supply station to load station, the apparatus comprising:

(a) first web gripping and feed means positioned along a web path of travel for pulling a web from a supply at the supply station;
(b) a web feed mechanism defining a section of the web path and including a second web gripping and feed means positioned along the web path of travel near the entrance to the mechanism; characterised by each of the gripping and feed means being adapted to isolate web tension producing forces upstream from it from a web section downstream and vice versa whereby to separate the web path into three sections in each of which web tension is controlled independently of the other sections.

According to another aspect of the invention there is provided, a method of feeding a web through a packaging machine characterised by the steps of:

(a) rotating at least one roll member of a nipped pair of roll members near a load station to drive a belt wrapped around a pair of roll members along one side of a web path of travel;
(b) driving an opposing belt wrapped around an opposing pair of roll members along an opposite side of the web path of travel;
(c) placing the web in contact with certain of the roll
members and the belts at a location spaced from the load station;

(d) threading the belt along the path by placing the web between the opposing roll members and feeding the web by continuing to drive the belts.

The preferred embodiment of the present invention comprises a packaging machine for loading bags having an upstanding support section mounted on a base at a location offset to one side of the base. A dancer assembly may be mounted on the base. A web supply positioner may be cantilevered from and connected to a frame of the dancer assembly. The positioner may project laterally from the dancer assembly frame at a bag supply station above the one side of the base toward the other side. Because in the preferred embodiment there is only a single, upstanding support section, a supply roll for the web can be quickly and easily mounted on the positioner.

A web dispensing section in the form of a bagger may be mounted on the support section above the position and the dancer assembly. The bagger may include a web feed mechanism which extends to a load station. The web feed mechanism and the dancer assembly may co-act to provide on of the outstanding features of the present invention. Together, they may segregate the web path of travel into three sections in each of which tension is controlled without effect on the other sections.

More specifically, nip rolls of the dancer assembly may feed the web evenly from the support roll no matter how badly wound that supply roll is. Any irregularities in the tension caused by a badly wound roll may be isolated from downstream sections of the web path of travel by the dancer nips. Belts of the web feed mechanism may grip the web as it enters the feed mechanism with the result that the section between the dancer and the web feed may have tension maintained by the dancer independent of any effects on tension in the other two sections. This enhances the operation of any accessory devices. The third section is in the web feed mechanism where the difference between the surface speed of the nips adjacent the load station and the belts of the feed mechanism assures tension control through the feed mechanism independent of web tension in the upstream sections.

The dancer assembly may include upper and lower dancer roll sets and upper and lower dancer frames respectively carrying the upper and lower sets. The frames may be pivotally connected together and may be selectively, relatively positionable in a web feed position or in a web tension control range. When the upper frame is in the web feed position, the upper roll set may be on one side of an imaginary plane located by the axes of the upstreammost and downstreammost rolls of the lower set. This allows facile feeding of a web through the assembly for set up. When the upper frame is in the tension control range, the upper set may be on the opposite side of the imaginary plane.

In order to sense relative frame pivoting in the tension control range, a segment of a gear may be connected to the frame pivot and a meshing “pot gear” may be connected to a potentiometer. At least one of the dancer nip rolls is preferably connected to a stepper motor. The pot gear may be rotated in response to the relative motion of the roll sets in the control range and may control the stepper motor via the potentiometer in response to such roll set motion to control the feed rate of the web from the web supply. This causes the driven dancer nip roll to feed the web at appropriate rates while the dancer roll sets maintain proper tension and alignment. The proper tension and alignment is maintained even when feed of the web is reversed from the load station for bag separation.

In the preferred machine, the bagger projects laterally from the support section toward the other side of the base section in a cantilever fashion. The web feed mechanism of the bagger may include an opposed pair of sets of elastic conveyor belts respectively positioned on opposite sides of the web path of travel. Upstream and downstream opposed pairs of spaced roll members are desirably also respectively positioned on opposite sides of the path. Each of the sets of the belts may be stretched around the roller pair on the like side of the path to delineate, as to each belt, a feed reach adjacent the path and a return reach spaced from the path. A stepper motor may be coupled to one of the roll members of each pair to rotate the coupled members and thereby cause the feed reaches to move in directions toward the load station for web feed. Preferably, the stepper motor reverses the direction of the feed reaches for bag tear-off after a bag has been loaded and as it is sealed.

Grooves may be provided in the roll members to receive the belts. Each of the grooves in the downstream roll pair, which are load station nip rolls, may have radial depth slightly greater than the diameter of the belts so that the linear speed of the belts is less than the surface speed of the load station nip rolls. Because of this speed differential, the belts place a drag on the web to help to maintain proper tension within the web, and the nips function to slightly pre-open within each bag.

Because, in the preferred embodiment, the bags are slightly pre-opened, reliable full opening at the load station is facilitated. In addition, slightly longitudinal offset perforations of the front and back of a bag in the web are no longer a problem. A spark detector that detects perforations for controlling advancement of the web can now detect the perforations in the back of a bag without hindrance from the front. To this end, the spark detector may be located a short distance upstream from the load station nip rolls so that detection of the perforations is at a location where the bags are partially pre-opened.

In the preferred embodiment, the upstream roll members are offset longitudinally of the path of travel. In addition, the rolls of the upstream pair and one of the downstream rolls may have axes located in a common plane. When the path of the belt reach travel is horizontal, the common plane may also be horizontal. The belts
of one conveyor may be each in the shape of an elongate oval with their feed reaches substantially horizontal. The feed reaches of the other conveyor may stretch from the offset upstream roll, downwardly under the other roll of the upstream pair and then substantially horizontally forward.

The described offset arrangement of the upstream roll pair of the preferred embodiment of this web feed mechanism provides another of the desirable features of a machine of this invention in that the belts provide self-threading web feed through the bagger during setup. Thus, the web feed through the feed mechanism only requires manual feed of the web to its entrance and "jogging" of the machine to thread the web through the mechanism. To unthread the machine or to correct a problem if, for example, initial feeding of a new web has become skewed, the jogging can be reversed to back the web out of the mechanism.

The support section may include an internal chamber that provides a portion of an air manifold. Additionally, the bagger may be connected to the support section by a tube that also defines an internal chamber. The tube chamber may communicate with the support chamber to define a further portion of the air manifold. The manifold may function as a plenum to provide air under substantially uniform pressure to the packaging machine, even with an inconsistent external air supply.

The advantages of the preferred embodiment of the invention are that it provides an improved packaging machine for loading products into bags from a web in the form of a continuous chain of bags while maintaining proper web alignment and tension as the web is fed through the machine and a method of packaging.

An embodiment of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a side elevational view of a packaging machine embodying the present invention;
Figure 2 is a side elevational view of the packaging machine of Figure 1 with parts of the bagger broken away and removed and a partial sectional view of a web tensioning device;
Figure 2A is an enlarged sectional view of the bagger with parts of the bagger broken away and removed;
Figure 3 is an enlarged sectional view of a web supply and tensioning device of the packaging machine;
Figure 4 is a top plan view of the packaging machine of Figure 1;
Figure 5 is a front elevational view of the packaging machine of Figure 1 on a reduced scale;
Figure 6 is an enlarged sectional view of a bagger of the packaging machine of Figure 1 with parts of the bagger broken away and removed;
Figure 7 is an enlarged elevational view of a nip roll drive assembly of the bagger of Figure 6;
Figure 8 is a top plan view of the nip roll drive assembly of Figure 7;
Figure 9 is a side elevational view of the drive assembly of the nip roll of Figure 7;
Figure 10 is a cross section view of the nip drive roll assembly of Figure 7 as seen approximately from the plane indicated by the line 10-10 in Figure 7;
Figure 11 is a top plan view of the web supply and tensioning device of Figure 3 with parts broken away and removed;
Figure 12 is a front elevational view of the web tensioning device of Figure 3 as seen from the plane indicated by the line 12-12 of Figure 11;
Figure 13 is a reduced scale side elevational view of the web tensioning device of Figure 3 illustrating an upper set of dancer rolls in an upright position;
Figure 14 is a front elevational view of the packaging machine of Figure 1 with the nip drive roll assembly and a sealing section removed;
Figure 15 is an enlarged front elevational view of a frame of the bagger illustrated in Figure 6;
Figure 16 is an enlarged sectional view of the bagger with parts of the bagger broken away and removed and illustrating the drive roll assembly mounted in an alternate location;
Figure 17 is a rear elevational view of a housing for the electronic controls of the packaging machine;
Figure 18 is a side elevational view of the housing for the electronic controls of the packaging machine; and
Figure 19 is a top plan view of the housing for the electronic controls of the packaging machine.

Referring to the drawings, a packaging machine constructed in accordance with a preferred embodiment of the invention is illustrated generally at 10. The machine 10 is constructed to load bags from a web 11 in the form of an interconnected chain of open bags. The bags are preferably connected together along lines of weakness so that each bag can be separated from the web after it has been loaded with a product.

The packaging machine 10 includes an upstanding support frame 12 that sits atop a base 13. The base 13 is supported by rollers 14 that allow the packaging machine 10 to be moved easily. The packaging machine 10 further includes a bagger 15 that is cantilever mounted on the support frame 12. The bagger includes a removable housing or cover 16 that encloses the bagger and covers a bagger web feed mechanism M, Figure 6. A web supply and tensioning device 17 is connected to base 13 below the bagger 15.

The support frame 12 is preferably a hollow, single-leg frame that is, as is best seen in Figure 5, laterally offset to one side of the base 13. An enclosed inner chamber 18 (Figure 1) of the support frame forms a portion of an air manifold. A support arm 20 projects laterally from the support frame 12. The arm 20 is the cantilever support for the bagger 15. The arm 20 is also preferably hollow to provide an air chamber which is in communication with the chamber 18 to form a further portion of
the air manifold. To this end, the tube 20 projects through and is secured to the stand 12, Figure 5. Apertures A in the arm 20 provide fluid communication between the chambers of the stand and the arm.

An air regulator 21 is connected to the support frame 12 and is connectable to an external air supply source (not shown). The air regulator allows air from an external source to enter the air manifold and maintain the air within the manifold at a desired pressure. A set of connectors 22 are provided along the support arm for connection of accessories (not shown). If an accessory requires a reduced air pressure, an air regulator can be attached to a connector in order to adjust the pressure of the air supplied by the manifold.

The Web Supply and Tensioning Device 17

As best seen in Figures 3, 11 and 13, the web supply and tensioning device 17 includes a lower frame 30 and a cantilevered supply shaft 31 for carrying a roll of bags R. A roll positioning hub 32 is mounted on the supply shaft near an end connected to the frame 30 while a hub assembly 33 is mounted at its opposite end. The two hubs 32, 33 have knobs 34, 35 for clamping of the hubs onto the shaft in adjusted positions along the shaft. In order to mount a supply roll to the supply shaft 31, the hub assembly 33 is removed from the supply shaft and a supply roll is slid onto the shaft. The hub assembly 33 is placed back on the supply shaft and is slid up against the supply roll such that a spring 36 of the hub assembly 33 is against the supply roll in order to bias the supply roll against the positioning hub 32 while allowing the roll to rotate freely.

The tensioning device 17 also includes an upper frame 39 which carries an upper dancer roll set 40. The upper frame 39 is pivotally connected to the lower frame 30 and is pivotable with respect to the remainder of the tensioning device about an axis co-axial with an idler roll 43. The upper dancer roll set has three idler rolls 41a, 41b, 41c. Three lower idler rolls 42a, 42b, 42c are carried by the lower frame 30 and form a lower roll set. The upper and lower rolls define a section of a web path of travel with the lower rolls being respectively laterally offset rearwardly of the path of travel with respect to the upper rolls.

With the machine set-up shown in the drawings, the web path of travel begins with the supply roll R, passes over the idler roll 43 and continues through the web tensioning device. The idler roll 43 is mounted on the frame 30 along the pivot axis of the upper dancer roll set 40 and its shaft serves as the pivot for the upper set.

A segment of a gear 44 is attached to the upper frame 39 so that it pivots with the upper dancer roll set 40 about the axis of the idler roll 43. The gear segment 44 is in mesh with a "pot gear" 45 that is connected to a potentiometer 46. This pot gear 45 causes pot rotation in response to the rotation of the gear segment 44 and thereby "informs" the potentiometer of the position of the upper dancer roll set 40.

A stepper motor 50 is controlled by the potentiometer 46 and drives a drive roll 51 via a toothed belt 52. The drive roll 51 has an idler roll 53 nipped against it to form a nip roll assembly. This nip roll assembly contributes to the definition of the web path of travel and provides one of the features of the invention. This assembly pulls the web from the supply roll R and functions to isolate tension effects of the supply roll in the feed section of the path of travel from sections of the web path which are downstream from the nip assembly.

The nip roll 53 is biased against the drive roll 51 by two springs 54a, 54b. When the upper dancer roll set 40 moves up and down, a shaft of the nip roll travels within a slot 55 provided by the upper frame 39. A second slot is on an opposite side of the frame 39, but is not illustrated. When the upper dancer roll set 40 is fully raised into its web feed position, as illustrated in Figure 13, the springs 54a, 54b are stretched and the nip roll 53 is pulled away from the drive roll 51 to move its axial shaft into offset end sections of the slots 55 and to horizontal sections of slots 56 defined within the frame 30. This retains the upper set in the position of Figure 13 to facilitate set-up feeding of the web between the nip roll and the drive roll and through the tensioning device.

Since physical properties of webs which can be fed through the machine fall in a wide range, a tension adjustment of the dancer assembly is required. Accordingly, two counter weights 60a, 60b are provided. Each counter weight has a control knob 61 that threadedly engages a screw 62 located in a corresponding slot defined by the upper frame 39. By loosening and tightening the knob, the counter weight can be shifted appropriately along an upper guide portion of the frame 39 to adjust the amount of tension applied to the web. The counter weights are small and compact as contrasted with dancer arms used with previous machines.

In operation, the web is fed from a supply roll R carried by the supply shaft 31 over the idler roll 43 and between the nip roll 53 and drive roll 51. When the upper dancer roll set 40 is in its web feed position of Figure 13, the web is laid across the three lower rolls 42a, 42b, 42c. The drive roll shaft is then manually moved out of the offset sections of the slots 55 and the horizontal sections of slots 56. The upper dancer roll set is then lowered until the upper dancer rolls 41a, 41b, 41c engage the web and push it down such that the web is now woven over each lower roll and under each upper dancer roll in a "zig-zag" fashion.

When the packaging machine 10 is operating and the web is being drawn through the bagger 15, the upper dancer roll set 40 moves upwardly thereby causing the gear segment 44 to pivot in conjunction with the upper dancer roll set movement which, in turn, rotates the pot gear 45. The potentiometer thereby "instructs" the stepper motor to drive the drive roll 51 to feed the web from the supply roll to increase the volume of web in the web tensioning device 17. This allows the upper dancer roll set 40 to move downwardly against the web. This, in turn, causes the segment of the gear to move...
the pot gear, which causes the potentiometer to "instruct" the stepper motor to slow its driving of the drive roll 51. In this manner, the upper dancer roll set 40 moves up and down in a tension control range to control the tension of the web.

The Bagger Feed Mechanism M

As best seen in Figures 2, 4 and 6, after the web travels under the third upper dancer roll 41c, it travels upwardly through a second section of the web path to the bagger 15. Optionally, accessory devices (not shown) may be positioned along the second section. The bagger feed mechanism M functions to isolate downstream tensional effects from the second section so that the mechanism M and the nip roll assembly of the device 17 cooperate to isolate this second section from up- and downstream tensional forces.

The feed mechanism M defines a third section of the web path of travel. An idler roll 71 over which the web 11 is fed delineates the upstream end of the mechanism M. A second idler roll 72 is further along the web path of travel within the bagger. A pair of load station nip rolls 73, 74, with the roll 74 being a driven roll, are positioned adjacent an output end 70b of the bagger 15.

Grooves 75 are defined in each of the rolls 71, 72, 73, 74. Four lower elastic belts 76 are around the rolls 71, 74 and in their grooves 75 to provide a lower web conveyor. Four upper elastic belts 77 are around the rolls 72, 73 and in their grooves 75 to provide a co-acting upper web conveyor.

The upstream rolls 71, 72 are offset, both longitudinally and laterally of the web path with the axis of the upstream lower conveyor roll 71 located above the plane of an upper conveyor feed reach 77f. While the location of the lower conveyor roll 71 may be adjusted, in the preferred and disclosed arrangement it is located in a plane that contains the axes of the upper conveyor rolls 72, 73. Because of the offset of the roll 71, the lower belts 76 are stretched around and in contact with an underside of the roll 72. The upper conveyor belts 77 are elongate oval in shape while belts 76 are otherwise configured because of the contact with the upper belt roll 72.

The bending of the lower belts 76 over the upstream upper belt roll 72 assures a positive clamping of a web being fed against the upper roll and positive frictional engagement of the belt with a web being fed through the bagger. This frictional engagement at the upper rearward roll 72 contributes to two of the outstanding features of the invention. First, it isolates downstream tensional forces from upstream sections of the web and thus, delineates a division between the second and third sections of the web path of travel. In addition, the assured frictional engagement with the belt permits the bagger feed mechanism M to grasp a web and self-thread it through the mechanism M to a load station adjacent the nip rolls 73, 74. Further, by reversing the direction of belt rotation, one may readily unthread the machine to facilitate change over to a different web or correct a malalignment should it occur as a web is self-threaded.

The dimensioning of the nip rolls 73, 74 provides another of the outstanding features of the invention. The radial depth of the grooves 75 in these nip rolls is slightly greater than the diameter of the belts 76, 77. Thus, the diameters of the rolls 73, 74 are slightly greater than the diametrical dimension of the belts as they are reeved around the nip rolls and disposed in the grooves with the result that the lineal surface speed of the rolls 73, 74 at their line of nip engagement is slightly greater than the surface speed of feed reaches 76f, 77f. This speed differential provides several outstanding advantages. First, it provides positive web tensioning through the third section in the path of travel between the feed reaches 76f, 77f. This assures proper alignment of the web throughout the bagger feed mechanism M. In addition, since the upper face of the web, as viewed in Figure 6, contains the open bag front, the speed differential between the nips and the belts slightly pre-opens the bags, greatly facilitating the speed and completeness of bag opening at the load station.

The Nip Roll Sub-Assembly

As best seen in Figures 8-10, the upper nip roll 73 is offset rearwardly along the path of travel with respect to the drive roll 74. The nip roll 73 is nipped against the drive roll by springs 80a, 80b. A lever 81 is connected to an outer shaft of the nip roll 73 in a cammed relationship such that movement of the lever selectively from its position in Figure 10 to its position in Figure 9 will cause the nip roll 73 to be separated from the drive roll 74 as shown in Figure 9. This separation facilitates machine service and maintenance.

The nip roll 73 and the drive roll 74 are connected to a support 73a to form a nip roll sub-assembly. The nip roll sub-assembly can be mounted in a selected one of two locations based upon operator choice. Four holes 78 are aligned with either of two sets of holes 79a, 79b (See Fig. 15) located on the bagger 15. Bolts 79c (two of four are shown) are used to secure the nip roll sub-assembly in its selected location on the bagger.

Figure 16 illustrates the nip roll sub-assembly mounted in its lower position and connected to the holes 79b. A longer belt 74b is required to connect the roll 74 and the stepper motor 74a in the lower position than is the case in the upper position.

A set of three fingers 82 is secured to the support 73a by fasteners 82a, Figure 10. The fingers 82 depend from the support 73a and then extend forwardly through arcuately curved sections 82b disposed in grooves 83 formed in the upper nip roll 73. The fingers extend further forwardly and downwardly through a second set of arcuately curved sections 82c which are complementally, closely adjacent the lower nip roll 74. The lower finger sections 82c serve as web deflectors to deflect the web downwardly and assure appropriate positioning of
each bag to be loaded at the load station.

A spark gap detector 82d is positioned slightly upstream from the nip rolls 73, 74 and co-acts with the fingers 82 to sense web perforations that delineate lines of weakness between successive bags. The web normally acts as an insulator preventing spark travel between the sensor and the fingers. When the perforations pass between the fingers and the sensor, arcs travel through the web from the sensor to the fingers, thereby providing a signal for registration of a bag in position to be loaded. Because the bags are slightly pre-opened by the tension created by the drag of the belts 76, 77, offset perforations at an upstream location in the backs of the bags can be detected by the sensor.

The Air Knife System

An air knife 84 is in communication with the air manifold defined by the support frame 12 and support arm 20. The air knife is commercially available from Exair Corporation, 1250 Century Circle North, Cincinnati, Ohio 45246 under Part No. X032092. An air tube 85 is also in communication with the air manifold. After a bag passes between the nip rolls 73, 74 and in a position for loading, a burst of air from air tube 85 opens the bag while a steady, laterally elongate, stream of air from the air knife completes and maintains the opening of the bag.

The air from the air knife passes from between upper and lower portions 84a, 84b, Figure 10. After the air passes between these two portions, it travels over and around a radiused corner 84c of the lower portion 84b and along a front side of the air knife and into the bag. Because of the long, lateral dimension of the air knife, it provides a sheet of air under low pressure 35 mmHg that allows the bag to be opened and maintained in an open position. The air from the air knife 84, a product may be either manually or automatically loaded into the bag. Once the product has been loaded into the bag, a solenoid 86 terminates the flow of air through the air knife 84. As the air flow is stopped, a clamping sub-assembly 90 is moved against the bag causing the bag to move against a heater bar sub-assembly 91, Figure 2.

The Clamping and Heater Bar Sub-Assemblies

The clamping sub-assembly 90 is connected with the machinery 10 by guide rods 96, 97. The sub-assembly 90 includes a support 92 and a seal pad 93 connected to the support, Figure 2. A seal pad housing 94 is connected to the support 92 via lost motion connections (one of which is shown at 95). The lost motion connections each include a pin 100 and a spring 101.

The heater bar sub-assembly 91 includes a heater bar 102 protected by a conventional Teflon® cover. Upper and lower gripper plates 103, 104 flank the heater bar. Each of the gripper plates 103, 104 has a flat surface 105. The plates are mounted on the bagger 15 by bolts 106, 107 that are surrounded by springs 108, 109. Upper and lower edges 105a, 105b of the plates are sharpened and serrated.

A jam prevention system is provided and includes two reflective devices located on the clamping sub-assembly, a light beam emitter and a light beam receiver. The structure and operation of the jam prevention system is more fully described in a co-pending patent application, which is incorporated herein in its entirety by reference, entitled "Packaging Machine and Method," filed concurrently herewith and owned by a common assignee.

The clamping sub-assembly 90 is moved against the heater bar sub-assembly 91 by an air cylinder 110. The air cylinder 110 is in fluid communication with the air manifold within the support frame 12 and support arm 20. The seal pad housing 94 compresses against its lost motion connections and the seal pad 93 clamps a loaded bag against the gripper plates 103, 104 and thence against the heater bar 102. While the loaded bag is clamped between the sub-assemblies, the stepper motor 74a reverses the web feed thereby separating the loaded bag from the web.

The Electronic Controls

Electronic controls for the machine 10 are contained within a housing 120 that is illustrated in Figures 17-19. The controls include a controller board defining a bus system and one or more auxiliary boards coupled to the bus system. The housing 120 is a removable section of the bagger 15 and therefore can easily be removed as a unit for maintenance and service as opposed to individually removing electrical circuit boards or other components. The structure and operation of the electronic control system of the machine 10 is more fully described in a co-pending patent application, which is incorporated herein in its entirety by reference, entitled "Bagging Control Apparatus and Method," filed 27th August 1992 and owned by a common assignee.

An input module 130 is connected to the support frame 12. The input module 130 includes a keypad 131 that allows operator input for programming and controlling the machine 10.

The bagger 15 and input module 130 are individually pivotable as illustrated in phantom in Figure 1. Two screws 132, 133 are respectively contained within slots 134, 135 located within a portion of a module support bracket 136. By loosening the screws 132, 133, the module can be rotated about an extension of the tube 201 to position the keypad at a desired orientation.

Split clamps 137, Figure 5, rotatively fix the bagger 15 at a desired orientation on the tube 20. Loosening of cap bolts 139 (only one of four being shown in Figure 5) allows the bagger to be rotated to a desired orientation and then clamped in that orientation.

Although the preferred embodiment of this invention has been shown and described, it should be under-
stood that various modifications and rearrangements of the parts may be resorted to without departing from the scope of the invention as disclosed and claimed herein.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

Claims

1. A method for providing tension control in a packaging machine utilising webs of pre-opened bags, characterised by:
   a) feeding an elongate web of pre-opened bags from a supply along a first section of a path of travel through a first web grasping and feeding mechanism by tensioning the web between the supply and the first mechanism while isolating such tensioning from downstream path sections;
   b) feeding the web from the first mechanism along a second section of the path through a second web grasping and feeding mechanism while isolating tension in the second section from a third downstream section of the web;
   c) controllably tensioning the web in the second section as the web is fed through the second section; and
   d) applying tension to a third section of the web downstream from the second mechanism.

2. A method according to claim 1 characterised by applying an accelerating force to a face of each bag as it approaches the load station while maintaining tension within the web, thereby slightly pre-opening the bags.

3. A method according to claim 1 or claim 2, characterised in that tension in the third section is maintained by applying differential feed rates with two components of the second mechanism.

4. A method according to any of claims 1 to 3, characterised in that the first mechanism includes a pair of drive nip rolls and the method further includes the step of varying the feed rate of the nip rolls in response to sensed web feed conditions.

5. A method according to claim 4, characterised in that relative movement of a pair of feed rolls is used to sense web feed conditions.

6. A method according to any of the preceding claims, further characterised by including the steps of:
   a) relatively positioning pivotally connected upper and lower dancer frames (30, 39) respectively carrying upper and lower dancer roll sets (40, 42) such that the roll sets are on opposite sides of an imaginary plane;
   b) feeding the web generally along the plane while the roll sets are so positioned on opposite sides of it;
   c) moving the upper frame to position its roll set on the other side of the plane in a web feed position in a tension control range;
   d) and controlling the web tension between the supply and the first mechanism by monitoring the relative positions of the dancer frames in response to the feeding of web through the bagger; and controlling the feed of the web in response to the relative positions of the dancer frames.

7. Apparatus for delivering a web from a supply station to a load station in a packaging machine, the apparatus comprising:
   a) first web gripping and feed means (1) positioned along a web path of travel for pulling a web from a supply at the supply station;
   b) a web feed mechanism (m) defining a section of the web path and including a second web gripping and feed means (76, 77) positioned along the web path of travel near the entrance to the mechanism; and the apparatus being characterised by:
   c) each of the gripping and feed means being adapted to isolate web tension producing forces upstream from it from a web section downstream and vice versa whereby to separate the web path into three sections in each of which web tension is controlled independently of the other sections.

8. Apparatus according to claim 7, characterised by the second web gripping means being a co-acting pair of belt conveyors (76, 77) and a downstream load station nip roll pair (73, 74) having a feed rate greater than that of the conveyors.

9. Apparatus according to claim 7 or 8, characterised in that a dancer mechanism (30, 39, 40, 42) controls tension in a middle one of the three sections, and in that the first gripping and feed means includes a powered nip roll set (51, 53) having a feed rate responsive to motion of the dancer mechanism.

10. Apparatus according to any of claims 7 to 9, characterised in that the first gripping and feed means includes:
   a) upper and lower dancer roll sets (40, 42);
b) upper and lower dancer frames (30, 39) respectively carrying the upper and lower sets; and further characterised by
c) the frames being relatively movably connected together and being selectively relatively positionable in a web feed position and a web tension control range;
d) the upper roll set when in the web feed position being on one side of an imaginary plane located by the axes of the upstream most and downstream most rolls of the lower set, the upper set being on the opposite side of the plane when in the tension control range;
e) a frame motion-sensing mechanism (44, 45, 46) operatively connected to the frames and adapted to sense relative motion of the frames when in the control range; and
f) a web feed rate control means (51, 53) positioned to engage a web being fed along the path for controlling the feed rate of the web in response to mechanism sensed relative motion of the frames.

11. Apparatus according to claim 10 characterised in that the feed rate control means comprises a pair of nip rolls (51, 53) at least one of which is connected to a stepper motor (50) and motor output control means (46) for sensing relative location of the roll sets in the control range and controlling the motor in response to such location sensing.

12. Apparatus according to claim 11 characterised in that the frames (30, 39) are pivotally connected and in that the output control means is a gear segment (44) connected to the frame pivot to sense relative frame pivoting in the range, the gear segment being meshed with a pot gear (45) that is connected to a potentiometer (46).

13. Apparatus according to any claims 10 to 12, characterised in that the machine includes structure (54, 55, 56) adapted to releasably retain the frames in the web feed position.

14. Apparatus according to any of claims 10 to 13, characterised in that the rate control means includes a pair of nip rolls, one of the nip rolls (51, 52) including a shaft projecting into a curved slot in the upper dancer frame, the slot (55) including a feed position retention portion, and said one of the nip rolls being movable from a tension control range position to a web feed position wherein a portion of the shaft is in the feed position retention portion.
The present search report has been drawn up for all claims.

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<tr>
<th>Category</th>
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<th>Relevant to claim</th>
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<td>EP-A-0 207 838 (P. VANNIER) * page 8, line 1 - page 9, line 10; figures *</td>
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**TECHNICAL FIELDS SEARCHED (Int.Cl.6)**

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