



US 20040025476A1

(19) **United States**

(12) **Patent Application Publication**
Oliverio et al.

(10) **Pub. No.: US 2004/0025476 A1**

(43) **Pub. Date: Feb. 12, 2004**

(54) **STAND-UP POUCH FORMING, FILLING AND SEALING**

Publication Classification

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(51) **Int. Cl.⁷** **B65B 9/06**
(52) **U.S. Cl.** **53/450; 53/550; 53/385.1; 53/386.1; 53/284.7; 53/469; 53/141; 53/492; 53/51**

(57) **ABSTRACT**

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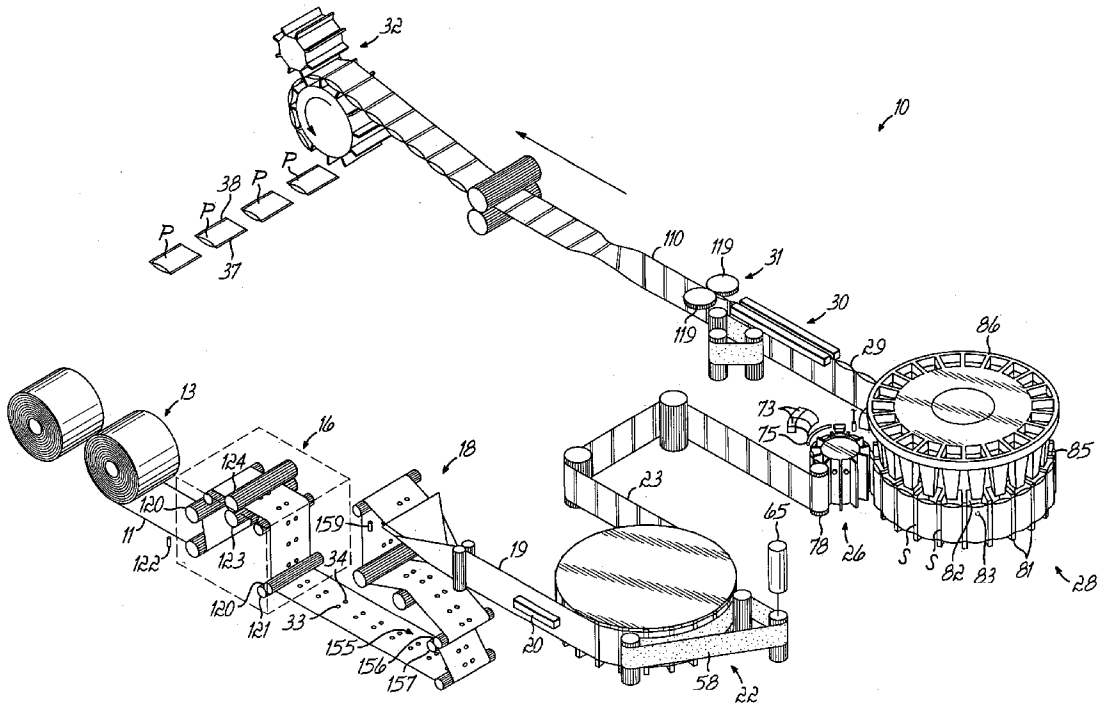
An in-line, continuously operating stand-up pouch forming, filling and sealing apparatus and process contemplates a continuously moving web and pouch train operating at rates in excess of 150 pouches or 500 to 600 web inches per minute, and at to at least about 1500 pouches or 4000 web inches per minute. Seal facilitating holes are continuously punched in a continuously moving web and side seams are formed by continuously sealing a continuous web. The stand-up pouches are positively opened by a continuous Coanda-Effect application or alternately by a combined vacuum/mechanical operation. Stand-up pouches are continuously formed, filled and sealed without intermittent web stops for web or pouch operations.

(21) Appl. No.: **10/410,563**

(22) Filed: **Apr. 9, 2003**

Related U.S. Application Data

(60) Provisional application No. 60/371,484, filed on Apr. 10, 2002.



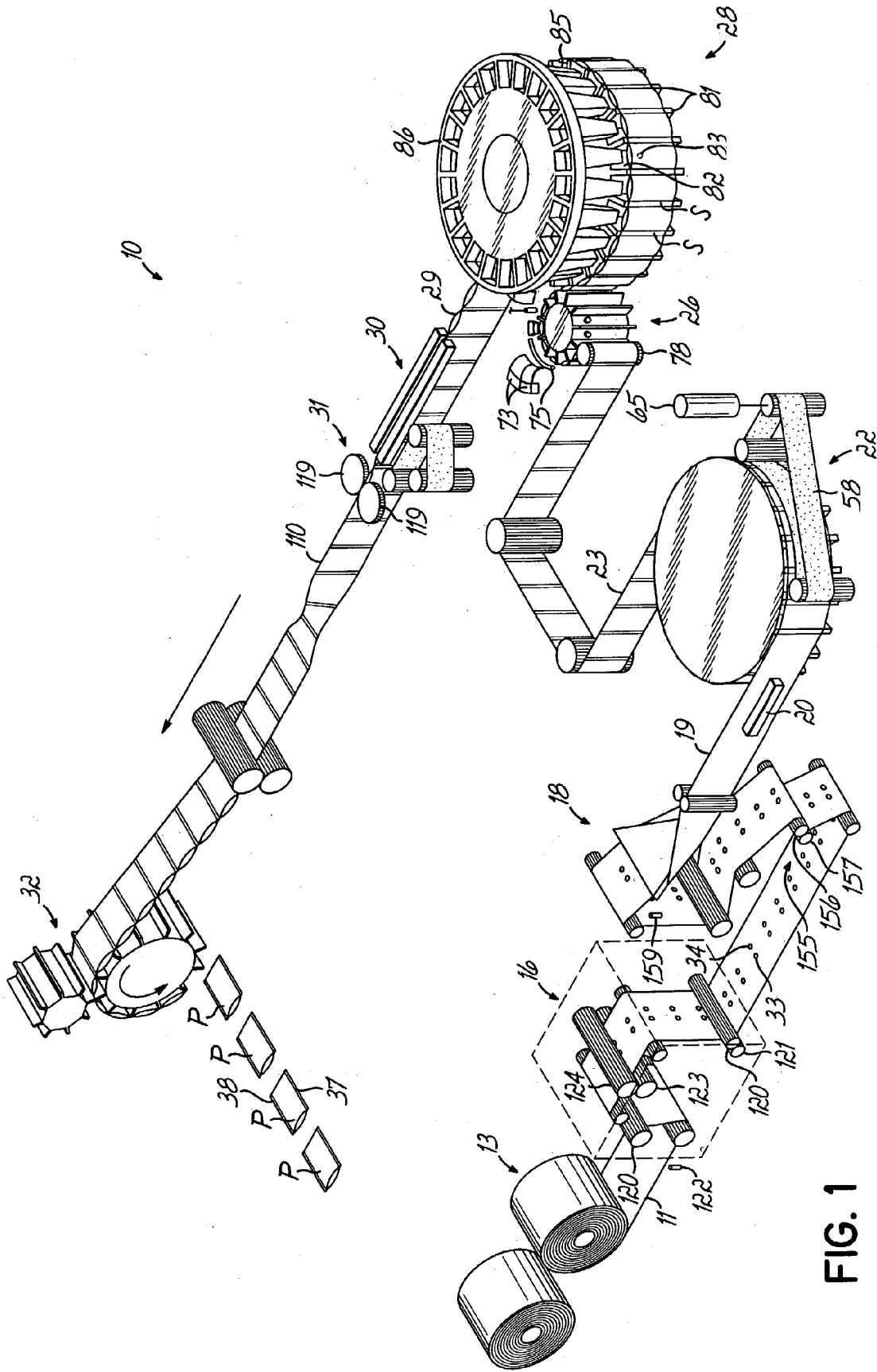


FIG. 1

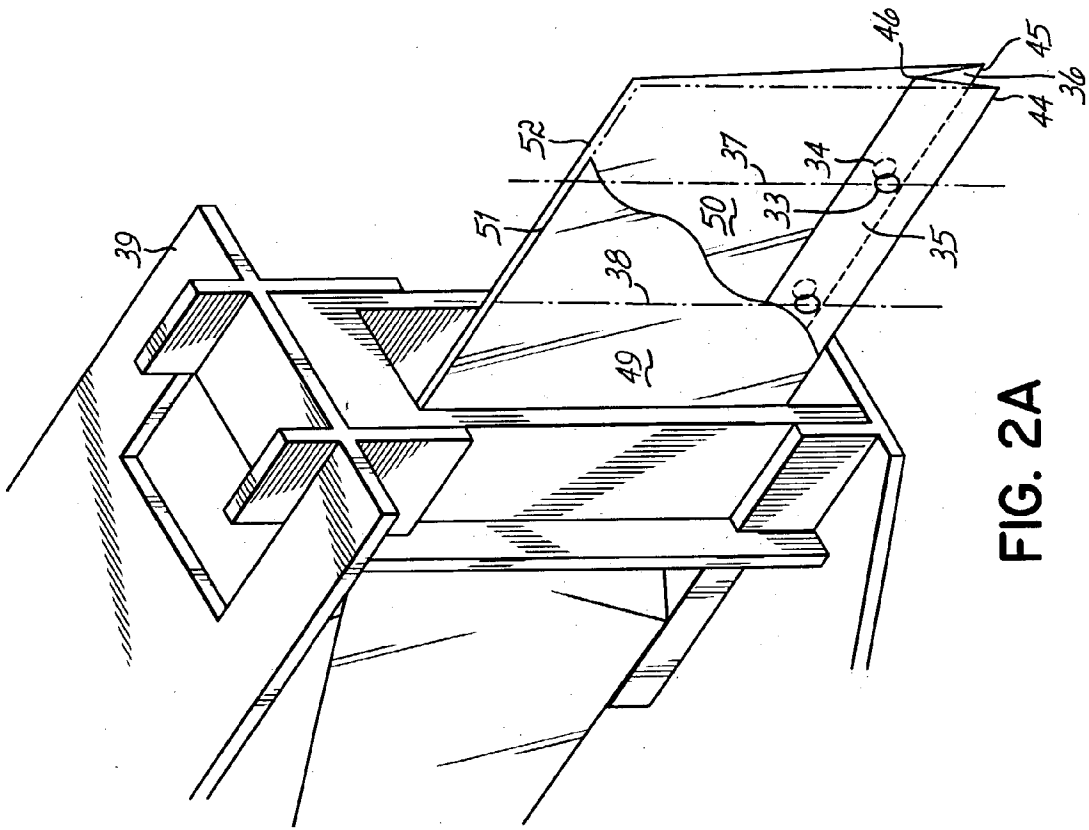


FIG. 2A

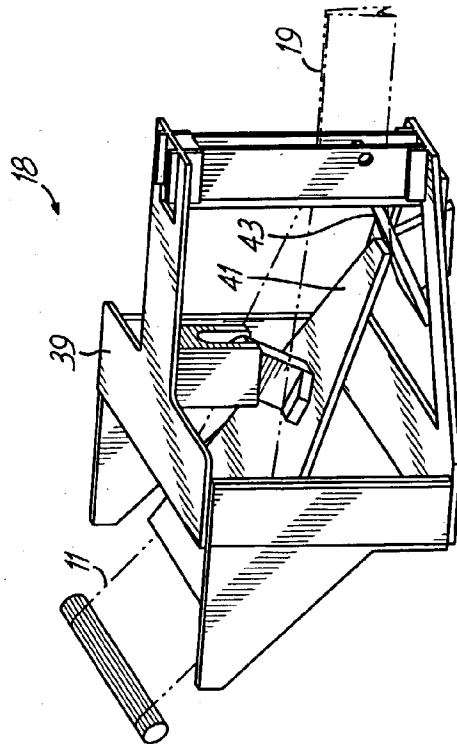


FIG. 2

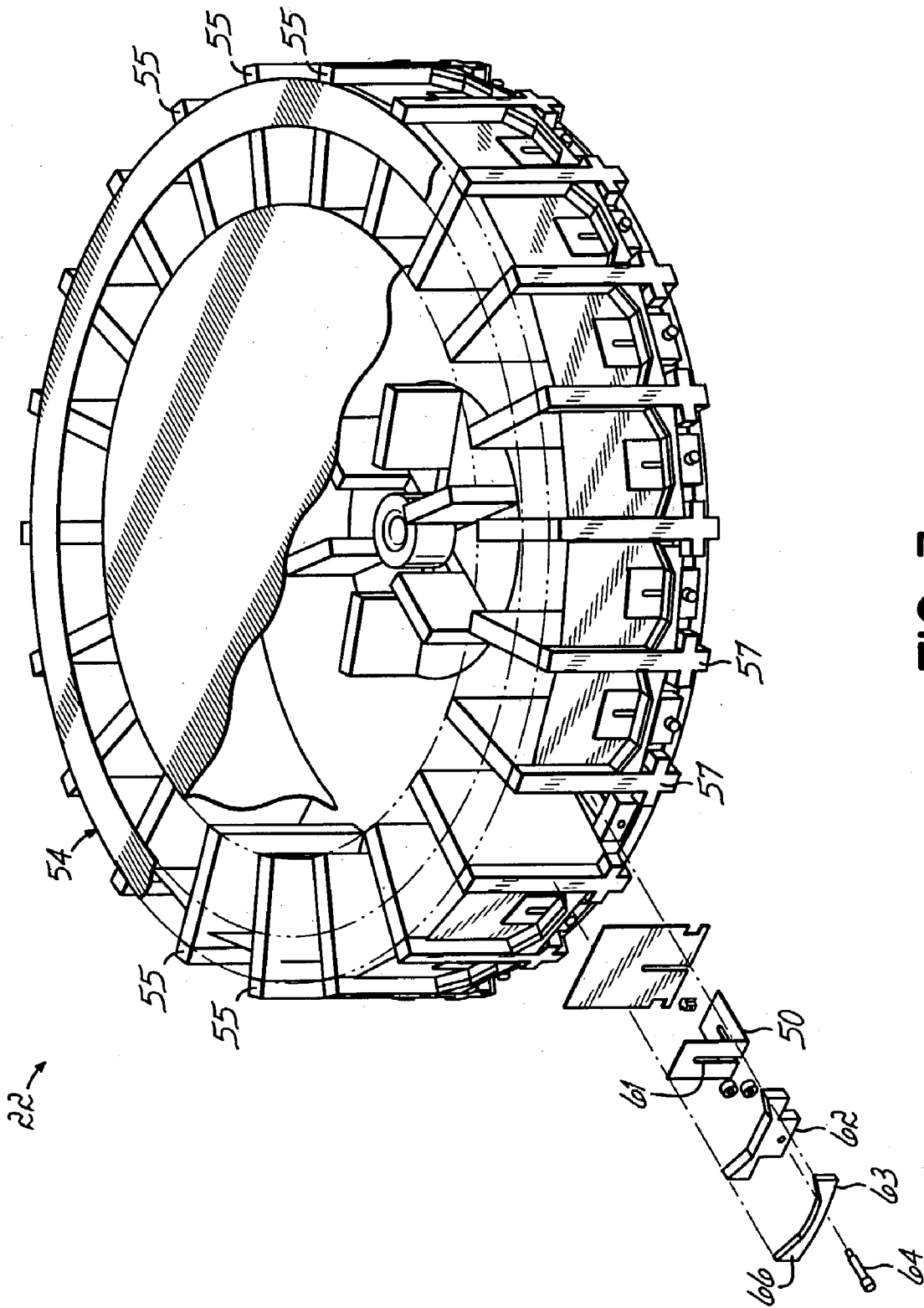


FIG. 3

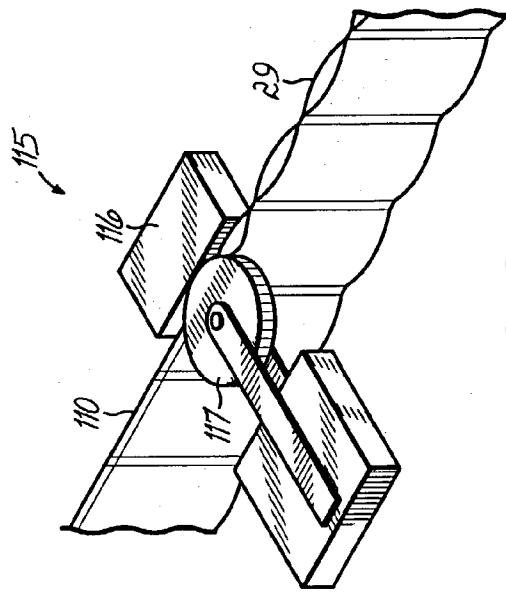


FIG. 9

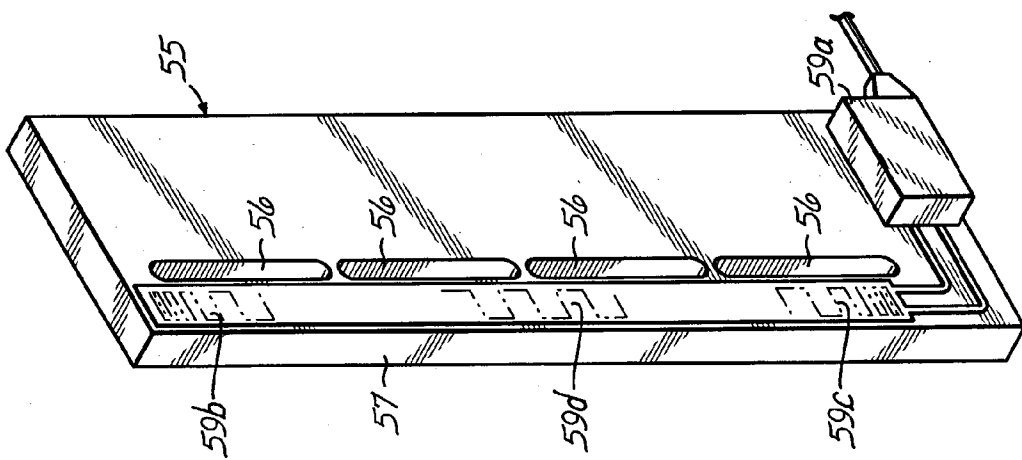


FIG. 3A

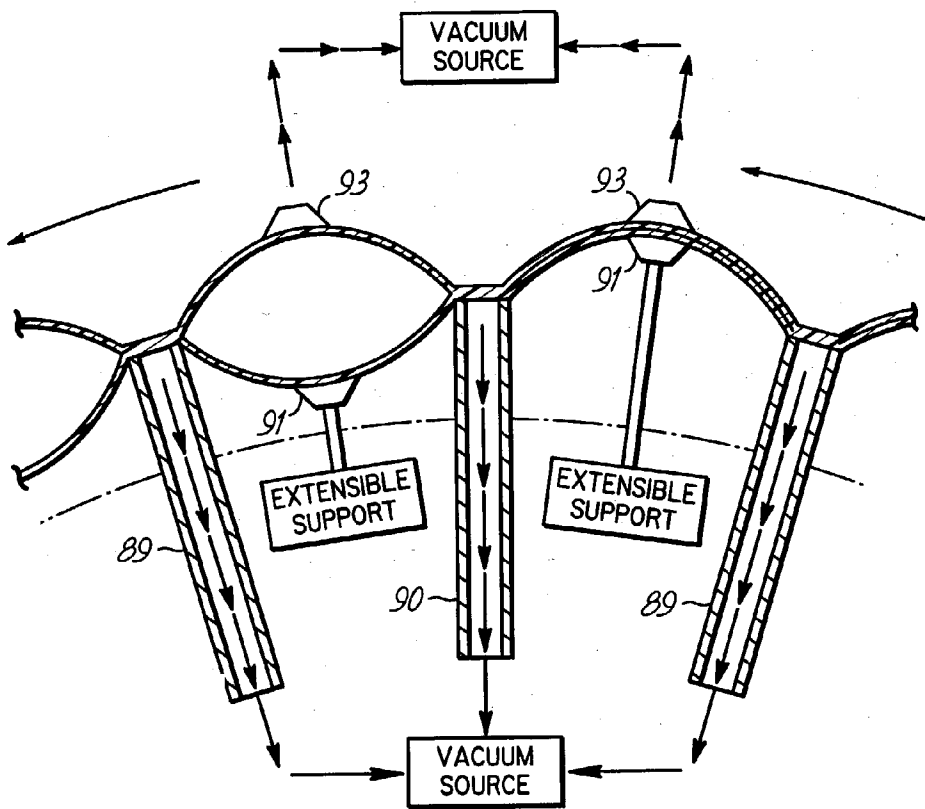


FIG. 4

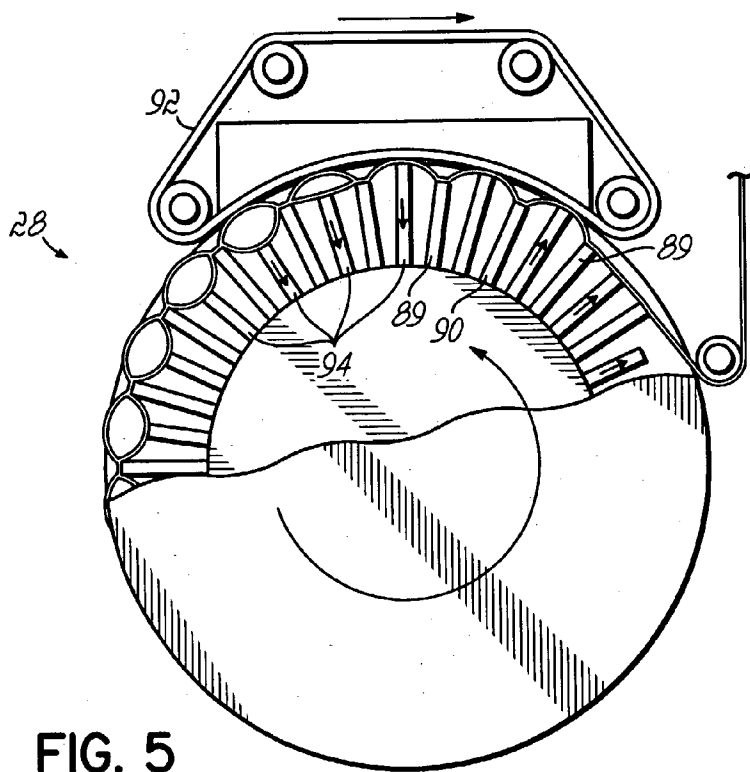


FIG. 5

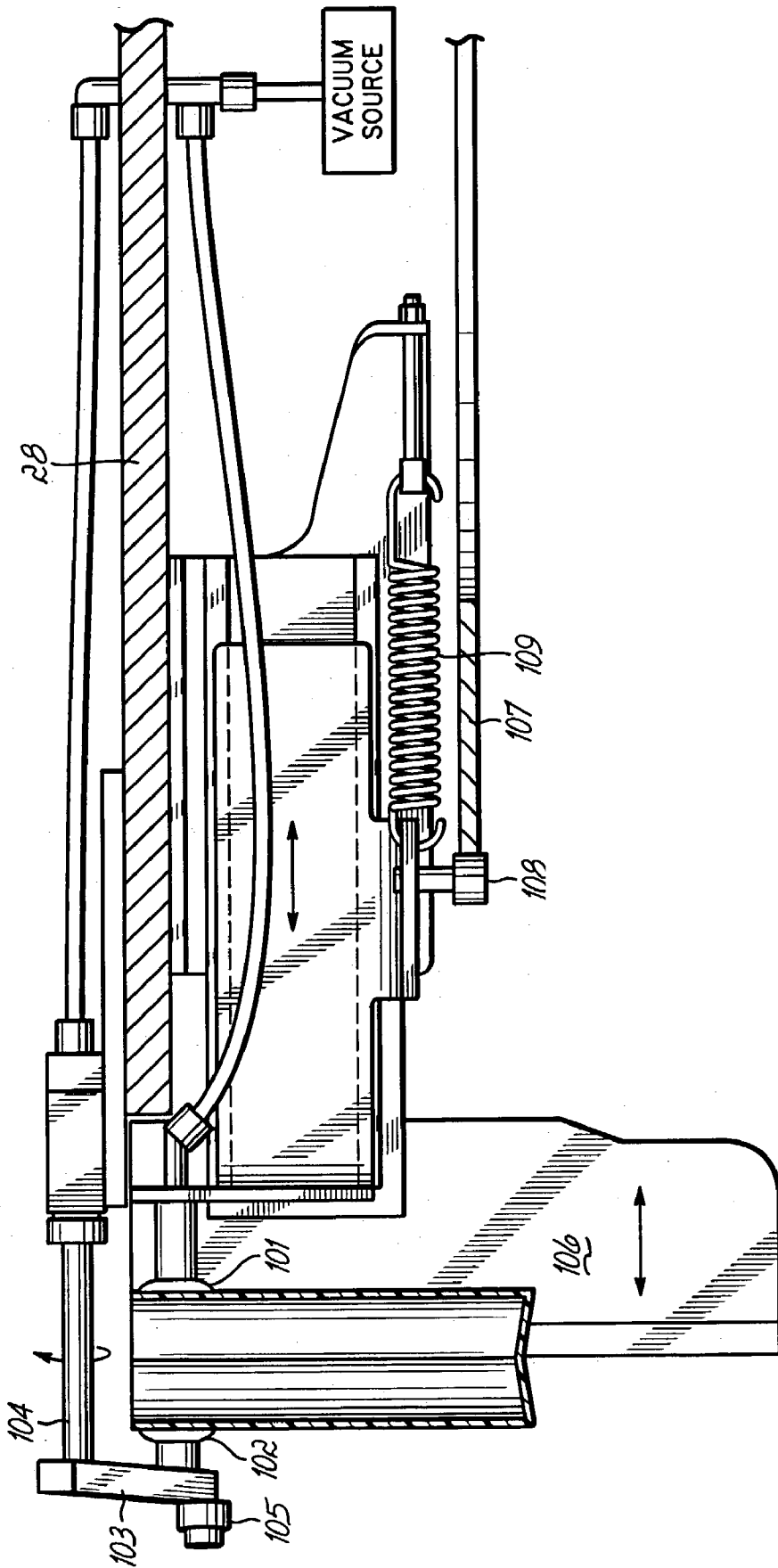


FIG. 6

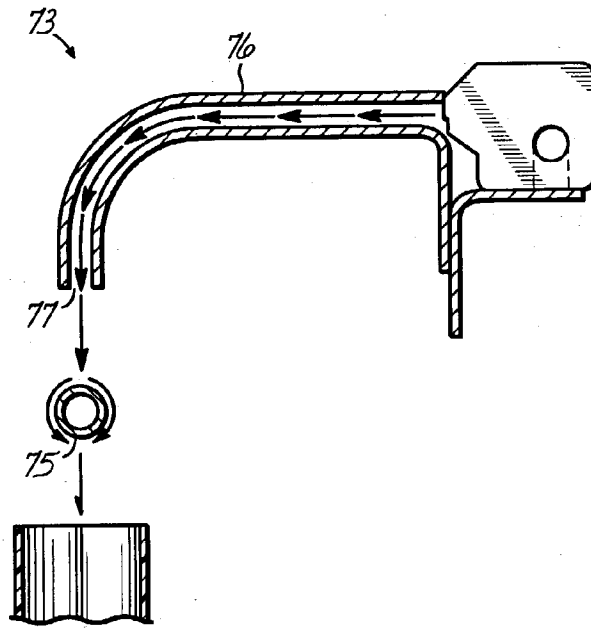


FIG. 7

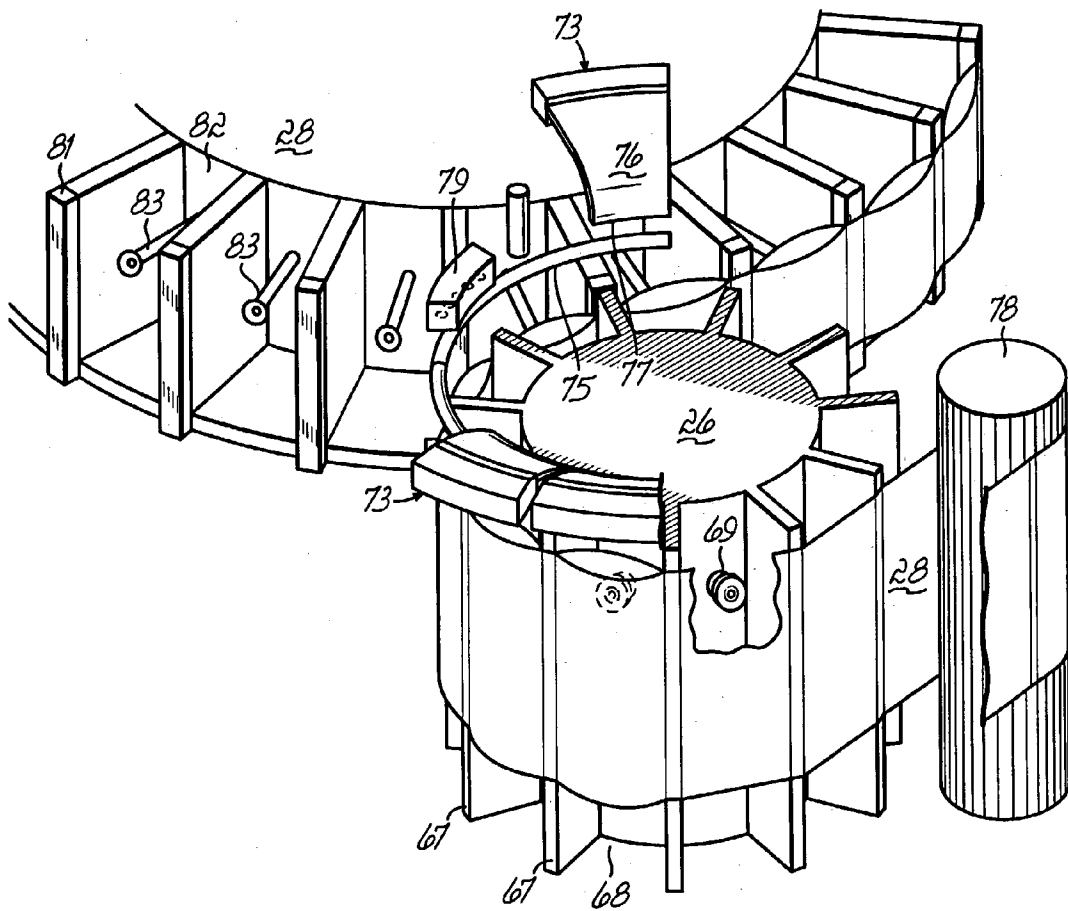


FIG. 8

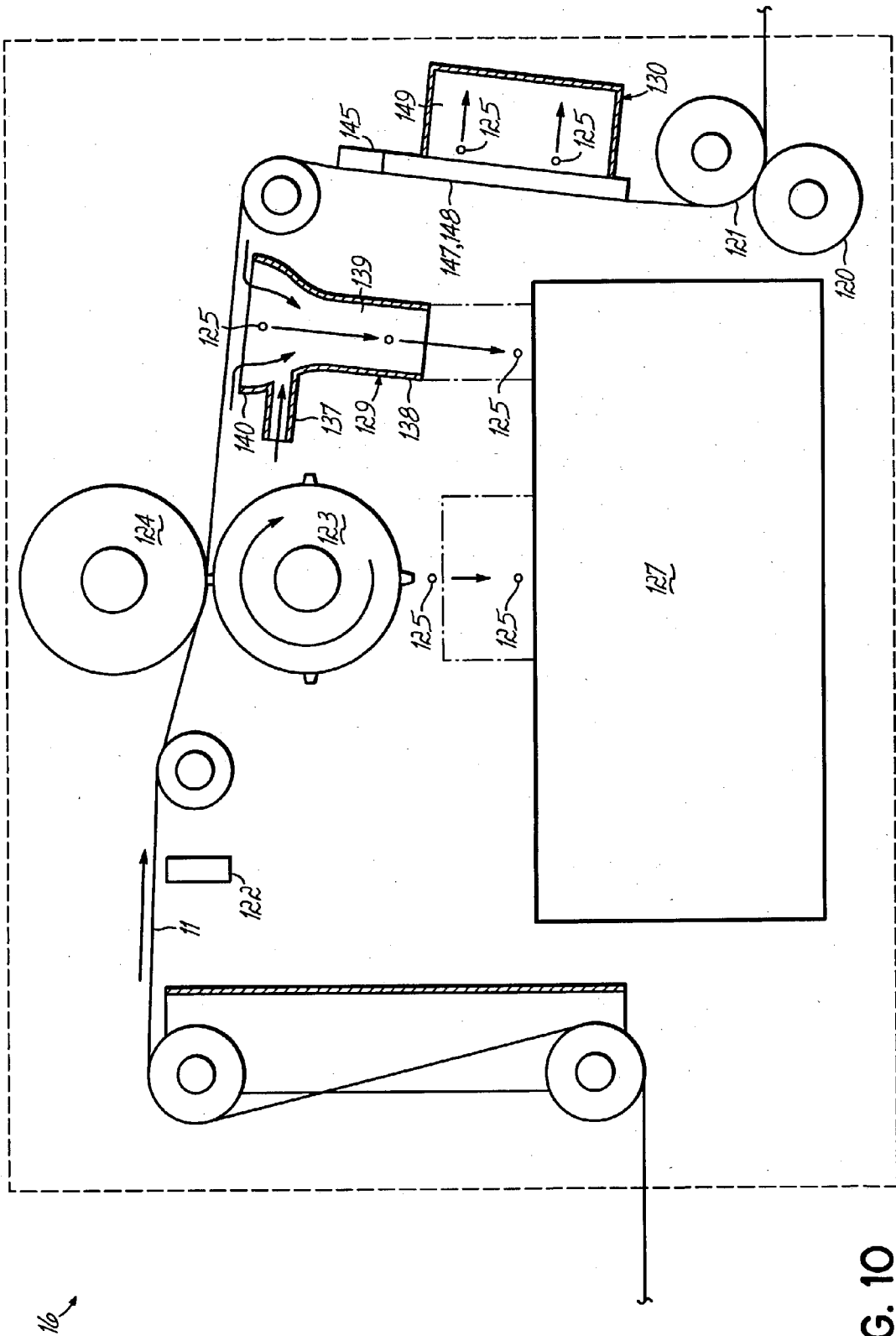


FIG. 10

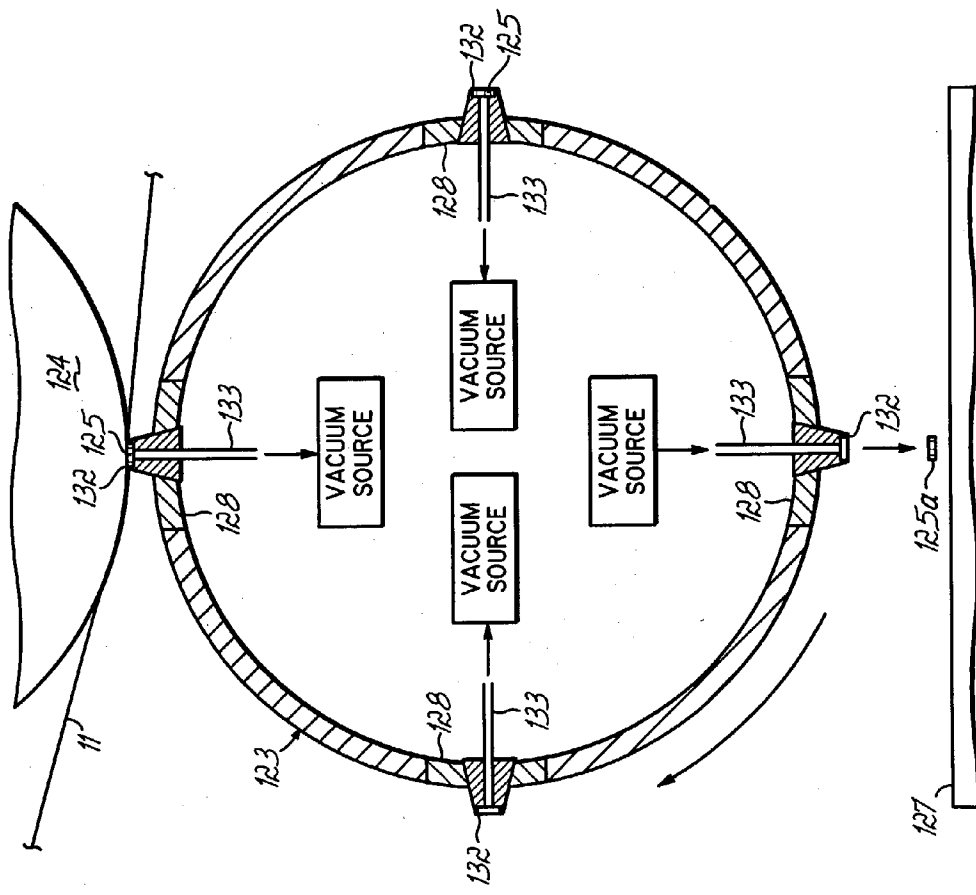


FIG. 11

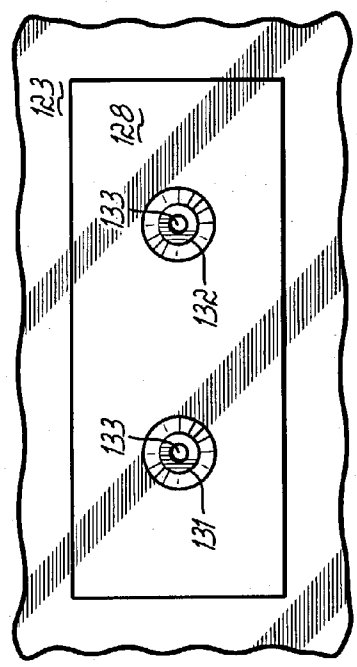


FIG. 12

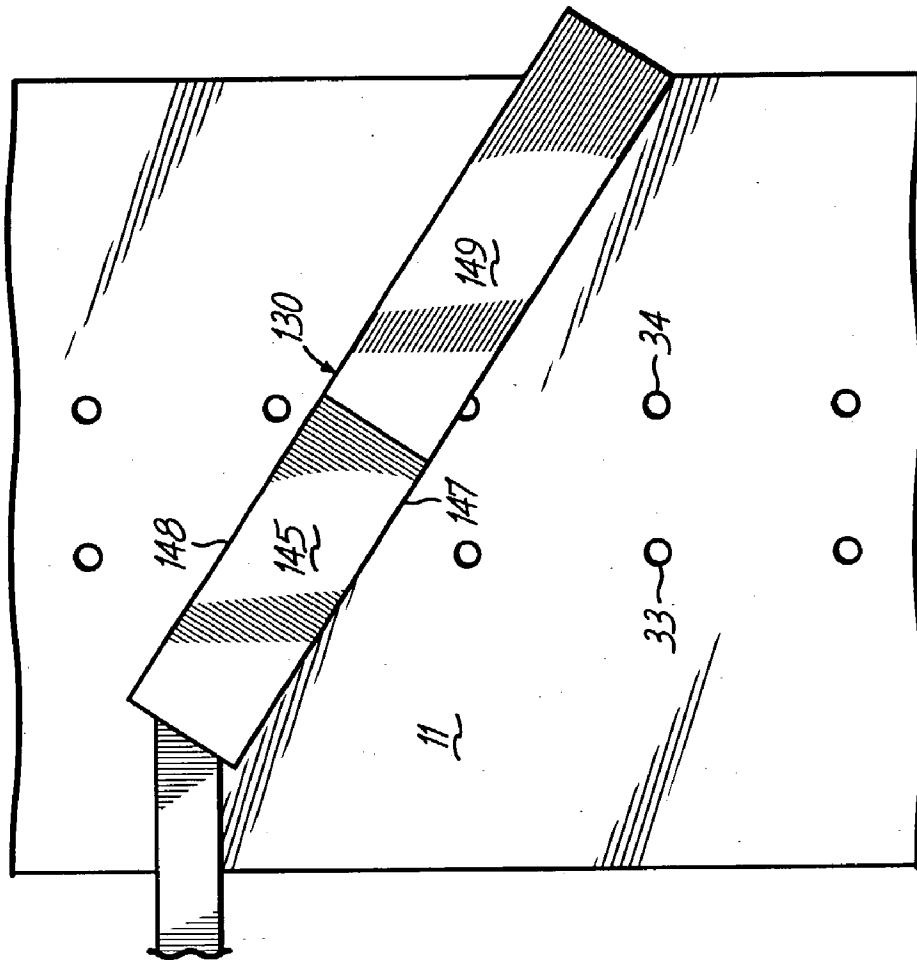


FIG. 13

STAND-UP POUCH FORMING, FILLING AND SEALING

PRIORITY CLAIM

[0001] Applicant claims the benefit of the filing date of U.S. provisional patent application Serial No. 60/371,484 entitled "STAND UP POUCH FORMING, FILLING AND SEALING" filed on Apr. 10, 2002. That application is expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to pouch forming, filling and sealing and more particularly to improved apparatus and methods for forming, filling and sealing stand-up pouches at relatively higher speeds than attainable in currently available systems.

BACKGROUND OF THE INVENTION

[0003] There are numerous process for forming, filling, sealing and handling of typical pouches which are not of the stand-up pouch variety. For example, U.S. Pat. Nos. 5,220,993; 5,320,146; 5,502,951; 5,579,894; 5,829,332; and 6,119,440; each contain a disclosure of at least some feature of apparatus or process for carrying out such forming, filling, sealing and handling of the non stand-up configuration. These cited patents are representative of this background. Each is expressly incorporated herein by reference as if fully written and drawn herein.

[0004] In particular, and referring, for example, only to **FIG. 1** of U.S. Pat. No. 5,502,951, a web is unwound and transported to a folding plow wherein the web is folded onto itself. A thermal sealer applies transverse seals or seams in the moving web creating a series or train of pouches with a single fold bottom, sealed edges and an open top. The open pouch train is then introduced to a filler wheel where the pouch sides are opened and the pouch is filled. A top seal is then applied to the pouches, still in train. Thereafter, the filled and sealed pouch train is transported to a rotary cutter wheel where pouches are cut from the pouch train and transported for further packaging in distribution. The pouch forming, filling and sealing apparatus is typically continuous and conducted in line.

[0005] Stand-up pouches are themselves old. They are configured differently than prior pouches noted above, and there are certain considerations that different configurations require when forming, filling and sealing such pouches.

[0006] The lower end of the typical stand-up pouch is of a gusseted construction. There is a bottom fold and two parallel reverse folds to create the gusseted bottom. The edge seams or seals extend through two web plies in the upper area of the pouch, and through four web plies in the bottom area of the pouch.

[0007] When filled, such pouches have a flat bottom and sides bulged out progressively toward the bottom after filling and product settling; the edges at the edge seams are drawn in so the width of the filled pouch at the expanded pouch bottom is narrower than the width of the filled pouch at the top (when viewed from the side of the pouch).

[0008] In the past, such stand-up pouches have been formed intermittently, then filled and sealed but usually at

relatively slow speeds, i.e., less than 150 pouches or 500 web inches per minute. The forming process has typically been intermittent as the pouches or train of pouches was stopped in order to carry out operations on the pouch web. Thus, one difficulty in providing increased speeds for stand-up pouch forming, filling and sealing operations was in the prior intermittent transport of the web as pouches were formed from it. At least two operations generally have required this intermittent operation, hole punching in the web at the gusset structure to enhance the side seam seal, and thermal sealing of the entire side seams. Stoppages of the web limit the throughput speed of the web and the speed at which finished pouches can be produced.

[0009] In another aspect of the stand-up pouch filling process, it is necessary to consistently open the pouches for filling. When traveling at higher speeds in excess of 150 pouches or about 500 or more web inches per minute, stand-up pouch opening devices previously used in prior systems are not adequate to positively open each pouch.

[0010] Each pouch seam is sealed at its sides, one side ply to the other, except at the pouch bottom, which is gusseted. The side seam seal must thus extend through four plies at the gusseted bottom. When the pouches are formed, a first longitudinal fold is made in a web, then two reverse folds are formed, one on each side of the first. From each of these two latter reverse folds, the web (which will form the pouch sides) extends upwardly. Thus, the bottom area of the web takes on a "W"-shape, i.e. a gusseted shape, in cross-section, with the outside legs of the "W" extending upwardly forming a gusseted bottom structure, then opposed pouch sides. The bottom sides now include four plies (the "W" shape) and these are sealed through the use of seal openings or holes, previously punched in the inner legs of the "W" shape so that the two outside plies can be sealed together through these holes.

[0011] The seal facilitating holes are intermittently placed in selected inner plies of the gusseted bottom, typically when the pouch web is intermittently halted prior to folding at a plow. As noted above, such intermittent holing operation is one factor slowing the production to a rate of significantly less than 150 pouches per minute. It is now desirable to produce pouches at web speeds in excess of 500 and preferably 600 web inches per minute, and up to about 1500 pouches per minute or web speeds up to about 4000 web inches per minute. Technology of web handling with attendant require hole punching at these speeds is not believed known prior to this invention.

[0012] Moreover, when the web is punched, chads are produced. It is important the chads are consistently removed and do not reside between the web folds as to contaminate the pouches to be formed. Increased speeds of continuous operation exacerbate the fugitive chad problems.

[0013] Moreover, since the pouch edge seams now have both two plies and four plies the effective sealing is typically accomplished by an intermittent sealing operation, not so hot as to burn through the two-ply seam, and not so cold as to ineffectively seal the four ply portion of the seam. If the sealing lands are too hot, as may be required for shorter dwell times if faster throughput is attempted, any slower speed, or any temporary stoppage can damage or burn through the side seam seal. And if too cold, at faster speeds or at start-up, the seals may not be well formed and fail.

[0014] Pouch opening for filling is generally accomplished by sucking the pouch into a recess on the filler wheel, and sucking an outer pouch away therefrom with a belt or vacuum cup, both with fixed suction devices. It is important to consistently open such pouches. Relying on vacuum introduced from fixed positions alone to pull apart sides for pouch opening may not provide the consistent opening desired for the stand-up pouch configuration.

[0015] Thus, in a typical stand-up pouch forming, filling and sealing operation, a process similar to that described above for typical pouches other than stand-up pouches is typically utilized with three major exceptions. First, an intermittent web hole puncher for punching gusset area holes to facilitate side seam sealing is usually situated upstream of the plow. Secondly, a revised plow is utilized to form the three bottom folds producing the gusset structure on the web forming the pouch bottoms. Third, the sealer must be modified to seal seams of varied plies, typically requiring an intermittent stoppage of the pouches while the seams are sealed.

[0016] Moreover, when considering a stand-up pouch operation, the pouch sizes desired may be changed. This requires significant downtime and change part expense, particularly in the sealer which must be provided to adequately seal the side seals along the pouch sides and at the gusseted bottom.

[0017] It has thus been one objective of the invention to provide improved apparatus and processes for the operation of forming, filling and sealing, stand-up pouches at rates in excess of 150 pouches per minute, or in excess of about 500, and preferably 600, web inches per minute.

[0018] It has thus been a further objective of the invention to provide improved apparatus and methods for forming, filling and sealing stand-up pouches at speeds not limited by the prior intermittent process of intermittent hole punching and intermittent sealing.

[0019] It has thus been a further objective to provide improved apparatus and methods for positively opening stand-up pouches for filling.

[0020] To these ends, a preferred embodiment of the invention contemplates apparatus and methods for forming, filling and sealing stand-up pouches where the method includes, continuously and in-line, forming stand-up pouches with gusseted bottoms in an interconnected pouch train, continuously providing seal facilitating holes in pouch side seam areas continuously sealing side seams of the pouches, along pouch sides and at their gusseted bottoms, continuously opening the pouches, continuously filling the pouches, and continuously sealing tops of filled pouches, all in a continuous motion and at a rate preferably in excess of 150 pouches or about 500, and preferably about 600, web inches per minute.

[0021] More particularly, the invention contemplates improvements in producing stand-up pouches by continuously punching sealing holes through application of unique web handling processes in the hole punching area, continuously forming seals to define pouch seams along sides thereof, and across pouch bottom gussets, and continuously and positively opening the moving pouches.

[0022] While pouches formed according to the invention herein include the seal enhancing holes in the pouch gusset

bottom structure, such holes are provided in predetermined locations in the web prior to folding; and on the fly as the web is continuously transported past a continuous hole cutting station. Such a structure comprises a hole cutter capable of cutting holes in the web at the web speeds indicated in excess of about 500 to 600 web inches per minute and up to at least about 4000 web inches per minute without requiring intermittent stoppages of the web. Such a hole cutter is operably disposed adjacent the web path just upstream of the gusset forming plow, and is associated with web edge guides, web tension and web registration processes to enable the speeds desired. Also, an improved chad removal system is provided by having multiple chad removal stages to insure the positive and consistent capture of chads away from the pouch interior.

[0023] Alternately, and according to the invention, hole cutting is eliminated in favor of using an "on demand" adhesive at the gusset area, such as heat, ultrasonic, radio frequency or other forms of activatable adhesive, pre-applied or pre-printed on the web.

[0024] Secondly, a sealer is now provided which can effectively place consistently sealed seams in the multiple ply, gusseted stand-up pouches in a continuous mode. This is accomplished preferably through the use of thick film heater technology. One such sealer is disclosed in U.S. patent application Ser. No. 09/704,686 filed Nov. 3, 2000 and entitled "Sealing System for Forming Thermal Seals and Method of Operation Thereof," which application is expressly incorporated herein by reference. That system permits continuous, in-line sealing of pouches with transverse seals along gusset sections that are four pouch web layers thick in the gusseted bottom area and are two pouch layers thick along the rest of the seam. The heating differentials provided in the above application produce a differential sealing effect sufficient to efficiently seal the entire multiple-ply pouch edge seam in a continuous, high speed operation with no need to stop the web.

[0025] Moreover, the invention contemplates preheating thicker webs of thickness about 0.005" or more prior to its introduction to the contact sealer wheel. This facilitates sealing and reduces necessary dwell time on the sealer lands.

[0026] An improved pouch opening apparatus and system contemplates apparatus and methods for opening the pouches by a variety of alternative methods and apparatus. A preferred embodiment includes utilization of a pre-opening wheel prior to the filler wheel combined with a unique Coanda-Effect surface, while another extends a support member carrying a vacuum cup on the filler wheel to push both sides of said pouches toward an off-side vacuum member, and then retracts the support member to pull one pouch side away from the opposite pouch side.

[0027] Apparatus for the preferred pouching opening operation includes a Coanda member, such as a circular cross-section, rod curved in a direction of the pouch path about an opening wheel just prior to the pouch filler wheel. An air guide directs air onto the rod which, by Coanda-Effect, flows around the rod, into the open pouch tops and along the pouch sides positively opening the pouches in the train, just below the curved rod.

[0028] Apparatus for opening pouches in an alternative embodiment includes a vacuum cup mounted on an exten-

sible support between two vacuum lands on a filler wheel. The vacuum lands hold respective edge seams of a pouch. The extensible member extends to move the vacuum cup to positively push the pouch sides toward an opposed vacuum member which holds the off-side of the pouch. The extensible support then retracts to pull the near-side of the pouch away from the off-side of the pouch, positively and consistently opening the pouches. A series of extensible supports, vacuum cups and lands are disposed about a filler wheel for this purpose. The opposed vacuum member can be a vacuum belt or, alternatively, traveling or belt-mounted vacuum cups.

[0029] In another embodiment, a series of inner extensible and outer pivoting vacuum cups are mounted on the filler wheel for engaging and pulling apart opposite pouch sides for opening. The outer extensible cups are also mounted on rotatable levers or arms and are cam operated for orientation at the outer pouch side, and for rotation, after opening, to accommodate entry of the pouch train onto the filler wheel just prior to opening. Thus, once the pouch is opened and/or filled, the outside vacuum cup or platen is spring-biased or cammed up and away from the pouch. It thereafter returns to aid in the opening of a pouch during the next revolution of the filler wheel.

[0030] Thereafter, the pouch train is conveyed through a top sealer of any suitable type and further to a knife, preferably rotary, for cut-off and cartoning.

[0031] In addition to these improvements, the invention contemplates an adjustable bottom gusset sealer to accommodate a variety of pouch sizes, i.e. depths. This is provided by adjustably mounting a bottom gusset sealing shoe between the side seal lands and adjusting the height of the shoe with respect to the lands to viably seal the gusset bottoms of a variety of different sized stand-up pouches.

[0032] Accordingly, a continuous in-line apparatus and process is provided for high speed pouch forming, filling and sealing operation of stand-up pouches which are formed, filled and sealed at continuous rates in excess of those attainable with current intermittent equipment, in excess of 500 to 600 web inches per minute and up to at least about 4000 web inches per minute.

[0033] These and other objectives and advantages will be readily apparent from the following detailed written description and from the drawings in which:

DESCRIPTION OF THE DRAWINGS AND OF THE INVENTION

[0034] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[0035] FIG. 1 is a diagrammatic view of apparatus and methods for forming, filling and sealing a stand-up pouch according to the invention;

[0036] FIG. 2 is a perspective illustration of the web plow used in the apparatus of FIG. 1;

[0037] FIG. 2A is a perspective illustration of a folded web as it exists in the plow of FIG. 2;

[0038] FIG. 3 is an isometric illustration of a vertical sealer of the apparatus of FIG. 1;

[0039] FIG. 3A is an isometric illustration of a sealer land of the sealer of FIG. 3;

[0040] FIG. 4 is an illustration in plan view of one embodiment for opening a stand-up pouch for filling;

[0041] FIG. 5 is an isometric view showing details of an apparatus for carrying out an alternative apparatus opening process of FIG. 4 on the filler wheel of FIG. 1;

[0042] FIG. 6 is an illustration of another embodiment for opening stand-up pouches on a filler wheel;

[0043] FIGS. 7 and 8 are illustrations of a preferred embodiment for opening stand-up pouches at the opening wheel of FIG. 1 prior to the filler wheel of FIG. 1;

[0044] FIG. 9 is a diagrammatic illustration of an ultrasonic top sealer for the stand-up pouches illustration in FIG. 1;

[0045] FIG. 10 is a schematic elevational view of details of a web hole punching station according to the invention;

[0046] FIG. 11 is a cross section illustrating the rotary die and anvil of a hole punching station according to the invention;

[0047] FIG. 12 is an illustrative view of a hole cutting die insert of the rotary die of FIG. 11; and

[0048] FIG. 13 is a side view of a third stage chad remover of the hole punching station according to the invention.

DETAILED DESCRIPTION

[0049] Apparatus Overview and Methods

[0050] Turning now to the drawings, there is illustrated in FIG. 1 an apparatus 10 and method for forming a plurality of filled and sealed stand-up pouches P from a web 11. A flat web 11 is unwound from a web roll 13 mounted on an unwind stand (not shown) of any suitable type. In brief, the web 11 is continuously conveyed through a continuous hole punch station 16 to a gusset forming and folding plow 18. From plow 18, the gusset folded web now designated at 19 is preferably conveyed through a web pre-heater 20 and from there to a vertical sealer 22 which transversely seals side seams into the folded web to form transverse seams of adjacent, gusset-bottom, stand-up pouches in a connected pouch train now designated at 23. Pouch train 23 is directed onto opening wheel 26, by one or more tuck rollers 27, where the pouches are opened, and then onto filler wheel 28 where the opened pouches are filled by any suitable filler mechanism.

[0051] The pouch train of filled pouches now described as 29 is then conveyed through a top sealer 30 where the open tops of the filled pouches are sealed and thereafter compressed or crimped at 31 after being sealed. The train 29 now designated as top sealed pouch train 10 is introduced to a rotary knife 32 where individually formed, filled and sealed stand-up pouches P are cut and conveyed to downstream cartoning or handling apparatus. If desired, the train 110 may be accumulated before reaching the knife, as is well known in pouch handling.

[0052] The entire operation is preferably carried out on a continuous operational basis with no intermittent motion or stoppage of web 11, folded web 19, sealed train 23, filled train 29 or top sealed train 110 being incurred. As a result, the gusseted stand-up pouches P can be produced at a rate exceeding 150 pouches per minute, i.e. in excess of about 500 web inches per minute and preferably at least 600 web inches per minute web speed.

[0053] Detailed Description of Apparatus and Methods

[0054] Hole Punching and Gusset Sealing

[0055] Holes 33, 34 (FIG. 2A) are continuously punched in the web, at a hole punch station 16, at predetermined locations where the internal folds 35, 36 will be sealed to form the transverse side seams of the pouches. See FIG. 2A. These holes allow the heat seals to penetrate all four layers of the gusseted bottom structure of the side seams at the pouch bottom.

[0056] One hole puncher at station 16 (not shown) capable of continuously forming holes 33, 34 in the web is the continuously operable hole cutter Model PHP-2001 D/30 manufactured by Mali Plastics Limited of Tel Aviv, Israel. Another suitable hole cutter, Model Jones 1-200, is available from Chicago Cutting Die Company of Chicago, Ill. Any suitable rotary die can be used, however, according to the invention, hole punching accuracy and chad removal at desired speeds are provided by apparatus and process as will be described.

[0057] Downstream of hole puncher 16, the web 111 is registered with an edge guide and a servo-driven registration system (not shown) of any suitable type, such that the holes will eventually line up on the to-be-formed side seams of the pouches.

[0058] Alternately, the hole punch could be eliminated and an on-demand adhesive system used at the same location to insure a seal along the four plies of the gusset bottom at the side seam. For example, an "on demand" printed adhesive could be pre-applied and activated upon sealing to provide the necessary seal. A hot melt glue system could be used. Alternately, an ultrasonic or radio frequency sealing process could be used to activate a pre-applied or pre-printed adhesive at the gusset area. These systems eliminate the need to punch or cut the described holes, both eliminate "chads" and both are continuously operable at desired web speeds to adequately produce a seam seal without stopping that web or requiring an intermittent web motion. Such adhesive systems could alternately be used for the entire pouch seaming, as will be described.

[0059] In a preferred hole punching apparatus and method, a plurality of structures and web handling processes are used, according to the invention, to continuously provide holes-in the web 11 at speeds in excess of 500 or 600 web inches per minute and up to at least about 4000 web inches per minute. In particular, reference is made to FIG. 1 and FIGS. 10-13.

[0060] It will be appreciated from FIG. 1 that web 11 is controlled through the punching operation by a variety of reference, registration and tensioning apparatus as shown. In the unwind station at 13, a certain tension placed on web 11. As it leaves the unwind station 13, web 11 is controlled in direction by an edge guide apparatus which senses the web

edge and adjusts the web path. Such a device can be purchased from Fife Corp. of Oklahoma City, Okla., as Model "Web Edge Guide #LRB". Any such web edge guide can be used.

[0061] As the web 11 enters the hole cutter, registration marks on the web edge are sensed by a sensor 122 and signals from this sensor are used to control a servo drive for tension rollers 120, 121. This web drive serves to tension the web 11 properly as it is driven between rotary cutting die roll 123 and anvil 124 (see FIG. 11). This insures holes 33, 34 are properly oriented in the web 11 with respect to the edge seams in the web as will be appreciated. As the holes are cut by die roll 123 and anvil 124, cut out chads 125 are held in the die 122 by vacuum from a reversible vacuum and pressure source (FIG. 12). As that die rotates away from web 11, about 180 degrees, positive pressure is applied through the die from the reversible source to gently discharge the chads 125A into collector container 127. Thereafter, a secondary stage chad remover 129 (FIG. 10) removes further chads remaining with web 11, and an optimal third stage chad remover 130 is applied to the web to remove any further chad from the web.

[0062] The die 123 comprises a die roll 126, and a die insert 128 comprising two side by side circular hole cutting die edges 131, 132 with a vacuum port 133 in each leading to collector 127.

[0063] From the cutting area between die 123 and anvil 124, the web is moved across a vortex-like second-stage chad remover 129. This apparatus is preferably disposed immediately downstream of die 123 and anvil 124 under the web. It comprises a pressure inlet 137 and a chad discharge outlet 138 operatively connected to collector 127. The vortex created in chamber 139 creates a vacuum at chad inlet 140 disposed to extend over the areas where holes 33, 34 are cut. This vacuum pulls remaining chads 125 away from the web 11. One type of second stage chad remover is purchased from Exair Company of Cincinnati, Ohio under model name "Air Amplifier Model # 120222".

[0064] An optional tertiary stage chad remover 130 is oriented across the other side of web 11 downstream of second stage chad remover 129. This unit comprises a vacuum box 145 having edges 147, 148 over which web 11 is drawn. Vacuum in vacuum chamber 149 pulls any remaining chad 125 away from web 11. Chamber 149 is operably connected to chad collector 127.

[0065] Also, any chad 125 sticking up from web 11 can be sliced off by edges 147, 148, providing yet another means, where desired, to insure consistent chad removal.

[0066] Preferably, edges 147, 148 are oriented at an angle across web 11 for chad slicing purposes (FIG. 13).

[0067] Thereafter, punched web 11 departs hole punching station 16. However, to help control the web in proper register as it leaves punch station 16, and prior to entering the gusset folding plow 18, the web is engaged by a registration nip 155, formed by rolls 156, 157 driven by a servo or other suitable drive controlled by a web registration mark sensor 159. Sensor 159 retards or speeds the web to synchronize the web with the proper mark position as the web is moved toward plow 18. As these rolls 156, 157 operate on the web, more or less tension is applied to the web 11, upstream toward the hole punch station 16. These

variations, however, are isolated from the hole cutter by rolls **120, 121** which apply the proper tension on web **11** for hole cutting as appropriate registered at the cutting die.

[0068] Registration sensors of the registration photo eye type used herein can be purchased from the Sick Company of Bloomington, Minn., under Model No. KTSW. Any suitable registration sensor can be used.

[0069] In this manner, the web **11** can be conveyed through the hole punching station **16** at speeds in excess of 500 or preferably 600 web inches per minute, and up to at least about 4000 web inches per minute, while seal facilitating holes are accurately cut and placed, and without fugitive chads contaminating the pouches to be formed.

[0070] In another aspect of this procedure, it will be appreciated that preferably, a single hole is punched in web **11** on the to-be-formed cut edges such as at **37, 38** (FIG. 2A). Thus, the actual sealing area at each side **37, 38** of the pouch will comprise a semicircular seal-through aperture, a single hole forming and facilitating a seal in the adjacent, to be cut-off edges **37, 38** of two adjacent pouches **P**.

[0071] These holes, of any suitable size, then facilitate the bottom gusset sealing, but must be accurately placed relative to the web. The web registration discussed above provides this function at the speeds indicated.

[0072] Thus, web tension control and web registration for accurate and consistent hole pouching is provided, while the use of a single hole, in effect, facilitating sealing in two pouches reduces the number of chads produced.

[0073] Gusset Forming Plow

[0074] Web **11** is drawn past a gusset forming plow **18** to form the bottom W-shaped fold shown in FIG. 2A. Plow **18** comprises a frame **39**, first fold plow member **41** and center fold plow member **43**. As the continuously moving web is drawn past member **41**, it defines folds **44, 45**. Member **43** defines center fold **46**. FIG. 2A shows the gusset-folded web **19** in partially broken away form so this gusset structure can clearly be seen.

[0075] Preheater

[0076] From plow **18**, gusset-folded web **19** is conveyed preferably through a pre-heater **20** of any suitable variety for preheating the web **19** at the bottom gusset fold. By preheating the web in this area, the dwell time of the web on the vertical sealer **22** wheel can be reduced. Since the web is preheated, less heat is required at the sealer **22** for adequately sealing, and continuous web speed in excess of 600 web inches per minute can be obtained through the sealing operation without degrading the consistent quality of the seal along the entire side seam of the pouch.

[0077] Preheating is particularly useful with webs for stand-up pouches in web thicknesses of about 0.005" and greater. It may be used but is not required in thinner webs of about 0.002" to about 0.004".

[0078] Of course, preheating may be eliminated by appropriate variation of the sealer **22** or use of the alternative sealing processes described above.

[0079] Vertical Sealer

[0080] After preheating the gusset folded web **19**, the web is introduced to vertical sealer **22** where transverse seals are

generated transversely across the web to form side seams defining a chain of attached, open-top pouches in a train **23**. These edge seals effectively seal or seam together opposite stand-up pouch sides **49, 50** (FIG. 2A) along edges or selvage areas thereof, and along the corresponding edges of the lower gusseted or folded plies shown at the pouch bottom in FIG. 2A. The edge seal at the bottom area of the pouch is of four layers, while at the upper pouch edge is of two layers. This leaves upper edges **51, 52** along each side defining an open top to the pouch. It is in this edge seal that individual filled and sealed stand-up pouches **P** will eventually be cut off, one from the other, leaving each edge sealed.

[0081] Details of the vertical sealer **22** are shown in FIGS. 3 and 3A. The sealer **22** includes a wheel **54** comprising a plurality of radially extending sealing lands **55** on which rest the selvage areas of adjacent pouches. These land areas are heated to seal through the web **19** to form the transverse edge seals of the pouches. The lands **55** may be adjusted in radial position with respect to sealer wheel **54** so to accommodate pouches of varied pitch, i.e. distance between pouch edge seals.

[0082] FIG. 3A illustrates one form of vertical sealer land **55**. Land **55** is provided with a plurality of slots **56** which thermally insulate sealing land edge **57** from the body of land **55**. A thick film heater **59** is applied to the side surface of sealing land edge **57** and comprises a plurality of elements interconnected with an electronic control **59A**. Heater **59** includes higher heat density areas **59B** and **59C** and lower heat density areas at **59D**. When the gusset-folded pouch web is engaged by the edge **57**, it heats the webs to seal them together in a pouch edge seam seal. The higher heat density at **59C** serves to facilitate the edge seal near the gusset bottom where more heat is required. A higher heat density at **59B** serves to adequately seal the top portions of the seam.

[0083] Of course, the heater **59** is provided with predetermined capacities and differential heat densities to obtain the continuous sealing as is required.

[0084] It will be appreciated that the slots **56** serve to thermally insulate, if not wholly isolate, the land edge **57** so that very little mass of the land **55** is heated to sealing temperature. This lower thermal mass in edge **57** results in the ability to more quickly raise the sealer to operating temperature on start, and to more quickly reduce the temperature on slow-down or shut down. This aids in reducing waste and yet provides adequate sealing of the web at the continuous speeds desired.

[0085] Other vertical sealers, and any sealer producing adequate edge seals through both the plies of the pouch sides **49, 50** and through them and gusset folds interior of them at the pouch bottom can be used. One particular form of sealer which can be used is described in co-pending U.S. patent application Ser. No. 09/704,686 entitled "SEALING SYSTEM FOR FORMING THERMAL SEALS AND METHODS OF OPERATION THEREOF", filed Nov. 3, 2000 and owned by this applicant. That application is expressly incorporated herein by reference.

[0086] In such a sealer, thick film heaters are used to apply heat from lands **55** in differentially heated areas depending on the quality of heat to be transferred, i.e. more at the lower gusset for four ply sealing and less from there to the pouch

tops for two ply pouch edge sealing. The lands **55** can be heated by such heaters applied thereto, or heating elements can be applied to the land faces, in differing heat producing densities to provide sealing.

[**0087**] Such a sealer provides adequate heat for sealing in precisely the required areas, yet it is unnecessary to heat a large land mass which may be slow to reach operating temperature upon start up, or too slow to release heat on shut-down. Either circumstance produces ruined seals or burn-through and resulting in waste and restart problems. Moreover, more heat can be applied to the web **19** in exactly the areas requiring it at the gusset fold and less heat in the two-ply area, while yet maintaining web speed in excess of 500 and preferably 600 web inches per minute, for example, through the sealer. On shut-down, heat is quickly dissipated due to low heated land mass, and on start-up, operating temperatures are quickly retained for the same reason, reducing waste.

[**0088**] In order to enhance sealing, a compression or pressure belt **58** (**FIG. 1**), servo driven by servo driver **65**, is juxtaposed adjacent sealer wheel **22**. Belt **58** is entrained about pulleys to press web **19** onto lands **55**, particularly at the lower gusset fold, to facilitate heat transfer to the web plies and sealing.

[**0089**] Alternately, an on-demand adhesive system such as described above could be used on the entire side seam of the pouches.

[**0090**] In another aspect of sealer **22**, adjustability is provided to accommodate webs **19** (and pouches) of varied depths, i.e. pouch heights. To this end, a bracket **50** (**FIG. 3**) is secured to sealer wheel **54** and is provided with an adjustment slot **61**. A heater shoe **62** and pouch shaped insert **63** is-mounted to wheel **54** via bracket **50** and a mounting bolt **64** extending through slot **61**. Pouch insert **63** has an outer sealing face **65** of contoured configuration with a radius approximately the same as that of lands edges **57**, with respect to wheel **22**.

[**0091**] Both heater shoe **62** and insert **63** are vertically adjustable for proper orientation at the bottom of the particular pouch web **19** being used; i.e. operationally at the lower gusset fold in the web. The heater **62** and insert **63** heat the gusset structure at the lower edges of the pouch during sealing to facilitate proper sealing for a variety of pouch heights.

[**0092**] Pouch Opening

[**0093**] Once the seals are formed, edge-sealed pouch train **23** departs sealer **22** in the form of a train **23** of open-topped stand-up pouches, joined at their sealed edges and with gusset-folded bottoms. From the sealer **22**, the pouch train **23** is continuously conveyed to the filling station, preferably comprising opening wheel **26** and filler wheel **28**. Here, the pouches in the train **23** are opened and filled as will be described.

[**0094**] As noted, the preferred embodiment includes an opening wheel **26** and filler wheel **28**. Alternate embodiments will be described wherein the pouch train **23** is introduced directly onto the filler wheel, opened while on that wheel, then filled.

[**0095**] In a preferred embodiment, **FIGS. 7 and 8**, the pouch train **23** is introduced onto opening wheel **26** having

vacuum lands **67** spaced at a pitch corresponding to the predetermined distance between the transverse edge seals defining the pouches when they are opened. In use, this chord distance is the pouch pitch of train **23**, reduced by about 18%.

[**0096**] Pockets **68**, between the lands **67**, include vacuum cups **69** for holding an inner side of the pouch between the lands once it is opened.

[**0097**] The web train **23** is placed on the opening wheel **26** by a tucking roller **78** laying the web onto the opening wheel vacuum land **67**. After the web **23** is laid onto the first vacuum land **67** and begins to be placed in the opening wheel pocket **68**, the air knife **73** provides a burst of air to inflate (i.e. pop-open) the full length of the pouch. The pouch, being constrained from moving at the lands, has air directed down from above. The forces from the air both entering and exiting the pouch exceeds the forces of air passing along the outside of the pouch and causes the pouch to inflate. When the pouch opens, the trailing side seam is pulled forwardly, landing on the next trailing land **67**. These lands are conveyed in a circular path about wheel **26**, defining a circular pouch path about that wheel.

[**0098**] More particularly, air is further controlled and directed by blowing the air from the air knives **73** onto a fixed, curved Coanda bar **75** of cylindrical or other air foil cross-section. A plurality of knives **73** each include opposed, curved plates or air guides **76** disposed with mouths **77** located proximate Coanda-bar **75**. Bar **75** is oriented along a complimentary path above the circular path defined by the lands **67**. The knives **73** and bar **75** are shown broken away in **FIG. 8** for clarity. They extend to a point over the web **23** as it begins to engage lands **67**.

[**0099**] The bar **75** helps direct air into the pouch opening using the Coanda-Effect (i.e. the term given to the fluid's propensity to follow the curvature of a surface). The open sides of the air knives **73** allow the surrounding air to be entrained, thereby multiplying the effective air being disbursed by the air knife. In other words, the open sides of the guide plates **76** draw in excess air to enhance the air flow through mouth **77** and around bar **75** for pouch opening.

[**0100**] Vacuum cups **69** in the pockets **68** of wheel **26** hold the inside web ply in open position. Subsequent air knives **73** blow air on subsequent lengths of bar **75** and continue to inflate the pouch as it moves about the wheel. Just prior to the handoff of the open pouch to the filler wheel **28**, one final air knife **73** provides inflation air to the pouch to aid the pouch in holding its shape before the spout of the filler wheel is inserted. And after opening of pouches by air from bar **75**, a plurality of air jets may be used, directed into the open pouch mouths, to snap open gusseted bottoms of the pouches.

[**0101**] Use of air knives **73** and elongated Coanda bar **75** to direct air into and onto the pouches is uniquely suitable for positive pouch opening. When the pouch train **23** is moved about wheel **26** under bar **75**, pressurized air is supplied by any suitable source or plenum and conduits (not shown) to between guides **76**. Air is drawn into the sides of guides **76** and issues from or flows outwardly of mouth **77** onto bar **75** where, under Coanda-Effect, the air tends to flow about the surface of bar **75** until departing from the bar in the close proximity of the mouths of pouches in the pouch train.

This air flows between the sides **49, 50** of each pouch in train **23** and blows the sides outwardly, opening the pouches and their mouths for receiving a product once they are conveyed to the filler wheel **28**.

[**0102**] It will be appreciated that the use of the bar **75** and guides **76**, combined, is believed to have the following unique application as applied to pouch opening. First, excess air is drawn into the guides **76** to increase the opening effect of air into the pouch. More turbulent air, in the center of the air wake departing bar **75** enters, and also leaves the pouch, while more non-turbulent, laminar flow air in the wake edges departing bar **75** flows down the outside surfaces of the pouch sides, creating lift. The combined effect of the more turbulent air entering and leaving the open mouth pouch with the more uniform flow of air down the outer sides of the pouch causes it to "pop" open. Pouches are thus positively opened, with the trailing side seam then picked up by the next land **67**, and the inner pouch side to the wheel held by suction **69** in open condition in pocket **68**. And, in any event, use of knives **73** and bar **75** serve to efficiently open the pouches.

[**0103**] The knives **73** can be oriented outside of bar **75** as shown in the drawings or on the inside of the bar **75**. Any suitable number of air knives **73** can be used.

[**0104**] Alternative Pouch Opening

[**0105**] Alternate pouch opening apparatus and processes are shown and illustrated in **FIGS. 4 and 5**. In these instances, there are no opening wheels and the pouches are introduced directly onto a filler wheel **28**, from the vertical sealer. In these embodiments, the filler wheel **28** is provided with a plurality of sets of radially oriented vacuum lands **89, 90** and an extensible suction cup **91** between each of the lands **89, 90**.

[**0106**] An offside vacuum means, such as a plurality of traveling vacuum cups **93** (**FIG. 4**) is disposed for traveling alongside the path of pouches as they move along a circular path defined by this wheel **28**. In the embodiment of **FIG. 4**, the extensible cup **91** is cammed or extended outwardly to push both sides of the pouch toward the cup **93**, where the outer side is gripped by vacuum. The inner cup **91** is evacuated and then retracted, pulling inwardly the inner side of the pouch and thus opening it, all as illustrated in **FIG. 4**. Thus, the open pouch resides between complimentary lands **89, 90** with its sides pulled open for filling in a well known manner by any suitable filler apparatus associated with wheel **28** as is known in the industry. In the other embodiment of **FIG. 5**, extensible vacuum lands **94**, alternating between non-extensible vacuum lands **89, 90**, holding the pouch seams, push the pouch web introduced to the wheel **28** outwardly toward the vacuum belt **92** which holds the outer sides of the pouch. The lands then pull the inner pouch sides inwardly where the inner pouch side is held by the retracted vacuum land, and the pouch is opened.

[**0107**] Alternate Embodiment

[**0108**] **FIG. 6** illustrates another pouch opening apparatus and method, useful for opening pouches in a train delivered to a filler wheel **28**. In this embodiment, an extensible inside vacuum cup **101** is retained. Its construction can be identical to that of the extensible mechanism for cup **91** of the prior embodiment.

[**0109**] Outside pouch side gripping, however, is different. Pivotal outside vacuum cups **102** are mounted on respective lever arms **103**, extending on rods **104** journaled on wheel **28**. A cam follower **105** is mounted on arm **103** for following a cam (not shown) to pivot cup upwardly and out of the way for receipt of a pouch web train **23**, and then downwardly on the outside of the pouch to receive and hold the outer side of the open pouch. Thus, the outside vacuum cups **102** are mounted on wheel **28**.

[**0110**] Once the pouch train **28** is introduced to wheel **28**, the outside cup **102** is cammed downwardly to the outside of a pouch. The inside cup **101** is then extended outwardly to push the pouch out toward cup **102** which is evacuated to grip and hold the outside of the pouch. The cup **101** is then retracted, pulling the inner side of the pouch (with respect to the wheel) toward wheel **28** to open the pouch. Once it is filled, the cups **102** are cammed upwardly as they rotate around for operation with a succeeding pouch in the web train.

[**0111**] Of course, an inner suction cup mechanism and an outer suction cup mechanism are associated with each pouch position or pocket between each of the vacuum lands **106** of wheel **28**.

[**0112**] It will be appreciated that a cam **107** is provided about the wheel periphery, followed by a cam follower **108** for extension and retraction (by return spring **109**) of the inner suction cup **101**.

[**0113**] Pouch Filler Wheel

[**0114**] As the train of opened pouches departs wheel **26**, the open pouches are introduced onto the filler wheel **28**, including radially extending pouch seam engaging lands **81** (**FIG. 1**), defining between them pouch receiving pockets **82** with suction or vacuum cups **83** therein. The lands **81** are spaced apart a chord distance similar to the chord distance spacing the lands **67** on opening wheel **26**. The sealed seams between the pouches are thus held by the lands **81** while the inner pouch side in each pocket **82** is held open by a suction cup **83**.

[**0115**] It will be appreciated that apart from the foregoing disclosures, filler wheel station **28** can be of any suitable pouch filling construction as is well known in the art. It includes a plurality of pouch filling spouts **85**, depicted diagrammatically in **FIG. 1**, depending from a spout plate **86**, also depicted in **FIG. 1**. Any suitable form of product feeder as is typical in the industry for feeding product to, and filling, open pouches in train **23** is operably disposed above the spout plate **86**. Multiple product or flavor feeders can be used as needed.

[**0116**] For example, reference is made to feeders and filler wheels shown in U.S. Pat. Nos. 5,320,146 and 6,119,440, each of which is expressly incorporated herein by reference, but which do not comprise part of this invention.

[**0117**] Moreover, reference is made to co-pending application Ser. No. _____, filed on even date herewith, and entitled, "ADJUSTABLE VOLUMETRIC SIDE DISCHARGE FEEDER" and naming Frank G. Oliverio, Boris E. Makutonin and Robert B. McCaslin as inventors and owned by this applicant. This application is also expressly incorporated herein by reference. It discloses a feeder which could be used in filler wheel station **28** above spout plate **86**

and is particularly useful for filling products classified as large particulates to the stand-up pouches in train 23. These could be, for example, items such as pet food, candy, cereals, chips, snacks and the like.

[0118] Top Seal

[0119] Once the stand-up pouches are filled, they depart wheel 28 as a train 29 of connected and filled stand-up pouches. They are then passed through a top sealer 30 for sealing the open tops of the pouches to form a sealed, filled, connected train 110 of stand-up pouches.

[0120] Such a top seal can be provided by any suitable top sealer 30, such as a heat sealer as is known in the industry.

[0121] One form of top sealer which may be used is an ultrasonic sealer 115 illustrated in FIG. 9. In this sealer 115, an ultrasonic head 116 is opposed by a back up roller 117. Pouch train 110 is passed between head 116 and roller 117 wherein the open top edges of the pouch train 110 are sealed ultrasonically.

[0122] It will be appreciated that the pouch trains 29, 110 in the top sealer area can be guided by side supports as indicated in FIG. 1 or can be supported by a belt (not shown) running under the pouch train as the pouches depart from the top sealer. At this point, the pouch train may be directed in a linear or a curvilinear path, as desired.

[0123] Rotary Knife Cut-off

[0124] After crimping by rollers 119 at 30 (FIG. 1), the now-sealed train 110 is directed to a suitable rotary knife 32 of any suitable configuration. Such rotary knives are shown in U.S. Pat. Nos. 5,220,993; 5,579,894; and 5,829,332 which are incorporated herein by reference as examples of rotary knives for cutting off pouches. At the knife 32, individual formed, filled and sealed stand-up pouches P are cut off from train 110. The formed, filled and sealed stand-up pouches P can be conveyed to further handling, cartoning, shipping or the like.

[0125] It will be appreciated that the pouch trains 19, 2329 and 110 are moved through the process illustrated in FIG. 1 continuously, without intermittent stoppages or interruptions, for the continuous production of formed, filled and sealed pouches at speeds in excess of 150 pouches per minute or 500, and preferably 600 web inches per minute and at rates in significant excess of the capacity of prior known apparatus and methods for stand-up pouches, up to at least about 1500 pouches per minute or 4000 web inches per minute. Prior intermittent web operations for standup pouches have been eliminated. At the same time, side seam and gusset seals are adequately provided, and system slow downs, starts and stops do not degrade or burn through the pouch web. Also, pouches are positively opened for filling on a continuous basis with no loss of control of open pouch sides.

[0126] While the present invention has been illustrated by a description of various embodiments and while these embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art without departing from the scope of the invention. The invention in its broader aspects is therefore not limited to the specific details, representative

apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept, and applicant intends to be bound only by the claims appended hereto.

What is claimed is:

1. A method of forming, filling and sealing stand-up pouches, comprising the steps of:

continuously forming said stand-up pouches from a folded web with gusseted bottoms and sealed side seams, in interconnected pouch trains;

continuously opening said stand-up pouches;

continuously filling said stand-up pouches;

continuously sealing open tops of filled stand-up pouches; and

carrying out said steps in-line at a rate in excess of 500 web inches per minute.

2. The method of claim 1 comprising the further step of cutting pouches from said pouch train.

3. The method of claim 1 including the step of carrying out said steps in-line at a rate in excess of 600 inches per minute of web speed.

4. The method of claim 1 wherein said pouches have two sides, including opening said pouches by engaging both of said sides with a vacuum and mechanically pulling at least one of said sides away from the other.

5. The method of claim 1 wherein said pouches have two sides, including opening said pouches by pulling said sides apart with a vacuum.

6. The method of claim 1 wherein said pouches have two sides, including opening said pouches by directing air flowing in Coanda-Effect onto open ends of said pouches defined by said two sides.

7. The method of claim 6 wherein said air blows one of said sides away from the other in each pouch.

8. The method of claim 6 including opening said pouches prior to introduction of said pouches onto a filler wheel.

9. The method of claim 1 including the stand-up pouch forming step of sealing side seams transversely of a gusset-folded web, engaging said pouch proximate said gusset bottom with a gusset side seam sealer and adjusting the position of said gusset side seam sealer to seal the gusset side seam for a plurality of pouch height sizes.

10. The method of claim 1 wherein said forming step comprises heat sealing side seams to form said pouches and further comprising pre-heating said web prior to heat sealing said side seams.

11. A method of continuously filling and sealing a series of interconnected open top stand-up pouches in line at a rate in excess of 500 web inches per minute, and method comprising the steps of:

continuously folding a web to form a pouch bottom gusset;

continuously sealing said web along transverse seals and across said pouch bottom gusset to form a series of interconnected stand-up, open top pouches;

continuously opening said pouches;

continuously filling open pouches;

continuously sealing top seams in said web to seal open tops of filled pouches;

and continuously cutting said pouches apart at transverse seals in said web;

thereby continuously producing separate filled and sealed gusseted bottomed stand-up pouches at rates in excess of 500 web inches per minute.

12. A method as in claim 11 including opening said pouches prior to introducing them onto a filler wheel.

13. A method as in claim 12 including opening said pouches by directing air flowing in Coanda-Effect onto open tops of said pouches defined by upper edges of opposed pouch sides.

14. Apparatus for opening a pouch, having two opposed pouch sides for filling and comprising:

a vacuum cup mounted on a support member extensible toward and retractable from a pouch;

said member selectively extending said vacuum cup toward a pouch and pushing said pouch in a direction transverse to said pouch;

said member being selectively retractable in an opposite direction away from said pouch to pull one pouch side in said opposite direction away from an opposite pouch side when vacuum is applied to said cup, thereby opening said pouch for filling.

15. Apparatus as in claim 14 further including a separate member for holding said opposite pouch side in the position to which it was pushed upon extension of said support member, when said one pouch is pulled away therefrom.

16. Apparatus as in claim 15 wherein said separate vacuum member comprises a vacuum member comprises a vacuum belt toward which said support member pushes said pouch.

17. Apparatus as in claim 15 wherein said separate vacuum member comprises a series of movable vacuum bands traveling in a path along a path of movement of said pouch.

18. Apparatus as in claim 17, wherein said vacuum bands are mounted at a level above said vacuum cups and are reciprocal from a remote position away from said pouch to a position adjacent to said opposite pouch side.

19. Apparatus as in claim 14, wherein said apparatus transfers a series of interconnected stand-up open top pouches in a path for filling at a rate in excess of about 500-600 inches per minute.

20. Apparatus for opening pouches conveyed in a train for filling, said apparatus comprising:

a filler wheel;

a vacuum means for engaging and holding one side of a pouch in a position on said wheel; and

an extensible vacuum cup for engaging, gripping and pulling another side of said pouch away from said one side to open said pouch.

21. Apparatus as in claim 20 wherein said extensible vacuum cup is mounted on said filler wheel for engaging said other side of said pouch which said other side is interior of the one side with respect to said wheel.

22. Apparatus as in claim 21 wherein said vacuum means is rotatable from a position above said train to a position proximate said one pouch side for holding said one side of a pouch when said other side is pulled away.

23. A method of opening a series of connected pouches at open top ends, defined by upper edges of two opposed pouch sides, the method comprising:

guiding a flow of air onto a curved surface, said air flowing along said curved surface toward said open top ends,

blowing said two pouch sides apart by said air flowing between top edges of said pouch, at a location upstream of a pouch filler wheel.

24. A method as in claim 23 including the step of flowing more turbulent air from said surface into said open top ends and flowing less turbulent air from said surface along outer surfaces of said pouch sides.

25. A method as in claim 24 including the steps of directing air onto said curved surface from between two guide surfaces, open at edges thereof, and sucking air from said edges into air being directed onto said curved surface.

26. A method as in claim 23 including the step of opening said pouches on a pre-opening wheel prior to introducing said pouches to a pouch filler wheel for filling.

27. Apparatus for opening open top pouches in a web train of connected pouches, moveable in a path, said apparatus comprising:

an air knife having an elongated mouth;

an elongated bar;

said mouth disposed proximate said bar in a direction along the bar;

said bar being elongated in a direction along said path proximate open tops of said pouches and in a position to direct air flowing over said bar onto open tops of said pouches.

28. Apparatus as in claim 27 wherein said air knife comprises opposed guide plates having elongated edges defining said mouth and opposed edges open to atmosphere whereby ambient air is sucked into said knife between said guide plates and discharged through said mouth onto said bar.

29. Apparatus as in claim 27 wherein air flowing over said bar forms a wake of more turbulent air in the center thereof and less turbulent air at the edges thereof.

30. Apparatus as in claim 29 wherein said bar is oriented with respect to said open top pouches, such that said more turbulent air is directed into said pouches and less turbulent air is directed to flow along outer surfaces of sides of said pouches.

31. Apparatus as in claim 27 wherein said pouches are stand-up pouches and further including an air jet oriented to blow downwardly into said open-tops and directing air into said pouches and expanding gusset bottoms of said stand-up pouches.

32. A method as in claim 111 including, prior to said folding:

cutting holes in said web with a rotary cutting die;

applying tension to said web at a tension nip downstream of said die;

applying web registration tension to said web downstream of said tension nip; and

isolating said registration tension from said cutting die with said tension nip.

33. A method as in claim 32 including removing chad cut from said web in said cutting dies.

34. A method as in claim 33 including the step of separating chad from said web downstream of said cutting die at a chad separation station.

35. A method as in claim 34 including separating further chad from said web downstream of said chad separation station.

36. A method of cutting holes in a moving web wherein the web is drawn between a rotary hole-cutting die and a rotary anvil forming a cutting nip, the method comprising the steps of:

pulling a web through said cutting nip with a web tension nip;

cutting holes in said web;

conveying said web from said tension nip through a registration nip; and

isolating effects of said registration nip on said web with said tension nip.

37. A method as in claim 36 including adjusting said web tension nip in response to a signal from a web registration sensor.

38. A method as in claim 37 including adjusting the registration nip in response to a signal from a web registration sensor.

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